Primary Extractor System - TA10

Technical manual

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DOCUMENT DESCRIPTION

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Abstract

Description and technical specs of the extractor system parts.

Keywords

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The following table identifies all authorities who have successively approved the present issue of this document.

AUTHORITY	NAME AND SIGNATURE	DATE
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DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION	DATE	REASON FOR CHANGE	SECTIONS PAGES AFFECTED
1.0		New document	All
1.2		First official release	All
1.3	29/04/08	Added CAM protocol Completed INI file descriptions	59, 67-70, 79-83, 92
1.4	23/06/08	Layout updated Correct convert to pdf	All

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

About this manual

The PSR extractor technical manual describes technical aspects of the primary radar extractor system designed by Intersoft Electronics. This manual assumes that you are familiar with that material. You should also be familiar with the operation of your computer, your computer's operating system.

Disclaimer Notice

The PSR extractor Software takes advantage of the data processing methods that are believed to be strict and accurate. This User Manual is believed to be accurate and complete. On no account Intersoft Electronics will be liable for any direct, indirect, special, incidental or consequential damage resulting from any defect or malfunction. Intersoft Electronics NV declines any responsibility for its usage.

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Organization of this manual

The PSR extractor technical manual is organized as follows.

- Chapter 1, *Introduction*, contains a basic introduction of the primary radar extractor system.
- Chapter 2, *Hardware overview*, describes the hardware components of the primary extractor system.
- Chapter 3, *Software overview*, contains all the details about the software components of the extractor system.
- Chapter 4, *Data formats*, this chapter gives a detailed view on the data formats used in the communication between the different hardware and software components.
- Chapter 5, *Network overview*, the network topology is discussed in detail in this section.

Conventions used in this manual

The following conventions are used in this manual:

Note: This icon to the left of bold italicized text denotes a note, which alerts you to important information.

Caution: This icon to the left of bold italicized text denotes a caution, which alerts you to the possibility of data loss or a system crash.

Warning: This icon to the left of bold italicized text denotes a warning, which alerts you to the possibility of damage to you or your equipment.

1. Introduction

The Primary Radar Extractor system exists of hardware and software components. In Figure 1-1 a schematic overview is given of the hardware system setup.

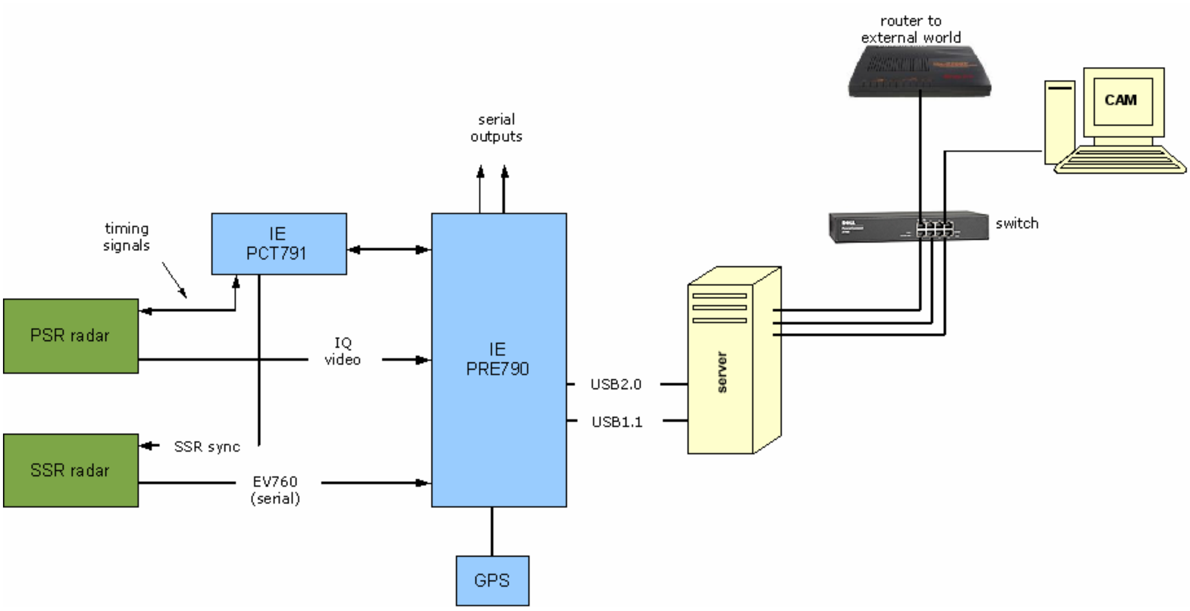

Figure 1-1 Hardware system overview

In software there are 3 modules: extractor service, combiner/tracker service and CAM application. For details about these modules see chapter 3 Software overview.

2. Hardware overview

In this section you can find all details about the hardware of the primary radar extractor designed by Intersoft Electronics.

Hardware components:

- PCT791
- PRE790
- GPS450
- Rackserver Dell PE860 = processing computer
- Switch Dell Powerconnect 2708
- Computer Dell Dimension 9200 = CAM computer

2.1 Programmable Controlled Timing Unit (PCT791)

2.1.1 Task(s)

Generate Timings signals in Master mode (limiter Sync, premodulation sync, master 1 sync, SSR sync)

Beam switching control

STC control

Receives ACP/ARP from the antenna and forwards it to the PRE790.

System clock generation.

2.1.2 Specifications

Specifications	
Specification	Value
Dimensions	220 x 103 x 53mm
Input voltage	85 – 250VAC
Input frequency	47-400Hz
Power consumption (230VAC supply, no other connections)	Slave – normal: 10.6VA Slave – generator: 11.6VA Master – normal: 11.6VA Master – generator: 12.9VA
Fuse(s)	1.5A Slow

Table 2-1 PCT791 specifications

2.1.3 Device depiction

The front panel [Figure 2-1] is divided in three sections:

Status

Tx On = This LED will light up when the timing generation is active.

No Clock = This LED will light up when there’s no clock signal present.

Operational = lights up when the PCT791 unit is in operational mode. Operational mode means that there’s no flash programming in progress and normal mode is selected.

ARP = lights up by an antenna North crossing

Fx ind. = not used for the moment, always on

Power = power indicator

Settings

Normal/Generator: this switch must be in normal settings for standard operation. If it's switched to generator function, the unit will output ACP, ARP, 15 MHz and 625 KHz (Radar simulation). This mode can be used to test another PCT791 unit.

Slave/Master: If slave mode is selected, the unit will slave to the active system (TPL800 in the TA10 case). In master mode, the unit will generate the radar sync signals, STC and beam switching.

Other

30MHz in (0dBm) = can be used as external clock source input.

SSR sync out (TTL) = SSR sync output

J2101 = interconnection panel connector

J2102 = interconnection panel connector

J2103 = interconnection panel connector

J2104 = interconnection panel connector

Figure 2-1 PCT791 front panel

On the left panel you can find the power input. The input power can vary between: 85-250VAC/47-400Hz [see also Table 2-1].

Figure 2-2 PCT791 left panel

On the right panel you can find following connections:

Extrasync output [SMA] = this output can be used as a pretrigger. This signal has an offset of -40µsec, duration 1 µsec.

PRE790 connector [HDMI] = used to connect the PCT791 with the PRE790

Maintenance USB [USB type B] = this connector is used to update the PLD firmware. In normal operation this is not used.

Figure 2-3 PCT791 right panel

2.1.4 Main components

M575 - PSR controlled Timing Unit

Power supply Tracopower TML 15512C

Inlet filter Shaffner FN9260-2/06

2.1.4.1 M575 – PSR Controlled Timing Unit

IE reference = M575 (16756)

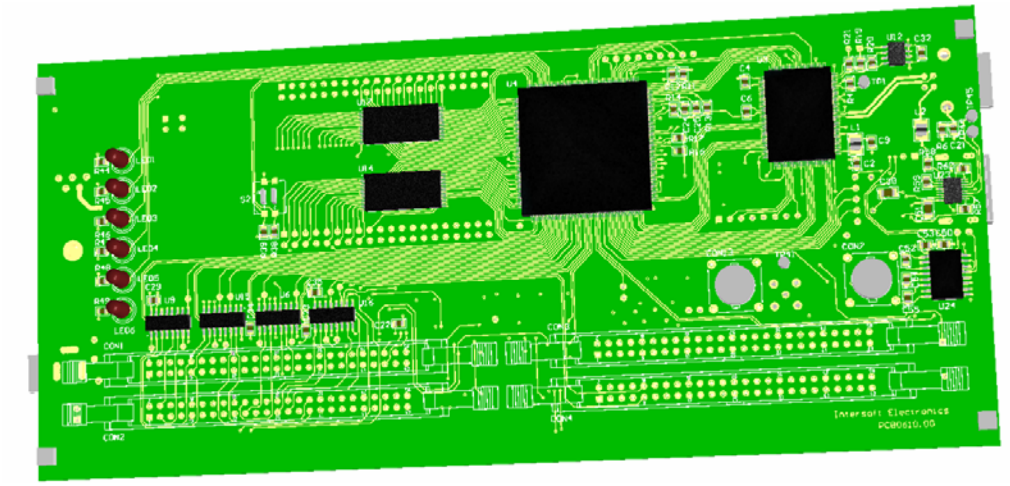

Figure 2-4 M575 - PSR Controlled Timing Unit

Specifications	
Specification	Value
Input voltage	+5V
Input current/power	
Slave – normal	524mA / 2.62W
Slave – generator	635mA / 3.175W
Master – normal	625mA / 3.125W
Master – generator	734mA / 3.67W
Operational temperature limits	0°C - 60°C
Storage temperature limits	-65°C to 150°C

Table 2-2 PSR Controlled Timing Unit specifications

2.1.4.2 Power source TracoPower TML 15512C

IE reference = C-66000061

Figure 2-5 TracoPower TML 15512C (other type in figure)

Specifications	
Specification	**Value**
Input voltage range	85 – 264VAC
Input frequency	47 – 440 Hz
Input current, no load	18mA / 25mA typ
Input current, full load	280mA / 165mA typ.
External fuse	1.5A slow blow type
Temperature ranges	
Operating	-25°C…+71°C
Power derating above 50°C	3.75%/°C
storage	-40°C…+85°C
Temperature coefficient	0.02% / °C
Efficiency	72 – 80%
Humidity (non condensing)	95% rel max
Switching frequency	100KHz typ (PWM)
Isolation voltage (in/out)	3000VAC
MTBF (MIL HDBK 217E)	> 660000h @ 25°C
EMI / RFI conducted	EN 55022, class B, FCC part 15, level B
EMC compliance	
Electrostatic discharge ESD	IEC / EN 61000-4-2 4kV / 8kV
RF field susceptibility	IEC / EN 61000-4-3 3V/m
Electrical fast transients / bursts on mainsline	IEC / EN 61000-4-4 1kV
Safety standards	UL 1950, IEC 60950, EN 60950
Safety approval	cUL/UL File E188913
Case material	Plastic resin + Fiberglass (flammability to UL 94-V0)

Table 2-3 TML 15512C specifications

2.1.4.3 Inlet filter Shaffner FN9260-2/06

IE reference = C-11000060

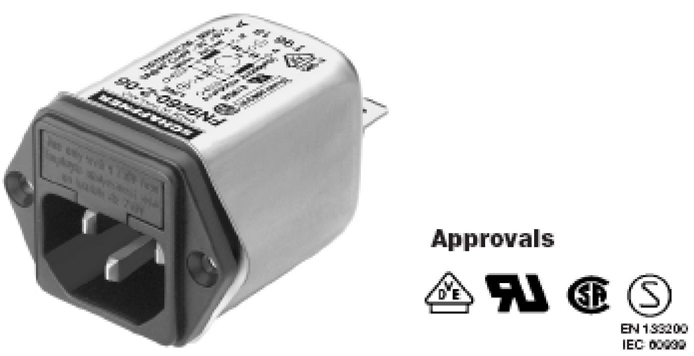

Figure 2-6 Inlet filter Shaffner FN9260-2/06

Specifications	
Specification	**Value**
Maximum operating voltage	250VAC
Operating frequency	DC to 400Hz
High potential test voltage	
PN -> E	2000 VAC
P -> N	1700 VDC
Capacitance Cx	100nF
Capacitance Cy	2.2nF
Maximum leakage µA/phase	190
Resistance R	1 MΩ

Table 2-4 Inlet filter Shaffner FN9260-2/06 specifications

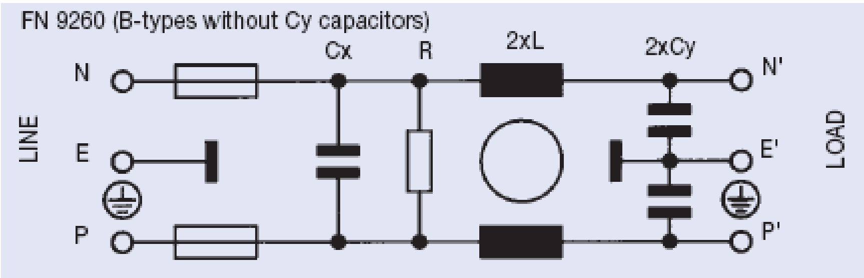

Figure 2-7 Inlet filter Shaffner FN9260-2/06 electrical diagram

2.1.5 Functional description

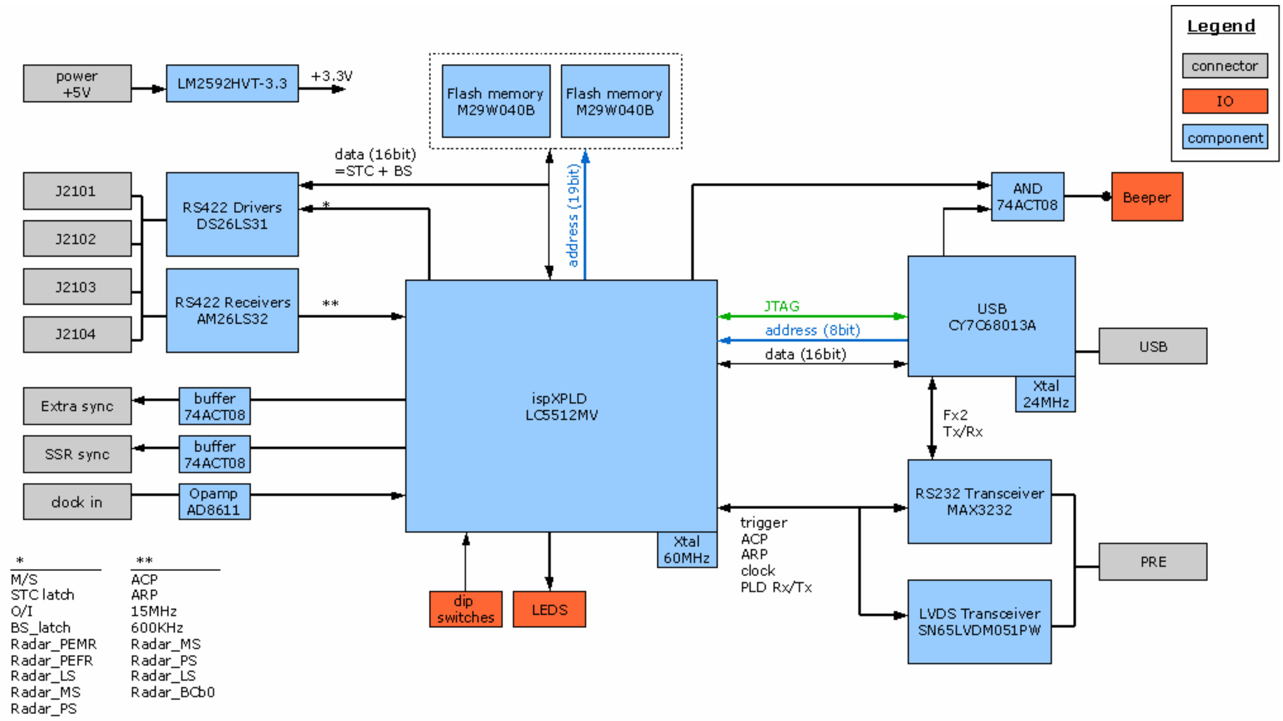

Figure 2-8 PCT791 schematic overview

Figure 2-8 gives a schematic overview of the PCT791 unit. The system is built up around an ispXPLD (In System Programmable eXpanded Programmable Logic

Device) running on a 60MHz crystal oscillator +-50ppm (CFPS-73B). This device is in system programmable via the USB controller. This allows an easy way to upgrade the PLD firmware via the maintenance USB connection.

The PCT791 system is also provided with flash memory (512Kx16). This memory is used to store the STC and beam switch map (see Figure 2-9 PCT791 flash organization). Programming of the flash content can be done via the maintenance USB connection or via the PRE790 USB connection.

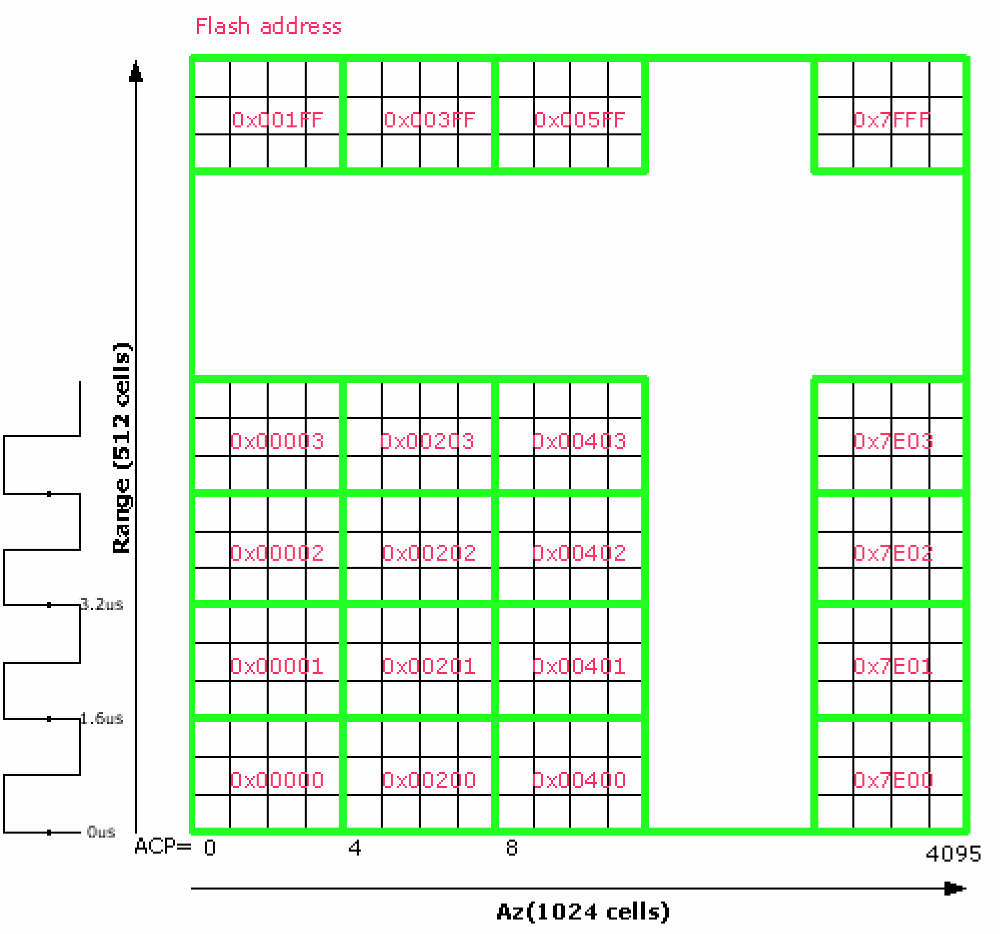

Figure 2-9 PCT791 flash organization

Flash address is calculated based on the following formula:

Flash_Address = [Azimuth counter/4)*0x200 + Min(RangeCounter(625kHz);0x1FF)]

The size of one cell is 0.13Nm x 0.352°

Data content of a memory cell:

Bit	Function	Bit	Function
b0	STC CH1	b8	STC CB4
b1	STC CH2	b9	STC CB5
b2	STC CH3	b10	Beam Switch (0=high; 1=lowbeam)
b3	STC CH4	b11	-
b4	STC CH5	b12	-
b5	STC CB1	b13	-
b6	STC CB2	b14	-
b7	STC CB3	b15	-

Table 2-5 Flash memory cell content

The value of STC is calculated at the following manner:

High beam: STC attenuation=min[value(b4-b0) x 1.5dB; 40dB] [dB]

Low beam: STC attenuation=min[value(b9-b5) x 1.5dB; 40dB] [dB]

For communication with the PRE790 there are some communication lines foreseen. The following table gives an overview of these signals.

Name	Function	Interface type	Direction
Trigger +/-	Range 0 trigger	LVDS	PCT791 -> PRE790
Radar Clock +/-	System sample clock	LVDS	PCT791 -> PRE790
ACP	Azimuth Change Pulses	RS232	PCT791 -> PRE790
ARP	Azimuth Reset Pulse	RS232	PCT791 -> PRE790
Fx_Tx	USB processor serial communication port	RS232	PCT791-> PRE790
Fx_Rx	USB processor serial communication port	RS232	PRE790 -> PCT791
PLD_Tx +/-	PLD serial communication port	LVDS	PCT791 -> PRE790
PLD_Rx +/-	PLD serial communication port	LVDS	PRE790 -> PCT791

Table 2-6 PCT791-PRE790 communication interface

The PCT791 unit can generate timing signals for the Thomson TA-10 radar. These signals are available on four 50- pin flatcable connectors who can mate direcly to the TA-10 interconnection panel. The signals are made RS422 compatible by using 26LS31 drivers and 26LS32 receivers.

For status indication there are six indication led's and one beeper. The meaning is explained in section 2.1.3 Device depiction

The system clock can be chosen out of three sources:

External 15MHz clock on flat cable connectors [see 2.1.6 Connectors]

External 30MHz clock connected on the front panel, 0dBm at 50Ω. Buffered by an AD8611 opamp.

Internal generated 15MHz clock (based on the 60MHz PLD clock)

2.1.6 Connectors

2.1.6.1 J2101

Connector type = 50 wire (2x25) right male flatcable connector with fasteners.

Pin number	signal	direction			
		Work mode			
		Slave		Master	
		N	G	N	G
9	Limiter sync +	I	I	O	O
10	Limiter sync -				
23	Azimuth +	I	I	I	O
24	Azimuth -				
25	North signal +	I	I	I	O
26	North signal -				
39	STC CH clock +	I	I	O	O
40	STC CH clock -				
41	STC CH1 +	I	I	O	O
42	STC CH1 -				
43	STC CH2 +	I	I	O	O
44	STC CH2 -				
45	STC CH3 +	I	I	O	O
46	STC CH3 -				
47	STC CH4 +	I	I	O	O
48	STC CH4 -				

Table 2-7 J2101 layout

2.1.6.2 J2102

Connector type = 50 wire (2x25) right male flatcable connector with fasteners.

Pin number	signal	direction			
		Work mode			
		Slave		Master	
		N	G	N	G
3	Master 1 sync (SP) +	I	I	O	O
4	Master 1 sync (SP) -				
5	Premodulator sync +	I	I	O	O
6	Premodulator sync -				
19	PEMR +	I	I	O	O
20	PEMR -				
21	PEFR +	I	I	O	O
22	PEFR -				
24	15MHz clock +	I	I	I	O
25	15MHz clock -				
27	625KHz clock +	I	I	I	O
28	625KHz clock -				
30	Beam comb bit 0 +	I	I	O	O
31	Beam comb bit 0 -				

Table 2-8 J2102 layout

2.1.6.3 J2103

Connector type = 50 wire (2x25) right male flatcable connector with fasteners.

Pin number	signal	direction			
		Work mode			
		Slave		Master	
		N	G	N	G
43	STC CH5 +	I	I	O	O
44	STC CH5 -				

Table 2-9 J2103 layout

2.1.6.4 J2104

Connector type = 50 wire (2x25) right male flatcable connector with fasteners.

Pin number	signal	direction			
		Work mode			
		Slave		Master	
		N	G	N	G
9	STC CB clock +	I	I	O	O
10	STC CB clock -				
11	STC CB1 +	I	I	O	O
12	STC CB1 -				
13	STC CB2 +	I	I	O	O
14	STC CB2 -				
15	STC CB3 +	I	I	O	O
16	STC CB3 -				
17	STC CB4 +	I	I	O	O
18	STC CB4 -				
19	STC CB5 +	I	I	O	O
20	STC CB5 -				

Table 2-10 J2104 layout

2.1.6.5 PRE790 connector

Connector type = HDMI right angle flange type (Molex 5002541931)

Pin number	Signal	Direction
1	Trigger +	PCT791 -> PRE790
2	GND	
3	Trigger -	PCT791 -> PRE790
4	PLD_Rx_0+	PRE790 -> PCT791
5	GND	
6	PLD_Rx_0-	PRE790 -> PCT791
7	PLD_Tx_0+	PCT791 -> PRE790
8	GND	
9	PLD_Tx_0-	PCT791 -> PRE790
10	Radar_Clock+	PCT791 -> PRE790
11	GND	
12	Radar_Clock-	PCT791 -> PRE790
13	/Fx_Tx_1	PCT791 -> PRE790
14	/Fx_Rx_1	PRE790 -> PCT791
15	/ACP	PCT791 -> PRE790
16	/ARP	PCT791 -> PRE790
17	GND	
18	+5V in (optional)	PRE790 -> PCT791
19	+5V in (optional)	PRE790 -> PCT791

Table 2-11 PRE790 connector layout

This connector is not compatible with connectors found on HDMI multimedia devices.

2.1.6.6 Maintenance USB connector

Connector type = USB type B

Pin name	Description
Shield	Connected via 1M and 100nF to Gnd
Gnd	Gnd
D+	USB data +
D-	USB data -
Vcc	Not connected, self powered device

Table 2-12 Maintenance USB layout

2.1.6.7 30MHZ in (0dBm) connector

Connector type = BNC-50

Specifications	
Specification	**Value**
Input impedance	50Ω
Minimum input level	-15 dBm
Recommended input level	0dBm
Maximum input level	15 dBm
Input frequency	30MHz

Table 2-13 30MHz in (0dBm) connector specifications

2.1.6.8 Extra Sync connector

Connector type = SMA

Specifications	
Specification	**Value**
standard	TTL

Table 2-14 Extra Sync connector specifications

2.1.6.9 SSR sync connector

Connector type = BNC-50

Specifications	
Specification	**Value**
standard	TTL

Table 2-15 SSR sync connector specifications

2.2 Primary Radar Extractor (PRE790)

2.2.1 Task(s)

Sampling IQ-video signals from the radar receiver

Control (parameter write, flash programming) and interface the PCT791 unit

GPS interfacing

Serial in- and output

2.2.2 Specifications

Specifications	
Specification	**Value**
Dimensions	45 x 395 x 88mm (mounting brackets excluded)
Input voltage	85 - 250VAC / 120 – 200VDC
Input frequency	44 – 440Hz
Power consumption (230VAC, no other connections)	20.35W
Fuses	1.6A slow (5x20mm)
Operational temperature limits	0°C…+40°C
Storage temperature limits	-30°C…+50°C
Humidity	10%...80% (non-condensing)

Table 2-16 PRE790 specifications

2.2.3 Device depiction

On the front panel there is an power LED

Figure 2-10 PRE790 front panel

On the back panel you can find three sections:

Power: input power connector, IEC inlet

Extractor connections

GPS: this connector is used to connect an Intersoft Weatherproof GPS P-450. This connector type is the same as a network connector type (RJ45), but is not compatible.

PCT791 connector: used to connect a PCT791 unit

Video I/Q: input for the radar receiver I and Q video.

Extractor USB: USB2.0 connection to the processing computer (running the extraction service)

DHM connections

HDLC out 1/2: serial output of DHM data

EV760 Input 1/2: serial input of the EV760 output

Datahandler USB: USB1.1 connection to the processing computer (running a DHM service)

2.2.4 Main components

M597-UVR for PRE790

M351–USB RDR (2x)

M576-PCT791 interface for UVR

Power source LPT42

Inlet filter Shurter CD44.1101.151

USB hub

2.2.4.1 M597 – UVR for PRE790

IE reference = M597

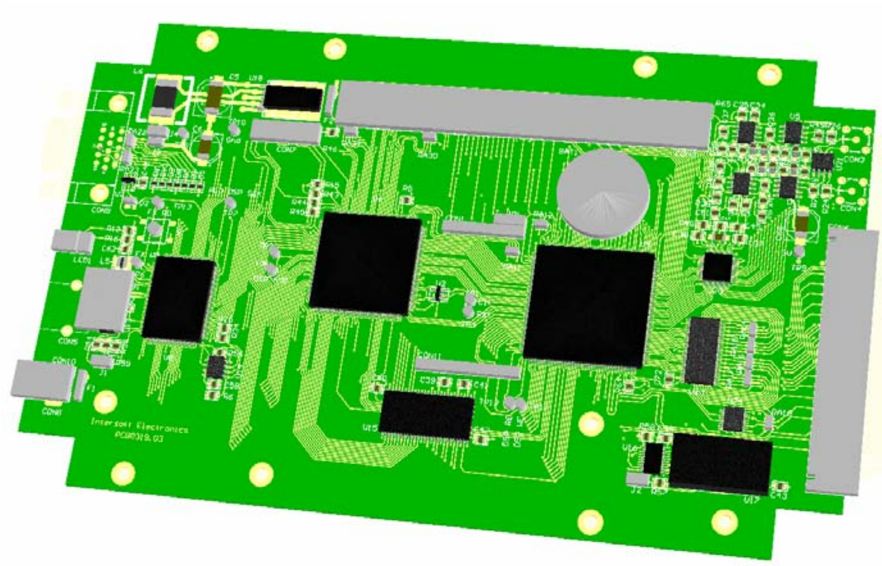

Figure 2-11 M597 - UVR for PRE790

This module receives the video inputs I and Q. These signals are sampled by an AD converter and preprocessed by a DSP (Digital Signal Processor). The result is streamed to the processing computer over USB2.0.

Other tasks performed by this module are:

Communication with the PCT791 unit

GPS messages processing to Time stamp information

ACP/ARP/PPS/Trigger signals generation for the UDR modules

The UVR module is connected to an extension board (see 2.2.4.2 M576 – PCT791 interface for UVR) for performing it's tasks.

Specifications	
Specification	Value
Operational temperature limits	0°C…+40°C
Storage temperature limits	-30°C… +50°C
Humidity	10%...80% (non-condensing)
power	See Table 2-18

Table 2-17 M597 - UVR for PRE790

2.2.4.2 M576 – PCT791 interface for UVR

IE reference = M576

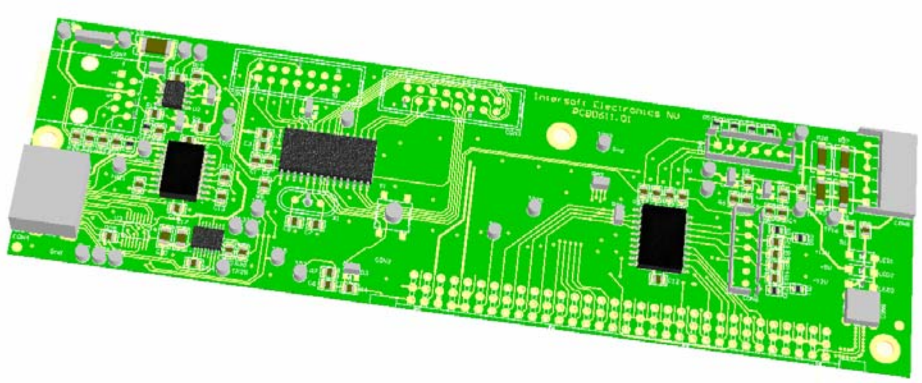

Figure 2-12 M576 - PCT791 interface for UVR

The module is used as an extension of the UVR module [see 2.2.4.1 M597 – UVR for PRE790]

Tasks performed by this module are:

Power providing of the UVR module

Interface the UVR module with the PCT791 unit (level translation, connector support,…)

Interface for the GPS450 module [see 2.3 GPS450]

Pass on the ACP, ARP, PPS and Trigger signals to M351 [see 2.2.4.3 M351 – USB RDR]

Specifications	
Specification	**Value**
Input voltages	+12V; +5V; -12V(optional)
Input current / power	
+12V	243mA / 2.62W
+5V	38.1mA / 0.19W
-12V	20.8mA / 0.25W
Operational temperature limits	0°C…+40°C
Storage temperature limits	-30°C...+50°C
Humidity	10%...80% (non-condensing)

Table 2-18 M576 – PCT791 interface for UVR specifications

The specifications in Table 2-18 are measured with and UVR board connected; further no other connections.

2.2.4.3 M351 – USB RDR

IE reference = M351

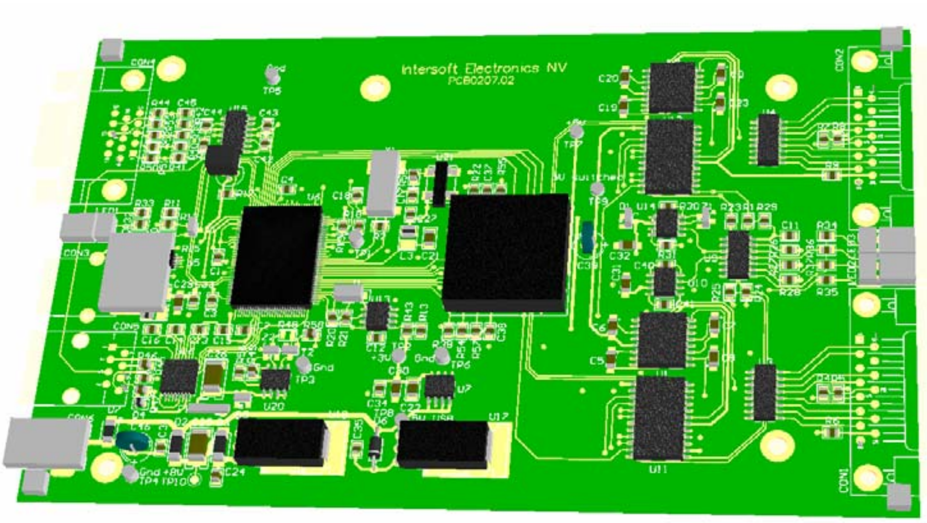

Figure 2-13 M351 - USB RDR

The PRE790 system is provided twice with this module. The function of this module is to handle serial communications. It can provide serial input and serial output as well. The functions are fully controllable in the DHM service software [see 3.3 DHM Service].

Specifications	
Specification	**Value**
Operational temperature limits	0°C …+40°C
Storage temperature limits	-30°C …+50°C
Humidity	10%...80% (non-condensing)
Max. operating altitude	3080m
Power supply	+12VDC
Input current / power (no other connections than power supply)	93mA@+12VDC / 1.1W

Table 2-19 M351 - USB RDR specifications

Serial inputs/outputs specifications	
Specification	**Value**
RS 232 C Receivers	
Input resistance	3kΩ min, 5kΩ typ, 7kΩ max
Low (logic zero) threshold	1.2V typ, 0.8 min.
High (logic one) threshold	1.7V typ, 3.0 max.
RS 232 C Drivers	
High level output	+5V min, +15Vmax
Low level output	-15V min, -5V max
Short circuit current	+-100mA
Power off impedance	300Ω
Slew rate R_L=3K, C_L=50pF	30V/µs
RS 422 Receivers	
Input resistance	4kΩ min
Low (logic zero) threshold	-6.0V min, -0.3V max
High (logic one) threshold	0.3V min, 6.0V max
Common mode range	-7.0V min, +7.0V max.
RS 422 Drivers	
Differential output	±2.0V min
Short circuit current	±150mA
Transistion time	40 ns max. (10%-90%)

Table 2-20 M351 - USB RDR serial input/output specifications

2.2.4.4 Power source LPT42

IE reference = C-66000034

Figure 2-14 LPT42

This module provides the necessary voltages for the system.

Output voltages				
Output voltage	Maximum load (convection cooling)	Peak load 1	Regulation 2	Ripple P/P (PARD)3
+5V	4A	7A	+-2%	50mV
+12V	2A	4A	+-5%	120mV
-12V	0.5A	1A	+-5%	120mV

Table 2-21 LPT42 output voltages specifications

Specifications	
Specification	**Value**
Input range	85-265VAC 120-300VDC
Frequency	47-440Hz
Inrush current	<18A peak @ 115VAC; <36A peak @ 230VAC, Cold start @ 25°C
Input current	1A max. (RMS) @ 115VAC
Efficiency	70% typical at full load
EMI filter	FCC Class B conducted CISPR 22 Class B conducted EN55022 Class B conducted VDE 0878 PT3 Class B conducted
Safety ground leakage current	<0.5mA @ 50/60Hz, 264VAC input
Maximum output power	40W for convection
Adjustment range	-5, +10% minimum
Cross regulation	+-2% on output 1; +-5% on outputs 2,3
Hold-up time	20ms @ 40W load, 115VAC nominal line
Overload protection	Short circuit protection on all outputs. Case overload protected @ 110-145% above peak rating
Operating temperature	0° to 50°C ambient; derate each output at 2.5% per degree from 50° to 70°C
Electromagnetic susceptibility	IEC 801, -2,-3, -4, -5, -6, Level 3
Humidity	Operating; non-condensing 5%-95%
Vibration	Three orthogonal axes, sweep at 1 oct/min, 5min. dwell at four major resonances 0.75G peak 5Hz to 500Hz, operational
Storage temperature	-40° to +85°C
MTBF demonstrated	>550 000h at full load and 25°C ambient condition
Safety	VDE 0805/EN60950 (IEC950) UL1950 CSA 22.2-234 Level 3 NEMKO EN 60950/EMKO-TUE (74-sec) 203 CB certificate and report CE Mark (LVD)

Table 2-22 LPT42 specifications

2.2.4.5 Inlet filter Shurter CD44.1101.151

IE reference = C-58000038

Figure 2-15 Shurter CD44.1101.151

Specifications	
Specification	**Value**
Maximum input voltage	250VAC / 275VDC
Maximum input current	6A
Allowable operation temp.	-25°C to +85°C
Dielectric Strength	> 1.7kVDC between L-N > 2.7kVDC between L/N-PE Test voltage (2sec)
Leakage Current	< 0.5mA (250V / 60Hz)
Climatic category	25/085/21 acc. to, IEC 60068-1
Degree of protection	From front side IP40 acc. to, IEC 60529
Protection class	Suitable for appliances with protection class 1 acc. to IEC61140
Material: housing	Thermoplastic, black, UL 94V-0
Appliance-Inlet /-Outlet	C14 acc. to IEC/EN 60320-1, UL498, CSA C22.2 no. 42 (for cold condition) pin-temperature 70°C, 10A, Protection class 1
Line Switch	Rocker switch 2-pole, non-illuminated, acc. to IEC 61058-1
MTBF	> 1,200,000h acc. to MIL-HB-217 F
L	2 x 0.8mH
Cx	68nF
Cy	2.2nF

Table 2-23 Shurter CD44.1101.151 specifications

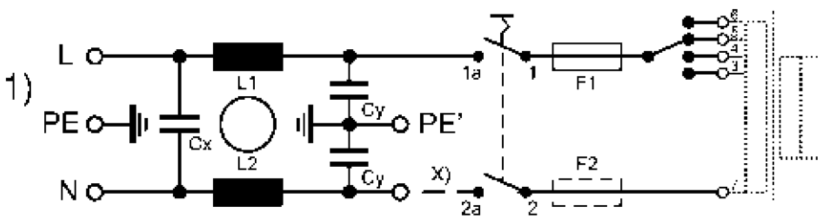

Table 2-24 Shurter CD44.1101.151 input filter

2.2.4.6 USB hub

IE reference = C-21000451

USB powered device

Specifications	
Specification	**Value**
Chipset	Genesys GL805A
Standards	USB specification 2.0 USB specification 1.1 USB specification 1.0 OHCI (Open Host Controller Interface) EHCI (Enhanced Host Controller Interface)
ports	2 downstream USB Type "A" receptacles
Wiring Topology	Tiered star
Operation Temperature	0°C to 40°C
Humidity	5% to 95%, non-condensing
Compliances	CE FCC class B VCCI UL
Power	Hub is USB powered, connected devices are self powered

Table 2-25 USB hub specifications

2.2.5 Functional description

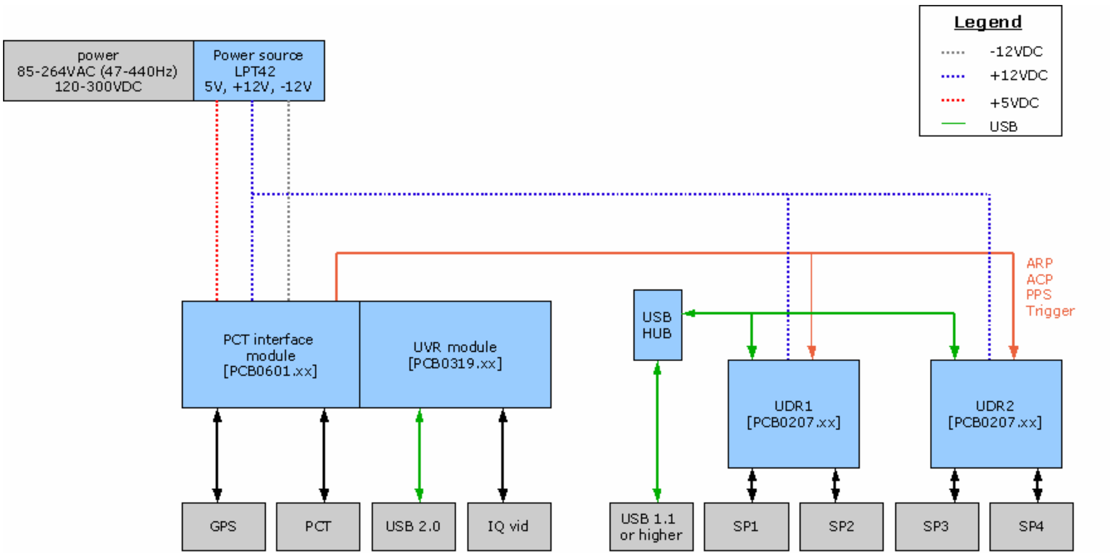

Figure 2-16 PRE790 schematic overview

The PRE790 system is a combination of some main components. We can distinct three main parts: video processing, serial port handling and power.

The video processing part is dedicated to the UVR module [see 2.2.4.1 M597 – UVR for PRE790]. The schematic of this module is displayed in Figure 2-17.

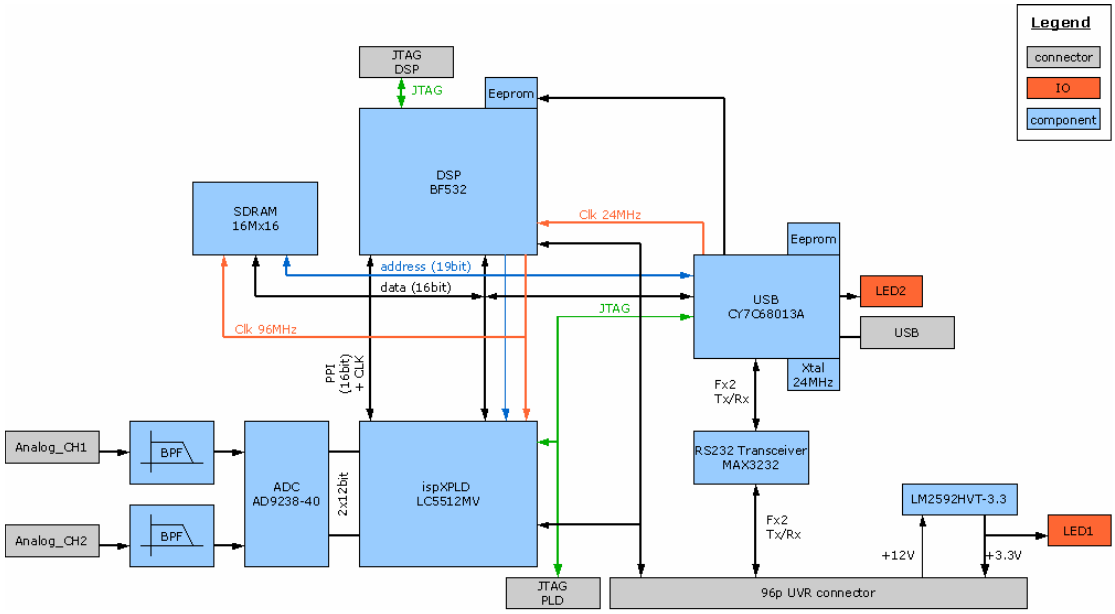

Figure 2-17 M597 schematic overview

The clock sources for the system are generated by the USB processor (CY7C68013A), further called FX2. The Fx2 itself is clocked by a 24MHz TCXO (50ppm, 2ppm/year, 2ppm 0°C -> 50°C). The DSP starts from this 24MHz to generate its core clock of 384MHz by using a PLL. The DSP outputs a 128MHz clock that's used by the PLD and the SDRAM devices.

The JTAG bus of the DSP is on a connector for emulation and in system debugging. The DSP EEPROM, which contains the program, can be reprogrammed by the FX2 so that the DSP firmware can be updated via the USB connection. The JTAG connections of the PLD are available on a connector, but are also connected to FX2 I/O lines so that the PLD can be reprogrammed in system via the USB connection. The FX2 can reprogram its own EEPROM, this results in a complete updateable system via the USB connection.

The I and Q video signals of the radar receiver are connected to the Analog_CH1 and Analog_CH2 input. These inputs are terminated with 50Ω; the input range goes from -2V till +2V. After the input the signals are low pass filtered, the 3dB point of this filter is at 11MHz. Figure 2-18 shows the frequency vs. attenuation graph.

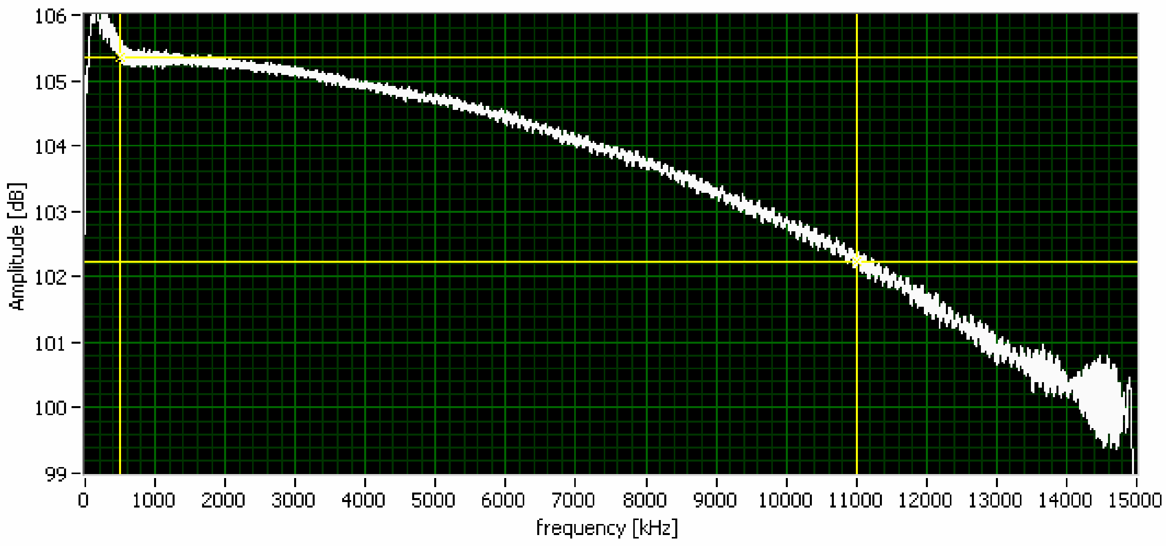

Figure 2-18 M597 analog input circuit frequency vs attenuation

The analog signal will next be digitized with 12bit resolution, 7.5MHz sample rate. This digital version of the signal is given to the DSP for further preprocessing.

The DSP preprocessing will take four consecutive samples and makes an average; the resolution is increased to 14bit, the sample rate decreased to 1.875MHz. The resulting video signals are aligned with the trigger signal (range zero), are time-stamped, ACP and ARP information is added and then send to the processing computer over USB where they will be further processed [see 3.1.2 PSR extractor DLL]

Besides video processing the UVR will also handle the communication with the PCT791 unit, GPS450 module and UDR modules. Therefore the UVR needs an extension module M576. A schematic overview of this module can be seen in Figure 2-19.

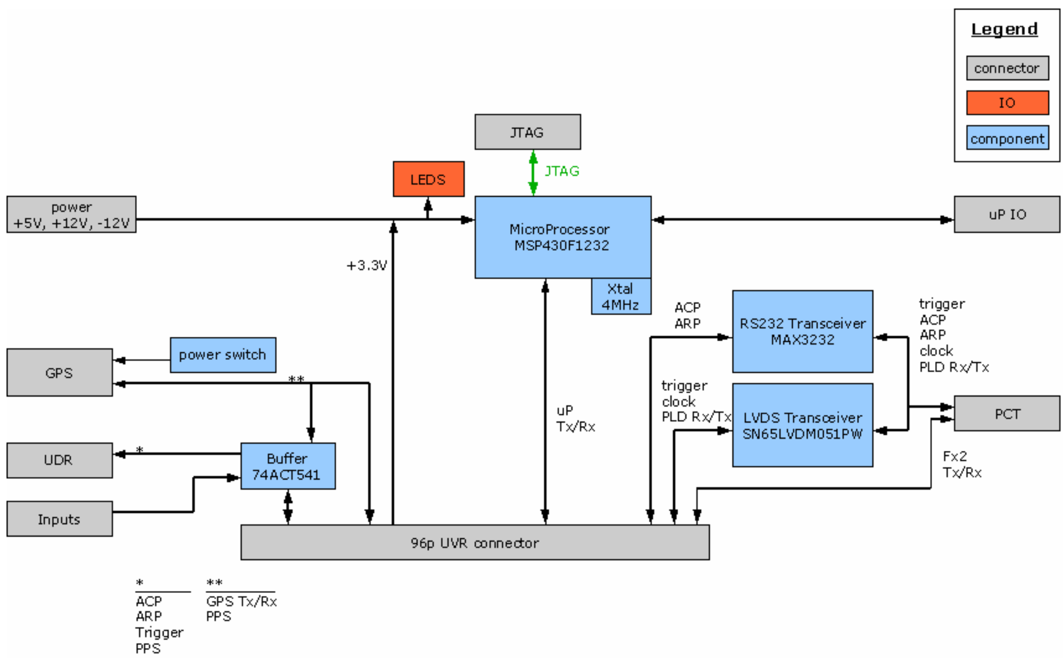

Figure 2-19 M576 schematic overview

Main components of this extension board are level converters, to adapt signal levels. There's also a microprocessor onboard that has as main purpose to supervise the system voltages and to do some extra IO for future requests or modifications.

The communications lines towards the PCT791 unit are displayed in Table 2-26

Name	Function	Interface type	Direction
Trigger +/-	Range 0 trigger	LVDS	PCT791 -> M576
Radar Clock +/-	System sample clock	LVDS	PCT791 -> M576
ACP	Azimuth Change Pulses	RS232	PCT791 -> M576
ARP	Azimuth Reset Pulse	RS232	PCT791 -> M576
Fx_Tx	USB processor serial communication port	RS232	M576-> PCT791
Fx_Rx	USB processor serial communication port	RS232	PCT791 -> M576
UVR_Tx +/-	PLD serial communication port	LVDS	M576-> PCT791
UVR_Rx +/-	PLD serial communication port	LVDS	PCT791 -> M576

Table 2-26 PRE790-PCT791 communication interface

The trigger signal comes from the PCT791 unit, and is used as range zero mark to align the video with. The radar transmitter is fired at the rising edge of this signal. The radar clock signal comes from the PCT791 unit; it is used to generate the analog digital conversion clock. The frequency of this clock is 30MHz, the ADC clock is 30/4 = 7.5MHz. ACP and ARP signals are antenna information signals. This information is added to the video signals and forwarded to the UDR modules. The Fx_Tx and Fx_Rx signals are used by the serial port communication between the two FX2 processors (one on the UVR, the other on the PCT791). This serial port is used to read/write parameters and to update the flash content of the PCT791 unit. UVR_Tx and UVR_Rx lines are reserved for a communication between the two PLD's in the system (UVR and PCT791). For the moment these lines are not used.

Table 2-27 shows an overview of the signals going to the UDR modules. An explanation of the meaning of these signals is already given. This info is needed in the UDR modules to synchronize serial data with the video data.

Name	Function	Interface type	Direction
Trigger	Range 0 trigger	TTL	M576 -> UDR
PPS	GPS pulse per second	TTL	M576 -> UDR
ACP	Azimuth Change Pulses	TTL	M576 -> UDR
ARP	Azimuth Reset Pulse	TTL	M576 -> UDR

Table 2-27 PRE790-UDR communication interface

The signals used between the GPS450 module and the UVR are shown in Table 2-28.

Name	Function	Interface type	Direction
GPS_RxD	Serial communication port	RS232	GPS450 -> M576
GPS_TxD	Serial communication port	RS232	M576 -> GPS450
GPS_Power	Power	+12V	M576 -> GPS450
PPS	Pulse Per Second	TTL	GPS450 -> M576
GPS_Detect	GPS connected detection	Pull-up input	GPS450 -> M576

Table 2-28 PRE790-GPS450 communication interface

For configuration and to get information there is a serial communication port between both (GPS_RxD and GPS_TxD). The GPS connector is the same type used in computer networks. Therefore it's not safe to set power on the connector before we are sure that there is a GPS connected. The GPS_Power line is switched on when the GPS_Detect line is pulled to GND. This will be when a GPS is connected, but not when by accident a network connector is plugged in. The PPS line gives every second a pulse, the rising edge is aligned perfectly with the second's transition.

2.2.6 Connectors

2.2.6.1 GPS connector

Connector type = Unshielded RJ45 PCB Socket 90¼ Low Profile (Stewart SS-6488-NF)

Pin number	Signal	Direction
1	GPS_RxD	GPS -> M576
2	GND	-
3	GPS_TxD	M576 -> GPS
4	GPS_Power	M576 -> GPS
5	PPS	GPS -> M576
6	GPS_Detect	GPS -> M576
7	-	-
8	GPS_Power	M576 -> GPS

Table 2-29 GPS connector layout

2.2.6.2 PCT791 connector

Connector type = HDMI right angle flange type (Molex 5002541931)

Pin number	Signal	Direction
1	Trigger +	PCT791 -> M576
2	GND	-
3	Trigger -	PCT791 -> M576
4	UVR_Tx_0+	M576 -> PCT791
5	GND	-
6	UVR_Tx_0-	M576 -> PCT791
7	UVR_Rx_0+	PCT791 -> M576
8	GND	-
9	UVR_Rx_0-	PCT791 -> M576

10	Radar_Clock+	PCT791 -> M576
11	GND	-
12	Radar_Clock-	PCT791 -> M576
13	Fx_Rx	PCT791 -> M576
14	Fx_Tx	M576 -> PCT791
15	/ACP	PCT791 -> M576
16	/ARP	PCT791 -> M576
17	GND	-
18	+5V	M576 -> PCT791
19	+5V	M576 -> PCT791

Table 2-30 PCT791 connector layout

This connector is not compatible with connectors found on HDMI multimedia devices.

2.2.6.3 I and Q connector

Connector type = BNC straight bulkhead jack

Specifications	
Specification	**Value**
Input impedance	50Ω
Input range	-2V till +2V
Input BW (-3dB)	0-11MHz

Table 2-31 I-video connector specifications

Connector type = BNC straight bulkhead jack

Specifications	
Specification	**Value**
Input impedance	50Ω
Input range	-2V till +2V
Input BW (-3dB)	0-11MHz

Table 2-32 Q-video connector specifications

2.2.6.4 Extractor USB

Connector type = USB type B

Pin name	Description
Shield	Connected via 1M and 100nF to Gnd
Gnd	Connected via 10uH to Gnd
D+	USB data +
D-	USB data -
Vcc	Connected via 10uH to +5V

Table 2-33 Maintenance USB layout

2.2.6.5 HDLC OUT 1/2

Connector type = SUB-D 15p female right angled

DB15 Pin number	RS422	RS232	Direction	RJ45 Pin number
1, 8	GND	GND	-	2
2	TxD-	TxD-	Out	3
3	-	-	-	-
4	RxD-	RxD-	In	1
5	+10V	+10V	Out	4
6	RxC-	RxC-	In	8
7	TrxC-	TrxC-	Out	5
9	TxD+		Out	-
10	-	-	-	-
11	RxD+		In	-
12	-10V	-10V	Out	6
13	RxC+		In	-
14	TrxC+		Out	-
15	+5V	+5V	Out	7

Table 2-34 HDLC Out1/2 connector layout

2.2.6.6 EV760 Input 1/2

Connector type = SUB-D 15p female right angled

Pin number	RS422	RS232	Direction	RJ45 Pin number
1, 8	GND	GND	-	2
2	TxD-	TxD-	Out	3
3	-	-	-	-
4	RxD-	RxD-	In	1
5	+10V	+10V	Out	4
6	RxC-	RxC-	In	8
7	TrxC-	TrxC-	Out	5
9	TxD+		Out	-
10	-	-	-	-
11	RxD+		In	-
12	-10V	-10V	Out	6
13	RxC+		In	-
14	TrxC+		Out	-
15	+5V	+5V	Out	7

Table 2-35 EV760 Input 1/2

2.2.6.7 Datahandler USB

Connector type = USB type B

Pin name	Description
Shield	Connected via 1M and 100nF to Gnd
Gnd	Gnd
D+	USB data +
D-	USB data -
Vcc	Not connected, self powered device

Table 2-36 Maintenance USB layout

2.3 GPS450

2.3.1 Task(s)

Provide UTC sync timestamp to the extractor system

2.3.2 Specifications

Specifications	
Specification	**Value**
Dimensions	122 x 122 x 50mm
Input voltage	+7 … +28VDC
Power consumption	0.75 W
Fuses	-
chipset	Rockwell Jupiter 12
Protocol	Binary
Operating temperature	-40°C to +85°C

Table 2-37 GPS450 specifications

2.3.3 Device depiction

Figure 2-20 GPS450 picture

2.3.4 Main components

M-264 Weatherproof GPS board

Jupiter 12 GPS Receiver TU35-D410-031

2.3.4.1 M-264 weatherproof GPS board

IE reference = M264

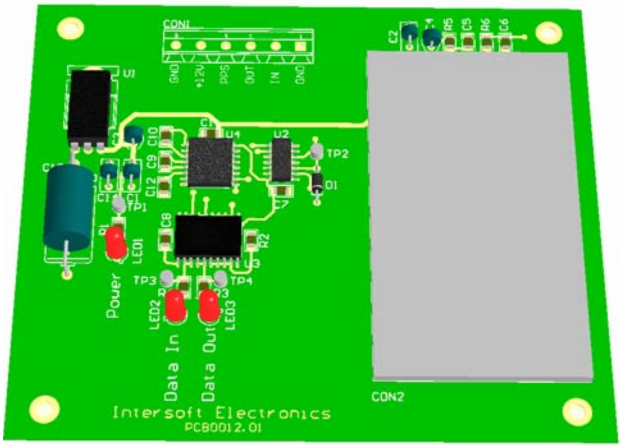

Figure 2-21 M-264 weatherproof GPS board picture

Specifications see Table 2-37 GPS450 specifications.

2.3.4.2 Jupiter 12 GPS Receiver TU35-D410-031

IE reference = C-13000171

Specifications	
Specification	**Value**
Receiver architecture	12-channel, L1 1575.42 MHz C/A code (1.023MHz chip rate) Code-plus-carrier tracking
Time accuracy	Better than 100ns (absolute), 40ns (1 sigma)
Acquisition/reacquisition performance	Hot start: 18 sec (valid almanac, time, position and ephemeris) Warm start: 48 sec (valid almanac, time and position) Cold start: 120 sec (no information)
Operating temperature	-40°C to +85°C
Humidity	Up to 95% (non-condensing)
altitude	-305m to 12190m

Table 2-38 TU35-D410-031 specifications

2.3.5 Functional description

This device consists of a GPS module, some electronics for level conversions, buffering and power management.

The power is external supplied and converted to +5VDC. The GPS module has a serial port for reading status information and to setup the GPS module. These serial ports are converted to RS232 standard.

The PPS output of the GPS module is buffered to drive an external load.

2.3.6 Connector(s)

Connector type = Twisted pair CAT5 type cable, 10m length

Pin number	Signal	Direction
1	OUT	GPS ->
2	GND	-
3	IN	-> GPS
4	+12V	-> GPS
5	PPS	GPS ->
6	GND	GPS ->
7	-	-
8	-	-

Table 2-39 P450 Weatherproof GPS connector layout

2.4 Rackserver Dell PE860

Figure 2-22 PE860 front view

2.4.1 Task(s)

Execution of the Extractor service, Combiner/Tracker service

Data distribution using the DHM service

2.4.2 Specifications

specification	value
Processor	Dual-Core Intel® Xeon® 3060, 2.40GHz, 1066MHz front side bus, 4MB cache
Chipset	Intel 3000
RAM	2GByte 667MHz Dual Rank ECC Memory (2x1GByte)
Operating system	Windows XP professional
Hard Drive	160Gbyte SATA (7200rpm) 3.5" Hard Drive
Drive Bay	8x IDE DVD-ROM drive
Network interface cards	Dual embedded Broadcom Gigabit1 NICs 5721J
Remote management	DRAC IV/P Server management card
Video	ATI ES1000 with 16Mbyte memory
support	3 Years NBD (Next Business Day) Premier Enterprise support 1 Year NBD (Next Business Day) On-Site support
Chassis	Form Factor: 1U Rack Height: 1.68" (4.27 cm) Width: 17.60" (44.70 cm) Depth: 21.50" (54.61 cm) Weight: ~ 26.0 lbs. (11.80kg)
Power	Single power supply (345W)
Environmental	Operating Temperature: 10° to 35°C (50° to 95°F) Operating Relative Humidity: 20% to 80% (noncondensing) with a maximum humidity gradation of 10% per hour Operating Maximum Vibration: 0.25 G's 0-Peak, 3-200 HZ sweep @ 1/2 Octaves/minute Operating Maximum Shock: 31G, 2.6ms, 20inch/sec, bottom side Operating Altitude: -16 to 3048 m (-50 to 10,000 ft.) Storage Temperature: -40° to 65°C (-40° to 149°F) Storage Relative Humidity: 5% to 95% (noncondensing) Storage Maximum Vibration: 1.54 GRMS - 6 sides @ 15 min/side

	Storage Maximum Shock: 71G, 2ms, 35inch/sec, 6 sides; 32G, 2ms, 270inch/sec, 6 sides Storage Altitude: -16 to 10,600 m (-50 to 35,000 ft.)
Regulatory	FCC Part 15 Class A EN61000-3-2, A1, A2: Current Harmonics EN61000-3-3: Voltage Flicker EN55022: 1998 and CISPR 22: 1997 Class A VCCI Class 1 MIC Class A BSMI EN55024: 1998 and CISPR 24: 1997 IEC 61000-4-2: Electrostatic Discharge specification IEC 61000-4-3: Radiated Immunity IEC 61000-4-4: EFT/Bursts Immunity IEC 61000-4-5: Surge Immunity IEC 61000-4-6: Conducted Immunity 0.15-80MHz IEC 61000-4-8: Power Frequency H-Field IEC 61000-4-11: Voltage Dips/Interrupts/Variations
Safety	EN60950-1, First Edition: Standard for Information Technology Equipment - Safety-Part 1: General Requirements IEC 60950-1, First Edition (2001) UL/CSA 60950-1, First Edition: Standard for Information Technology Equipment - Safety-Part 1: General Requirements EK1-ITB 2000:2003 : Ergonomics ISO 9241 : VDT Ergonomic Requirements ZH1/618:GS-VW-SG7:1997 :Ergonomics ISO 13406-2 : Ergonomic requirements for work with visual displays based on flat panels ISO 7779 : Sound Pressure at Operator Position (Acoustics) MsanPiN 001-96: Interstate Sanitary rules and norms (Acoustics)

Table 2-40 PE860 specifications

2.5 Switch DELL PowerConnect 2708

Figure 2-23 PowerConnect 2708 front view

2.5.1 Task(s)

Network connection of the extractor system

2.5.2 Specifications

Delivers full wire-speed switching across all ports and web-managed features

Dell-designed switch is default an unmanaged switch, but can be easily set up as a web-managed switch with the push of a button

8-port Gigabit Ethernet PowerConnect switch includes features not usually found on unmanaged LAN switches, such as integrated front panel LEDs and cable diagnostics

PowerConnect 2708 supports maximum switching capacity of 16 Gbps

Supports auto MDI/MDIX and auto-negotiation of speed, duplex and flow control

Easy web access to management features

Up to 64 industry-standard VLANs

Four priority queues for optimizing network traffic using industry standard quality-of-service capabilities

Port mirroring so that traffic flowing through one port can be mirrored to another port for intrusion detection and troubleshooting

Link aggregation for up to 6 groups supporting up to 4 ports in each group

Supports Virtual Cable Diagnostics by Marvell® to provide advanced troubleshooting capabilities for your cable infrastructure

Specification	Value
Port Attributes	8 10/100/1000 BASE-T ports Auto-negotiation for speed, duplex mode and flow control Auto MDI/MDIX mode and flow control Integrated Port LEDs Individual port controls
Performance	Switching Capacity 16.0 Gbps Forwarding Rate 11.9 Mpps
Management	Web-based management interface

	BootP/DHCP IP address management or Static IP address assignment RMON statistics
Class of Service	Four priority queues per port Adjustable WRR and strict priority Layer 2 IEEE 802.1p tagging and port-based priority Layer 3-aware prioritization using DSCP values
Security	Switch access password protection (read-only and read-write access) Restricted IP address
VLAN	IEEE 802.1Q port-based tagging up to 64 VLANs Honors all 4096 VLAN tags
Switching Features	Link Aggregation, up to six groups and up to four aggregated links per group (IEEE 802.3ad) Port mirroring (up to four source ports)
Availability	Firmware Uploads to the Switch Broadcast Storm Control Virtual Cable Tester by Marvell® Optical Transceiver Diagnostics
Chassis	Dimensions: 1.70 in (H) x 10.42 in (W) x 6.37 in (D) Height: 1U, rack-mounting kit included Weight: 5 lbs
Standards Supported	IEEE802.3 CSMA/CD IEEE802.3u 100BaseTx IEEE802.3z/ab 1000BaseT IEEE802.3x Flow Control IEEE 802.1p
Environmental	Operating Temperature: 0° C to 45° C (32° F to 113° F) Storage temperature: -20° C to 70° C (-4° F to 158° F) Operating Humidity: 10% to 90% Relative Humidity Storage Humidity: 10% to 95% Relate Humidity
Power	Maximum Power: 1.0A @ 100V

Table 2-41 PowerConnect 2708 specifications

2.6 Computer (CAM display) Dell Dimension 9200

Figure 2-24 CAM display computer

This computer system is used to control and monitor the extractor/tracker system. The tools used are the Extractor CAM module and the MRD display. The computer system is connected via a >10Mbps network connection to the extractor system switch.

The computer system used for the moment is a Dell Dimension 9200, Pentium D820 2.8GHz with an NVIDIA Geforce 7900GS video card but it can be any other COTS computer. The only requirements are a modern processor and a video card with minimum 128Mbyte (256Mbyte preferred) memory onboard.

3. Software overview

The main part of the extractor and combiner/tracker system is software based. The software consists off modules, communicating with each other. Each module has its own function.

The software components runs on the processing computer [see 2.4 Rackserver Dell PE860].

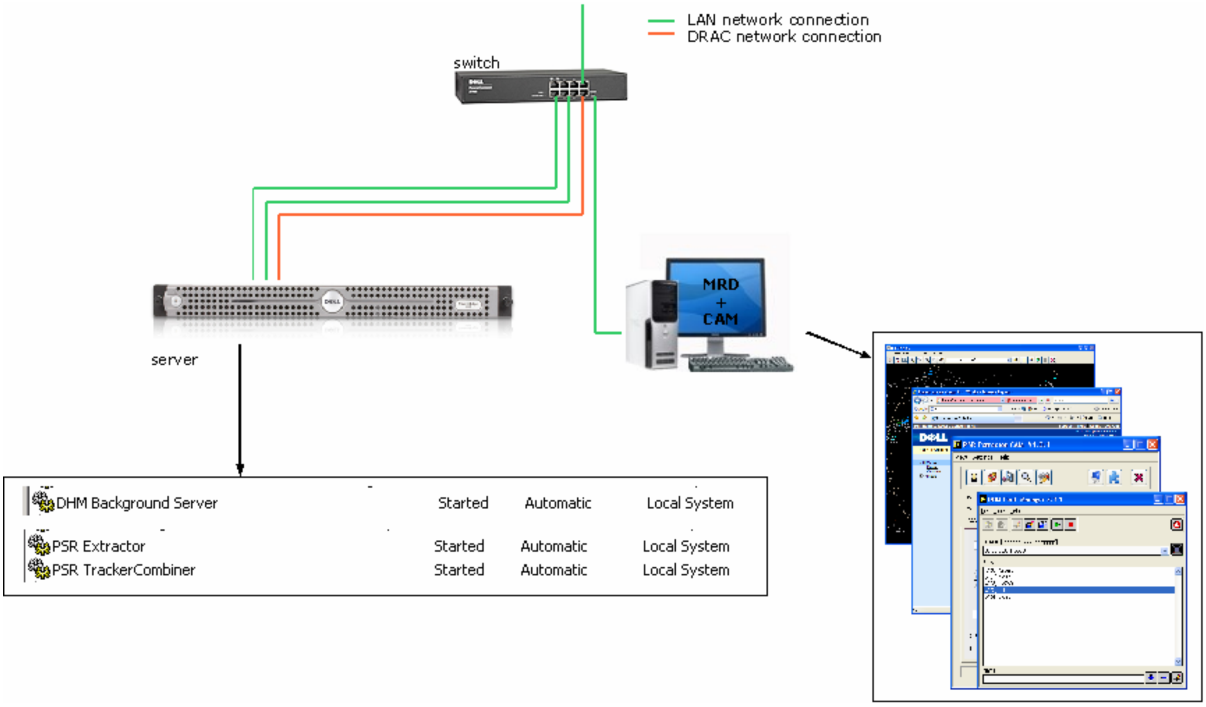

Figure 3-1 PSR extractor software overview

3.1 Extractor Server

3.1.1 Description

The Extractor server module is configured to run as a Windows XP service. The module doesn't have a user interface of its own. Control and monitoring is done with the CAM module software. The tasks executed by this service are summed below:

Manage hardware components of the PRE790 system

Read and process reply stream from the device

Output video and data onto the network

Manage the cluttermap (check, build, adapt, save, load)

The extractor service is built in a modular way, Figure 3-2 shows an overview. The following list gives an enumeration with a short description of each module. Further in the document each part is explained in detail.

PSR extractor DLL: this module is responsible for the main part of the calculations. It receives the video data from the device or a previously recorded file and does the FFT processing, thresholding and probe streaming. The clutter-maps are also calculated and updated in this part of the software.

PCT: manages the PCT791 unit (only in live mode). It will write/read parameters, monitors the PCT791 status and updates the flash content.

Reply Combiner: combines the separate replies coming form the PSR extractor DLL and makes primary plots of the data. The output of this module is forwarded to the Plot streamer module.

Plot Streamer: this module streams the primary detected plots out to the network over UDP.

PPI: this engine is responsible for PRE790 system status information. It will output sector messages on the requested network sockets and to the user CAM interface. It will also measure the antenna rotation time, reads GPS status and time, reads ACP, ARP and IPR info.

Probe Streamer: configures and manages the video probe output of the PSR extractor DLL.

EDR Replay: replays recorded digital data stream files synchronous with the primary 2MHz file (only in replay mode).

CAM server: handles communication with the user CAM interface and the subengines

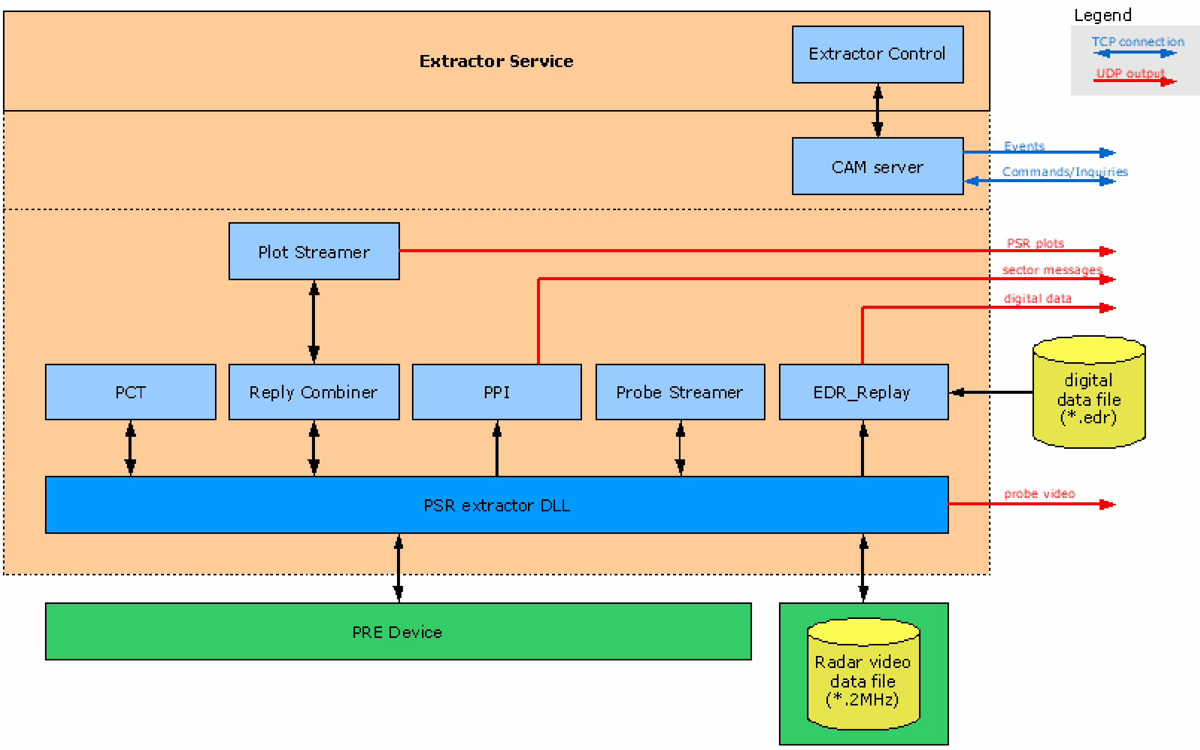

Figure 3-2 Extractor server overview

3.1.2 PSR extractor DLL

This module is responsible for the main part of the calculations. It receives the video data from the device or a previously recorded file and does the FFT processing, thresholding and probe streaming. The clutter-maps are also calculated and updated in this part of the software. An overview of the internal structure of this module can be seen in Figure 3-3.

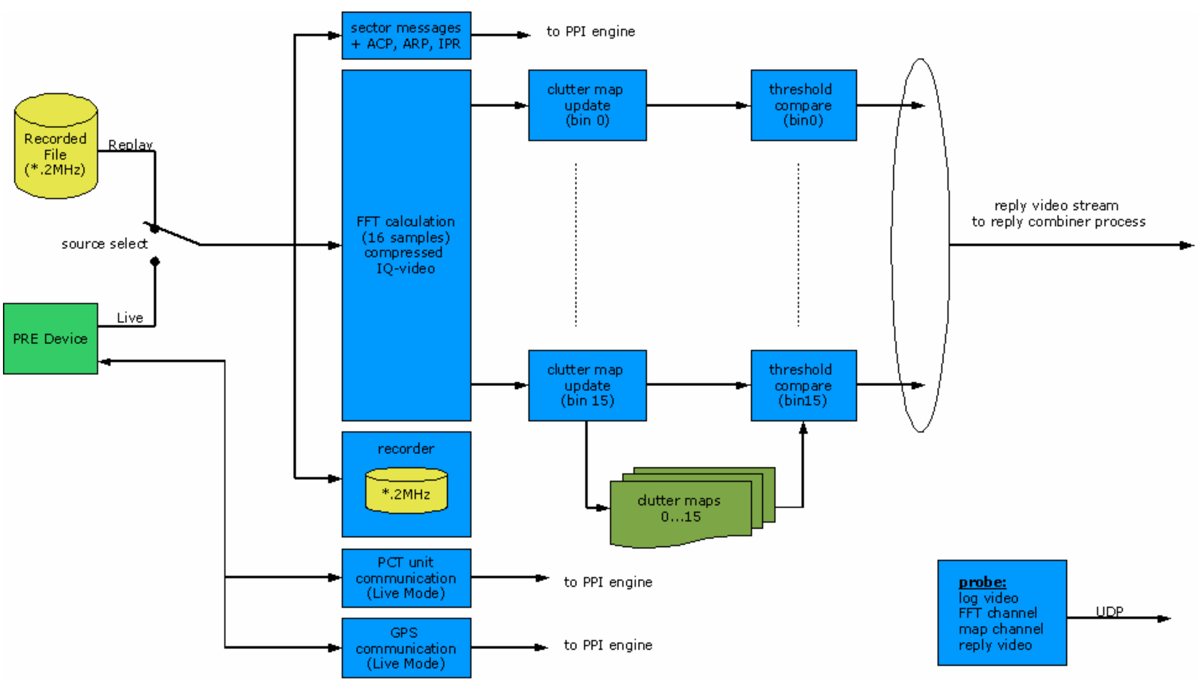

Figure 3-3 PSR extractor DLL overview

3.1.2.1 Functional description

At startup of the extractor system the DLL opens a connection to a PRE790 device (called LIVE mode) or a previously recorded 2MHz video file (called REPLAY mode). For the further description it's called "device".

In case of live mode the data is received over an USB2.0 connection which must exclusively used for the PRE790 device due to bandwidth requirements. This means that no other high bandwidth devices must be connected to the same computer. A mouse, keyboard, UDR is not a problem.

The DLL receives the interrogation sweep data in the format found in section 4.1 from the device where it's fed to a FFT filter bank. It calculates a 16 bin FFT result for the current cell by using the data at the same range of the previous 15 interrogations, see Figure 3-4

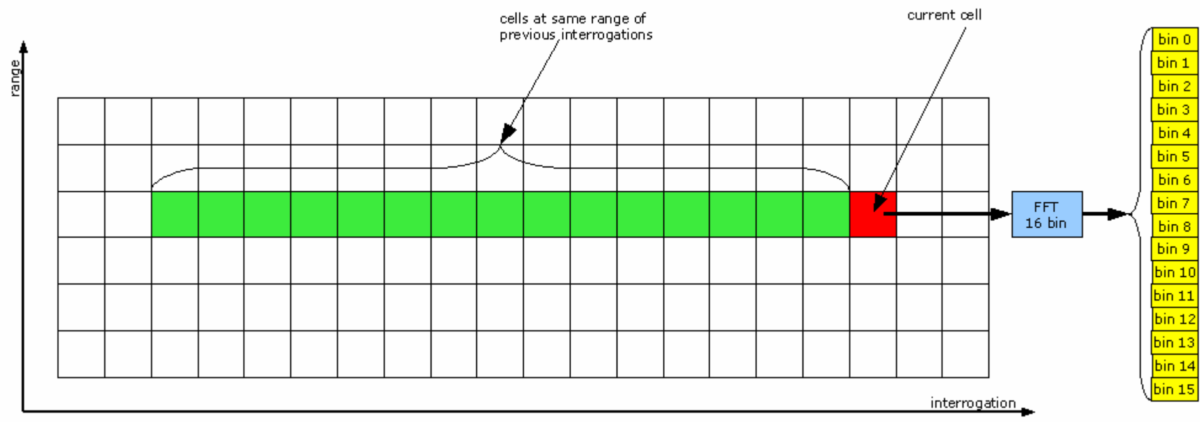

Figure 3-4 16-bin FFT calculation mechanism

This means that for each cell sixteen results are outputted. These results are compared against the clutter-map value for that cell [for more information about the clutter-map see section 3.1.2.2 The Clutter-map]. The FFT result will be outputted as a reply when the condition (3-1) is true. This output is called the reply video stream.

Condition [T|F] = FFT value [dB] > clutter-map value [dB] + Threshold [dB] (3-1)

The input data of the device is also fed to a recorder; this makes it possible to record the input stream for later playback (in replay mode).

The sector messages part of the DLL generates 32 sector messages per rotation, the messages are fed to the PPI engine [see 3.1.6 PPI].

The GPS communication block reads information from the GPS if connected. This information is used for time-stamping.

For monitoring of the several calculation and processing steps there is a probe output foreseen. It streams the selected probe data out at a preconfigured UDP socket. The control of this probe is done by the probe streamer engine [see 3.1.7 Probe Streamer]. The different probe types are:

Log video

FFT channel

Map channel

Reply video

Log video

Outputs the log video of the input signal. The log video is calculated at the following manner:

$$\text{Log video [dB]} = 10 \times \text{Log}\{I[AD]^2+Q[AD]^2\} \quad (3\text{-}2)$$

FFT channel

Outputs the output of a FFT calculation channel. Because a 16-bin FFT processing is used, there are 16 channels available to output. The output is in dB

Map channel

Outputs the clutter-map of the selected processing channel (0 to 15) in dB.

Reply video

This probe type is used as "controller video", previously in the document named as reply video stream. The video which is outputted comes from the end of the DLL processing chain. It outputs only the video cells which are strong enough to be a possible target. The value outputted is calculated at the following manner:

Reply video [dB] = MAX [IF (FFT{i}[dB]>CM{i}+threshold) THEN (FFT{i}[dB] – CM{i}[dB]); i=0 -> 15] (3-3)

3.1.2.2 The Clutter-map

A clutter-map contains static objects seen by a radar: for example mountain reflections, obstacles or other non moving parts. On the other hand, also dynamic objects like weather can be stored in the clutter map, these are slow moving objects. This means that the clutter map is continuously changing while the Extractor is running.

The clutter-map consists of cells containing the expected background reflection signal amplitude for that region. For each processing channel there is a clutter-map (sixteen in total). The size of a clutter-map is 1024 by 1024 cells, data is 8 byte = 8Mbyte. The physical size of a cell is 2 range units at 4 ACP units (see Figure 3-5) thus eight resolution cells share the same clutter-map cell.

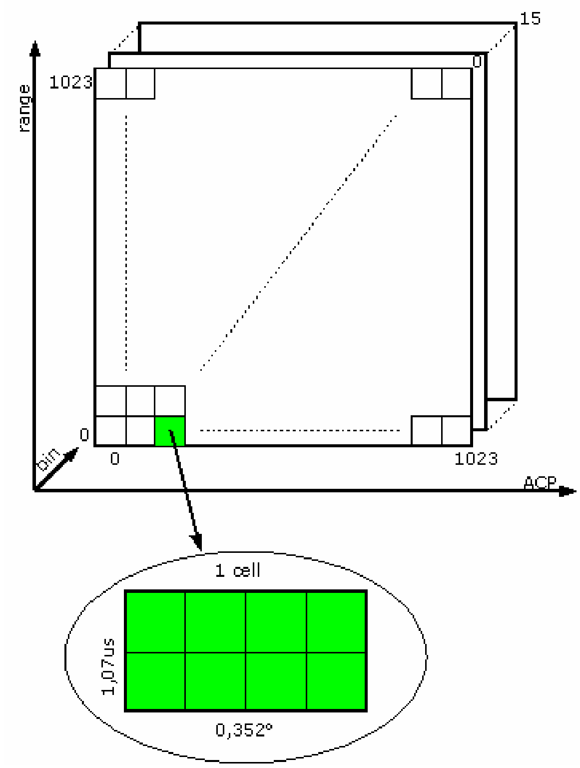

Figure 3-5 clutter-map dimensions

Each scan the clutter-map is adapted to the new FFT calculations. This update process is discussed in section 3.1.2.2.3 Clutter-map adaptation process.

At startup the clutter-map is loaded from file, if there's no clutter-map found on disk or it's out of range [see 3.1.2.2.1 Clutter-map compare process], the system will build a new map [see 3.1.2.2.2 Clutter-map build process].

3.1.2.2.1 Clutter-map compare process

At startup of the extraction process the software will determine if the clutter-map loaded from disk is still valid for the current environment. This check will only be executed on the zero bin clutter-map, assuming that if this map is ok, the rest will be also ok. The compare process is managed by the Extractor Server engine [see 3.1.1 Description], but takes place in the PSR extractor DLL.

3.1.2.2.2 Clutter-map build process

When a clutter-map is not found at startup or the loaded clutter-map is out of range, the system will start in cold-start mode. This means that the clutter-map will build up from scratch. This process is managed by the Extractor Server engine [see 3.1.1 Description], but takes place in the PSR extractor DLL.

At the beginning of the build process, the extractor control will configure the DLL with the following parameters: UpStep=50dB; DownStep=25dB; Threshold=200. The clutter-map contained by the DLL memory will be all set to 0. Now the clutter-map adaptation process [see 3.1.2.2.3 Clutter-map adaptation process] will do the rest of the work, every scan the build process will decrease the up- and downstep with a factor 0.75; this process repeats 12 times. The result is that after 12 scans the clutter-maps have approached the FFT result values within a certain range. In Figure 3-6 you can see an example of the approach of a fixed value of 60,52dB in 12 iterations. In real the goal value is not stable; this will increase the approximation error.

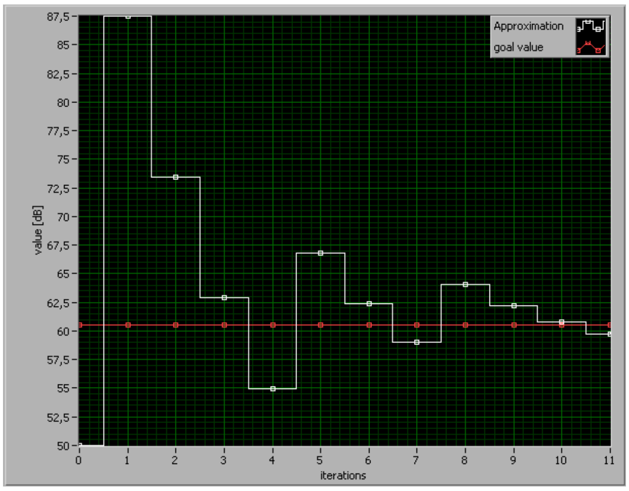

Figure 3-6 build clutter-map approximation process 1

In Figure 3-7 you can see in the left figure the approach value versus the goal value for goal values going from 0 to 150. In the right figure you can see the error (approximation – goal value).

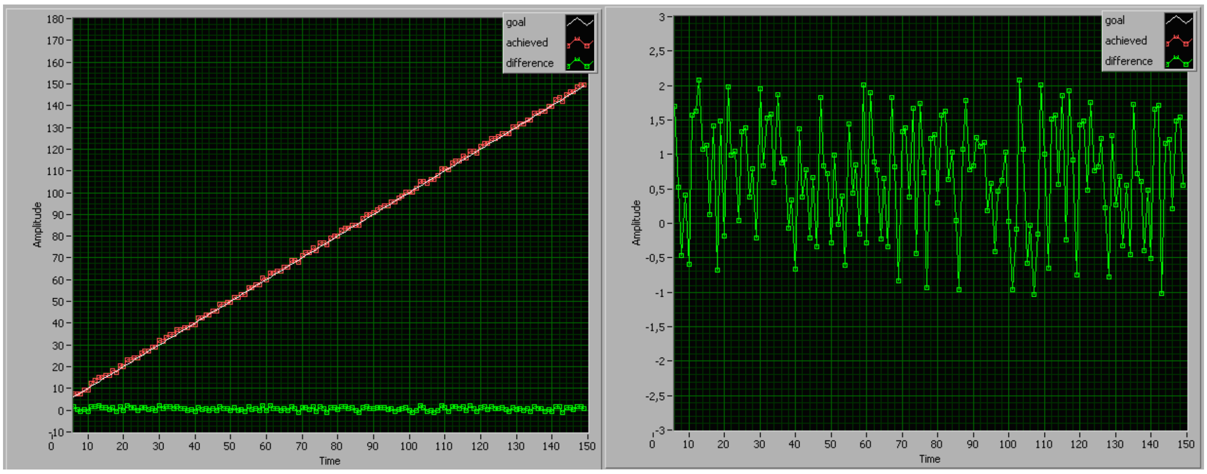

Figure 3-7 build clutter-map approximation process 2

At the end of the build process the maps are increased with 6dB to create a save margin, next the map is saved to disk and the build process is ended. The previous settings of upstep, downstep and threshold are set back as before.

3.1.2.2.3 Clutter-map adaptation process

Each scan each clutter-map cell is updated according to the results of the FFT-calculations for the resolution cells belonging to that specific clutter-map cell. This adaptation process is autonomous managed by the DLL

There are two map-parameters defined; upstep and downstep, which are user controllable. If all FFT results of the resolution cells are lower than the clutter-map cell value, then the value of the cell will be decreased with downstep. If the outcome of one of the FFT calculations for the resolution cells is higher then the current clutter-map cell value, the value will be increased with upstep.

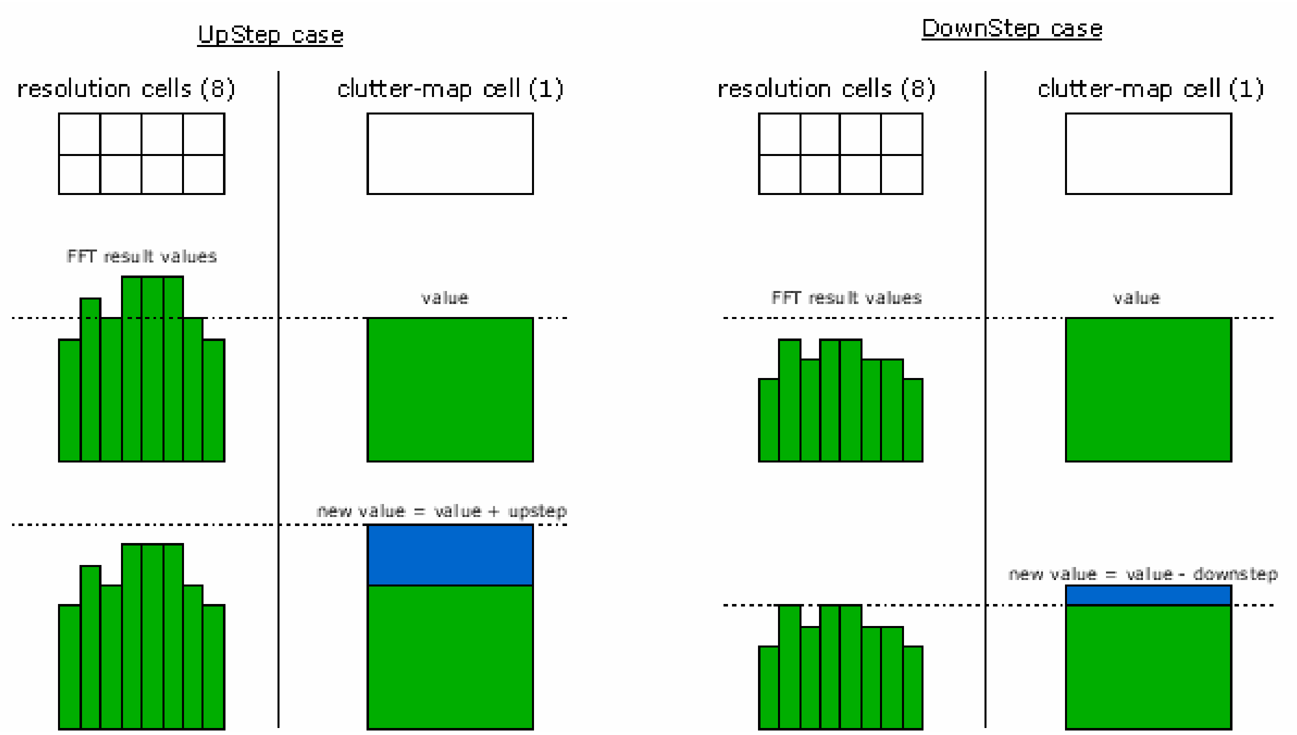

Figure 3-8 Clutter-map adaptation process

3.1.3 PCT engine

The PCT engine handles the communication with the PCT791 unit, connected via de PRE790 device to the processing computer. The engine is only started when a live device connection is initiated; in replay mode this engine has no function. Figure 3-9 shows an overview of the engine.

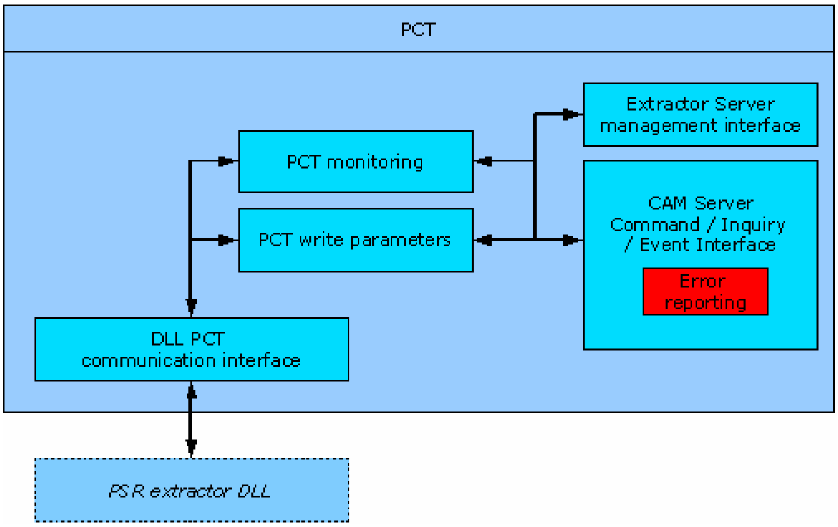

Figure 3-9 PCT engine overview

The engine is split in separate tasks; first you see the communication with the PSR extractor DLL. The two function blocks PCT monitoring and PCT write parameters can communicate with the PCT791 unit by using read/write commands via the DLL PCT communication interface block. The PCT monitoring block checks the connection with the PCT791 unit, and monitors the status indicators (also found on the PCT791 unit front panel). The PCT write parameters block is used to set the PCT791 unit parameters according to the TimingPrefs INI file. The INI file to use can be selected at startup of the extractor, if none is chosen; the default.ini will be used [see 3.1.3.1 TimingPrefs INI file].

The two blocks at the right are both communication blocks. The first, Extractor Server management interface, is used to communicate with the extractor server engine. This interface is used to trigger events in the PCT engine. The second, CAM server Command / Inquiry / Event Interface, is used to communicate with the CAM server, this interface will be discussed in detail in section 3.1.9 CAM server

3.1.3.1 TimingPrefs INI file

The INI files are located in the C:\Program Files\Intersoft Electronics\PSR Extractor\Extractor Server\TimingPrefs directory. If you open such a file you will see something as below:

[Timing]

Limiter Sync (SL)=13.600000

Offset Limiter Sync (SL)=-2.9000000

Premodulation Sync (MOD)=1.000000

Master Sync (SP)=1.000000

Offset Master Sync (SP)=-3.1500000

SSR Sync (SSR)=1.000000

Offset SSR Sync (SSR)=-35.000000

Extra Sync (ES)=1.000000

Offset Extra Sync (ES)=-40.000000

TxOn=TRUE

stagger=FALSE

30MHz clock?=FALSE

PRF=750.000000

PEMR Range=65.000000

PEMR Azimuth=180.000000

PEFR Range=65.000000

Fixed STC H=0,000000

Fixed STC L=0,000000

fixed HL beam=FALSE

BS=FALSE

STC=FALSE

internal clock?=TRUE

Important: changing values in these files can result in damage of the radar system in master mode. Especially the timing settings must be matched with each other for a proper working system. If you doubt something, ask a second opinion.

A TimingPrefs INI file contains settings to configure the PCT791 unit. In Table 3-1 you can find an explanation of the meaning of each value.

Value name	Possible values	Meaning
Limiter Sync (SL)	[0,6; 16,7]	Duration in µs of the limiter sync pulse
Offset Limiter Sync (SL)*	[-40; +28,1]	Position of the rising edge in µs
Premodulation Sync (MOD)	[0; 1,8]	Duration in µs of the Premodulation Sync pulse
Master Sync (SP)	[0; 1,8]	Duration in µs of the Master Sync pulse
Offset Master Sync (SP)*	[-40; +28,1]	Position of the rising edge in µs
SSR Sync (SSR)	[0; 1,8]	Duration in µs of the SSR Sync pulse (placed at the front of the PCT791 unit device)
Offset SSR Sync (SSR)*	[-40; -31,7]	Position of the rising edge in µs
Extra Sync (ES)	[0; 1,8]	Duration in µs of the Extra Sync pulse (found on the right side of the PCT791 unit device)
Offset Extra Sync (ES)*	[-40; -39,1]	Position of the rising edge in µs
TxOn	TRUE | FALSE	Defines the default setting of the timing signal generation (TRUE=On; FALSE=Off)
Stagger	TRUE | FALSE	Defines the default setting of the stagger (TRUE=On; FALSE=Off)
30MHz clock?	TRUE | FALSE	Defines the selection of the 30MHZ clock source on the front panel of the PCT791 unit. (TRUE=30MHz clock source on PCT791 front | FALSE=15MHz clock source on flatcable)
PRF	[458; 976]	Pulse Repetition Frequency, define the PRF of the radar. Leave it on the default 750Hz
PEMR Range	[0; 66,1]	Default moving test pulse range
PEMR Azimuth	[0; 359,2]	Default moving test pulse azimuth
PEFR Range	[0; 66,1]	Fixed test pulse range
Fixed STC H	[0; 40]	Default fixed STC H attenuation
Fixed STC L	[0; 40]	Default fixed STC L attenuation

Fixed HL beam	TRUE | FALSE	Default fixed HL beam setting
BS	TRUE | FALSE	Defines the default beam switching setting (TRUE=manual | FALSE=automatic)
STC	TRUE | FALSE	Defines the default STC setting (TRUE=manual | FALSE=automatic)
Internal clock?	TRUE | FALSE	This setting defines to use the internal PCT791 clock or not, this setting overrides the 30MHz clock selection. (TRUE=internal clock | FALSE=30MHz clock selection dependent)
*the offset is taken from the rising edge of the MOD pulse.		

Table 3-1 PCT TimingPrefs INI file values

3.1.4 Reply Combiner engine

The reply combiner engine reads the reply video stream coming from the PSR Extractor DLL and processes this data to digital plot outputs.

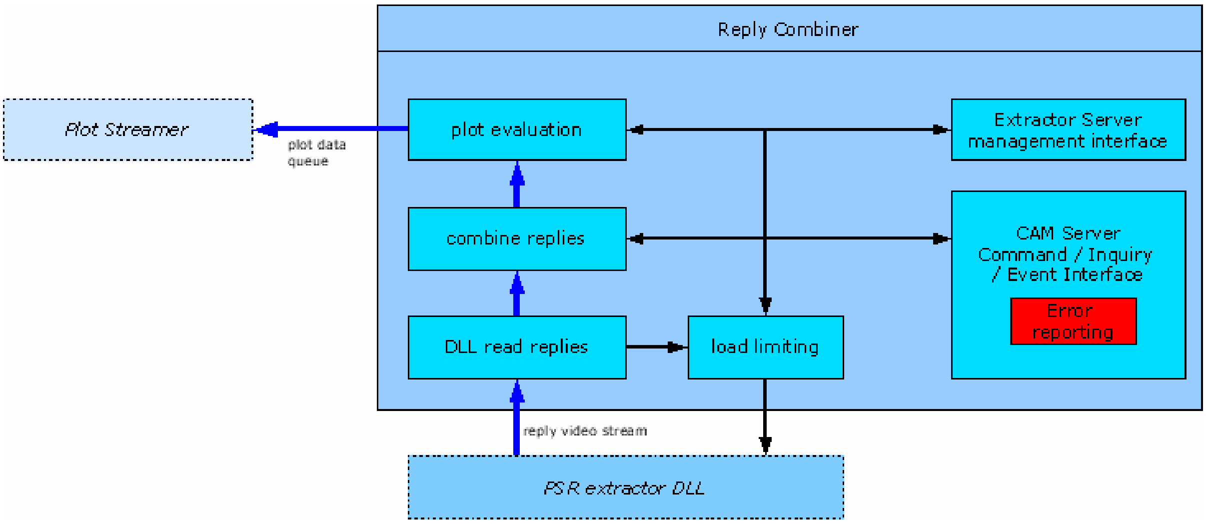

Figure 3-10 Reply Combiner overview

The blue lines are showing the main data path in Figure 3-10. You can distinct the three main processing blocks on the left: DLL read replies, combine replies and plot evaluation. These blocks will be discussed further in this document.

The load limiting block raises the detection threshold in case a system overload condition occurs.

The two blocks at the right are both communication blocks. The first, Extractor Server management interface, is used to communicate with the extractor server engine by triggering events in the Reply Combiner engine. The second, CAM server Command / Inquiry / Event Interface, is used to communicate with the CAM server; this interface will be discussed in detail in section 3.1.9 CAM server

3.1.4.1 DLL Read replies

This block reads the reply video stream coming from the PSR extractor DLL and forwards it to the combine replies block.

3.1.4.2 Combine replies

This block will group separate replies to a possible target reply group.

3.1.4.3 Plot evaluation

This part of the software evaluates the target reply groups. It will test the replies against several criteria's to determine if it's really a target or just clutter. If a valid target if found it will be forwarded to the plot streamer engine.

Reply group evaluation sequence:

First the reply group passes a quantity and size filter:

Quantitiy filter: the number of replies grouped in the reply-group must be in certain limits. The minimum number is 5 and the maximum is 2000. [5; 2000[

Size filter: the dimensions of the reply group must be in range and interrogation limits. ΔRange <= 10 and ΔInterrogation <= 100. [see Figure 3-11]

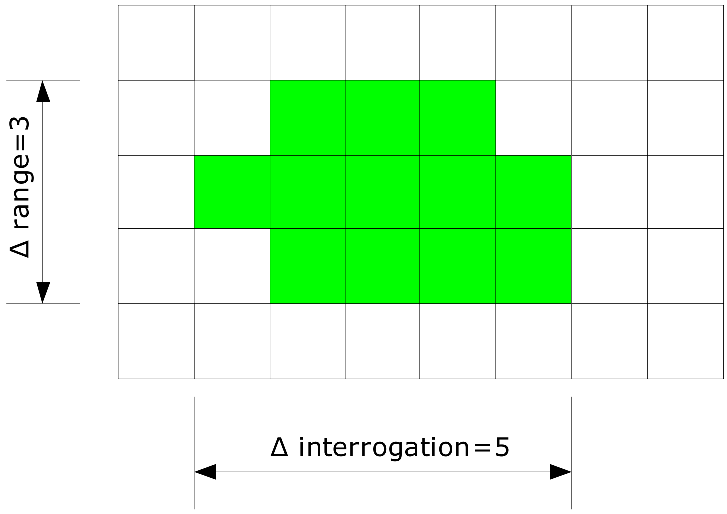

Figure 3-11 range and interrogation sizes

After passing the first filter the reply group is analyzed for spectrum content. It will search for the dominant peak frequency bin(s). If all frequency bins have the same power (within 3dB) then the reply group will be treated as a jammer. If there are more than 5 peaks detected, the group is treated as clutter. In al other cases the reply group will be further treated as a possible target group.

The maximum power bin will now be analyzed in the interrogation direction (slow time). If a target is interrogated, the power curve in interrogation direction must fit ideal to a parabola:

$Y=ax^2+bx+c$

There are 3 parameters which has each its own weighting-factor to a score value. The score value is calculated with the formula below (3-4)

Score = [(a x 1000) - g_qf] x s_qf + (mse-g_mse) x s_mse + (length – g_length) x s_length (3-4)

a = the quadratic parameter of the parabola (ax^2+bx+c)

mse = mean square error between the parabolic fit and the real beam.

Length = the number of interrogations in beam

g_qf , g_mse, g_length= these values defines the ideal target beam.

s_qf, s_mse, s_length = these are the weighting factors of each term in the score sum.

3.1.5 Plot Streamer

This small engine does nothing more than sending the targets declared by the reply combiner engine over an UDP socket. See Figure 3-12 for an overview of the engine.

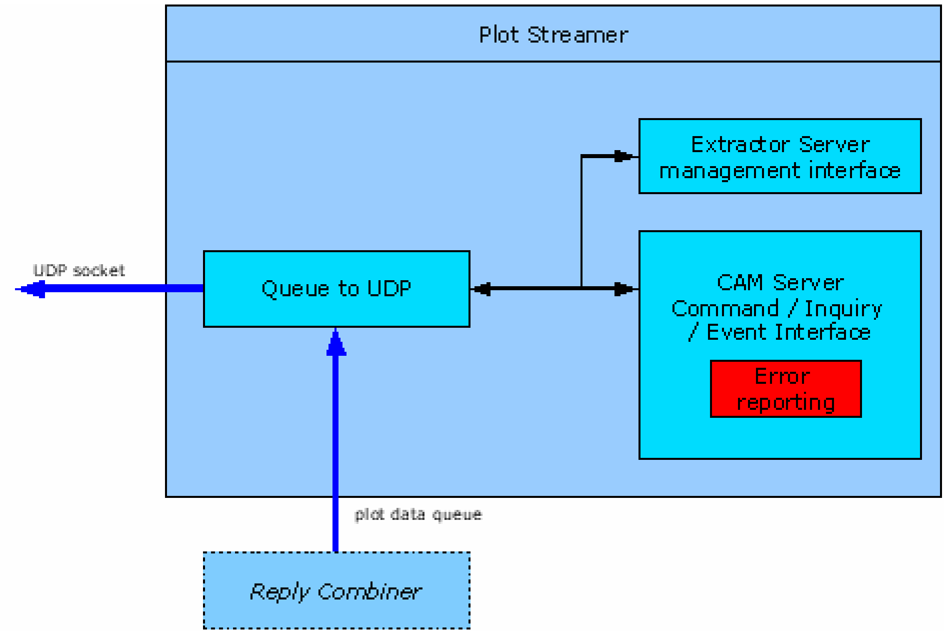

Figure 3-12 Plot Streamer overview

The block at the left, Queue to UDP, reads the data coming from the reply combiner and sends it over the network via an UDP socket. The data is in D6 format.

The two blocks at the right are both communication blocks. The first, Extractor Server management interface, is used to communicate with the extractor server engine by triggering events in the Plot Streamer engine. The second, CAM server Command / Inquiry / Event Interface, is used to communicate with the CAM server; this interface will be discussed in detail in section 3.1.9 CAM server

3.1.6 PPI

This engine is responsible for PRE790 system status information. It will output sector messages on the requested network sockets and to the user CAM interface. It will also measure the antenna rotation time, reads GPS status and time, and reads ACP, ARP and IPR info. See Figure 3-13 for an overview.

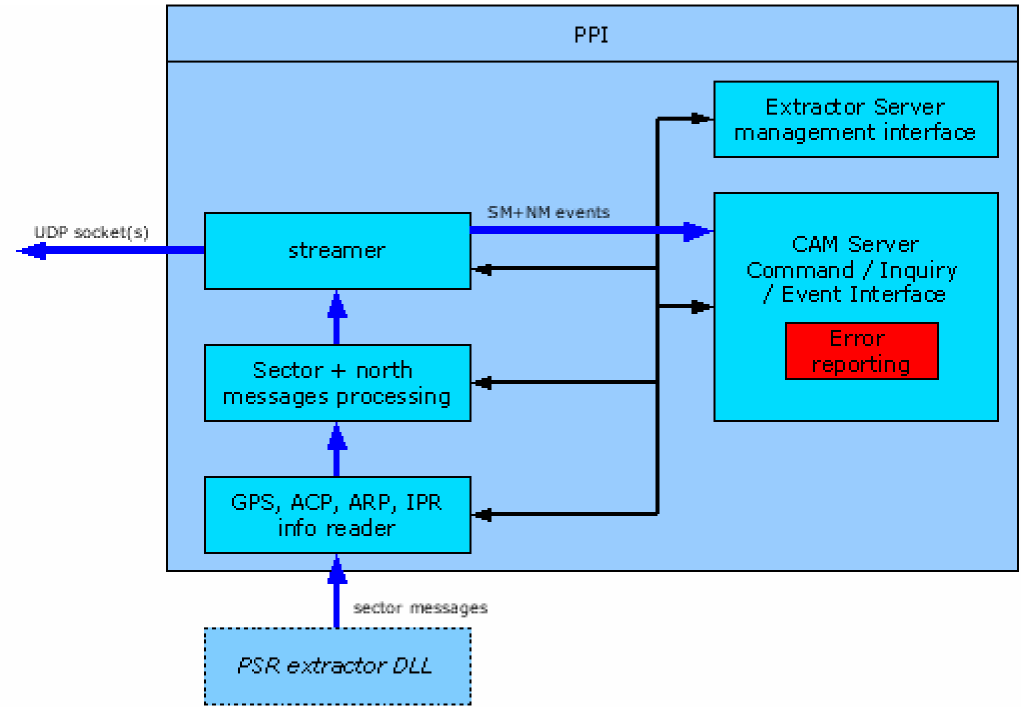

Figure 3-13 PPI overview

The info reader block extracts the ACP, ARP, IPR and GPS info so it is available for the system and CAM software.

The sector + north messages processing block receives the antenna information (sector messages) from the PSR extractor DLL. If for a predefined time there's no new sector message the PPI engine will generate an error message. The received sector message information is converted to the D6 format, and a North message is generated for a north crossing. The data is streamed to the network by the streamer block. This streamer block can handle more than one socket, so the sector info can be send to multiple UDP sockets. The Sector data is also send as events to the CAM server communication block; these events are used to drive the PPI display in the CAM user interface.

The two blocks at the right are both communication blocks. The first, Extractor Server management interface, is used to communicate with the extractor server engine by triggering events in the PPI engine. The second, CAM server Command / Inquiry / Event Interface, is used to communicate with the CAM server; this interface will be discussed in detail in section 3.1.9 CAM server

3.1.7 Probe Streamer

This engine configures and manages the video probe output of the PSR extractor DLL. See Figure 3-14 for an overview.

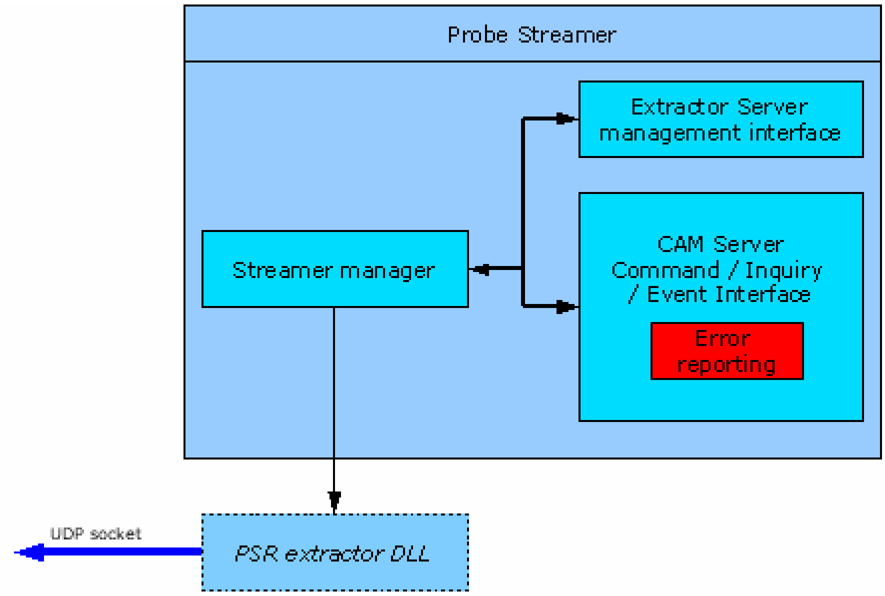

Figure 3-14 Probe Streamer overview

The streamer manager block can start-stop the probe output, configures the socket (ip:port), selects the probe type and channel and sets offset and gain. The offset parameter is used to compensate for a DC offset at a probe output; the gain parameter is used to regulate the contrast.

The two blocks at the right are both communication blocks. The first, Extractor Server management interface, is used to communicate with the extractor server engine by triggering events in the Probe Streamer engine. The second, CAM server Command / Inquiry / Event Interface, is used to communicate with the CAM server; this interface will be discussed in detail in section 3.1.9 CAM server

3.1.8 EDR_Replay

Left empty.

3.1.9 CAM server

This engine handles communication with the user CAM interface over two TCP/IP connections. The CAM server functions as TCP server for both connections. Socket 2 is used as event reporting communication line and socket 1 is used as command/inquiry communication interface. An overview of the engine can be seen in Figure 3-15.

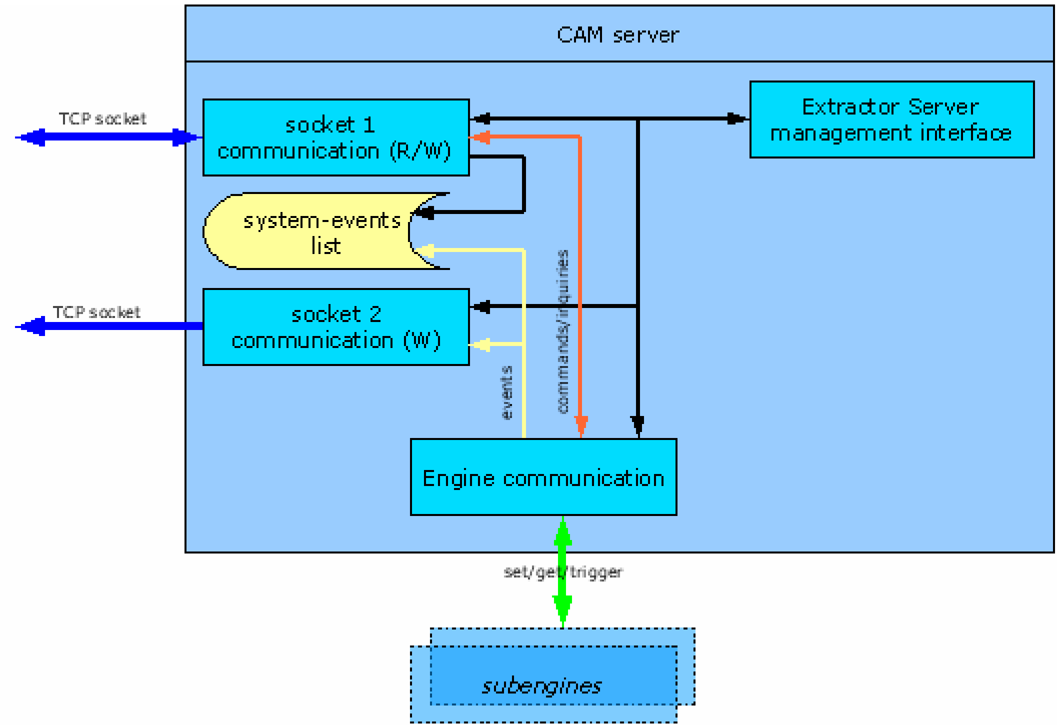

Figure 3-15 CAM server overview

The function of socket 1 and socket 2 communication is obvious. The Engine communication block manages the communication between the CAM server and the other system engines. This communication is done by set, get and trigger commands.

The system-events list block stores the last 500 events reported by the system. This list can be read by the CAM software.

The Extractor Server management interface is used to communicate with the extractor server engine by triggering events in the CAM server engine.

3.1.9.1 Socket 1 communication

This communication is always initiated by the CAM software (=client). There are two possible manners of communication:

Command: the client writes a new setting to the system, the system will answer with an OK message is the action is a success, if it fails, the system will answer with an error message

Inquiry: the client asks some information about the system. The inquiry is forwarded to the sub-engine who knows the answer of the inquiry and the result is replied to the client. In case of an error, the error code is replied in stead of the answer on the question.

3.1.9.2 Socket 2 communication

The communication on socket 2 is always initiated by the server and is event driven. This medium is used to inform the CAM software of a change in the software not initiated by the CAM software. Examples of events are:

Error/warning/info messages

Sector + north messages

Parameter change done by the system (for example: automatic threshold control in overload situations)

Device (PRE790 and PCT791) operation mode changes.

…

3.1.10 UserPrefs

The Extractor Server has several settings. The settings are grouped in userprefs INI files. They are located in the C:\Program Files\Intersoft Electronics\PSR Extractor\Extractor Server\UserPrefs directory. If you open such a file you will see something as below:

[Extractor Control]

MapCmpThr=30.000000

AboveNoiseLvL=6.000000

Offsets.ADC1=8000.000000

Offsets.ADC2=8000.000000

Rec FileSize=8192.000000

UpStep=2.000000

DownStep=-0.2000000

ACPR=4096

#sector messages=32

plot queue size=1000

rec dir="/G/Recordings"

[Reply Combiner]

parameters.max #plots active=100

parameters.max #replies/plot=2000

threshold=9.000000

Open FP?=FALSE

out queue name="plot out"

sample freq=1.875000

score threshold=5.000000

goal value's.qf=-70.000000

goal value's.#points=22

score_factors.s_qf=0.100000

score_factors.s_mse=0.700000

score_factors.s_length=0.300000

goal value's.pwr=20.000000

loop time limit=2000

reply limit=100000

All peaks?=FALSE

Pathloss comp?=TRUE

[Plot Streamer]

Remote (IP:port)=10.20.100.255:11000

Local (IP:port)=10.20.100.1

TTL=1

Queue in="plot out"

Open FP?=FALSE

[Probe Streamer]

Remote (IP:port)=10.20.100.255:10000

Local(IP:port)=10.20.100.1

GS ctl.Gain=10.000000

GS ctl.Slide=0.000000

Probe Type=ReplyVideo

Probe Channel=0

Open FP?=FALSE

[CAM Server]

Open FP?=FALSE

Open connection FP?=FALSE

address1=10.20.100.1:18000

address2=10.20.100.1:18001

Timeout=500

Automatic startup delay=60000

[PPI]

Open FP?=FALSE

Send UDP=TRUE

Send CAM=TRUE

sockets.<size(s)>=2

sockets 0.Remote (IP:port)=10.20.100.255:12000

sockets 0.Local(IP:port)=10.20.100.1

sockets 0.TTL=1

sockets 1.Remote (IP:port)=10.20.100.255:11000

sockets 1.Local(IP:port)=10.20.100.1

sockets 1.TTL=1

[PCT]

Open FP?=FALSE

[EDR_Replay]

Open FP?=FALSE

Important: changing values in these files can result in a not working or degraded extractor system. Make always a backup of the file you want to edit so you can restore the old settings if some change doesn't work.

The following tables will give an overview of the parameters found in the ini file. For each section there is a table:

Extractor control section [see Table 3-2]

Reply Combiner section [see Table 3-3]

Plot Streamer section [see Table 3-4]

Probe Streamer section [see Table 3-5]

CAM server section [see Table 3-6]

PPI section [see Table 3-7]

PCT section [see Table 3-8]

EDR_Replay section [see Table 3-9]

Name	Normal value range	Meaning
MapCmpThr	[0;100]	Defines the compare threshold for the startup cluttermap check
AboveNoiseLvL	[0;10]	Clutter cells above exceeding the current cluttermap + AboveNoiseLvL are taken into account for the clutter map check
Offsets.ADC1	[-8192; 8191]	Startup ADC offset of video channel 1 (I)
Offsets.ADC2	[-8192; 8191]	Startup ADC offset of video channel 2 (Q)
Rec FileSize	>0	Filesize in Mbyte of a video recording. The filesize defines the length of a recording. The recording load is 4.4Mbyte/sec at a PRF of 750Hz
UpStep	>0	See section 3.1.2.2.3 Clutter-map adaptation process
DownStep	<0	See section 3.1.2.2.3 Clutter-map adaptation process
ACPR	4096	number of ACP/scan
#sector messages	32	number of sector messages/scan
plot queue size	1000	Do not change, defines the internal memory size of the reply combiner
rec dir	/G/Recordings	Defines the directory where the extractor places its video recordings.

Table 3-2 Extractor server UserPrefs – Extractor control section

Name	Normal value range	Meaning
parameters.max #plots active	100	Do not change, used for debug purpose. This value defines the maximum number of active plots.
parameters.max #replies/plot	2000	Do not change, used for debug purpose. This value define how many replies can be assigned maximum to a plot queue
threshold	9	The default threshold value, see section 3.1.2.1 Functional description
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode
out queue name	plot out	Name of the plot output queue. This name is used to link the Plot streamer engine to the Reply Combiner engine.
sample freq	1.875	The DSP video sample rate
score threshold	5	See section 3.1.4.3 Plot evaluation
goal value's.qf	-70	See section 3.1.4.3 Plot evaluation
goal value's.#points	22	See section 3.1.4.3 Plot evaluation
score_factors.s_qf	0.1	See section 3.1.4.3 Plot evaluation
score_factors.s_mse	0.7	See section 3.1.4.3 Plot evaluation
score_factors.s_length	0.3	See section 3.1.4.3 Plot evaluation
goal value's.pwr	20	See section 3.1.4.3 Plot evaluation
loop time limit	2000	Defines the maximum loop time before an overload condition is generated.

reply limit	100000	Defines the maximum number of replies read at once to generate an overload condition. There are replies thrown away if there are more than this value replies.
All peaks?	TRUE | FALSE	Debug, leave on FALSE. If TRUE the plot engine can generate multiple plot reports for the same target, different in Doppler bin.
Pathloss comp?	TRUE | FALSE	Debug, leave on TRUE. When this parameter is set to FALSE, the reported power will not be compensated for pathloss.

Table 3-3 Extractor server UserPrefs – Reply Combiner section

Name	Normal value range	Meaning
Remote (IP:port)	10.20.100.255:11000	Remote UDP socket on which the primary plots are outputted.
Local (IP:port)	10.20.100.1	Local network adapter to use for outputting the data.
TTL	1	Time To Live setting.
Queue in	plot out	Name of the plot output queue. This name is used to link the Plot streamer engine to the Reply Combiner engine.
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode

Table 3-4 Extractor server UserPrefs – Plot Streamer section

Name	Normal value range	Meaning
Remote (IP:port)	10.20.100.255:10000	Remote UDP socket on which the primary video is outputted.
Local (IP:port)	10.20.100.1	Local network adapter to use for outputting the data.
GS ctl.Gain	10	Default video gain setting
GS ctl.Slide	0	Default video offset setting
Probe Type	ReplyVideo	Default video type
Probe Channel	0	Default video channel (only for FFT or MAP video)
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode

Table 3-5 Extractor server UserPrefs – Probe Streamer section

Name	Normal value range	Meaning
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode
Open connection FP?	TRUE | FALSE	Debug purpose, opens the connection engine front panel in dev mode
address1	10.20.100.1:18000	Defines the socket1 configuration
address2	10.20.100.1:18001	Defines the socket2 configuration
Timeout	500	Defines the communication timeout setting in ms

Automatic startup delay	60000	Defines the automatic startup delay in ms. This mean that the extractor will startup automatically after the given time with the default settings. If there is a CAM connection this autostart feature can be overridden.

Table 3-6 Extractor server UserPrefs – CAM server section

Name	Normal value range	Meaning
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode
Send UDP	TRUE | FALSE	Default setting, if true the PPI engine will send sector messages over the defined UDP sockets
Send CAM	TRUE | FALSE	Default setting, if true the PPI engine will send sector messages to the CAM software
sockets 0.Remote (IP:port)	10.20.100.255:12000	Remote UDP socket on which the sector message information is send
sockets 0.Local(IP:port)	10.20.100.1	Local network adapter to use for outputting the data.
sockets 0.TTL	1	Time To Live setting
sockets 1.Remote (IP:port)	10.20.100.255:11000	Remote UDP socket on which the sector message information is send
sockets 1.Local(IP:port)	10.20.100.1	Local network adapter to use for outputting the data.
sockets 1.TTL	1	Time To Live setting

Table 3-7 Extractor server UserPrefs – PPI section

Name	Normal value range	Meaning
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode

Table 3-8 Extractor server UserPrefs – PCT section

Name	Normal value range	Meaning
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode

Table 3-9 Extractor server UserPrefs – EDR_Replay section

3.1.11 Windows Registry Contents

You might need to be logged on as an administrator or a member of the Administrators group in order to perform some tasks.

Take care using the Registry Editor, you may cause serious problems that may require you to reinstall your operating system.

The Extractor server has a key entry in the windows registry found at the following location:

HKEY_LOCAL_MACHINE\SOFTWARE\Intersoft Electronics\Extractor_SRV

To edit value's in this key you must use the registry editor tool. To open the registry editor: click **start** -> click **run** -> type in: **regedit** -> click the Ok button. Now the registry editor is started. Figure 3-16 shows a screenshot of the extractor server key entry.

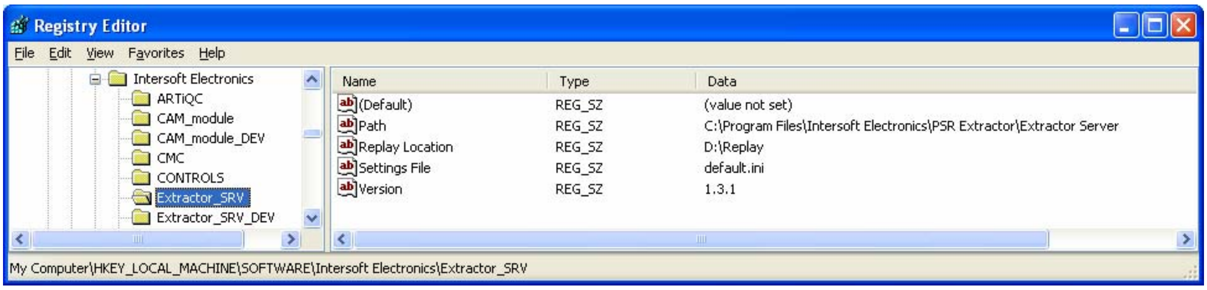

Figure 3-16 Extractor Server windows registry content

Key contents:

Path [string]: contains the installation path of the extractor service. In this directory you can find the Extractor Server.exe

Replay Location [string]: must contain a valid, existing path to the directory containing the replay sets.

Settings File [string]: defines the UserPref ini file to use.

Version [string]: defines the version number of the current software. At startup the software will check its internal version number against the version number in the registry.

3.1.12 Running the Extractor Server

You might need to be logged on as an administrator or a member of the Administrators group in order to perform some tasks.

The Extractor server is configured to automatically run at start-up of your computer, you may alter this default setting and start the service manually when needed.

The Extractor server can be started using the Windows XP services management console.

To open Services, click **Start**, point to **Settings**, and then click **Control Panel**. Double-click **Administrative Tools**, and then double-click **Services**. For information about using Services, click **Help** on the **Action** menu in Services.

The following window appears (this window might look different on your system depending on your installation):

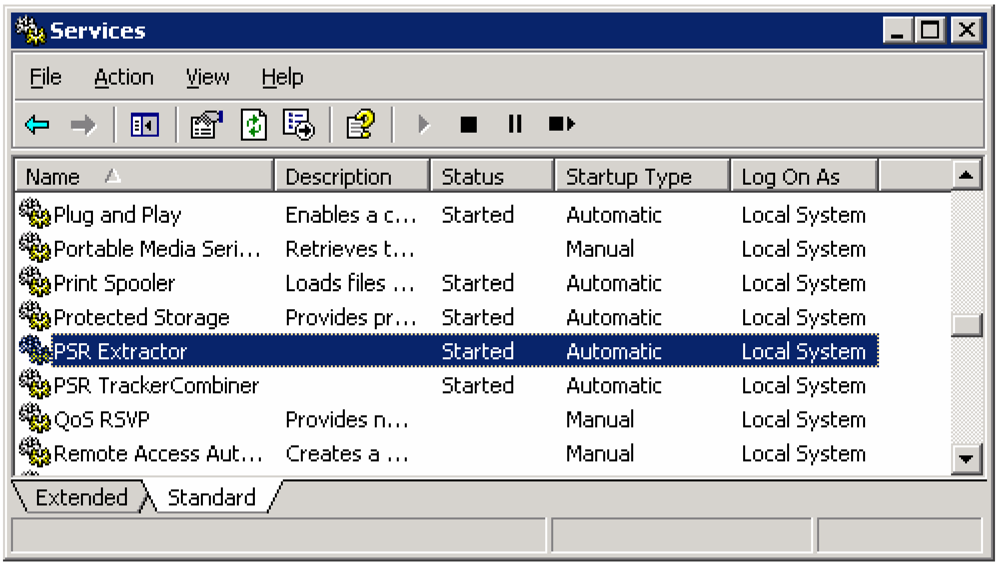

Figure 3-17 Services Management Console

Locate the entry “PSR Extractor” and press the “Start Service (▶)” button to start the service and press the “Stop Service (■)” button to stop the service.

3.2 Combiner/Tracker Service

3.2.1 Description

The Combiner/Tracker server module is configured to run as a Windows XP service. The module doesn't have a user interface of its own. Control and monitoring is done with the CAM module software. The tasks executed by this service are summed below:

Combines and synchronizes primary and secondary plot data streams received over UDP.

Grouping of separate plot reports to tracks.

Stream track report over an UDP network socket.

The tracker/combiner service is built in a modular way, Figure 3-18 shows an overview. The following list gives an enumeration with a short description of each module. Further in the document each part is explained in detail.

Combiner: this module reads the UPD sockets for primary and secondary plots. The primary plots are matched with the secondary plots if possible. The combined data is passed to the tracker module

Tracker: this module groups incoming plots to tracks.

Track Streamer: this module streams the track data out over the network on a UDP socket.

Tracker CAM: handles communication with the user CAM interface and the subengines

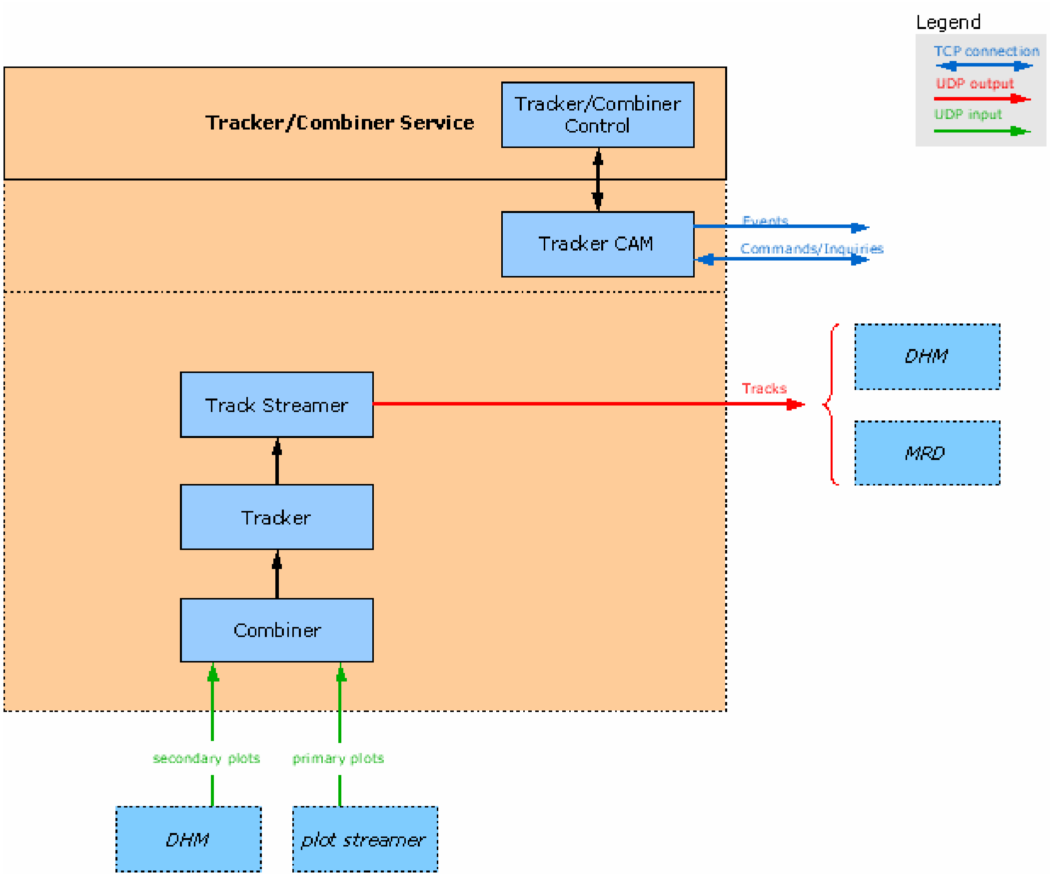

Figure 3-18 Tracker/Combiner server overview

3.2.2 Combiner

The task of this engine is to synchronize both input streams, PSR and SSR plots, and to match a PSR plot with a SSR plot (=combining). If no match is found, the original data will be maintained. The output data stream of this engine is forwarded to the tracker module [see 3.2.3 Tracker], the data exist of PSR only, SSR only or combined plots. An overview of this engine can be seen in Figure 3-19.

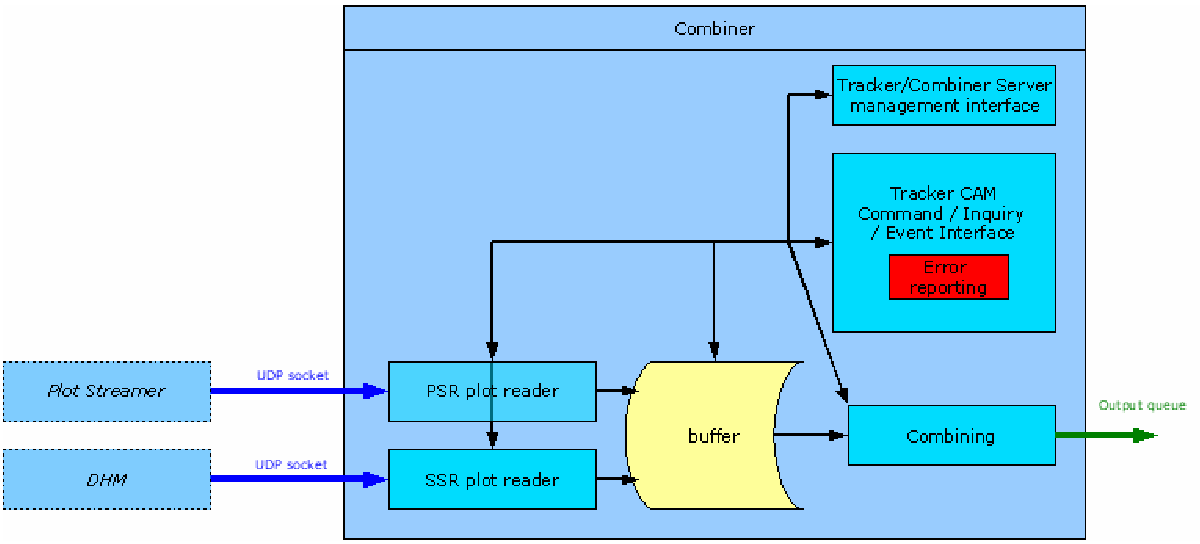

Figure 3-19 Combiner overview

The blue lines on the left are the input sockets. One is for the primary plot data coming from the plot streamer engine, the other is for the secondary plot data coming from the DHM. Both data-streams are red and stored in a synchronization buffer. The combining block searches for matches in the input data. The green arrow shows the output data queue.

The two remaining blocks at the right above are both communication blocks. The first, Tracker/Combiner Server management interface, is used to communicate with the tracker server engine by triggering events in the combiner engine. The second, Tracker CAM Command / Inquiry / Event Interface, is used to communicate with the Tracker CAM module; this interface will be discussed in detail in section 3.2.5 Tracker CAM.

3.2.3 Tracker

The tracker engine groups several plots to a track. The incoming plots are stored in a kind of FIFO buffer and will stay there for a maximum time (=tracker delay). If the tracker delay is expired for a plot, the tracker will calculate the best matching track for that plot, if there's no track found then a new track will be initiated.

An overview of the tracker engine can be viewed in Figure 3-20.

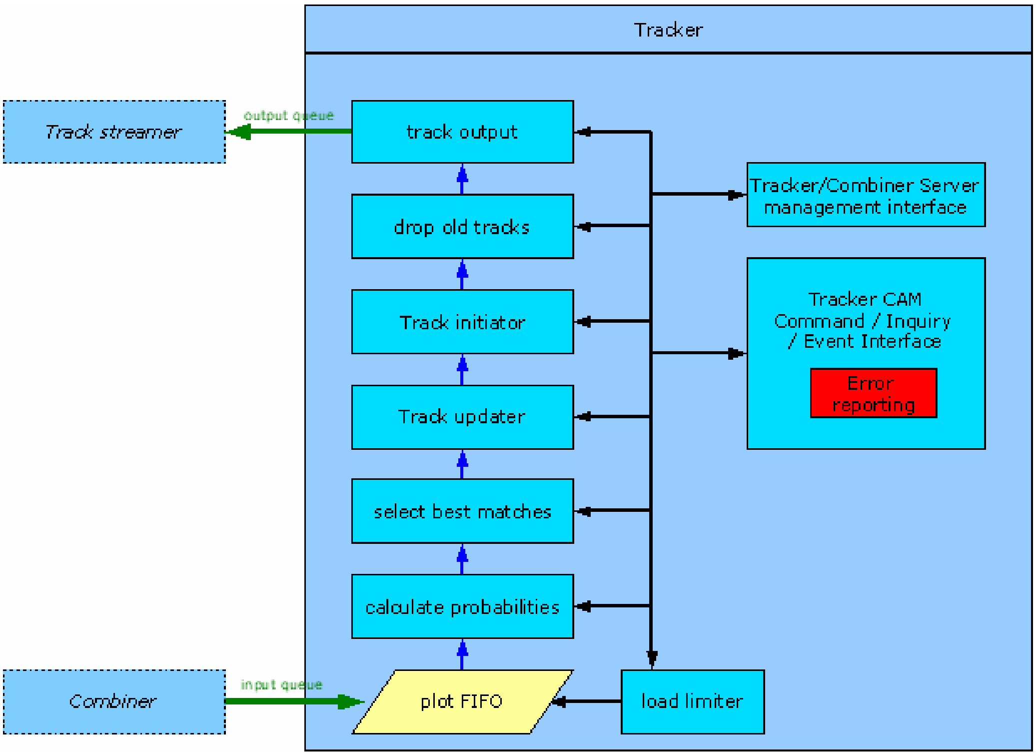

Figure 3-20 Tracker overview

The calculate probabilities block will calculate the chance that a plot belongs to an existing track. Based on these calculations the select best matches block will decide which plots belong to which track. After the calculations there is a track updater block which updates the track with the current plot information. It will also calculate the expected position of the following plot report by using adaptive Kalman filters. If no matching track was found there will be a new track started if certain conditions are satisfied. Tracks that aren't updated for a period are dropped and an End Of

Track (EOT) message will be generated. Track info is outputted to the Track streamer module [see 3.2.4 Track Streamer].

The load limiting block monitors the engine loop time, if it's too high the plot FIFO will be flushed and data will be lost. This prevents an engine stall.

The two blocks at the right are both communication blocks. The first, Tracker/Combiner Server management interface, is used to communicate with the tracker server engine by triggering events in the tracker engine. The second, Tracker CAM Command / Inquiry / Event Interface, is used to communicate with the Tracker CAM module; this interface will be discussed in detail in section 3.2.5 Tracker CAM.

3.2.4 Track Streamer

The function of this engine is simple, it places the data received at its input queue at an UDP network connection socket. It also manages this UDP connection.

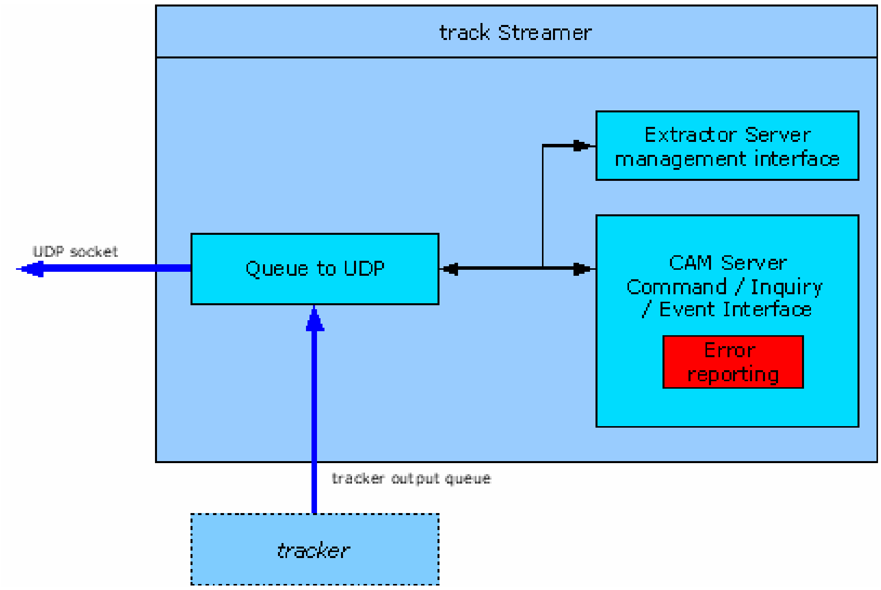

Figure 3-21 Track streamer overview

The queue to UDP block reads the input queue, if there's incoming data it will be forwarded at the UDP socket. At startup the UDP connection is initiated with the parameters given in the configuration file.

The two blocks at the right are both communication blocks. The first, Tracker/Combiner Server management interface, is used to communicate with the tracker server engine by triggering events in the track streamer engine. The second, Tracker CAM Command / Inquiry / Event Interface, is used to communicate with the Tracker CAM module; this interface will be discussed in detail in section 3.2.5 Tracker CAM.

3.2.5 Tracker CAM

This engine handles communication with the CAM software over two TCP/IP connections. The Tracker CAM module functions as a TCP server for both connections. Socket 2 is used as event reporting communication line and socket 1 is used as command/inquiry communication interface. An overview of the engine can be seen in Figure 3-22.

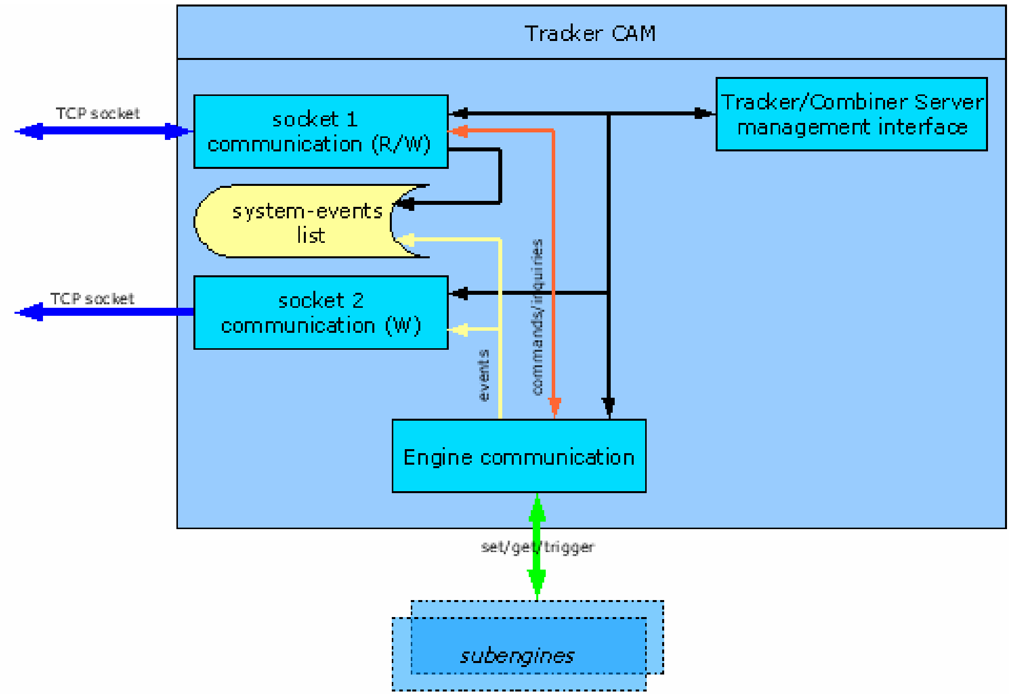

Figure 3-22 Tracker CAM overview

The function of socket 1 and socket 2 communication is obvious. The Engine communication block manages the communication between the CAM server and the other system engines. This communication is done by set, get and trigger commands.

The system-events list block stores the last 500 events reported by the system. This list can be read by the CAM software by sending the right command for it.

The Tracker/Combiner Server management interface is used to communicate with the tracker/combiner server engine by triggering events in the Tracker CAM engine.

3.2.5.1 Socket 1 communication

This communication is always initiated by the CAM user interface software (=client). There are two possible manners of communication:

Command: the client writes a new setting to the system, the system will answer with an OK message if the action is a success, if it fails, the system will answer with an error message

Inquiry: the client asks some information about the system. The inquiry is forwarded to the sub-engine who knows the answer at the inquiry and the result is replied to the client. In case of an error, the error code is replied in stead of the answer on the question.

3.2.5.2 Socket 2 communication

The communication on socket 2 is always initiated by the server and is event driven. This medium is used to inform the CAM user interface software of a change in the software not initiated by the CAM software. Examples of events are:

Error/warning/info messages

Parameter change done by the system

…

3.2.6 UserPrefs

The Tracker/Combiner Server has several settings. The settings are grouped in userprefs INI files. They are located in the C:\Program Files\Intersoft Electronics\PSR Extractor\Tracker Server\UserPrefs directory. If you open such a file you will see something as below:

[Tracker Control]

comb queue name="comb out"

max size=1000

[Combiner]

Open FP?=FALSE

PSR.Remote (IP:port)=10.20.100.255:11000

PSR.Local(IP:port)=10.20.100.1

SSR.Remote (IP:port)=10.20.100.255:13000

SSR.Local(IP:port)=10.20.100.1

window.Time+=0.500000

window.Time-=-0.500000

window.dRange=1.000000

window.dAzimuth=2.000000

CombinerProcessingDelay=1000

PSR.Az offset=0

PSR.Range offset=0

PSR.Range gain=0

PSR.TORoffset=0

SSR.Az offset=0.500000

SSR.Range offset=0.140000

SSR.Range gain=+7000

SSR.TORoffset=0

UDP buffer size (Kbyte)=512

percentage PSR=50.000000

[Tracker]

Open FP?=FALSE

in queue name="comb out"

out queue name="track out"

PSR=15

minPowerToStartTrack=25.000000

minConfirmedTrack=3

useKalmanFilter=TRUE

processingDelay=1500

Tracker Parameters.random range error=150.000000

Tracker Parameters.random azimuth error=0.5000000

Tracker Parameters.bridge MODES gap=10

Tracker Parameters.bridge PSR-SSR gap=4

Tracker Parameters.maximum speed=350.000000

Tracker Parameters.acceleration, m/s^2=100

Tracker Parameters.time window=0.500000

Tracker Parameters.revolution period=4.800000

Tracker Parameters.association threshold=150

Tracker Parameters.code association threshold=-300

Tracker Parameters.time slot=0.200000

Tracker Parameters.range slot=0.200000

Tracker Parameters.code history=3

Tracker Parameters.A-codes="<size(s)=0>"

Tracker Parameters.bridge A-code list=10

Tracker Parameters.x1=-100000.000000

Tracker Parameters.x2=100000.000000

Tracker Parameters.y1=-100000.000000

Tracker Parameters.y2=100000.000000

6-parameterKalmanFilter.sr=150.000000

6-parameterKalmanFilter.sAz=0.500000

6-parameterKalmanFilter.a=0.010

coastings=FALSE

plot initiations=FALSE

max #tracks=500

processing late tolerance=100

[Track Streamer]

Open FP?=FALSE

Remote (IP:port)=10.20.100.255:12000

Local(IP:port)=10.20.100.1

TTL=1

In queue name="track out"

[Tracker CAM]

Open FP?=FALSE

Open connection FP?=FALSE

Automatic startup delay=50000

Address1 (IP:port)=10.20.100.1:19000

Address2 (IP:port)=10.20.100.1:19001

Timeout=500

Important: changing values in these files can result in a not working or degraded extractor system. Make always a backup of the file you want to edit so you can restore the old settings if some change doesn’t work.

The following tables will give an overview of the parameters found in the ini file. For each section there is a table:

Tracker control section [see Table 3-10]

Combiner section [see Table 3-11]

Tracker section [see Table 3-12]

Track Streamer section [see Table 3-13]

Tracker CAM section [see Table 3-14]

Name	Normal value range	Meaning
comb queue name	comb out	Do not change, defines the link between the combiner and tracker engine

Table 3-10 Tracker/combiner server UserPrefs – tracker control section

Name	Normal value range	Meaning
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode
PSR.Remote (IP:port)	10.20.100.255:11000	Remote UDP socket on which the primary plots can be received.
PSR.Local(IP:port)	10.20.100.1	Local network adapter to use for receiving the data.
SSR.Remote (IP:port)	10.20.100.255:13000	Remote UDP socket on which the secondary plots can be received.
SSR.Local(IP:port)	10.20.100.1	Local network adapter to use for receiving the data.
window.Time+	0.5	Combiner window time +
window.Time-	-0.5	Combiner window time -
window.dRange	1	Combiner delta range
window.dAzimuth	2	Combiner delta azimuth
CombinerProcessingDelay	1000	Combiner processing delay, defines how long the data stays into the combiner data buffer.
PSR.Az offset	0	Used to add a azimuth offset at incoming primary plots
PSR.Range offset	0	Used to add a range offset at incoming primary plots
PSR.Range gain	0	Used to add a range gain at incoming primary plots
PSR.TORoffset	0	Used to add a time offset at incoming primary plots
SSR.Az offset	0	Used to add a azimuth offset at incoming secondary plots
SSR.Range offset	0	Used to add a range offset at incoming secondary plots
SSR.Range gain	0	Used to add a range gain at incoming secondary plots
SSR.TORoffset	0	Used to add a time offset at incoming secondary plots
UDP buffer size (Kbyte)	512	Defines the buffer size of the receiving sockets
percentage PSR	50 [0;100]	Used to define how much (%) of the primary plot position is used in the combined plot position

Table 3-11 Tracker/combiner server UserPrefs – combiner section

Name	Normal value range	Meaning
Open FP?=FALSE	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode
in queue name	comb out	Do not change, defines the link between the combiner and tracker engine
out queue name	track out	Do not change, defines the link between the tracker and track streamer engine.
# PSR	15	Defines the minimum number of hits to start a PSR only track. This parameter is in combination with the following parameter
minPowerToStartTrack	25	Defines the minimum power to start a PSR only track.
minConfirmedTrack	3	The number of matching plots needed to create a confirmed (=outputted) track.
useKalmanFilter	TRUE | FALSE	Enables/disables the use of a Kalman filter. The kalman filter is an efficient recursive filter that estimates the state of a dynamic system from a series of incomplete and noisy measurements.
processingDelay	1500 [ms]	Defines the maximum time a plot can stay in the tracker input buffer. If the age of a plot exceeds the processingDelay value it must either be used for a track or thrown away.
Tracker Parameters.random range error	150 [m]	Expected range accuracy of the radar (standard deviation).
Tracker Parameters.random azimuth error	0.5 [deg]	Expected azimuth accuracy of the radar (standard deviation).
Tracker Parameters.bridge MODES gap	10	Maximum number of consecutive misses for MODE-S tracks.
Tracker Parameters.bridge PSR-SSR gap	4	Maximum number of consecutive misses for PSR-SSR tracks.
Tracker Parameters.maximum speed	350 [m/s]	Maximum expected speed of AC, increasing this parameter will lead to the increase of the false association rate.
Tracker Parameters.acceleration	100 [m/s²]	Accounts to maneuverability of the traffic.
Tracker Parameters.time window	1 [sec]	Time window around the expected time of the next detection.
Tracker Parameters.revolution period	4.8 [sec]	Time needed for antenna to complete one rotation.
Tracker Parameters.association threshold	150	Plot-to-track association threshold: minimum probability of the true association (logarithmic)
Tracker Parameters.code association threshold	-300	Plot-to-track association threshold: minimum probability of the true association in presence of the

		matching and correct A-code (logarithmic)
Tracker Parameters.time slot	0.2 [sec]	Max time difference for split plot detection.
Tracker Parameters.range slot	0.2 [Nm]	Max range difference for split plot detection.
Tracker Parameters.code history	3	This parameter defines how long a previous combined track holds it A-code when there's no IFF plot available for the current track update. For example: combined track A2345, next scans there's only a PSR only plot available, during 3 scans the tracker will output a PSR only track with A-code 2345. By setting this parameter to zero it is disabled.
Tracker Parameters.A-codes	"<size(s)=0>"	experimental
Tracker Parameters.bridge A-code list	10	experimental
Tracker Parameters.x1	0 [m]	experimental
Tracker Parameters.x2	0 [m]	experimental
Tracker Parameters.y1	0 [m]	experimental
Tracker Parameters.y2	0 [m]	experimental
6-parameterKalmanFilter.sr	150 [m]	Expected radar range accuracy (standard deviation).
6-parameterKalmanFilter.sAz	0.5 [deg]	Expected radar azimuth accuracy (standard deviation).
6-parameterKalmanFilter.a	0.01 [m/s^3]	Expected random change of the acceleration (standard deviation). The model uses the AC model flying with a constant acceleration with random Gaussian acceleration error.
coastings	FALSE [TRUE | FALSE]	By enabling this parameter the tracker will output coastings. A coasting is a tracker prediction of an existing track. This coasting is generated when there's no new matching plot for that track.
Plot initiations	FALSE [TRUE | FALSE]	By enabling this parameter the tracker will output plot initiations. An initiation is a not confirmed track so it has no track number.
Max #tracks	500	This parameter defines the maximum number of active tracks. By setting a higher number, the processing load will increase.
Processing late tolerance	100 [%]	This parameter is used in conjunction with the processing delay. When the timestamp of a track is higher than processing delay + tolerance the input queue will be flushed = data loss.

Table 3-12 Tracker/combiner server UserPrefs – Tracker section

Name	Normal value range	Meaning
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode
Remote (IP:port)	10.20.100.255:12000	Remote UDP socket on which the tracks are outputted.
Local(IP:port)	10.20.100.1	Local network adapter to use for outputting the data.
TTL	1	Time To Live setting
In queue name	track out	Do not change, defines the link between the tracker and track streamer engine.

Table 3-13 Tracker/combiner server UserPrefs – Track streamer section

Name	Normal value range	Meaning
Open FP?	TRUE | FALSE	Debug purpose, opens the engine front panel in dev mode
Open connection FP?	TRUE | FALSE	Debug purpose, opens the connection front panel in dev mode
Automatic startup delay	50000	Defines the automatic startup delay in ms. This mean that the tracker/combiner will startup automatically after the given time with the default settings. If there is a CAM connection this autostart feature can be overridden.
Address1 (IP:port)	10.20.100.1:19000	Defines the socket1 configuration
Address2 (IP:port)	10.20.100.1:19001	Defines the socket2 configuration
Timeout	500	Defines the communication timeout setting in ms

Table 3-14 Tracker/combiner server UserPrefs – Tracker CAM section

3.2.7 Windows Registry Contents

You might need to be logged on as an administrator or a member of the Administrators group in order to perform some tasks.

Take care using the Registry Editor, you may cause serious problems that may require you to reinstall your operating system.

The Tracker server has a key entry in the windows registry found at the following location:

HKEY_LOCAL_MACHINE\SOFTWARE\Intersoft Electronics\Tracker_SRV

To edit value's in this key you must use the registry editor tool. To open the registry editor: click **start** -> click **run** -> type in: **regedit** -> click the Ok button. Now the registry editor is started. Figure 3-23 shows a screenshot of the tracker server key entry.

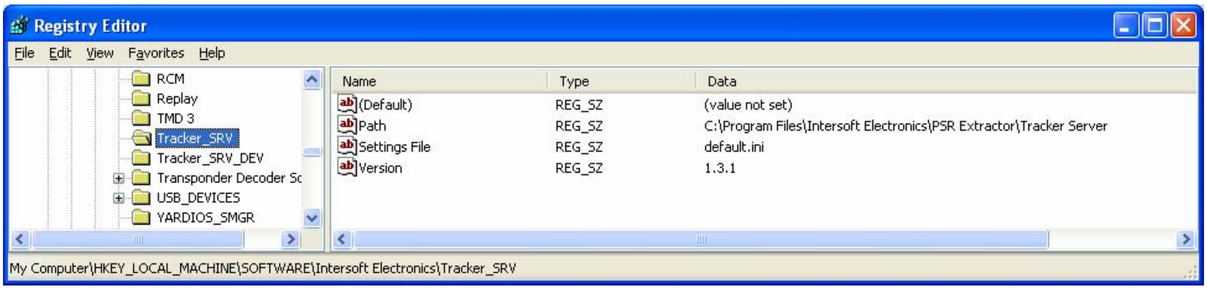

Figure 3-23 Tracker Server windows registry content

Key contents:

Path [string]: contains the installation path of the tracker service. In this directory you can find the Tracker Server.exe

Settings File [string]: defines the UserPref ini file to use.

Version [string]: defines the version number of the current software. At startup the software will check its internal version number against the version number in the registry.

3.2.8 Running the Tracker Server

You might need to be logged on as an administrator or a member of the Administrators group in order to perform some tasks.

The Tracker server is configured to automatically run at start-up of your computer, you may alter this default setting and start the service manually when needed.

The Tracker server can be started using the Windows XP services management console.

To open Services, click **Start**, point to **Settings**, and then click **Control Panel**. Double-click **Administrative Tools**, and then double-click **Services**. For information about using Services, click **Help** on the **Action** menu in Services.

The following window appears (this window might look different on your system depending on your installation):

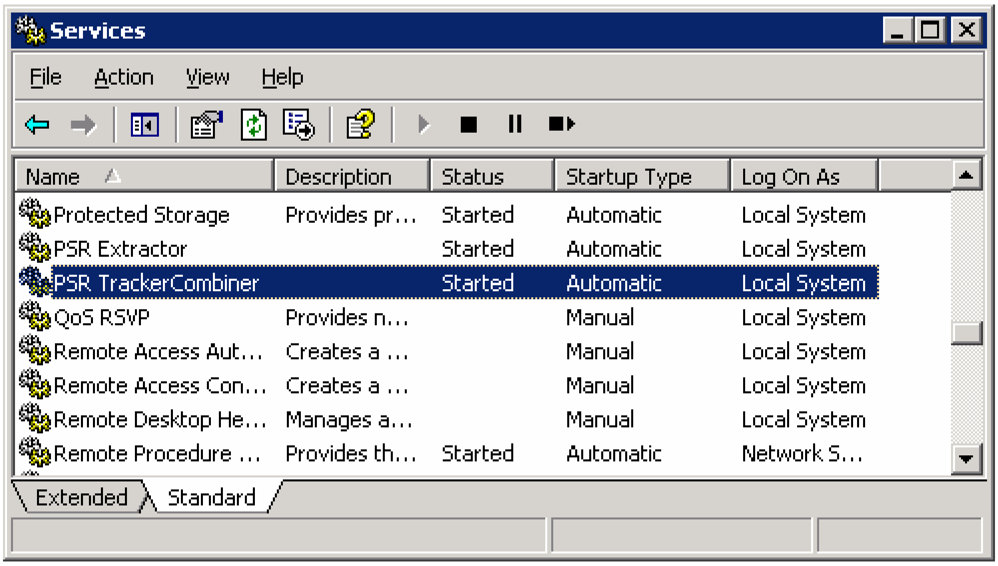

Figure 3-24 Services Management Console

Locate the entry "PSR TrackerCombiner" and press the "Start Service (▶)" button to start the service and press the "Stop Service (■)" button to stop the service.

3.3 DHM Service

For a detailed explanation of the DHM consult the DHM user manual. This chapter describes the DHM session used in the extractor system. Because every system installation has difference, this description can be seen as an example. So the sessions on your system can differ from the ones shown here.

Session list:

UDR [active session]

EV760 [active session]

Asterix [active session]

Video [dummy session]

Digital [dummy session]

3.3.1 UDR session

This session reads data from the serial input channels of the PRE790 device. In this setup only ch1 is used as a passive serial input. This channel correspondent to the EV760 input1 of the PRE790 device. The data is forwarded to an UDP output for use in a different session.

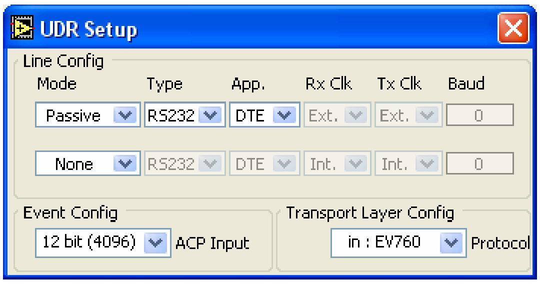

Figure 3-25 Serial input UDR configuration

There is also data coming from remote addresses. The setup given in Figure 3-26 shows two UDP input sockets for data coming from Semmerzake. The data is in ASTERIX CAT 1 and 2 format. This data is recorded to file for later use, the setup of the recorder can be seen in Figure 3-27. Further the data is split and converted to D6, this data is used to display on the MRD display.

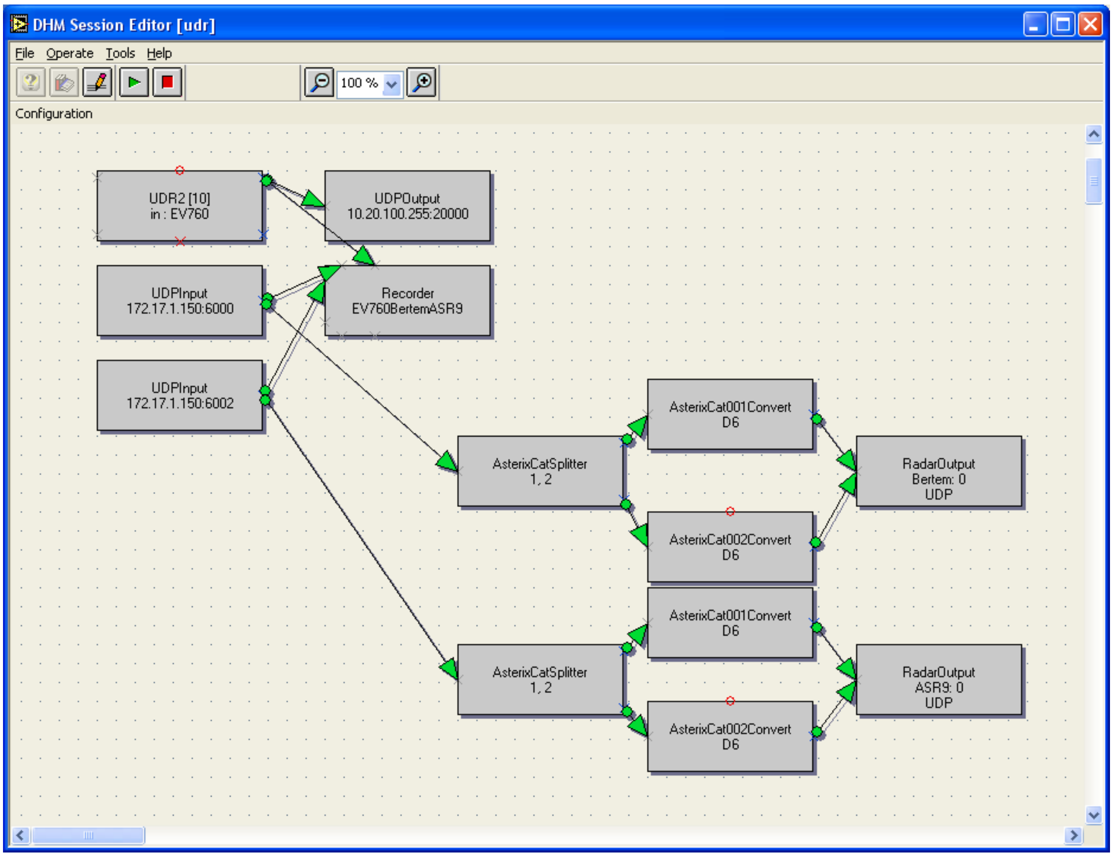

Figure 3-26 Beauvechain UDR session

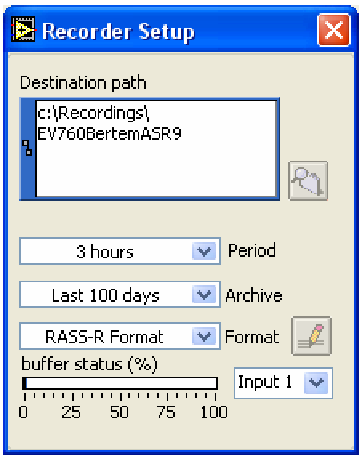

Figure 3-27 Beauvechain RASS-R recorder setup

3.3.2 EV760 session

This session reads the EV760 data placed by the UDR session on the network. The UDP input block streams the data to the EV760 convert block (setup can be seen in Figure 3-29). After the convert the data is placed on the network for the tracker/comber service. The data is also made available for the MRD display by the RadarOutput block.

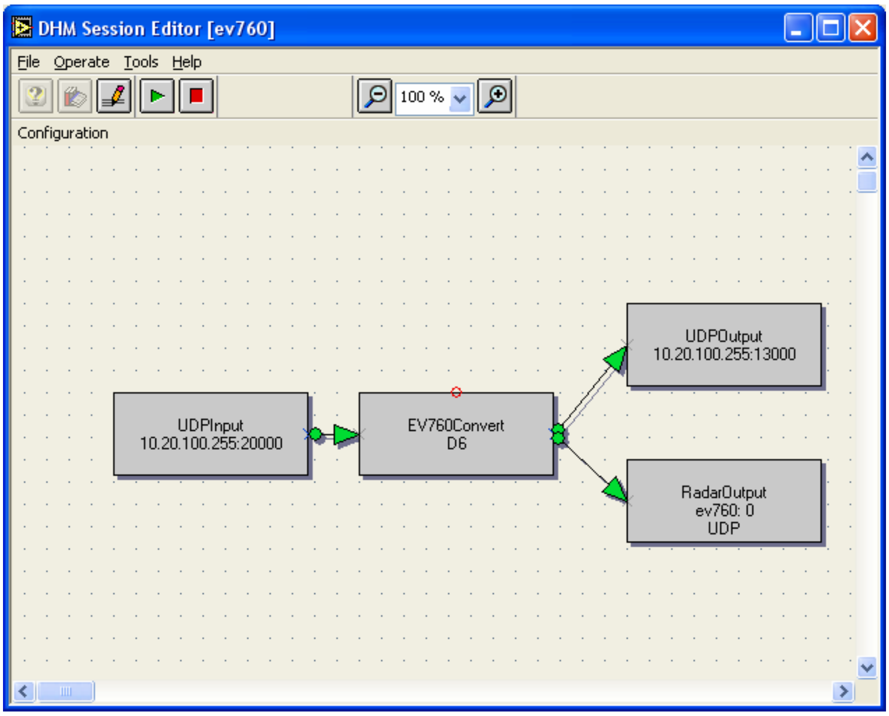

Figure 3-28 EV760 session

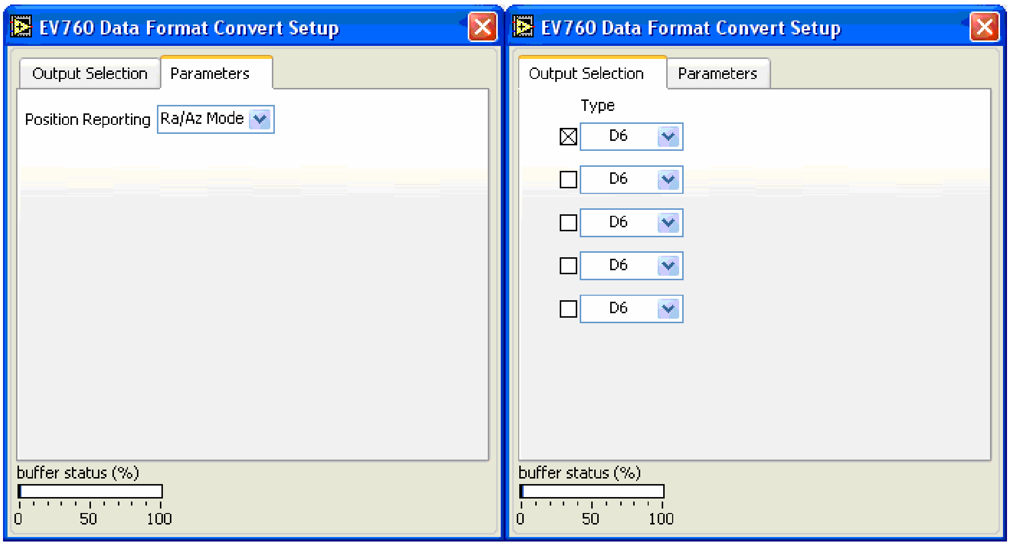

Figure 3-29 EV760 convert setup

3.3.3 Asterix session

This session sends the results (track data) of the extractor system towards Semmerzake. The data is in D6 format on the network, therefore the data is converted to ASTERIX CAT 34/48 and outputted and a UDP socket towards Semmerzake. An overview can be seen in Figure 3-30.

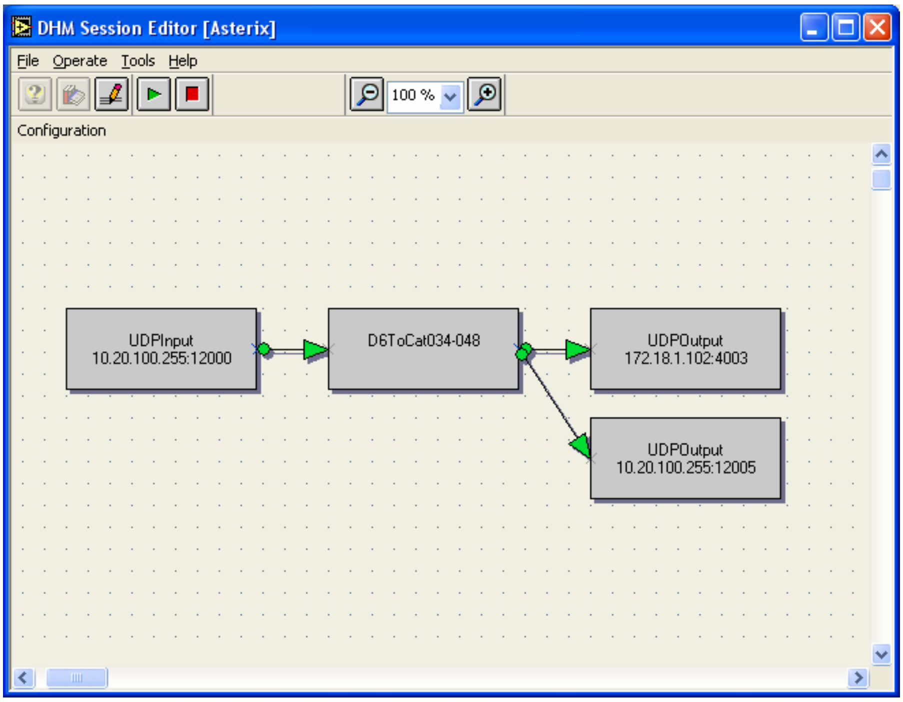

Figure 3-30 Asterix session

3.3.4 Video session

This is a dummy session to inform the MRD display on which socket the Extractor video data is available. This session mustn't run, it has only to be in memory.

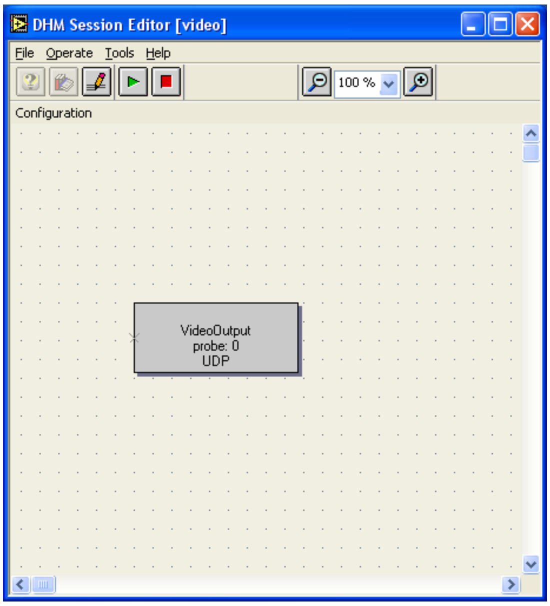

Figure 3-31 Video session

3.3.5 Digital session

This is a dummy session to inform the MRD display on which sockets the Track and Plot data of the extractor system are available. This session mustn't run, it has only to be in memory. The AsterixCat048Convert blocks are needed to tell the MRD which symbol list to use.

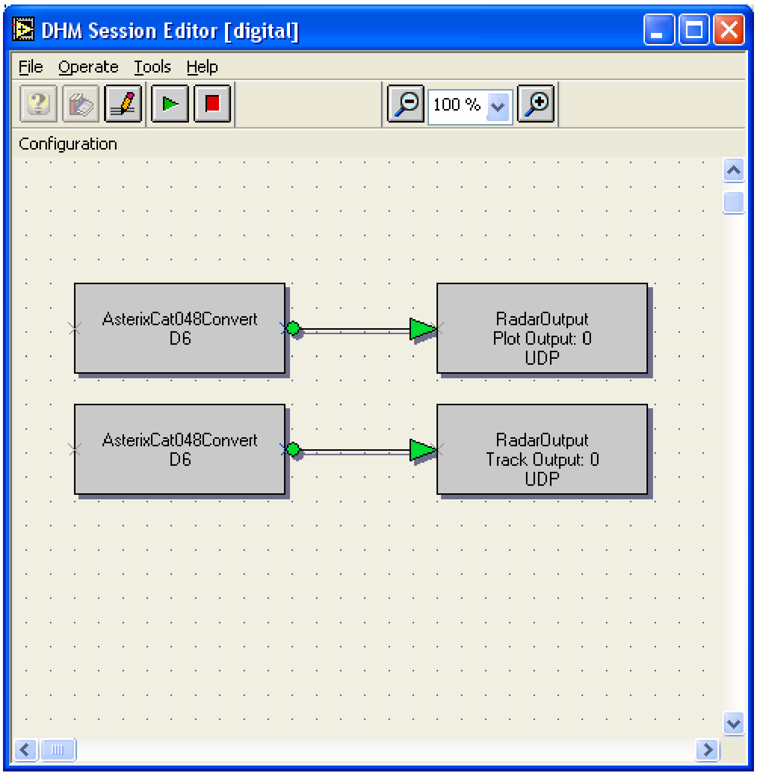

Figure 3-32 Digital session

4. Data formats

This chapter gives an overview of the data formats used between the different hardware and software components.

4.1 Interrogation sweep data format

This format is used to transmit an interrogation sweep towards the PSR extractor DLL module. Each interrogation of the radar such a record is transmitted. The size of one record is 6144 byte.

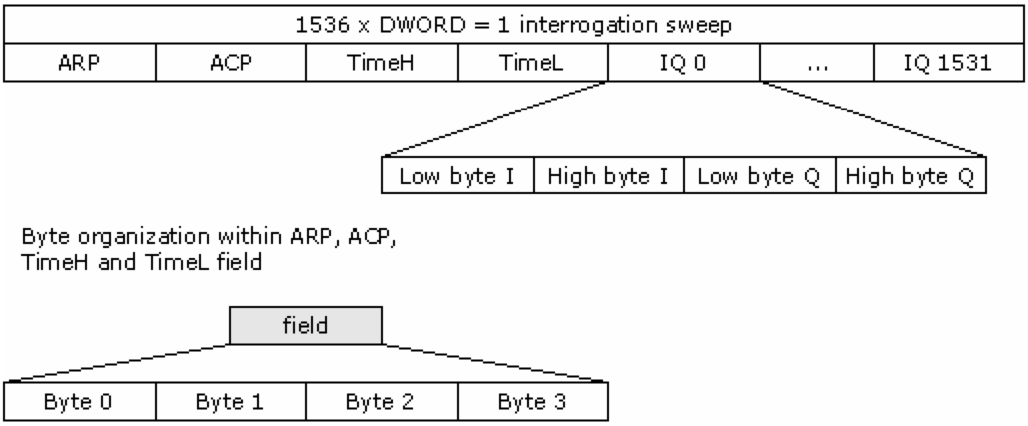

Figure 4-1 Interrogation sweep record structure

Field	Size [byte]	Content
ARP	4	Azimuth Reference Pulse count value.
ACP	4	Azimuth Change Pulse count value
TimeH *	4	Time of detection high
TimeL *	4	Time of detection low
IQ [1532] **	1532 x 4	High word = I-video [2-byte integer, low byte first] Low word = Q-video [2-byte integer, low byte first]
* The time of detection is composed out of two fields. To obtain a time of seconds you need to multiply the TimeL value with 2^{-32} and add it by TimeH. ToD [sec] = TimeH + TimeL x 2^{-32} ** sample rate of video signal is 1.875MHz, so the size of a range cell is 0,0432Nm {(1/1.875[MHz] x 150[m/us]) / 1852[m/Nm]}. Maximum range is 1532 x 0,0432 = 66Nm		

Table 4-1 Interrogation sweep record - field description

4.2 CAM communication protocol

commands / inquiries

socket 1 (client -> server)	
byte	**description**
0 (first)	0x5A
1	0xFF
2	length
3	length
4	command
5	type (W=0; R=1)
6	sequence number
7	data
length-1	data

socket 1 (server->client)	
byte	**description**
0 (first)	0x5A
1	0xFF
2	length
3	length
4	sequence number
5	data
length-1	data

Events

socket 2 (server->client)	
byte	**description**
0 (first)	0x5A
1	0xFF
2	length
3	length
4	type
5	code
6	code
7	code
8	code
9	Timestamp
10	Timestamp
11	Timestamp
12	Timestamp
13	Timestamp
14	Timestamp
15	Timestamp
16	Timestamp
17	data
length-1	data

SOF = start of frame
length of the packet without the SOF
data

Figure 4-2 CAM protocol

value	command
0x00	not used
0x01	probe type
0x02	probe channel
0x03	probe gain
0x04	probe offset
0x05	probe connection
0x06	plot stream connection
0x07	sensitivity threshold
0x08	UpDown Step
0x09	raw data sweep
0x0A	Start Recording
0x0B	Abort Recording
0x0C	PCT version info
0x0D	Event Filter
0x0E	PCT Load INI
0x0F	Plot Ev Params
0x10	PCT Tx OnOff
0x11	PCT stagger
0x12	PCT PEMR
0x13	PCT PEFR
0x14	AOC trigger
0x15	Clutter Map
0x16	Extractor start

0x17	Autostart
0x18	System Event List
0x19	Extractor stop
0x1A	Extractor state
0x1B	Settings file
0x1C	free_1
0x1D	Subengines
0x1E	UVR version info
0x1F	ReplayList
0x20	PCT STC
0x21	PCT BeamSwitch
0x22	PCT file list
0x23	ClutterMap List
0x24	ProgramPCT_Flash
0x25	PCT_FlashFileList

Table 4-2 Extractor commands

value	event
0x00	not used
0x01	message
0x02	warning
0x03	error
0x04	sector message
0x05	recording info
0x06	clutter map
0x07	engine
0x08	value change
0x09	autostart count
0x0A	PCT
0x0B	UVR
0x0C	LoadData

Table 4-3 Extractor events

value	command
0x00	not used
0x01	Start tracker
0x02	Stop tracker
0x03	Autostart
0x04	Combiner processing delay
0x05	PSR offset/gain
0x06	SSR offset/gain
0x07	System Event List
0x08	Tracker state
0x09	PSR position percentage
0x0A	Tracker processing delay
0x0B	Settings file
0x0C	Subengines
0x0D	Combiner Window
0x0E	Tracker #PSR

0x0F	minPowerToStartTrack
0x10	minConfirmedTrack
0x11	useKalmanFilter
0x12	Tracker parameters
0x13	6-parameterKalmanFilter
0x14	Tracker load limiting
0x15	Coastings

Table 4-4 Tracker commands

value	event
0x00	not used
0x01	message
0x02	warning
0x03	error
0x04	engine
0x05	value change
0x06	autostart count
0x07	CombinerStatus
0x08	TrackerStatus
0x09	CPU_MemLoad

Table 4-5 Tracker events

5. Network overview

The network topology of the PSR extractor system is shown in Figure 5-1.

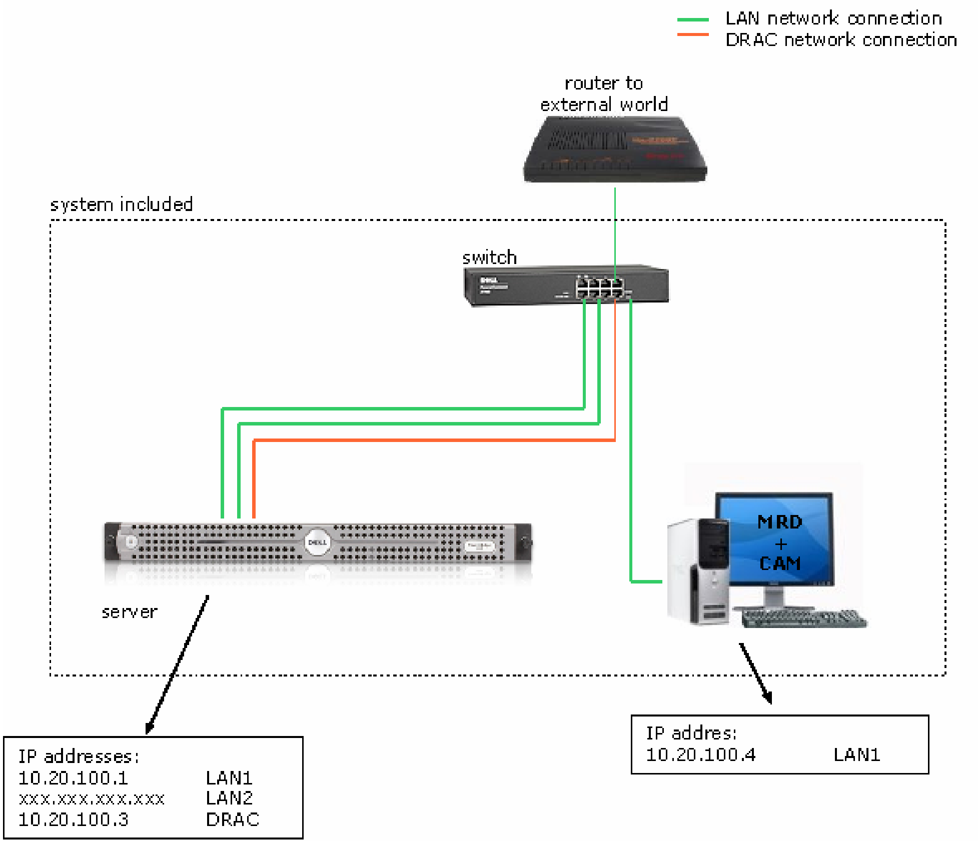

Figure 5-1 PSR extractor network topology

The server, also called processing computer, has two normal LAN connections. LAN1 is used to connect to the local network. LAN2 is site depended; it's used to an external network via an optional router. The server has also a DRAC network connection. This connection can be used to manage the server totally remote. For more information see the IE-PSR-Extractor-UM-Vxx manual. All these network connections are connected to a switch.

The CAM computer has only one LAN connection which is connected also to the same switch as the one for the server. This connection is used to send/receive data, manage the server etc…

On these LAN connections there are several network sockets used. Table 5-1 gives an overview of these sockets.

Socket	Source	Destination(s)	Format	Type	Name
10.20.100.255:10000	PSR extractor DLL	MRD	Raw video	UDP	probe
10.20.100.255:11000	Plot streamer	MRD Combiner	D6	UDP	PSR plots
	PPI				Sector + north messages
10.20.100.255:12000	Track streamer	MRD DHM	D6	UDP	Tracks
	PPI				Sector + north messages
10.20.100.255:13000	DHM: EV760 convert	Combiner (MRD)	D6	UDP	SSR plots
10.20.100.255:20000	DHM: udr	DHM: EV760 convert	EDR V2.0	UDP	SSR plots
10.20.100.1:18000	CAM server	CAM software	CAM	TCP	Cmd/Inq
10.20.100.1:18001	CAM server	CAM software	CAM	TCP	Events
10.20.100.1:19000	Tracker CAM	CAM software	CAM	TCP	Cmd/Inq
10.20.100.1:19001	Tracker CAM	CAM software	CAM	TCP	Events
Depending on the site installation, other sockets can be specified. See the site specific setup document for more information					

Table 5-1 Network sockets overview

LEFT EMPTY