To be sure that the radar that is going to be used as the « spectrum analyzer » does not see any other radar of the PSR-500 system, we shall set the delay >=40us.
To be able to set « delay », the PSR-500 Installer application shall be disconnected to the radar.

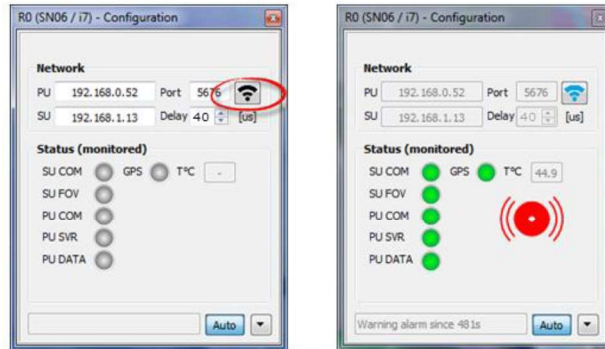-   Once the delay set, click on the button to connect to the PU associated with the radar :

Figure 113: Connection to the PU of a radar

-   Since the delay value has been modified, the **PSR-500 Installer** application automatically detect that the PU shall be updated.
-   The following window opens automatically.

Figure 114: Configuration alignment window

-   Click on "Send to Radar PU" to update the PU configuration.
-   After few seconds, the PU is updated.

Finally, the following steps shall be followed so that the synchronization instruction is received and taken into consideration by the SU:
-   Power off the PU
-   Power off the SU
-   Power on the SU
-   Power on the PU

The PSR-500 Installer application loses its connection with the radar and retrieves it after one minute. The radar now has taken into account its new synchronization instruction.

Note: the AUTO button, on the bottom of the window that allow the connection to the radar, when checked, enables the application to automatically retry to connect to the radar every 10 seconds when the connection is lost. If uncheck, this automatic re-connection is not performed anymore.

Now that we set the radar delay to a value >= 40us, if the radio environment is clean, i.e. if there is no jammer in the operating frequency band of the radar, then no interference shall be received.

Click on « System Management -> Activate Observation Period" to activate the observation period.

Figure 115: PSR-500 Installer – Activate observation period

- A new gauge appears in the radar configuration window. This gauge indicates the level of interference received by this radar. When this level is higher than 2%, the SU is jammer.
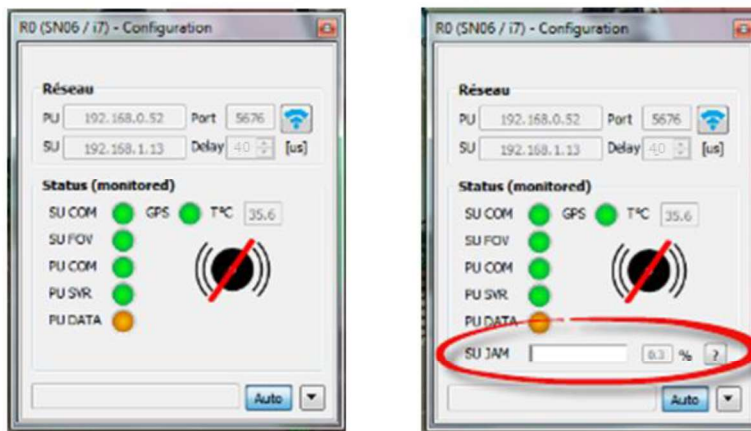

Figure 116 - "interference" gauge

- The level shall be stable and below 2%

    o If this is the case, we can proceed with the radar interoperability setting.
    o If this is not the case, it means that there is a jammer in the oepration frequency band of the PSR-500 radars. It shall be identified and power down otherwise the PSR-500 system will be ineffective.

6.3.3. Radar interoperability setting

6.3.3.1. General principle

The minimum « delay » between any two radars is 15us. Nevertheless, if the radars are installed too close to each other, the value shall be set to a higher value.
In his first system configuration, the operator can start so that all radars are shifted by 15us one to others.

After this first configuration, we then synchronize the radars, validate the predefined synchronization strategy and possibly modify it.

The operator shall proceed radar by radar:

- Start by a radar whose delay is higher than 40us and then turn on the deployed radars until ending by the radars whose delay is lower than 40us.
- For each radar, the user shall set the synchronization instruction as described in the previous chapter and check that no interference is received once applied.
    - If this is the case, go to the next radar.
    - If this is not the case, it means that the predefined synchronization strategy is to optimistic, i.e. that the radar are too closed to each other's. You shall iterate by step of 5us until reaching a delay value where there is no interference anymore.

Note: With the minimum delay of 15us, 40 radars can be operated simultaneously. Nevertheless, it may be some deployment situation where this delay can be farther reduced, even be the same if the radars are physically isolated, i.e. two radars on two sides (north and south) of a same big site. In such a situation, the number of radars that can operate simultaneously on the same site can be increased.

Note: If a radar is jammed, it means that it is also jamming another one. If a radar is not jammed, it means that it is not jamming another radar neither.

6.4. Alignment

Once we reach this step, we consider that the interoperability is configured and verified. The radars are in nominal operational configuration and are not jamming each other's. The following steps cannot be performed if the radar interoperability has not been correctly configured.

6.4.1. Alignment of a radar

The objective of this step is to update the radar installation properties so that radar alerts are correctly geo-localized. To do so, we are going to ensure that the positions of the alerts on the map are in coherence with their real position.

Depending on where was the deployment, you have two options:

Option #1: the **PSR-500 Installer** is not closed. Click on the bottom left button « Next step: Radar(s) alignment operation…" to start the calibration phase.
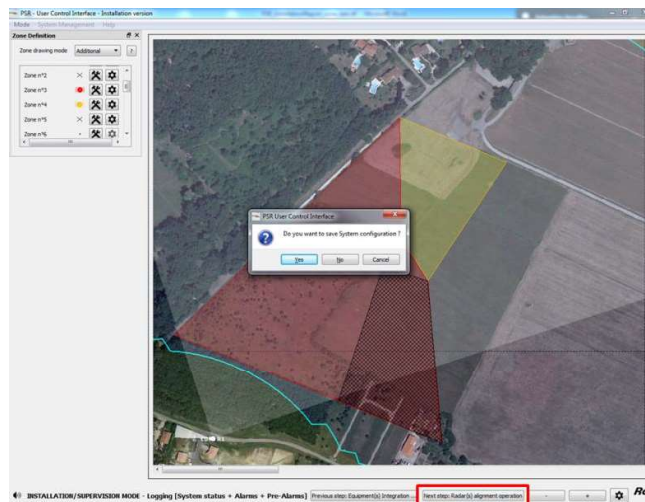

Figure 117: PSR-500 Installer – "Next step: Radar(s) alignment operation" button

Option #2: the **PSR-500 Installer** is closed.
- Start the **PSR-500 Installer** application
- The Authentification window opens

Figure 118 – PSR-500 Installer – Authentification window

- Enter the default password
- Click on « Update … » :

Figure 119: PSR-500 Installer – « Update … » button

- Select the System Configuration you would like to update
- Select « Radar(s) alignment procedure »

Figure 120: PSR-500 Installer –« Radar(s) alignment procedure »
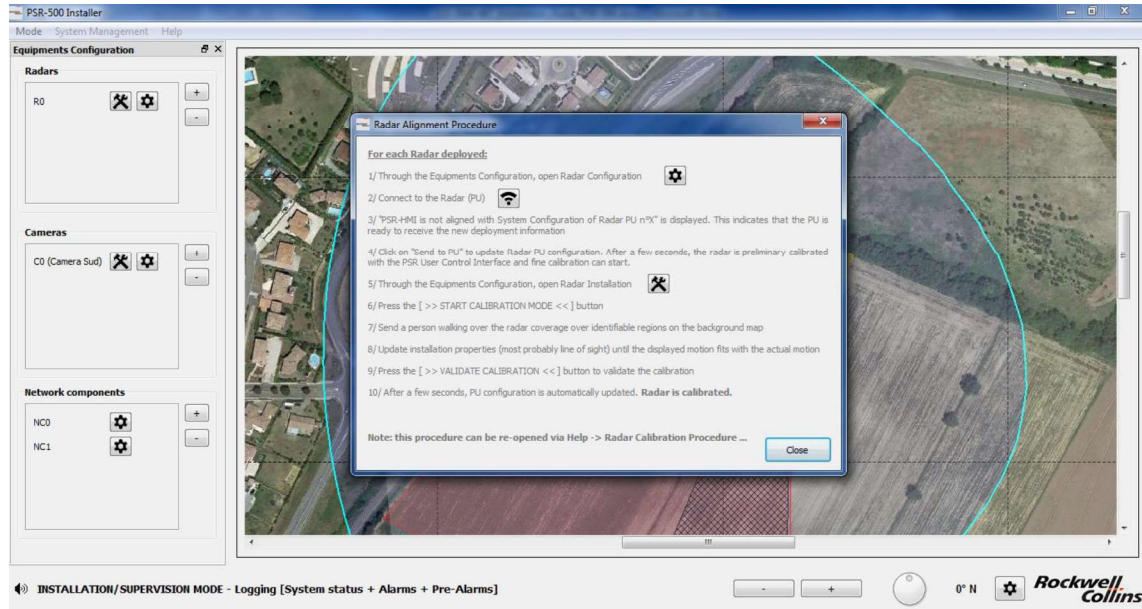
The following window automatically opens.

Figure 121: PSR-500 Installer – Alignment procedure window

We will now pursue with Option#2.

Note: Option#1 is the same except that at the end of each step, you have the bottom buttons that guide you to switch to the next phase up to the Final Installation Report generation.

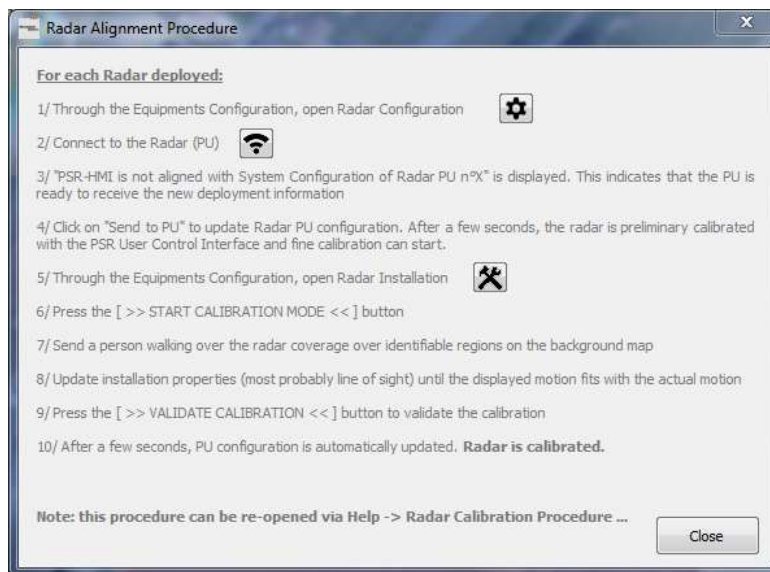After clicking on « Radar(s) alignment procedure » button, the following window appears:

Figure 122: Procédure d'alignement radar

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To perform radar calibration, the operator shall follow the 10 steps described in the procedure.

The procedure ensures that the alerts raised oar the radar fit with the background map. For example, if an « intruder » walks along the road, it shall appear along the same road on the background map. This correlation is essential for the system since the camera will also be aligned based on the background map. The background map is the common reference shared by all the sensors of the PSR-500 system.

Note: This procedure can be access anytime in the **PSR-500 Installer.** Click on « Help » tab on the menu bar and then click on « Radar Calibration Procedure …», cf. following picture:

Figure 123: Radar calibration procedure through the Help menu

Note: this procedure shall be performed for each radar.

Note: It is recommended to use a target with a high reflectivity to align the radar so that radar mismeasurement does not influence the calibration procedure. A very slow car or a pedestrian with a reflector are example of a good target. It is also recommended that the target follow a path that can be easily identifiable on the map.

Note: During the calibration phase, when the target is moving on the radar coverage, it is possible to modify the radar installation properties :
- Move the radar directly on the map if its GPS position is wrong
- Modify its GPS coordinates its height, its line of sight and its tilt directly in the radar installation properties window (either by entering new values or by using the arrow to increase or decrease the values step by step).
- Modify its line of sight using the North, East, South, West rotary wheel:
    o Click on it, keep it pressed and move the mouse
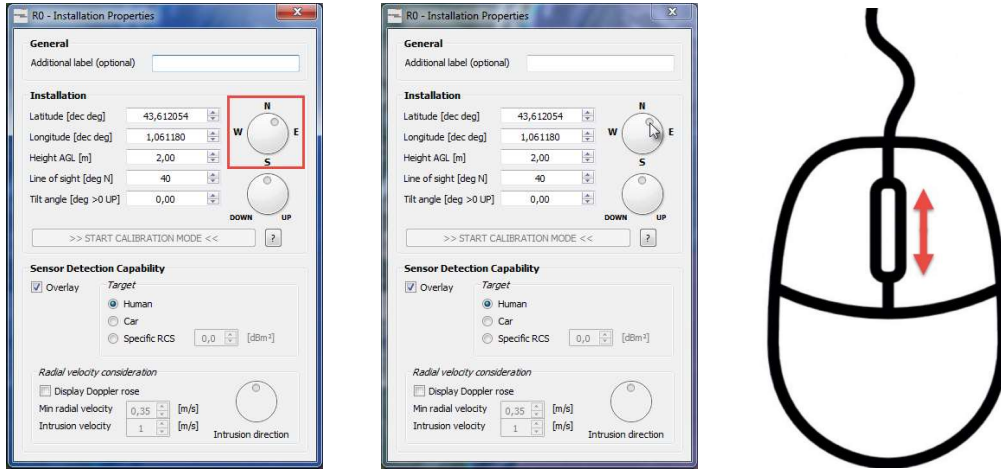   o Putting the mouse over it and using the mouse scroll (maximum precision)

Figure 124 – Handling during radar alignment

- The same handling scan be use to adjust the radar tilt with the DOWN/UP rotary wheel

Note: when calibration mode is activated, when the installation properties are modified, the radar information is automatically updated in real time on the display of the application as shown in the example below:

Figure 125 – Radar installation properties modification effect during radar calibration phase

Note: the user can observe that when he is connected to the radar, the installation properties can only be modified when the calibration mode is activated.

Note: If the operator does not have any background map to align the radar (in the desert for instance), the camera will only be aligned with the radar as explained below.

6.4.2. Camera Alignement and standby position setting

6.4.2.1.   Camera alignment

The objective of this step is to update the camera installation properties so that the camera pointing fits with the alerts. Once this will be performed, since the radar is already aligned, the associated camera will then be aligned with the alerts raised by the radar.

The following steps shall be performed for each camera (each CCS):

- Open the camera calibration procedure through the « Help » tab of the menu bar, then click on « Camera Calibration Procedure … », as illustrated by the following figure:
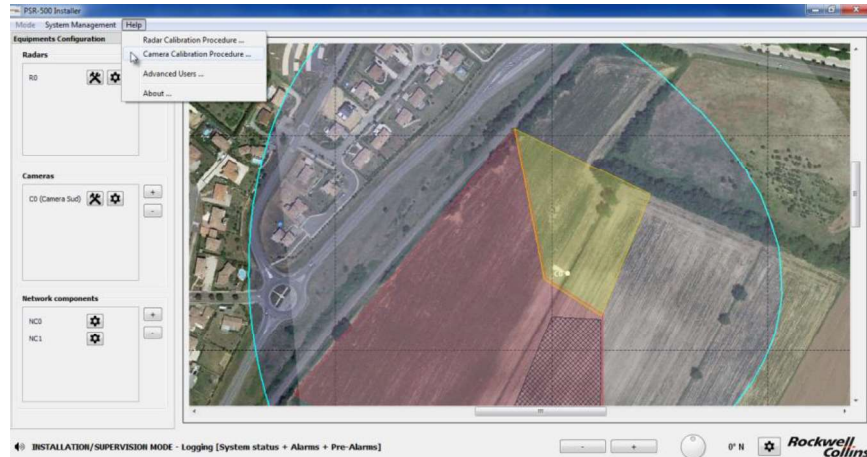
Figure 126 – Open the Camera calibration procedure

- The following window automatically opens

Figure 127 – Camera alignment procedure

The 10 steps shall be performed to correctly calibrate the camera.

This procedure consists in ensuring that the camera knows its position of reference and point toward the requested direction. If possible, the user will prefer remarkable positions over the map. If remarkable position are not available (desert zone for instance), the user will rely on a cooperative intruder that is static on the radar coverage zone.

To connect to the camera, click on the button with the gear at the right of the camera to align.

Figure 128 – Open the camera connection window

The Control Camera Software module is automatically launched and the connection window is updated as illustrated below:
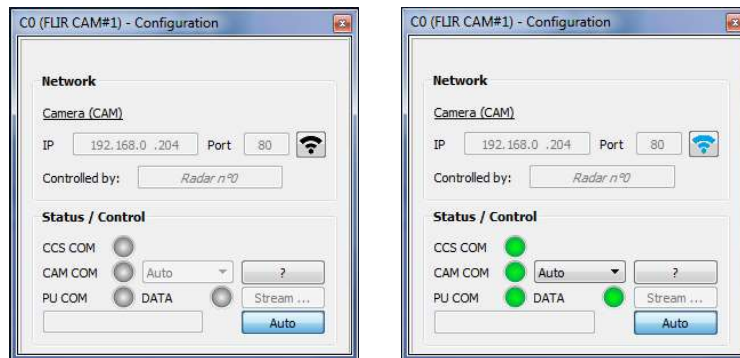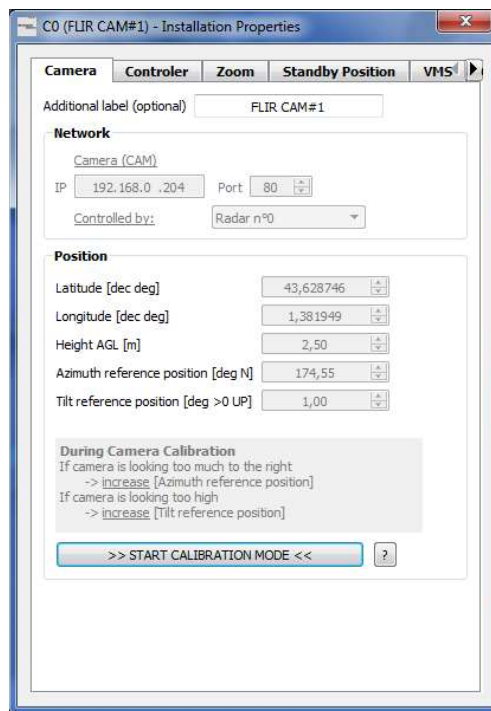

Figure 129 – Connection to the camera

- CCS COM = indicate the CCS module status
- CAM COM = indicate the status of the connection with the IP camera
- PU COM = Indicate the status of the connection from the CSS to the radar (PU)
  - o DATA = if green, indicate that there is traffic exchanged between the radar and the CSS.

Click on the button (as shown below) to open the camera installation properties modification window.
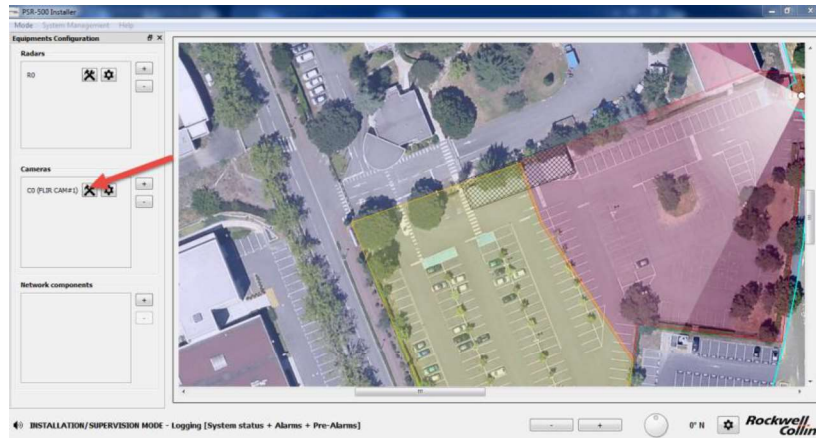
Figure 130 - Ouverture de la fenêtre de configuration des propriétés

The following window opens; the « << START CALIBRATION MODE >> is clickable.

Figure 131 – Camera Installation properties window when a camera is connected

Note: the operator does not need to be connected to the radar to align the camera. The two sensors are aligned based on the background map, in a totally independent way.

As described in the procedure, to be able to align the camera, we shall display the camera video stream. To do so, several solutions are available.

The recommended solution is to use the camera web page. Enter http://adresse_IP_camera in a web browser.
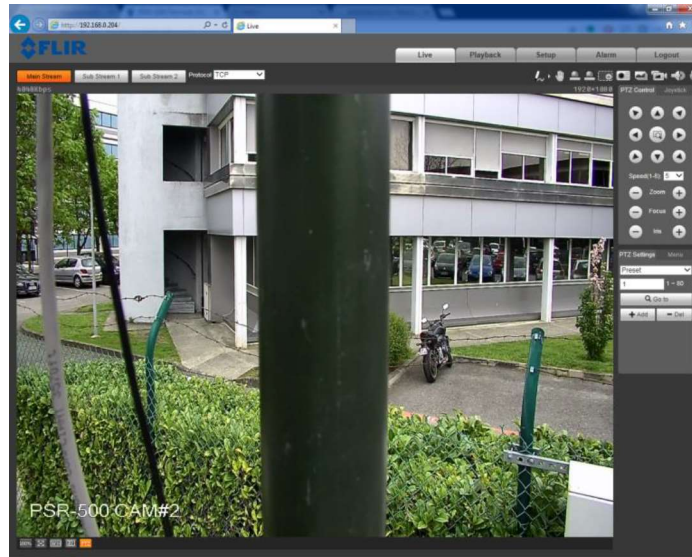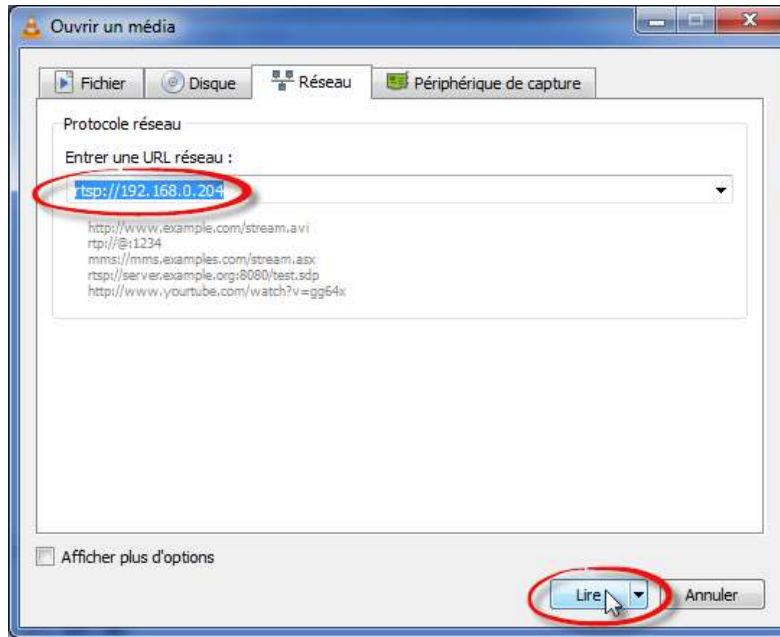
Figure 132 – Example of an IP camera web page

The other solution is to use VLC application. This solution induces a more important latency than the previous one. To use VLC::
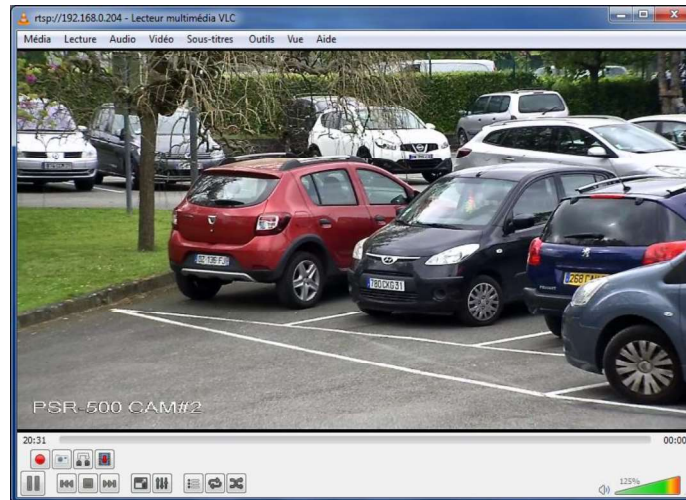
- Start VLC application
- Through the « Media » menu, Click on « Open a network stream … »
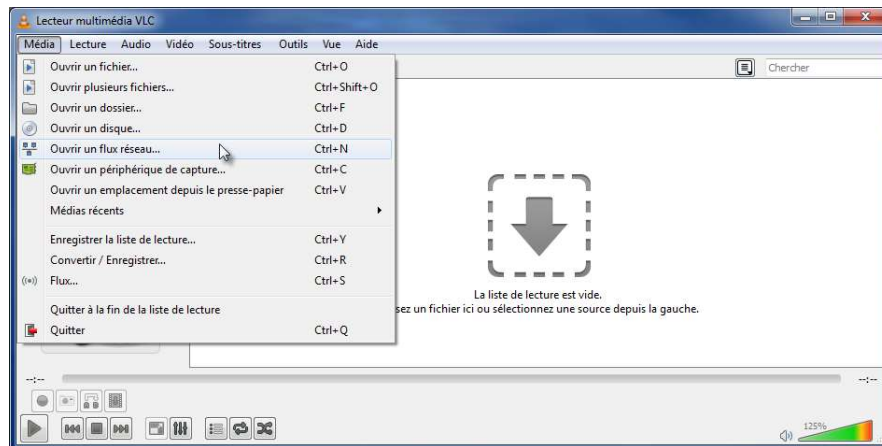
- In the « network» tab, enter the URL of the camera video stream and click on "Read"

- VLS displays the camera video stream

- Click on « view » and then « Minimal Interface » or CTRL+H to keep only the video stream on the screen

By default VLC does not remain on top. To do so and be able to maintain both the **PSR-500 Installer** and the video stream on the screen, use an application such as the DeskPins software. Start DeskPins, click on « Enter pin mode » then move the pin to the VLC window and left click on VLC window top menu bar. VLC will now remain on top of the screen.
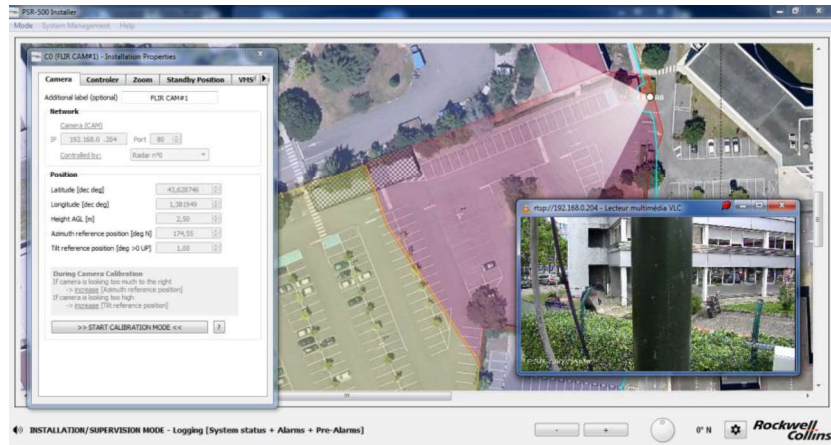
Figure 133 – DeskPins use

To calibrate the camera :

- In the camera installation properties window, click on >> START CALIBRATION MODE <<. The camera is no more controlled by the radar but by the user's click on the map.
- Select a point of interest on the map with the mouse. The selected point of interest is marked on screen by the yellow cross. In the following example, the point of interest is the angle of a building.

Figure 134 – Selection of a point of interest

- The CCS module is using its current position of reference azimut and tilt settings to steer the camera to the point of reference chosen by the user. By default, the camera is not centered to the good position.
- Adjust « Azimuth reference position » and « Tilt reference position » values until the camera image is centered on the point of reference:
    o If the camera is too much on the right, increase the « Azimuth reference position » and decrease it if too much on the left.
    o If the camera is steered too high above the target, increase the « Tilt reference position » and decrease it if the camera is steered too much to the ground.

Figure 135: Adjust camera installation properties

- When the point of interest is centered in the camera video stream, click on >> VALIDATE CALIBRATION << in the camera installation properties window to validate the calibration. Our point of interest is well centered in the camera video stream.
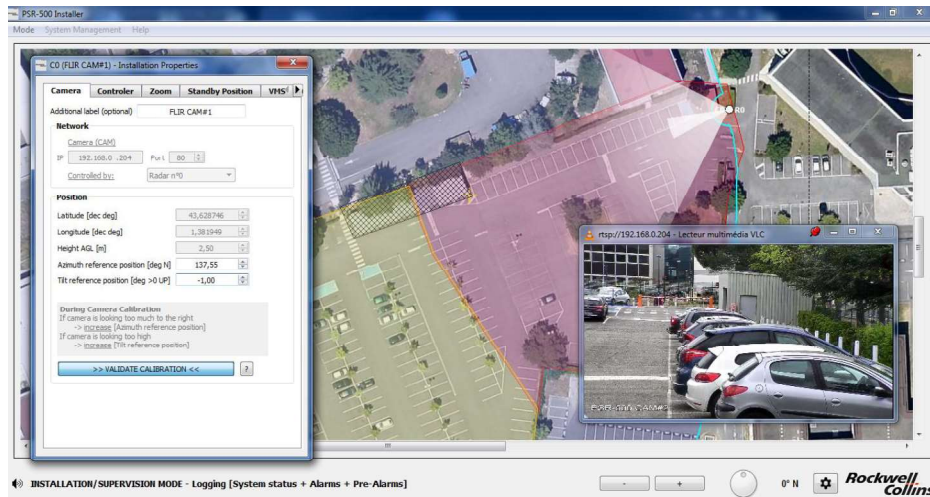
Figure 136: Center camera image on the point of interest

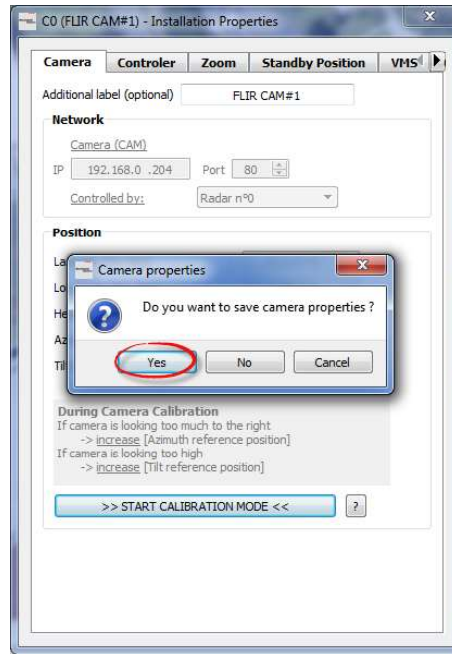- Close the camera installation properties window and click on save.

Figure 137 – Save the camera installation properties

6.4.2.2. Camera standby position setting

To set the camera standby position, open the camera installation properties window and open the « Standby Position » tab.
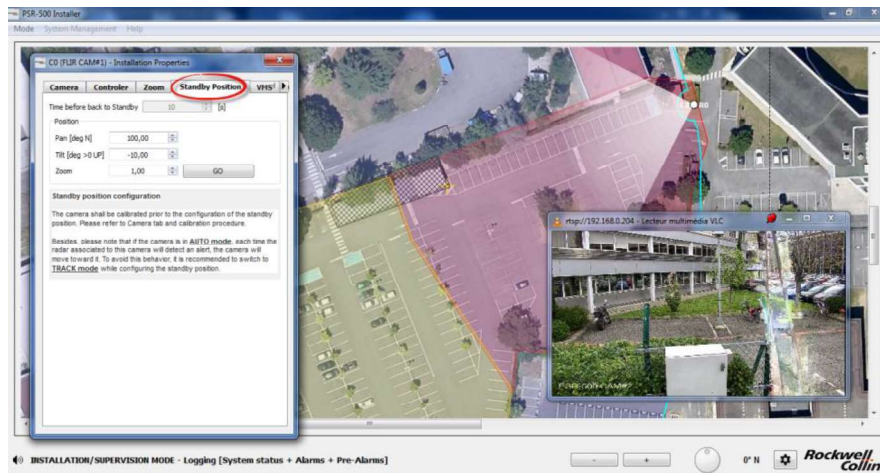

Figure 138 - Camera "Standby position" tab

- As mentioned in the window, to be able to set the camera standby position, it is essential that the camera has previously been aligned following the procedure described above.
- By default, the CCS module is in AUTO mode. The CSS module proposes several modes:

- o **AUTO** = the camera will point toward each alert raised by the associated radar one after another, based on the policy defined during the installation in the Controller tab.
  - o **MAP** = the camera points to the position indicated by the user on the map.
  - o **TRACK** = the camera track an alert designated by the user (by clicking on the alert)
  - o **PTZ** = the camera point to a fixed PTZ order.

- It is recommended to set the CCS mode to TRACK during the camera standby position setting. Open the camera connection window as explained previously, select the TRACK mode in the dedicated drop-down menu.
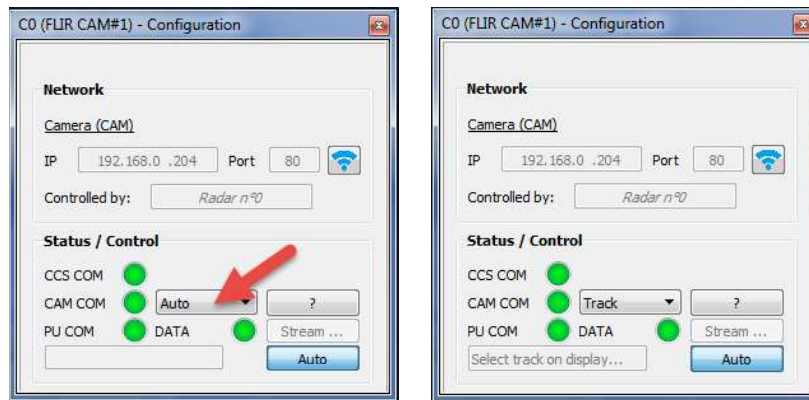

Figure 139 - Selection of the TRACK mode

- In the camera installation properties window, modify the standby position setting the pan, Tilt and zoom values. Each time a value is modified, the camera update its real position automatically so that the user is able to see its new position. As indicated in the window,:
  - o The PAN standby position is defined with respect to the geographical North (clockwise)
  - o The TILT standby position is defined with respect to the horizontal (positive value toward the top)
- Once the standby position set, the CCS mode can be set back to AUTO. The camera will get back to this standby position automatically as soon as there is no alert on the associated radar coverage.

Note: All the grey fields of the camera installation properties modification window are only accessible when the application is not connected to the camera. To modify them, use the camera connection window. If these fields are modified, it is necessary to close the camera installation properties modification window, and same them. These new values will be taken into account at the next connection to the camera.

When the application is connected to the radar and to the camera(s) associated to this radar, as soon as an alert is raised, the camera is steered toward the alert. On the application, the alert currently tracked by the camera is identified through an additional icon and the camera field of view representation is also turned toward the alert.
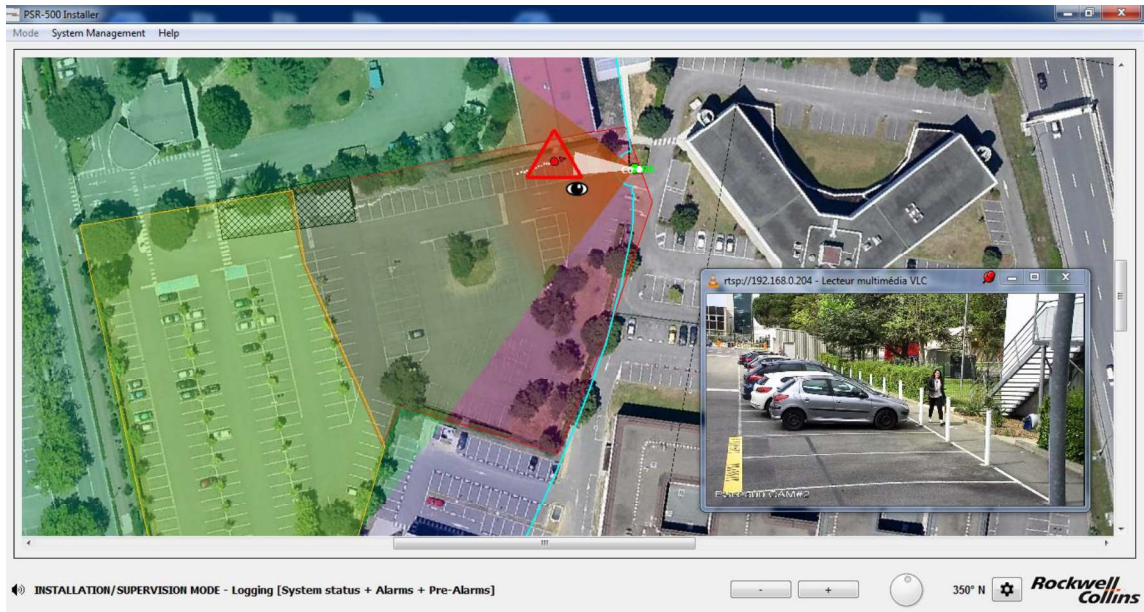
Figure 140 - Identification of an alert tracked by a camera