TRAINING COURSE RADAR DATA VISUALIZATION TOOL (RDV)

Primary Surveillance Radar Systems ATM

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Signature Sheet

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Changes Record

	D	DCUMENT CHANG	ES RECORD	
EDITION	REVISION	DATE	CHAPTER	REASON OF THE CHANGES
А	0	18/04/2017	All	First Edition
А	1	09/03/2020	All	Second Edition



Acronyms

ADS-B	Automatic Dependent Surveillance-Broadcast
AGL	Above Ground Level
ASL	Above Sea Level
ASTERIX	All Purpose STructured Eurocontrol suRveillance Information Exchange
CFAR	Constant False Alarm Rate
CMCFAR	Clutter Map CFAR
CPC	Central Processor Computer
dB	Decibel
Dmi	Data miles
GPS	Global Positioning System
LAN	Local Area Network
MSSR	Monopulse Secundary Surveillance Radar
MTD	Moving Target Detector
NM	Nautical Mile
PPI	Plan Position Indicators

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Acronyms

PSR 🗳	Primary Surveillance Radar
RCFAR	Range CFAR
RDM	Radar Data Merger
RDV	Radar Data Visualization
SLG	Local Control System
SR	Surveillance Radar
SSR	Secondary Surveillance Radar
STC	Sensitivity Time Control
Тх	Transmission



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General Description

- System Overview
- Block Diagram
- Functional Description

System Overview

- The Radar Data Visualization Tool (RDV) consists of an application running on a PC Installed in the Radar Site.
- RDV allows user to view Radar Data Information (Plots and Tracks in ASTERIX format), Digitalized Radar Video in several points of the processing chain and the creation and visualization of site adaptation maps.





Block Diagram





Functional Description

- The main of RDV are:
 - Radar Data: Visualization and recordings of ASTERIX Data from PSR, MSSR, RDM and ADS-B. Monitor PSR real time samples and detections.
 - PSR Video: Visualization of PSR Digitalized Video from all possible points in the processing chain as raw signal a signal after compression in every single channel, weather levels, detections, etc.
 - PSR Adaptation Maps: Creation, edition and displaying of PSR site adaptation maps, including Digital STC, Analogue STC, Receiver States, Transmission Blanking and Tracking Areas.
 - Analyses: The RDV provides tools to analyse radar information as PSR/SSR Alignment, North Alignment, Accuracy and Probability of Detection, PSR Amplitud Profile, SSR Altitude Profile, etc.
 - Reports: Evaluation of radar data files, providing information related to recording duration, radar detections, radar site location, etc. functions



Operation & Monitoring

- Features
- Main Screen
- Menu Bar
- Toolbar



Features

- Features:
 - □ Radar Data Display.
 - PSR Video Monitoring.
 - □ Site Maps Creation.
 - □ Analyses and Reports.





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Main Screen





Main Screen

- The main screen of the RDV shows three different areas:
 - I Menu Bar:
 - Menus to access different application functions.
 - □ Toolbar on top:
 - Shortcut buttons for main functionalities.
 - Visualization Area:
 - Radar Data and Video Visualization.

The Menu Bar includes the following menus

RDV - Radar Data Visualization Tool (Indra PSR Version)

File Scale View Analysis Injection Signal Monitoring Terrain Maps Radar Maps Polylines Data Selection Help

- **File**
 - **Operation Mode** Selection.
 - On-line Mode.
 - File Mode.
 - Allows managing recordings: New (On-Line mode) and Saved (File mode).
 - Set User Preferences.
 - Obtain Summary **Report**, etc.
- **Scale**
 - Rescale (zoom in/out) and recenter the visualization area between predefined ranges
- **View**
 - Allows managing playback control, visualization of some elements displayed on the visualization area obtain and show reports.
- Analysis
 - Allows performing analysis over a recording with ASTERIX radar data.

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The Menu Bar includes the following menus

RDV - Radar Data Visualization Tool (Indra PSR Version)

File Scale View Analysis Injection Signal Monitoring Terrain Maps Radar Maps Polylines Data Selection Help

□ Injection

- Analogue and Digital signal injection as static or dynamic targets.
- Signal Monitoring
 - Capture (On-Line mode) and load saved radar samples.
 - Display video signal (On-Line mode).
- **Terrain Maps**
 - Displays altimetry maps that can be shown as terrain heights, visible heights, angles of visibility, etc.
- **Radar Maps**
 - Creation and edition of PSR site adaptation maps and their transfer between the RDV, SLG and PSR.
- Polylines
 - Creation and edition tools for **polylines**, capability to load **geographical** maps, etc.



The Menu Bar includes the following menus

RDV - Radar Data Visualization Tool (Indra PSR Version)

File Scale View Analysis Injection Signal Monitoring Terrain Maps Radar Maps Polylines Data Selection Help

Data Selection

• Filter and edition of chaining lists that used to select specific detections for visualization and analysis.

Help

• RDV Help Window and version information.

😵 Radar Data Visualization Tool (RDV)	
Valtar Altás Imprimir Opciones	
 Entroduction User Interface Common Tools Online Mode Tools File Mode Tools Shortcuts Exit RDV 	INTRODUCTION The Radar Data Visualization Tool (RDV) is a special test equipment provided to evaluate radar performance by using live or recorded flight data. It can record, store, process, analyse, list, display and redisplay radar data (including meteorological information).
	The RDV Tool is installed in a commercial off-the-shelf (COTS) workstation that is interfaced with radar equipments through the system ETHERNET LAN, enabling the RDV to receive online radar data and send requests for specific data.
	Main functions of the RDV include:
	 Visual presentation of real-time radar data;
	• On-demand recording of real-time radar data;
	• Radar signal samples monitoring;
	Video visualization;



• Menu File: General configuration menus. Includes the following options:

File	Scale View Analysis Injecti	ion Sign
	Set On-Line Mode	Ctrl+L
	Set File Mode	Ctrl+F
	New Radar Data Recording	Ctrl+R
	Open Radar Data File File Summary Report	Ctrl+0
	ADS-B Data Visualization	•
	Preferences	
	Report Configuration Propagation Models SLG Login Configuration	+
	Copy Figure to Clipboard	Ctrl+P
	Save Figure as Image	Ctrl+S
	Exit	

- **<u>Set On-Line Mode</u>**: Displays real-time data when the RDV is properly connected to the radar.
- □ **<u>Set File Mode</u>**: To analyse recordings, create detections chains, etc.
- <u>New Radar Recording</u>: In On-line Mode, to configure new ASTERIX recordings.
- Depen Radar Data File: Opens an ASTERIX Data Recording used in the File Mode.
- **<u>File Summary Report</u>**: Generates File with information about the recording.
- ADS-B Data Visualization: To enable the visualization and recording of ADS-B ASTERIX data.
- **Preferences:** To set preferences for lines, symbols, colors, traces, units, etc..
- **<u>Report Configuration</u>**: Sets the information given in the Report List and Single Data.
- **Propagation Models**: Sets the parameters for the propagation models.
- **<u>SLG Login Configuration</u>**: Sets the user/password for the communication with the SLG.
- **<u>Copy Figure to Clipboard</u>**: To use current figure in another program.
- **<u>Save Figure As Image</u>**: Allows saving current figure in different formats.
- **<u>Exit</u>**: Closes the application.

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• <u>Menu Scale</u>: Rescale the visualization area using the range units set in Menu \rightarrow Preferences. Includes the following options:

Scale	View Analysis	Injection	0	5NM/10km
	5 Nm	Ctrl+1		
	10 Nm	Ctrl+2		<u>10NM/20km</u>
	20 Nm	Ctrl+3		201111/50/00
	50 Nm	Ctrl+4	Ц	<u>2011111/50Km</u>
	100 Nm	Ctrl+5		50NM/100km
	150 Nm	Ctrl+6		
-	275 Nm	Ctrl+7		<u>100NM/200km</u>
	Zoom In x2		п	150NM/200km
	Zoom Out ÷2		Ц	150INIVI/SUUKIII
	Centre Radar Site	Ctrl+C	۵	<u>275NM/550km</u>





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• Menu Analysis: To evaluate ASTERIX recordings in File mode. Includes the following options:

Anal	lysis Injection	Signal Monitoring	Terrain I
	SR-SSR Alignn	nent	
	North Alignm	ent	×
	Detection Ana	lysis	
	Target Position	n Accuracy and Reso	lution +
	SR Amplitude	Profile	
	SSR Altitude P	rofile	
	Time Delay		

- PSR-SSR Alignment: For a recoding with PSR and MSSR/Mode-S combined data, performs an analysis of the different positions reported in both sensors for the same targets. The results are graphically displayed.
- North Alignment: After the introduction of the Fix Transponder information an analysis over the data is performed to analyze the system north alignment.
- Detection analysis: Detection analysis performed over chaining lists of radar data.
- Target Position Accuracy and Resolution: Accuracy and resolution analysis over GPS synchronized recordings.
- **PSR Amplitude**: Analysis of the PSR Plots received amplitude. The results are graphically displayed.
- **SSR Altitude Profile**: Analysis of the altitude detection based on the MSSR/Mode-S code C information.
- D <u>**Time Delay**</u>: Analysis of radar data time delays.

• <u>Menu Injection</u>: Allows injection of signal in the PSR in On-Line mode. Includes the following options:

Inje	ection Signal Monitoring
	Digital Injection
	Stop Digital Injection
	Analogue Injection
	Stop Analogue Injection

- **<u>Digital Injection</u>**: Allows injecting digital signal into the EPG, generate trajectories, static targets, etc.
- Analogue Injection: Allows injecting analogue signal into the MWG, in RF, or the RXG, in IF, as static or dynamic targets, etc.





• Menu Signal Monitoring: Visualization of PSR data samples and video signal. Includes the following options:

Sig	nal Monitoring Terrain Maps Ra
	Capture New Samples
_	Load Samples File
	Video Visualization
	Stop Video Visualization Ctrl+V

- Capture New Samples: In On-line Mode, allows to request signal samples from processing chain in different points.
- **Load Samples File**: Load a Samples file previously saved. Available in both operation modes.
- U <u>Video Visualization</u>: In On-line Mode, Digitalized PSR Video Display window is opened.





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• Menu Terrain Maps: Visualization of site environment altimetry (DTED). Includes the following options:

- Load Map: Load an altimetry map from a file.
- <u>Close Map</u>: Removes map visualization.

Terr	ain Maps Radar Maps	1
	Load Map	
	Close Map	
	Visualization Type	•
	View Azimuth Profile	
	View Legend	
	Set Effective Radius	
	Set Flight Levels	
	Set Colour Map	

- <u>Visualization Type</u>: Allows chosing between visualizations as:
 - Terrain Heights
 - Visible Terrain Heights
 - Terrain Elevation Angles
 - Visible Terrain Elevation Angles
 - Minimum Visible Angles
 - Minimum Visible AGL Flight Levels
 - Minimum Visible ASL Flight Levels
 - Visibility Zones for Selected AGL Flight Levels
 - Visibility Zones for Selected ASL Flight Levels
- Usualization of desired azimuth
- <u>View Legend:</u> Displays colour information
- <u>Set Effective Radius:</u> To consider propagation effects
- Set Flight Levels
 To display visibility Areas
- **Set Colour Map**: To set the colour palette



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• Menu Radar Maps: PSR maps creation, edition, transfer and management. Includes the following options:

	New Map	
	Open Map	×
	Save Map	×
	Close Map	3
	Map Edition	
	STC Edition	Þ
	Undo Last Change	
	View Legend	
	Set Colour Map	
~	View Radar Map	
	Map Transfer	×

- New Map...: Creation of Digital STC, Analogue STC, TX Blanking, Receiver States, Site Environment and Tracking Areas Maps..
- Open Map: To open a map from Local Database, CPC or from SLGs.
- Save Map: To store current map in the RDV Database and to distribute to SLGs.
- □ <u>Close Map:</u> Removes map visualization.
- □ <u>Map Edition:</u> To modify current map.
- D STC Edition: In Digital / Analogue STC Maps, allows fine adjustment.
- □ <u>Undo Last Change:</u> Allows not considering last modification.
- <u>View Legend:</u> Displays colour information
- □ <u>Set Colour Map:</u> To set the colour palette
- <u>View Radar Map:</u> Hides radar map.
- □ <u>Map Transfer:</u> Distribution of maps from active CPC to the RDV Database or map by map to SLGs.

• **Menu Polylines:** Lines management, geographical maps. Includes the following options:

Pol	lylines Data Selection Help	
	Load User Polyline File	۲
	Save User Polylines to File	
	Add Polyline	Þ
	Add Point To Polyline	
	Edit Polyline	
	Delete Polyline	
_	Delete All Polylines	
	Polyline Geo Maps	Þ

- Load User Polylines File: Opens a user-defined polyline.
- **Save User Polylines to File:** Saves current polylines into a file.
- Add Polyline: Creates a new polyline using polygones, circles, rings, sectors and arcs.
- Add Point to Polyline: To add a new point in current polyline.
- <u>Edit Polyline:</u> Selects a polyline to edit.
- Delete Polyline: Deletes current polyline.
- Delete All Polylines: Deletes all polylines.
- Delyline Geo Map: To display geographical maps.

• Menu Data Selection: Filter options and creation of data lists. Includes the following options:



• Menu Help: Application help and information. Includes the following options:



- Help: Displays the RDV application Help File.
- About: Shows the RDV Tool Version.





Toolbar

• The Toolbar includes shortcuts to the main functions of the RDV.





Toolbar

• The Tolbar in the RDV has shortcuts to the main functions of the application.





Toolbar

• The Toolbar in the RDV has shortcuts to the main functions of the application.



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Operation Mode

- Operation Modes
- On-Line Mode
- File Mode



Operation Modes

- The RDV is able to work in two different modes:
 - On-line Mode.
 - When the RDV is connected to the Radar. Allows data display, capture of PSR data samples, digital video display, test signal injection, etc.
 - □ File Mode.
 - Opening a recording file. Allows recording playback, data analyses, etc.



On-Line Mode

• The RDV provides the capability to display the radar detections read from LAN. The representation of all the data is displayed in PPI fashion.



• The detections in the Visualization Area are updated in real time. Auxiliary tools such as the zoom, the cursor text or the single radar data reports can be used as well.

On-Line Mode Video Display

• When the Video Display is enabled the Video Control Window appears:





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On-Line Mode Video Display

• By means the Video Display Tool, it is possible to select between different monitoring points, depending of chosen CPI (CPI1 or CPI2)



- □ OFF
- □ MTD0 to MTD7 (MTD5 in CPI2 selection) Filters
- Max MTD0 to MTD7 (MTD5 in CPI2 selection)
- Max MTD1 to MTD6 (MTD4 in CPI2 selection)
- Max MTD2 to MTD5 (MTD3 in CPI2 selection)
- Max MTD3/MTD4
- Clutter Map Layer 0 to 3 (2 in CPI2 selection)
- After Compression Target Low
- After Compression Target High
- After Compression Target Comb HL
- After Compression Weather Low
- After Compression Weather High
- After Compression Comb. HL
- Raw Video Target Low F1 / Raw Video Target Low F2
- Raw Video Target High F1 / Raw Video Target High F2
- Raw Video Weather Low F1 / Raw Video Weather Low F2
- Raw Video Weather High F1/ Raw Video Weather High F2
- Weather Filter 0 to 3
- Weather SP Level Filter 0 to 3
- Target Detections after RCFAR
- Target Detections after CMCFAR
- □ Target Detections after STC Dig.
- Second Time Around Returns
- Third Time Around Returns
On-Line Mode Video Display

• Once the monitoring point is selected is possible to see the Video Data in the PPI:





- Using the control bars for setting the colours for the Minimum and maximum value in dB, so it is possible to visualize only the signal in certain dB range.
- It is also possible to use the PPI to resize automatically de video area or set the Min/Max Range and Azimuth margins.

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On-Line Mode Video Display

- Clicking in the "OSCILLOSCOPE" Button, opens the Oscilloscope view:
 - ☐ This view shows the video signal in an X-Y Oscilloscope, showing Range vs. Signal Level.
 - □ The azimuths shown and the min/max range is set with the PPI zoom or the boxes in the Video Display Control.
 - Normal, Scan maximum and Absolute maximum views can be selected.





File Mode

- The RDV provides the capability to display radar detections stored in an ASTERIX file. The visual representation of all the recorded items maintains the same PPI fashion used by the on-line mode.
- The playback control allows displaying data at different update speeds, varying the instant of representation, etc. In addition, there are keyboard shortcuts that allow progressing, jumping to time, etc, manually.

U 44 M 25	S 40	
n. 11 M. 25	3. 10	#5. 0
		DD D
		· · · ·





File Mode

- The user can run offline analyses that evaluate radar performance (PSR-SSR alignment, north alignment, accuracy in range, azimuth, height and elevation).
 The alignment analyses also provide a method to correct the estimated misalignment error.
- The File Mode also implements two functionalities for data selection: the filter tool and the chaining lists.
 - □ The filtering process is used to discard detections that do not comply with the configured parameters. The filter not only affects the playback tool, but it also affects the radar data reports and offline analyses.
 - The chaining lists provides a method to isolate detections according to the operator's criteria.

HIGUNS PIL	ots — "— Origin — —	Sectors & Scans		
All			Ini	End
	Real	S.Range (Nm)	0.0	420.0
TSSR V	PSSR V Simulated	Azimuth (°)	0.0	360.0
TRR 🔽	PRR 034/048	Height (ft)	0	409600
TEX	☑ 001/002	Scan #	0	721
	Scan Mark			
Code Types —		<u>.</u>		
Mode 1	Any	v **	[**
Mode 2	Any	****	***	•
Mode 3/A	Any	*	***	•
Mode C	Any	•		
Track #				
Track #Tr	rack 1:1	Track 2:	2	
Track #Tr Tr Chaining Lists -	rack 1: 1	Track 2:	2	
Track #Tr Tr Chaining Lists -	rack 1: 1	Track 2:	2	



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Analysis

- PSR-SSR Range Alignment
- North Alignment
- Detection
- Target Position Accuracy and Resolution
- PSR Amplitude Profile
- SSR Altitude Profile
- Time Delay



PSR-SSR Range Alignment

• PSR-SSR Alignment: Analyzes the alignment difference reported from PSR and SSR sensors in a recording with combined data



 The user can generate an alignment report, view the error distribution, the evolution of error, mean, maximum deviation and a histogram view.



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North Alignment

- There are two possible ways to perform the North Alignment:
 - An offset sent from MSSR is used to know the position. Range, Azimuth and Elevation of the Fix Transponder used for the analysis shall be introduced.
 Correlation parameters can be adjusted.
 - □ Second way is using the **Solar Strobe Analysis** from RDV tool :





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Detection

• The RDV analyses detection of a radar data chain previously created from a recording.

- First it is necessary to create a new list from the Data Selection Menu.
- Then, the analysis can be run.







Detection

- SR Detection : Primary Radar Detections
- SSR Detection : Secondary Radar Detections
- RR Detection : Combined Detections
- The analysis provides the following results:
 - □ An Statistic Report with information about the analysis.
 - □ Hit/ No Hit Diagram:





Detection

• Obtaining the following results:

□ Probability of Detection Vs Range Diagram:





Target Position Accuracy and Resolution

- The RDV can estimate the accuracy and resolution in range, azimuth and height of PSR and MSSR/Mode-S, based on the absolute position of up to two specific targets such as test flights or fix reflectors or transponders.
- These analysis (range & azimuth and fix target based) display similar results; the only difference is the source of the reference position and the evaluated parameters. Additional features that are specific to a certain analysis will be clearly indicated.



	* MOVING T.	ARGET ACC	URACY -	DETECTIONS 1	REPORT **	
File Name: 201501 File Date: 28-Jan	28_rdatare -2015	c.ast				
TRAJECTORY LIMITS						
Initial Time:	14:55:45.8	4				
End Time:	14:58:58.0	4				
	Min	м				
SPance (Nm)	77 91	00	32			
Azimuth (°):	82.01	85.	78			
DIDIMPTEDS						
TYPE - Dete						
TIPE . Data	report cyp			1		100
-	OR . OR FI	1 700	A. SOR F	TOD FR	D . DD T-	.00
-	DR : DR II	ack 155	R: DOR I	IACK IN	R : RR II	ack
-	M : Scon	polaced I	Fack	311	RD: STICE)e
DET TIME · Badar	data dete	stion tim	-			
SRANGE Badar	data slan	t range	6			
AZTM Badar	data agim	uth				
AMPL : SR Am	plitude	0.000				
M3/A Mode	3/A Code					
AMC/HEX : Mode	C/Extrapol	ated Alti	tude			
TYPE DET. TIME	SRANGE	AZIM AM	PL M3/A	AMC/AEX		
(UTC)	(Nm)	(°) (d	в)	(ft)		
PRR 14:55:45.84	99.34	82.00 50	.0 4037	29675		
PRR 14:55:51.84	98.65	82.10 62	.0 4037	29550		
PRR 14:55:57.85	97.97	82.22 60	.0 4037	29425		

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PSR Amplitude Profile

• The PSR Amplitude Profile takes the information of the PSR and combined detections and displays them in a X-Y diagram.

This helps designing PSR Adaptation Maps.





SSR Altitude Profile

• The SSR Altitude Profile takes the information of the SSR/Mode-S detections and displays them in a X-Y diagram.

- □ This helps designing Adaptation Maps and evaluating coverages.



Slant Range (Nm)

- 0 - X

Time Delay

• The RDV can analyse a recording synchronized through NTP (.gps) to evaluate time delay.

Delay can be displayed vs. Time, Azimuth, Range, Histogram view and generate a report.





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RDV Management

- Maps
- Functionalities
- Map Modification Criteria





Processing maps

In addition to tilt selection and CFAR sensitivity values configuration, system optimization is strongly related with processing maps edition through RDV:

Processing Map	Main Edition Objective
Receiver Status Map	Configure High/Long Beam
Analog STC Map	RF Attenuation
Digital STC Map	Minimum Threshold for Target Detection
Site Environment Map	CFAR Processing Election
Tracking Zones Map	Special Areas
Transmission Blanking Map	Non Radiation Azimuths

New Map	
Select Map Type:	Digital STC
	Digital STC
ок	Analogue STC Tx Blanking
	Site Environment





Transmission Blanking Map

The Blanking map has the capability to stop the transmission over certain azimuths of the coverage. This function is only applied by customer's request, to avoid radiating nearby PSR sensors with similar frequencies or other devices or buildings that might be prevented to be radiated.

This map is applied in the transmission, restricting transmission is the configured areas.

The default Blanking Map does not apply any blanking.





Analog STC Map

- The analog STC Map is usually configured the first one by following the next tips:
 - Depending on the antenna rotation speed it must be configured an attenuation for the long pulse transmission in order to prevent failures in the reception chain.
 - Several Signal Monitoring should be done in case of presence of RX Saturation. This monitoring will help in discovering the areas where Analog STC should be increased to avoid that RX Saturation.
 - Once the long pulse is attenuated to avoid RX damage and there is no RX saturation the Analog STC Map is completed.
 - It is compulsory to analyze that the modification of the map does not affect the PD obtained before the modification.





Site Environment Map

The Site Environment Map allows the user to configure the CFAR processing in the system, applying CM-CFAR with all the MTD Filters, only low speed filters or no filters at all.

The edition of this map will relay on the punctual loses generated by the CM-CFAR. When this type of loses appear, the CM-CFAR process should be removed over those areas. If those loses are produced by the Clutter Map 3 (filters 3&4), the removal of the high speed filters for the CM-CFAR application should be enough.





Receiver Status Map

The receiver status map has a limitation that must always be followed about the pulses. All the receiver configurations with short pulse must be applied in the first 8 NM, and the long pulse configurations after 8 NM.

The configuration of this map is usually intended to avoid false targets coming from the ground without losing PD. The receiver configuration can be modified to maintain the priority of the high beam reception over low beam in order to maximize the power of detections coming from high altitudes. This effect can not be extended further than 50 NM, where low beam is compulsory for low level flights.





Digital STC Map

The Digital STC Map stablishes a threshold of power for a signal to be considered on the digital process. Every possible detection under this threshold will be dismissed.

This map is usually modified after the Site Environment and Receiver Status to eliminate every low power false detection remaining. It is not recommended to increase the threshold too mucho to prevent the PD loss for low power flights.





Tracking Areas Map

The tracking areas map is used to create specific areas with special tracking conditions, filtering detections by speed, course variation, acceleration... Several parameters can be modified to filter chained plots with characteristics uncommon for flying vehicles, such us speeds under a low threshold or over a high threshold, sudden course variations, high acceleration...

Also, some areas with special treatments can be created, such as:

- Non Automatic Initialization
- Blanking
- Reflections

fault Zone Configuration			
	NTF DB	Птв	ANGEL
ngel Zone Parameters			
Number of scans:	3	Track number threshold:	4
TZ/FTZ Parameters			
Range margin (NM):	0	Azimuth margin (°):	0
onfiguration Sets			
New Delete			
00			
00 Std. Dev. Range (Nm):	0.03125	Std. Dev. Azim (*):	0.219727
00 Std. Dev. Range (Nm): Max. Speed Update (km/h):	0.03125	Std. Dev. Azim (*): Max. Speed Init (km/h):	0.219727
00 Std. Dev. Range (Nm): Max. Speed Update (km/h): Min. Speed Update (km/h):	0.03125 2000 80	Std. Dev. Azim (*): Max. Speed Init (km/h): Min. Speed Init (km/h):	0.219727 2000 80
Std. Dev. Range (Nm): Max. Speed Update (km/h): Min. Speed Update (km/h): Max. Course Inc (*):	0.03125 2000 80 90	Std. Dev. Azim (*): Max. Speed Init (km/h): Min. Speed Init (km/h): Max. Course Accum (*):	0.219727 2000 80 120
Std. Dev. Range (Nm): Max. Speed Update (km/h): Min. Speed Update (km/h): Max. Course Inc (*): Max. Linear Accel (g):	0.03125 2000 80 90 1	Std. Dev. Azim (*): Max. Speed Init (km/h): Min. Speed Init (km/h): Max. Course Accum (*): Max. Radial Accel (g):	0.219727 2000 80 120 4





The map edition, creation and management is done with the Indra RDV software.

RDV Configuration:

- Execute the quicksetup app to configure the RDV software
 - Little Endian: PSR with only 1 GPB
 - Big Endian: PSR with 3 GPBs







Create a New Map on RDV

- 1. Execute Indra RDV Software as administrator.
- 2. Once the RDV software is operative, open the "Radar Maps" tab in the top bar by left-clicking on it.





Create a New Map on RDV

3. Select "New Map" and select in the pop-up window which map is about to be created.





Sending Maps to SLGs with Indra RDV Software

- 1. Open the RDV software.
- 2. Open the map that needs to be applied in the CPC.
- 3. Go to Radar Maps, Save Map.
- 4. Select "to Local Database and send to SLGs". The maps will be loaded in the CMS.
- 5. Applying the map can be done from the CMS in the Maps tab.







RDV

Monitoring

Functionalities RDV Monitoring



Signal Monitoring

RDV allows the user to perform a Signal monitoring at a certain time by pressing "M". This monitoring will capture the signal through all the steps along the system (raw video, after compression, CFAR channels...). It will capture several CPIs over the area where the mouse was placed.

This operation can be also performed through the menu Signal Monitoring > Capture New Sample.





Functionalities RDV Monitoring



Signal Monitoring

A Signal Monitoring can be saved in the PC to be sent in case of need.

This monitoring can help searching for faults in the system/process or analyze the reason of losses along the coverage.

It can be observed if a plane was detected after compression or MTD filtering and lost along the signal process, helping to detect faults in the optimization.

It also allows seeing the output of every MTD filter.



Functionalities RDV Monitoring



Video Configuration

The video configuration allows the user to see in real time the status of several monitoring points of the system. Some examples of this monitoring points are the status of the 4 Clutter Maps.

RDV can also perform a recording of a specific monitoring point to see the evolution of it during time.



Analysis & Backups

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Analysis of the PSR2D performance

To analyze a system's performance it is needed a recording of several hours. To perform a recording Indra provides several tools such as:

- ASTTools
- RDV (also used for the analysis of the recording)
- VR3000



Functionalities Analysis & Backups



Analysis of the PSR2D performance

To analyze a recording it is used the RDV and the SASS-C / Verif combined.

The SASS-C / Verif is used to obtain the global recording's results such as PD, number of false targets per scan or accuracy.

The RDV is used to detect the conflictive areas, punctual losses, false target appearance areas etc.

The RDV has filters and shortcuts to move though the recording easily and observe only the desired situations, which are explained in the following pages.



Analysis & Backups



Analysis with RDV

First thing is to open the recording with RDV. In order to do so, click on the folder icon under	is to open the recording with RDV. In order to do so, click on the folder icon under nenu. Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Image: Polylines Data File To open the filtering options for an easier display of the information, click on the red cone icon under the "Signal Monitoring" menu. Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Wideo Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) File Scale View Analysis Injection Signal Monitoring Video Terrain Maps Radar Maps Polylines Data Selection Image: PSR2D - Radar Data Visualization Tool (RDV) Image: PSR2D - Radar Data Visualization Tool (RDV) Image: PSR2D - Radar Data Visualization Too	× nd 420.0 360.0 19600 2018 128.0
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	Apply Filter Update Filter Close	



Analysis & Backups



RDV Shortcuts

The following shortcuts allow the user to navigate faster through the recording:

- "E" : The recording will go straight to the last scan.
- "H": The historic of the detections from the selected time to the beginning of the recording will be displayed.
- "T": When a detection is manually selected, will place the time of the recording at the moment of the detection.
- "Q" & "A": will run the recording one scan before ("Q") or after ("A") the actual scan.

For example, to see the hole recording historic, press "E" and then "H". This function is very useful when looking for specific areas such as losing areas of false detection areas.



Analysis & Backups



RDV Analysis

RDV can also perform several types of analysis with a recording.

The most used are the SR-SSR Alignment to analyze if it is necessary to perform a correction on the PSR azimuth and range, and the Target Position Accuracy and Resolution to verify the standard deviation of the PSR plots.

For the analysis of the type of traffic, the Height/Altitude Profile analysis is very useful, allowing the user to see the paths of take off and landing.

Analysis	Injection	Signal Monitoring	Vide
SR-S	SR Alignmei	nt	
Nort	h Alignment		>
Dete	ction Analys	is	
Targ	et Position A	ccuracy and Resolution	n >
SR A	mplitude Pr	ofile	
Heig	ht/Altitude	Profile	
MTD	Polar Diagra	am	
Time	Delay		
Rank	Factor Estin	nation	



Analysis & Backups



RDV Maps Backup

When the optimization process has achieved a successful result, it is highly convenient to create a copy of the maps being used by the CPC. To do this, follow the steps below:

- 1. Open the RDV software.
- 2. Go to Radar Maps, Map Transfer, Download All Maps from CPC.



3. Select the directory to save the maps.


Map Modification Criteria Blanking Map

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Modification Criteria and Edition Process

The Blanking Map is only edited to add blanking azimuths by customer's request to prevent radiation over certain surfaces. This prevention can not be applied over a determined range, it will be applied to the azimuth.

With the RDV software, open the blanking map from the CPC and open the map edition.

In the pop-up window is made the selection of azimuths where Tx is going to be applied or removed.

Start Azimuth (°):	0		
End Azimuth (°):	360		
Blanking (TX OFF):	ON	~	



Map Modification Criteria Site Environment Map



Modification Criteria

The modification of this map is related with a low Pd issue. If the default map is applied and there are several losses over a certain area, that area should be analyzed.

- If the area has very high clutter levels, the CM-CFAR with all filters should remain applied.
- If it is an area with moderate clutter levels, the CM-CFAR should be modified to apply only the low speed filters.
- If the area does not have relevant noise levels, the CM-CFAR can be removed and leave only R-CFAR.



Map Modification Criteria Site Environment Map



Edition Process

To modify the default map, the following steps must be followed:

- 1. Open the RDV software
- 2. Open Site Environment Map from the CPC
- 3. Go to Radar Maps > Map Edition and select in the pop-up window what kind of filter is going to be applied.
- 4. Draw the polyline over the area to apply the filter selected.



Before drawing a polyline over an area where a different algorithm is desired, the new filter must be selected in Radar Maps > Map Edition.



Maps Modification Criteria

Analog STC Map

Map Modification Criteria Analog STC Map



Modification Criteria

This map is not usually modified, because the Indra PSR sensor has other methods to avoid false target over certain areas. Nevertheless, in some cases of big false target appearance, the Analog STC Map can be modified to increase the attenuation over a certain range to prevent this false targets. For example, in big cities with multiple sources of clutter, the STC attenuation can be increased to prevent the vast majority of those false targets caused by the city clutter.

The use of this map is also related with avoiding the RX saturation in specific areas. Areas with specially high clutter can saturate the RX with many incoming false targets. If this incoming clutter is unstable, the CM-CFAR will not filter it, and the use of the Analog STC Map will be compulsory.

All the false targets will never be eliminated only with the Analog STC Map edition, because increasing the attenuation at very high levels to prevent all false targets will cause the loss of several real targets.



Map Modification Criteria Analog STC Map



Edition Process

The Analog STC Map is edited by the creation and application over the selected azimuths of STC Laws, which are in range profiles of attenuation.





Map Modification Criteria Analog STC Map





Map Modification Criteria Receiver Status Map



Modification Criteria

The Receiver Status Map usually stays as default. In some circumstances of loses, the range of the high beam might be increased in certain azimuths. If the PSR sensor is the approach radar of an airport, the map might be modified to receive the approach path with the Low Beam instead of the High Beam, depending on the angle of the approximation and the height of the flight.

If there is a big presence of high altitude flights and low traffic of low altitude in certain areas, it can be considered to increase the range of the high beam, even until 60 NM.

In case of presence of wind turbines, it must be applied the Adapt. Null option over the area. This will reduce radically the interferences produced by the wind turbines.

The Combined HL configuration allows the radar to process both the high level flights and the low level aircrafts, combining the power obtained by both beams.



Map Modification Criteria Receiver Status Map



Edition Process

The first step is choosing the configuration of the beam that needs to be applied, and then stablish over which area needs to be applied. To do that, there are four parameters, which are Start and End Range in Nautical Miles, and the Start and End Azimuth in degrees. This way, areas can be created with specifics limitations in range and azimuth.

The High and Low coefficients are used only for the Combined HL configuration.

The software will not allow a modification that implies receiving a short pulse farther that eight nautical miles, either a long pulse before.

The edition of this map can also be performed using polylines to establish determined areas.

Edit Receiver	- 🗆 ×		
Rx. Status:	High Long ~		
Start Range (Nm):	0		
End Range (Nm):	80		
Start Azimuth (°):	0		
End Azimuth (°):	360		
High coefficient:	0.5		
Low coefficient:	0.5		
Add	Close		

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Modification Criteria

The Digital STC Map is meant to stablish thresholds for those areas with high clutter that surpasses the CFAR filtering.

As the CM-CFAR is constantly adapting, all the areas with a constant level of clutter will be compensated by the CM-CFAR, but the areas with sudden changes on the clutter level will not be filtered by the CM-CFAR. For this reason this areas should be covered with a digital STC threshold. This areas can be roads for example, with low traffic. A car with high Doppler speed will not be filtered by the CM-CFAR and will appear as a false target, but stablishing a threshold over that road, only targets with a high power will appear.





Edition Process

When creating a new Digital STC Map, some global parameters must be specified.

The Maximum Range has to correspond with the range of the working mode of the radar. The minimum threshold applicable is 20 dB, and it will always be applied to the whole coverage. The range between the maximum and minimum threshold is where the maximum threshold is going to be exponentially reduced until the minimum threshold. From the range for minimum threshold to end of the coverage, the digital STC threshold will stay linear with the value of the Minimum Threshold.

承 New Digital STC Map	-		×	
Maximum Range (Nm):		80		
Azimuth Sectors:		512		
Maximum Threshold (dB):		60		
Range for Max. Thr (Nm):		1		
Minimum Threshold (dB):		20		
Range for Min. Thr (Nm):		30		
ОК		Close		

Indra



Edition Process

This is the default profile of the Digital STC:







Edition Process

Once this parameters have been set (in case of editing the map opened from the CPC, this parameters have already been set), press OK. This will be the basic threshold applied over the coverage. To add specific areas with different thresholds:

- 1. Go to Radar Maps, Map Edition.
- 2. In the pop-up window stablish the desired threshold for the area that it is about to be created.
- 3. Draw the desired areas with the specified threshold using the polylines.
- 4. If the desired threshold for another area, repeat the steps to modify the threshold before drawing the area.
- 5. The threshold can not be modified for a painted area. In case that threshold has to be modified, the area must be drawn again with the desired threshold.





Edition Process

The Range Profile can be manually modified also.

In order to do so, go to Radar Maps, STC Edition, STC Range Profile Editor. Using the top bar tools the profile can be easily edited. Once edited, clicking the save button, the edited profile can be applied only to the reference azimuth or to several azimuth even the whole coverage.



Indra



Edition Process

In the following image the previous range profile has been applied to half of the coverage, from 0° to 180°.







Modification Criteria

The application of the different possibilities in the Tracking zones is based on several conditions. As this map is the last one in being processed in the digital signal processing, it is also going to be edited the last one. The purpose of this edition is to remove the false targets with special conditions (high speed, reflections...) that remain after all the digital processing of the signal.

The type of area applied depends on the type of false targets over that area.

- NTF zones can be applied in areas where the visibility is compromised and planes take off in that area. The take off is always more difficult to detect, so it can be considered to apply a NTF zone to have a better detection.
- NAI zones are very used in the optimization process. These zones are especially useful in areas of good detection and high traffic with false targets. The
 NAI will eliminate all the false targets over the area. Another interesting use of the NAI zones is to eliminate radial false targets.





Modification Criteria

The type of area applied depends on the type of false targets over that area.

- PB and TB zones are very uncommon to use. In some rare cases, demanded by the customer, it might be possible to add this blanking zones over specific areas, like the taxi roads of the landing track, to avoid the detection of plots or tracks.
- Angel zones are applied over areas that eventually have sudden appearance of false plots. This effect usually happens at sunrise and sunset.
- NONE zones does not have any of the previous filters, but applies the filtering parameters of speed and angle. This type of zone is applied through areas that contain false targets with low speed, like cars, or ships. The parameters of modification depends of the undesired targets over that certain area.





Edition Process

To edit this map there are several tips to count on:

- Several Configuration sets can be previously prepared with different parameters of speed, angle and acceleration. This will allow the user to determine every zone's parameters easily.
- All the editable parameters are always applied regarding of the type of zone (NAI, NONE, PB...). When a tracking area is defined, the Configuration Set is selected with or without a specific type of algorithm.





Edition Process

To create a Tracking zone proceed like the following steps:

- 1. Open the Tracking Areas map.
- 2. Create the desired Configuration Sets through the Radar Maps tab, Map Edition.
- 3. Create a polyline through the desired area.
- 4. Apply the type of tracking area wanted (or none) and select the configuration set appropriate for the purpose of that area.

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Edition Process

- 5. Add the desired areas following the previous steps.
- 6. Once finished, apply the changes by saving the map and send it to the CMS.



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