

THREOD SYSTEMS CONFIDENTIAL



# ORCA-130 A03 USER MANUAL

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# APPROVAL

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## ABBREVIATIONS AND ACRONYMS

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Beidou	:	GNSS constellation operated by the People's Republic of China
EO	:	Electro optical TV camera
Galileo	:	GNSS constellation operated by the European Union
GLONASS	:	GNSS constellation operated by the Russian Federation
GNSS	:	Global Navigation Satellite System
GPS	:	GNSS constellation operated by the USA
HDTV	:	High-definition image with a resolution of 1920x1080 pixels
INS	:	Inertial Navigation System
ISR	:	Intelligence, Surveillance, Reconnaissance
LWIR	:	Long Wave Infrared Camera
MS	:	Mission Software
POI	:	Point of Interest
SBAS	:	Satellite-based augmentation system, a technology to enhance GNSS accuracy
UTC	:	Coordinated Universal Time
VSS	:	Video Server Software

# 1. DESCRIPTION

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Orca-130 gimbal is a dual axis gyro stabilized optical sensor platform for performing intelligence, surveillance, and reconnaissance (ISR) tasks. Orca integrates HDTV EO and LWIR thermal into a single compact and light package.

The stabilization actuation is performed by direct drive brushless motors. The use of direct drive brushless motors ensures accurate stabilization by allowing for a high torque output while avoiding the inevitable backlash of a geared motor solution.

Orca gimbal incorporates an onboard video processor. The benefits of on-board video processing include improved stabilization with the best possible video quality and the lowest latency. The video processor also features additional capabilities such as scene and object tracking, image enhancement, symbology display, on-board snapshots, and recording.

Mission Software allows the observer to perform critical mission tasks such as controlling the gimbal and sensors using a dedicated hand controller, displaying, and analyzing the video feed, creating intelligence reports, and performing artillery fire correction.

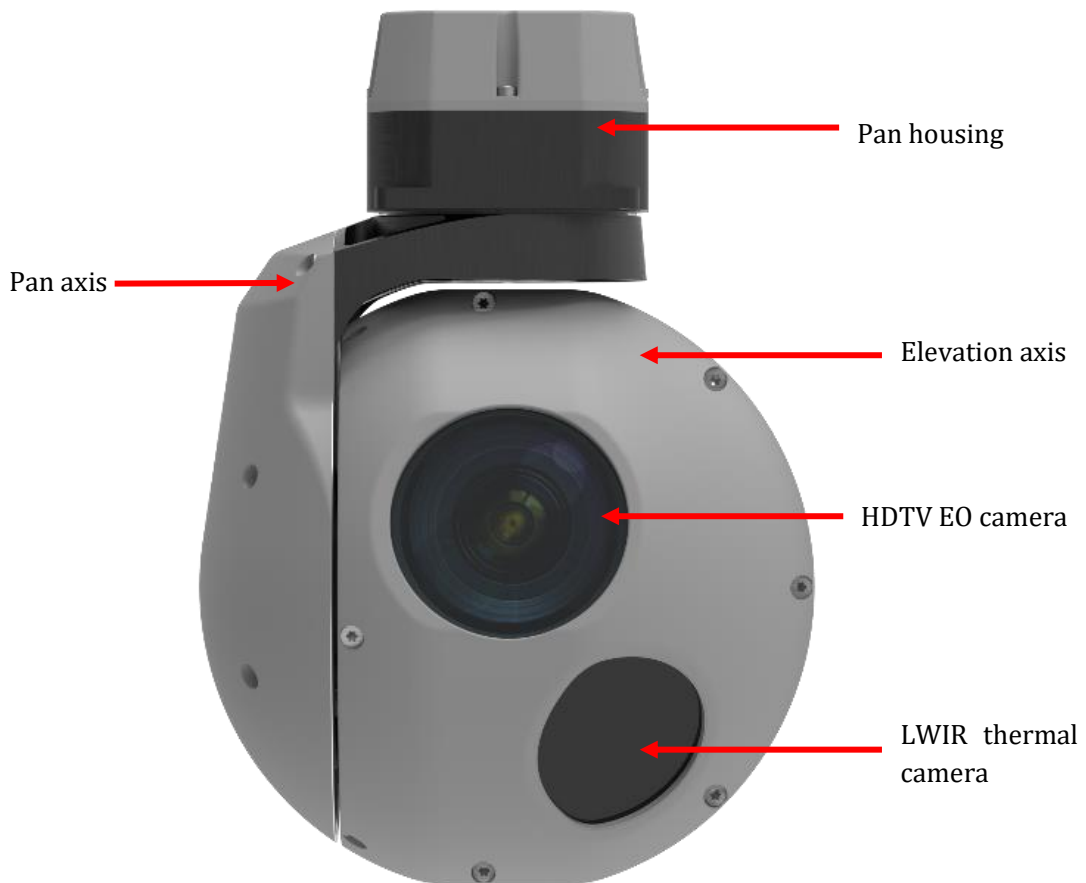


Figure 1: Orca 130 A03 Front view

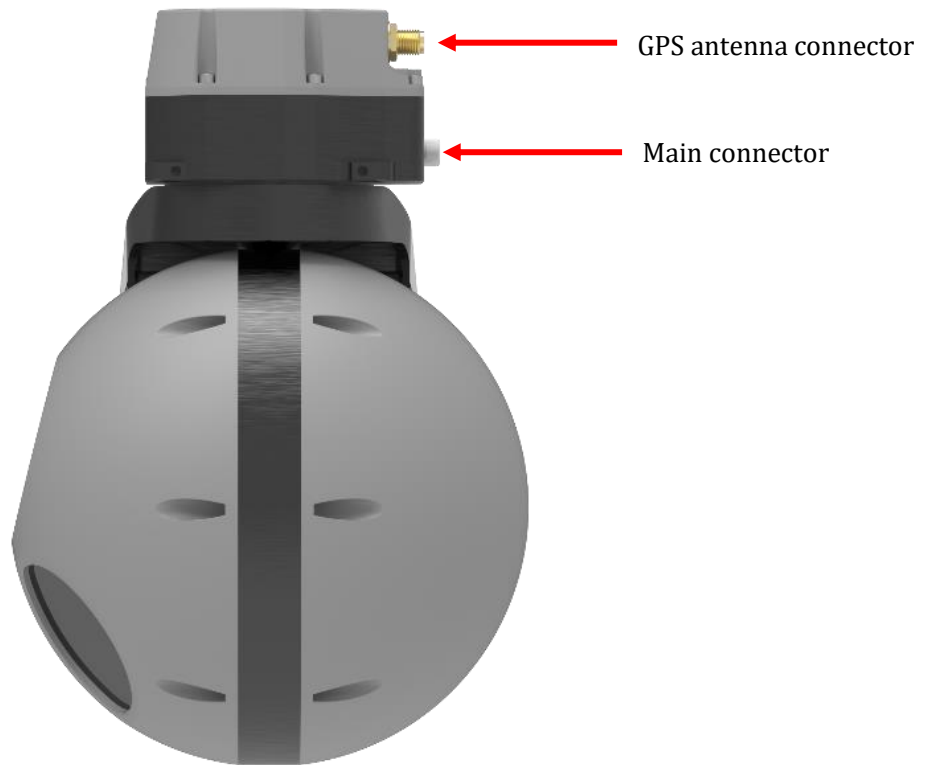


Figure 2: Orca 130 A03 Side view

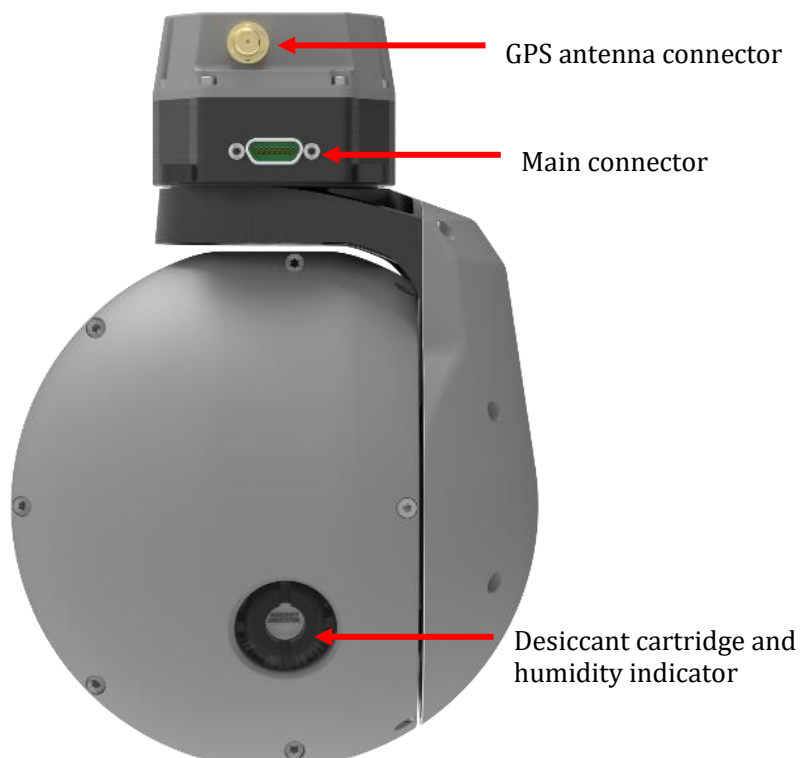


Figure 3: Orca 130 A03 Rear view



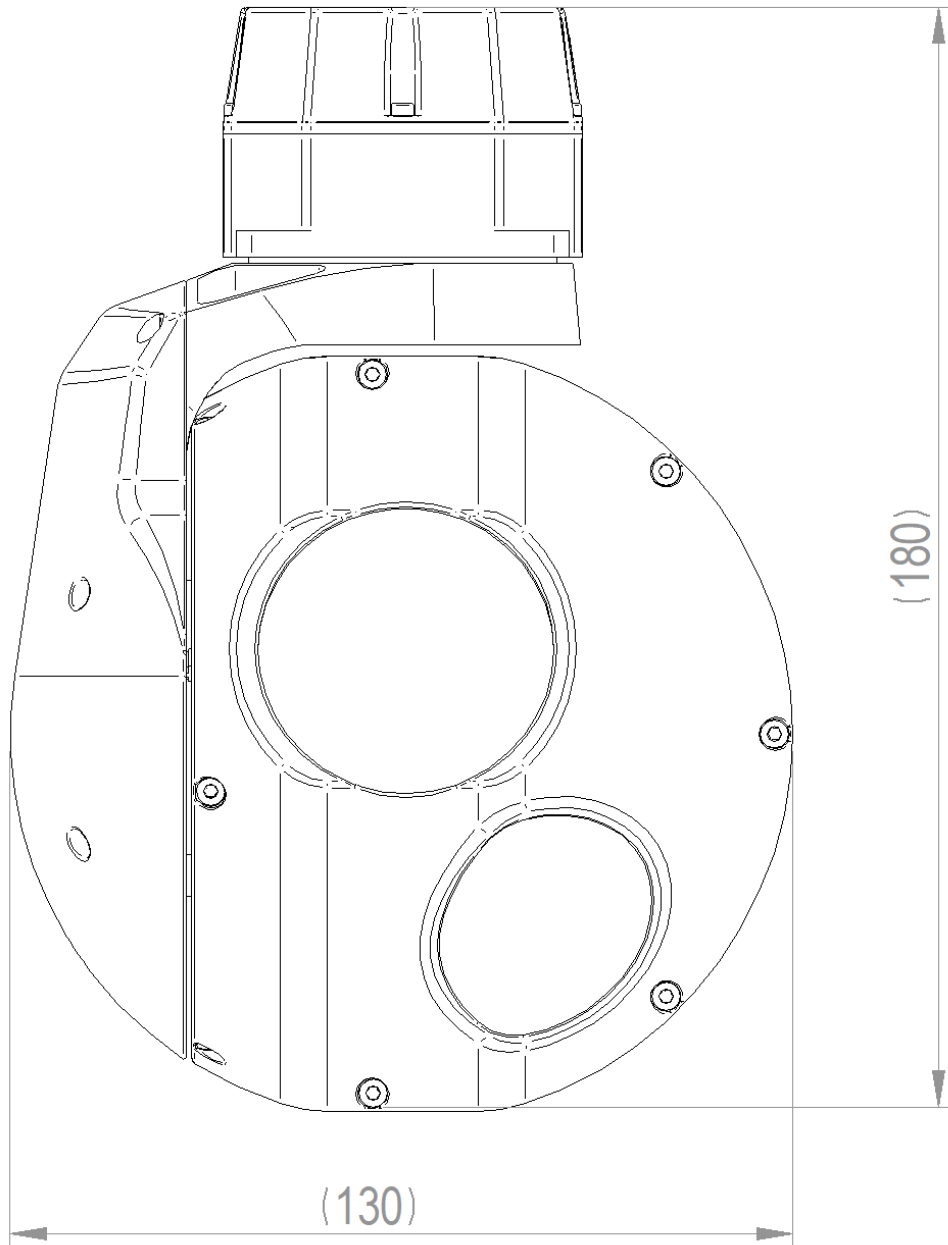


Figure 4: Orca 130 A03 Gimbal dimensions

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## 2. SPECIFICATION

Table 1: Orca gimbal general specifications

GENERAL	
<b>Weight</b>	1.1 kg
<b>Dimensions (D x H)</b>	130 x 174 mm
<b>Supply Voltage</b>	18 – 30 VDC
<b>Current Draw</b>	25 W nominal, peak 45 W
<b>Temperature</b>	-20°C to +50°C (sustained operation when airflow is present)
<b>Altitude</b>	5000 m / 16,000 ft AMSL
<b>Airspeed</b>	200 km/h / 108 KTS
<b>Sensors</b>	HDTV EO camera, LWIR thermal camera
<b>Pan Axis</b>	360° continuous
<b>Tilt Axis</b>	+30° to -110°
<b>Stabilization</b>	Gyro-stabilization in pan and tilt axes Electronic stabilization in roll axis

Table 2: LWIR thermal camera specifications

LWIR THERMAL CAMERA	
<b>Type</b>	Uncooled long wave infrared sensor (LWIR)
<b>Sensor</b>	Uncooled Vox Microbolometer
<b>Resolution</b>	640 x 512 pixels
<b>Pixel Pitch</b>	12 µm
<b>Spectral Range</b>	Between 7 and 14 µm
<b>Lens Aperture</b>	F 1.0
<b>Focal Length</b>	24 mm
<b>Field of View</b>	18° <i>(Equivalent to 35mm in previous generation LWIR cameras such as FLIR Tau2)</i>
<b>Digital Zoom</b>	1 – 8X <i>(continuous)</i>
<b>NETD</b>	40, 50, 60mK <i>(options)</i>
<b>DRI Human</b>	Detect: 1280 m / Recognize: 320 m / Identify: 160 m
<b>DRI Vehicle/NATO</b>	Detect: 3850 m / Recognize: 950 m / Identify: 295 m

Table 3: HDTV EO camera specifications

HDTV EO CAMERA	
<b>Sensor</b>	1/2.8 CMOS
<b>Resolution</b>	1920 x 1080 pixels
<b>Wavelength</b>	Visible + NIR
<b>Lens Aperture</b>	F 1.6 – 4.7
<b>Focal Length</b>	4.3 - 129 mm
<b>Lens Diameter</b>	37 mm
<b>Field of View</b>	63.7° - 2.3°
<b>Optical Zoom Factor</b>	1 – 30X <i>(Continuous optical)</i>
<b>Digital Zoom</b>	1 – 3X <i>(Continuous digital)</i>
<b>Frame Rate</b>	Up to 30Hz
<b>Sensitivity (Visible)</b>	0.01 lx @ 30Hz, 0.0013 lx @ 4 Hz
<b>Sensitivity (NIR)</b>	0.0015 lx @ 30 Hz, 0.0008 lx @ 4 Hz <i>(Low light/night mode with infrared filter off)</i>
<b>DRI Human</b>	Detect: 14 km / Recognize: 6 km / Identify: 2.5 km
<b>DRI Vehicle/NATO</b>	Detect: 22 km / Recognize: 12 km / Identify: 6 km

Table 4: INS Specification

INS	
<b>Heading Accuracy</b>	0.2° <i>(Dynamic while GPS locked and tracking)</i>
<b>Pitch/Roll Accuracy</b>	0.03° <i>(Dynamic while GPS locked and tracking)</i>
<b>GPS</b>	GPS L1, Galileo, SBAS <i>(Other constellations disabled, can be enabled on request)</i>
<b>Horizontal Position Accuracy</b>	± 1 m RMS <i>(Dependent on SBAS, clear view of GNSS satellites, good multipath environment, compatible GNSS antenna, and measurement duration period)</i>
<b>Vertical Position Accuracy</b>	± 1.5 m RMS <i>(Dependent on SBAS, clear view of GNSS satellites, good multipath environment, compatible GNSS antenna, and measurement duration period)</i>

Table 5: Standards

STANDARDS	
<b>Environmental</b>	MIL-STD-810G
<b>Video Encoding</b>	MPEG4 AVC (Advanced Video Codec) H.264 MPEGH HEVC (High Efficiency Video Coding) H.265
<b>Metadata</b>	STANAG 4609 (KLV, FMV)
<b>Video Stream</b>	MPEG-TS
<b>Integration</b>	STANAG 4703 AEP-83 <i>(Designed to be compatible with and to be integrated into platforms which comply with the above standard when applicable to payloads)</i>

Table 6: Interfaces

INTERFACE	
<b>Video Output and Control</b>	Ethernet 100Mbit/s
<b>Secondary Control</b>	Serial TTL, 500kbit/s

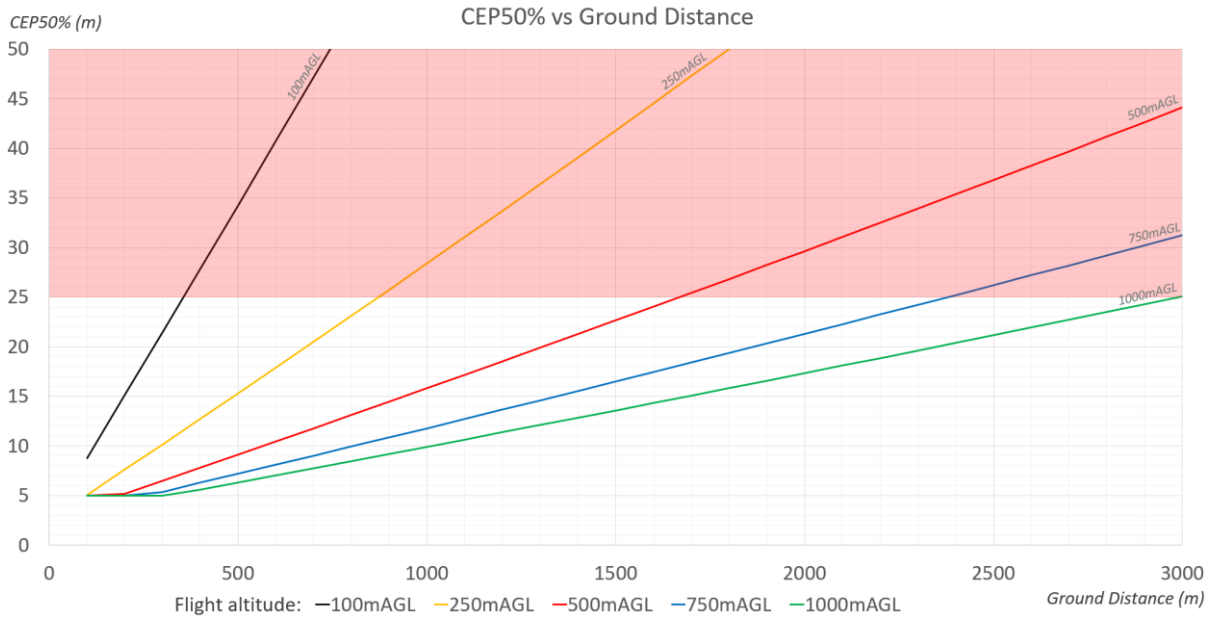


Figure 5: CEP 50% (Circular Error Probability) vs ground distance, maximum errors

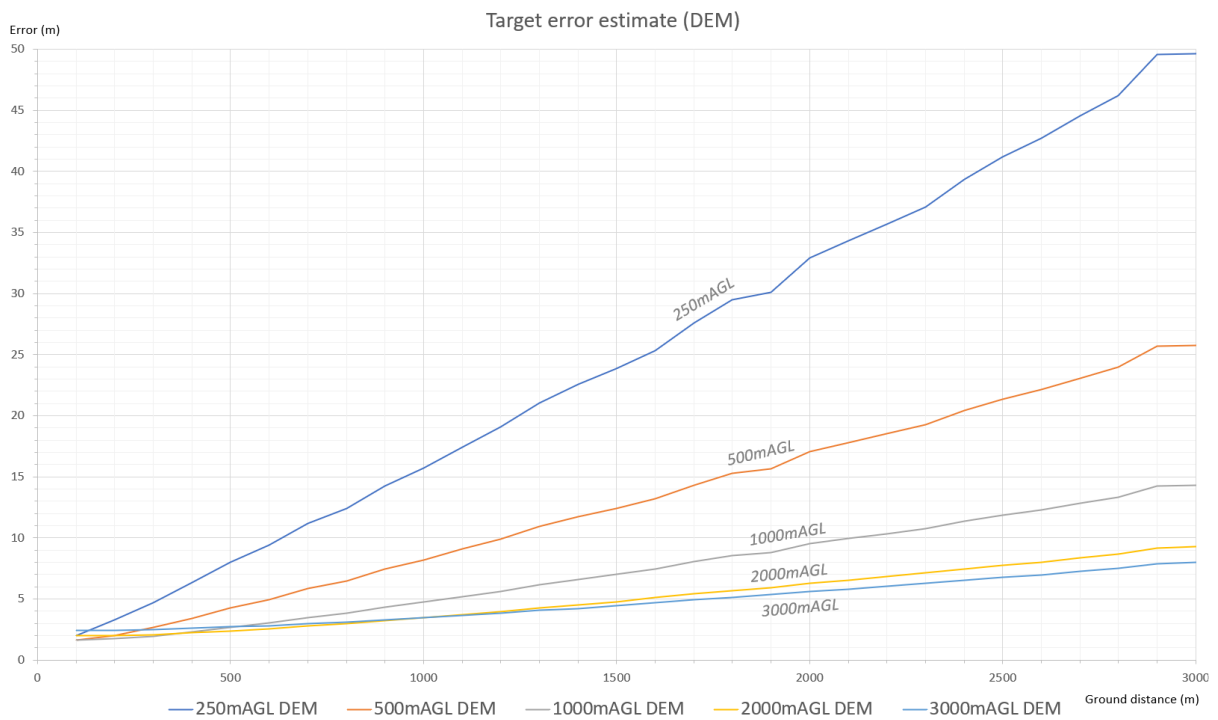


Figure 6: Randomized and averaged errors vs ground distance

Please note that the accuracy charts are valid only when the INS and GPS are in tracking mode and the solution accuracy is nominal!

### 3. HANDLING

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Orca gimbal is delivered in a dedicated shipping and transportation case. The Orca gimbal shall always be transported using the dedicated transportation case to protect the gimbal.

When unpacking the Orca gimbal, inspect the gimbal for any damage and ensure both the pan and elevation axis moves freely. It is recommended to directly mount the gimbal to the carrier platform or a suitable test stand after the gimbal has been removed from the transport case. The gimbal can be mounted to the test stand on an angle.

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## 4. COMMUNICATION

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Table 7: Orca-130 gimbal default IP addresses

<b>Command and Control interface</b>	10.101.1.11:43330 (UDP)
<b>Responses sent by gimbal</b>	224.1.1.10:43331 (multicast)
<b>Video (MPEG-TS H.264 with embedded KLV metadata)</b>	224.1.1.10:15004 (multicast)
<b>FTP Access to SD card (recordings and snapshots)</b>	10.101.1.11 (username & password: slroot)

The gimbal accepts control packets from the GCS (Ground Control Station) on UDP port 43330, and accepts packets sent over the UART interface. Responses from the gimbal to the GCS are sent over multicast to 224.1.1.10:43331, or via the UART interface, depending on which interface (ethernet or UART) was last used for the communicate with the gimbal.

Detail information regarding the communication with the gimbal is described in the ICD document, number 304-409-110579-01-10.



Contact Threod Systems via e-mail, [support@threod.com](mailto:support@threod.com), if you require a different IP address configuration.

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## 5. OPERATION

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### 5.1 BOOTUP

Immediately after applying power to the Orca-130 avoid any movement of the camera. During power-on the system will perform an automated self-check by first slowly moving both axes to its internal zero reference and then calibrates its gyro bias by accumulating a series of readings. After this process is complete the gimbal will alert the user with a distinct beep sound. During the initialization process the camera is in operating mode INIT as indicated on the on-screen display (see 5.2 On-Screen Display).

When the self-test is unsuccessful the Orca-130 will beep thrice during the boot-up sequence and an ERR operating mode will be visible on the on-screen display.

After a successful boot-up sequence the gimbal will start acquiring a GNSS signal (GPS, Galileo, GLONASS or Beidou as configured by the operator). Before valid time information is received from the satellites the on-screen display shows a date of 1970-01-01 00:00:00Z. After time information is decoded by the GNSS receiver the gimbal will display current time in Coordinate Universal Time (UTC).

The number of actively tracked space vehicles is displayed by the SAT field. A maximum of 16 SV-s will be used by the INS for a tracking solution. The INS selects the best SV-s as it sees fit for the solution and ignores all others.

After booting-up the INS field displays ALIGNING status. This indicates that the attitude provided by the INS is not within the specification and therefore the reported target (LOS) coordinates and cardinal directions displayed are not accurate. Once the gimbal experiences some dynamic movement the INS will be able to calculate its orientation and will enter TRACKING mode. When tracking mode is achieved and displayed, the LOS coordinates reported on the display in the metadata will be within specification.

## 5.2 ON-SCREEN DISPLAY



Figure 7: Video display

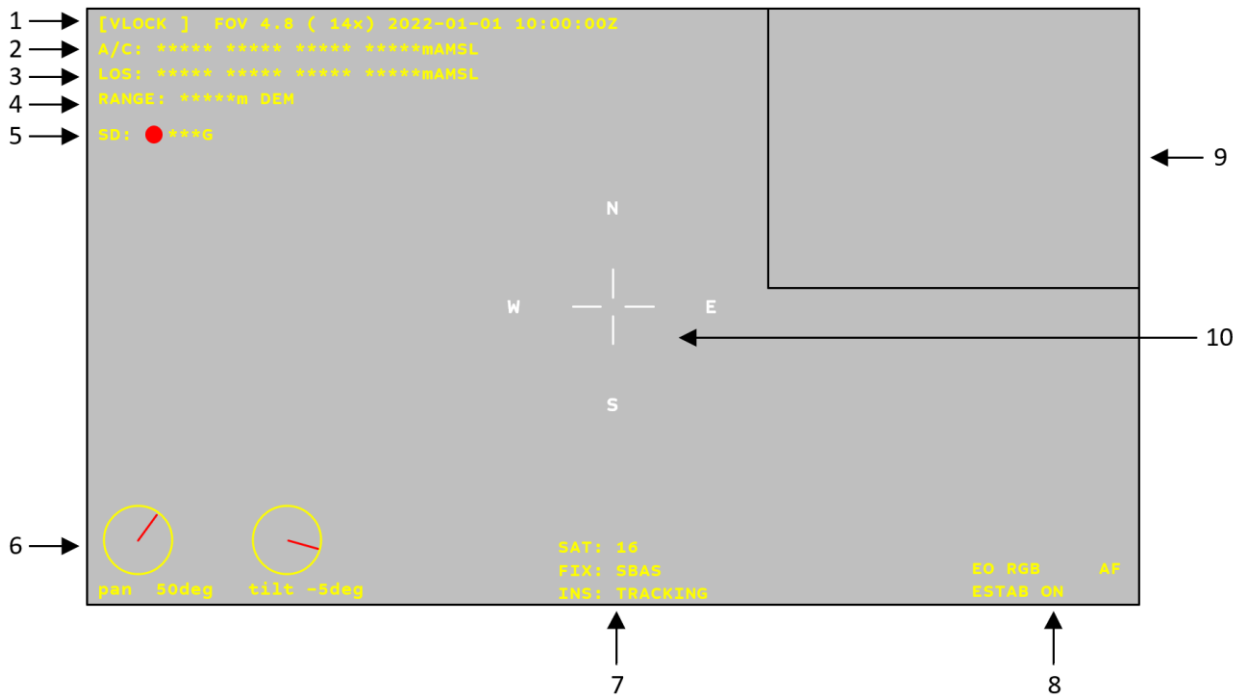


Figure 8: On-Screen display

Table 8: Video Overlays Description

Item	Description
1	<p>Mode, field of view (FOV), zoom level, date, and time display</p> <p>INIT – Gimbal is initializing            STAB – Gyro stabilized mode            SCENE – Scene steering mode            GEO – Geo pointing mode            ENCDRIVE – Fixed position mode, no stabilization            ERRSPD – Gimbal is moving too fast, switch to STAB or ENCDRIVE</p> <p>FOV – field of view in degrees            Zoom level – 1X – 90X            Date and time in UTC (Coordinated Universal Time, Zulu time, GMT)</p>
2	Aircraft coordinates and altitude above mean sea level in MGRS or Lat/Lon
3	Line of sight (LOS) coordinates and altitude above mean sea level (target at crosshair) in MGRS or Lat/Lon. Ground elevation is calculated using on-board elevation data (DEM)
4	Slant range from the camera to the target in meters. DEM indicates calculated distance using digital elevation model.
5	SD card remaining capacity and recording status. Red – recording, grey – not recording
6	Pan and tilt positions in relation to the aircraft
7	<p>GPS and INS status</p> <p>SAT – number of satellites (maximum is 16, the INS automatically chooses best SV-s for optimal operation)            FIX – GPS fix quality (SBAS – best, 3D – good, 2D – poor)            INS – Attitude and position quality (tracking is indicated when measurements are nominal and in spec, aligning is shown when not)            EXT. NAV – using external navigation source (autopilot for example)</p>
8	<p>EO camera modes are RGB (full color) or NIR (near infrared). Focus modes AF (auto focus) or MF (manual focus)</p> <p>IR camera modes are WH (white hot) or BH (black hot)</p> <p>ESTAB ON/OFF indicates digital image stabilization status</p>
9	Picture in picture display of secondary camera
10	Target crosshairs indicating line of sight (LOS) and cardinal directions

## 5.3 OPERATING MODES

Orca gimbal has multiple operating modes for multiple operational scenarios.

### 5.3.1 Stabilise / STAB

In gyro-stabilised operating mode the gimbal counteracts aircraft attitude changes but does not lock onto any specific target. Use this mode when observing the aircraft fuselage or when visual tracking is impossible (limited visibility, fuselage or wings are blocking the view).



Figure 9: Gimbal in STAB mode

### 5.3.2 Scene steering / SCENE

Scene steering mode keeps the gimbal pointed at a specific target using image processing. The entire image is used to estimate the movement of the aircraft while the gimbal tries to compensate for it. Scene steering works well in all cases where the view is not obstructed and there is some detail in the image.



Figure 10: Image is suitable for SCENE mode

Good image to track using SCENE mode. The target is not obstructed, there are plenty of details to track.



Figure 11: Image not optimal for SCENE mode

Image not optimal for SCENE mode as clouds are blocking the view and there is not enough detail in the image for scene tracker to lock on. Switch to STAB mode and manually track the target. When kept in SCENE mode for too long during similar conditions the gimbal starts to drift and may quickly move in a random direction.



Figure 12: Image not optimal for SCENE mode

Image not optimal for SCENE mode as the fuselage is blocking the view, switch to STAB mode and manually track the target.

### 5.3.3 Video lock / VLOCK

Video lock is used to visually track moving or stationary targets. Gimbal uses an image processing algorithm to match the tracking box on consecutive video frames and moves the camera when the tracking box is not centred on the frame. When the target is obstructed, the system uses most recent velocity and direction estimate to try and keep the target centred. If the target reappears and has kept similar visual appearance, the tracking box is re-engaged and video lock resumes. If the target is not successfully re-acquired, the gimbal will automatically switch to SCENE mode.



Figure 13: Proper use of moving target tracker

Proper use of the tracking box, cover the entire target and make sure it is distinguishable from the background and unobstructed.





Figure 14: Coasting mode

Target is obstructed, tracker is coasting as indicated with by the dashed outline of the tracking box.



Figure 15: Video lock not recommended

Sub-optimal use of video tracking feature to lock onto a moving target. Slant angle is very shallow, and target will become obstructed shortly. For good observation results use SCENE tracking instead.

### 5.3.4 Fixed view / ENCDRIVE

Fixed view and encoder drive operating mode keeps the gimbal at specified fixed angle in relation to the aircraft. Gyro-stabilisation is not active and platform movements are not compensated. Use this mode to fix the camera view in relation to the aircraft. For example, looking forward during guided flight mode or directly down during landing.

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### 5.3.5 Geo-pointing / GEOLOCK

This operating mode fixes the camera view to specific geographic coordinates and ground elevation. The Orca-130 uses the coordinates, altitude, and attitude from the internal INS to calculate required pan and tilt angles to keep the user-specified geographic location in view. The accuracy of this mode depends on the INS fix quality and cannot exceed the maximum target coordinate accuracy of the electro optical system.

Use this mode to point the gimbal to a known location using the map view and “Look Here” functionality of the mission software or engage the GEOLOCK mode at the line of sight (LOS) coordinates using the mission grip.

## 5.4 MISSION GRIP

Playstation DualSense hand controller is used to control the Orca-130. Both wired and wireless operation is supported. For proper wireless operation open source DS4windows software should be installed.

Switchology has been designed in such a way that most used functions are directly accessible and for less common operations a combination is needed.

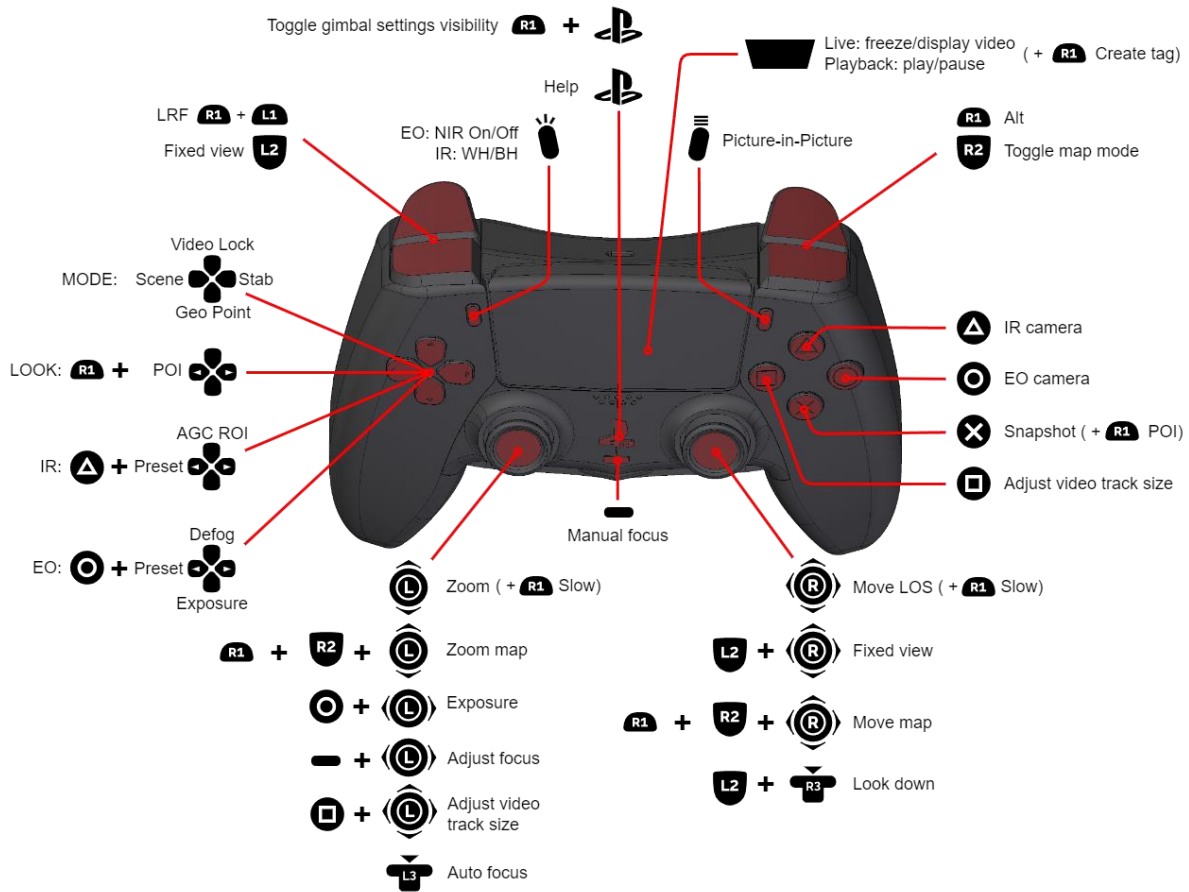


Figure 16: Button layout

Table 9: Controller button definitions

Button	Modifier	Description	Function
<b>△</b>		Press triangle	Select LWIR (thermal) camera as primary
<b>○</b>		Press circle	Select TV camera as primary
<b>R</b>		Right Stick	Move line of sight (LOS). When in video tracking mode, nudges the tracking box to the direction of the stick.
<b>R</b>	<b>R1</b>	Right stick while holding down R1	Reduce the sensitivity of the stick for fine adjustment of the line of sight
<b>R</b>	<b>L2</b>	Right stick while holding down L2	Switch the gimbal to a fixed looking mode (ENCDRIVE). Stick direction selects the view – left, right, forward, backward, or down.
<b>R</b>	<b>R1</b> <b>R2</b>	Right stick while holding down R1 and R2	Move the map view in mission software

Button	Modifier	Description	Function
		Left stick up-down	Zoom the primary camera in and out
		Left stick up-down while holding down R1	Reduce the sensitivity of the stick for fine zoom adjustment
	 	Left stick up-down while holding down R1 and R2	Zoom the map view in and out in mission software. If map centering and automatic map zoom enabled then adjust offset added to calculated map zoom level
		Left stick left-right while holding circle	Adjust TV camera exposure in shutter priority mode
		Left stick left-right while holding the horizontal bar	Switch to and adjust TV camera manual focus
		Left stick left-right while holding the square	Adjust video tracking box size
		Press left stick down	Switch TV camera to auto focus mode
		Press cross	Create snapshot in MS and also in gimbal
		Press cross while holding R1	Create POI at the line of sight (LOS) target
		Press left vertical bar	TV camera – toggle between RGB/NIR modes LWIR camera – toggle between white hot/black hot (WH/BH) modes
		Press right vertical bar	Toggle Picture-in-Picture on/off
		Press D-Pad left	Switch gimbal operating mode to SCENE
		Press D-Pad right	Switch gimbal operating mode to STAB
		Press D-Pad up	Switch gimbal operating mode to VLOCK
		Press D-Pad down	Switch gimbal operating mode to GEOLOCK
	 	Press D-Pad left or right while holding circle	Select next or previous TV camera preset
		Press D-Pad up while holding circle	Select TV camera defog level (none, low, medium, high)
		Press D-Pad down while holding circle	Select TV camera exposure mode (auto or shutter priority)
	 	Press D-Pad left or right while holding triangle	Select next or previous LWIR camera preset
		Press D-Pad up while holding triangle	Select LWIR camera AGC ROI size (automatic gain control region of interest)
		Press PlayStation logo	Open help screen that displays mission grip button functions
		Press PlayStation logo while holding R1	Toggle gimbal settings visibility
		Press horizontal bar	Switch to TV camera manual focus mode
		Hold R1 and L1	Laser range finder enabled while holding down buttons. * If gimbal has laser range finder
		Press big touch button	Live video - freeze/unfreeze video Playback video – play/pause
		Press big touch button while holding R1	Create tag
		Press R2	Toggle between map centering modes

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## 6. MAINTENANCE

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Orca gimbal is designed to be maintenance free. Regular inspection is recommended.

Check the humidity indicator on the back cover of the gimbal before operation. The change of the color indicates that the humidity level has risen above 40% level inside the gimbal.

Replace the desiccant cartridge once the indicator has turned pink from its regular blue color.

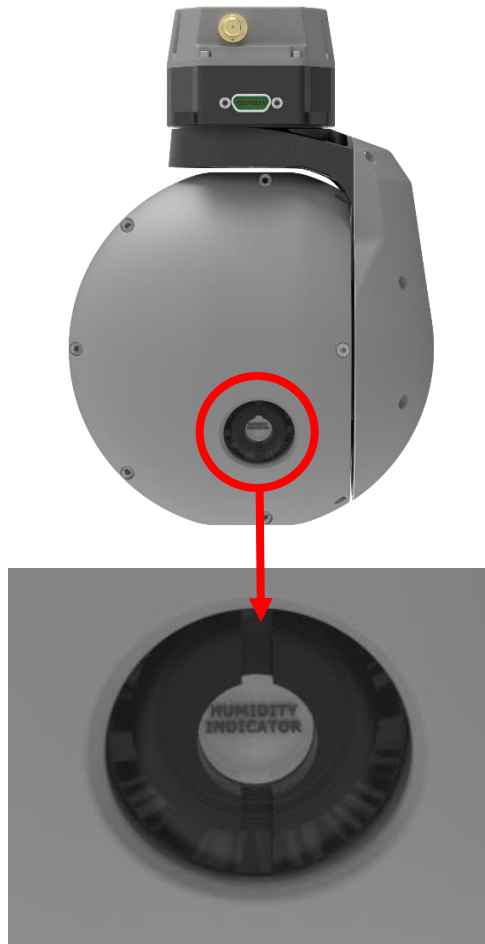


Figure 17: Humidity indicator

A spare humidity indicator is delivered in a hermetic cap. The rear part of the cap acts as a screwdriver to remove and install the cartridge. To replace the indicator in the gimbal, unlock the indicator using the rear end of the cap.

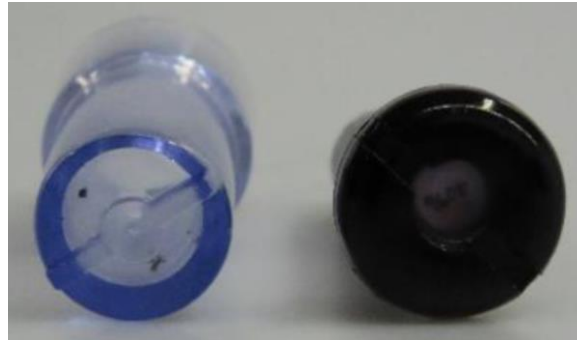


Figure 18: Desiccant cartridge removed from the cap

The new indicator can be installed and locked to the rear side of the gimbal using the storage cap as screwdriver.

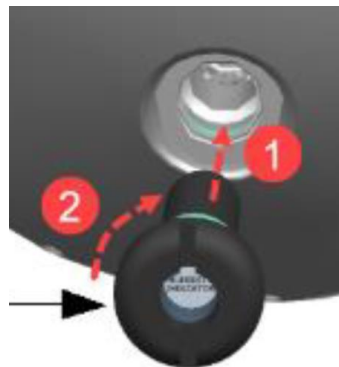


Figure 19: Desiccant cartridge replacement

If the gimbal unit is exposed to rain, sleet, and cold temperatures it is recommended to perform regular visual inspections. Depending on the weather conditions and usage of the gimbal, it is essential to inspect the gimbal for forming ice or any other obstruction on the main windows, such as small gravel sand.

Cleaning of the sensor lenses may be required and should only be done using a standard lens cleaner.



## 7. MISSION SOFTWARE

### 7.1 PAYLOAD OPERATOR

Payload operator (shortened to operator) version of the mission software is designed for the payload operator who is in direct control of the Orca-130. Operator version may be standalone or connected to a datacentre for collaboration and video sharing.

NB: operator version refuses to start if Threed GCS is running.



Figure 20: Mission software deployment – payload operator

Internally, the payload operator software has two distinct components that work in tandem to provide the full functionality of the mission software. These components are the user interface and server.

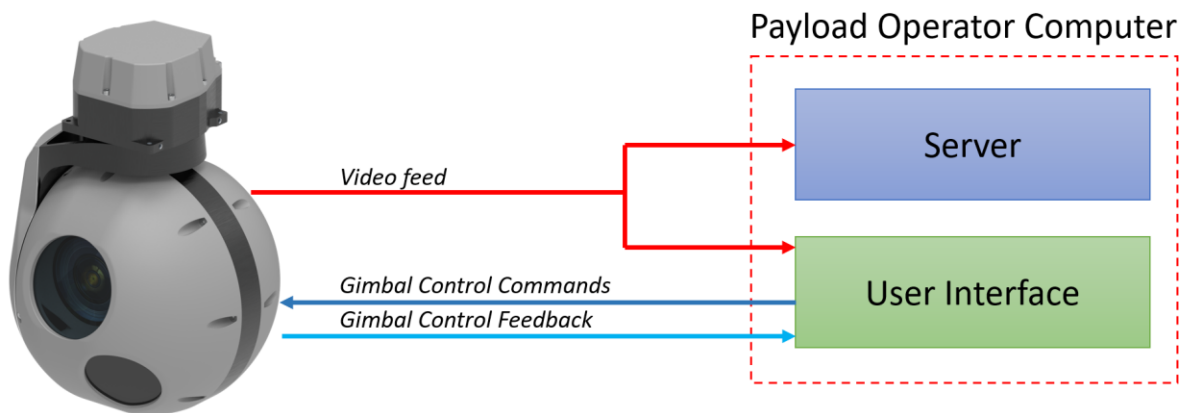


Figure 21: Data flow in payload operator mode

## 7.2 DATACENTER

Datacenter is a specialized server that connects one or multiple payload operator computers into a centralized system for storing and sharing of live and archived missions.

Observers can connect to a datacenter to watch live missions or review archived videos from previous missions.

Payload operator computers connect to the datacenter to stream live video and to communicate with observers.

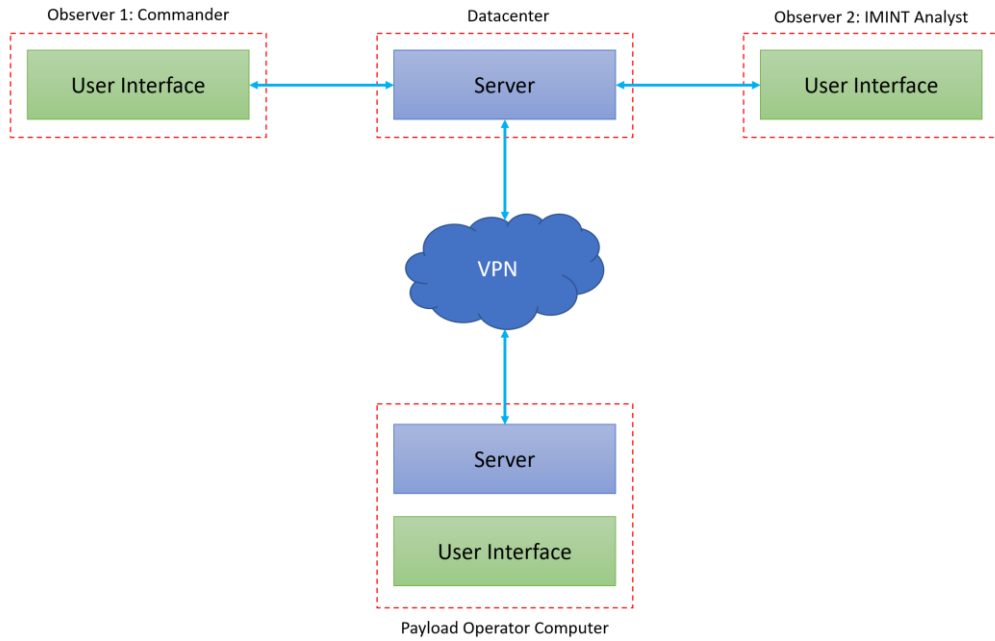


Figure 22: Datacenter role in the system

### 7.3 OBSERVER

Observer version is deployed on end user computers such as laptops and desktop computers. These computers must have a connection with datacentre to receive live video and access archived missions for review and search. Communication with the payload operator is implemented through the ground server.

Observer workstations are typically used by commanders, IMINT analysts and other parties who need to access the video feed or intelligence products created by the unmanned aircraft system.



Figure 23: Mission Software observer examples

## 7.4 LAYOUT

This section describes different layout options provided for with the MS.

For all deployment scenarios there are options for single or dual monitor layouts. In single monitor layout all the information is displayed in one window.

For dual monitor setups the layouts provide a separate map window.

When reviewing an archived mission, the user can choose any available video stream attached to the mission. These streams are either feed received by datacentre or payload operator server original feed (if mission with original video is synced to datacentre).

### 7.4.1 Overview

For error dialogs and confirmation dialogs you can use ESC keyboard key as an alternate to cancel and ENTER keyboard key as an alternate to confirm/ok.

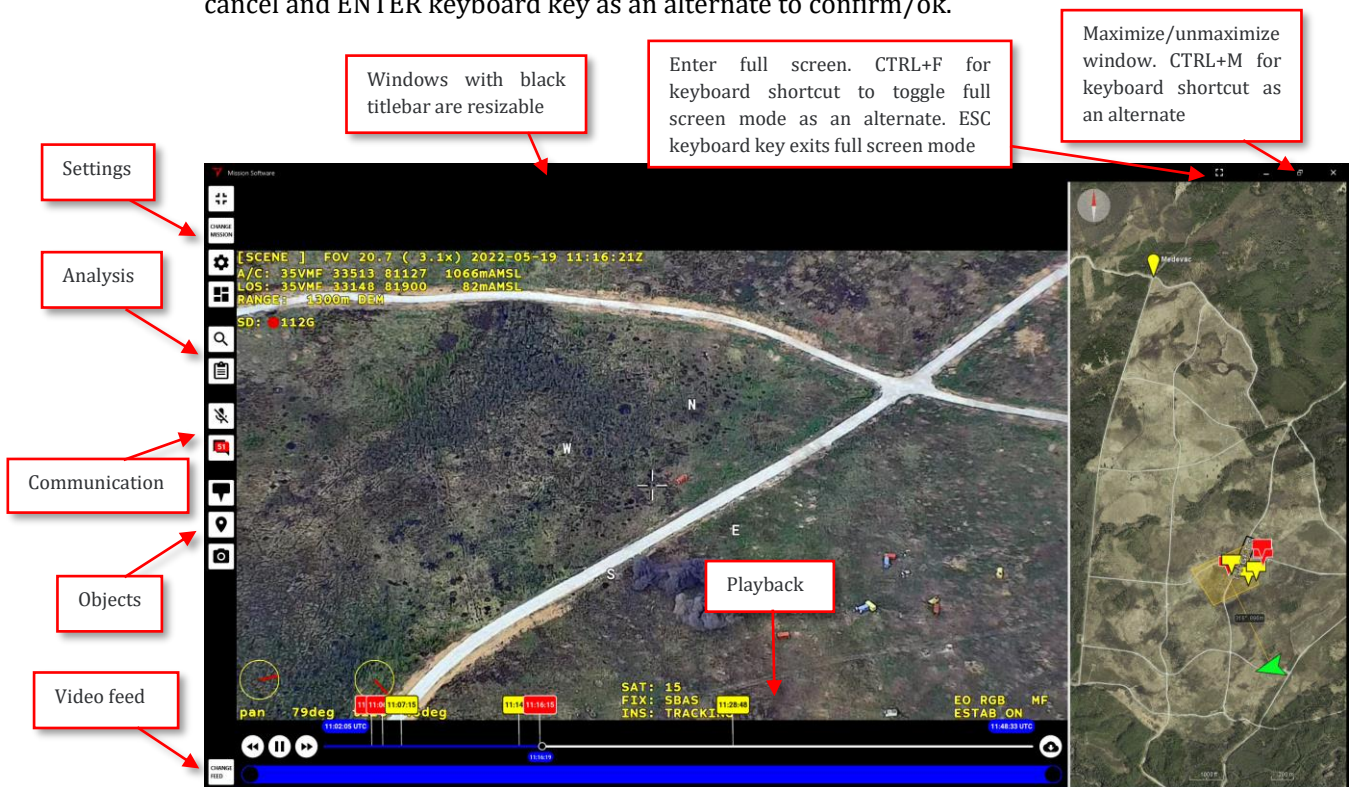


Figure 24: Layout overview

### 7.4.2 Single monitor

Map is on the left and video on the right. Map and video view size is adjustable by the user. Button panel is on the right side in vertical orientation. Playback and time controls are on the bottom when in replay mode.

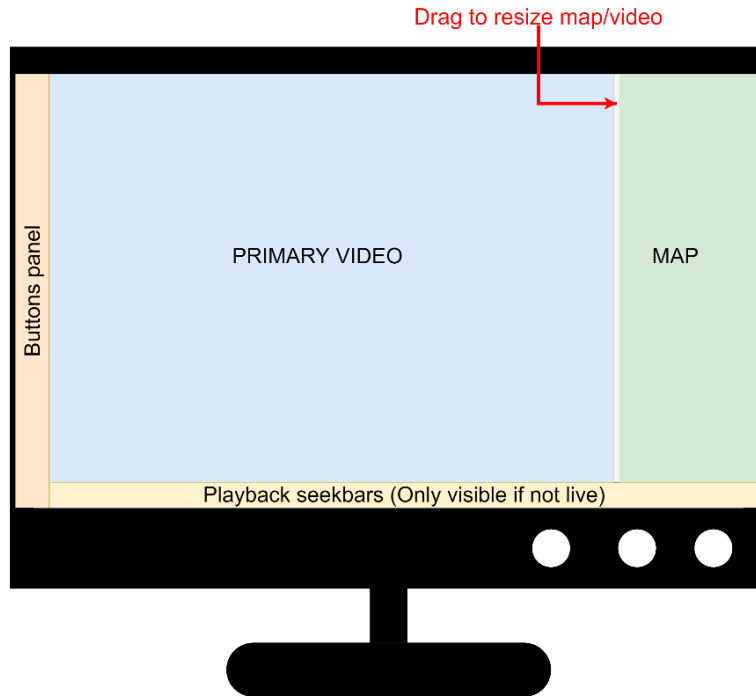


Figure 24: Single monitor layout

### 7.4.3 Dual monitor

One window for the map and one window for primary or selected video feed with a vertical controls panel.

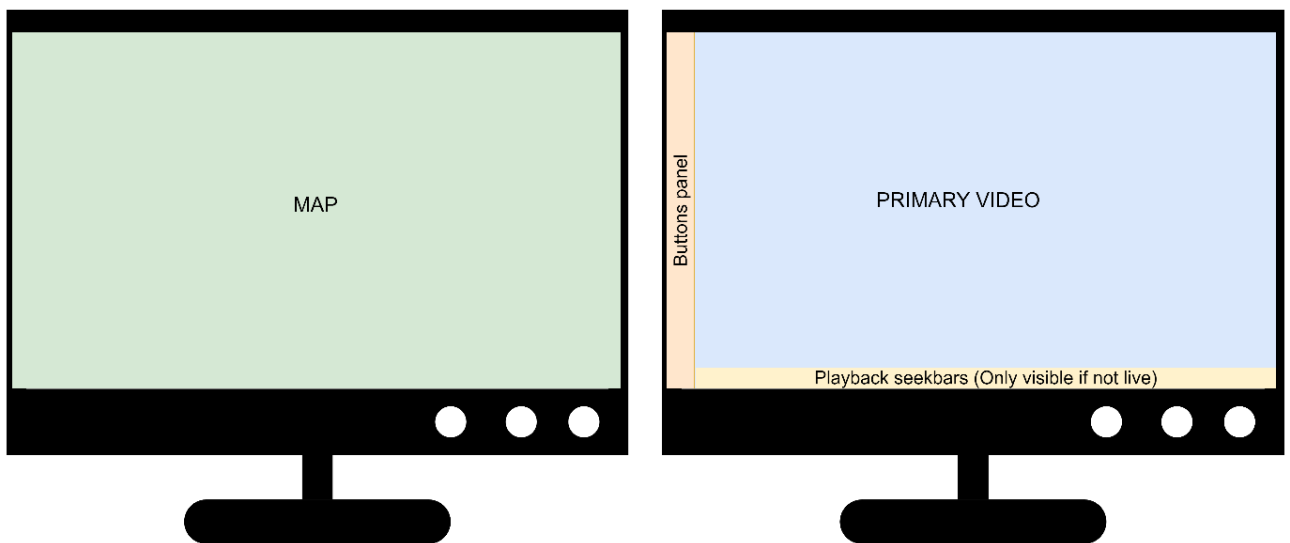


Figure 25: Two monitor layout

### 7.4.4 Layout selection

Layout pre-sets can be chosen by the user from the layout dialog at any time. Chosen layout and window positioning will be restored on next startup and is user based in computer (not saved to server). CTRL+L keyboard keys to toggle as an alternate.

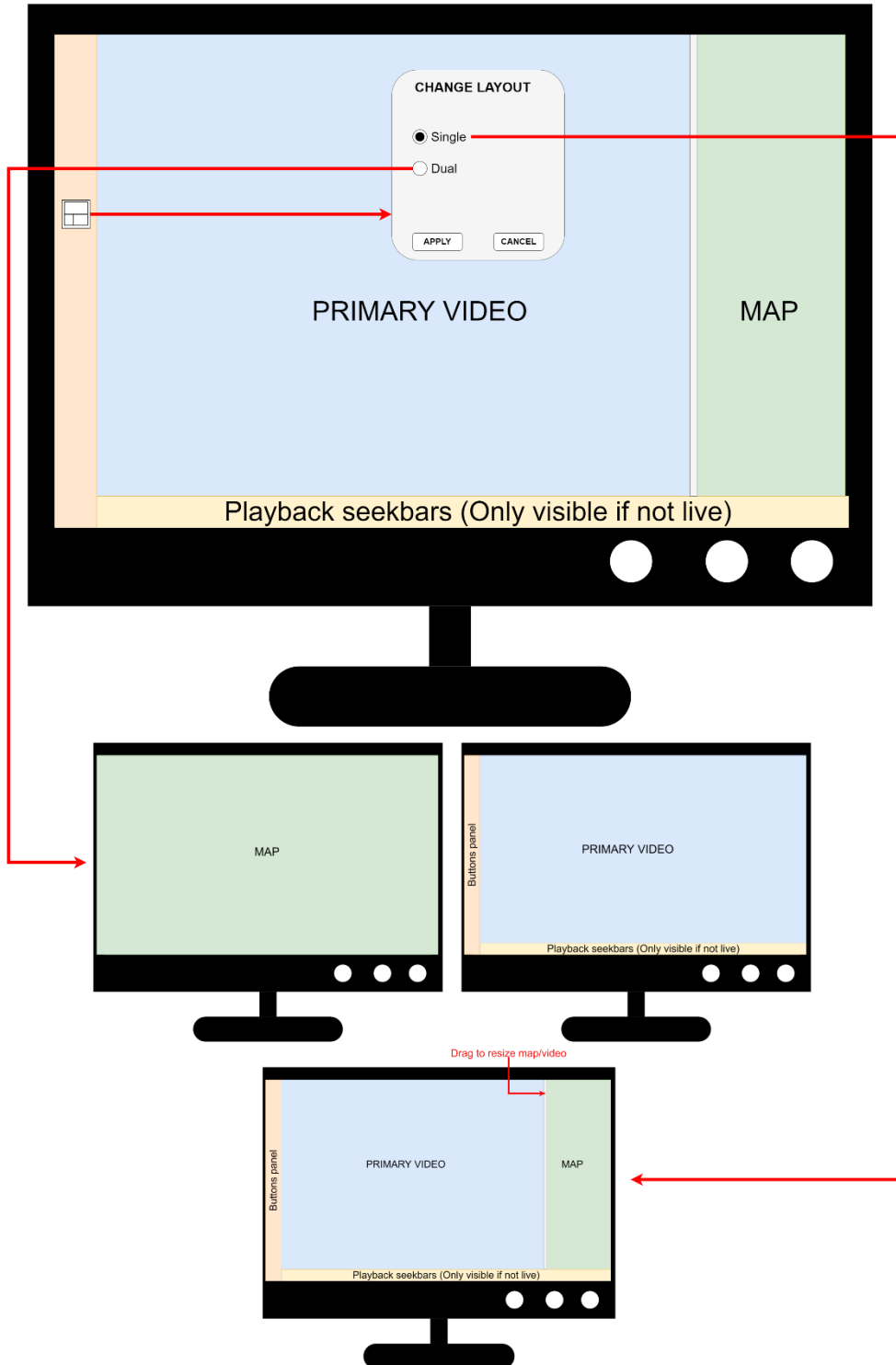


Figure 26: Layout selection

## 7.5 START UP

This section describes the process of starting the software, authenticating the user, and creation or selecting a mission.

### 7.5.1 Login

User account is required to use the fully featured mode of the mission software. Without user account, functionalities are limited. Initial administration accounts are provided by Threod Systems. Upon start up a login dialog will be displayed.

In the operator deployment the user account is authenticated by the server installed in the mission computer itself. For observer deployment all clients are authenticated via datacentre server. One account can be logged in only in one computer. If same account is logged in in another computer, then that account is automatically logged out in previous computer. Exception is if same account is logged in on operator deployment – user is denied access to observer deployment (datacentre server) in that case.

On successful login a mission selection or creation dialog will be presented.

On unsuccessful login a notification is shown. When the user enters wrong password 5 times in observer deployment the account will be locked by the server. If account is locked, then only administrator can unlock it. In MS operator deployment there is no limit in entering wrong password and if the account becomes locked on datacentre it's will not be locked in operator deployment. If 5 failed login attempts are made in a row from the same IP, then it's not possible to login for 1 minute. This timeout is to neutralize brute force attacks for finding username and password.

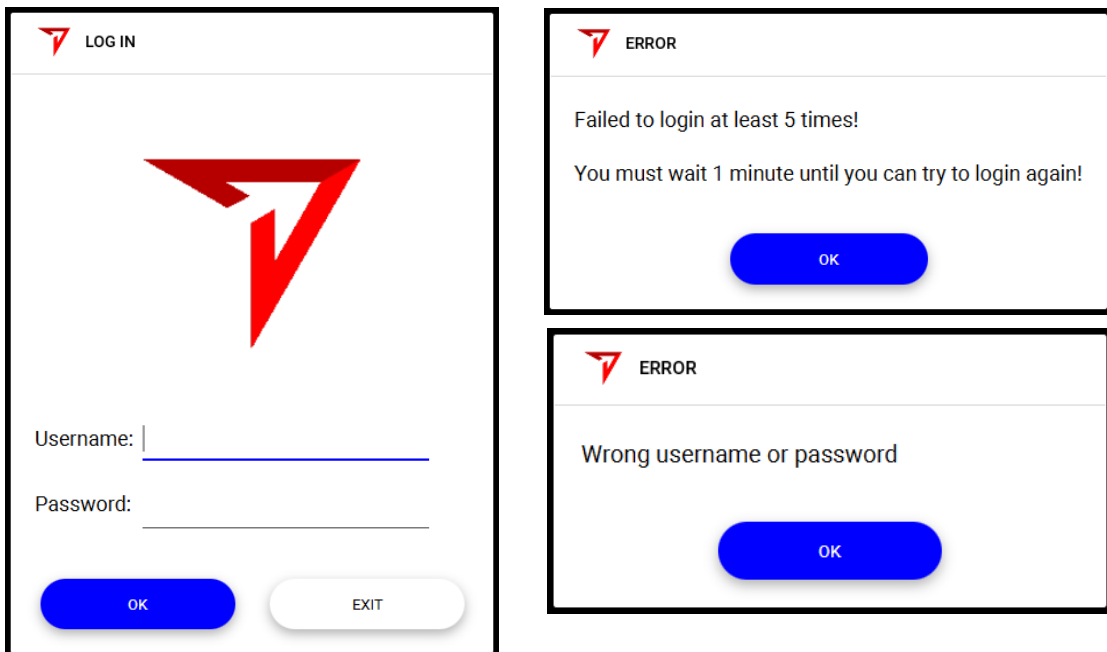


Figure 27: Login dialog

### 7.5.2 Observer mission selection

After logging into the datacenter the user must choose a mission to view. There are two types of missions – archived and live.

Archived missions are missions that have ended and may also include footage transferred from operator server. In addition to the video footage a mission also includes all the metadata, chat messages, recorded audio channels, associated points-of-interest, tags and reports.

Live missions are missions currently in progress and connection between operator server and datacentre server has been established. Opening a live mission allows the user to monitor and replay the footage, send points-of-interest to the operator and other users, tag certain moments, create reports, chat, and talk over VoIP audio protocol with all connected clients.

A third option, no mission mode, is also present. Operating the MS without a mission allows to perform administrative tasks without recording any data. Administrative tasks include system testing, managing maps and layers, managing user accounts, and creating locally stored points-of-interest.

The screenshot shows two panels: 'MISSIONS LIST' on the left and 'FILTER MISSIONS' on the right. The 'MISSIONS LIST' panel contains a table of missions with columns for status (LIVE, REPLAY, LOAD), title, date, and duration. A 'NO MISSION MODE' button is at the bottom. The 'FILTER MISSIONS' panel includes search fields for title and description, date range pickers, and a 'Recorded video status' dropdown with 'All' selected. Below this is a list of users with checkboxes, and 'RESET FILTER' and 'APPLY' buttons.

**Callouts:**

- Watch live mission. Button is blue if it's live mission. Double-click on list item as alternative** (points to 'LIVE' button)
- Currently playing mission** (points to 'Playing...' button)
- Start mission playback. Double-click on list item as alternative** (points to 'REPLAY' button)
- Playback mission without recorded video can be loaded** (points to 'LOAD' button)
- Mission date and duration (or text "ongoing" or "no video!")** (points to mission row)
- Mission title** (points to mission title)
- Show or edit mission details** (points to info icon)
- Back to missions list. This will not apply filter (must click apply button to filter missions)** (points to back arrow)
- Click on calendar icon to open up calendar for date choosing** (points to date picker)
- Enabled only if recorded video status option 'Has recorded video' is selected. Empty means length not used. Minimum value for minimum length is 1. If minimum and maximum are both filled then maximum must be greater than minimum** (points to 'Min minutes' and 'Max minutes' fields)
- Recorded video status options: All, Has recorded video and Without video** (points to dropdown menu)
- Select which users created missions to show. By default all selected** (points to user list)
- Remove filter from missions list** (points to 'RESET FILTER' button)
- Apply filter. Only non-empty fields are used** (points to 'APPLY' button)
- Start software in no mission mode (only map shown). User can manage map layers and private POI's, fire support targets and use search. Admin can manage user accounts and groups.** (points to 'NO MISSION MODE' button)

Figure 28: Observer mission selection



### 7.5.3 Operator Mission selection

After logging into the MS operator version, the mission selection dialog will be shown.

If user logs in and ongoing mission exists in server then live mission is automatically loaded and mission selection dialog is not shown and can't be opened until live mission is ended. If logged in user doesn't have permission to watch the live mission, then he can't see any mission data except metadata but can end the mission to be able to create new mission if previous mission (which user doesn't have permission to watch) was forgotten to be finished.

The user is presented with three courses of action:

1. Create a new mission
2. Operate the software without a mission
3. Replay previously recorded missions

Creating a new mission will open a mission creation dialog.

Operating the MS without a mission allows for the administrative tasks to be performed without recording any data. Administrative tasks include system testing, managing maps and layers and creating locally stored points-of-interest and fire support targets.

Final option is to replay a mission stored in the mission computer.

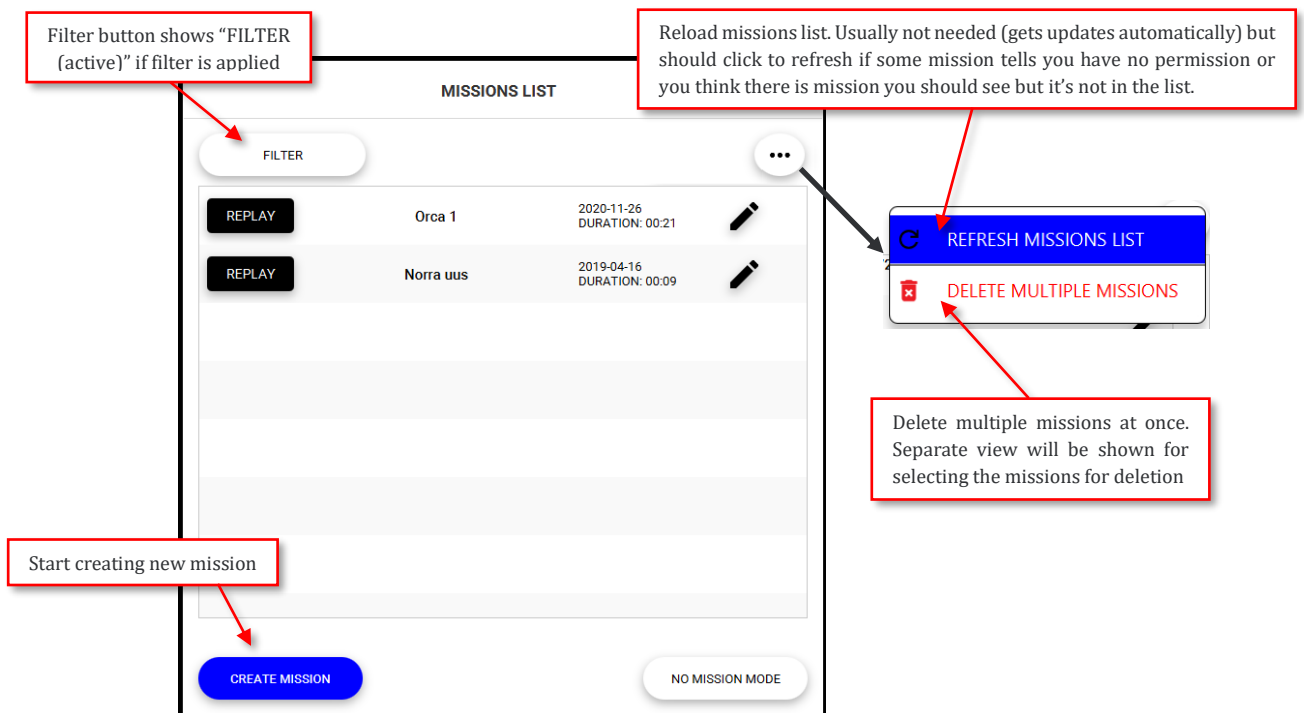


Figure 29: Operator mission selection

## 7.5.4 Mission creation

Mission creation dialog allows the operator to create a new mission. A mission can be created only in the operator MS instance and all data is stored in the on-board mission computer. When MESH network connection is present, the mission will be automatically replicated into the datacentre server where only the data received via data link is stored until it is manually updated with data stored in the mission computer removable storage device.

Missions must have a title, group access policy (at least 1 group selected) and optional description.

All members of allowed groups may join the live view of a mission when connected via MESH network to datacentre and access the archived missions later. When a user is not in a group with permissions to access a mission, all data will be unavailable (mission doesn't appear in the list).

Mission group access can be modified later to change the access policy.

Server starts recording video automatically if time difference from computer time is less than 30 days. If it's more then it's assumed that time in KLV data or computer is wrong but not known which one. It's possible to start force record video (option shown in edit mission dialog).

Computer time must not be changed while live mission is in progress otherwise time system of the mission may break, or live mission will be ended.

If computer time is changed to earlier time, then live mission will be ended automatically. If computer time is changed to later time more than 8 hours, then live mission will be ended automatically. If live mission is ended automatically in operator version, then it's ended also for datacentre. If live mission is automatically ended in datacentre, then in operator version it'll not be ended.

With mission creation request to server MS will tell server where to listen for video. Also backup video source is given. Both, MS and server, will listen main and backup source and will show/record video automatically from whichever source it's coming. If main and backup feeds both are coming then main source will be used.

The figure illustrates the 'CREATE MISSION' workflow through three sequential screenshots:

- Top Left Screenshot:** Shows the 'Mission' tab. The 'Operator' field is pre-filled with 'Marko.Tandre'. The 'Title' field is empty. A large text area for 'Description' is available. A checkbox for 'Pause recording in server' is at the bottom. A blue 'CREATE' button is at the bottom right.
- Top Right Screenshot:** Shows the 'Groups' tab. A list of groups is displayed with checkboxes: 'Admin' and 'Changed6'. Search icons are next to each group name. A blue 'CREATE' button is at the bottom right.
- Bottom Screenshot:** Shows the 'USERS IN GROUP' screen for the 'Admin' group. A list of users is shown: 'Indrek', 'Kalle', and 'Mikk'. A blue 'CREATE' button is at the bottom right.

Callout boxes provide the following details:

- Operator name is automatically filled:** Points to the 'Operator' field.
- Title of the mission visible in missions list. Must not be empty:** Points to the 'Title' field.
- Select which groups are applied to the mission. At least one group must be selected on creation:** Points to the group selection checkboxes.
- Optional description:** Points to the 'Description' text area.
- Check if server should not start recording video yet. Button to quickly resume recording video will be shown next to system warning text is paused:** Points to the 'Pause recording in server' checkbox.
- Create and enter the mission:** Points to the 'CREATE' button in the top-left screenshot.
- Back to missions list and cancel the mission creation:** Points to the back arrow in the top-right screenshot.
- Back to mission creation:** Points to the back arrow in the bottom screenshot.
- Non-admins can't see inactive users here. Admins see all users here and also it's shown in brackets if user is locked or inactive. Inactive users are sorted to the end of the list:** Points to the user list in the bottom screenshot.

Figure 30: Mission creation

### 7.5.5 Mission info and editing

Mission editing dialog allows the authorized user to modify mission name, description, and group-based access permissions. Authorized users for editing are creator of the mission and admins.

This is also where a mission will be ended and can be deleted from the system. Mission should be ended on MS operator deployment but is possible also on MS observer deployment if needed in extreme cases (for example MS operator deployment broke down or operator forgot to end the mission). In MS operator version everyone can end the current live mission but editing/watching the mission depends on if user is authorized or not. Everyone can end mission in MS operator version to avoid case where last operator forgot to end the mission and new operator isn't authorized for the current live mission resulting in impossible to create new mission.

#### 7.5.5.1 Playback mission

The figure displays four screenshots of the 'EDIT MISSION' dialog, arranged in a 2x2 grid. Each screenshot shows the 'EDIT MISSION' interface with different user roles and actions:

- Top Left:** A red box labeled 'Creator of the mission and admins' is positioned above the screenshot. A red box labeled 'Back to missions list. Unsaved work will be lost' has an arrow pointing to the back arrow icon in the top left corner of the dialog. The dialog shows the 'Mission' tab selected, with fields for 'Operator' (Indrek.Kivi), 'Title' (Remote mission), and 'Description' (Testing). A 'SAVE' button is highlighted with a red arrow from a box labeled 'Save the changes in mission'.
- Top Right:** A red box labeled 'Not creator nor admin' is positioned above the screenshot. The dialog shows the 'Mission' tab selected, with fields for 'Operator' (Paul.Smith), 'Title' (Flight 4 at PZL with gimbal - Night Flight), and 'Description' (To test night flight operation).
- Bottom Left:** The dialog shows the 'Groups' tab selected, displaying a list of users with 'Test users' checked. A 'SAVE' button is highlighted with a red arrow from the 'Save the changes in mission' box.
- Bottom Right:** The dialog shows the 'Metadata' tab selected, displaying a search bar and a list of users with 'Test users' selected.

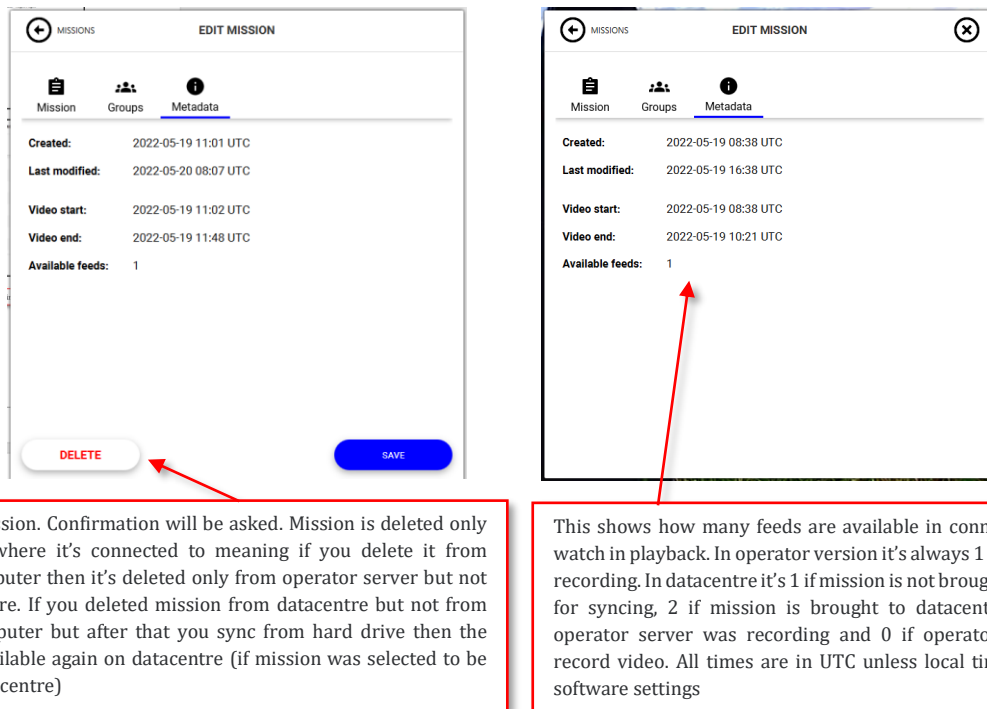


Figure 31: Edit mission - playback

### 7.5.5.2 Operators live mission

For operator version it's not possible to select another mission for playback while live mission is in progress so there is no back button visible until mission is ended.

By default, server starts recording video if time difference between computer time and time in KLV attached to video is less than 30 days and then the KLV time is the video time.

If computer time is too different from KLV time (no GPS fix in gimbal whole time or gimbal is currently booting up for example) then it's possible to force start recording video by clicking force record button. In this case computer time will be the video time. Force record button is disabled if server is already recording. Force record is only for backup usage and should be used only if it's known that there will be no GPS fix to get precise time.

Operator can pause recording of the video in server. If video recording is paused then video is also not sent to datacentre. This means operator will see live video but observers will not see live video if recording is paused. Pause recording functionality is useful if you want to save hard drive space (not recording useless video) or you must not record something because of security reasons.

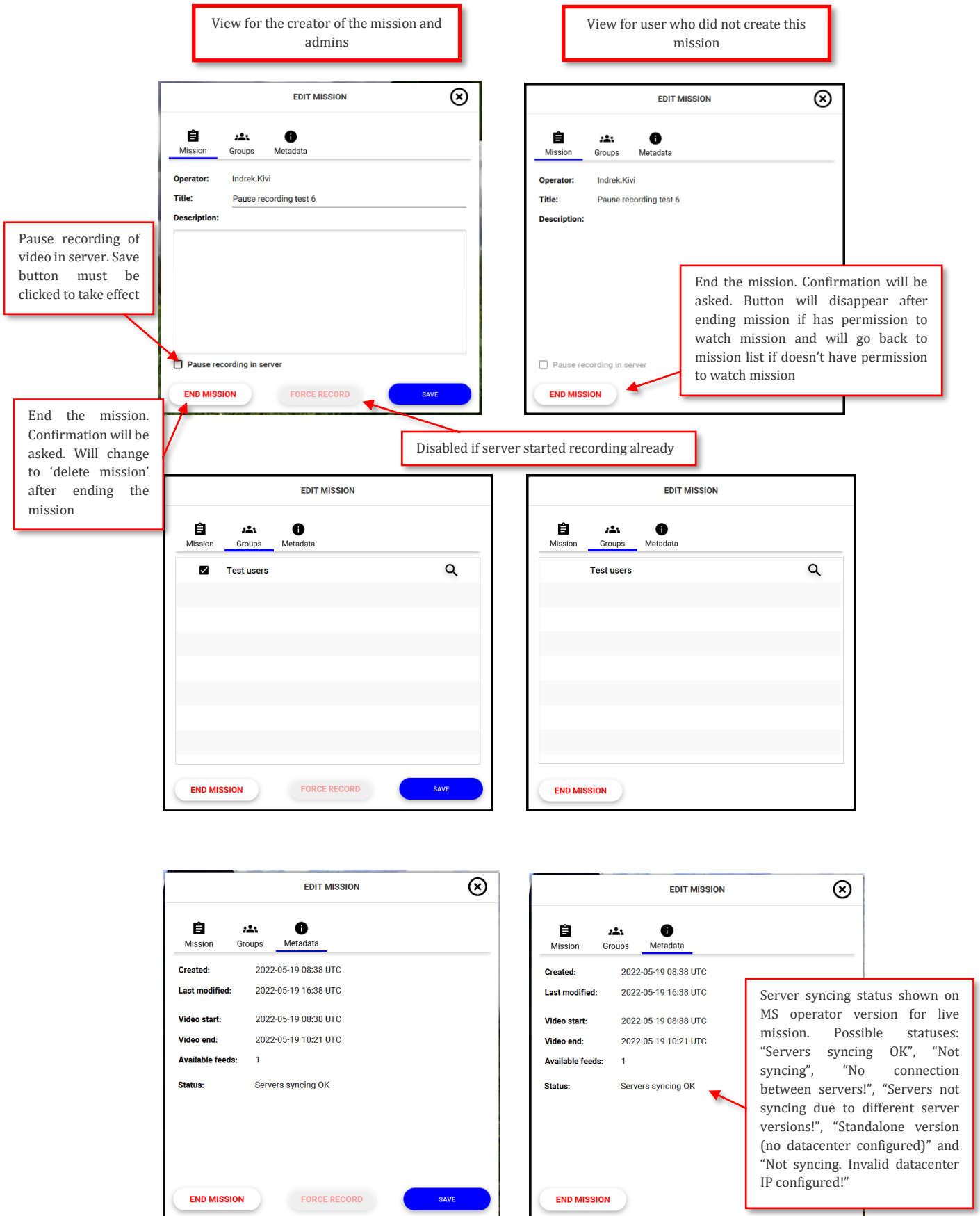


Figure 32: Edit mission – operator live

### 7.5.5.3 Observer live mission

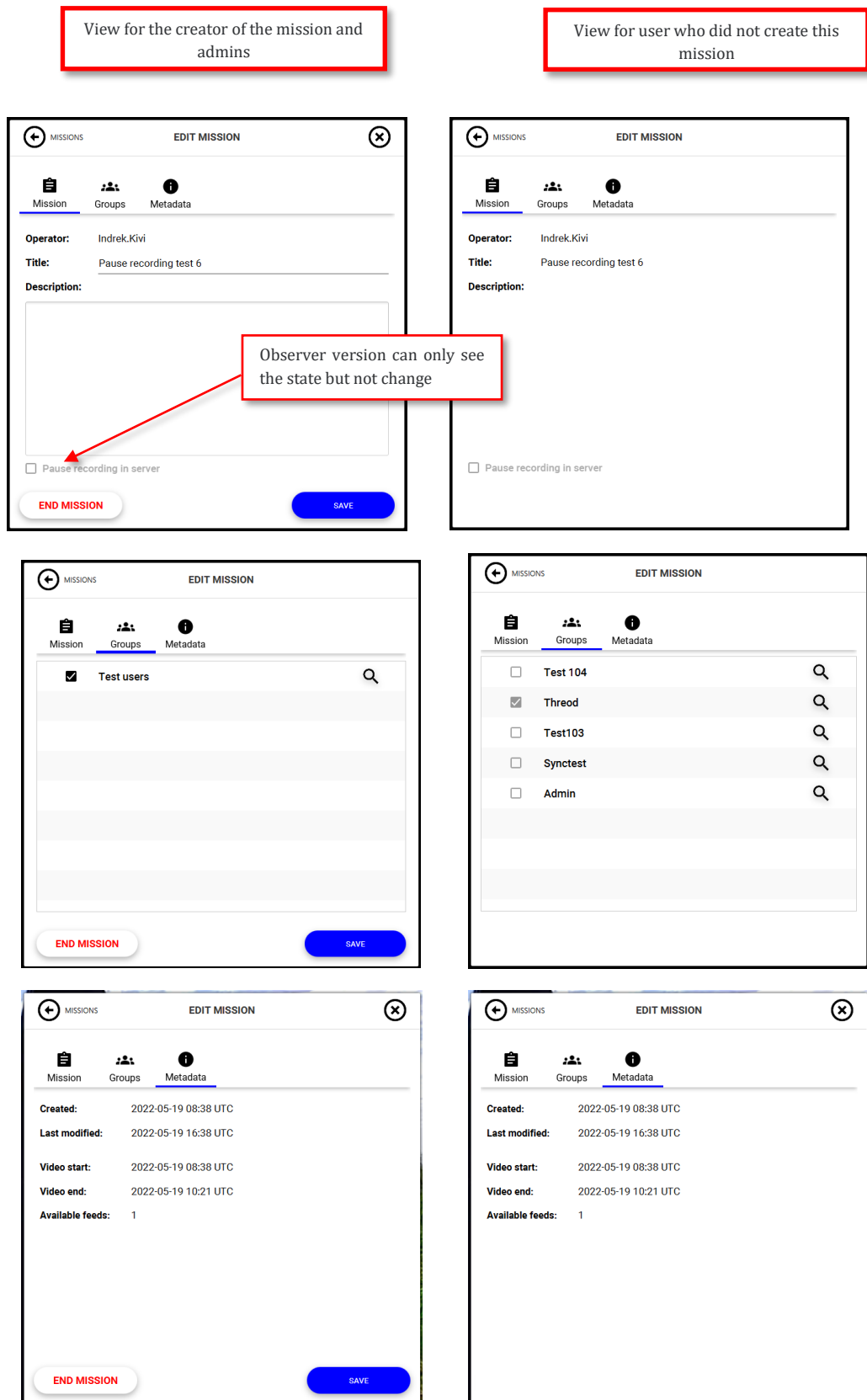


Figure 33: Edit mission – observer live

### 7.5.6 Delete multiple missions

Normally you delete missions one by one from mission edit view but in some cases you need to delete more missions (test missions, missions without video etc) and then it's not convenient anymore.

In this case you can use multiple mission deletion view which you open from mission list window "more" button option "Delete multiple missions".

Missions list in this view contain only the missions you have permission to delete.

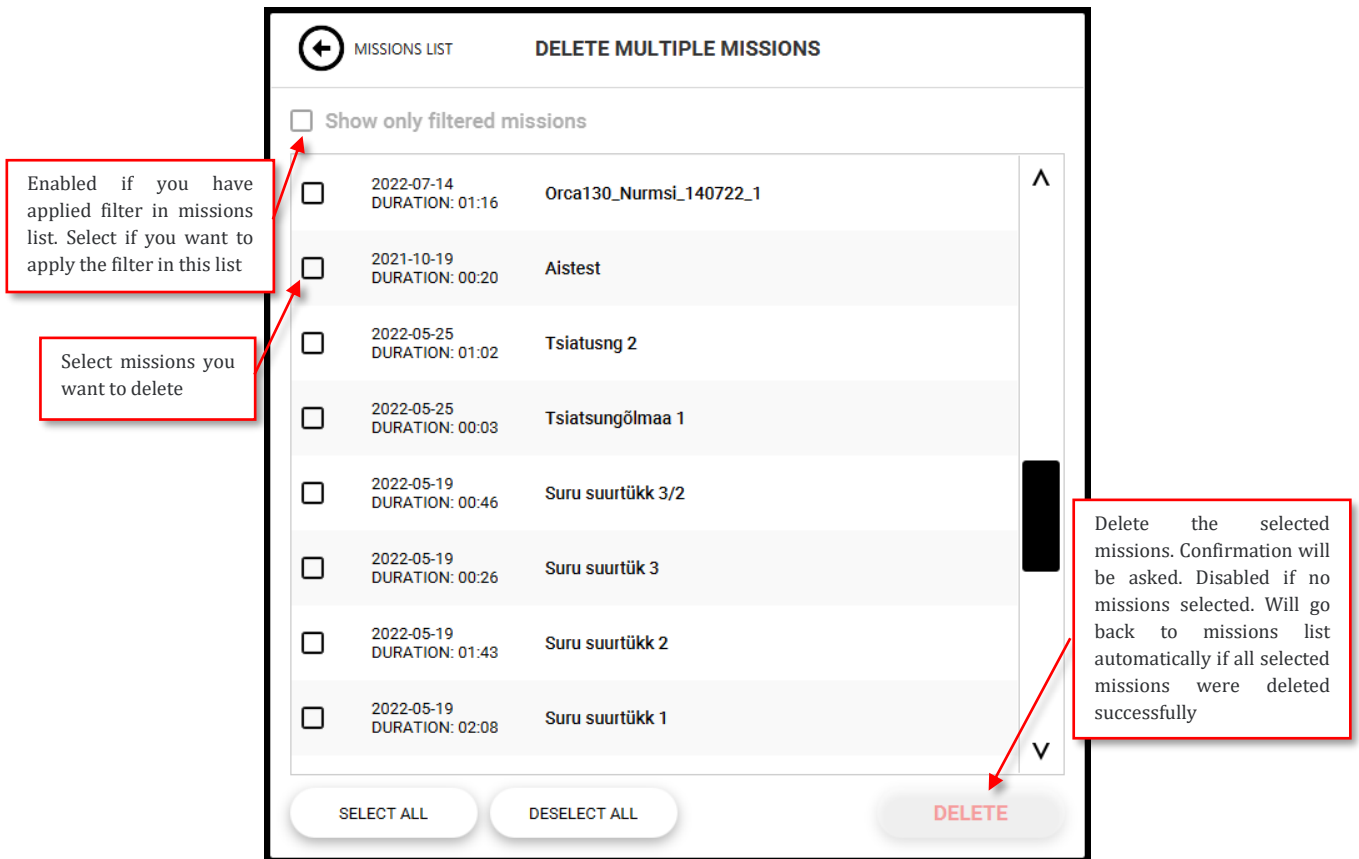


Figure 34: Delete multiple missions



## 7.6 BUTTONS

Buttons are used to execute most used commands and access functionality of the MS. All buttons can be engaged with mouse or touchscreen interface.

### 7.6.1 Buttons for the payload operator

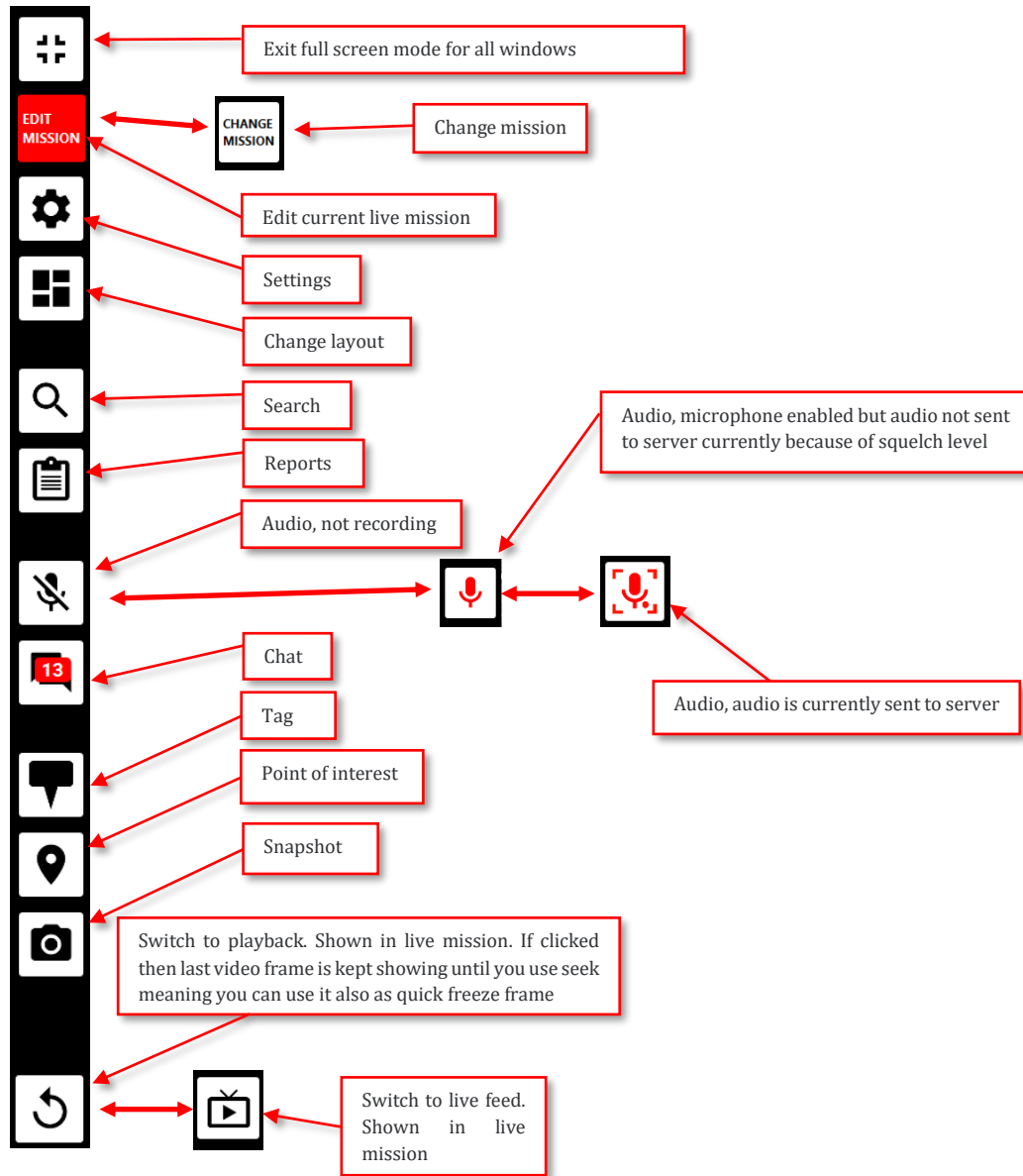
















Figure 34: Buttons for the payload operator

Table 10: Payload operators buttons description.

Icon	Name	Description
	Exit full screen	Exit full screen mode in all windows. CTRL + F on keyboard will toggle single window to be full screen.
	Tag	Left click - create a new tag. Right click – show/hide tags list. Visible only if watching mission.
	Point-of-Interest	Left click - add a locally stored POI. Right click – show/hide POI list. Visible only if logged in.
	Snapshots	Left click - take a snapshot of all available video feeds with metadata. Snapshot is stored in MS (no snapshot in gimbal, use joystick to create both). Right click – show/hide snapshots list. Visible only if watching mission.
	Replay	Toggle between replay and live view modes. Visible only if watching live mission live video. Mission timeline is reset to default, seek dot is put to end on seekbar and mission timeline end is time of last received video frame when switched to playback mode. NB: for MS operator version it takes several seconds until video starts when switched. Last received video frame is kept showing until you use seek.
	Live Feed	Toggle between live view and replay modes. Visible only if watching live mission playback video. NB: for MS operator version it takes several seconds until video starts when switched.
	Search	Show/hide search window. Area search tab selected, and last target coordinates filled automatically when opened. Visible only if logged in.
	Report Manager	Show/hide report manager window. Visible only if watching mission.
	Edit Mission	Show/hide edit mission window. Is replaced by change mission button after live mission is ended.
	Change Mission	Show/hide mission list to choose other mission to play or edit. Visible only if logged in.
	Select Layout	Show/hide a window that allows the user to select between different layouts. Can also use CTRL + L keyboard keys to show.
	Audio	Right click - show/hide audio chat control dialog. Left click – enable/disable sending audio to server (only live mission) Visible only if watching mission
	Text chat	Show/hide chat window. Will show number of unread messages. Visible only if watching mission.
	Settings	Show/hide settings and admin window.

### 7.6.2 Buttons for the observer

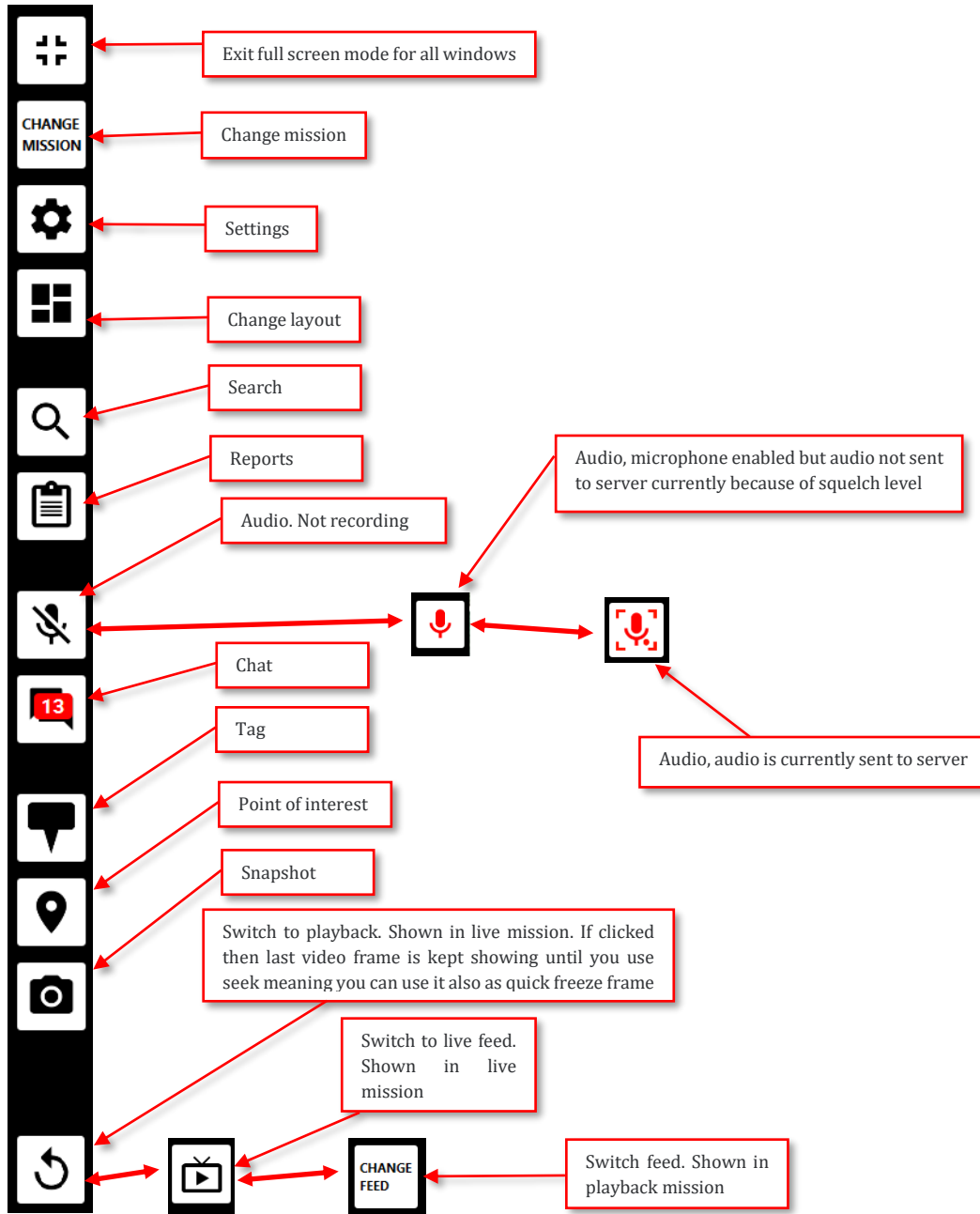
















Figure 35: Buttons for the observer

Table 11: Observer buttons description.

Icon	Name	Description
	Exit full screen	Exit full screen mode for all windows. CTRL + F on keyboard will toggle single window to be full screen.
	Tag	Left click - create a new tag. Right click – show/hide tags list. Visible only if watching mission.
	Point-of-Interest	Left click - add a locally stored POI. Right click – show/hide POI list. Visible only if logged in.
	Snapshots	Left click - take a snapshot of current video feed with metadata. Snapshot is stored locally. Right click – show/hide snapshots list. Visible only if watching mission.
	Replay	Toggle between replay and live view modes. Visible only if watching live mission live video. Mission timeline is reset to default, seek dot is put to end on seekbar and mission timeline end is time of last received video frame when switched to playback mode. Last received video frame is kept showing until you use seek.
	Live Feed	Toggle between live view and replay modes. Visible only if watching live mission playback video.
	Select camera	Select video feed in playback mode. Visible only if watching mission.
	Search	Show/hide search window. Area search tab selected and last target coordinates filled automatically when opened. Visible only if logged in.
	Report Manager	Show/hide report manager window. Visible only if watching mission.
	Change Mission	Show/hide missions list to open another archived or live mission. Visible only if logged in.
	Select Layout	Show/hide a window that allows the user to select between different layouts. Can use also CTRL + L keyboard keys to show.
	Audio chat	Right click - show/hide audio chat control dialog. Left click – enable/disable sending audio to server (only live mission) Visible only if watching mission
	Text chat	Show/hide chat window. Visible only if watching mission.
	Settings	Show/hide settings and admin window.

### 7.6.3 Selecting playback feed

On observer MS version it is possible to select between two types of video feeds during playback mode, if present. The selection window indicates the types of feeds available in server.

Typically, a low-resolution primary video feed is available when a live mission was recorded in the server during a mission with network connection.

Low quality feed doesn't mean lower resolution but video with possible lagging or missing parts due to network issues (no or bad connection between operator and datacentre servers).

When the mission data is copied from the operator computer and archived in the datacentre, original feed will be available.

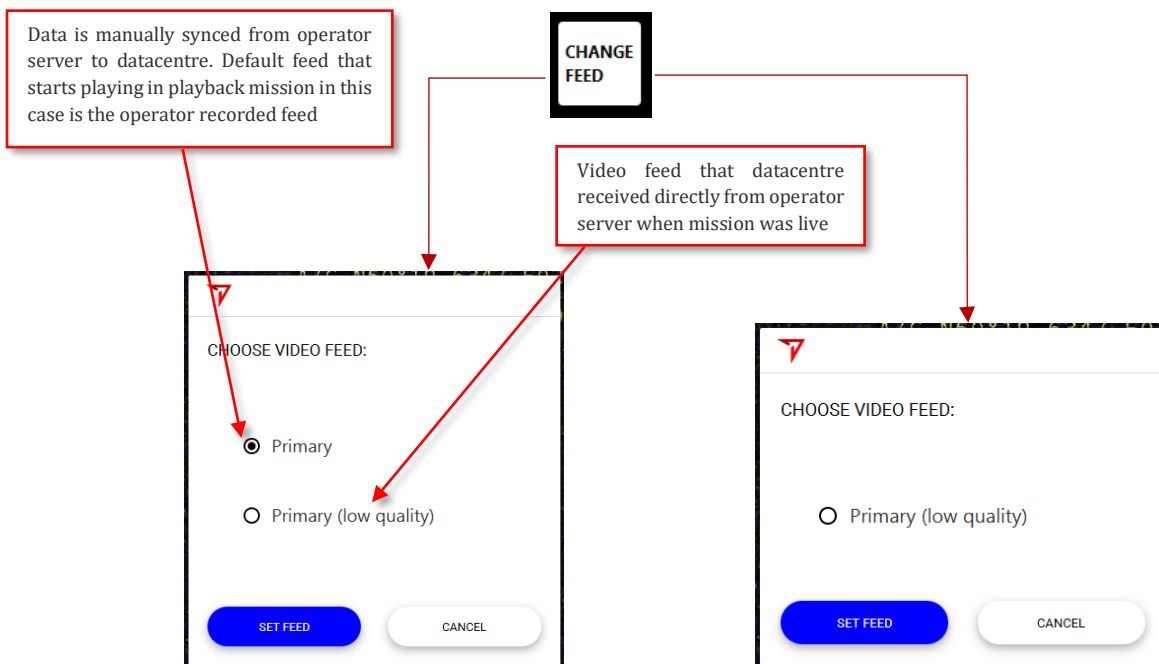


Figure 36: Select playback camera

## 7.7 SETTINGS AND ADMINISTRATION

Settings window allows user to define some values used MS wide, see changelog and perform admin tasks depending on user account type (admin, non-admin) and MS type (operator or observer) or see server info and restart server if it's MS operator version.

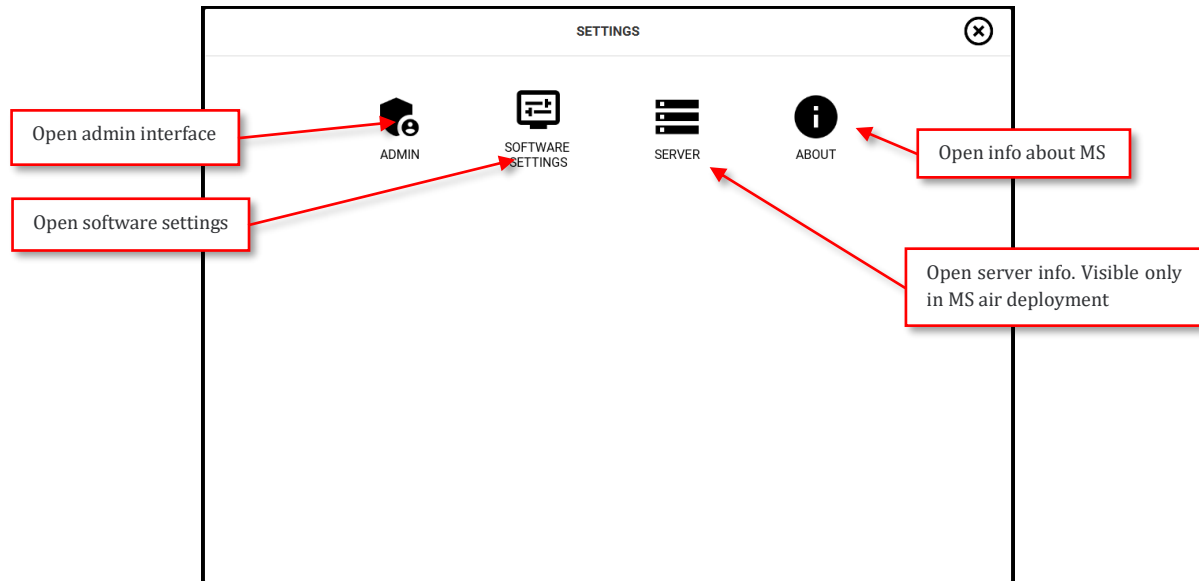


Figure 37: Settings window

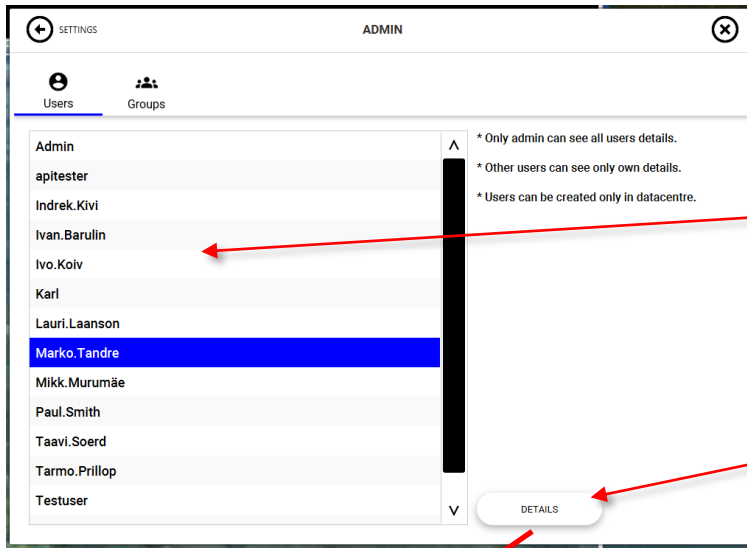
### 7.7.1 User management

User management is done through the administration interface. Operator MS instance can only view user information and change the password. Other user management tasks are performed in the observer instance connected to a datacentre. This is done to ensure an up-to-date user list as the operator might not have connection with the ground server thus avoiding conflicts in data. User list is visible to all users but user details can be only viewed by administrators and to the user themself.

User management can be opened from settings window under "Admin" button.

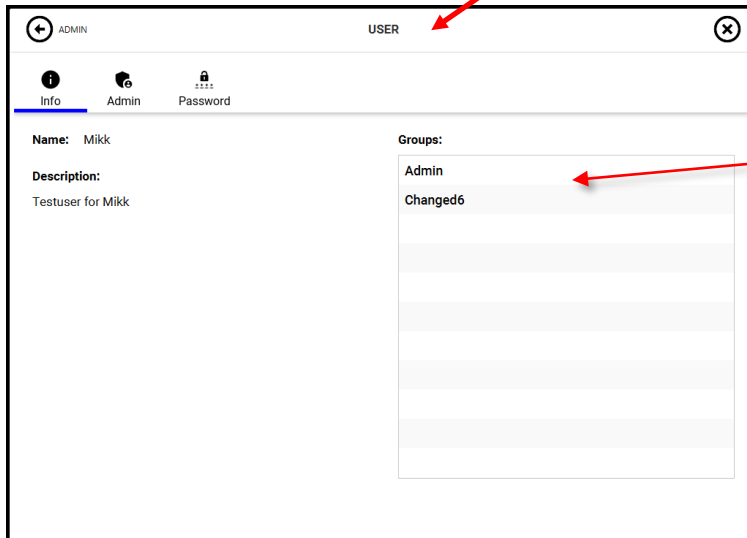
### 7.7.1.1 Operator administration interface

Operator administration interface allows the user to view users and groups information and change the password.



Non-admins can't see inactive users here. Admins see all users here and also it's shown in brackets if user is locked or inactive

If logged in user is not admin then it's enabled only if logged in user is selected in list



List of groups user belongs to



Tab visible only to admin

Checkboxes disabled in MS operator version. Shown here only for information purposes

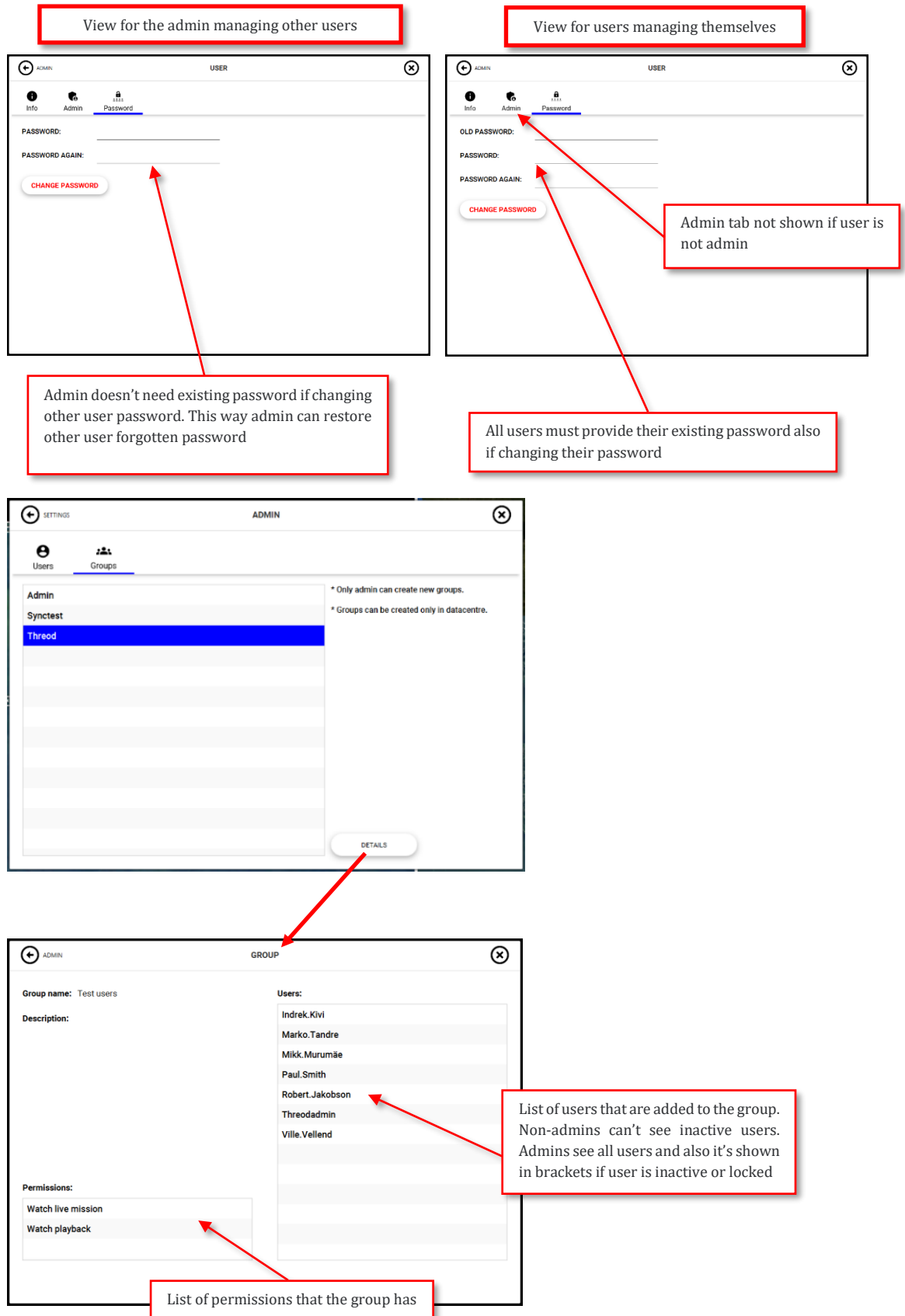


Figure 38: Operator administration interface

### 7.7.1.2 Observer administration interface

Observer (connected to datacentre) administration interface allows administrator account holders to manage users and groups. Non-administrators can see their own info, user list



and groups. Once a user is created it cannot be deleted to prevent un-associated mission items and data to be present. Instead of deleting a user it can be inactivated. Username can't be changed.

Non-admins can't see inactive users here. Admins see all users here and also it's shown in brackets if user is locked or inactive

For non-admins it's enabled only if user selected himself in the users list

Visible only to admins

\* Only admin can see all users details.  
\* Other users can see only own details.  
\* Only admin can create new users.

Non-admin

Admin

Select groups where user should belong

Non-admin can change only description and password for itself. Can be empty

This will be text field if creating new user

Create button if creating new user

Back to users list. Any unsaved changes are lost

Password tab if editing user

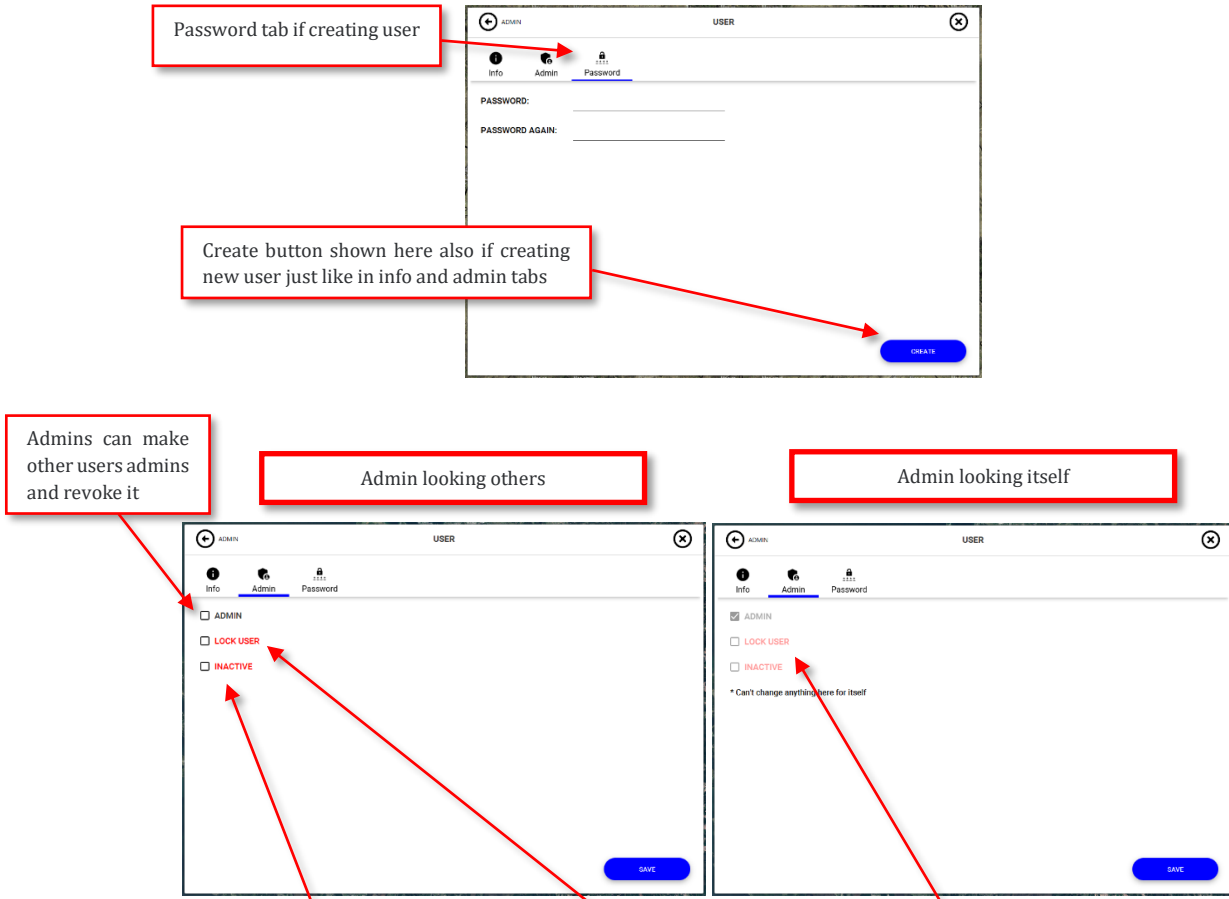


Figure 39: Observer administration interface - users

User can't be deleted but can be marked as inactive. In this case user can't log in anywhere. Deleting user completely is impossible because data integrity will be broken otherwise - for example don't know who created the mission or sent chat message anymore.

User becomes locked if enters wrong password 5 times in MS observer version. Admin can lock and unlock user at any time. User can log in in MS operator version if locked.

Can't change itself

Access to missions is determined by group membership. To give a user access to a specific mission it must be a member of any group that is listed under a mission and the group must have permission(s). Group based access provides a quick way to manage different access policies.

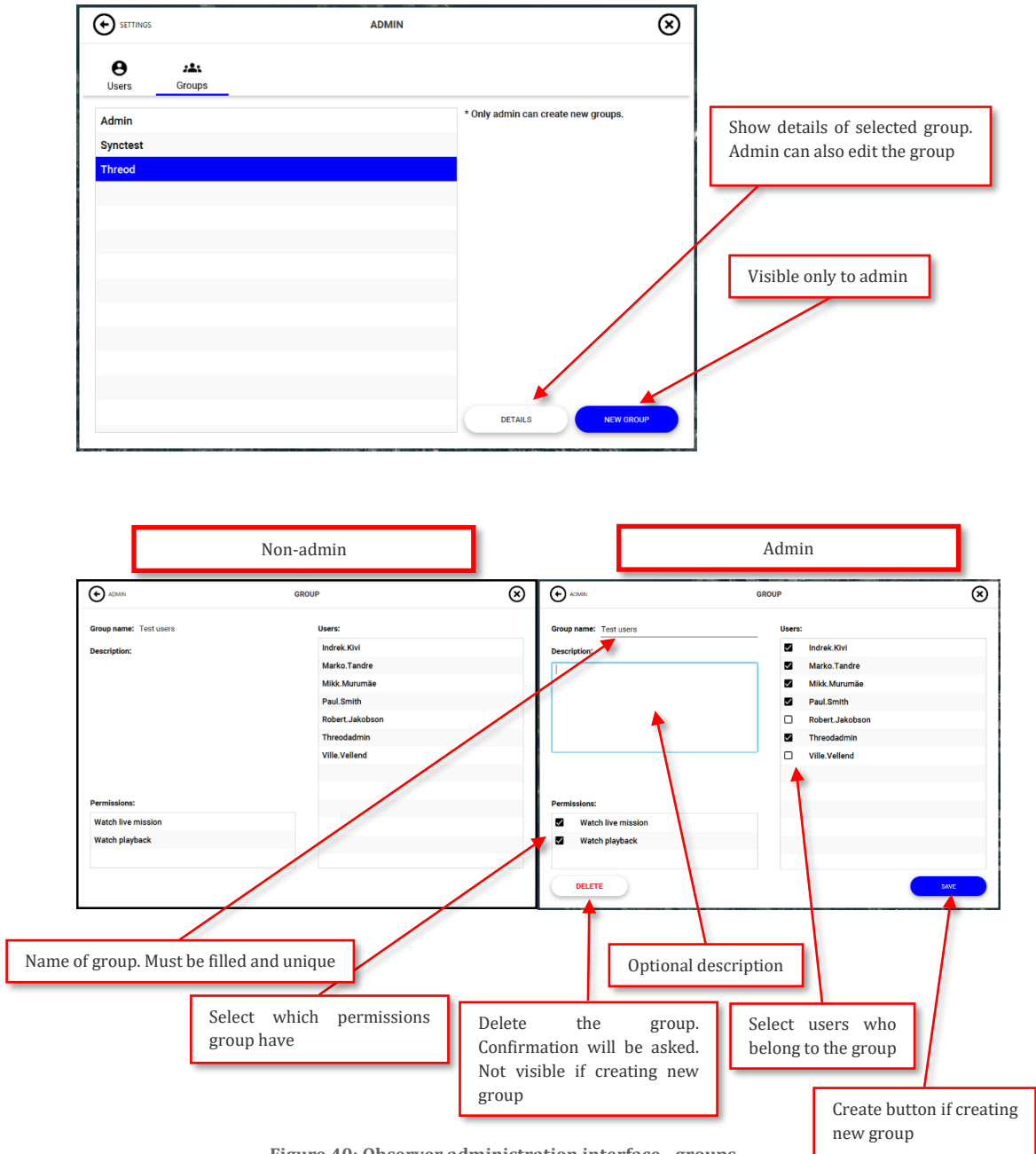


Figure 40: Observer administration interface - groups

### 7.7.2 Software settings

Software settings are user based and stored locally.

The screenshot shows the 'SOFTWARE SETTINGS' window with three main sections: MISSION, SYSTEM, and JOYSTICK. The MISSION section includes a checked checkbox for 'All chat popups turned on by default' and an unchecked checkbox for 'Automatic audio recording'. The SYSTEM section includes dropdown menus for 'Time mode' (set to 'UTC time') and 'Coordinate system' (set to 'MGRS'). The JOYSTICK section includes a dropdown for 'Joystick next POI' (set to 'Title starts with') and a text field containing 'JOYSTICK'. A note below the JOYSTICK section reads: '\* Choose how next/previous POI (joystick) is chosen where gimbal should look'. Five callout boxes provide additional details: 1. 'All chat popups turned on by default': 'If selected then all chat channels when loading mission and newly created chat channels will show popup when new message arrives by default just like normal chat programs'. 2. 'Automatic audio recording': 'If audio will be automatically recorded or not when loading live mission'. 3. 'Time mode': 'MS wide time mode how times will be shown. Options: time in UTC, local time and time from mission start. Time from mission start can't be applied everywhere (for example all 'created at' times, chat message times etc) then UTC time is used. Changing here will apply everywhere in MS and if changed elsewhere (seekbar for example) then it changes here also automatically'. 4. 'Coordinate system': 'Coordinate system used MS wide. Options: MGRS, LATLON, DDM, DMS'. 5. 'Joystick next POI': 'Choose at which POI gimbal should look at (turn to watch and set to geolock mode) when watch next/previous POI is selected in joystick. This is visible only for operator version. Options: "Title starts with", "Title contains", "All local POIs" and "All POIs". For first two options text field will be shown next to the drop down menu to write the sentence for searching the POI'.

Figure 41: Software settings

### 7.7.3 Server info

Allows to see server info about how much free space is left on hard drive where server records mission data and approximately how long mission can be recorded with given free space. Additionally, server can be restarted when required in this tab if it's operator version.

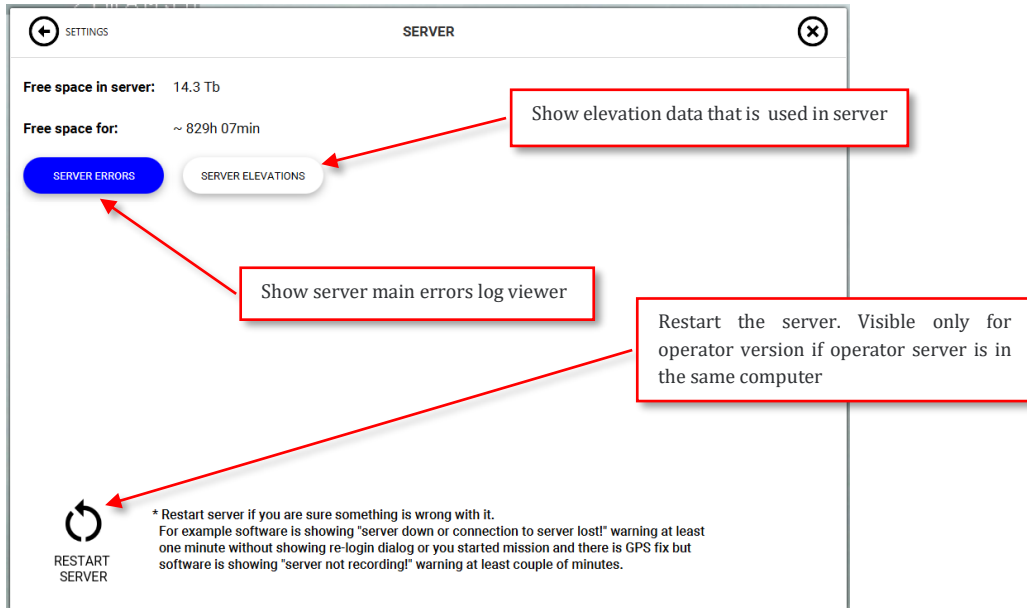


Figure 42: Server info

### 7.7.4 Server errors

Server main errors log viewer. Main purpose is help for administrators and developers if something doesn't work and can see what is failing and maybe why it's failing.

In the logs there is no sensitive data like passwords or usernames.

Can take out logs for certain date period and save it to file. This way if something doesn't work it's first place administrators or developers can debug what or why something is not working and decide if more precise logs are needed from server and/or MS.

Errors shown here are stored in database and these are duplicated in server own log files.

Deleting errors here will not delete errors from server own log file.

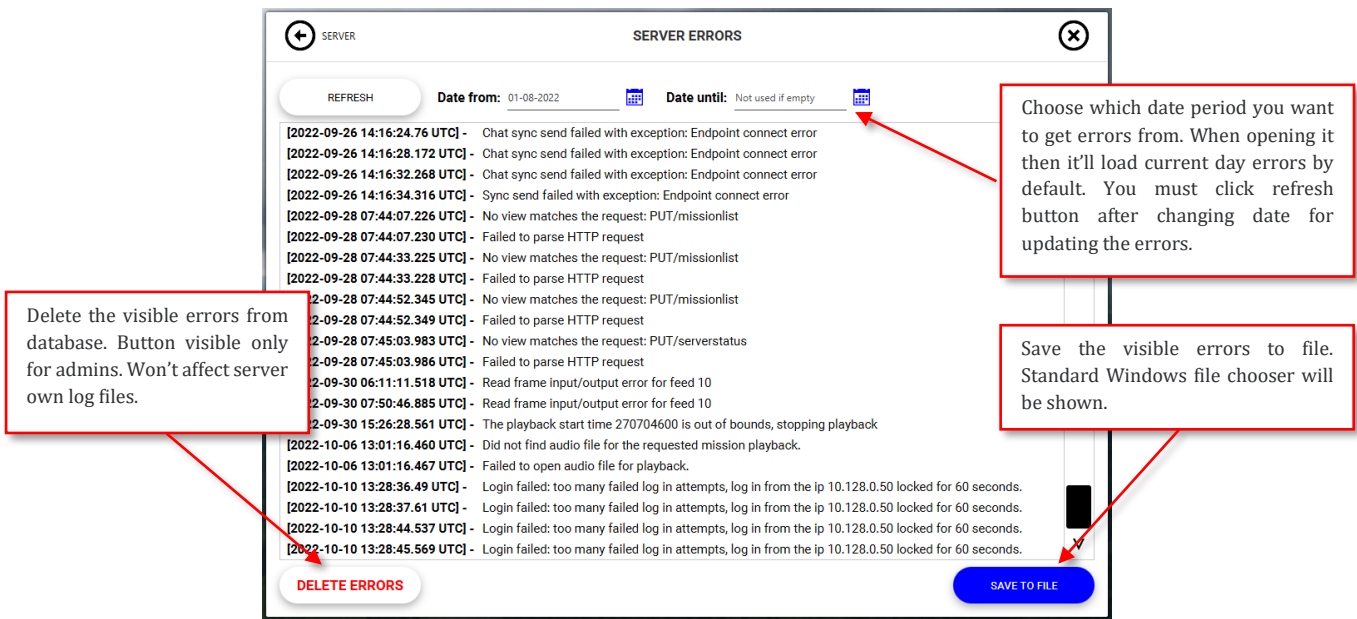


Figure 43: Server errors

### 7.7.5 Server elevation data

Displays list of elevation files installed and used in server for data calculations. With this information you know if data calculations (footprint for example) for current flight area are correct.

Server can be manually commanded to reload the elevation data files. Usually, it's not necessary as they are reloaded automatically when user logs in or a new live mission appears (create new in operator version or found new live mission after syncing in datacenter). It may be necessary if new elevation data was installed to the server in the middle of live mission especially for operator version.

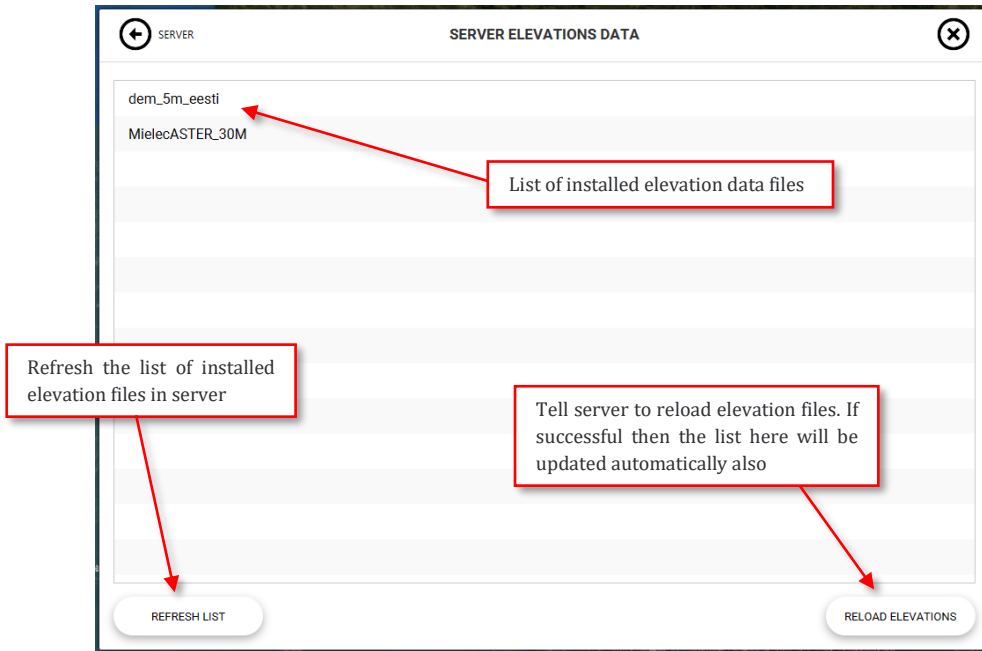


Figure 44: Server elevation data

### 7.7.6 About

About section contains current MS software version and changelog where you can track changes, added or removed functionalities and information about error corrections.

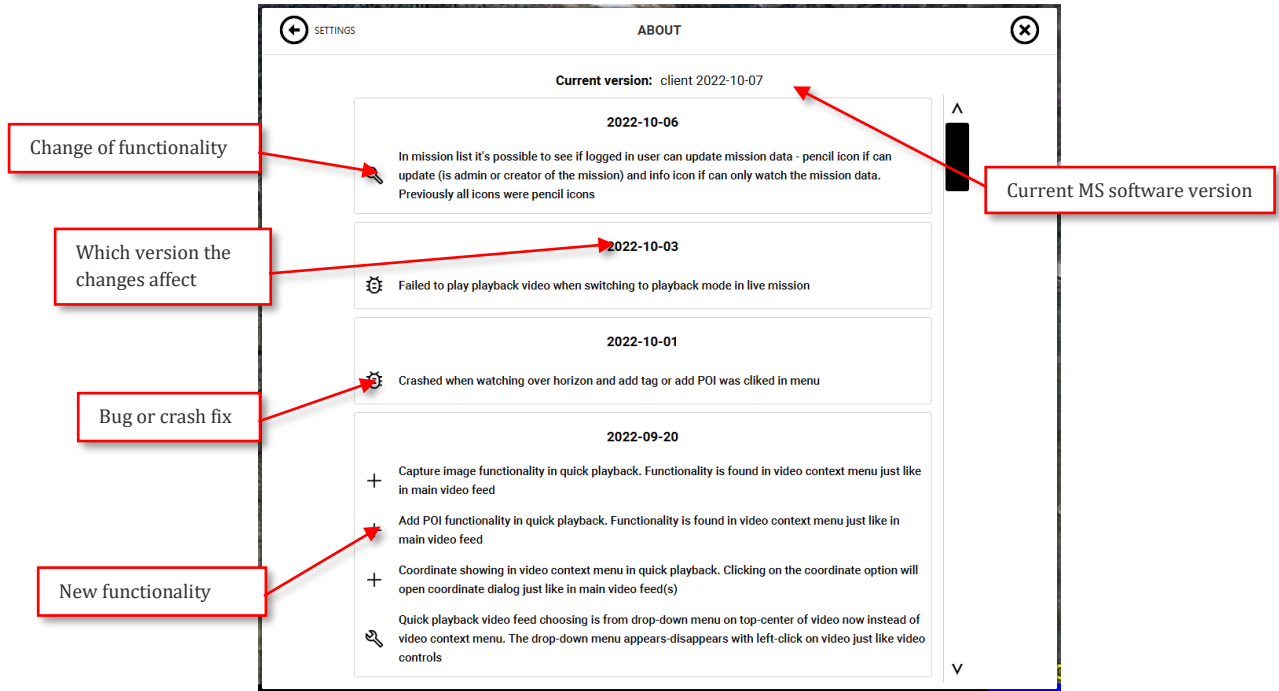


Figure 45: About



## 7.8 SEEK BAR

Seek bar is used to control video playback, extract clips, and navigate between recorded tags.

Seek bar is divided into two separate navigable bars. Lower bar is the main video timeline with a user adjustable zoom box. Zoom box width is adjustable from the two sides and it determines the start and end times for the upper zoom box timeline bar. Main video timeline also indicates the timestamps where tags are present with vertical lines.

Upper bar is the zoom box timeline. It allows for the fine seeking of video footage to a precise point in time regardless the overall video duration or window size. Tag icons are also highlighted on it and can be clicked on to toggle tag dialog visibility or double-click to navigate there quickly.

Seek bar provides buttons for seeking 15 seconds forwards or backwards and one button for play or pause the video.

Play/pause can be toggled with keyboard space key, rewind 15 seconds with keyboard left key and forward 15 seconds with keyboard right key. Keyboard keys can be used only if all dialogs are closed, or last click was on one of the main windows (where video or map is).

Video extract button will command the server to generate a video file that corresponds in duration to the zoom box and download it to user specified destination.

Left click on video will show/hide the seekbar.

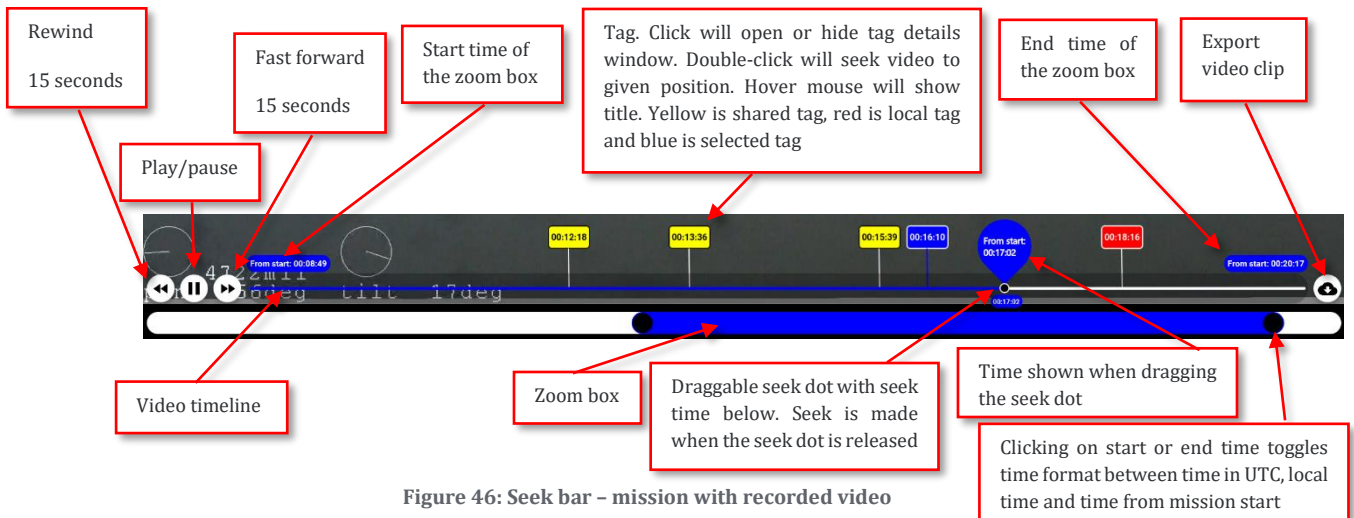


Figure 46: Seek bar - mission with recorded video



Figure 46: Seek bar - mission without recorded video

### 7.9 EXPORT VIDEO CLIP

Video clip exporting function sends the server video feed ID, a start and end timestamp based on the zoom box. The server generates a video file from chosen video feed which is then provided to the client.

You should set start of the video 10 seconds before seek position you want to see in exported clip as first couple of seconds might not be playing. Best is to play the exported file with Movies & TV app. VLC will not play the file. Windows Media Player seek will take time.

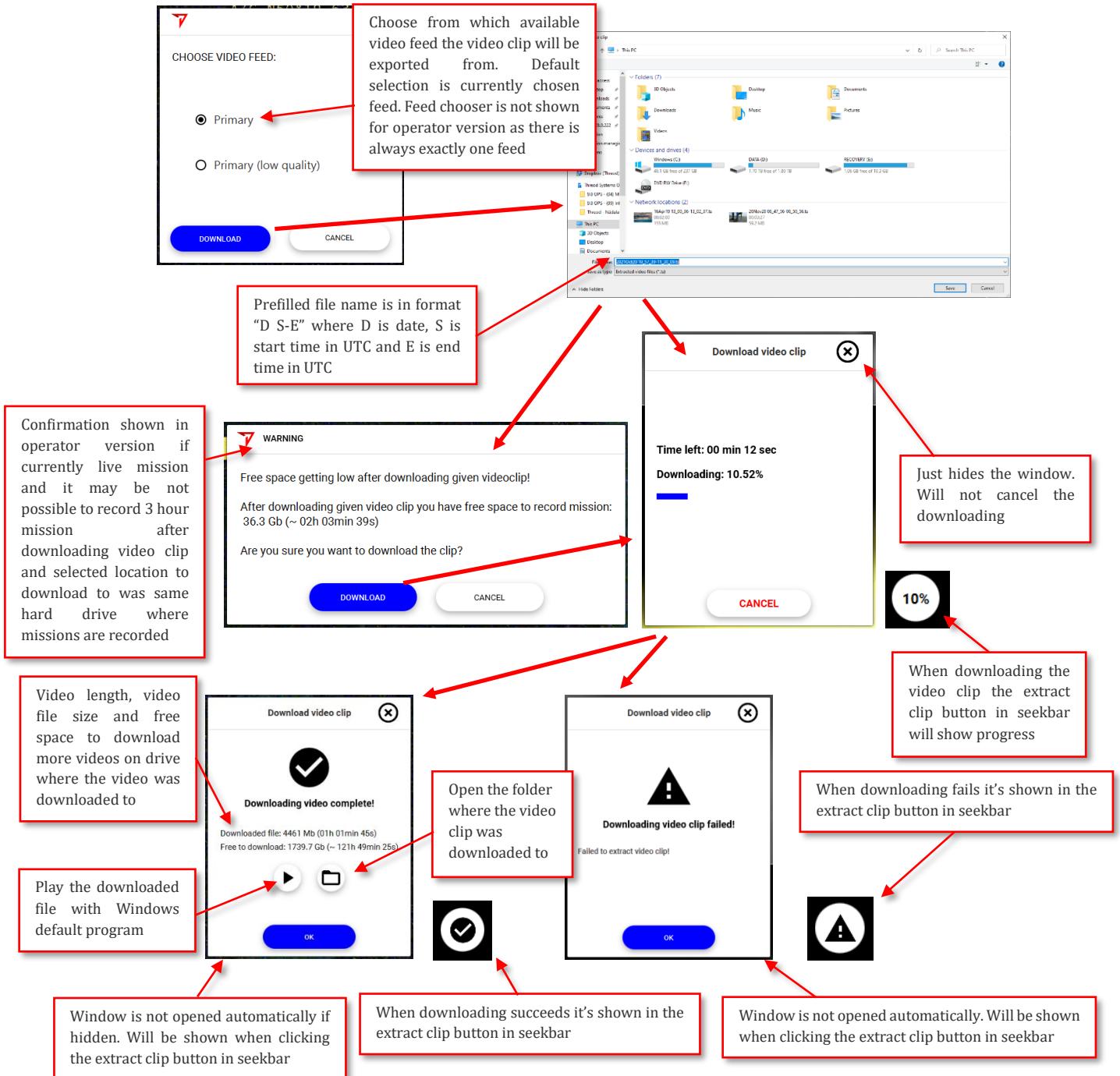


Figure 47: Export video clip flow

## 7.10 MOVING MAP DISPLAY

Moving map display displays the base maps and all geographical information. The moving map display consists of map layer such as imagery, topographic maps, elevation data, camera footprint, video on map, history, heatmap, tags, points of interest and aircraft position and heading indicator.

Map layers are controlled with map layer manager. Other functions and tools are accessed through a context menu which can be activated by a right click or touchscreen alternate directly on a map or map icons. Mouse left button drag will move the map and mouse right button drag will turn the map viewport to view it in different angle in 3D.

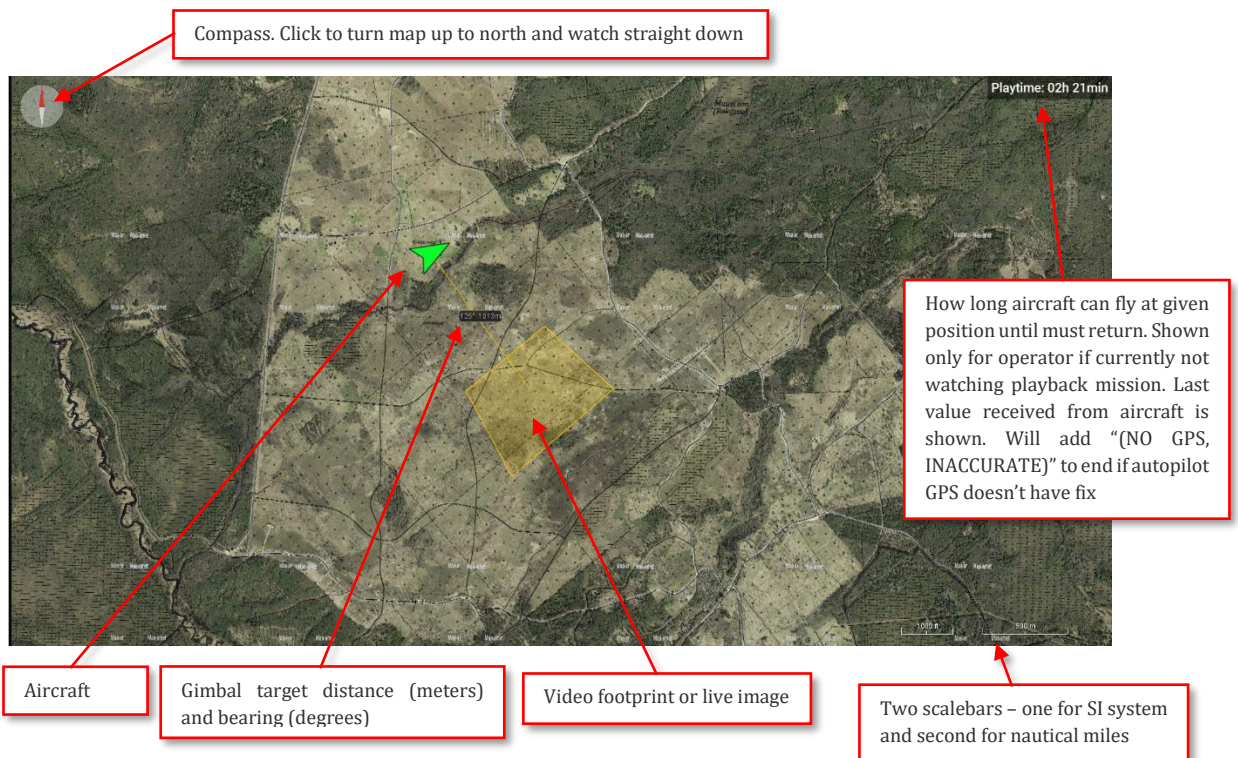


Figure 48: Moving map display

### 7.10.1 Map layer manager

Map layer manager provides the user with controls to show, hide and configure all available layers. Map layer manager can be opened from map context menu.

Imported layers can be either raster or vector layers, or WMS source imported to the mission software by the operator. All files except KML/KMZ files are copied internally and can be deleted after successful importing. KML/KMZ files are not copied, meaning they must not be deleted/renamed/moved but are automatically restored next MS start-up. KML/KMZ files are user-based meaning if one user imports it then other user who logs in and wants to see it also must import the same KML/KMZ also. Enabled states and order in list are not user based but for all users.

Importing layer from file can take long time. If there are multiple computers where the same layer is required to be installed from file, then it can be imported once in one computer and then the generated folder can be copied manually over to other computers. To see the folder where the layer was imported Windows file explorer must be set to show hidden files (view tab -> hidden items checkbox). Location where imported layers folders are usually "C:\ProgramData\WorldWindInstalled". In some cases, it may be located under: "C:\ProgramData\Application Data\WorldWindInstalled".

WMS layers are shared with Threod GCS and are cached automatically for offline usage.

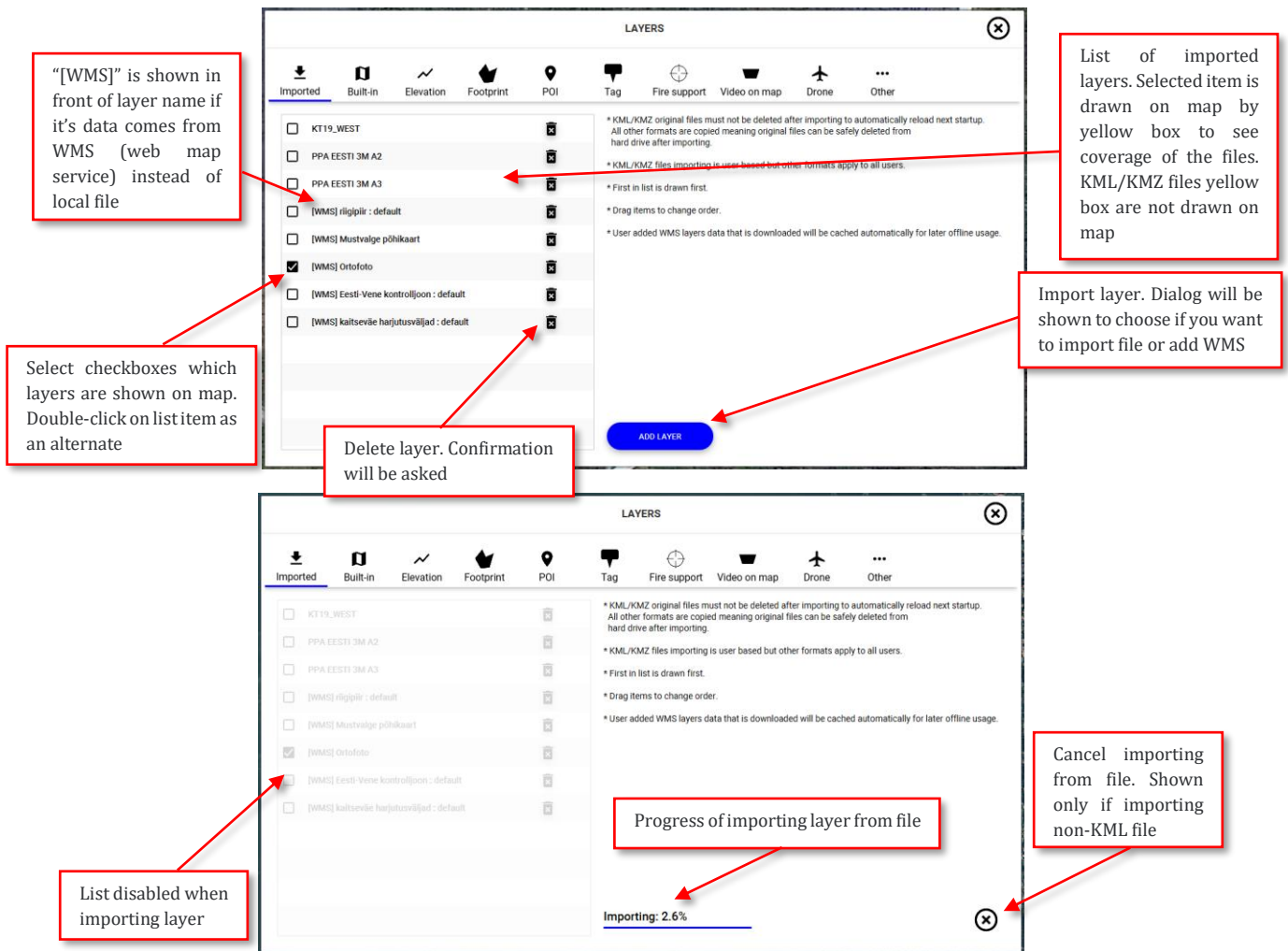


Figure 49: Map layer manager – imported layers

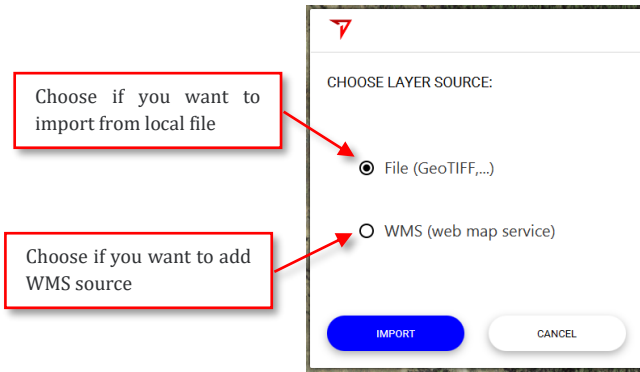


Figure 50: Import layer source dialog

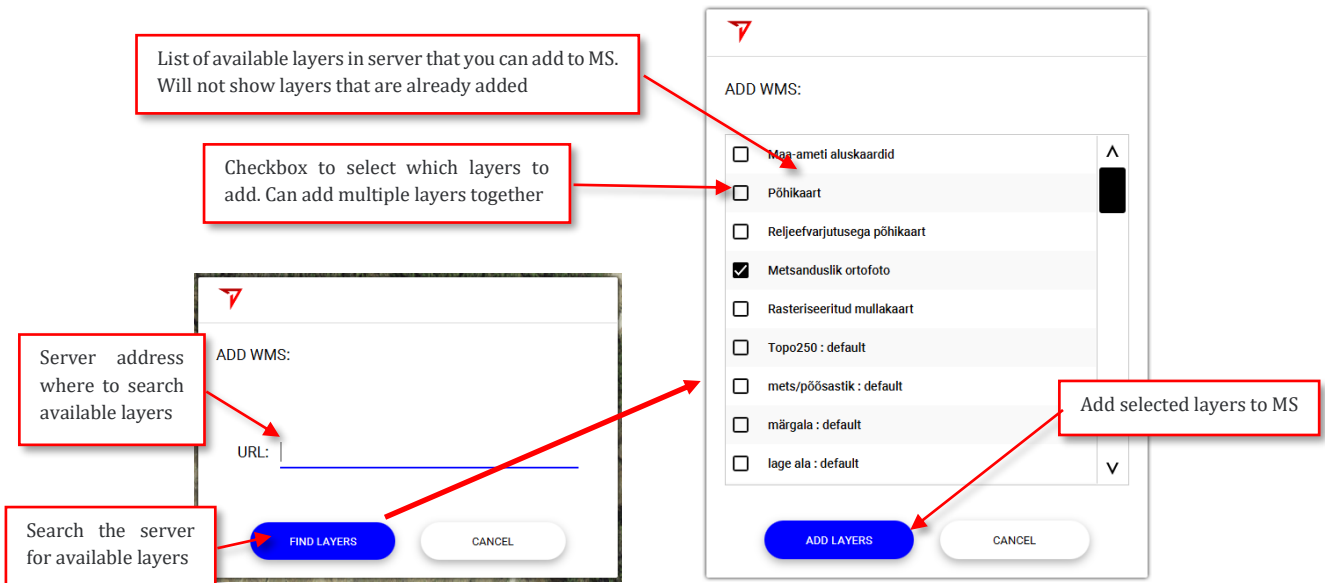


Figure 51: Add WMS layer dialog

Built-in layers are integrated into the mission software and may be enabled or disabled by the user. Drawing order of the built-in layers can't be changed by dragging and they cannot be deleted. Maps that are loaded will be cached automatically and can be shown when offline.

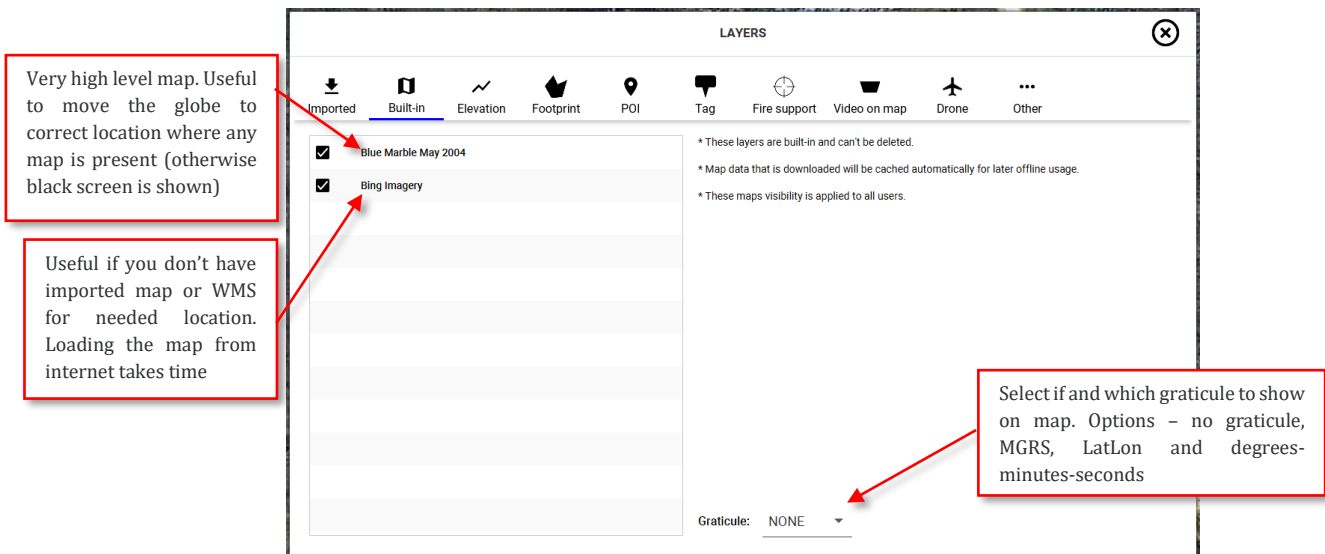


Figure 52: Map layer manager - built in layers

Elevation layers or DEM-s (digital elevation models) are imported to the mission software by the operator.

On the left list there is elevation data that is used by map to draw the map in 3D and on the right list there is elevation data that is used for coordinate and other calculations. The latter are used also by the server.

For the right-hand list (used for calculations), it is necessary to have the elevation GeoTIFF file stored in folder shown under the list. The folder is scanned only on MS startup, so changes made during runtime will not show before MS is restarted. For left-hand list (used to render the map in 3D) it is necessary to import it. As a note, importing can take long time and if performed once, the generated folder can be copied to other computers the same way as map layers.

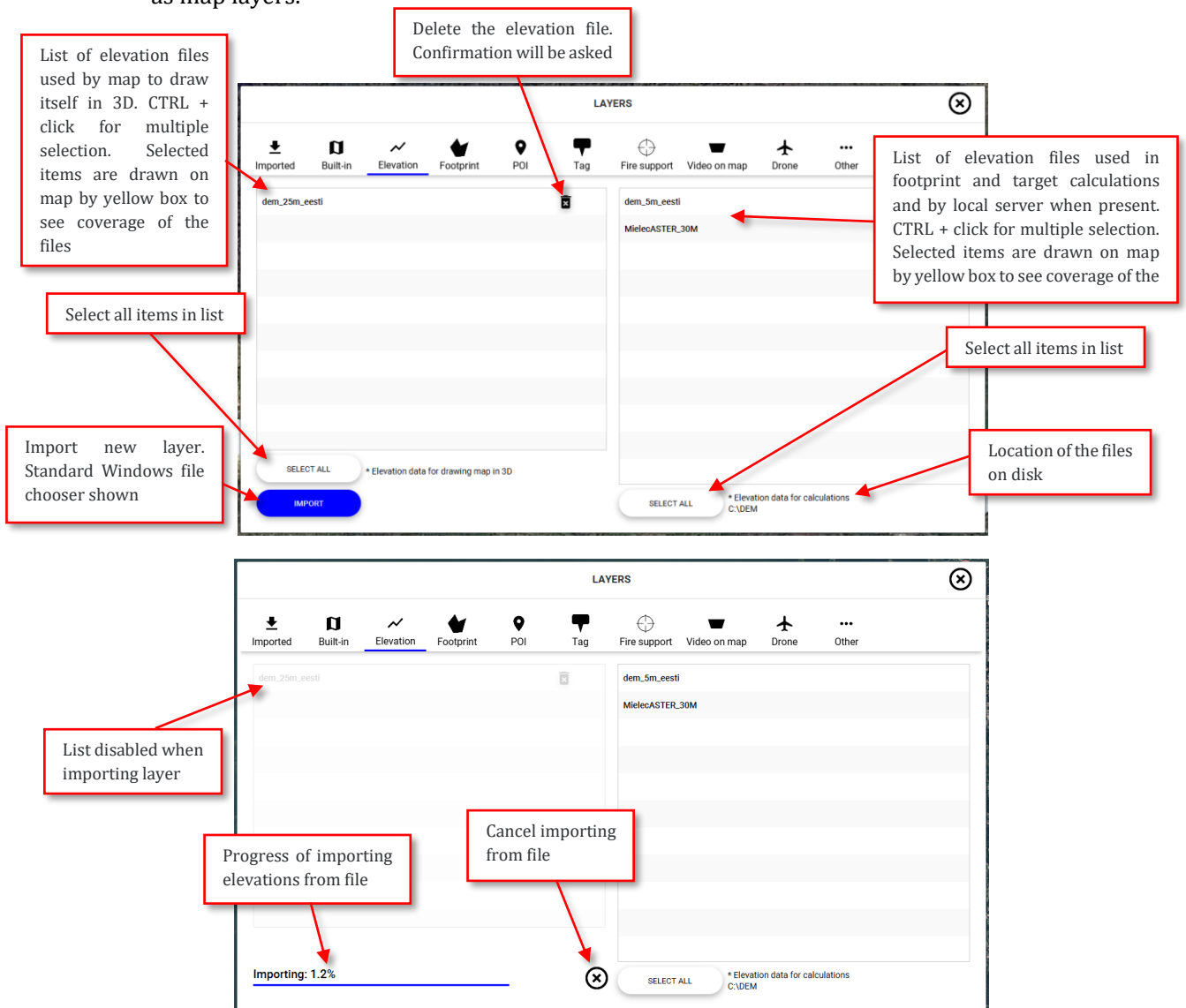


Figure 53: Map layer manager - elevation data

Footprint layer combines the instantaneous video footprints into a historic coverage overlay to visualize the observed area. Limited (MS operator version) or no settings (MS observer version) are shown if no mission is selected currently. Footprint is drawn for areas where the diagonal of the video footprint on map is equal or less than 2 kilometers.

NB: last minutes footprint type is reset when changing to other footprint type or deselecting "Show" checkbox.

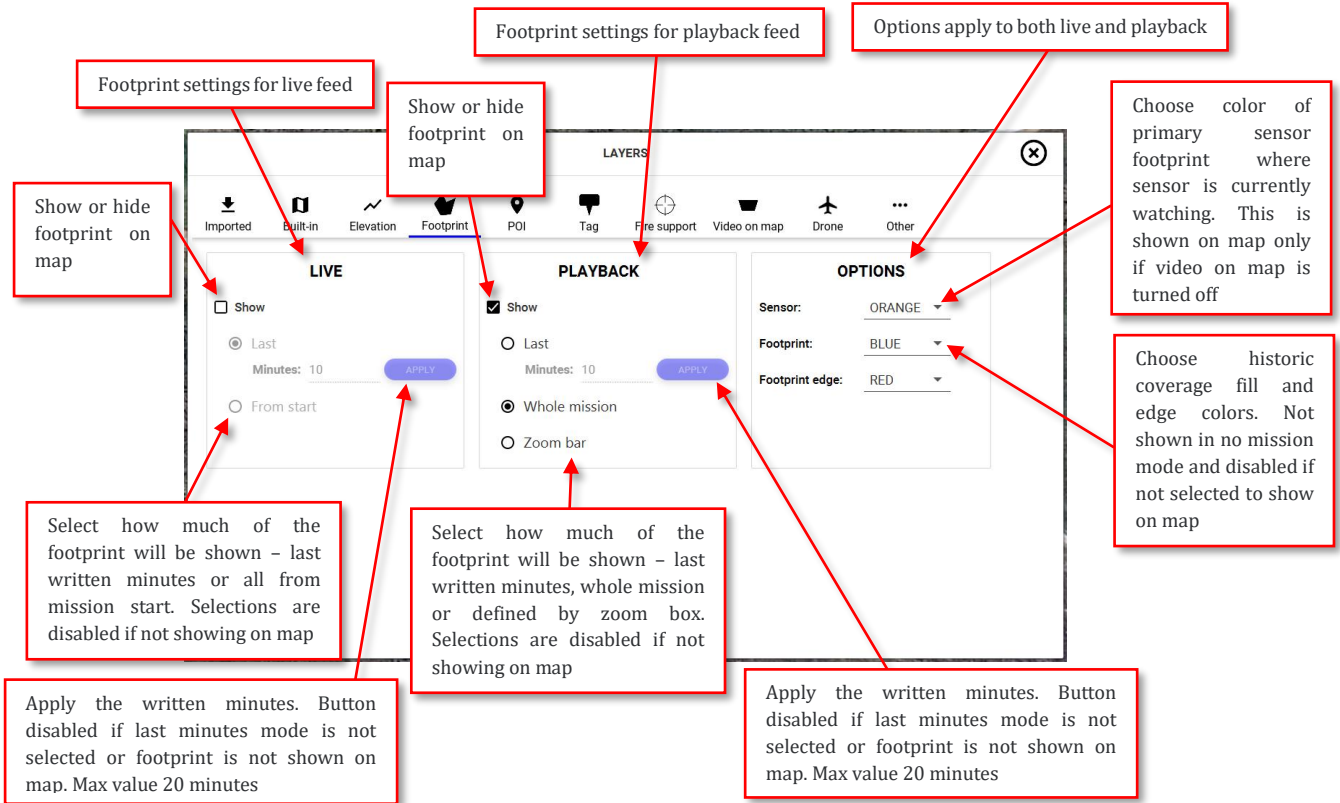


Figure 54: Map layer manager - footprint

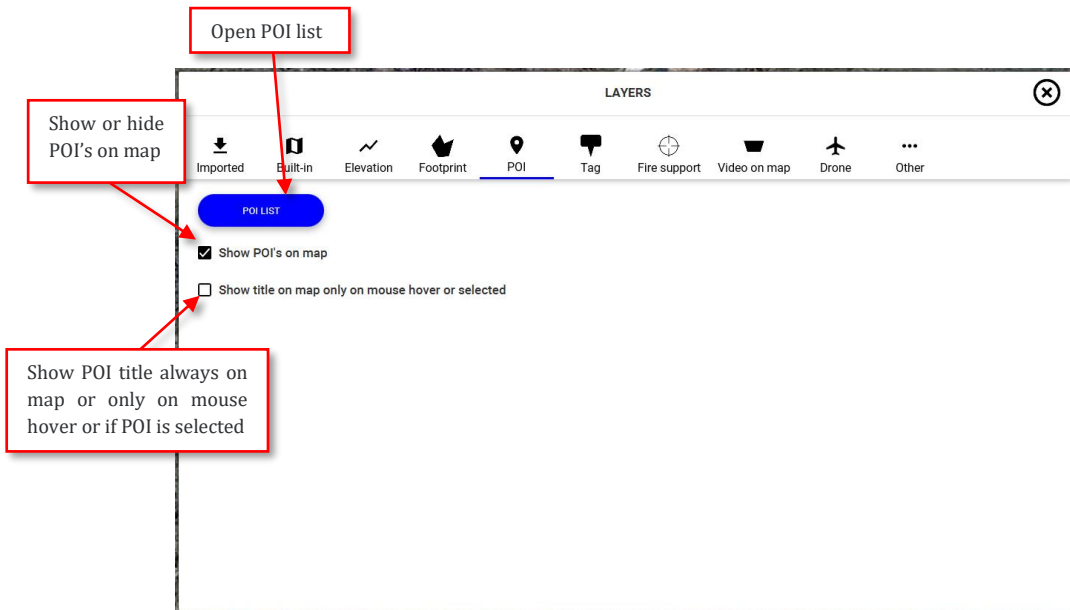


Figure 55: Map layer manager - point of interest

Tag settings are not shown if no mission is selected currently.

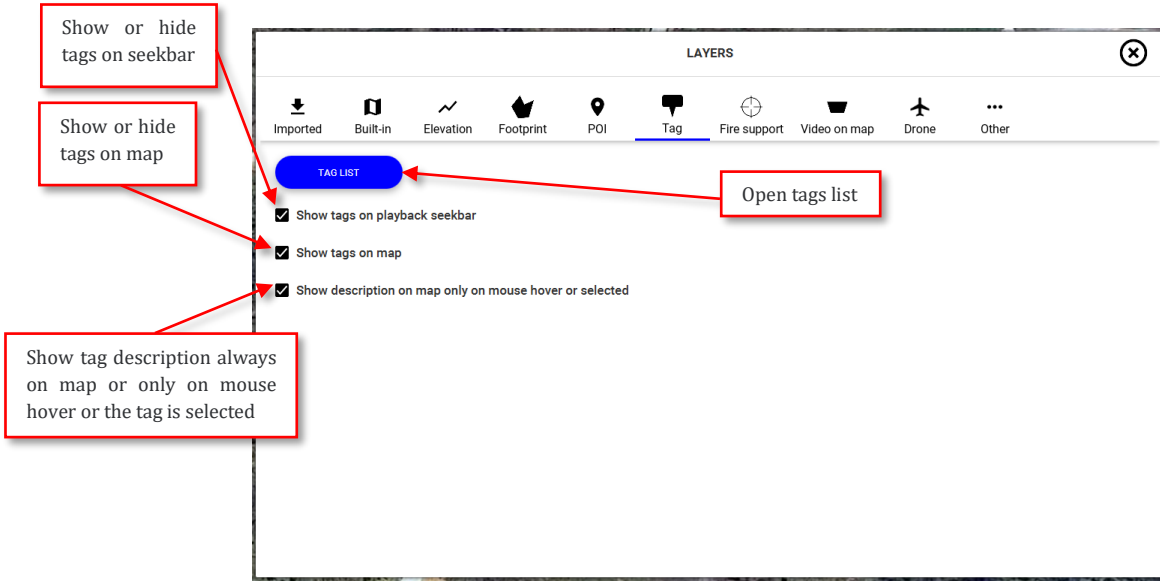


Figure 56: Map layer manager - tags

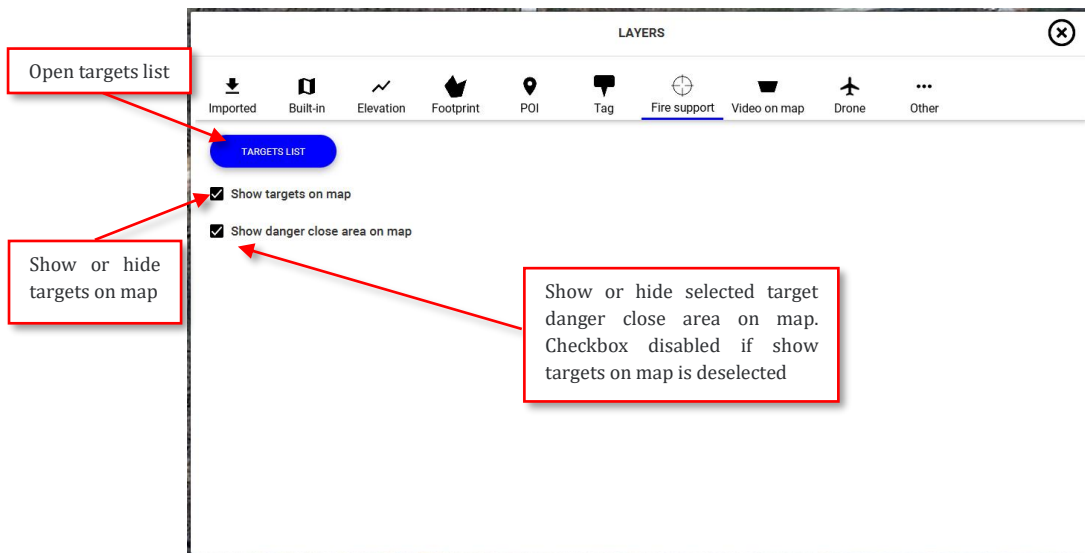


Figure 57: Map layer manager - fire support

Video on map layer shows live video feed on the map layer instead of the footprint. In MS observer version settings are not shown if no mission is selected currently.



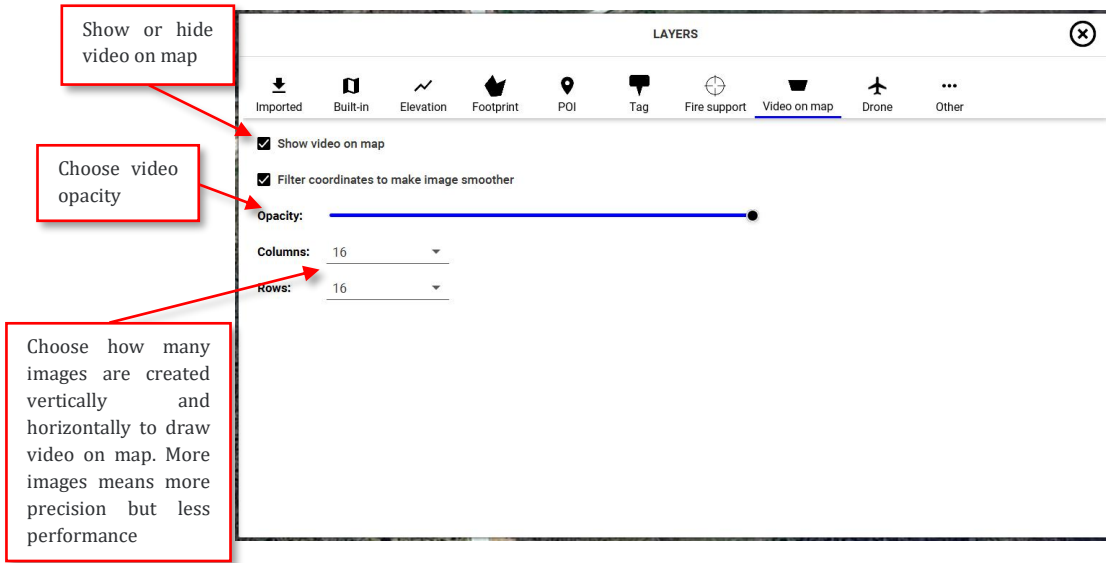


Figure 58: Map layer manager – video on map

Drone tab is shown only for operator and if MS is configured to be used with Threod GCS. Pilot can send the mission route from Threod GCS to MS. Manual loiter info is taken from autopilot telemetry and is shown/hidden automatically. Route information is not preserved, meaning after MS restart pilot must send route again.

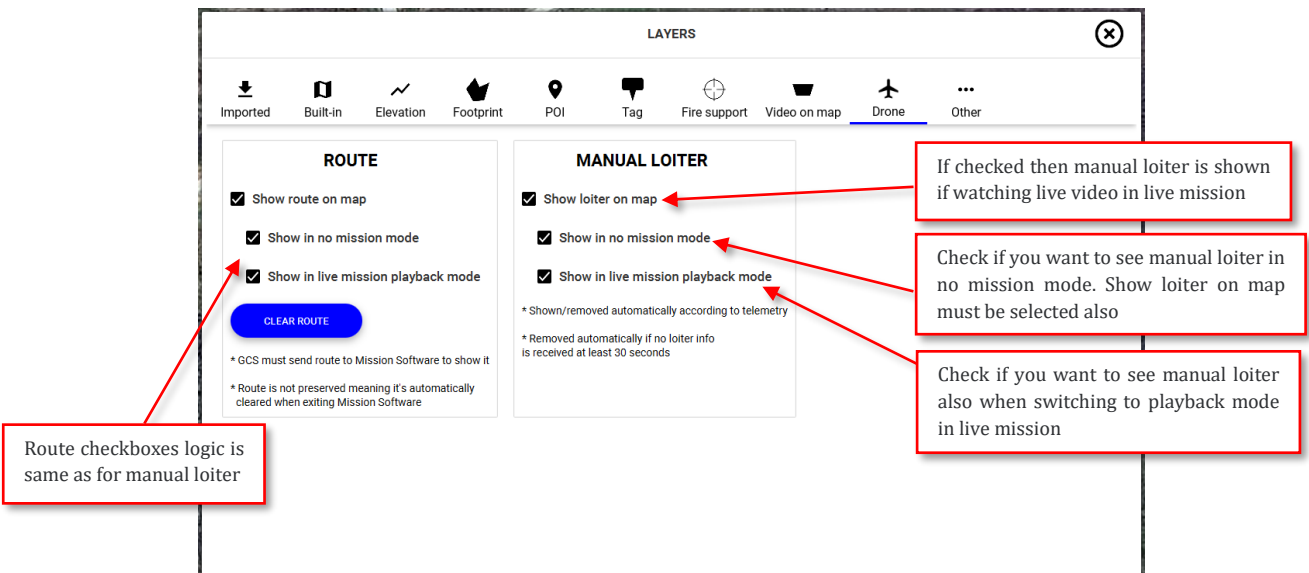


Figure 59: Map layer manager - drone

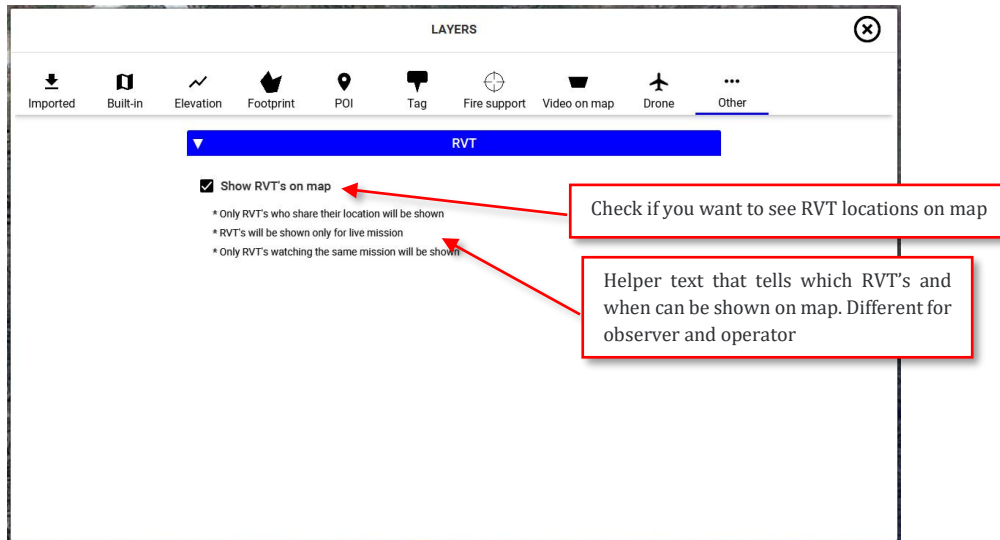


Figure 59: Map layer manager - other

### 7.10.2 Map context menu

Map context menu is displayed when the user right clicks or performs a touchscreen alternate on the map.

From the map context menu, the user can access map related functionality. Here is described default context menu. In some cases, there might be differences and those are described in relevant sections.

Coordinate and ground elevation of the clicked location. Elevation is from calculations elevation file(s) by default. If there is no calculations elevation file for given location then ground elevation is taken from map itself and "\*\*\*" will be appended to end of altitude. If clicked then coordinate dialog will be opened to see coordinate in different coordinate systems and copy to clipboard

Set gimbal to geo-point mode to watch the location. Not visible in playback mode and MS observer version

Create new local POI to the location. Not visible if not logged in

Show fire support sub-menu. Not visible if not logged in. Described in firesupport section

Open map ruler window to measure on map

Show map centering sub-menu. Not shown in MS observer version in no-mission mode

Open layers window

Search coordinate on map. Dialog will be opened to enter coordinate to find

Search archived videos for given coordinate. Search window will be opened and given coordinates are automatically filled

Show search sub-menu

Choose if map is kept centered on aircraft, video target or LOS line centre. Moving map manually (by dragging) will cancel it automatically. Clicking "zoom in map" button anywhere will disable it also

If checked then map is zoomed in/out automatically in a way the selected centering is always visible. Has minimum zoom in and maximum zoom in to not loose context of area. If active then using mouse scroll button you can change the offset to calculated zoom level meaning zoom in more/less than calculated zoom. Each map centering mode has own offset. If automatic zoom is disabled and enabled again then all map centering modes offsets are reset

If checked then map is rotated automatically so that map up is LOS line direction

If checked then map is rotated automatically so that map up is aircraft flight direction

Figure 60: Map context menu

CLICKED COORDINATE

MGRS LATLON DMS DDM

MGRS: 35VMF 34317 82537

CLOSE TO CLIPBOARD SEND CALL FOR FIRE

Copy the coordinate to clipboard in selected coordinate system and close the dialog

Choose in which coordinate system you want to see the location

Send call for fire over network for this location. Button shown if integration is implemented

Figure 61: Clicked coordinate dialog

### 7.10.3 Searching for coordinate on map

Coordinates search tool allows the user to enter and convert known coordinates and indicate them on the map layer.

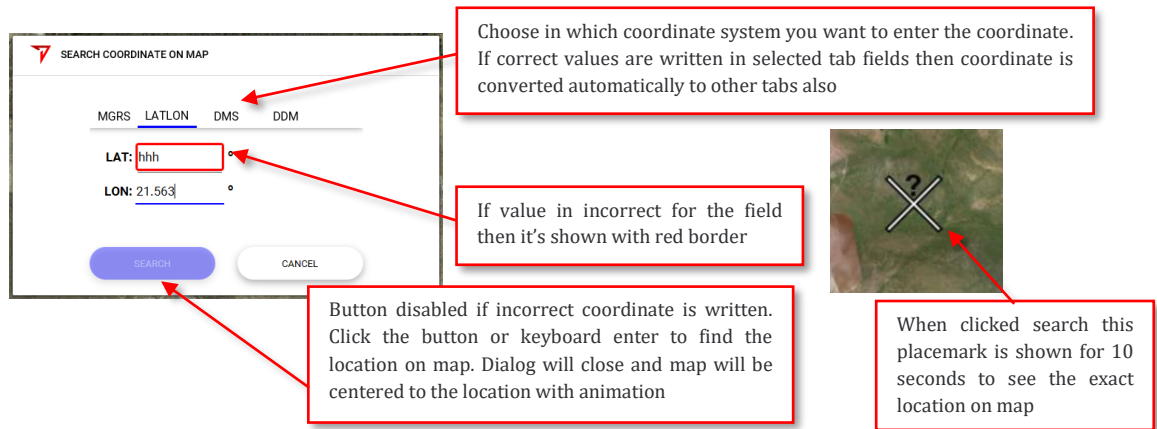


Figure 62: Search coordinate on map

### 7.10.4 Map measure tool

Map measure tool allows the user to measure lengths between two or more points and areas of polygons.

Map measure tool is accessible via the map context menu. Map measure tool settings are saved, and user based.

If map measure tool is open then no objects (tag, POI, target) can be selected on map so that it is easier to place measurement points near or on top of existing objects.

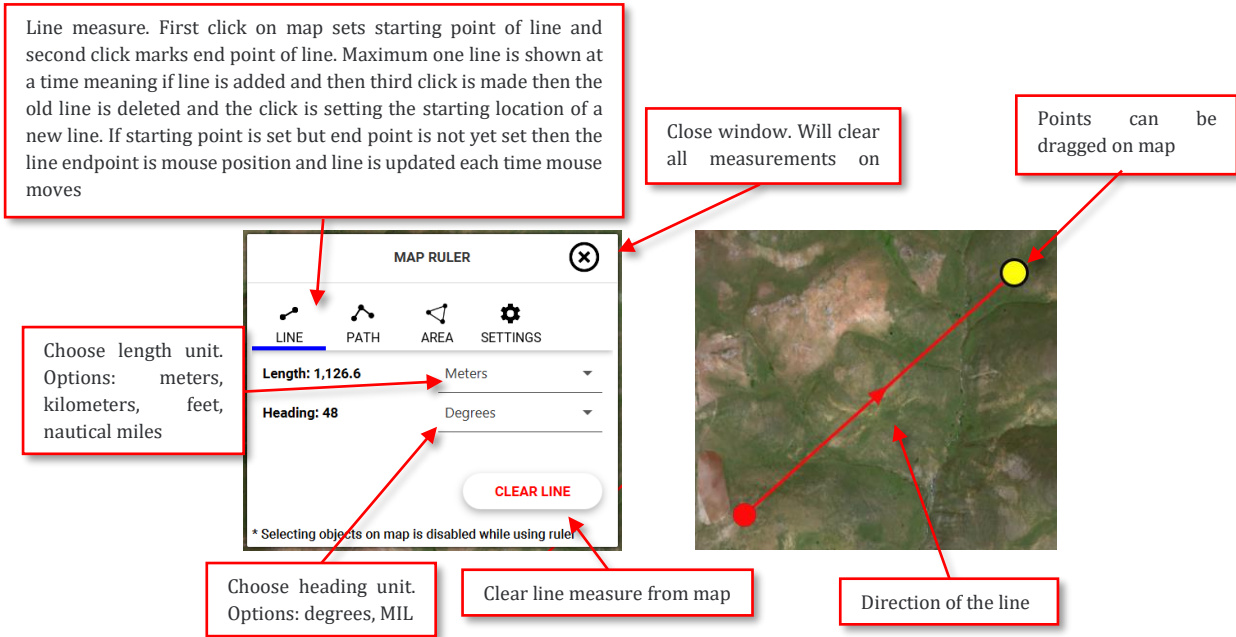


Figure 63: Measure tool - line

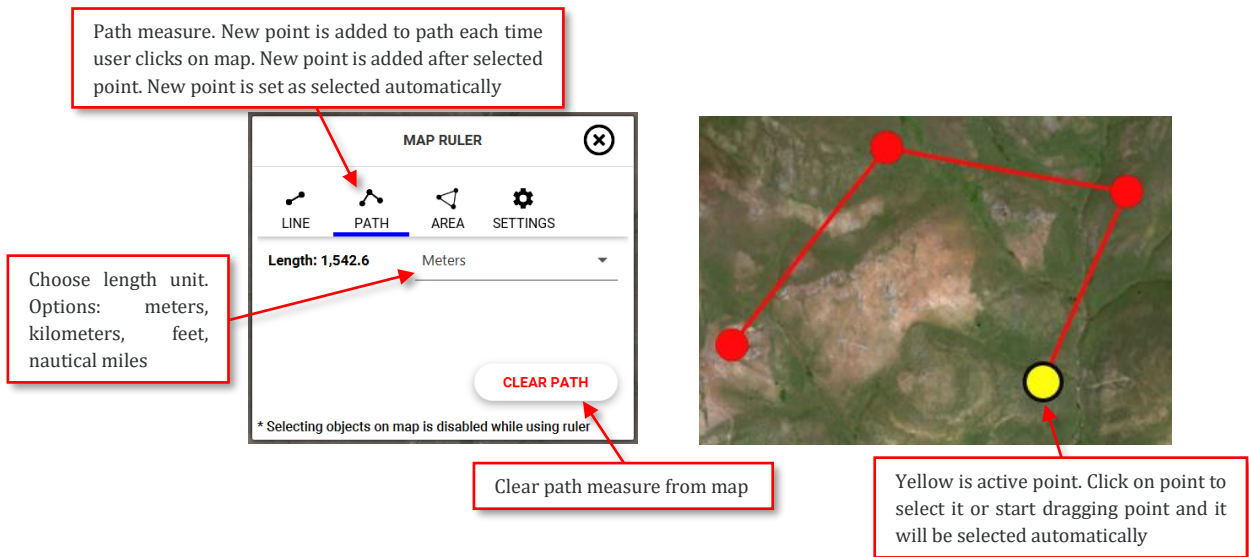


Figure 64: Measure tool - path

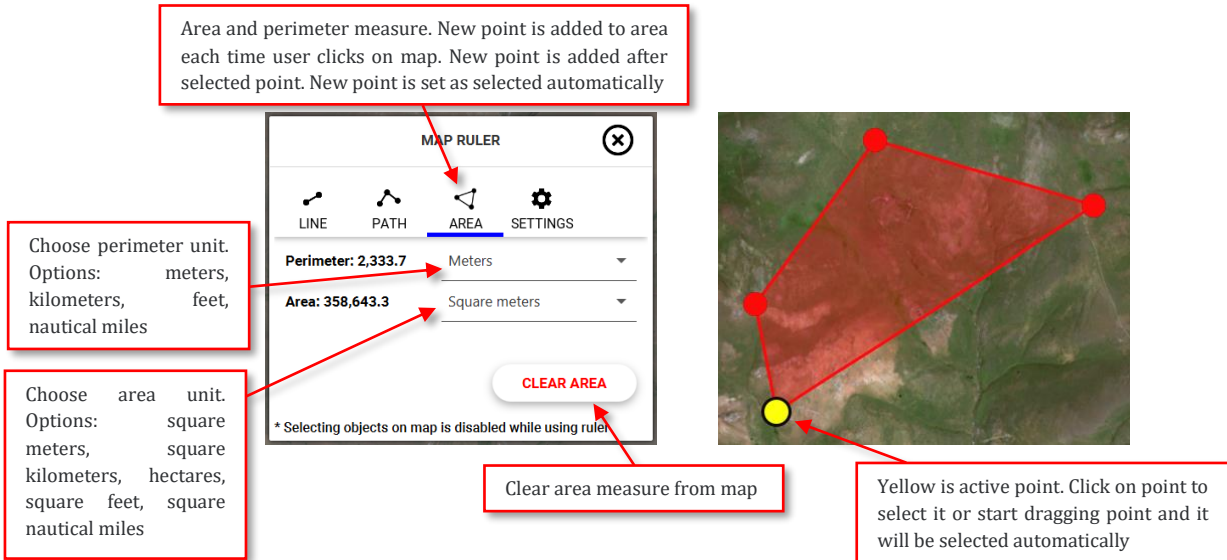


Figure 65: Measure tool - area

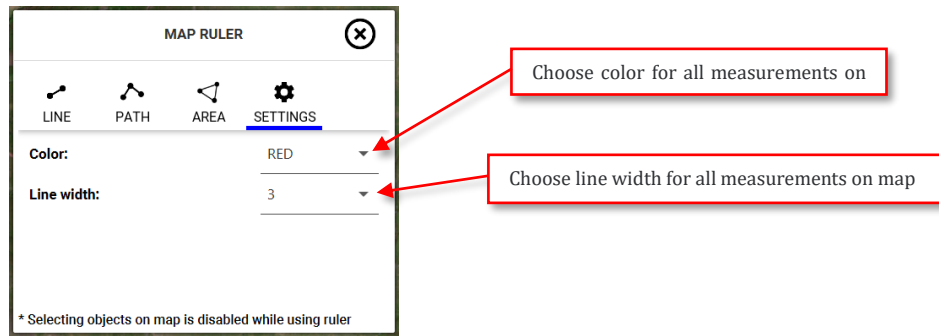


Figure 66: Measure tool - settings

### 7.10.5 Tags

Tags are references to a specific video timestamp and an associated snapshot image taken from video feed. Tags also contain the target coordinates of the gimbal at the point of capture. They can be thought of as bookmarks but with geographical information and optional description by user. Only creator of the tag can edit or delete tag.

Tags are on the video seek bar and represented on the map as an icon. Tags are always related to an ongoing or loaded mission and stored in the server or locally as part of mission data.

To create a tag, click the tag button on the button panel.

Map display provides a context menu when right clicking or using the touchscreen alternate on a tag icon. Tag will be selected automatically.

Tag images (that should be visible currently) which fail to download from server will be re-tried automatically every 20 seconds. Download fail may happen for example if servers sync the data and text part is synced but image syncing is not yet done or connection is bad.

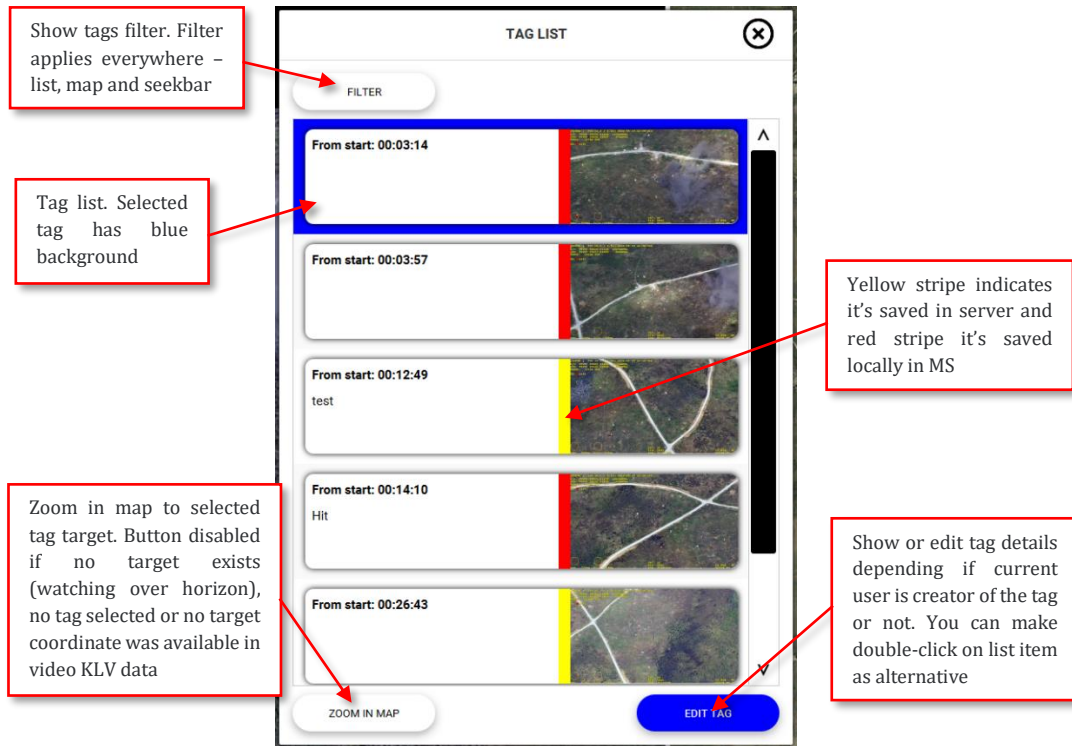


Figure 67: Tag list

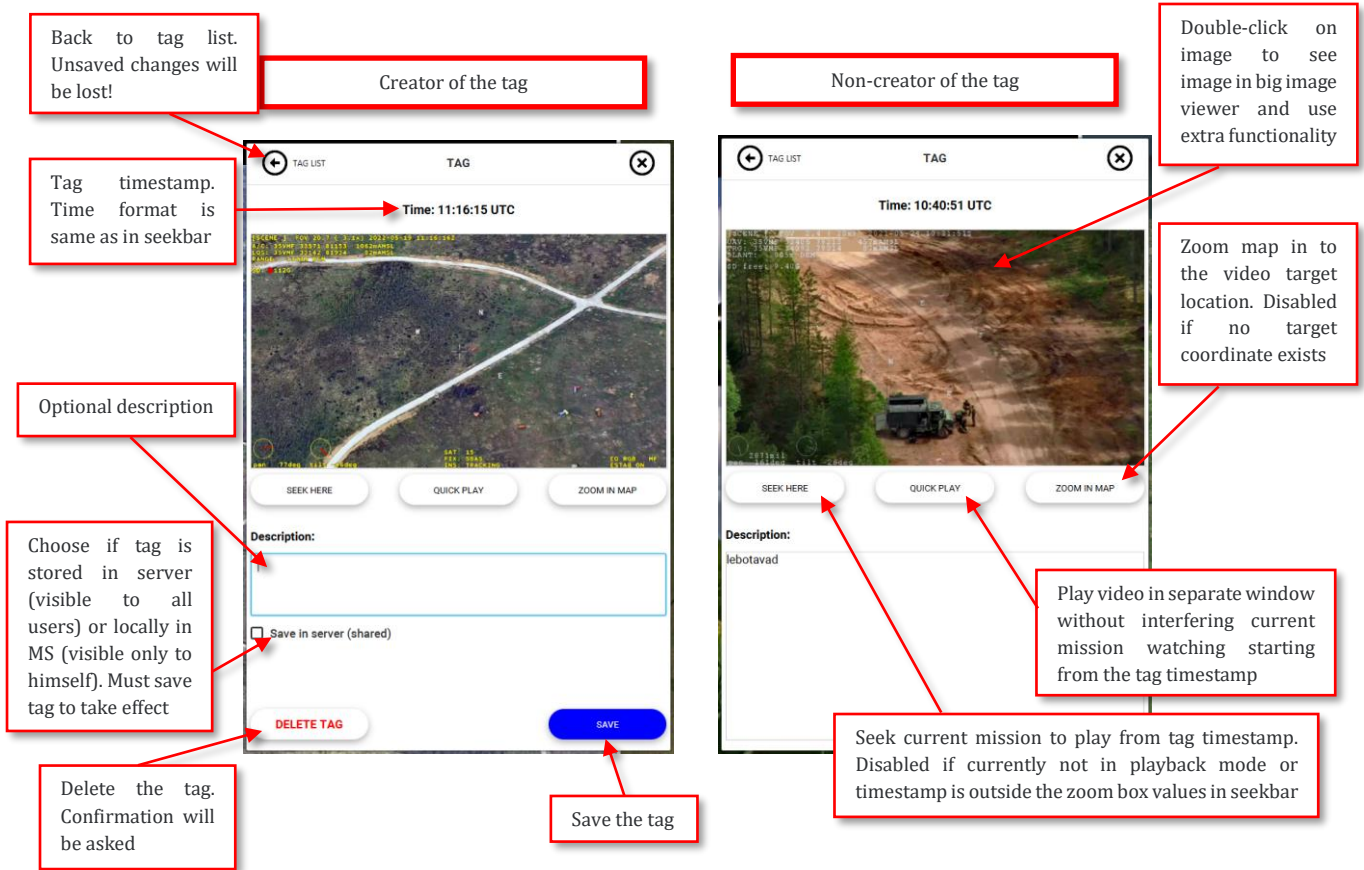


Figure 68: Tag details

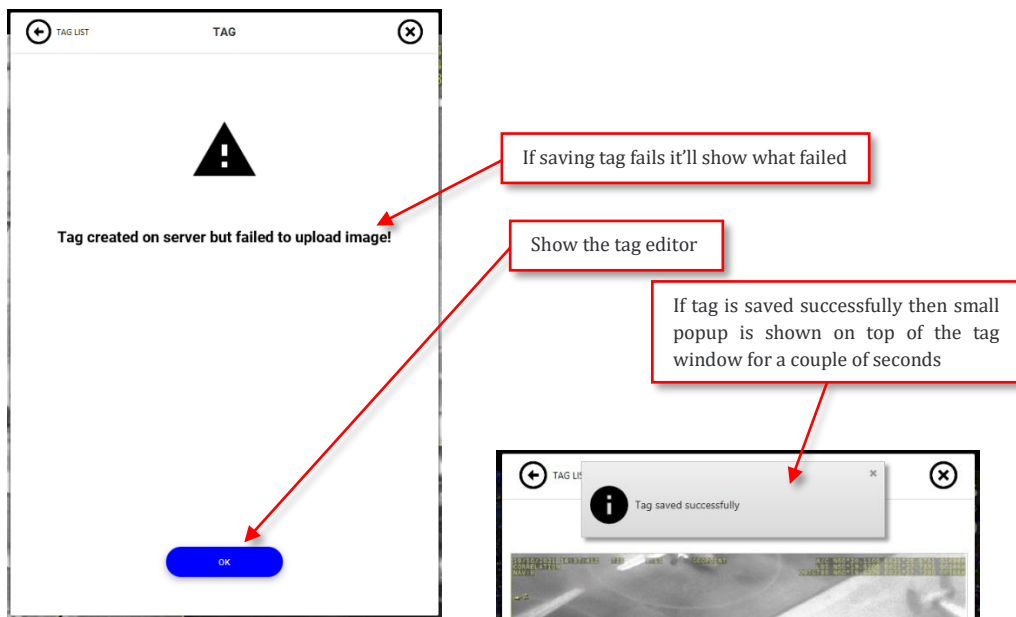


Figure 69: Tag save result



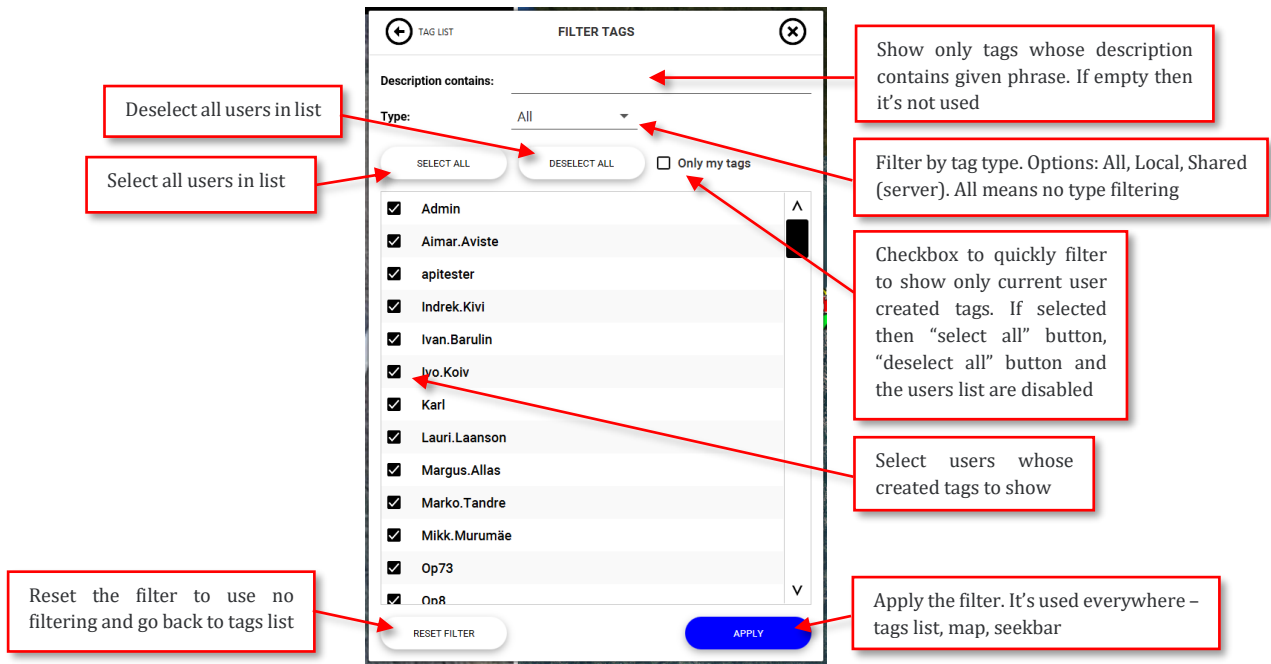


Figure 70: Filter tags

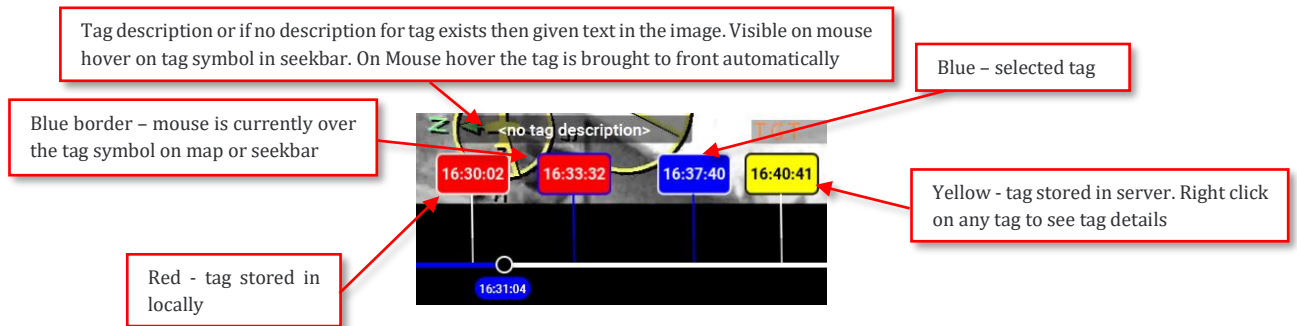


Figure 71: Tag icons on seekbar

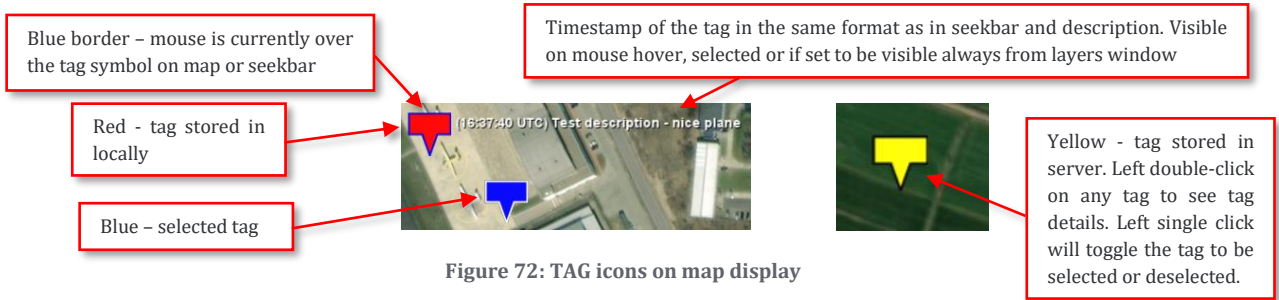


Figure 72: TAG icons on map display

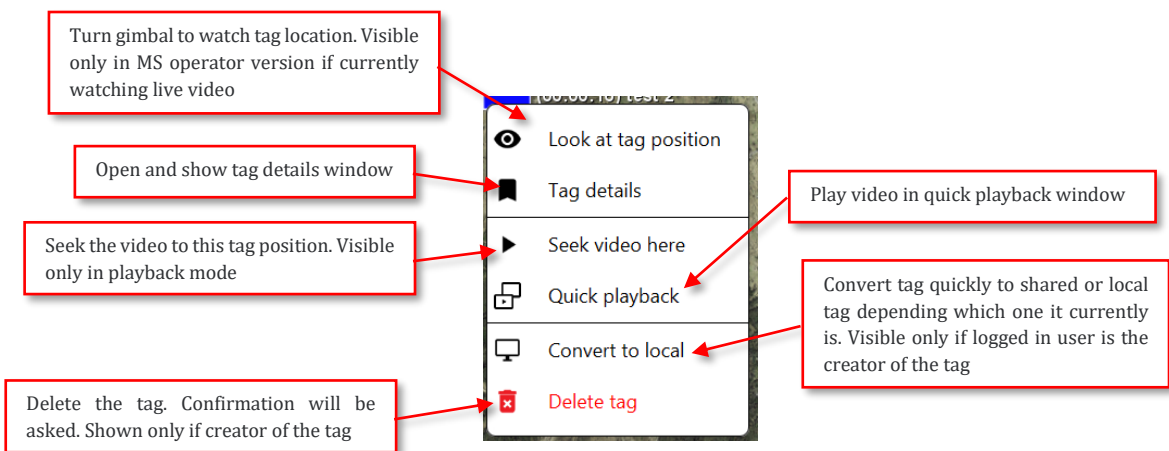


Figure 73: TAG context menu on map display

### 7.10.6 Points of interest

Point of interest is a local or shared coordinate with an optional title and description. POI is visible on the map as an icon with title, if present and enabled.

POI can be created by “Create POI” button or by map context menu (both described above).



Figure 74: POI icons on map display

Shared POI-s are stored in server. All clients authorized to access an ongoing mission can view these POI-s when monitoring the mission. Shared POI-s are the main method of pointing out targets and coordinating actions between multiple parties. Only creator of the POI can edit and delete given POI.

Local POI-s are stored only in the computer where MS is installed in. Local POI-s may be used as mission planning aids or for any other user specific purposes because local POI-s are not related to mission. When a POI is created using the button menu shortcut a local POI is created on the point of aim of the gimbal and placed on a map. Local POI-s are user-based meaning user will see only his/her created local POI-s.

#### 7.10.6.1 Point of interest map context menu

POI context menu is opened by right clicking or using the touchscreen alternate on a POI icon. POI will be selected automatically.

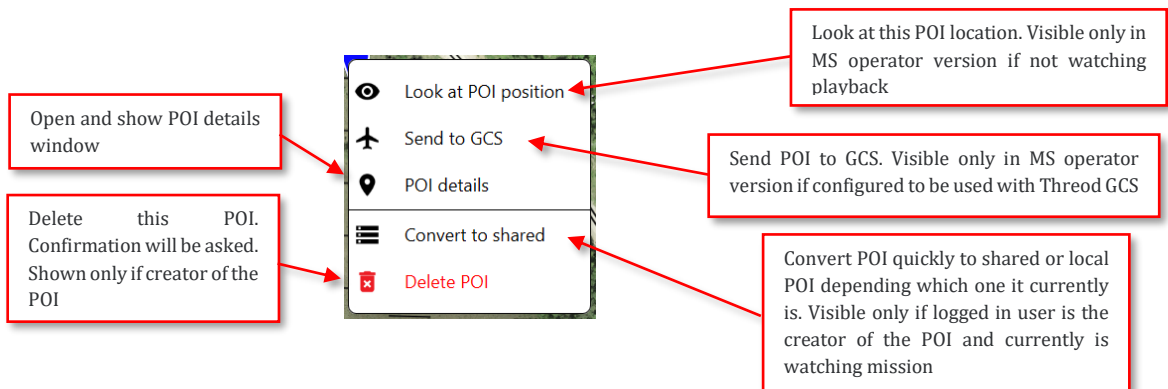


Figure 75: POI context menu

7.10.6.2 Point of interest list

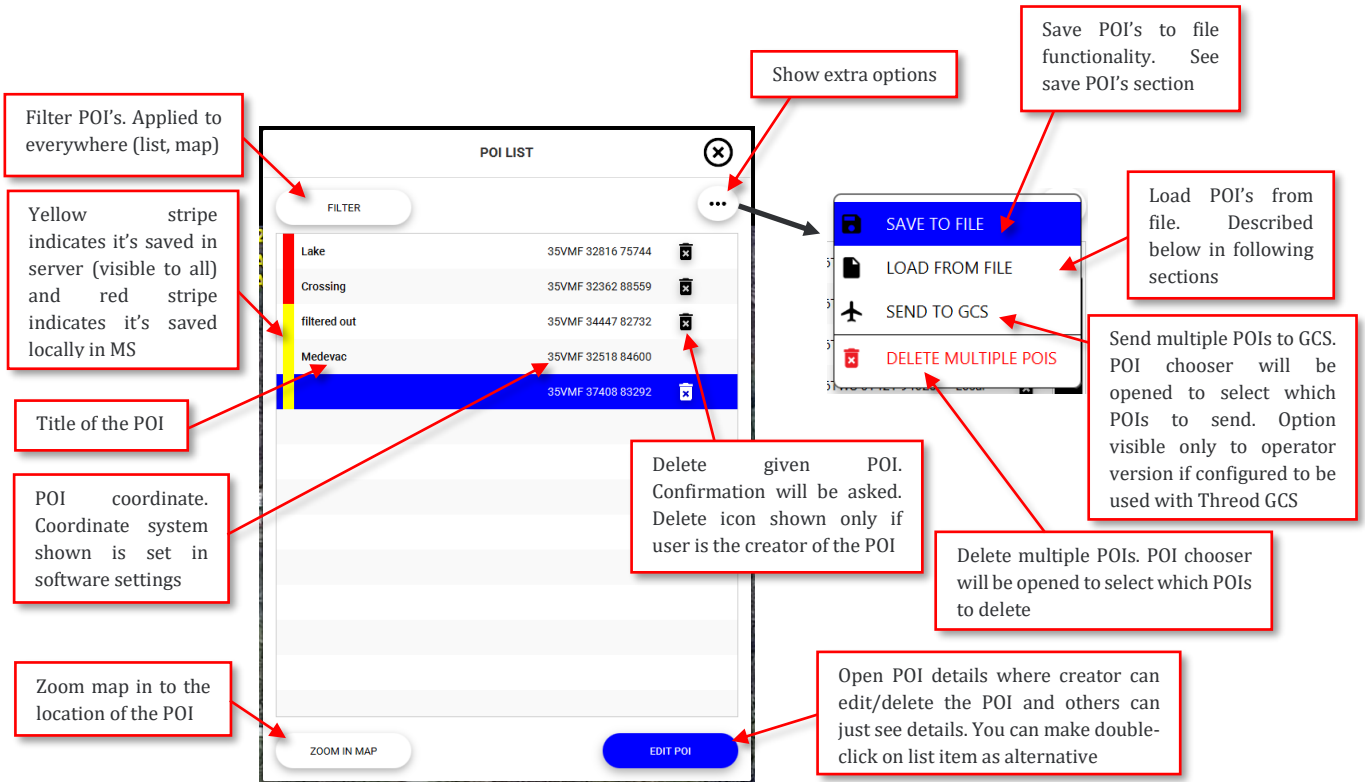


Figure 76: POI list

### 7.10.6.3 Point of Interest filter

POI filter dialog provides the means to display or hide POI-s according to their types or names to declutter the map and POI list.

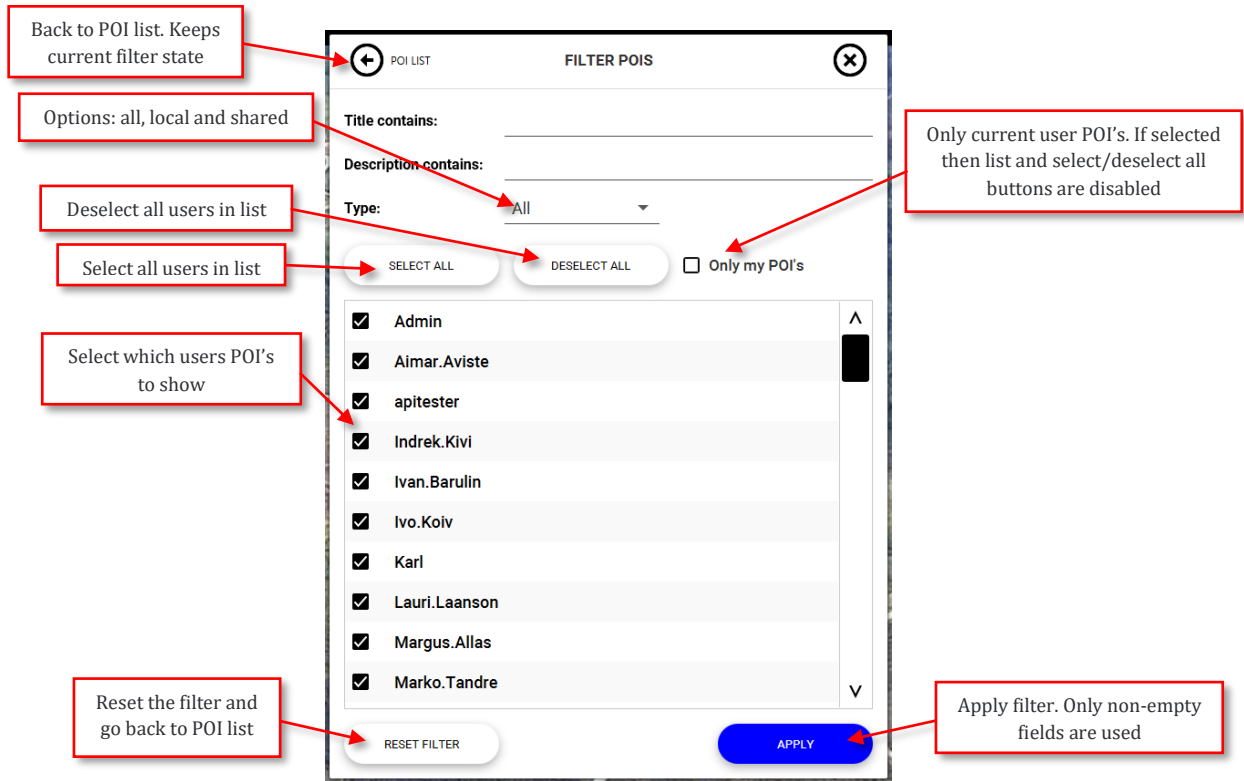


Figure 77: POI filter dialog

### 7.10.6.4 Point of Interest details/editor

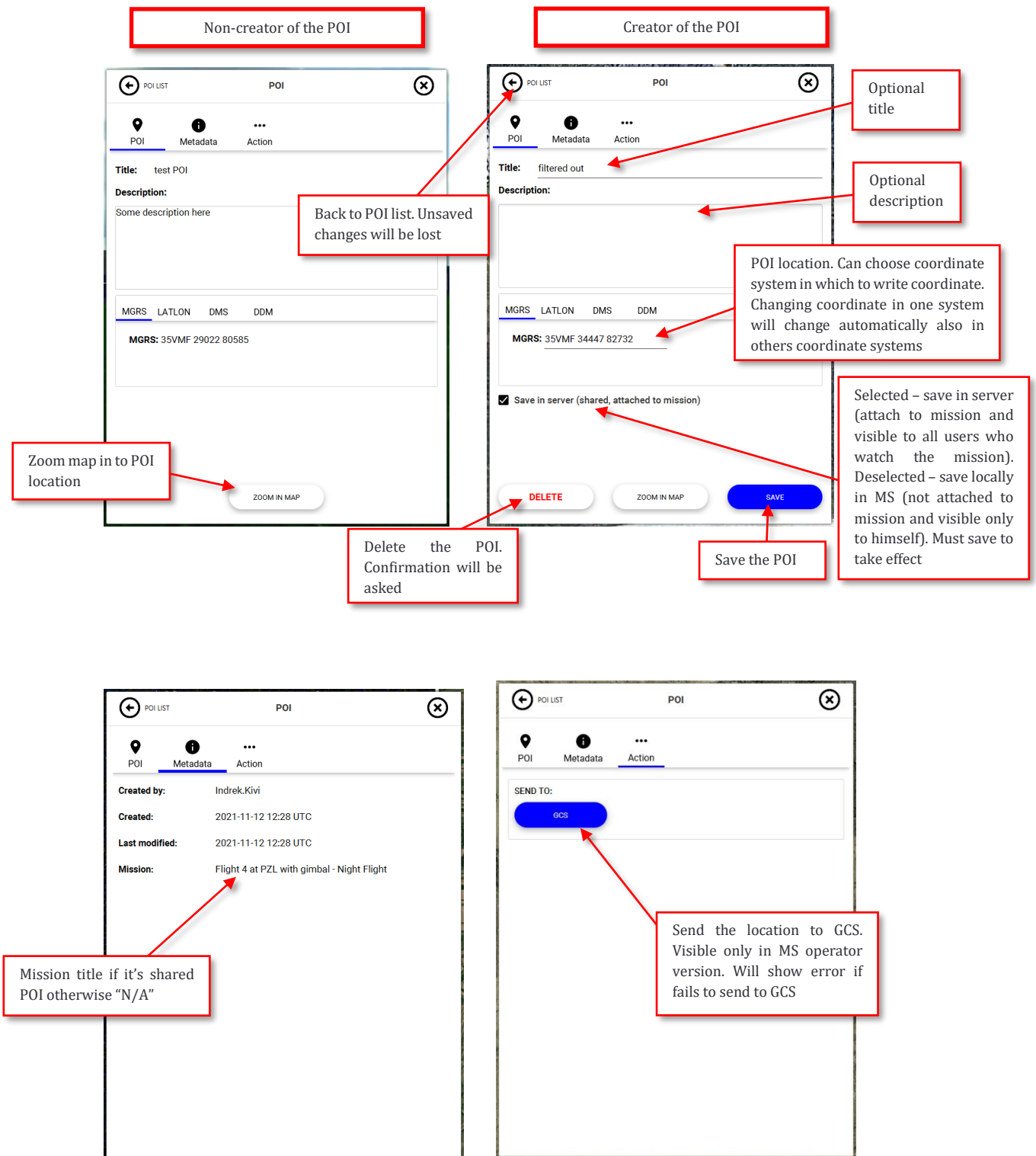


Figure 78: POI details

### 7.10.6.5 Loading POI-s from file

POI-s can be loaded from file which was previously saved. If currently not watching mission then all POI-s are local POI-s by default. If user is currently watching a mission then user can choose if the loaded POI-s will be local or shared.

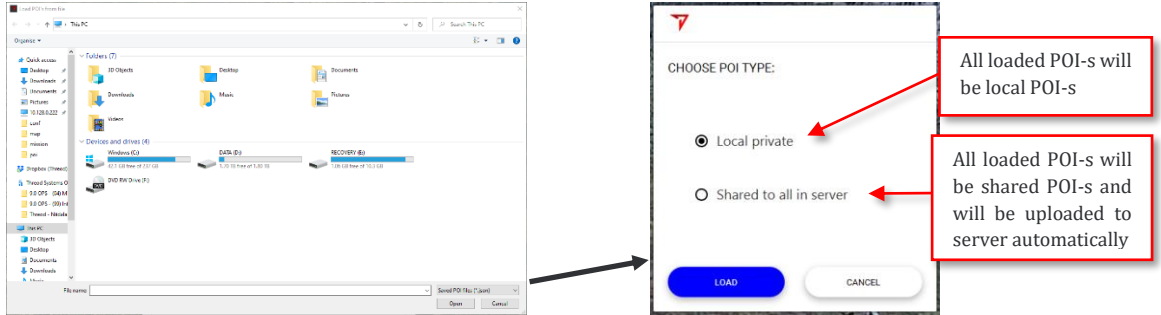


Figure 79: Load POI-s from file

### 7.10.6.6 Saving POI-s to file

POI-s can be saved to file (MS own format). When “Save POI’s to file” option is clicked in the POI list extra options dialog then a dialog will be shown where you can choose if you want to save all currently visible POI’s or choose which POI’s to save. Standard Windows file save dialog will be shown if you choose to save all currently visible POI’s.

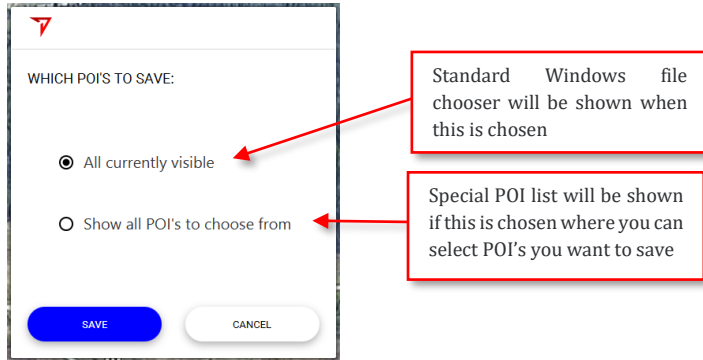


Figure 80: Save POI dialog

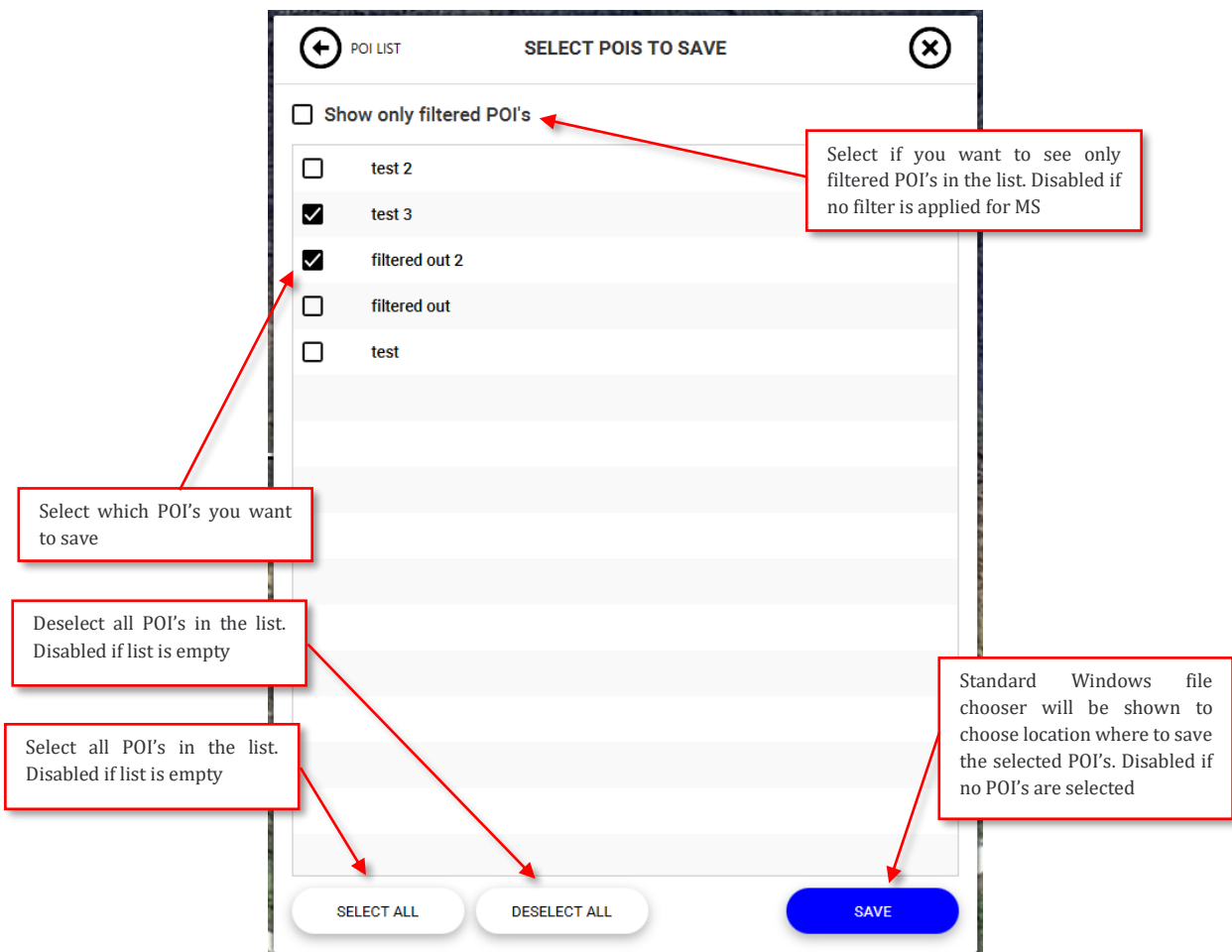


Figure 81: Save POI chooser



### 7.10.6.7 Deleting multiple POIs

When “Delete multiple POIs” option is clicked in POI list extra options dialog then POI chooser will be shown where you can select which POIs to delete. Only POIs created by logged in user are shown in the list because user can delete only POIs created by himself.

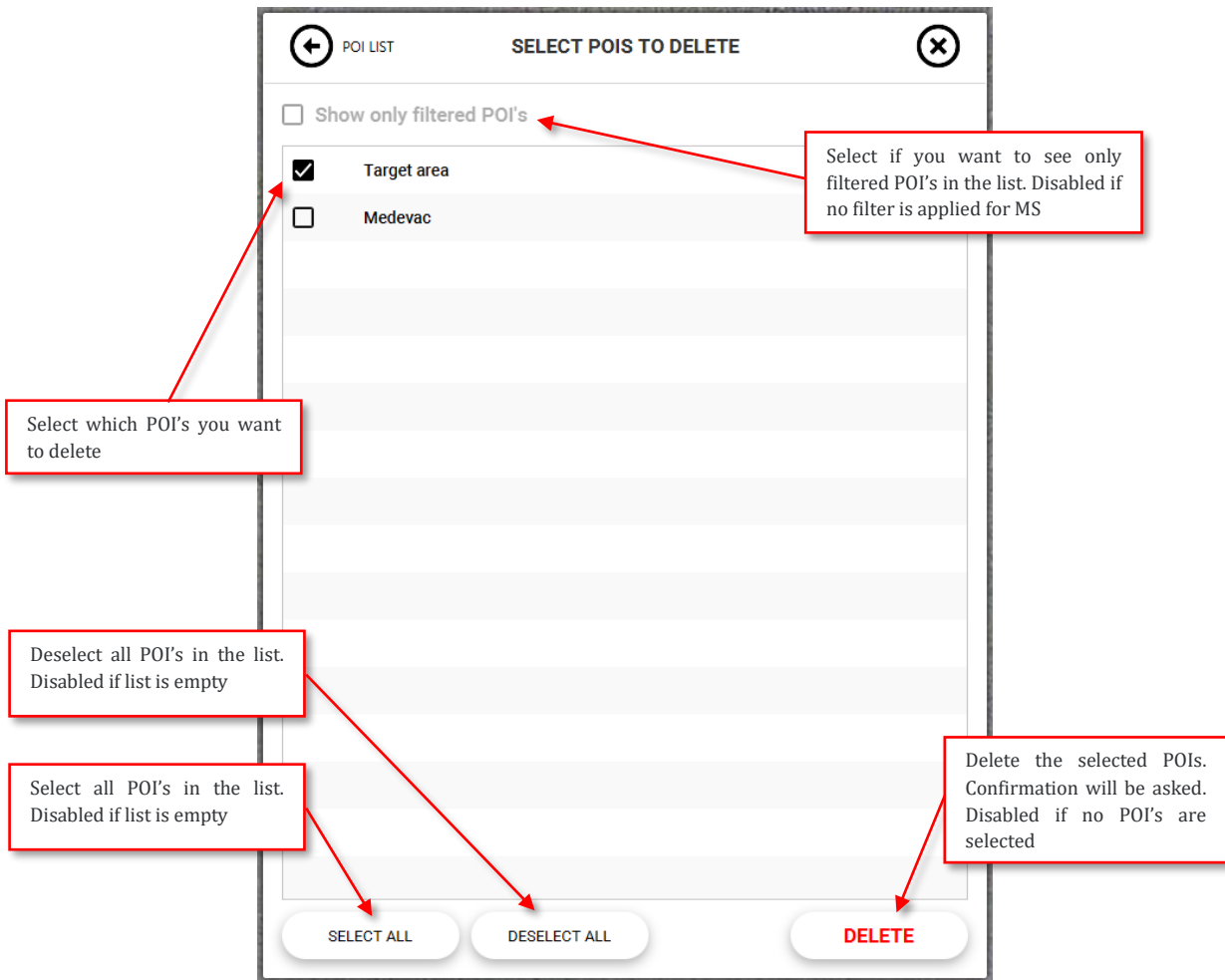


Figure 82: Delete multiple POI chooser

### 7.10.7 RVT

RVT (Threod Android app) can send their locations to server and in this case MS can show the locations on map. MS operator version can see all RVT's connected to operator server regardless they watch mission or not and also RVT's connected to datacentre who watch same live mission. Observer version can see RVT's only if watching live mission and only these RVT's who are watching the same live mission. Both, operator and observer version, will remove RVT from map if RVT decides to not send location anymore.

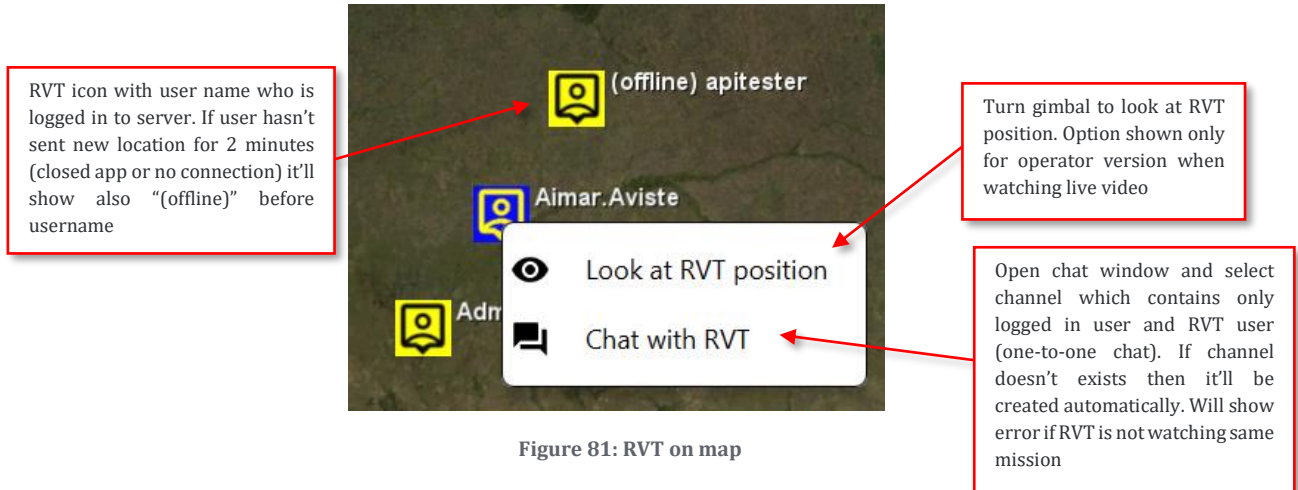


Figure 81: RVT on map

## 7.11 REPORTING

Reporting tool provides the means of compiling images, tags, map views and user provided comments to into a standardized format for exporting and sharing.

The main view for reporting tool presents a list of prepared reports and detailed view for the selected report. Every report has information tab, imagery tab and metadata tab.

Reports are part of a specific mission and thus stored in the database as mission items.

Every user can create a report and edit their own previously created reports. Other users can read prepared reports but not edit. If a user wants to modify a report compiled by anyone else but themselves, they can create a duplicate. This ensures that the reporter who created the report is the source of the information and no one else has tampered with it.

Reports are not saved locally but only in server meaning if report is created and not saved to server it'll be lost and unsaved changes in reports will be lost when exiting the MS.

Report images (that should be visible currently) which fail to download from server will be re-tried automatically every 20 seconds. Download fail may happen for example if servers sync the data and text part is synced but image syncing is not yet done or connection is bad.

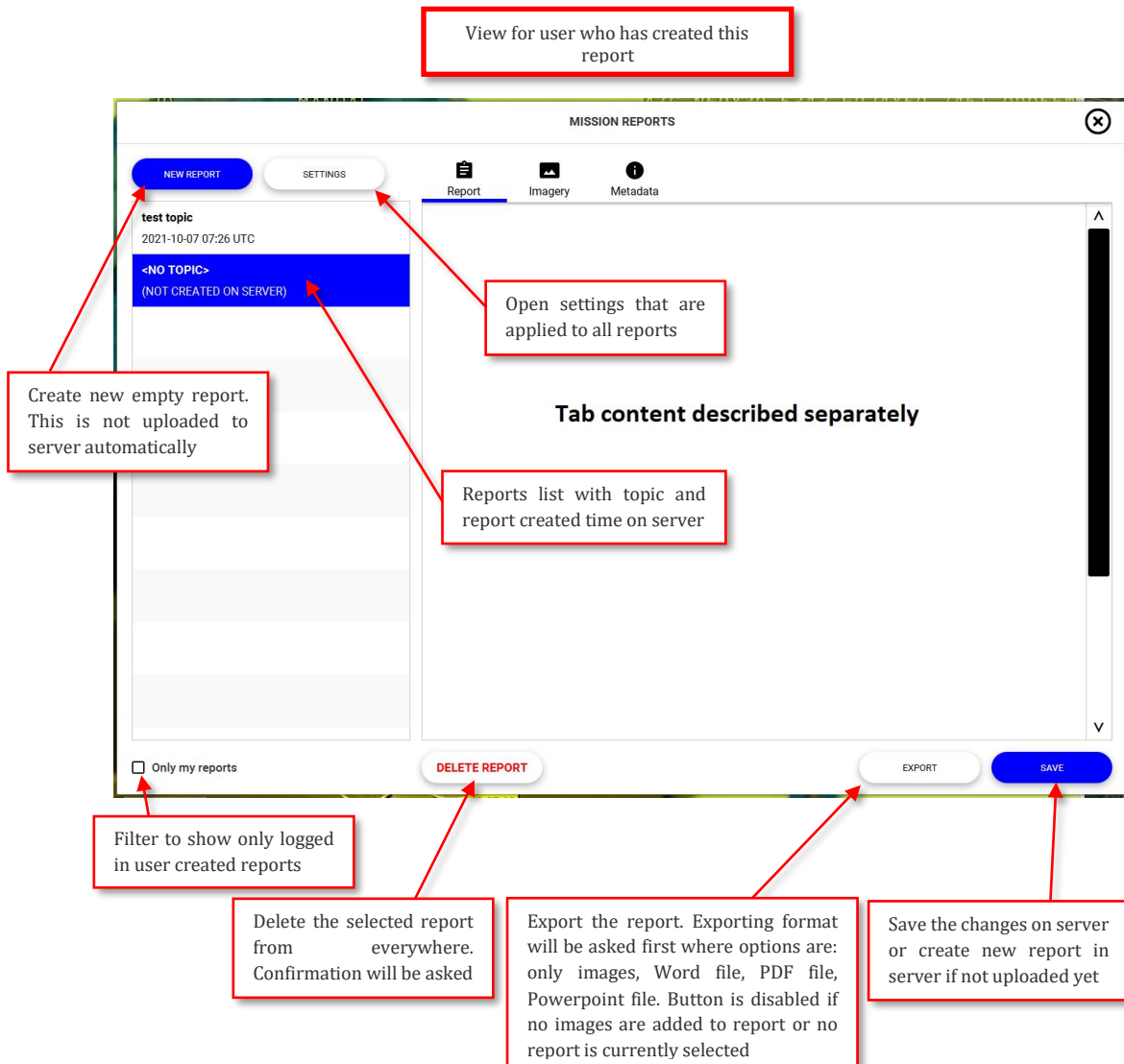




Figure 82: Reporting tool main view

Information tab allows the user to enter essential textual data for the report. The format of this information is designed according to guidelines from STANAG 2511.

**View for user who has created this report**

**Title:** \_\_\_\_\_  
\* Title is not saved to database.  
\* Each report created may have own title

**To:** test to 2

**From:** test from

**Topic:** test topic

**Classification:** test classification

**PIR:** test PIR

**Info origin:** test origin

**Grading:** B (usually reliable)   
2 (probably true)

**DTG (event):** 2021-08-19 12:02 UTC  
\* Filled automatically from images

**Location:** 31NAA 66021 00000   
\* Always check if map exists before exporting  
\* Map window defines map width/height ratio

**Information:**  
test information

**Comment:**  
test comment

**Your opinion, "I think", "maybe" etc. text here**

**View for user who has not created this report**

**Title:** \_\_\_\_\_  
\* Title is not saved to database.  
\* Each report created may have own title

**To:** test to 2

**From:** test from

**Topic:** test topic

**Classification:** test classification

**PIR:** test PIR

**Info origin:** test origin

**Grading:** B (usually reliable)  
2 (probably true)

**DTG (event):** 2021-08-19 12:02 UTC  
\* Filled automatically from images

**Location:** 31NAA 66021 00000   
\* Always check if map exists before exporting  
\* Map window defines map width/height ratio

**Information:**  
test information

**Comment:**  
test comment

View for user who has created this report

Title is not saved anywhere. It's used only when exporting the report

Creator of the report can edit all fields. All fields are optional

Data reliability. Options: A-F. All letters are described in brackets but the description is not added to exported report only the letter

Source reliability. Options: 1-6. All numbers are described in brackets but the description is not added to exported report only the number

Event time is taken from image timestamp automatically. If multiple images are added then two times are shown where first is the earliest time and second is the latest time

Only facts here!

Coordinate is set automatically which you can override in report map window. If you have selected each image has own map then first image coordinate is shown. Coordinate system in reports is different from other parts of MS and is set in reports settings separately

View for user who has not created this report

Non-creator of the report can edit only title which is not saved anywhere and used only when exporting the report

Open report map window where you can see and edit (if creator of the report) location data related to the mission, define map width-height ratio that is generated for exported report and see or define (if creator of the report) if generated report has one map or each image has own map

Figure 83: Reporting - info tab

Report map window allows to define if report is using single map for report, or all images have own maps. Correction to location(s) can be done if deemed necessary. Report map is always looking down meaning can't be turned to 3D view what you can do with main map.

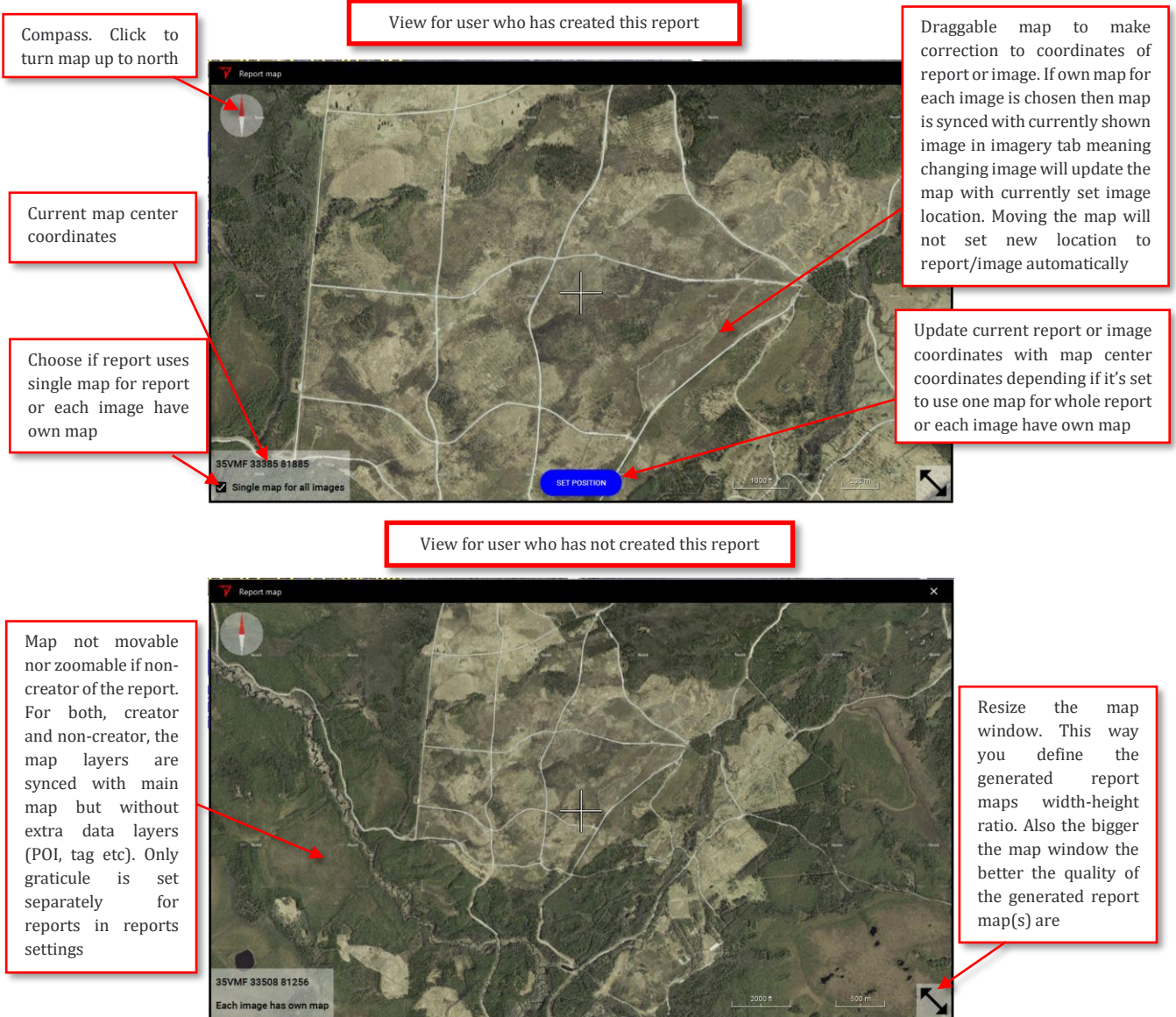


Figure 84: Report – map window

Imagery tab presents the list of tags and screenshots attached to the report. A report can contain multiple images.



Figure 85: Reporting - images tab

Images can be added to the report from the add images page shown in reports window. Both tags and local snapshots may be added. Tag description is set automatically as report image description.

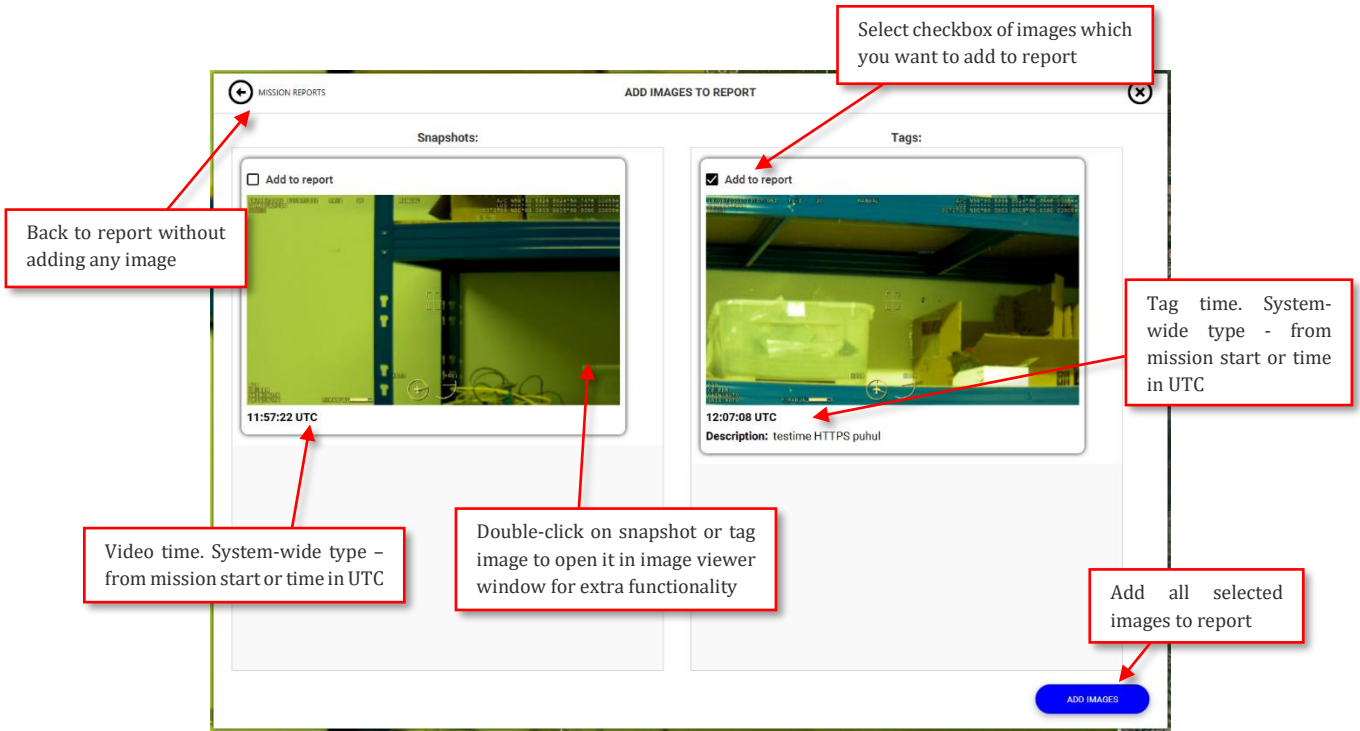


Figure 86: Reporting - add images



### 7.11.1 Report annotation

Users can annotate the image by adding shapes (arrows, boxes, text etc) for additional explanatory information. In server there is always the original image saved not annotated one. Only data how to redraw the shapes (annotations) is saved in server so it's possible to edit it later or from another computer. Image editor will show the image in full size always.

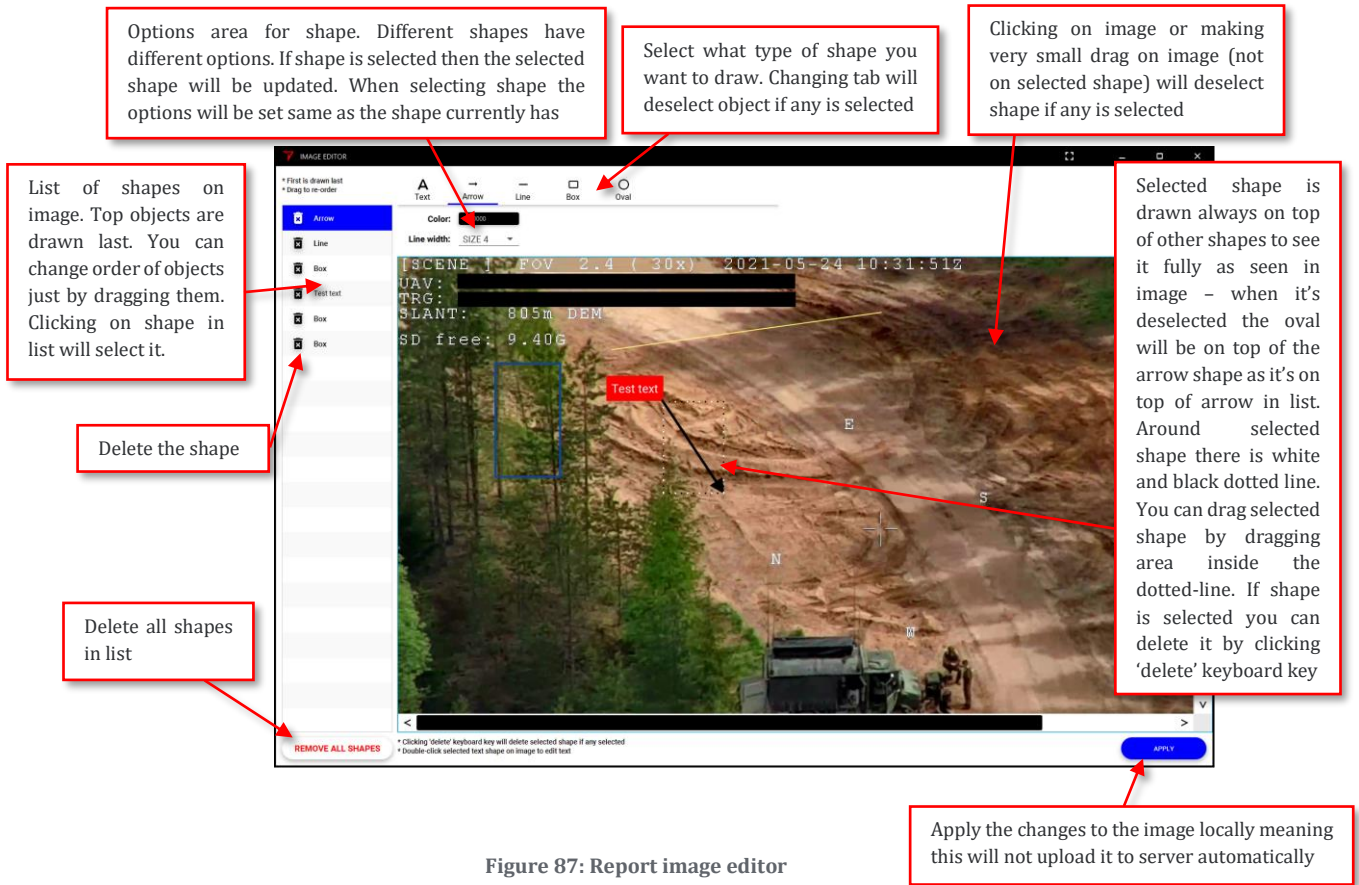


Figure 87: Report image editor

Adding new shape to image is done just by dragging its size on image (start dragging outside selected shape). All shapes have minimum size meaning if you want to add a new shape you must drag at least minimum amount.

If you add arrow shape, then the head of the arrow is placed in the release end.

Text shape size is different from other shapes - if you add text shape then the size of the shape will be the size of the text itself. When adding text shape, it's initial status is text edit mode where you write the text. Click 'enter' keyboard key to set the text to the shape and exit text edit mode. Click 'esc' keyboard key to cancel the text editing (if you changed the text, it'll be reverted back what it was before) and exit text edit mode. If you clear the text in text edit mode and click 'enter' keyboard key the shape will be deleted. If in text edit mode, you select another shape or change shape tab to another shape then the text you wrote will be set to the shape automatically. In text edit mode you can't start adding another shape by dragging on image.

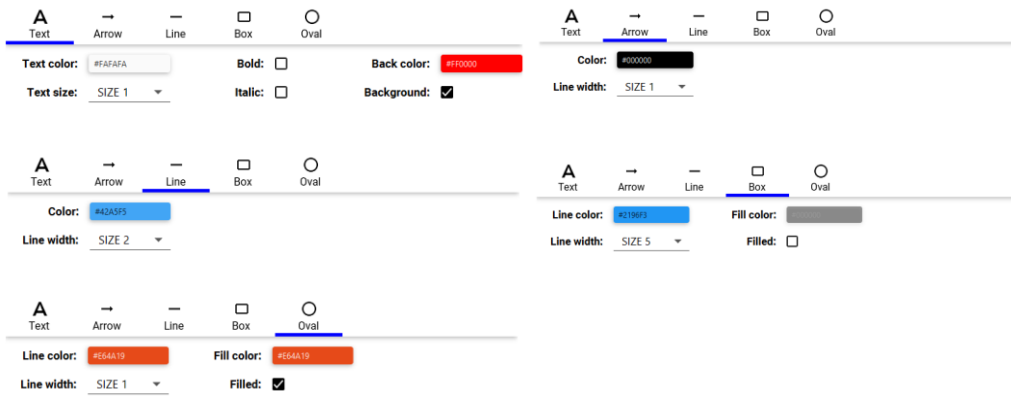


Figure 88: Report image editor shapes

Reports can be exported to various formats for sharing outside of the MS.

Users can choose to export only the images, PDF or editable Word and PowerPoint files.

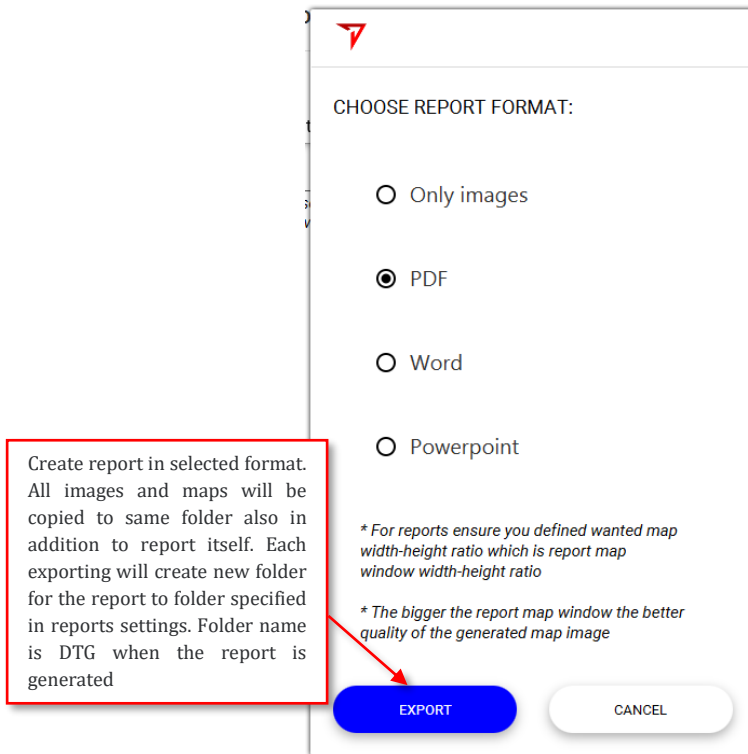


Figure 89: Reporting - export dialog

### 7.11.2 Report settings

Reporting settings provides the means for customizing the report according to user requirements. Report settings are applied to all generated reports and are not related to a specific report. This means if a report with different settings is necessary, the settings have to be modified between exporting the different reports.

All changes in settings are applied right-away and do not need separate saving/applying.

Map graticule layer and scalebar for report maps is configured separately from MS main map meaning changing it for MS main map doesn't change it for report map and vice versa.

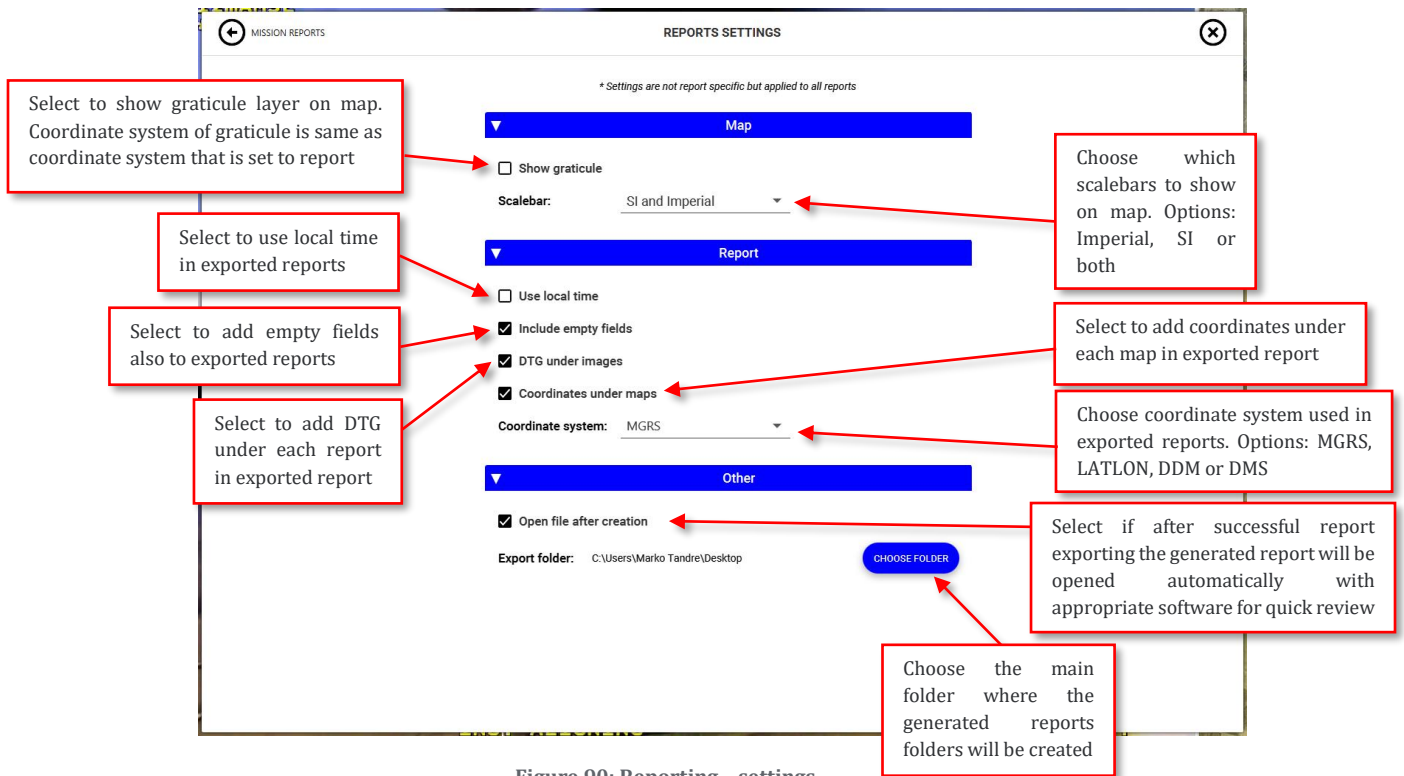


Figure 90: Reporting - settings

## 7.12 QUICK PLAYBACK

A separate playback window provides the possibility to load clips from other missions or compare footage in main window.

This is useful when looking at a target and wanting to compare a historic view of the same area while still maintaining the live feed or playback position.

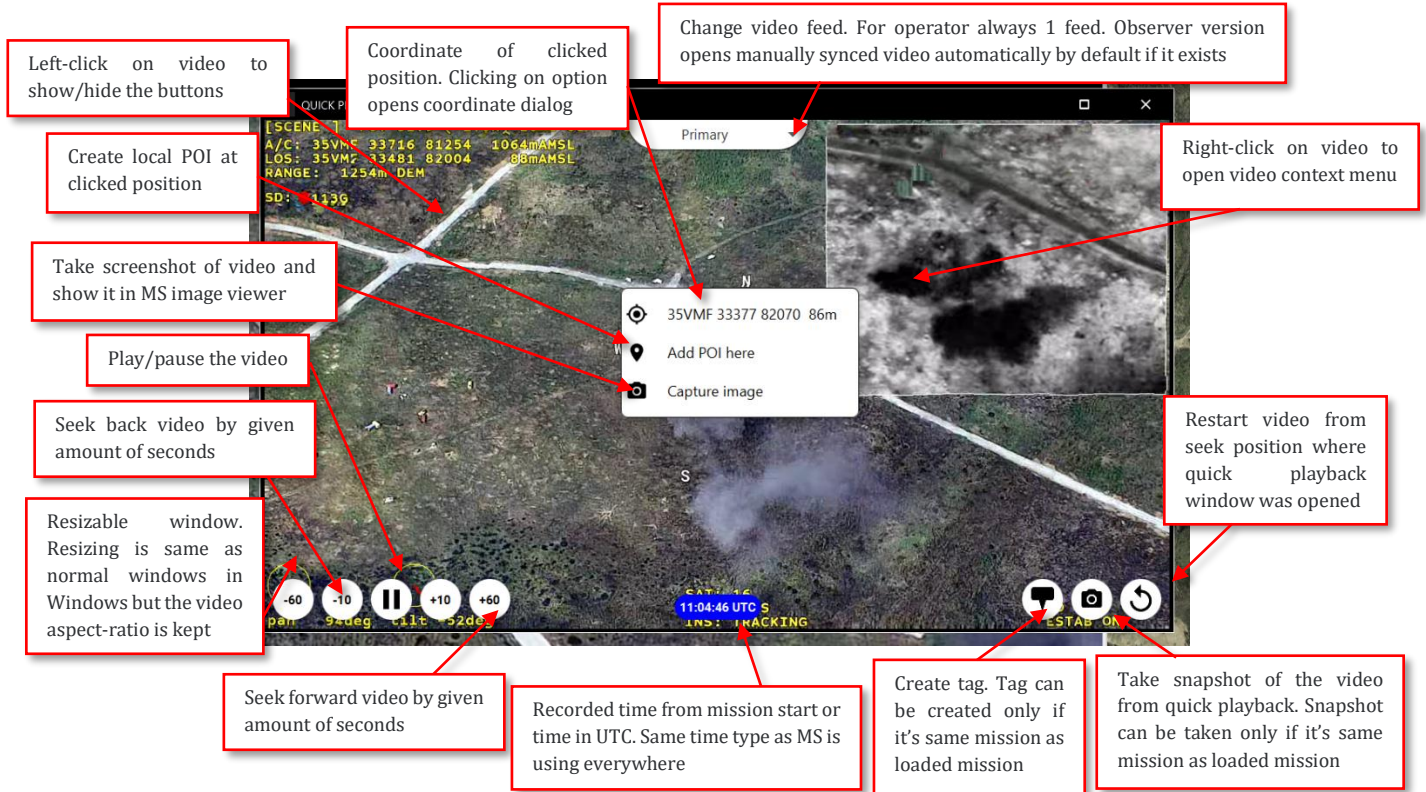


Figure 91: Quick playback

## 7.13 SEARCH

Search functionality allows the user to search videos, tags, reports, and POI-s from the collection of all archived missions in currently connected server or only from the loaded mission.

Search window is divided into groups: area, POI, tags, and reports. Special placemark is shown on map for location of area search, selected POI (in search result) and selected tag (in search result and if tag has coordinate meaning not watching over horizon etc).

Search is cleared when closing the window.



Figure 92: Search placemark

### 7.13.1 Searching videos by area

Videos can be searched by specifying a geographic location. This gives the user a way to search for a specific location that the video footprint has covered. When accessing the search window directly from the search button then last target coordinates are filled automatically. Server will return only results where footprint diagonal for primary feed is equal or less than 2km. This is to avoid getting too zoomed out results where it's too hard to see anything.

An alternate way to search videos by footprint is to use the map context menu and choose search in history or use the video context menu and choose search video for location. This action will open the search window with coordinates prefilled.

Coordinates must be filled to search

Date field can be written in dd-mm-yyyy format or click on calendar icon to open date chooser

Clicking on year opens year chooser

Search only from current mission

Start searching for recorded videos. Not-filled fields are not used

Click on day to select day

Click on year to select year

Figure 93: Search video by area

After clicking on the search button, a progress dialog box is shown. When searching from a large archive of missions an indication is shown that the search may take some time to complete.

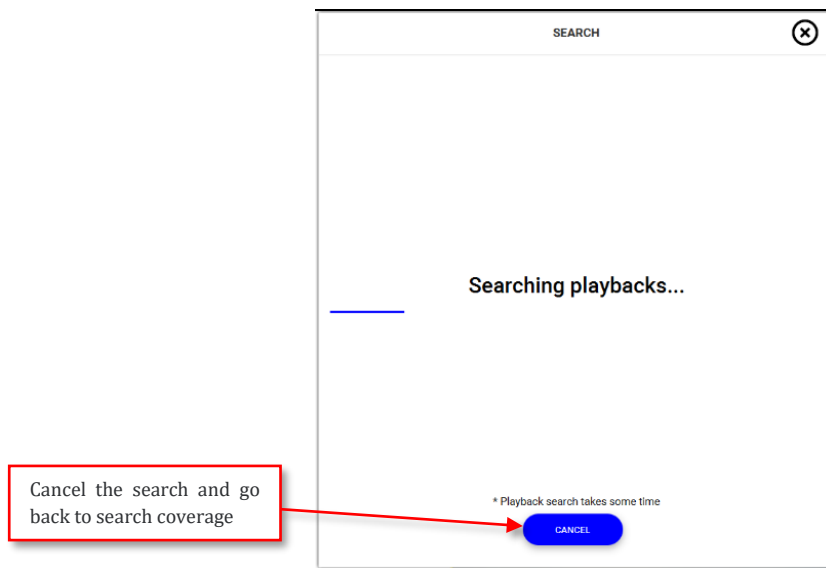


Figure 94: Search video by area progress

Upon successful completion of search a window with results is displayed.

User is presented with all corresponding timestamps that have been recorded where the gimbal target matches the coordinates specified and the total time on target for an uninterrupted time.

Search results can be sorted according to the recording time or duration on target.

If the results are for the loaded mission the video timeline can be sought directly to the beginning of the selected clip. If it's same mission and currently watching live video, then playback mode will be entered. Otherwise, other mission will be loaded and sought to the position.

In all cases the user can open the selected clip in a separate window for quick review.

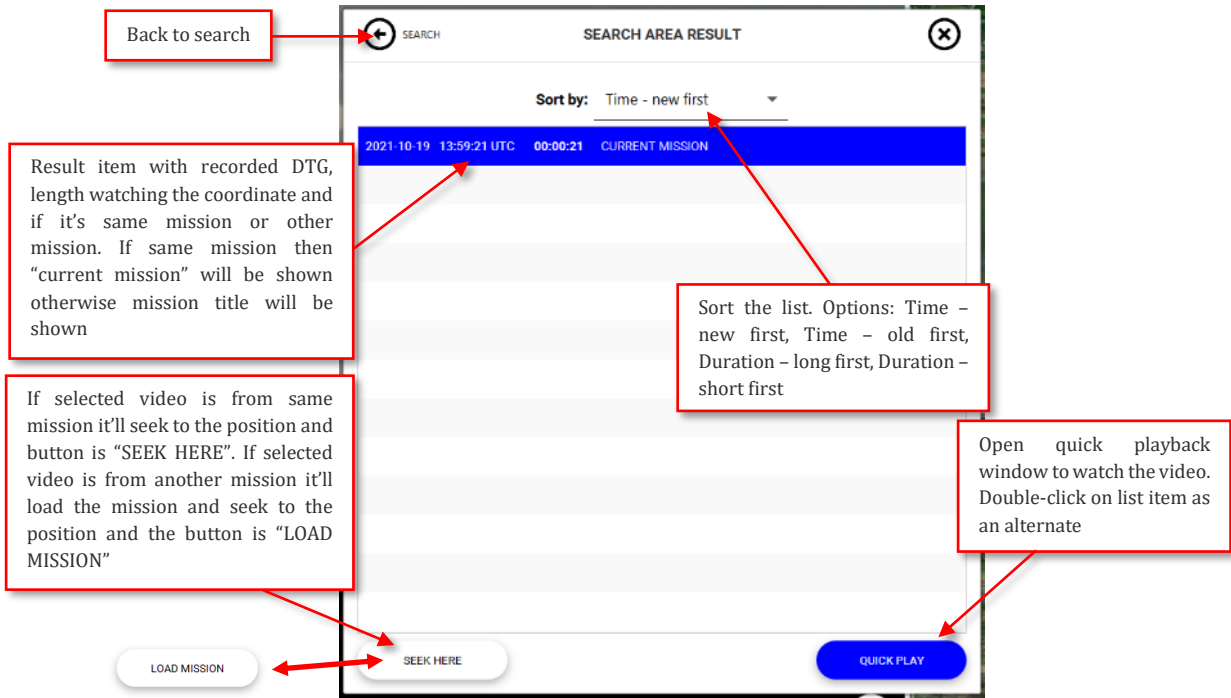


Figure 95: Search video by area results

### 7.13.2 Searching for points of interest

POI-s can be searched by title and description within specified creation time. Only the POI-s created by the user or by everyone can be specified in the search settings. Only the loaded mission or the entire set of archived missions in currently connected server can be searched. At least one checkbox or text field must be filled to search.

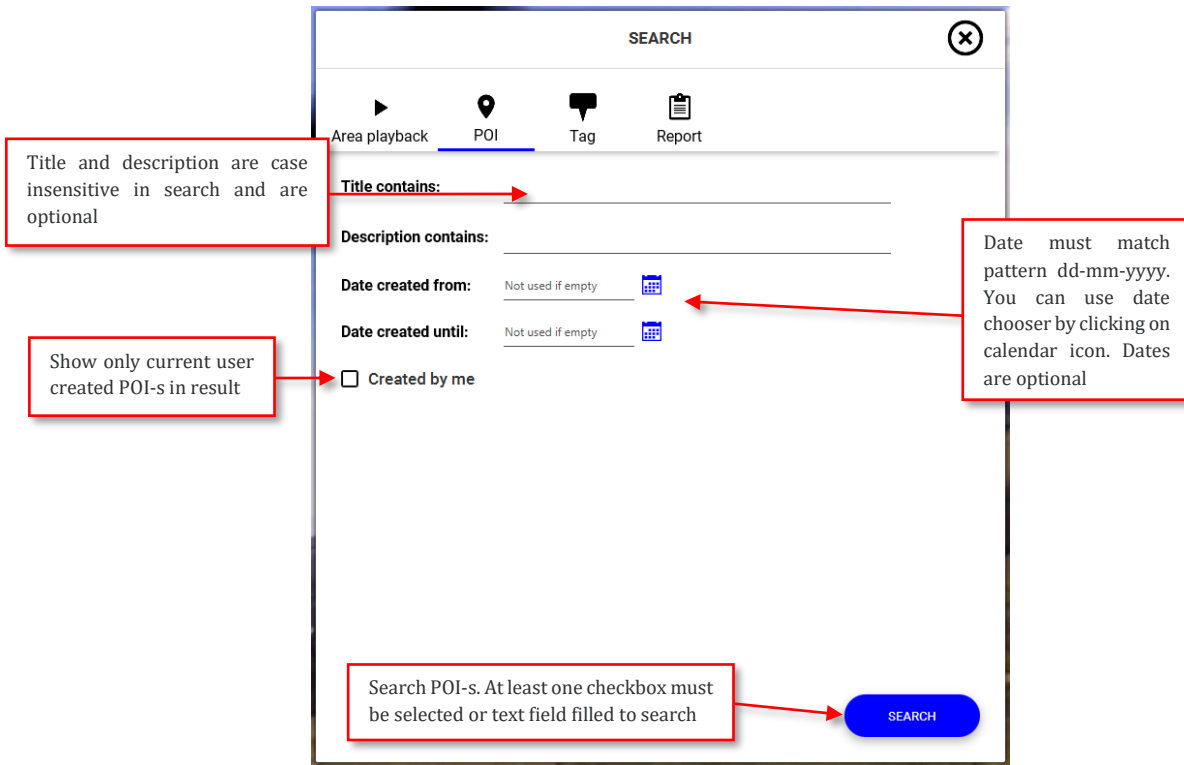


Figure 96: Search POI

Upon successful search the results window is presented with a list of POI-s. The user can centre and zoom the map to the selected POI or view its detailed description



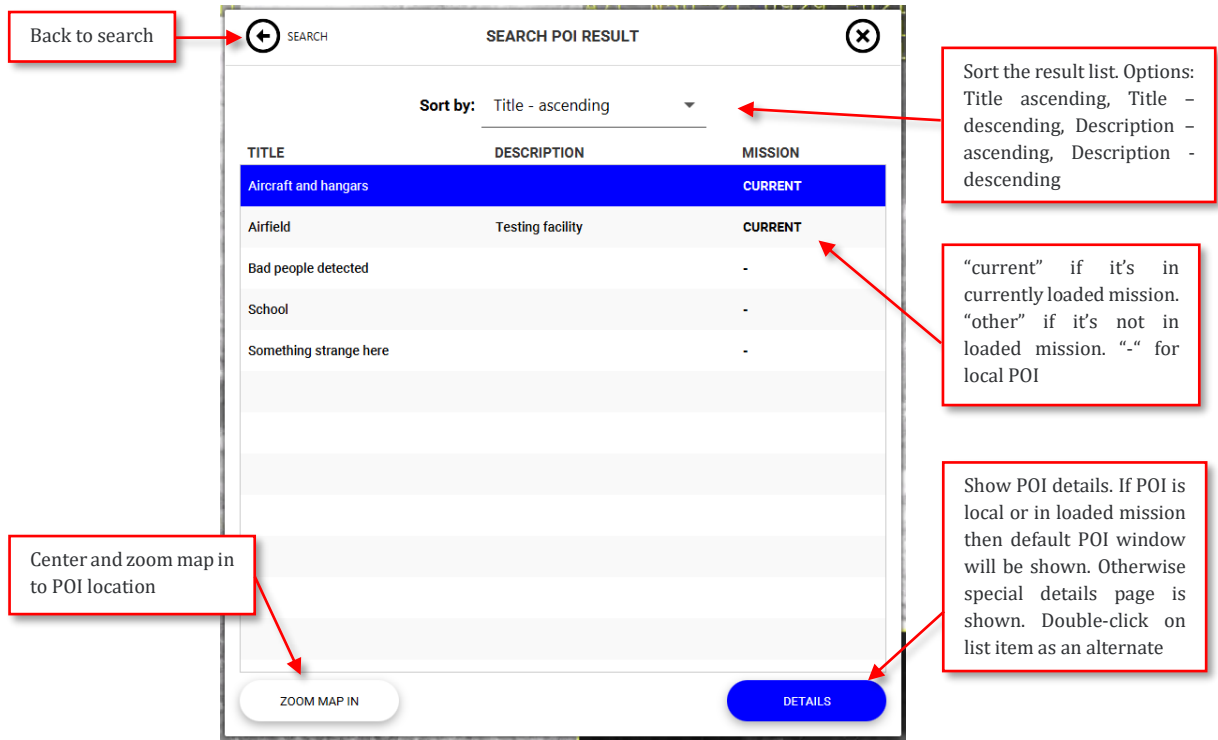


Figure 97: Search POI results

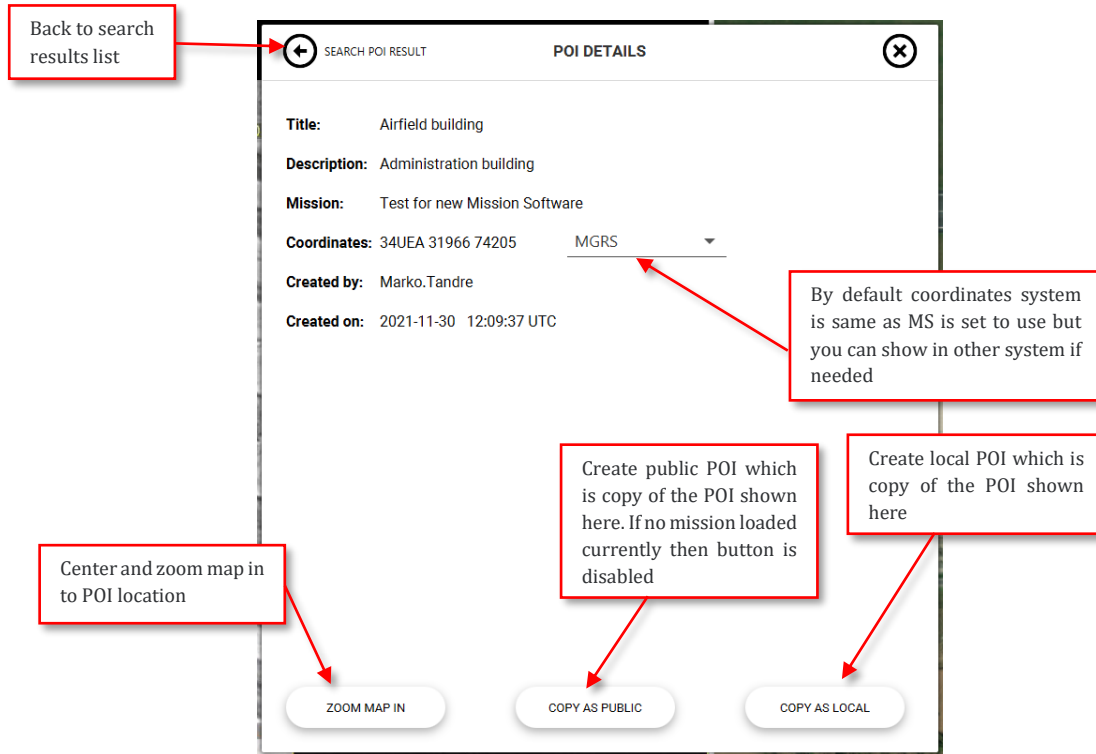


Figure 98: Search other mission POI details

### 7.13.3 Searching for tags

Tags can be searched by their description text and recorded time. Both tags created by the user, or someone else can be searched. Only the loaded mission or the set of all archived missions in currently connected server may be specified.

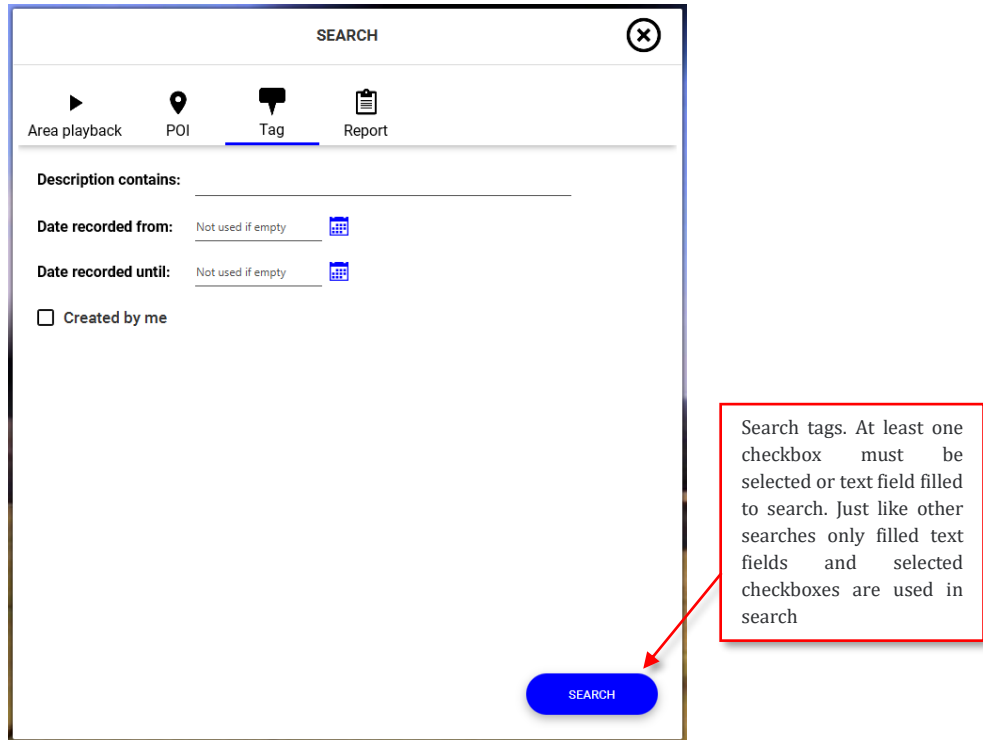


Figure 99: Search tags

Upon successful search a list of matching tags is presented to the user.

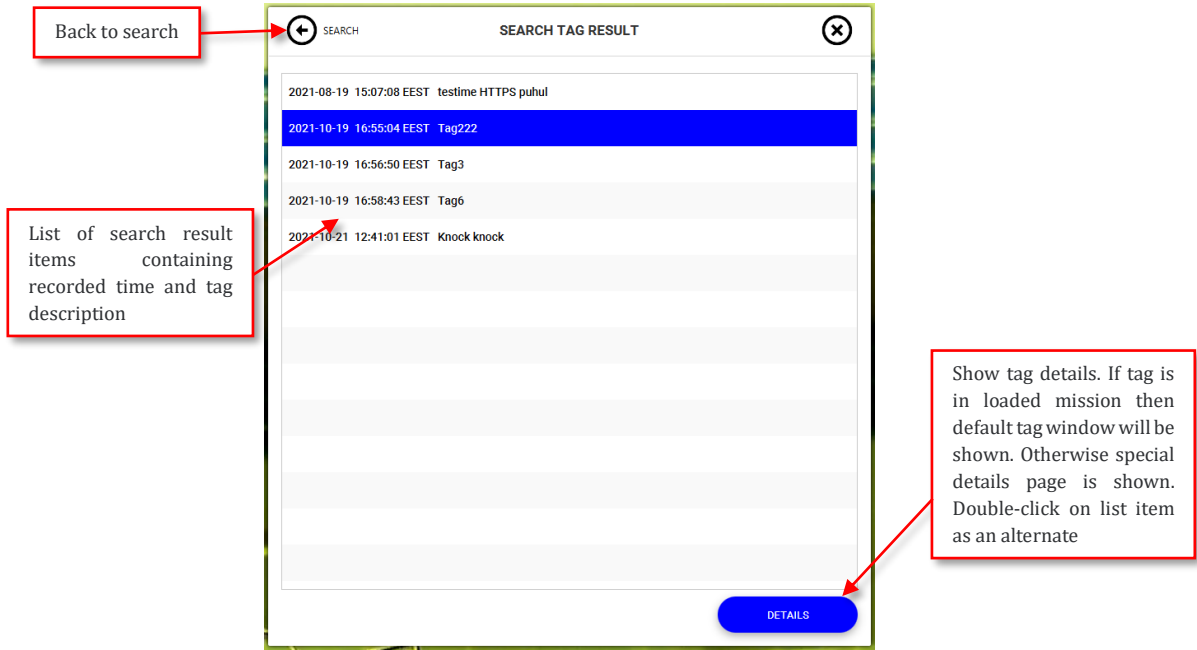


Figure 100: Search tags result

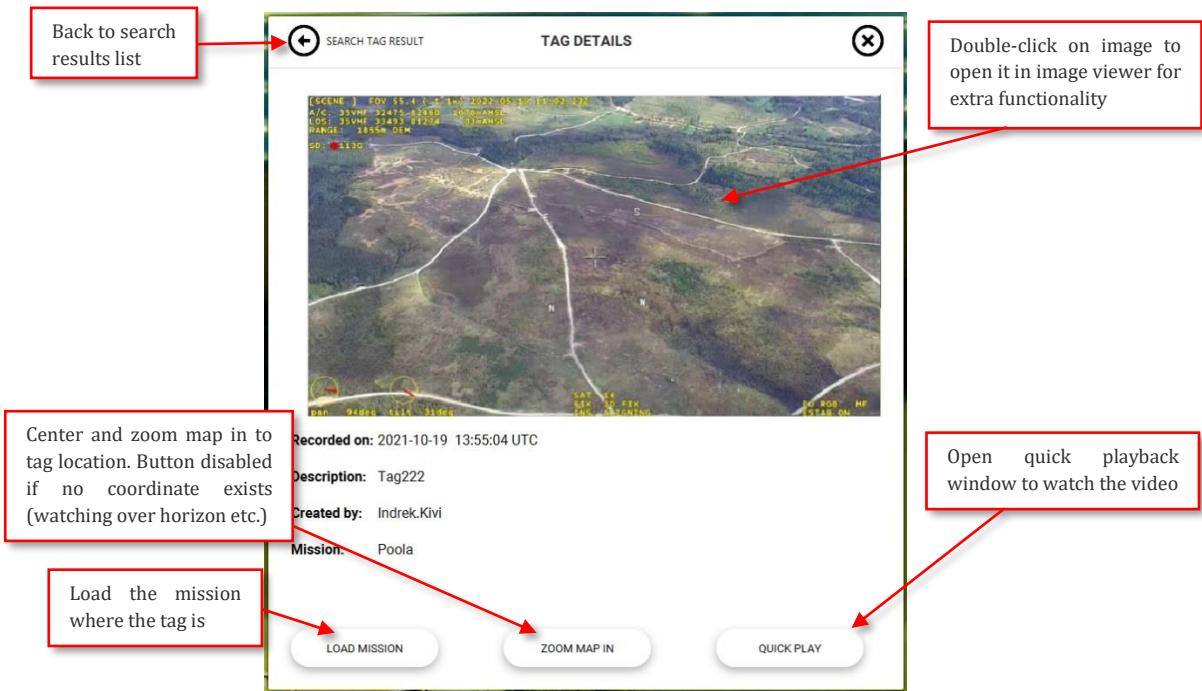


Figure 101: Search tags details

### 7.13.4 Searching for reports

Search reports allows the user to search for reports created by themselves or everyone in currently loaded or all archived missions in connected server.

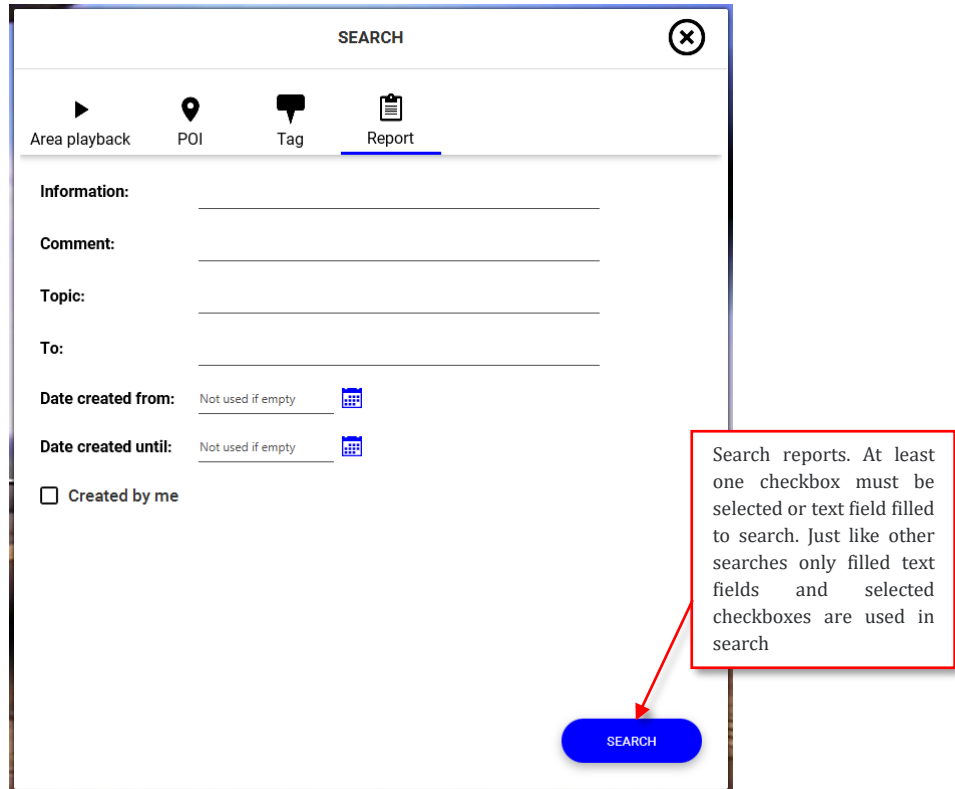


Figure 102: Search reports

Upon successful search a list of matching reports is presented to the user.

Selected reports can be opened in a separate report window described above in the report section.

Back to search

CREATED	TOPIC	USER	MISSION
2021-09-30 16:04:21 EEST	topic	Ville.Vellend	OTHER
2021-09-30 17:02:33 EEST	topic 2	Ville.Vellend	OTHER
2021-10-01 09:02:02 EEST		Indrek.Kivi	OTHER
2021-10-01 09:56:38 EEST	Somme random topic	Ville.Vellend	OTHER
2021-10-01 11:01:38 EEST	t	Ville.Vellend	OTHER
2021-10-07 10:26:50 EEST	test topic	Kalle	CURRENT
2021-11-15 16:47:24 EET	ryry	Indrek.Kivi	OTHER

LOAD MISSION

OPEN REPORT

If the report is in loaded (current) mission or other mission

Who created the report

Open report. If report is in loaded mission and you are creator of the report you can edit it but if the report is in another mission or you are not the creator you can't edit it. Double-click on list item as an alternate

Load the mission where the report is. Disabled if selected report is in loaded mission

Figure 103: Search reports

Reports from other missions than currently loaded mission can't be edited. You can only export it.

MISSION REPORTS

OTHER MISSION REPORT

SETTINGS

Report Imagery Metadata

Title:   
 \* Title is not saved to database.   
 \* Each report created may have own title

To: S2

From: UAV 1

Topic: Example report

Classification: For internal use

PIR: NONE

Info origin: UAV

Grading: A (completely reliable)   
 1 (confirmed by other sources)

DTG (event): 2022-05-19 11:03 UTC   
 \* Filled automatically from images

Location: 35VMF 33464 81943   
 \* Always check if map exists before exporting   
 \* Map window defines map width/height ratio

Information:   
 Example information

LOAD MISSION

OPEN MAP

EXPORT

\* You must load the mission to edit/duplicate the report. Currently you can only export it

Back to loaded mission reports list

Open reporting settings. Same values as loaded mission reporting settings

Load the mission where the report is

Figure 104: Report search – other mission report

## 7.14 VIDEO DISPLAY

This section describes the functionality available for video display windows.

### 7.14.1 Video Context Menus

Context menus are accessed by right clicking or performing a touchscreen alternate on a video display.

#### 7.14.1.1 Operator Video Display

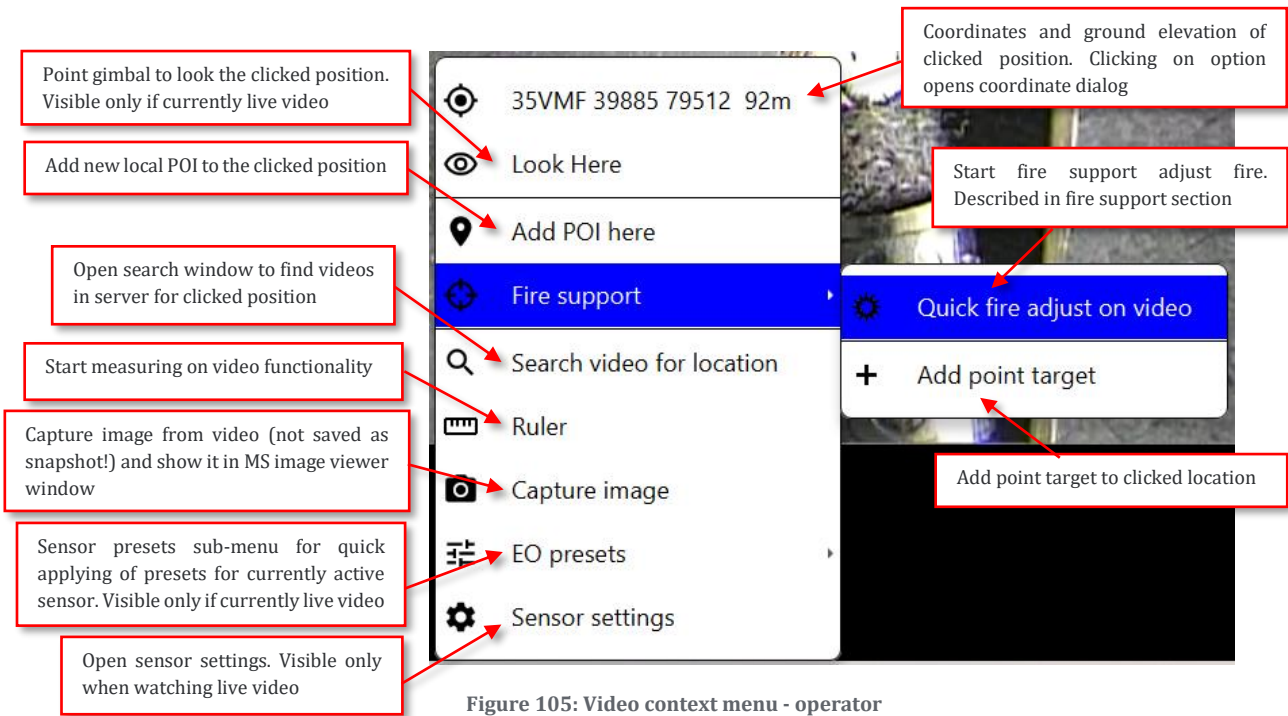


Figure 105: Video context menu - operator

### 7.14.1.2 Observer Video Display

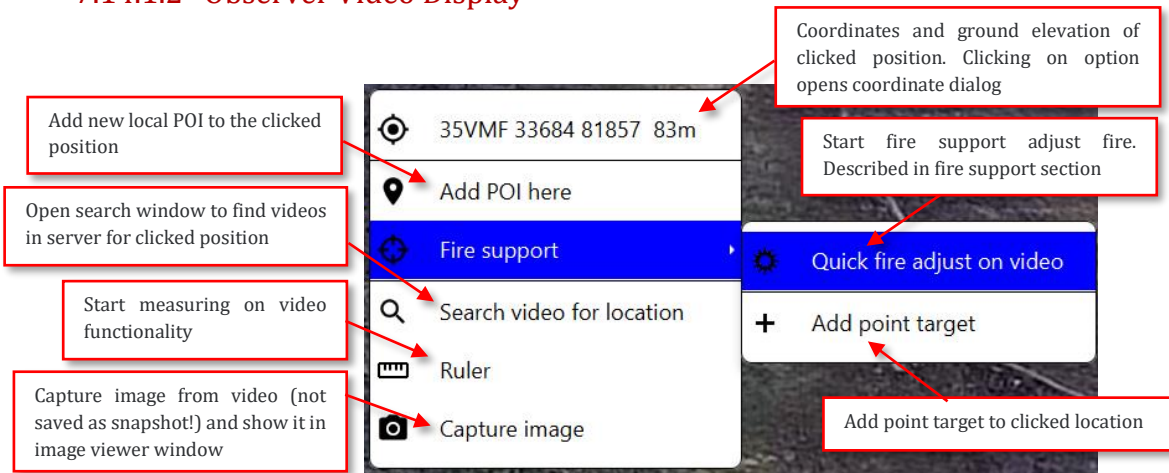


Figure 106: Video context menu - observer

### 7.14.2 Measure on video

Video measure tool allows the user to measure lines, paths, and areas directly on the video. The tool is accessed via the video context menu.

When measurement on the video is started then playback is paused and seekbar will be hidden or live video is frozen automatically. Changing the video feed (playback in MS observer version), switching between live and playback modes, and accessing video context menu is not possible while performing measurement on video. Also keyboard keys can't be used to control play/pause/rewind/forward the playback video during measurement

Closing the measure tool dialog will automatically clear all measurement lines on video and resume live or playback as it was before starting the measure on video.

Making measurements on video is exactly same as in MS image viewer window. Measuring is described in image viewer window section.



Figure 107: Video measure



## 7.15 GIMBAL CONTROL

Controlling gimbal functions, sensor and video output settings is accessible through the context menu by pressing right mouse button or performing touchscreen alternate push on the video.

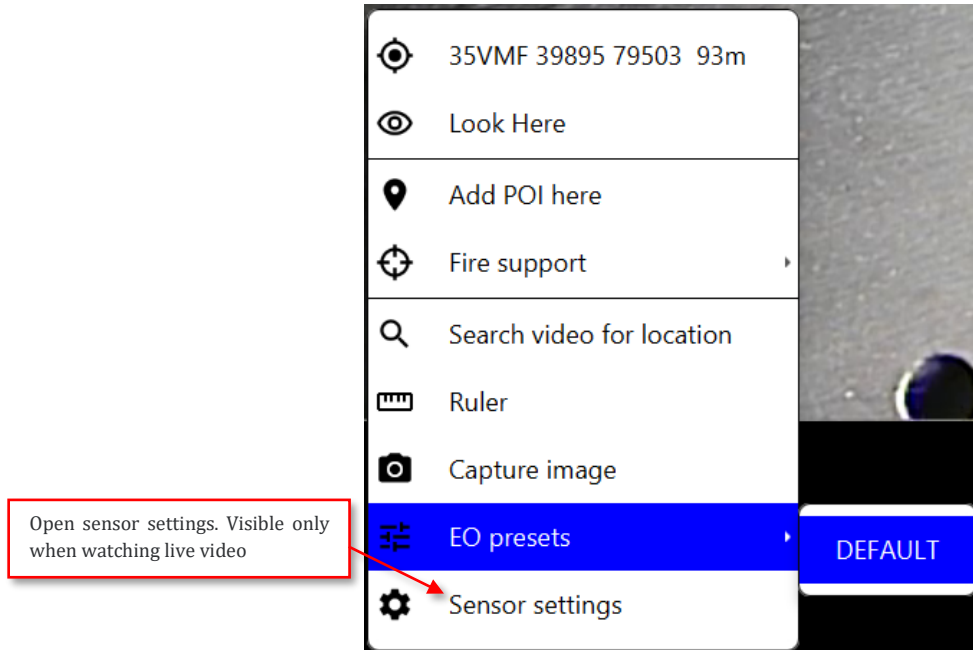


Figure 108: Video context menu - operator

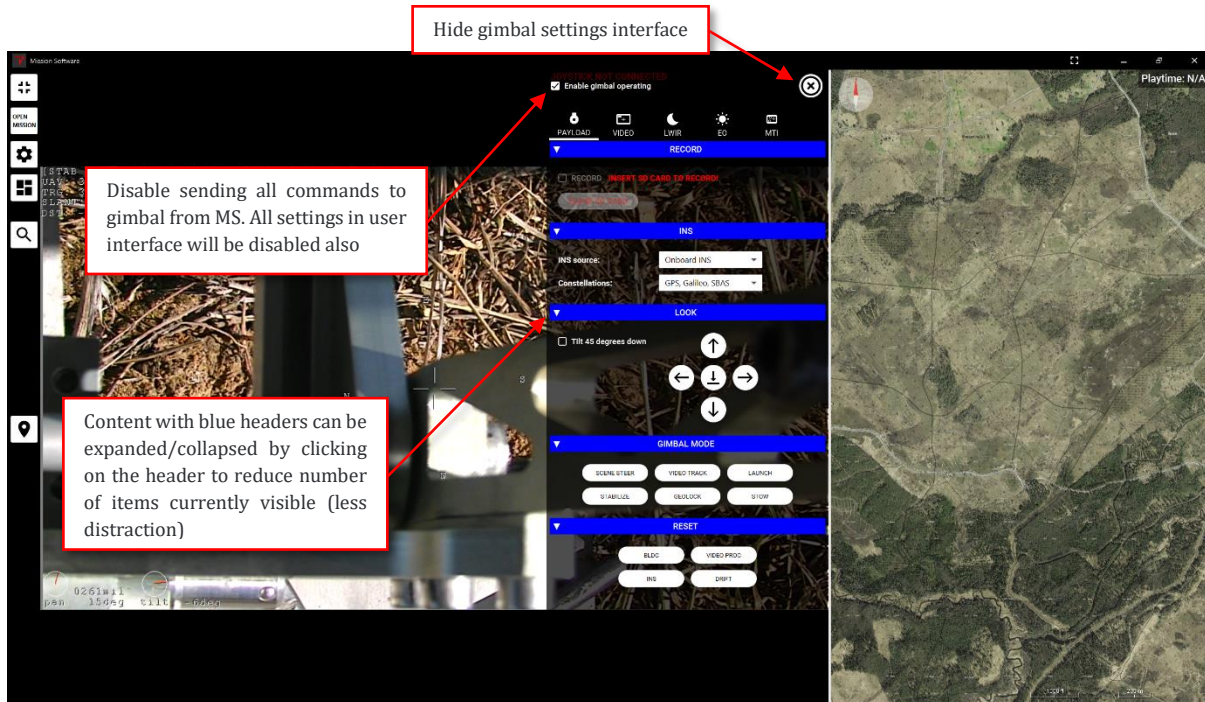


Figure 109: Gimbal settings overview

### 7.15.1 Payload settings

Payload settings tab can be used to control high-level settings of operation.

Onboard recording can be enabled or disabled, together with an option to delete onboard recordings.

The inertial data source of the payload can be optionally switched between onboard and aircraft data. Also used constellations combinations can be selected based on operational area and conditions.

Fixed orientation modes (without gyro stabilization) can be selected using the provided buttons under the “Look” options.

Gimbal main operation modes are also selectable from the menu buttons. The only operational modes that are not selectable also from the hand controller are Launch and Stow positions.

When encountering issues with the payload, various internal components can be reset to restore their operation. User can reset the gimbal motion controller (BLDC), video processor, on-board INS.

There is additional selection to reset the drift cancellation. This may be necessary if too much constant motion is observed in pure gyro stabilisation mode with stationary gimbal. Performing this operation during flight is not advised as it can cause performance degradation in all operational modes, where gyro stabilisation is used,

Enable gimbal operating

PAYLOAD VIDEO LWIR EO MTI

**RECORD**

RECORD **INSERT SD CARD TO RECORD!**

\* Start/stop recording may take up to 10 seconds

ERASE SD CARD

**INS**

INS source: Onboard INS

Constellations: GPS, Galileo, SBAS

\* Change only after gimbal has booted up completely!  
(when data is drawn on video)  
\* NB: keeps both changes after reboot!

**LOOK**

Tilt 45 degrees down

Look forward  
Look left  
Look straight down  
Look right  
Look back

**GIMBAL MODE**

SCENE STEER VIDEO TRACK LAUNCH  
STABILIZE GEOLOCK STOW

**OPTIONS**

Invert gimbal tilt

Calculate geolock in: Mission Software

**RESET**

BLDC VIDEO PROC  
INS DRIFT

**LOGGING**

ENABLE LOGGING DISABLE LOGGING

Start/stop recording to gimbal SD card. NB: It takes some seconds to really start recording! Checkbox disabled if no SD card found in gimbal

Delete all videos and logs from gimbal. Confirmation will be asked

Choose if onboard (gimbal) INS or autopilot INS is used

Choose constellations. Can choose only if onboard INS is selected to be used. NB: signal will be temporarily lost until INS gains fix again!

If look forward/left/right/back should look straight or 45 degrees down. Will act right away if any of the four looks is active currently

Start video track. The video track red box will be at the center of the video

Start geolock. Coordinate will be target (video centre) coordinate

If checked then right joystick stick up-down is inverted. Applies to rotate gimbal, move video track box and move geo-lock position

Choose if calculating new geolock target (moving geolock target with joystick in geolock mode) is made in MS or gimbal. NB: gimbal must have elevation map for the area to calculate correctly if chosen to calculate in gimbal!

Enable logging in gimbal. Will be enabled also after reboot. By default when gimbal is sent out from Threod logging is disabled. Enabling option is meant for debugging purposes or finding faults if it behaves wrongly somehow

Disable logging in gimbal. Will be disabled also after reboot

Figure 110: Payload settings

### 7.15.2 Video settings

In the video settings tab, user can control various options for the displayed image.

Picture-in-Picture can be enabled with specified location and size to show both sensor images at the same time. Switching between cameras with PiP enabled will select which camera is displayed as a main sensor and which is displayed as secondary.

On screen display can be enabled or disabled and the coordinate format shown can be selected from the provided options.

Additionally digital stabilization can be disabled, useful when looking through the propeller of the aircraft which can cause unwanted image movements.

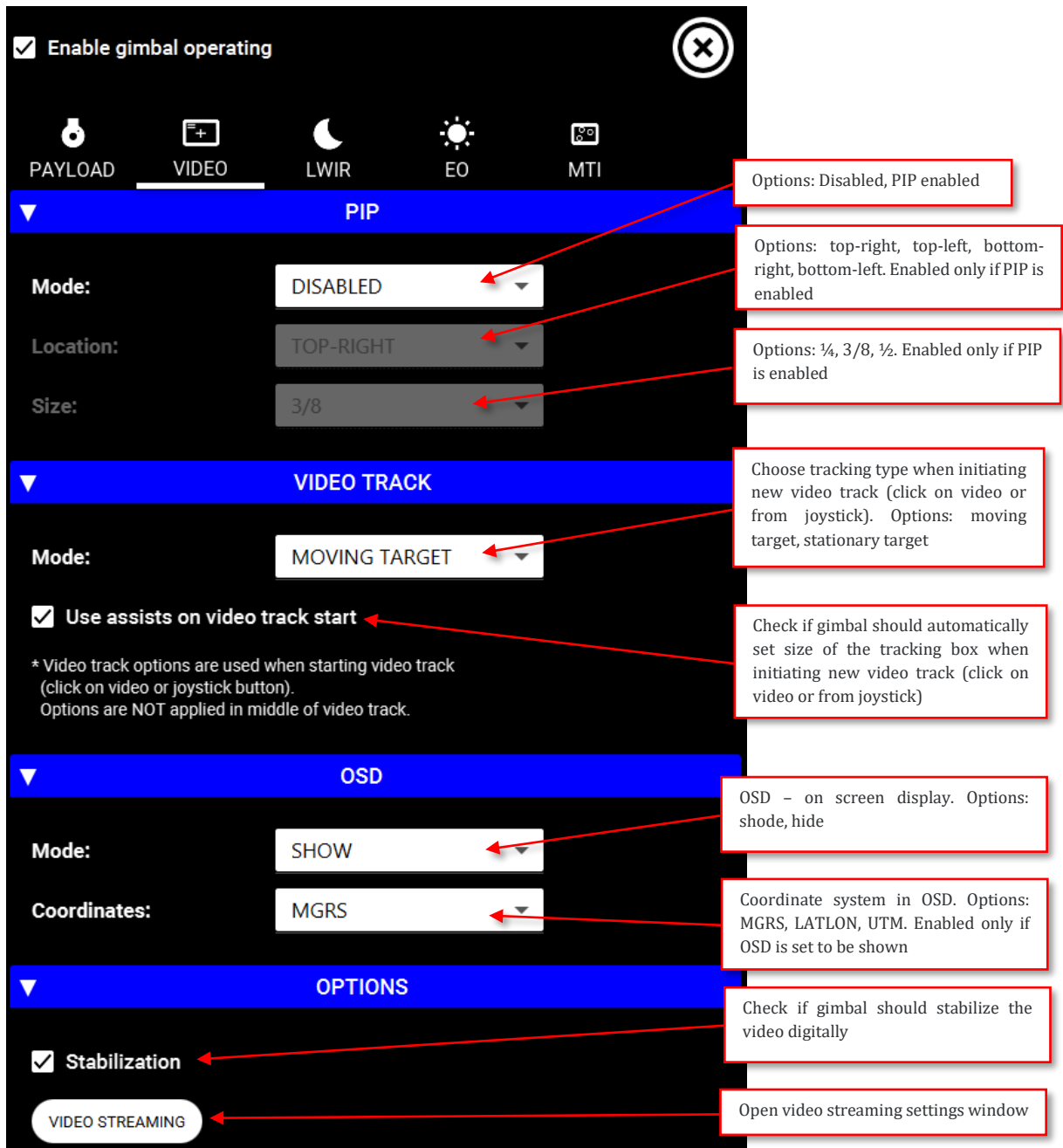


Figure 111: Video settings

### 7.15.3 Video streaming settings

Gimbal has two simultaneous video feeds with configurable options.

User can configure the data rate, destination and quality from the provided settings. As onboard recording uses the highest bitrate video stream available, changing the settings while recording is active, restarts the recording based on the new settings and re-determines the highest bitrate video stream to be used.

Caution must be taken as misconfiguration can cause no/bad video due to bandwidth limitation of the aircraft communication system and/or link distance. Also, one must make sure that the video streams are configured to different IP address/port combinations.

Values here are not updated from gimbal feedback.

User based pre-sets can be created and stored locally.

MS is configured to listen for 224.1.1.10:15004 as main video source and 224.1.1.40:15008 as backup video source. If configuration doesn't have neither source then MS and server can't show/record any video. For live feed in MS operator version MS shows "HQ" or "LQ" on top right corner of video indicating if it's currently showing main or backup feed.

The screenshot shows the 'VIDEO STREAMING SETTINGS' interface with the following fields and controls:

- Video output:** #1 and #2
- Bitrate:** 10.0 and 3.0 Mbps (0.1-10)
- IP:** 127.0.0.1 and 224.1.1.10
- Port:** 15008 and 15004 (1-65535)
- Frame step:** 1 and 1
- Encoding:** H.265 and H.264
- Enabled:** Two checked checkboxes
- Buttons:** APPLY TO GIMBAL (blue), STORE IN GIMBAL (white), NEW PRESET (white), SAVE (grey), DELETE (red)
- Fields:** Preset: GDT + HQ SD-Card
- Warnings:** \* Values here are not currently used values in gimbal! \* Values are not sent to gimbal automatically when changed

Callouts provide the following explanations:

- APPLY TO GIMBAL:** Send and apply currently visible settings to gimbal
- STORE IN GIMBAL:** Tell gimbal to save last sent values so that after gimbal restart the settings are used again
- NEW PRESET:** Create new preset using currently visible values
- SAVE:** Save currently visible values to selected preset. Default presets can't be overwritten
- DELETE:** Delete currently selected preset. Default presets can't be deleted
- SELECT PRESET:** Select preset. Selecting preset will not send them to gimbal automatically - only shows them in user interface

Figure 112: Video streaming settings

### 7.15.4 MTI settings

The MTI settings window allows the user to enable and configure the moving target indication functionality.

User can select between different detection modes based on the task.

MTI settings can either be adjusted automatically, being only able to control the overall sensitivity. Other settings like the threshold of detection, and how many frames the object must be present in order to be detected can be enabled manually if automatic settings by sensitivity selection are not satisfactory.

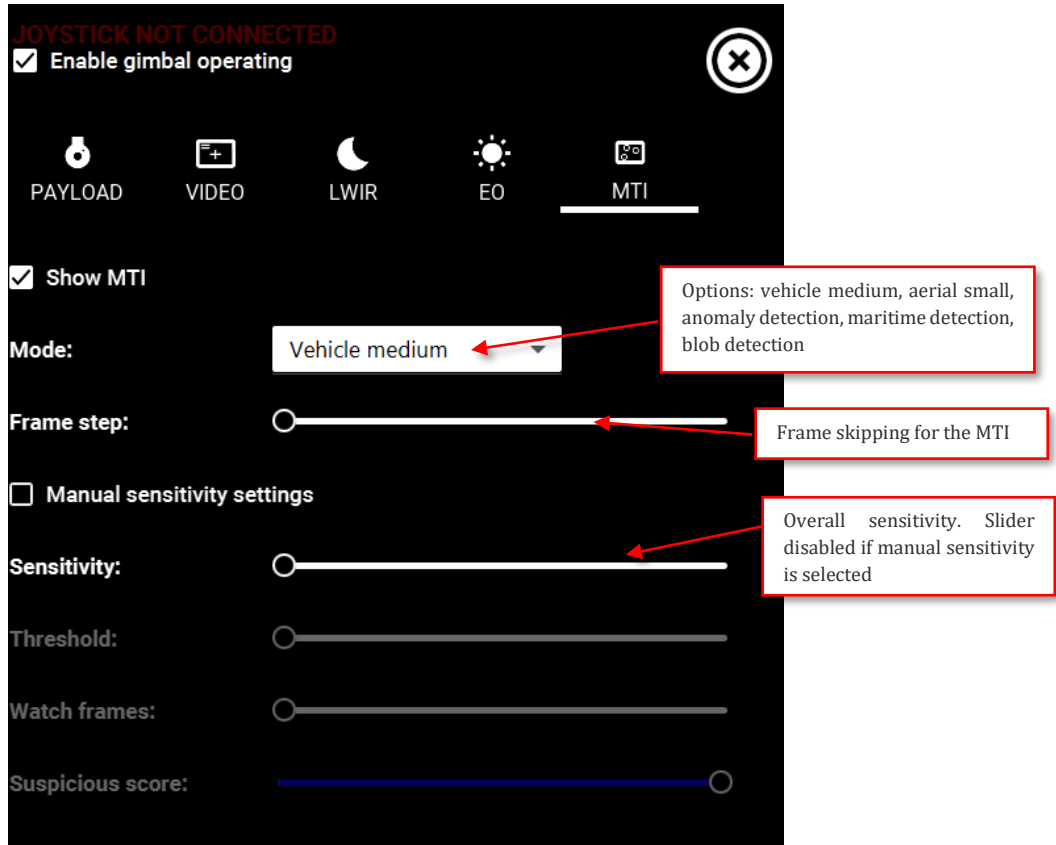


Figure 113: MTI settings

### 7.15.5 HDTV / EO camera settings

Provides settings for the HDTV EO camera. User can configure various image enhancements like CLAHE or defog, configure camera focus, exposure and colour settings.

Users can save different pre-sets of settings and recall them as needed.

Pre-sets are saved locally and are user based.

The screenshot shows the EO camera settings menu. At the top, there is a toggle for 'Enable gimbal operating' and a close button. Below are tabs for PAYLOAD, VIDEO, LWIR, EO (selected), and MTI. The main settings are grouped into sections: CLAHE (with a warning note), Defog (MID), Infrared cut filter (RGB), White balance (OUTDOOR), FOCUS (Mode: AUTO, Direct value slider), AUTOMATIC EXPOSURE (Mode: AUTO, Iris, Shutter, Gain sliders), and COLOR ADJUSTMENT (Gain, Hue sliders). At the bottom, there is a 'DEFAULT' dropdown, 'APPLY', 'SAVE', 'CREATE NEW', and 'DELETE' buttons. Red callout boxes provide details: 'Options: Disabled, low, mid, high' for Defog; 'Options: auto, NIR, RGB' for Infrared cut filter; 'Options: outdoor, outdoor auto' for White balance; 'Options: auto, manual' for FOCUS Mode; 'Options: auto, manual, shutter priority' for AUTOMATIC EXPOSURE Mode; 'Apply currently selected EO sensor preset settings to gimbal (NOT settings that are currently visible but the saved preset settings). Useful if you selected preset and then changed something and now want back the saved settings' for the SAVE button; 'Save current settings to currently selected preset. Default settings can't be overwritten and button is disabled then' for the APPLY button; 'Delete the selected preset. Default preset can't be deleted and button is disabled then' for the DELETE button; 'List of EO sensor presets. When selecting other preset than currently selected preset then it will be applied to gimbal right away' for the DEFAULT dropdown; and 'Create new preset for EO sensor with current settings. Prompt will be shown to write name of the preset' for the CREATE NEW button.

Figure 114: EO settings

### 7.15.6 LWIR / thermal camera settings

Provides sensor settings for the LWIR camera.

User can select between different colour palettes; sensor gain with region of interest and various advanced settings

User based pre-sets can be created and stored locally.

The screenshot shows the LWIR settings menu with the following elements and callouts:

- Enable gimbal operating:** A checked checkbox.
- PAYLOAD:** A button with a camera icon.
- VIDEO:** A button with a video camera icon.
- LWIR:** A selected button with a moon icon.
- EO:** A button with a sun icon.
- MTI:** A button with a target icon.
- Palette:** A dropdown menu set to "White hot".
- GAIN:** A blue header bar.
- ROI:** A dropdown menu set to "50%". Callout: "Options: 100%, 75%, 50%, 25%, top, bottom, left, right".
- Mode:** A dropdown menu set to "High". Callout: "Options: high, low, auto, dual, manual".
- Max gain:** A slider control.
- IMAGE ADJUST:** A blue header bar.
- FFC:** A toggle button.
- Plateau:** A slider control.
- ACE:** A slider control. Callout: "FFC - Flat Field Correction? The shutter acts as a flat reference source for the detector to calibrate itself to and thermally stabilize. This calibration compensates for certain errors that build up during camera operation."
- Damping factor:** A slider control.
- Tail rejection:** A slider control.
- Smoothing factor:** A slider control.
- DDE:** A slider control.
- Detail headroom:** A slider control.
- Linear percent:** A slider control.
- DEFAULT:** A dropdown menu.
- APPLY:** A button.
- SAVE:** A button.
- CREATE NEW:** A button.
- DELETE:** A button. Callout: "Same usage logic as for EO sensor".

Figure 115: LWIR settings



## 7.16 IMAGE VIEWER

Image viewer is meant to see bigger tag, snapshot, and report images. Image viewer allows to save the images separately outside MS, add POI, and perform measuring from the images or video (screenshot from video is taken then).



Figure 116: Image viewer

### 7.16.1 Image measure tool

Image measure tool allows the user to measure lines, paths, and areas directly on the image. The tool is accessed via measure button in image viewer window.

Closing the measure tool dialog will automatically clear all measure lines on image.

Closing image viewer window will also close measure tool automatically.

#### 7.16.1.1 Line measure

Line measure allows the user to measure distance and bearing between two points. The units of distance and angles can be specified from the drop-down menus. First click on video sets starting point of line and second click marks end point of line. Max one line is shown at a time meaning if line is added and then clicked on image again then the old line is deleted, and the click sets new start position of the line. Both, start point and end point, can be dragged on image. Point is not added to image with click and point is not moved when dragging if coordinate calculation fails (over the horizon for example).

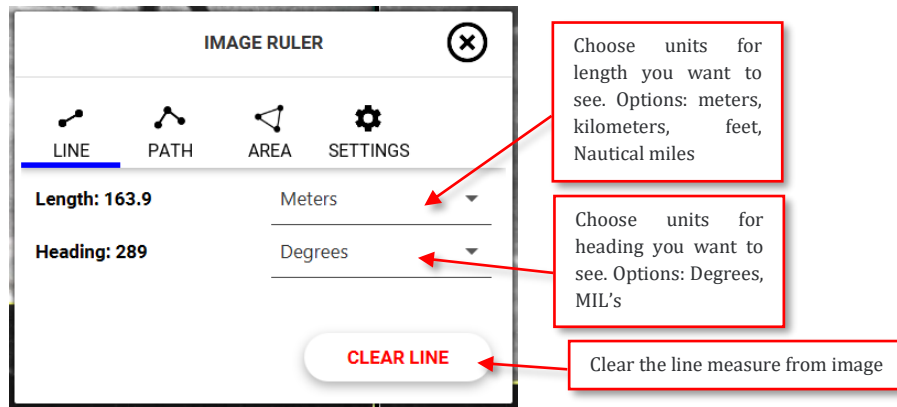


Figure 117: Image measure tool - line dialog

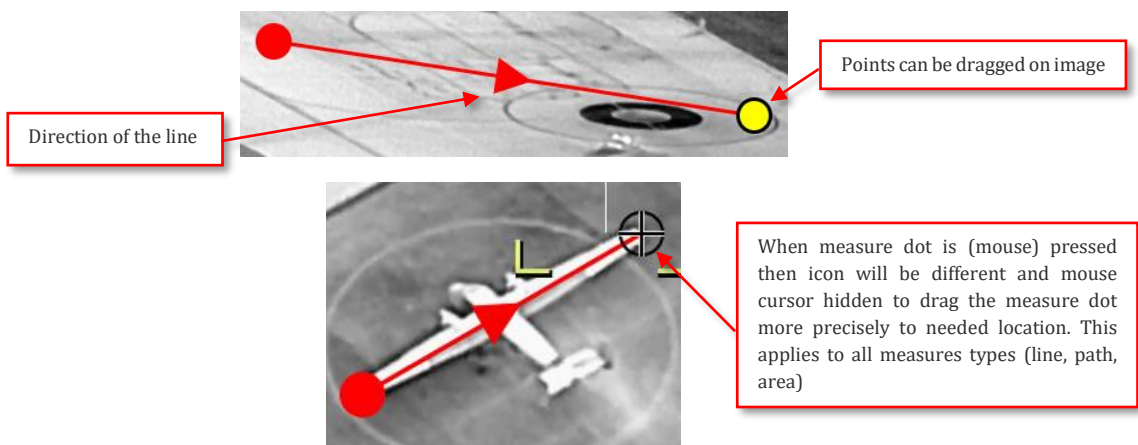


Figure 118: Image measure tool - line measure

### 7.16.1.2 Path measure

Path measure allows the user to measure distances along a path with multiple points. Units of distance can be specified from the drop-down menu. New point is added to path each time user clicks on image. New point is added after selected point. New point is set as selected automatically.

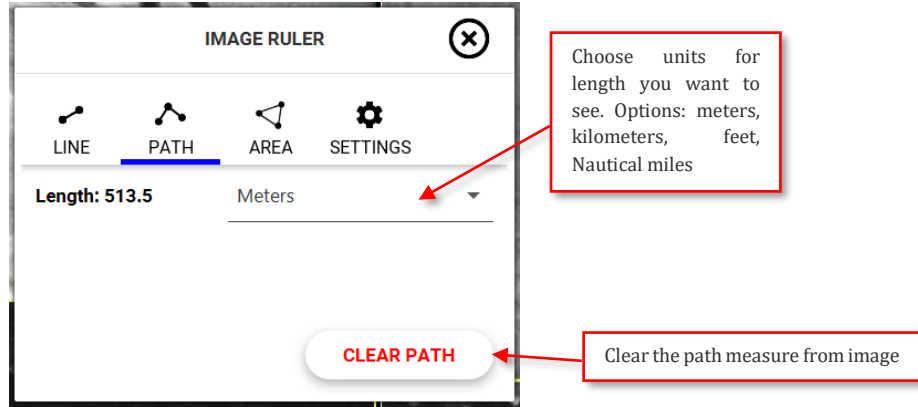


Figure 119: Image measure tool - path dialog

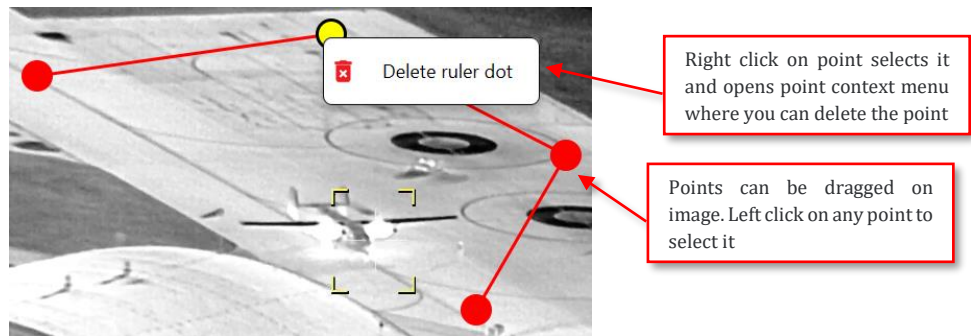


Figure 120: Image measure tool - path measure

### 7.16.1.3 Area measure

Area measure allows the user to measure polygonal areas. Units of area and perimeter can be specified from the drop-down menu. New point is added to polygon each time user clicks on image. New point is added after selected point. New point is set as selected automatically. Perimeter and area are not calculated until at least three points are added to image.

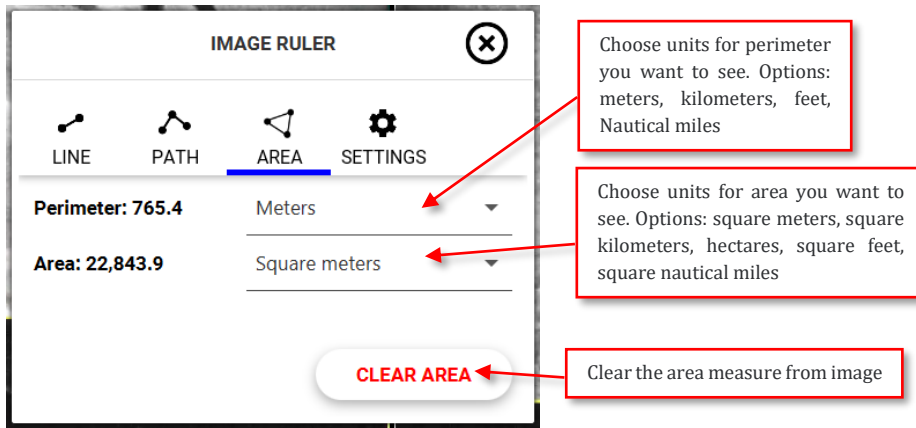


Figure 121: Image measure tool - area dialog

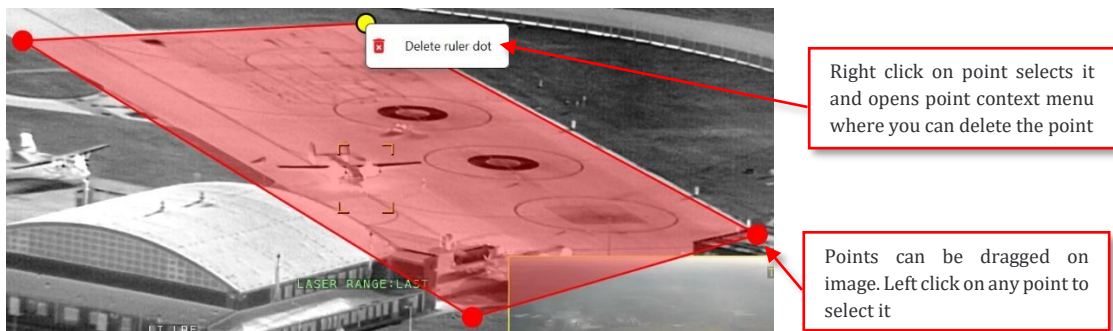


Figure 122: Image measure tool - area measure

### 7.16.1.4 Image Measure Settings

User can define line colors and line widths. Image measure settings are saved and user based. Colors and line widths are applied right away when changed and doesn't need saving separately.

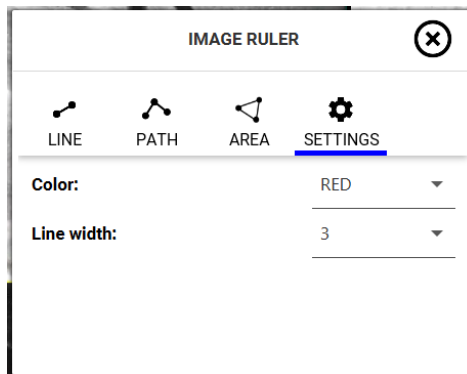


Figure 123: Image measure tool - settings

## 7.17 FIRE SUPPORT

Fire support functionality provides the users a tool to assign targets for indirect fire units.

Main interface for the tool is the map where target icons are added. Targets may be added directly on the map from the map context menu.

Once a target icon has been added to the map, it can be used to build a call for fire text to read out or make fire adjustments.

Targets are saved locally and are user based but are not attached to any mission.



Figure 124: Fire support target icons

Selected targets are highlighted with the danger close radius if selected to show it in fire support tab in layers manager.

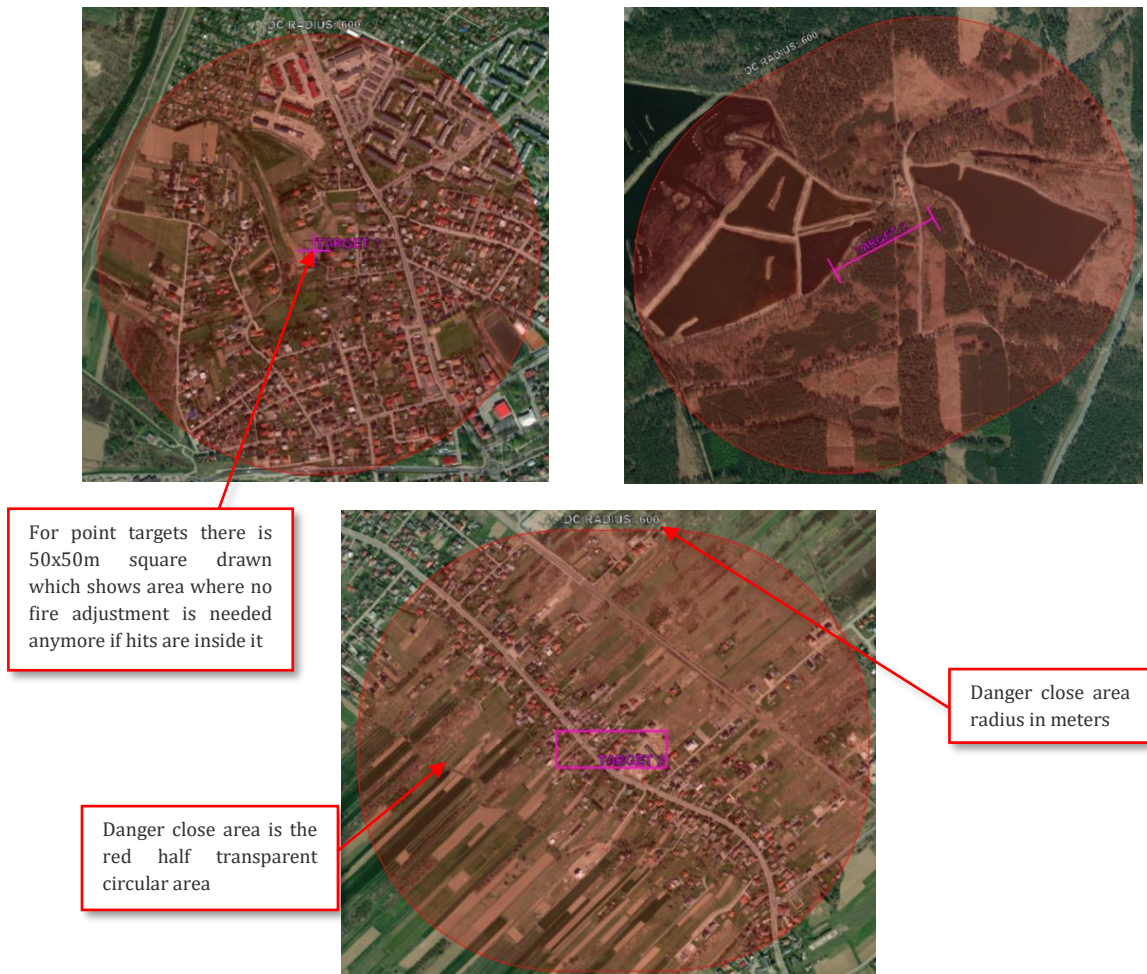


Figure 125: Fire support selected target icons

### 7.17.1 Fire support context menu

From map context menu you can added targets, open targets list and set hit points for adjusting fire.

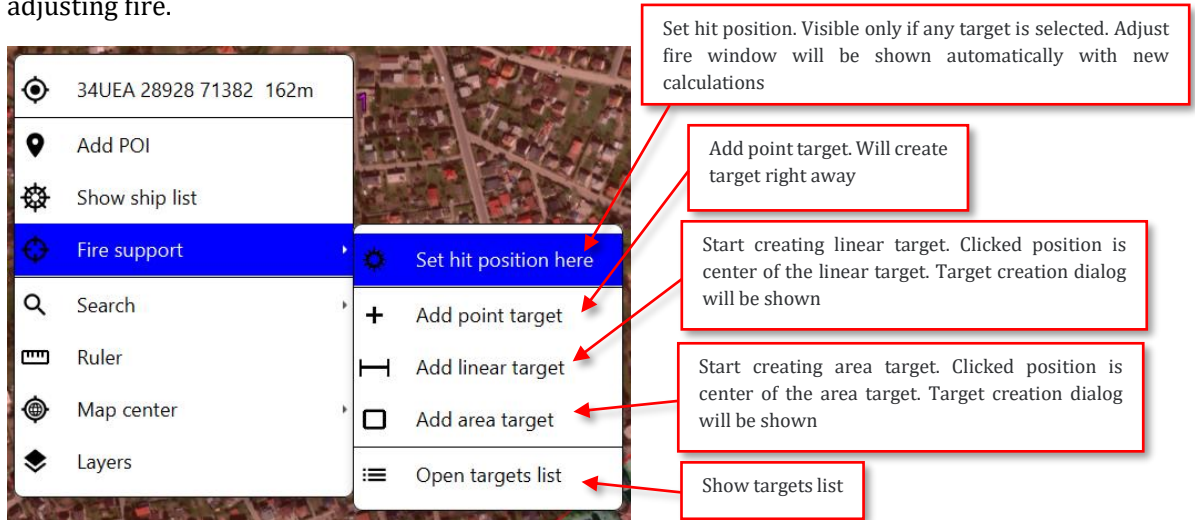


Figure 126: Map context menu – fire support sub menu

When adjusting fire, the map context menu is kept minimum in size. Other objects (POI, tag, ship) are not clickable.

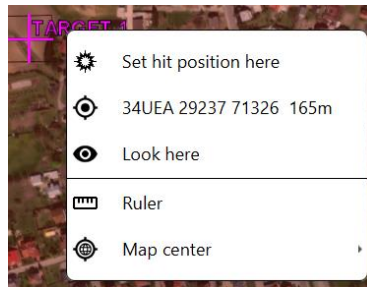


Figure 127: Map context menu – adjusting fire

Single left click on target name to select/deselect target. Left double-click on target name to open target details. Right click on target name to open target context menu instead of default map context menu is shown and selecting is active only if currently is not shown any of following dialogs: adjust fire, call for fire, read call for fire.

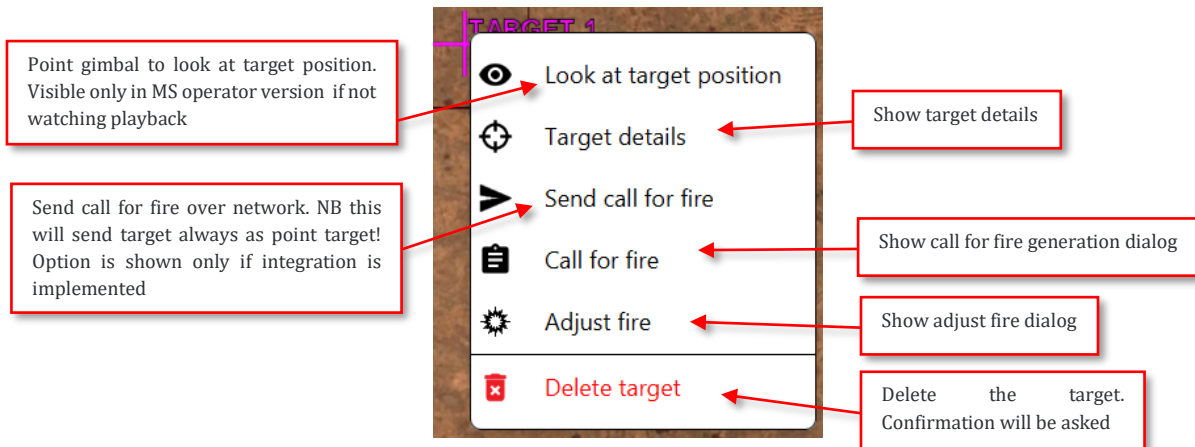


Figure 128: Target context menu

## 7.17.2 Creating target

### 7.17.2.1 Creating target manually

Creating targets manually is useful for targets which coordinates are known. Temporary red target is drawn on map if target centre coordinate is correct and target size (linear and area targets) are correct values.

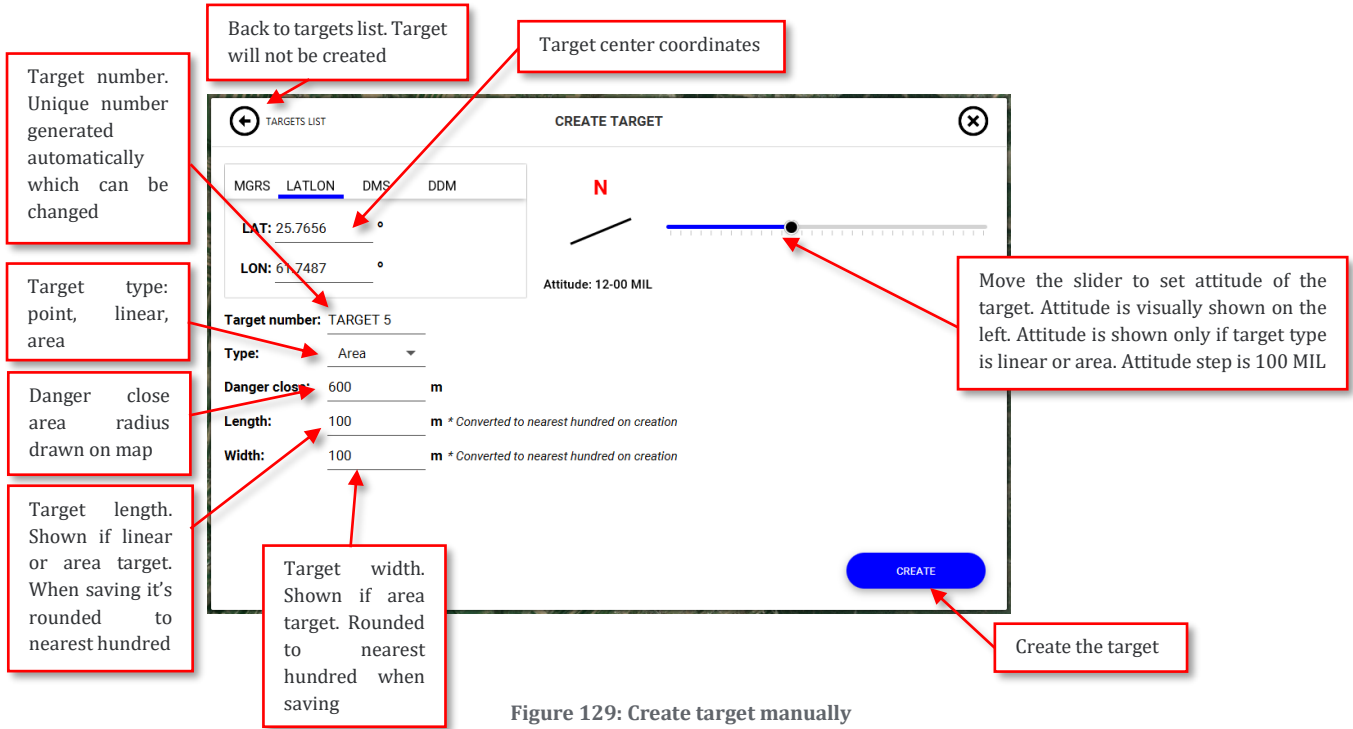


Figure 129: Create target manually



Figure 130: Create target manually - temporary targets on map

### 7.17.2.2 Creating target on map

Creating targets on map is possible through map context menu fire support sub-menu. When point target is chosen the target is created right away. If Linear target or area target is chosen, then target parameters dialog will be shown where to define attitude and size of the target. Temporary target in red colour without target name is drawn on map to see it on map when changing the target parameters in the dialog. Clicked position is target center.

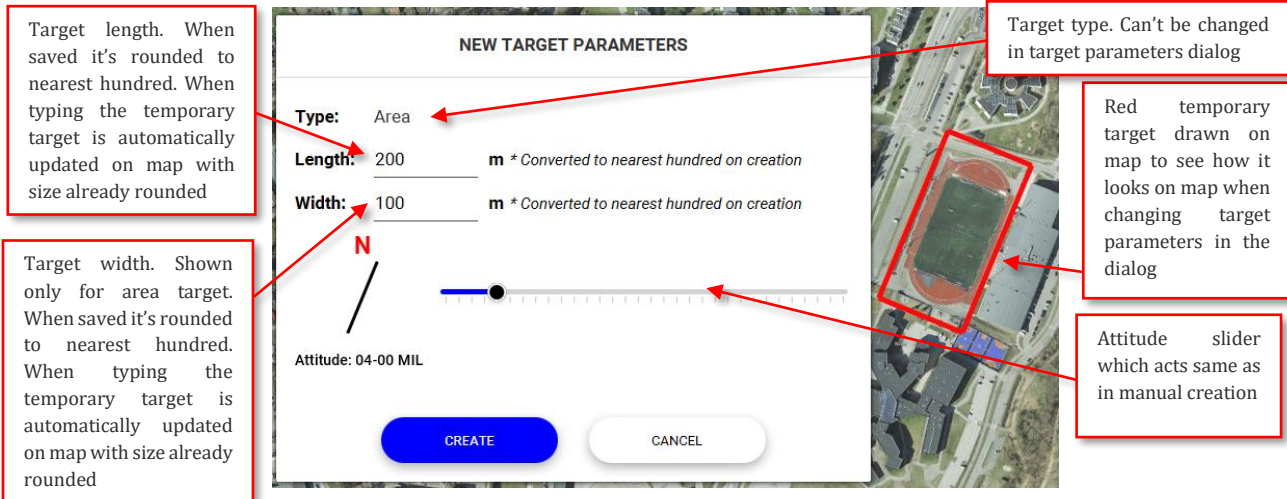


Figure 131: Create target on map – dialog

### 7.17.3 Editing target

Targets can be edited later and it's visually same as creating target manually. Difference from target creation is you can delete, start call for fire creation, zoom in map and create button is replaced with save button. When target editor is shown then red temporary target with values from the editor is shown in addition to the target with currently saved values to see the changes visually on map.

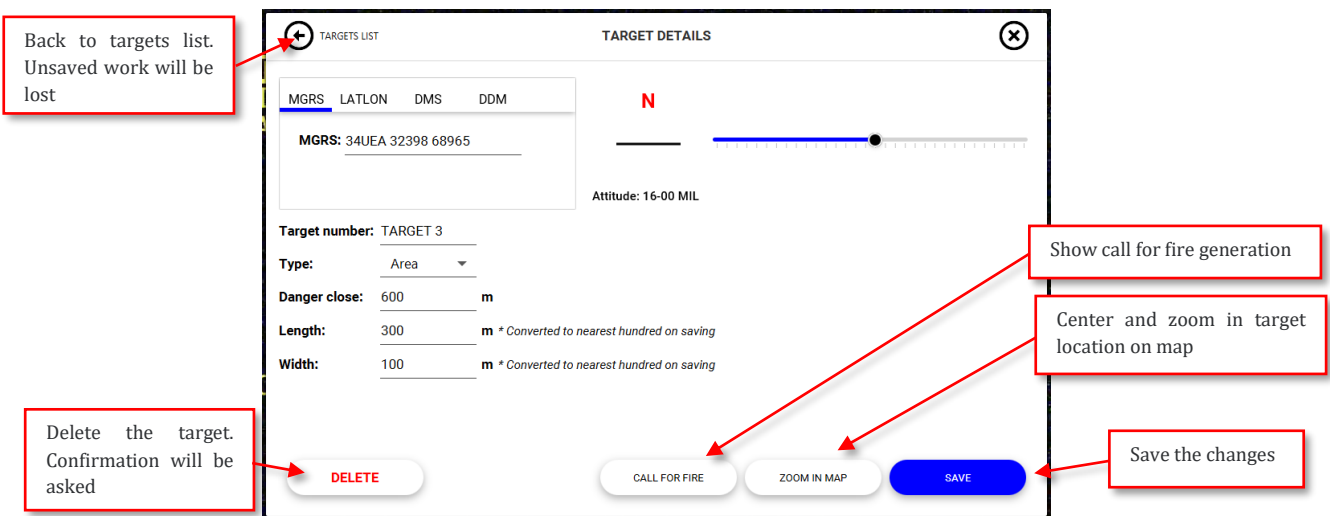


Figure 132: Edit target





Figure 133: Edit target icons on map

### 7.17.4 Target list

Targets list can be opened from map context menu fire support sub-menu, layers manager window fire support tab and clicking back in target details.

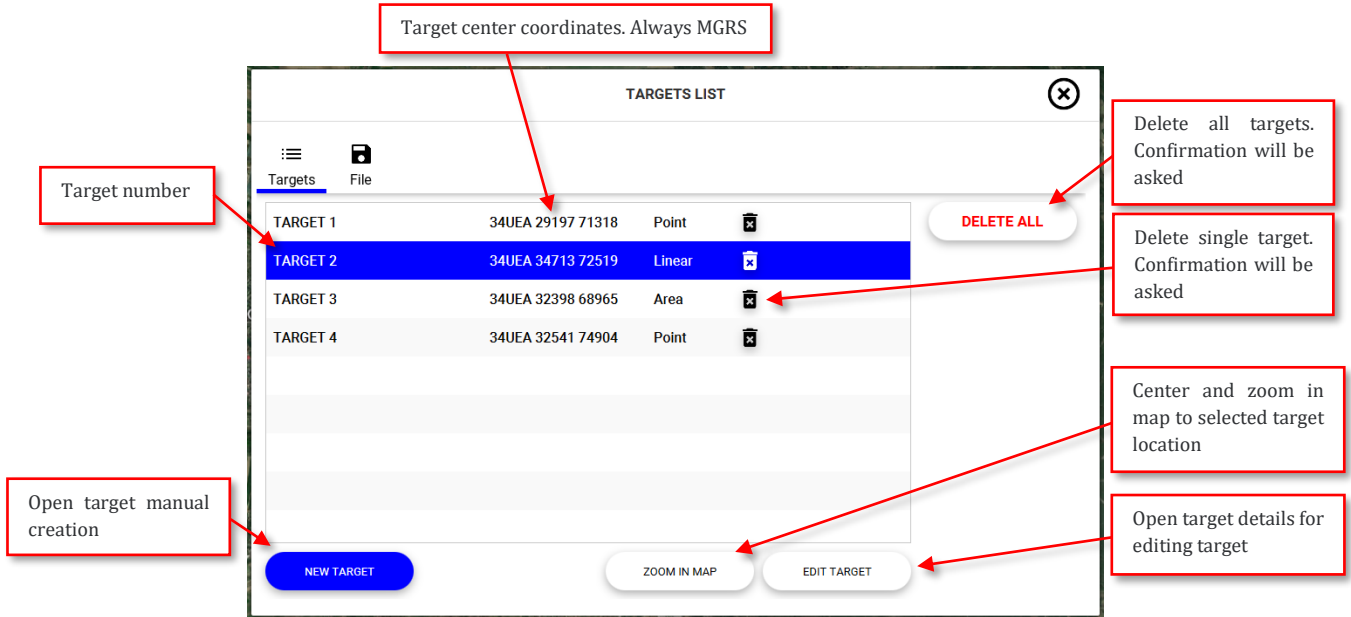


Figure 134: Fire support target list

### 7.17.5 Save-load targets

All targets can be saved to file and loaded from file. Standard Windows file chooser window will be shown.

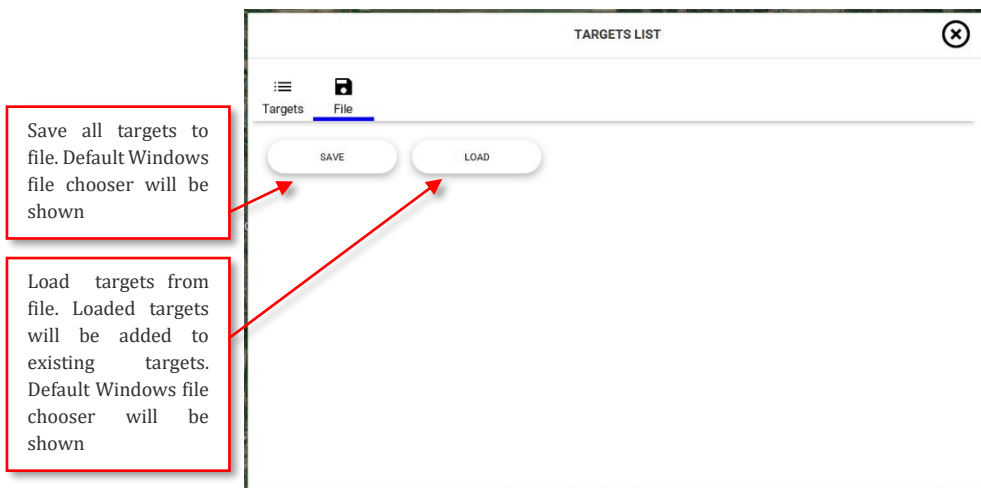


Figure 135: Save-load fire support targets

### 7.17.6 Call for fire

To start generating the call of fire, right click on the target icon and choose call for fire or click call for fire button in target details dialog.

To generate call for fire text for reading out call sign fields and target description must be filled. Call signs are attached to given target until new call for fire text is generated for the target. Call signs are used also in adjusting fire text.

**CALL FOR FIRE**

**1. Identification**  
 Observer C/S:   
 FDC C/S:

**2. Warning order**  
 Type of mission: ADJUST FIRE  
 Size of element: DEFAULT

**3. Target location**  
 Target number: TARGET 1  
 Elevation: 84 m  
 Use target number instead of coordinates

**4. Target description**  
 \* number, type, activity, covert

**5. Method of engagement**  
 Ammo type: DEFAULT  
 Effect: DESTROY  
 Angle: LOW ANGLE  
 Danger close  
 Delay fuse

**6. Method of fire control**  
 FIRE WHEN READY

Buttons: ADJUST FIRE, SEND, READ OUT

**Callouts:**  
 - Call signs. Must be filled  
 - Back to target details  
 - Options: adjust fire, fire for effect, suppress, immediate suppression  
 - Options: none, HE, illum, smoke. None is not read out  
 - Options: destroy, neutralize, harrass  
 - Options: default, 1 gun, 2 guns, 3 guns. Default is not read out  
 - Optional elevation. Not used if empty but is prefilled automatically with ground elevation  
 - Select if target number instead of coordinates will be read out meaning receiver has the target data already  
 - Target description must be filled  
 - Start adjusting fire for the target  
 - Options: default, low angle, high angle. Default is not read out  
 - If is danger close  
 - If needs delay fuse  
 - Options: fire when ready, at my command, time on target, do not load. If time on target then text field for time shown also next to drop-down menu  
 - Generate the call for fire text to read out over radio  
 - Send call for fire over network. NB will send always as point target and without extra options! Visible only if integration is implemented

Figure 136: Fire support call for fire

**READ FIRE MISSION**

1	2	3
Nest 21 this is Eagle 1 ADJUST FIRE over	Grid 35VMF 3367 8206 elevation 84 m AMSL over	Target is 5 TANKS IN THE OPEN DESTROY FIRE WHEN READY over

Buttons: SEND, ADJUST FIRE

**Callouts:**  
 - Call for fire separated to three parts to read out  
 - Send call for fire over network. NB will send always as point target and without extra options! Visible only if integration is implemented  
 - Start adjusting fire

Figure 137: Read out call for fire

### 7.17.7 Adjust fire

To generate fire adjustments, right click on the target icon and choose adjust fire, click adjust fire in call for fire read dialog, click set hit position on map context menu (will add hit position then) or click adjust fire on video or quick fire adjust on video in video context menu. All but the first and last options need target to be selected beforehand. Crosshair is shown in map centre when adjusting fire if target is selected. When adjusting fire, no object (tag, POI, target) context menu is accessible to be able to set hit position near/on top of the object meaning the adjust fire map context menu is shown with right click on map regardless what's under the click position. If quick adjust fire on video is used then only targets can't be selected.

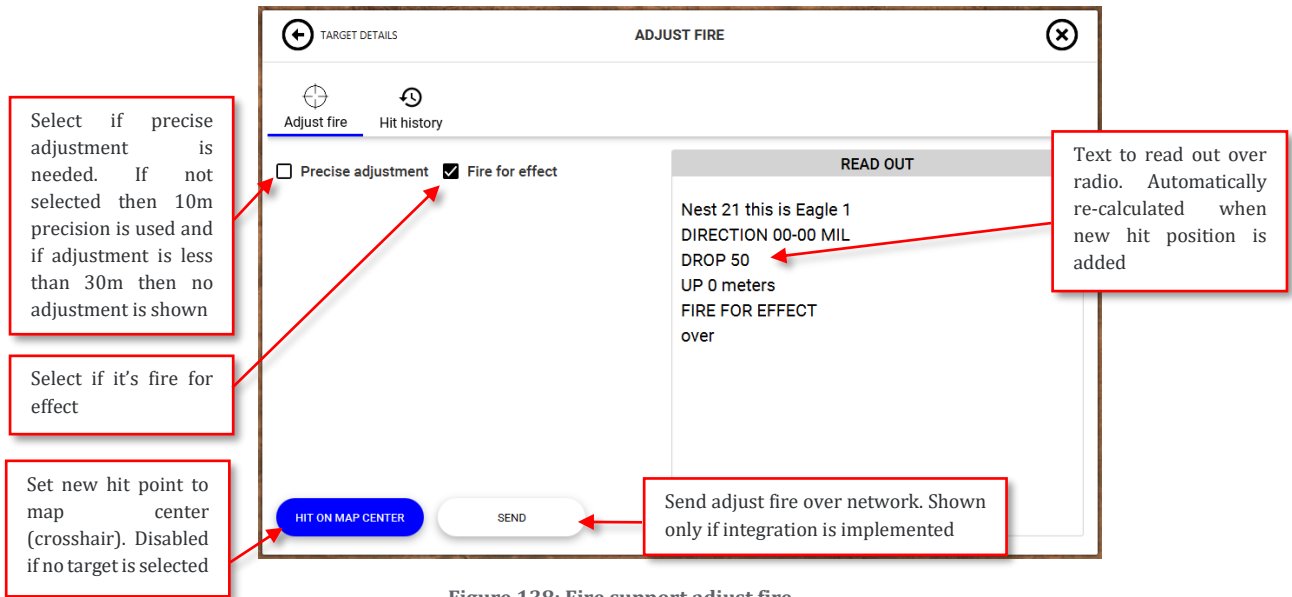


Figure 138: Fire support adjust fire

When hit history tab is selected then instead of last hit position selected hit positions are shown on map. Selecting adjust fire tab will show only last hit position again. If quick adjust fire on video is used (no target selected) then hit history list is empty and buttons disabled.

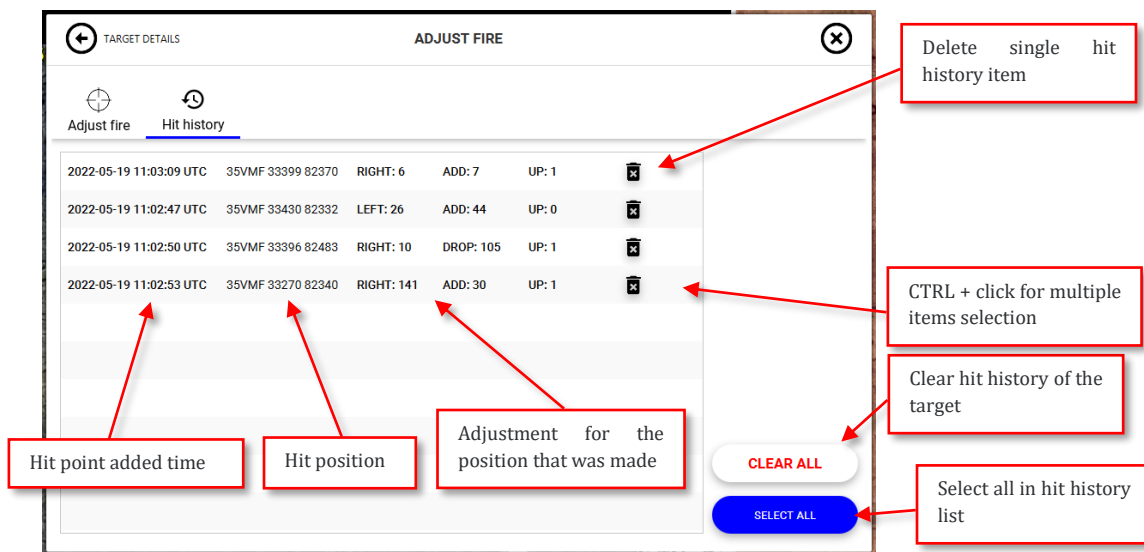


Figure 139: Fire support target hit points history

Hit point(s) on map are red crosses. When adjusting fire also virtual observer position is shown which is always 32-00 MIL from the target. If target is selected then virtual observer

is shown always. If no target is selected when adjusting fire (quick fire adjust on video) then virtual observer is shown only if hit and target positions both are set on video.



Figure 140: Fire support adjust fire icons on a map

### 7.17.7.1 Adjust fire on map

Adjusting fire on map is just choosing “Set hit position here” option on map context menu or clicking “Hit on map center” button in adjust fire window if currently adjusting fire. If currently not adjusting fire and target is selected, then choosing “Set hit position here” option in fire support sub-menu in map context menu. If adjust fire window is not open then it will be opened automatically. Hit point can’t be set on map if quick adjust fire on video is used.

### 7.17.7.2 Adjust fire on video

Adjust fire on video can be started from video context menu choosing “Adjust fire on video” option or “Quick fire adjust on video” option depending if target is selected on map or not. Video will be frozen (live feed) or paused (playback) automatically and controls will be hidden. To set hit point you must perform two clicks on video where first click is setting target on video and second click is setting the hit position on video. Clicks are marked on video. After the two clicks you can make another two clicks right away for adding new hit position. When the two clicks are made then the hit position is added to map and new adjusting values will be calculated automatically. If adjust fire window is not opened then it’ll be opened automatically. On bottom-centre of the video there is shown what (target or hit) is next click and you can end the adjust fire on video there. If you close the adjust fire window then adjust fire on video will be ended also automatically. When adjust fire on video is ended then previous video state (controls showing, resume live feed or playback).

If adjust fire on video is active, then keyboard keys can’t be used to play/pause/rewind/forward the playback video.

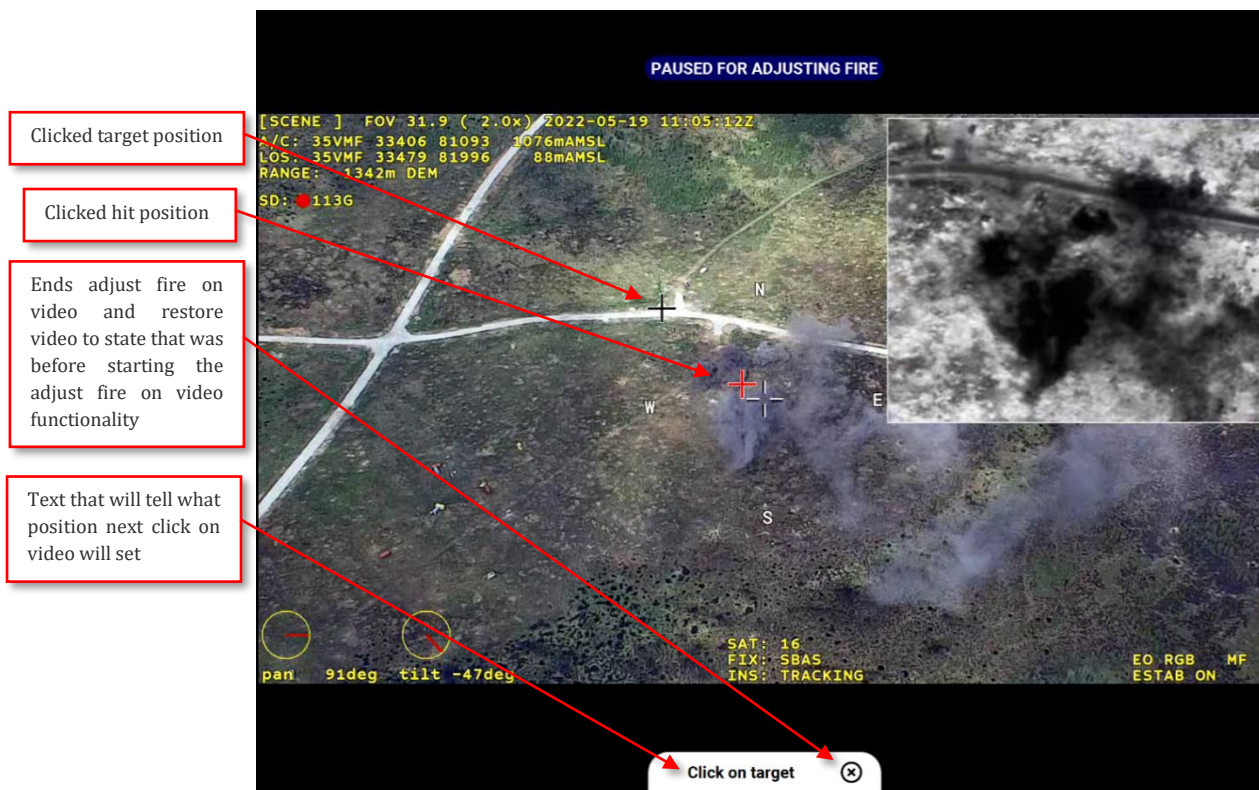


Figure 141: Adjust fire on video

## 7.18 TEXT CHAT

Text chat allows all users connected to a live or archived mission to send and receive chat messages. Channels can be created, and users added. Users can't be removed from channel once added. Chat messages are stored in the database as mission items and all received messages are shown all the time during playback regardless seek position.

Text chat window can be opened by clicking on the chat button on the main toolbar.

To add a new channel, click on the new channel button.

To change the channel name or add users click on the modify button. Only channel creator can modify channel. Others can only see the details of the channel (users list added to channel).

Channels can't be deleted.

User can see only channels where it's added to.

Broadcast channel is always present and cannot be modified as it includes all the users that have permission to access the mission.

Channel with only two users is considered as one-to-one chat. Other user name is shown in list instead of channel name and icon next to name if the other user is online or offline.

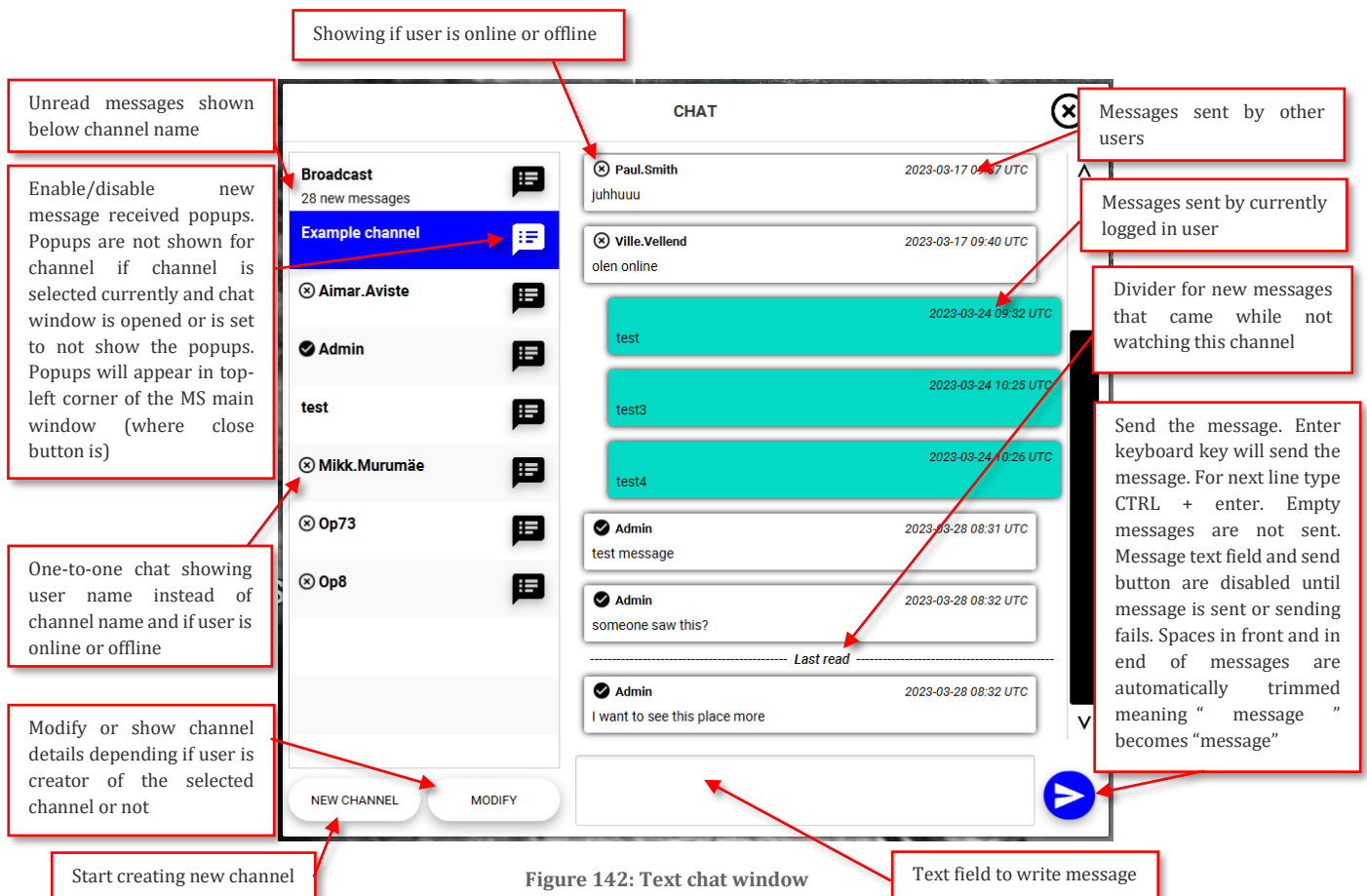


Figure 142: Text chat window

In create/modify channel dialog the user can assign or change the visible name of the channel. Users can be added when creating or editing a channel. Users can't be removed from channel.

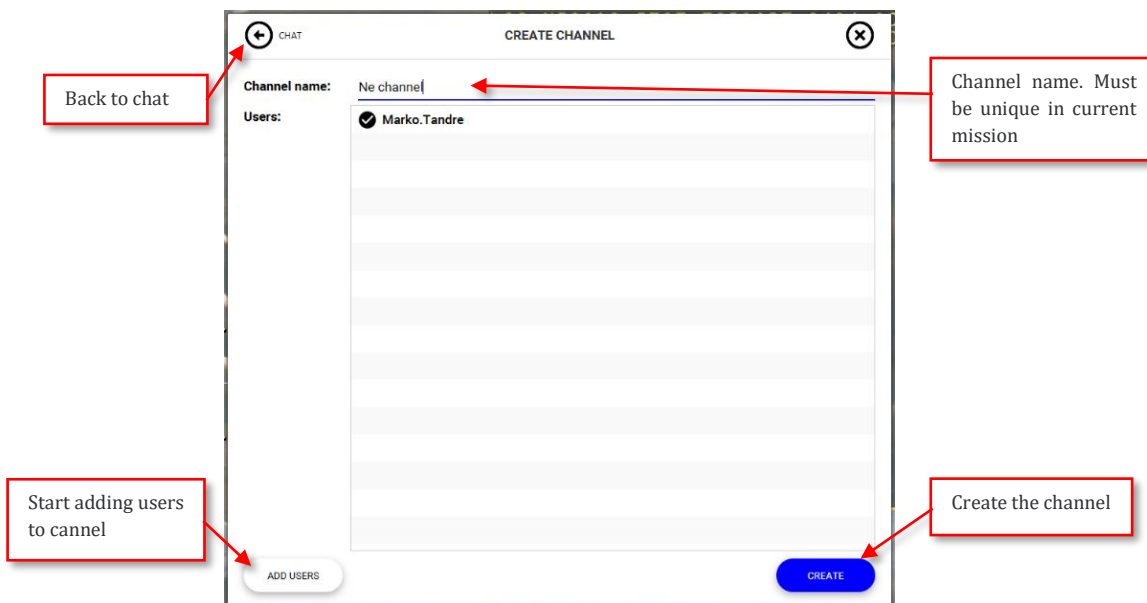


Figure 143: Create text chat channel

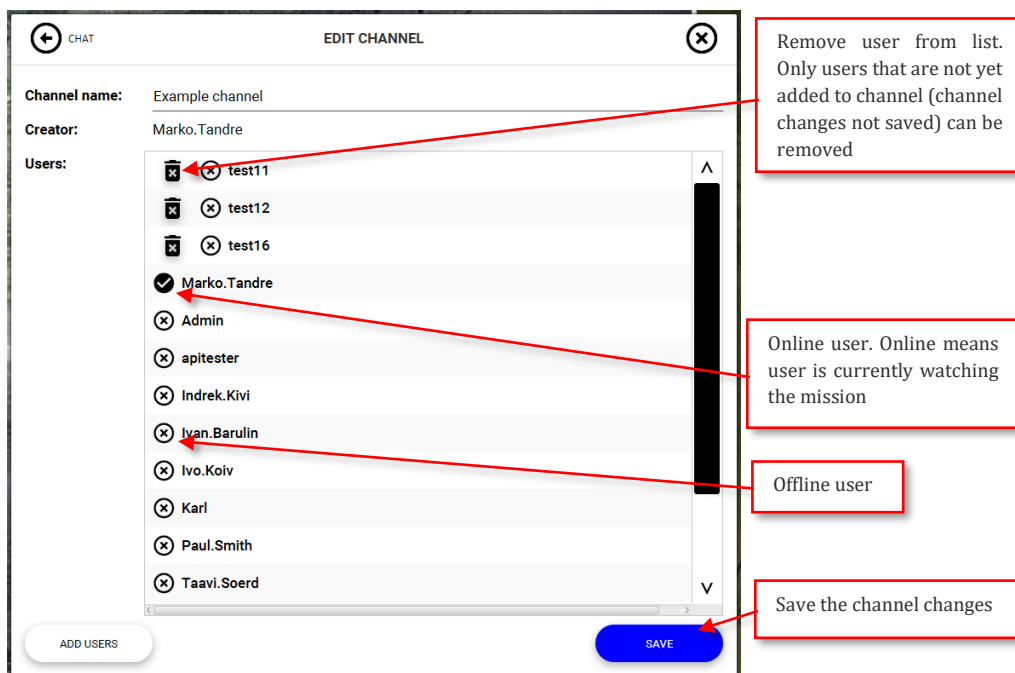


Figure 144: Edit text chat channel



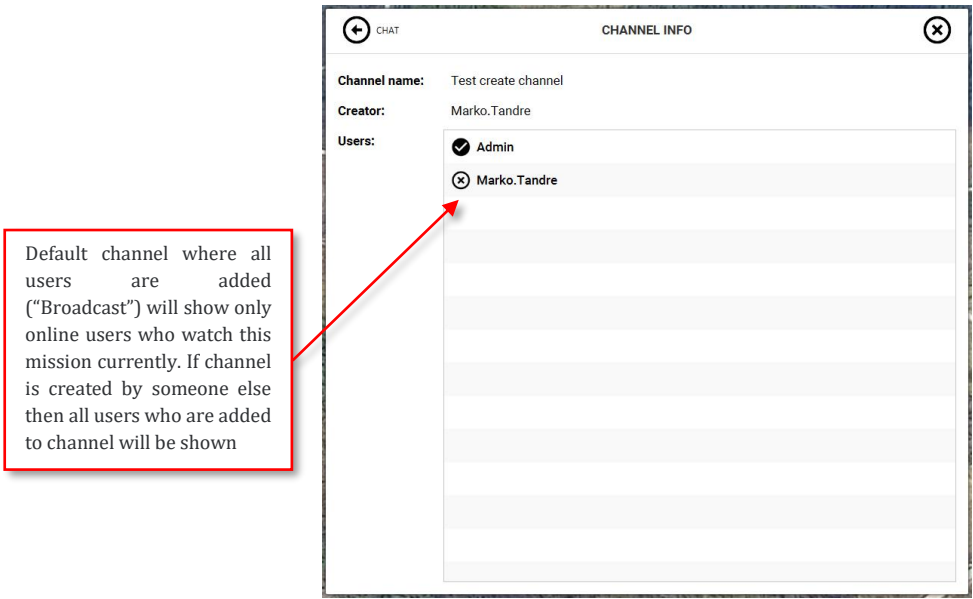


Figure 145: Show text chat channel details

Add user dialog shows all the users that have permission to access the mission. Search box can be used to find specific users when the list is large.

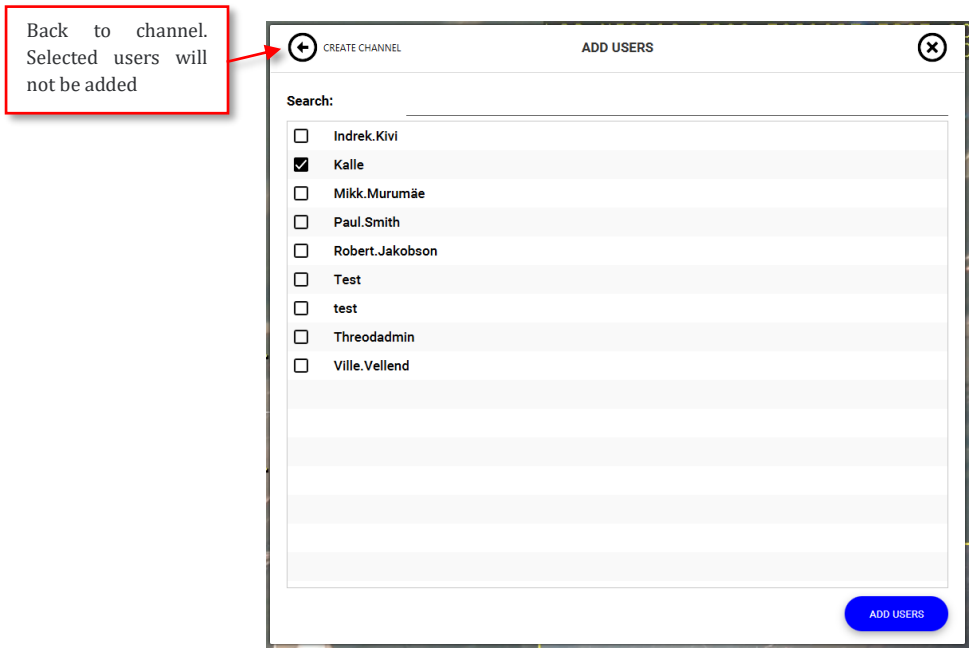


Figure 146: Text chat add user to channel

## 7.19 AUDIO CHAT

Audio chat allows all users connected to an ongoing live mission to communicate using voice.

Audio chat uses the computer sound card to capture microphone input and play back the received audio. Audio chat control opens from the main menu audio button. All voice communication is sent to the server and recorded for playback.

Audio chat control dialog allows the user to mute the incoming audio (other people speaking) and to mute the microphone (stop broadcasting audio out).

MS will listen for microphone input when watching live mission but sends it to server only if it's set to be recorded and audio level is over squelch level. By default audio is not sent to server when entering live mission but can be set to be enabled automatically when loading live mission in software settings page under settings window.

Live mission will play always live audio even when switched temporarily to playback mode. Playback audio is played only for non-live mission.

NB: audio is recorded in server only if server has started recording video! If server started recording video for the mission at least once and then it's paused it'll record audio also.

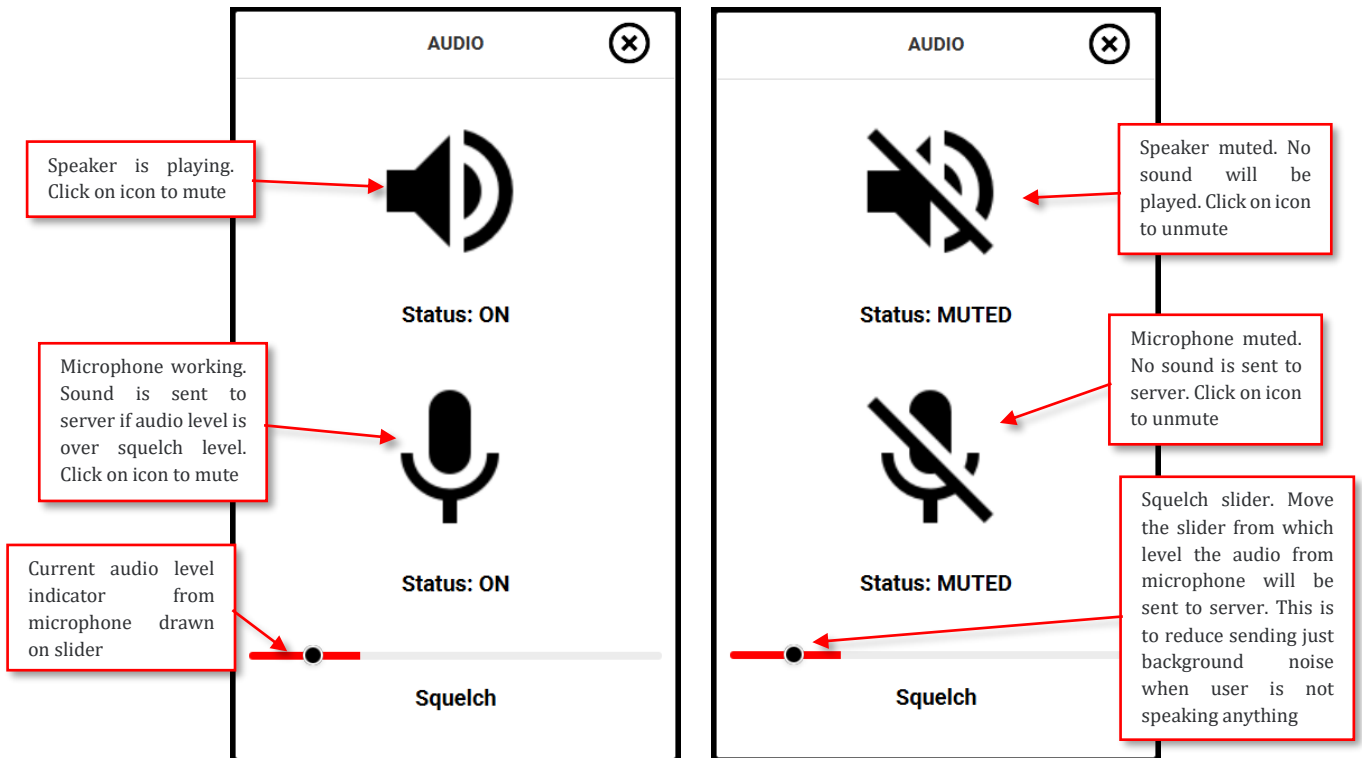


Figure 147: Audio control dialog

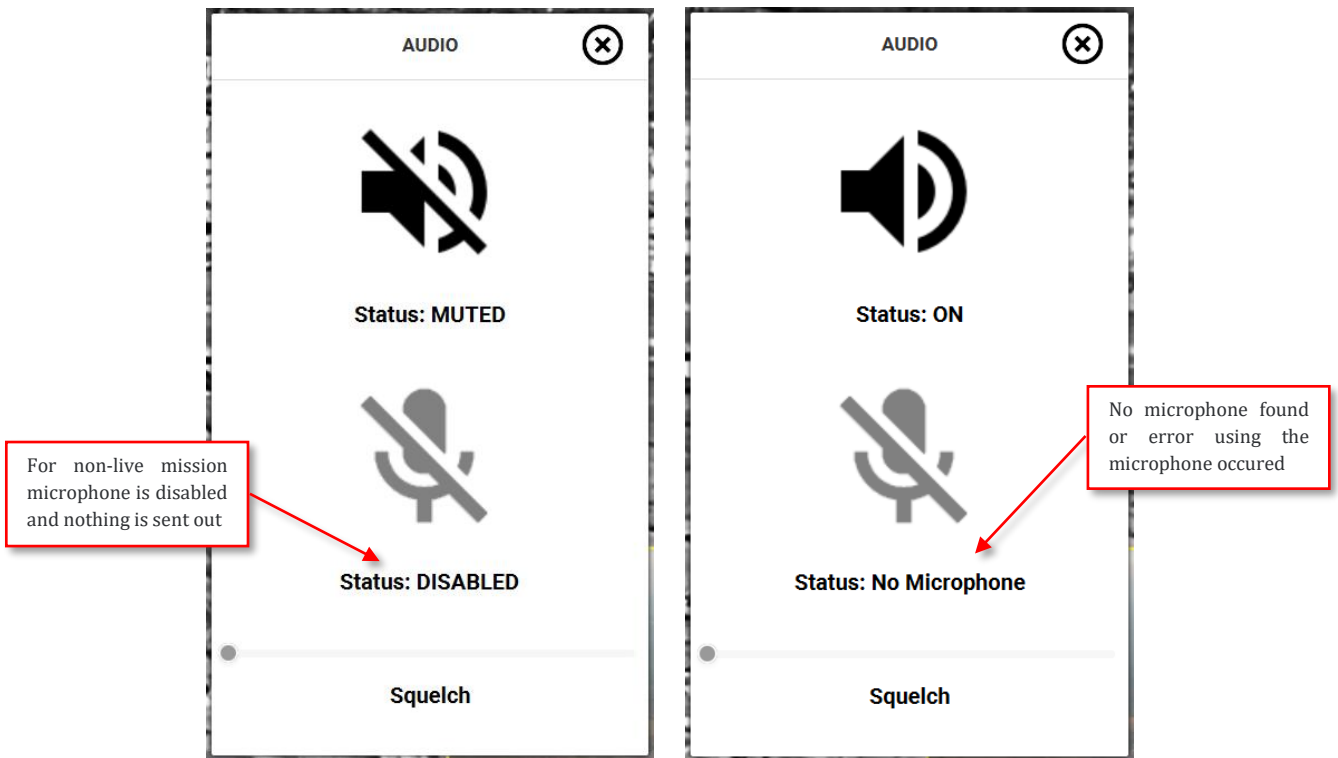


Figure 148: Audio control dialog

## 7.20 SNAPSHOT GALLERY

Snapshot gallery can be opened with right-clicking on snapshot button.

Snapshot gallery enables to see and manage all taken snapshots for current mission.

Control + A combination in keyboard will select all images.



Figure 149: Snapshot gallery

## 7.21 SYSTEM WARNINGS

System warnings are not result of some action (for example creating POI failed) but warning about system state that something is not working currently by some error or intentionally.

Warning is shown in top-centre of main window as a red text.

### 7.21.1 Cable unplugged

This is shown if cable is not connected to ethernet port that is configured to be used with the system, cable is broken or the ethernet port is disabled.

For operator version it tells if issue is related to cable/connection used for communicating with gimbal.

For observer version it tells if issue is related to cable to communicate with datacentre.



**NETWORK CABLE UNPLUGGED OR INTERFACE DISABLED!**

Figure 150: System warning – cable unplugged

### 7.21.2 Server not recording

This can be shown only in operator version for live mission.

It's shown if server hasn't started recording yet when mission is created, recording has stopped somehow or when starting up computer and there was ongoing mission which recording should be resumed automatically but hasn't started recording. For server to be able to start recording the time difference between time in video KLV data and computer must be less than 30 days or operator must have clicked force record button.



**SERVER NOT RECORDING!**

Figure 151: System warning – not recording

### 7.21.3 Server down

This is shown if requests to server are failing for some reason.



**SERVER DOWN OR CONNECTION TO SERVER LOST!**

Figure 152: System warning – server down

### 7.21.4 Server temporarily unavailable

This is shown if currently data is manually being synced from operator version to datacentre.

This can be only happen in observer version of the software.



**SERVER TEMPORARILY UNAVAILABLE**

Figure 153: System warning – server temporarily unavailable

### 7.21.5 Recording video paused

This is shown if operator ordered server to pause recording the video in server.

Observer won't see live video in this case. If this is shown then "SERVER NOT RECORDING" warning is not shown.



Figure 154: System warning - recording video paused

# NOTES

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