

6.5. Validation

In order to evaluate the general performances of the installation, the best way to proceed is to send people walk over the coverage of the radar.

Following this evaluation, two types of setting can be performed:

- Update the equipment and their installation properties (see § 6.5.1)
- Update the zones, (see § 6.5.2)

6.5.1. Equipment and installation properties update

The camera and radar installation properties can be updated through the « System Management -> Equipment Configuration » menu.



Figure 141 – Equipment installation properties update

Radar installation properties update:

- Solution#1
 - Disconnect from the radar to be updated (PU), update the radar installation properties and re-connect to it. The **PSR-500 Installer** will automatically detect a discrepancy between the current version of the System Configuration of the **PSR-500 Installer** and what the radar is aware of. The application proposes either to apply the modification to

the PU or to import them from the PU. After 10 seconds, the PU configuration is automatically imported toward the **PSR-500 Installer**.

- Extend the network configuration window and click on « Send to PU » button to apply the update to the PU.



Figure 142 - PSR-500 Installer - Extension of the radar configuration window

- Solution #2
 - Once connected to the PU (radar), re-start the calibration procedure for this radar.

Camera installation properties update:

- Solution #1
 - Disconnect the camera to be updated from the **PSR-500 Installer**, update camera installation properties and re-connect to it. The **PSR-500 Installer** will automatically detect a discrepancy between the current version of the System Configuration of the **PSR-500 Installer** and what the CCS is aware of. Then click on « Send to CCS ».
- Solution #2
 - Once connected to a camera, re-start the calibration procedure

6.5.2. Zone update

In Installation mode, through the System Management -> Zone Definition menu, you can update zones definition and their properties (sensitivity level...).



Figure 143 – Zones update

Please note that each zone modification performed in the **PSR-500 Installer** will not be known by the Radar(s) until you update their own configuration.

Therefore, you have two possibilities:

- Solution #1
 - Disconnect all the radars to be updated from the **PSR-500 Installer**
 - update zones properties through the **PSR-500 Installer**
 - Click on System Management -> Equipment Global Management -> Update All Radar PU(s). The application re-connects to all the radars and updates them with the new system configuration.

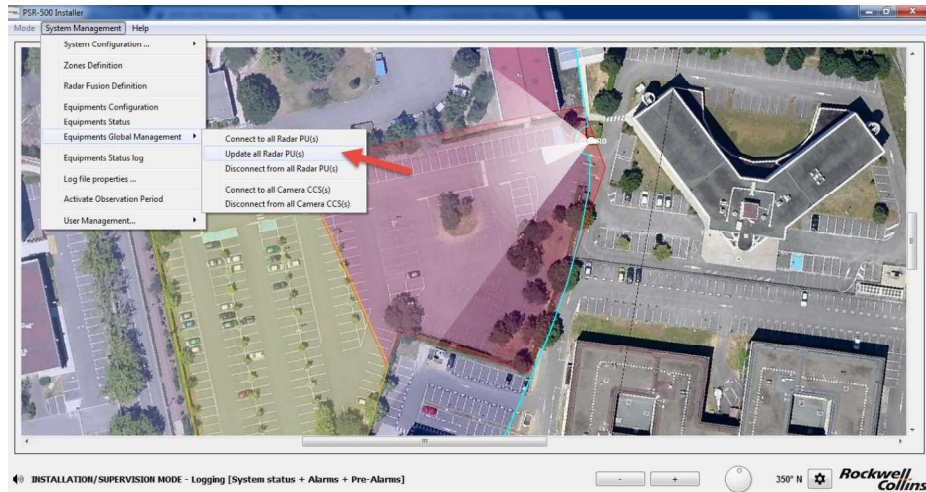


Figure 144: update of the system configuration of all the radars

- Solution #2

- Do not disconnect radars from the **PSR-500 Installer**
- Update zones properties through the **PSR-500 Installer**
- Radar by radar, extend the network configuration window of the radar, and click on « send to PU » to apply the update to the PU.

Each time you change zones sensibility, keep in mind the induced effect.

- **The best performances of the PSR are achieved in « normal » sensibility.**
« Normal » sensibility is the best trade-off between detection probability and false alarm rate (min 0.35m/s and 4s before triggering the alert)
- **« High » sensibility mode** will lead the radar to be more reactive on very low radial velocity motion (min 0.2m/s) and faster to trigger alerts (2s) but will also lead the radar to be more subject to false alarm due to animals or moving trees.
- **« Low » sensibility mode** will lead the radar to be less sensitive to spurious activity (animals, moving trees) (min 1m/s and 4s before triggering the alert) but will also lead the radar to be much less sensitive to low radial velocity targets.
- **« User defined » sensibility mode** gives you access to more properties (available in Help -> Advanced mode only (no password required)) (min 0.05m/s and 1s before triggering the alert)

6.5.3. End of the validation phase

Once deployment validation is over, you can generate the Final Installation Report clicking on System Management -> System Configuration... -> Generate Installation Report.

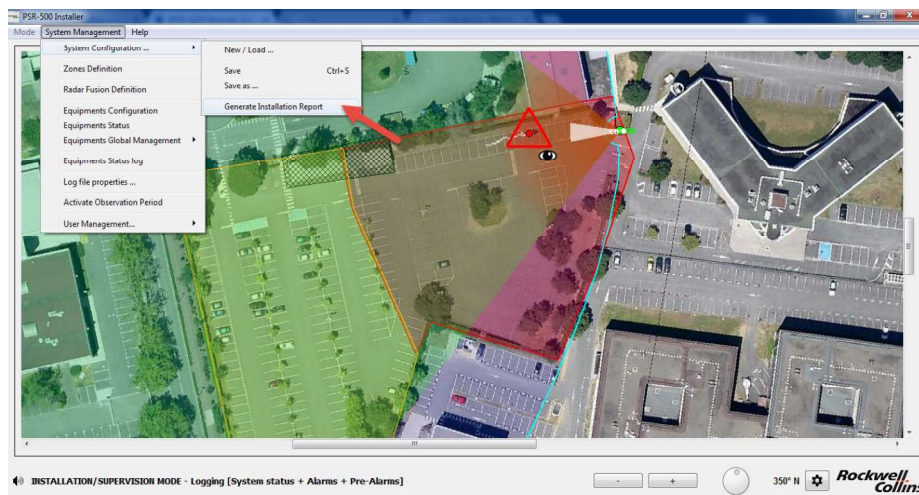


Figure 145 – Manual generation of the installation report

7. 24H Operation of the radar system

This chapter is not yet detailed in the English version of the document (please refer to French version if required).

8. System performances optimization

System performances optimization is linked with the radar technology concepts, which were detailed in previous sections of this document.

8.1. Detection capability

8.1.1. Reactivity

The PSR-500 radar maximum reactivity time to trigger an alert (linked to an intrusion) is 4 seconds.

This performance is achieved if the following conditions are fulfilled:

- The intruder shall be in the detection area covered by the radar
- The intruder shall not be hidden by any obstacles between the radar and him. If the intruder is partially hidden, then the performances of the radar will be decreased.
- The radial velocity of the intruder's trajectory shall be enough, taking into account radar location and features of the detection area.

If one of the previous conditions is not fulfilled, then the performances in terms of reactivity and detection range will be decreased. In this case, radar installation optimization is required to fulfill these conditions (as detailed in previous sections of the document).

Furthermore, it's important to bear in mind that this reactivity can be locally improved through tuning of detection zones features.

8.1.2. Localization accuracy

Alert localization accuracy for each radar is directly linked to the quality of the intruder detection.

The better the detection will be, the most accurate will be the localization accuracy.

As explained before in this document, the localization accuracy is linked to :

- The proximity between the intruder and the radar
- The proximity between the intruder and the boresight of the radar
- No masking area, even partial, between the intruder and the radar

These aspects have to be taken into account when the operating zones are created (detection or exclusion).

At the edge of the detection range (500m), the test results in a clean environment (flat zone with pedestrian perfectly visible) show that each radar can localize an intruder with the following performances:

- Range accuracy: worst case +/-5m whatever the distance between the intruder and the radar
- Angular accuracy: worst case +/-15m @500m (i.e.: +/-1.7°). It's important to bear in mind that this accuracy gets better as the intruder comes closer to the radar.

8.1.3. *Effect of the outside temperature*

Outside temperature has a direct effect on the detection performances of a radar. The colder it will be, the more sensitive the radar will be. Indeed, when the outside temperature increases, the internal noise of the radar reception chains increases as well and the efficiency of the amplifiers decreases. Thus the impact of this phenomenon is a reduction of the radar sensitivity.

As a conclusion, outside temperature has a direct effect on the reactivity and the localization accuracy of the radar.

8.2. False alarm

The performances of an « active » surveillance sensor are defined by its detection rate and its false alarm rate.

Each radar of PSR-500 system is preset to reach optimum performances, i.e.: to ensure the best trade-off between detection sensitivity and false alarm. Nevertheless, radar system performances can vary depending on the environment where it's deployed:

- Infrastructure (buildings, fences,...)
- Vegetation (trees, forest, ...)
- Type of terrain (tarmac, grass,...)
- Seasons and meteorological conditions (temperature, humidity...)

The performances of each radar have to be monitored for each deployment and also in operation.

Indeed, the real value of a radar false alarm rate can not be calculated in a very short time. Usually the false alarm rate of a radar is defined by the number of false alarms per hour or per day of operation. In order to validate that the false alarm rate is in line with customer expectation, the radar will have to operate during several days.

Various meteorological conditions are necessary during the observation period of the radar in order to optimize the performances. For instance, it could be useful to focus on days where the weather conditions were bad.

Performances optimization will need to investigate non-detections or potential false alarms and system configuration update could be performed as well (i.e. : features of operating zones).

Finally, it's impossible to confirm whether a radar alarm is due to a real intrusion or not without visual confirmation. If the operator is not there during the false alarm analysis phase, then access to recorded video stream from cameras (installed on the site) will be mandatory for visual check and doubt removal.

8.3. Observation period activation

To activate the observation period, click on System Management -> Activate Observation Period:



Figure 146: PSR-500 Server – Observation period activation

In this phase, each radar will transmit to the **PSR-500 Server** all detailed information on the observed alerts.

The **PSR-500 Server** will then permanently record all the data, which will be used by the operator/installer to check the performances of each radar.

WARNING : it's mandatory to have the registers's level of details set to the maximum value, i.e. : « Statuts + Radar data (Alarms + Pre-alarms) ».

WARNING : minimum hard disk space is required when observation period is activated.

In average,

The recorded data from a radar when the observation period activated is around 15Mo/day in average. The size of the memory will depend on the activity observed in front of the radar.

The graph below shows an example of hard disk memory space used on a site where 7 radars were deployed and in operation during 8 days:

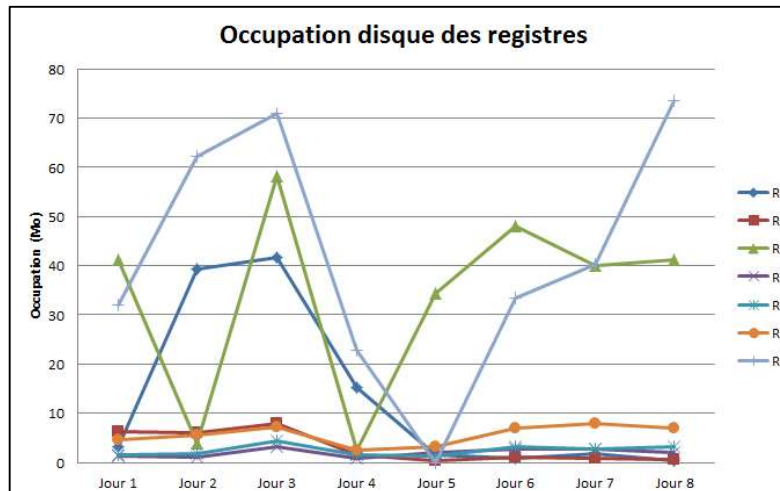


Figure 147 – Memory register analysis

When the observation period is activated, the system shall operate during at least 24h.

8.4. Investigation

As previously explained, when the observation period is activated, the **PSR-500 Server** continuously records detailed information of all the alerts observed by each radar.

The **PSR-500 Investigator** will allow to go through all the registers of each radar and retrieve relevant information by :

- Displaying the list of recorded alarms
- Showing on the site map the movement of the intrusion alerts.

To use the recorded data by the **PSR-500 Server**, some files transfer will have to be performed in the **PSR-500 Investigator**.

To do so :

- Copy/Paste the system configuration folder from repository /PSR_System_Configuration of the **PSR-500 Server** (or **PSR-500 Installer**) to the repository /PSR_System_Configuration of the **PSR-500 Investigator**

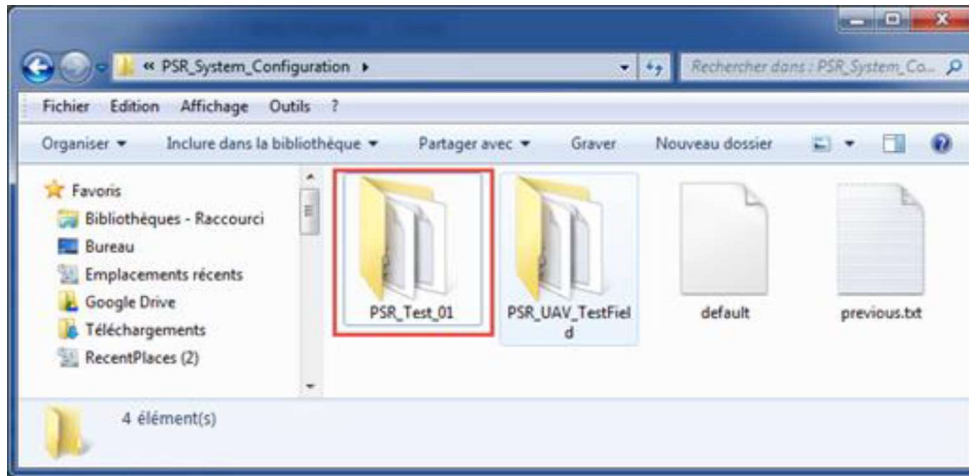


Figure 148 – System configuration folder transfer

- Retrieve relevant files corresponding to the days and radar of interest in the folder /PSR_Logs of the **PSR-500 Server** and transfer these files to the folder /PSR_Logs of the **PSR-500 Investigator**. The example below shows the status system (global) files retrieval of radar R0 corresponding to the days of 3 and 4 April 2017.

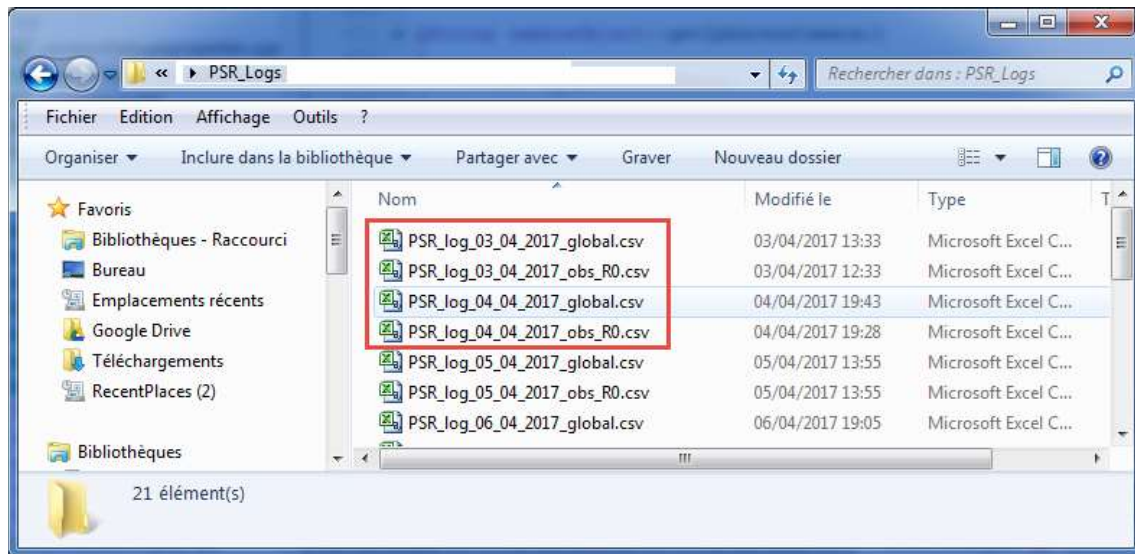


Figure 149 – Activity files retrieval

- Start the **PSR-500 Investigator**
- Load the system configuration, which was just prepared by the **PSR-500 Installer**
- The application knows that the system configuration was prepared by another application and/or another PC, so it asks the user to locate the map on this new application. To do that, go to the folder /PSR_Background_Maps/ of the application **PSR-500 Investigator**

The register analysis window pop-up with map below. It's recommended to have 2 screens to perform register analysis.

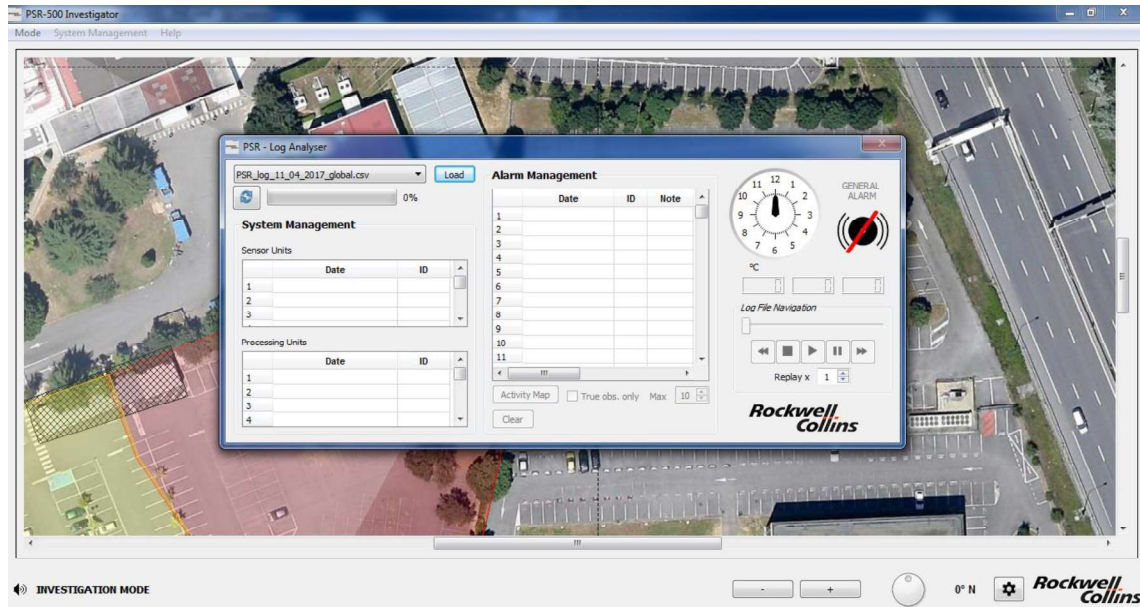


Figure 150 – Register analysis window

8.4.1. Register loading

- Open the file corresponding to the day when the false alarms have to be analyzed
 - o To select an observation file containing the alerts corresponding to the radar Rx at the date of dd/mm/yyyy, click on the the drop-down list and select the file PSR_log_dd_mm_yyyy_obs_Rx.csv
 - o To select an observation file containing the system status of all the PSR-500 equipment at the date of dd/mm/yyyy, click on the the drop-down list and select the file PSR_log_jj_nn_aaaa_global.csv

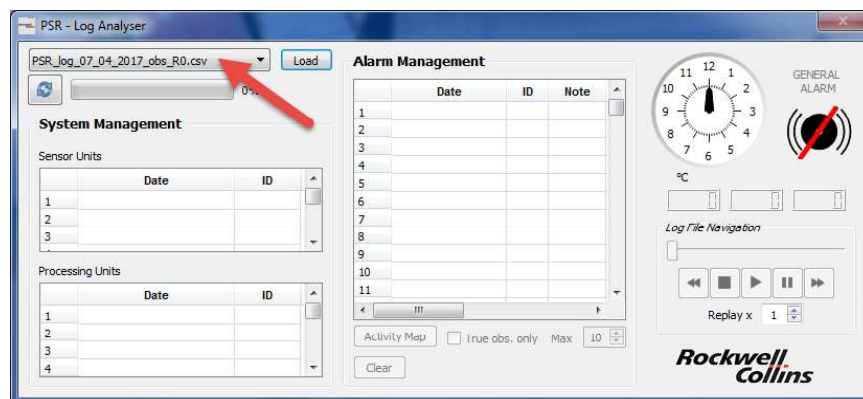


Figure 151 – Observation file selection

- Click on « Load »

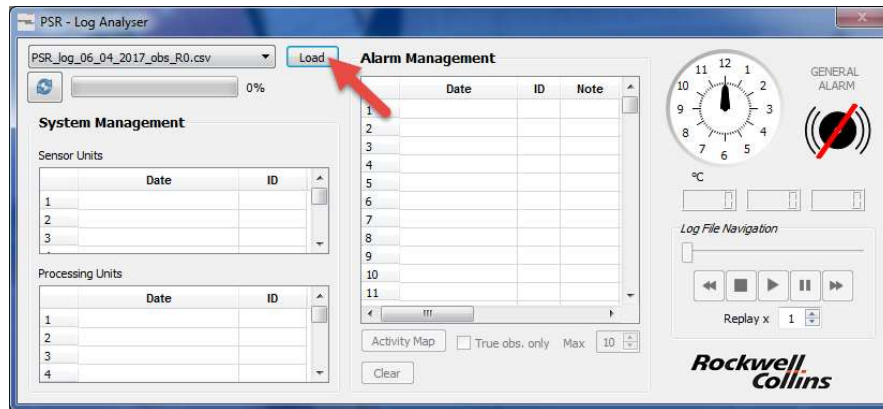


Figure 152 – Observation file loading

- If the loaded file is a file containing alerts for a dedicated radar, then a window will appear to select the level of alerts to retrieve (Awareness and/or Caution and/or Warning) => then click on « LOAD » button.



Figure 153 – Window of alerts to retrieve

- After a certain amount of loading time (depending on the density of the activity at the selected date), all the alerts will appear in the « Alarm Management » window:

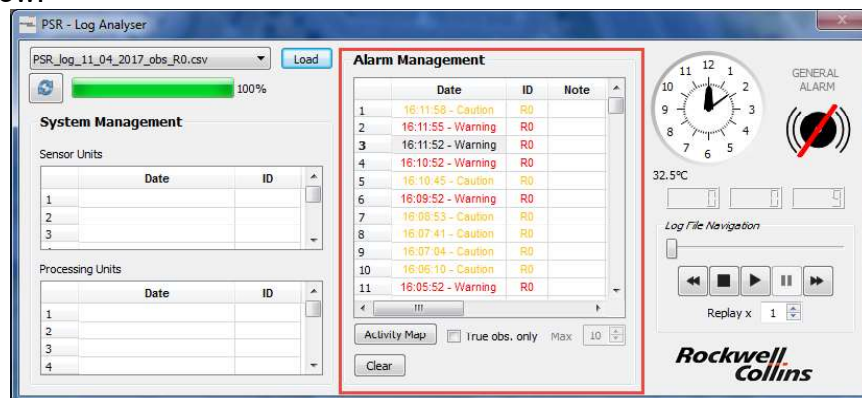


Figure 154 – Display of alerts file

8.4.2. Replay of a single alarm

- Open the video record of the camera associated to the radar under investigation

- Write down the time of each alarm and using the video record, validate the alarm (intruder on the screen) or a false alarm (no intruder on the screen).

In case of a false alarm, an advanced investigation is possible :

- Display this alarm on the map by double-clicking on the alarm in the window « Alarm Management »:

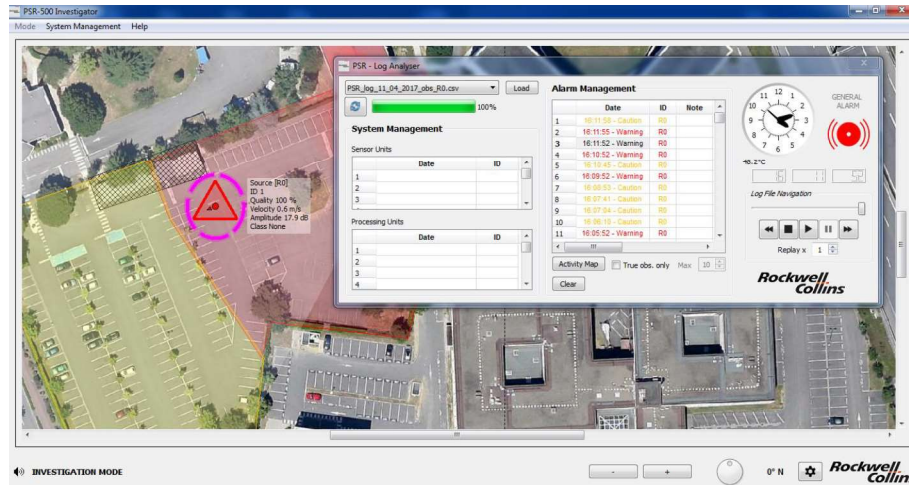


Figure 155 – Replay of an alarm

- Display the alarm trajectory by using the command buttons (Rewind, Stop, Play, Pause, Fast Forward, Replay factor) available in the Log Analyser window:

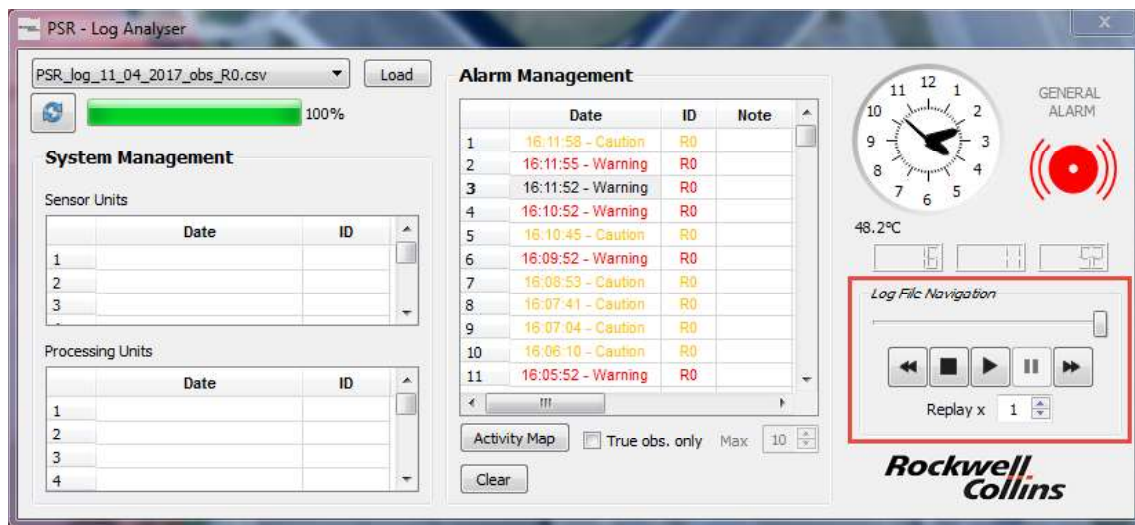


Figure 156 –Command buttons of an alarm trajectory

- Analyze the alarm properties (speed, amplitude,...) in order to define the mitigation plan. The alarm properties are displayed on the map close to the alarm and follow it.

8.4.3. Accumulation of observed activity on one day

Log analyser has advance feature, which allows to accumulate observed activity for a dedicated radar for a specific day (corresponding to the file loaded).

This function will go through the map and count during the selected day the number of alerts per pixel on the map.

As a result, the function will display an accumulation of alerts, which will be used to assess the density of alerts per zone.

Furthermore, this function is very useful to identify areas with a lot of spurious alarms (for instance due vegetation,...). The result of this “Activity Map” has been already used in operation to update exclusion zones in order to reduce the false alarms rate close to these zones.

- To display this accumulation map, click on « Activity Map » button. This action requires some time, as the **PSR-500 Investigator** application has to go through all the recorded data of the selected file:

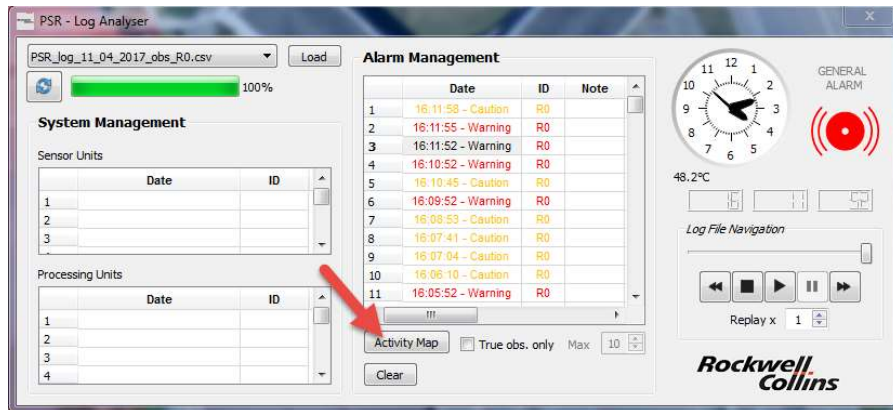


Figure 157 – Display of « Activity Map »

- To display the « Activity Map » only based on True observations (and not based on tracking algorithm extrapolation), check the box « True obs. only » just at the right of “Activity Map” button.
- Once the « Activity Map » is displayed, the box at the right corner « Max » can be used to tune the display threshold value (max number of observations per pixel)

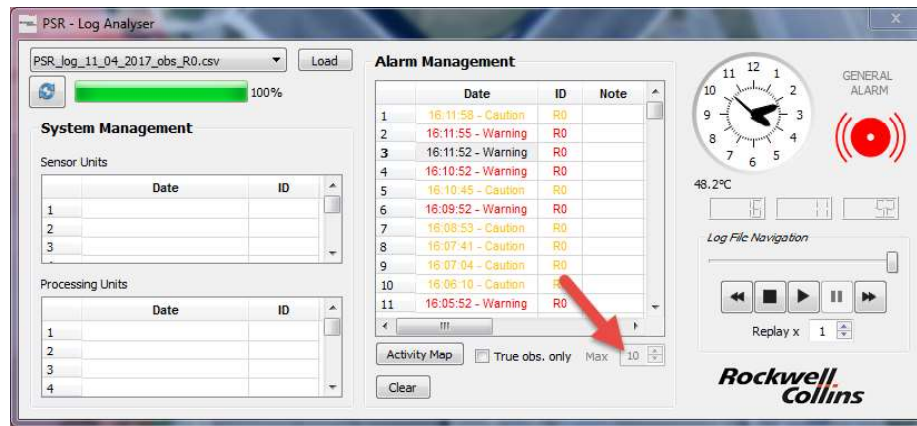


Figure 158 – Display threshold tuning

- To clear the map, click on « Clear »

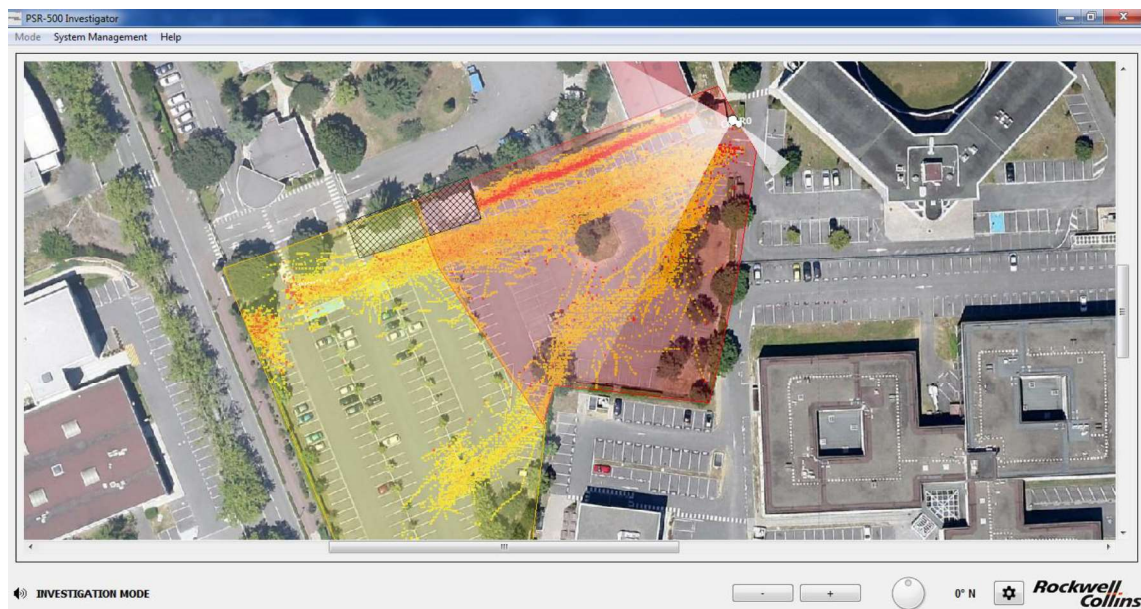


Figure 159 – « Activity Map » display (threshold with 10 observations)

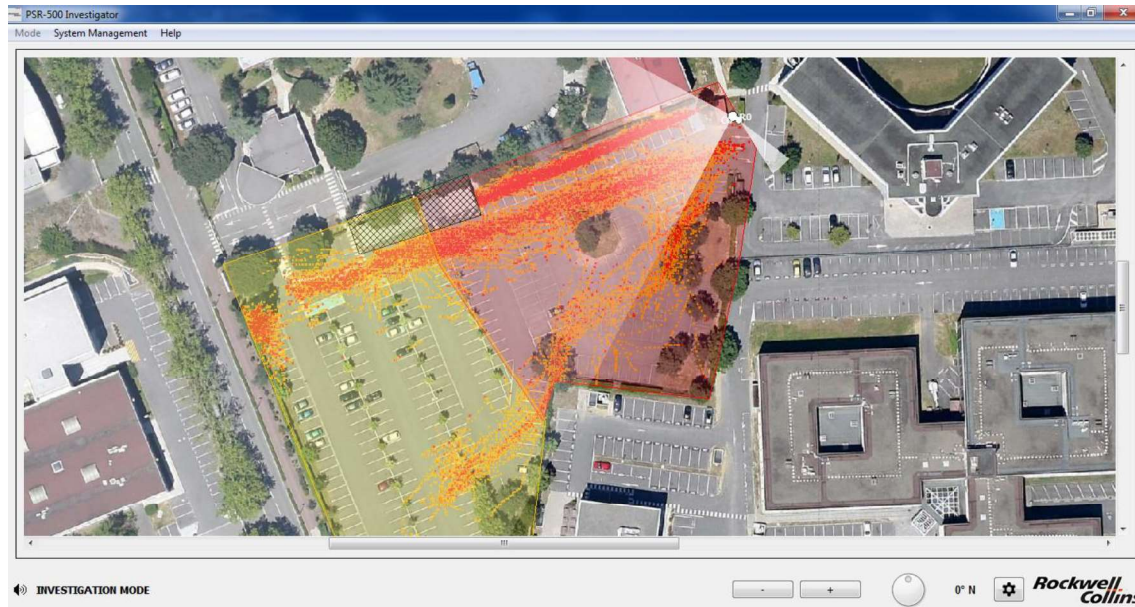


Figure 160 - « Activity Map » display (threshold with 2 observations)

8.5. False alarm mitigation

False alarm mitigation consists in changing some system installation parameters to reduce the false alarm rate. This installation parameters change will be performed with **PSR-500 Installer** application thanks to the method described in section 6.5.

As explained in this section, the most common way to mitigate the false alarms is to adjust the drawing of the surveillance zones (warning, caution, exclusion) in order to erase zones with high density of false alarms. But it's also possible to modify the sensitivity of the detection zones, which are configured in the system.

When the system configuration is changed via the **PSR-500 Installer**, if the **PSR-500 Server** (master and/or slave) is connected to the radars, then the server will automatically see the changes on each radar. Without any action from the user, the system configuration known by the **PSR-500 Server** will be automatically updated in the **PSR-500 Server**. The last action will consist in connecting to the server machine to annually save the system configuration via the menu System Management -> System Configuration -> Save. Then, in case of restart, the **PSR-500 Server** will be launched with the last system configuration version.

8.6. Mitigation validation

Mitigation validation will consist in performing the previous investigation step in order to ensure that the PSR-500 false alarm rate is compliant with customer expectations.

Note : it's possible that the false alarm rate changes after several months or years, due to soil modification, infrastructure modification, new obstacles (mobile or not),... Thus the PSR-500 system false alarm rate will have to be carefully monitored over the time.

9. Maintenance & Troubleshooting

9.1. Display of the radar covering area

After creation of a new system configuration and in particular the addition of a new radar with the **PSR-500 Installer**, the shape of the radar covering area shall be displayed as below:

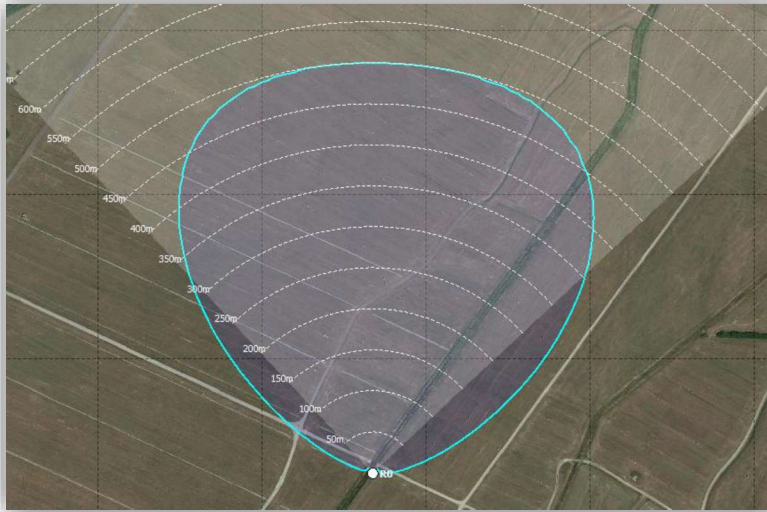


Figure 161 – Nominal shape of the PSR-500 radar covering area

If the shape is different, then the final performances of the PSR-500 system will be impacted.

The map referencing was not correctly performed. Perhaps the geographical localization was inverted (latitude/longitude) or the coma was not well placed. In this case, the creation of the system configuration shall be performed again, starting from the beginning.

Indeed, the map referencing and its accuracy are the key points to ensure system performances.

9.2. Control the status of the deployed radars

Each radar of the PSR-500 system is monitored by maintenance network components (if they are deployed, configured and tested as explained in this guide) through the « master » **PSR-500 Server**.

In case of abnormal operation, the automatic maintenance is launched. Nevertheless, it may occur operational scenario where the automatic maintenance can not solve the problem.

Be careful, if an operator needs to perform a maintenance operation of a radar, the **PSR-500 Server** (master and slave) shall be disconnected from this radar to avoid

that the automatic maintenance takes the control of the associated network equipments during the maintenance operation.

In any case (automatic maintenance or not), it is needed that the operator is able to control the deployed radars and to diagnose an eventual failure.

Within the **PSR-500 Installer**, **PSR-500 Viewer** or **PSR-500 Server** applications, the status of all deployed equipment can be seen by opening the System Management -> Equipments Status menu:

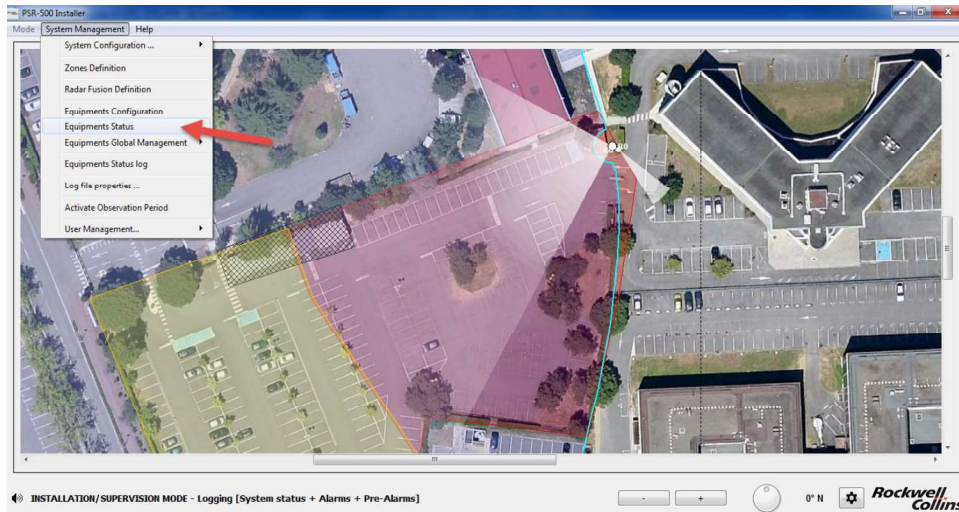


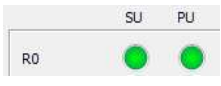
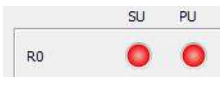
Figure 162 – Opening the window to check the status of all deployed equipments

In this window, let's focus on the « Radars » section. The statuses are indicated radar by radar, for its SU and its PU. The Alerte status indicated the alert state of this radar. The following picture presents an extract of this report.

Statut des Equipements			
Radars			
	SU	PU	Alerte
R0 (COF-0000:			
R1 (COF-0000:			
R2 (COF-0001:			
R3 (COF-0001:			
R4 (COF-0004:			
R5 (COF-0004:			
R6 (COF-0004:			
R7 (COF-0000:			

Figure 163 – Extract related to the radar status

- Scan the list to find any radar in failure. Several scenarios may happen :

Scenario	Diagnosis
	Nothing to Report. The radar is 100% operational.
	The radar is in default. The PU is facing a problem and can not communicate with the SU. See below.
	The radar is in default. The radar is facing a problem to get access to the PU. See below.

- When a radar is identified as in default, click on one of its indicators in order to identify precisely the exact reason of the defect.
- A new window opens giving acces to the detailed status of the radar. This is the network component properties configuration that we already used during the installation. This window contains also all the status associated with this radar.

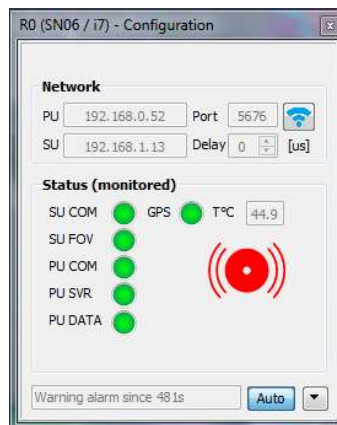
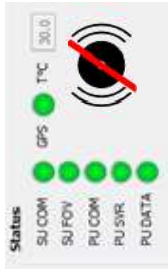
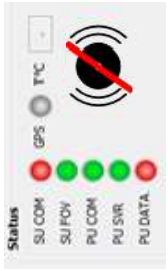
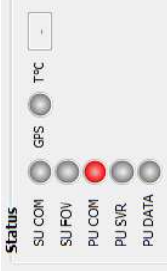


Figure 164 – Radar network properties configuration window

- Several scenario may occur:

Scenario	Diagnosis	Maintenance operation
	The associated radar is 100% operational.	Nothing to Report.
	The radar has a problem with the radar antenna (SU).	1/ Re- initialize the radar (see below) 2/ If 1 is OK, check the link between the SU and the PU 3/ If 1+2 is OK, check is the SU is correctly powered 4/ If 1+2+3 is OK, change the SU
	The radar has a problem with its PU.	1/ Re-initialize the radar
	The radar server can not communicate with the PU.	1/ Check the link between the radar and the application used for the diagnosis 2/ If 1 is OK, check that the PU is powered and up 3/ If 1+2 is OK, control the PU power supply 4/ If 1+2+3 is OK, replace the PU

How the re-initialize a radar?

- Power off the PU
- Power off the SU
- Power on the SU
- Power on the PU

To do so, you may use the maintenance network equipments or you may perform the operation manually. Following the re-initialization, the radar statuses may evolve as presented below:

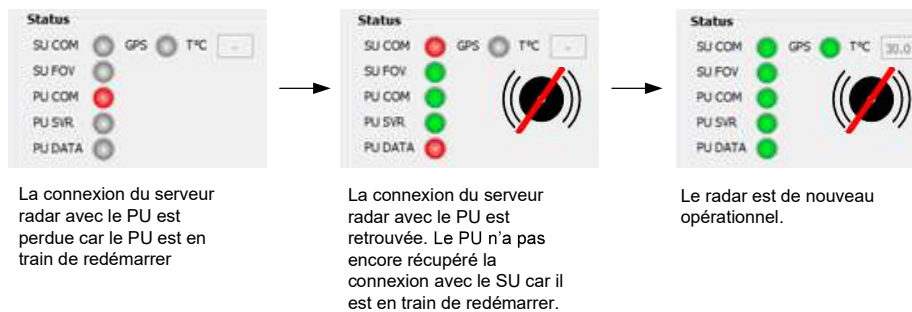


Figure 165 – Evolution of the radar statuses after re-initialization

9.3. Control the CCS modules status

Within the **PSR-500 Installer**, **PSR-500 Viewer** or **PSR-500 Server** applications, **Open the System Management -> Equipments Status** menu to check the status of all the PSR-500 system equipment deployed

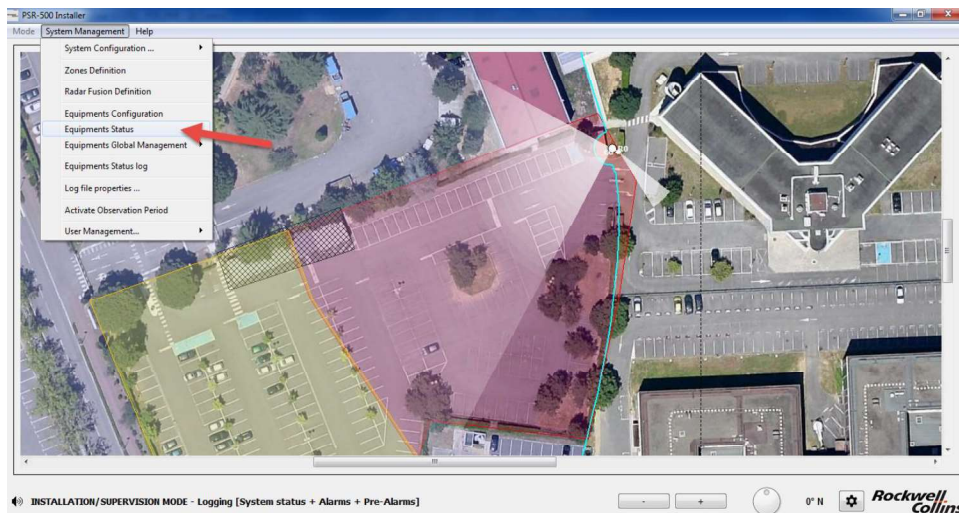
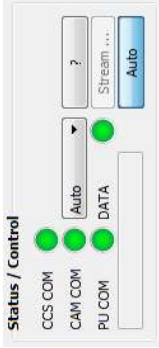
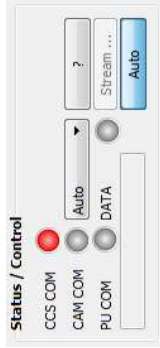
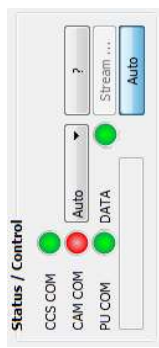
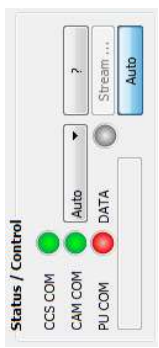


Figure 166 – Window showing the status of all the deployed equipments

In the window, we are going to focus on the Cameras section. Look over the list to find faulty radars. Several scenarios may happen:

Scenario	Diagnosis	Maintenance operation
	The status of the camera is 100% operational.	Si the camera does not move on the radar alerts or when the user click on the map in MAP mode, re-start the camera through its web page or through a hard reboot.
	The CCS module does not start.	Check the camera configuration and more particularly the « Controler » tab.
	The CCS module does not connect with the camera.	1/ Check the connection (physical/network) from the server hosting the application launching the CCS (PSR-500 Installer or PSR-500 Viewer) and the camera. 2/ If 1 is OK, check the camera configuration and more particularly the « Controler » tab.
	The CSS does not communicate with the radar.	1/ Check the connection (physical/network) from the server hosting the application launching the CCS (PSR-500 Installer or PSR-500 Viewer) and the radar. 2/ If 1 is OK, Check the radar/camera association in the camera installation properties configuration window.

9.4. Control the status of the data flow that comes out of the PSR-500 Server

The external client does not receive or does not receive anymore any message from the **PSR-500 Server**:

- Launch the test with the local web page on the server hosting the PSR-500 Server application (see section **Erreur ! Source du renvoi introuvable.**). Does the web page receive some CONFIG, STATUS, ALERTS or CAM_TRACKING_ACTIVITY messages?
 - Yes = the reception is thus possible locally by not remotely which may be due to a firewall problem → Authorized the PSR-500 application in the Windows firewall settings. (see section **Erreur ! Source du renvoi introuvable.**)
 - No = the reception is not possible locally
 - Case 1 = the answer FAILED is received during the authentication → check the user name and the password used to connect to the **PSR-500 Server**. Have they been correctly created in the **PSR-500 Server**?
 - Case 2 = no answer is displayed
 - Is the server module of the **PSR-500 Server** activated?
 - No = activate it
 - Yes = contact the support

9.5. Control the radar and/or camera alignment status

If the intruder is not correctly positioned on the background map:

- Control the calibration of the radar
- Control the map georeferencing

If the intruder is not correctly centered in the image:

- Control the calibration of the radar
- Control the calibration of the camera
 - Warning: Some COTS camera may drift after a certain period of operation. Before modifying the calibration properties of a camera, it is recommended to first re-start the camera.
 - The CCS module assumes that the terrain on which the PSR-500 is deployed is flat. If the terrain presents some relief (is not flat), since the CCS does not take into account, the radar alert may not be well positioned depending on the distance from the camera.

10. Annexes

10.1. Quick Installation Guide for the PSR-500

This guide is intended to be used as an installation checklist for a seasoned installation operator of the PSR-500 system. It is recommended to a new user to read the entire system installation document in order to get familiar with the concepts and operations described in the document.

- **Step 1** = Prepare the deployment system configuration with the **PSR-500 Installer**
 - Load and reference the background map
 - Define operating zone for the radars
 - Add, pre-position the radars and configure the network addresses
 - In option
 - Add, pre-position the cameras and configure the network addresses
 - Add and configure the maintenance network components
 - Generate the preliminary installation report
 - Perform a visit of the site and validate/update the installation
 - Add installation operators (if needed)
- **Step 2** = Install physically and start the radars
- **Step 3** = Define and validate the radar interoperability strategy
- **Step 4** = Align the radars and the cameras
- **Step 5** = Validate/update the installation and generate the final installation report
- **Step 6** = Deploy the **PSR-500 Server** on the « master » host
 - Transfer the system configuration as well as the background map prepared from the **PSR-500 Installer** toward the **PSR-500 Server**
 - Start the application and load the system configuration
 - Add and activate the server module
 - Add user to the server
 - Test that the server can be accessed
 - Add and configure the master/slave module as « master »
 - Save the new system configuration
 - Connect to all the equipments
 - Activate the observation period
- **Step 7** = Deploy the **PSR-500 Server** on the « slave » host
 - Transfer the entire folder from the **PSR-500 Server master** to the **PSR-500 Server slave** (to retrieve the system configuration and the authorized user list)

- Start the application and load the system configuration
 - Modify the configuration of the server module
 - Test that the server can be accessed
 - Modify the configuration of the master/slave module as « slave »
 - Save the new system configuration
 - Connect to all equipments
 - Activate the observation period
- **Step 8** = Investigate/optimize the performances