

UFODAS

Unidentified Flying Object

Data Acquisition System

Systems for the UFO Data Acquisition Project (UFODAP)

ufodap.com

System Installation Guide

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RHOlch Systems

***** PRELIMINARY *****

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Disclaimer

This document is under active development and as such there may be mistakes and omissions — please watch out for these and report any you find to the developer at team.ufodap@gmail.com.

Contributions of material, suggestions and corrections are welcome.

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INTRODUCTION

A data collection system configured as part of the UFO Data Acquisition Project (UFODAP) utilizes UFO Data Acquisition System (UFODAS) components. A UFODAS consists of a number of hardware and software components including cameras, cables, a Power over Ethernet (PoE) Injector and software. This document will guide you through the initial physical and software selection and setup of these components.

The basic unit of a UFODAS is a Data Acquisition Unit (DAU). There are several types of DAUs:

- Optical Tracking DAUs (OTDAU) which provides all of the functions to stream, analyze, detect and track targets in video streams from cameras
- Multi-Sensor DAUs (MSDAUs) which collect data from non-optical sensors including magnetic, gravitational, GPS and RF data

A complete UFODAS installation includes one or more DAUs and supporting components. Planning your system involves the following considerations:

- Site selection – Verification of usable viewing site lines to the intended field of view.
- If you will collect data from one or more cameras, Multi-Sensor Data Acquisition Units (MSDAUs) or both.
- If you are using a camera(s), selection of the type of camera(s) for your situation -- Pan-Tilt-Zoom (PTZ) or fixed, optical field width and, if PTZ, maximum zoom.
- Equipment mounting methods – Using a tripod for temporary field studies or implementing a more permanent attachment of the equipment to a structure.
- Power source selection – Determining if AC power will be provided from a source near the installation or if the system must be self-sustaining, using, for instance, a solar/battery inverter power source.
- Communication infrastructure – Availability of local or remote routers and internet connections and whether the OTDAU or MC software will be run on one or more computers and whether those computers are local or remote.

- Communication interfaces – Cable runs, connections to routers or computers whether by cable or WiFi and IP address setup, forwarding and additional security measures. A camera could be hardwired to a local computer or router, remotely connected to a computer or router via an RF range extender or hardwired to a WiFi extender that communicates with a local router via WiFi.
- Protecting equipment from lightening-induced voltage surges.
- Software installation -- Optical Tracking Data Acquisition Unit (OTDAU) for camera data collection and Mission Control (MC) to collect data from OTDAUs and MSDAUs.

A minimal system could be nothing more than OTDAU software running on a local computer and using a USB webcam on a windowsill.

The most complex installations may utilize a combination of up to six DAUs with a total of up to 12 cameras and six MSDAUs. The six units may be widely separated with OTDAU computers remote from their associated cameras and MC running at yet another remote site. The internet connections that tie all these elements together may involve local or WiFi-connected routers and possibly a dedicated server.

UFODAS cameras may be provided mounted on a weatherproof junction box with a sealed Ethernet connector. They may be provided with a tripod mount or with mounting hardware appropriate for permanent mounting to a building, pole or tower.

This guide shows how to implement a UFODAS system for any combination of the above selections.

CAMERA SELECTION

OTDAU software requires one camera, and optionally two, to detect and then track moving objects. It provides for two types of hardware and software interface to cameras:

- USB webcams which may be external to your computer or built-in
- IP cameras by Ethernet connection thru a router or directly to your computer

Two cameras may be used to track and zoom in on an object that may be first detected in a direction that is much wider than the PTZ camera's field of view (FOV). Making the initial detection using a wide-angle fixed camera and handing off continuous tracking to the PTZ camera can make best use of both their capabilities.

When the general direction of interest is known, then the selection of a single camera may hinge on its FOV, shown as horizontal angle of view in the table below.

Another aspect of selection is the tradeoff between higher resolution and a PTZ function. A PTZ camera can continuously track (center) a target while zooming in which effectively increases the number of active pixels, thus compensating for its lower un-zoomed resolution. However, a fixed camera will not experience the motion lag of a PTZ camera and thus does a better job at tracking faster-moving objects.

Note also the difference in light sensitivity between these cameras. In color mode, this will not be apparent during the day but may result in more granularity of the image in very dark conditions.

Near-infrared light (700-1000 nm) is beyond what the human eye can see, but most camera sensors can still detect and use it. When there is plenty of light, a day/night camera uses an IR-cut filter to block the IR light so that it doesn't distort the other colors in the image. When the camera is in night mode, the IR-cut filter is removed, thus boosting the camera's light sensitivity to 0.001 lux or lower.

Each camera may be set to a "black and white" mode by accessing its Setting menus, in Camera > Conditions > Day & Night and setting the profile to night. This removes the IR cut filter and thus enhances the camera's ability to image near IR wavelengths. If the camera has an IR illuminator, it should always be disabled by setting its Mode to off in the Illuminator menu.

Information about the Sony STARVIS sensor used by Dahua cameras may be found at:

<https://www.sony-semicon.co.jp/e/products/IS/security/technology.html>

See the individual data sheets for each camera, available on the ufodap.com website, for more details.






Dahua cameras tested and selected for UFODAS over competing brands and models due to:

Best price vs performance

Excellent light sensitivity and resolution

Rugged enclosures and ability to maintain water-proof rating mounted dome-up

5-year warranty

| |  |  |  |  |  |
|---|---|---|---|--|---|
| | N53AB52 | DH-IPC-EBW81242N | 42212TNI | 50232XANR | 49425XBNR |
| Image sensor | 1/2.7-in 5MP | 1/1.7-in 12MP | 1/2.8-in 2MP | 1/2.8-in 2MP | 1/2.8-in 4MP |
| Sensor type | Low light CMOS | Low light CMOS | Sony STARVIS | Sony STARVIS | Low light CMOS |
| Microphone | yes | yes | no | no | no |
| Effective pixels | 2592 x 1944 | 4000 x 3000 | 1920x1080 | 1920x1080 | 2560x1440 |
| Electronic shutter speed | 1/3 s to 1/100,000 | 1/3 s to 1/100,000 | 1/3 s to 1/30,000 | 1/3 s to 1/30,000 | 1/3 s to 1/30,000 |
| Main channel resolutions | 2592 x 1944 | 4000 x 3000 | 1920 x 1080 | 1920 x 1080 | 2560 x 1440 |
| | 2688 x 1520 | 2880 x 2880 | 1280 x 720 | 1280 x 960 | 2048 x 1536 |
| | 2304x1296 | 2880 x 2160 | | 1280x720 | 1920 x 1080 |
| | 1920 x 1080 | 2048 x 1536 | | 704 x 480 | 1280 x 960 |
| | 1280 x 960 | | | 352x240 | 1280 x 720 |
| | 1280 x 720 | | | | 704 x 480 |
| | 704x480 | | | | 352x240 |
| | 640x480 | | | | |
| | 352x240 | | | | |
| Sub Stream 1 resolutions | 704 x 480 | 704 x 576 352 x 288 | 704 x 480 352 x 240 | 704 x 480 352 x 240 | 704 x 480 352 x 240 |
| Sub Stream 2 resolutions | 1280x720 | 1280 x 960 704 x 480 | 1280 x 720 704 x 480 352 x 240 | 704 x 480 | 1920 x 1080 704 x 480 |
| Color sensitivity | 0.005 lux | 0.001 lux | 0.005 lux | 0.005 lux | 0.005 lux |
| B&W (IR) sensitivity | 0.0 lux | 0.01 lux | 0.0005 lux | 0.0005 lux | 0.0005 lux |
| With illuminator on | N/S | 0.0 lux | N/A | N/A | 0.0 lux, IR on |
| Focal length | F1.6 | F1.85 | F1.6 | F1.35 | F1.6 |
| Pan-Tilt-Zoom control | no | no | yes | yes | yes |
| Optical zoom | none | none | 12x | 32 x | 25 x |
| Angle of View, Horizontal | 98 deg | 180 deg | 58.2 - 4.2 deg | 62.8 - 2.2 deg | 62.8 - 2.6 deg |
| Angle of View, Vertical | 72 deg | 180 deg | N/S | 36.7 - 1.3 deg | N/S |
| Environment | IP67 | IP67 | IP66 | IP67 | IP66 |
| Temperature range, °C | -40 to +60 | -30 to +45 | -30 to +60 | -40 to +60 | -40 to +70 |
| Power consumption, W | <5.4 | 12.9 | 12 | 16 | 13 |
| N/S -- Not Specified | N/A -- Not Applicable | | | | |
| ** See individual camera data sheets for specification qualifiers | | | | | |
| -- Cameras can simultaneously stream video from both the Main and Sub stream outputs | | | | | |
| -- All cameras have IR cut filters that can be selected for normal color or electronically removed for IR | | | | | |
| -- IR sensitivity shown with IR emitter off | | | | | |

SYSTEM POWER REQUIREMENTS AND SOURCES

UFODAP cameras and the Multi-Sensor Data Acquisition Unit (MSDAU) both use Power over Ethernet (PoE) as a power source as a path for the data to a computer or router. All six of the recommended cameras are PoE compatible meaning that a single Ethernet cable provides the communication signals as well as power over otherwise unused wire pairs. The single-port and 4-port power “injectors” derive approximately 56VDC from the AC line and provide it to each port. The camera then converts this voltage to lower voltages used internally.

The hardware required for that function is known as a PoE Injector or Injector/Switch. This is a small device that is powered from a 115/230VAC, 50/60Hz source. An Ethernet cable connects a computer or router to the Injector’s uplink or LAN port and another connects the Injector’s PoE port to the camera or a MSDAU.

An injector may have more than one PoE port. Each port may be used to connect a camera or MSDAU up to the limit of the injector’s total output power capacity. UFODAP injectors have the following capabilities:

| Part No. | Description | PoE Ports | Power, Watts |
|--------------|---------------------------------|-----------|--------------|
| OPT-POE-1-30 | Planet POE-164, 10/100Mbps | 1 | 30 |
| OPT-POE-1-60 | Planet POE-173, 10/100/1000Mbps | 1 | 60 |
| OPT-POE-4-60 | Planet FSD-504HP, 10/100Mbps | 4 | 60 |



The approximate maximum power requirements for UFODAS components are:

- 50230UNI-A 30x optical zoom camera – 23W max.
- 42212TNI 12x optical zoom camera – 12W
- NK8BR4 panoramic camera – 12W
- N53AB52 bullet camera – 6W
- MSDAU – 4W
- PowerBeam Ethernet Bridge – 8.5W

AC power for an Injector and possibly a computer may simply be from a wall-outlet in a fixed installation or from a portable source such as a DC-to-AC inverter powered by an automotive 12VDC source or from a solar/battery system.

Sizing a power source for a remote UFODAS installation is based on the total power required and run time until recharged if battery storage is included.

Thus, for example, the total system power required for a field installation that includes the panoramic camera, a 50230 camera, an MSDAU and an RF bridge to a remote router would be 47.5W. Thus, this system could run continuously with a 100W solar panel during the day and continue during the night using battery storage in the GoalZero Portable Power Station, shown below. The Power Station provides a 396WH battery and thus could sustain the 47.5W load for up to about 8 hours without recharging. Additional 33Ah batteries could be added for longer run times.

The Power Station may be recharged by plugging it into an AC outlet or charged in the field by means of a 100W (or larger) solar panel, as shown below.



DOMA CAMERA PREPARATION

Dahua dome cameras are provided with a lens cover and tape to protect the pan/tilt mechanism from damage during shipping. This must be removed prior to use.

Remove the dome using the provided star wrench to unscrew the three screws that fasten the dome to the housing, as shown below.



Remove the tape and lens cover and set aside for possible shipping, perhaps for warranty repair, should that be necessary.



Replace the dome onto the camera, **taking care that the o-ring is in place** and tighten the three screws.

TRIPOD INSTALLATIONS FOR CAMERAS

DAHUA 50230 OR 42212 CAMERA SETUP

Your system may have one or more Dahua 50230 30x zoom or 42212 12x zoom cameras. If so, then perform the following steps.

A Dahua 44212 camera mounted on a Camera Mount is shown below.



Note that the tripod legs may be extended and spread from vertical to fully horizontal to accommodate a wide range of height and stability requirements. However, if the legs are spread too far, then the leg tips cannot grip the ground which may result in undesired spread.

For tripod mounting, open the tripod legs sufficient for stability. Place the System mount on top of the tripod and start the tripod screw into the mount socket. Try to align the mount in the approximate center of the tripod head. Tighten the tripod screw by hand using the handle under the screw. Adjust the tripod legs for length and spread for the required MSDAU/camera height and for good stability.

Collect the following components:

1. Dahua camera on junction box with tripod mount and Ethernet connector.
2. Surveyor-style tripod with 5/8"-11 threaded mount.
3. Planet POE171 single-output, 60W injector or a FSD-504HP four-output, 60W PoE power injector with power supply and line cord. **Note:** These cameras cannot be used with a POE164 Injector due to its lower, 30W output power. The POE164 may be used with the N53AB52 camera.
4. Ethernet 6' cable
5. Ethernet 100', 196' or 300' all-weather cables. **Note:** The maximum length for a camera to injector cable is 100 meters or 328 feet.
6. Optional castor cups to protect a floor from the tripod tips.

Setup Procedure:

1. Open the tripod in the selected location. Remove the protective cap on the tripod threads.
2. Place the camera assembly on top of the tripod and using the knob under the tripod, screw the tripod treads into the bottom of the camera assembly. The assembly does not have to be precisely located at the center of the top of the tripod.
3. The initial height of the camera may be adjusted by spreading the tripod legs and by how far the legs are extended. To extend them, unlatch, extend/retract and re-latch. For stability, it is better to spread the legs to a wider rather than narrower stance and extend the legs if necessary to achieve a desired height.
4. To protect your carpet or flooring, optionally place a castor cup under each of the three legs.

DAHUA N53AB52 CAMERA SETUP

If your system has one or more Dahua N53AB52 bullet or other fixed cameras perform the following steps.

Collect the following components:

1. Dahua camera on junction box with tripod mount and Ethernet connector.
2. Standard camera tripod with 1/4-20 threaded mount
3. POE164 Injector. This camera may also be used with the Planet POE171 single-output, 60W injector or a FSD-504HP due to their higher, 60W outputs.
4. Ethernet 6' cable
5. Ethernet 100', 196' or 300' all-weather cables. Note: The maximum length for a camera to injector cable is 100 meters or 328 feet.

Setup Procedure:

1. Open the tripod in the selected location.
2. Place the camera assembly on top of the tripod and using the knob under the tripod, screw the tripod threads into the bottom of the camera assembly.



3. The initial height of the camera may be adjusted by spreading the tripod legs and by how far the legs are extended. To extend them, unlatch, extend/retract and re-latch. For stability, it is better to spread the legs to a wider rather than narrower stance and extend the legs if necessary to achieve a desired height.

FIXED CAMERA INSTALLATION

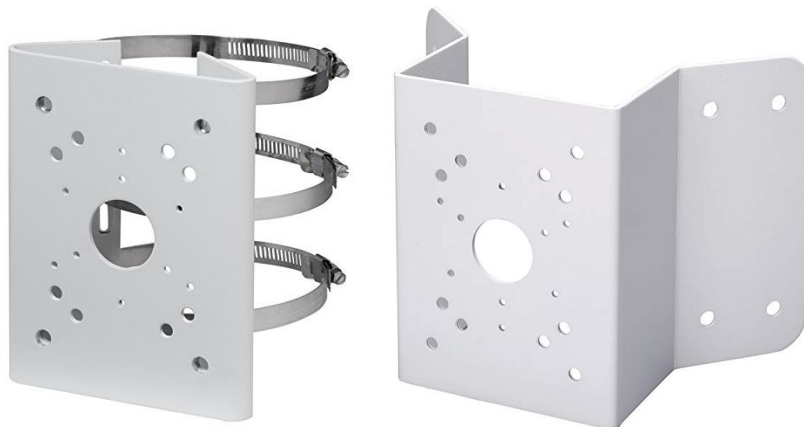
POLE OR CORNER MOUNTING

Installing a camera on a fixed structure such as a building or a tower requires consideration of how the camera will be attached to the structure and how its PoE connection will be made to assure a waterproof connection.

Several junction boxes and adapters are available from ufodap.com. Please request a detailed parts list customized for your particular system configuration.

The brackets shown below may be attached to a camera or MSDAU mount to adapt it to a building corner or pole/tower. The stainless-steel straps are provided with the pole mount adapter.

Note: Your installation may require attachment of the pole mount to a larger diameter pole or structural element than the standard provided straps can accommodate. In that case, you may have to purchase longer straps.

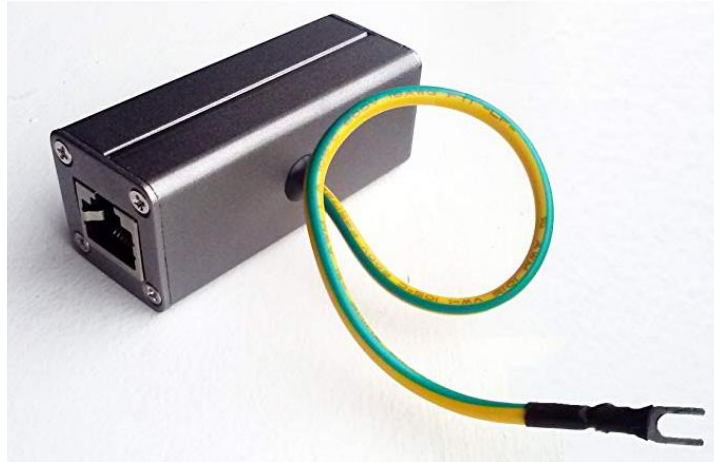


NOTE: If pole/pipe mounting, the pipe should be rigidly attached and supported to the structure such that the camera and/or MSDAU do not move in windy conditions, as shown in the example below.



The optional addition of the owl can sometimes be helpful to prevent birds from landing on the dome, leaving behind residue that can obscure the view.

Outdoor installations in environments known for potential lightning action should provide for proper surge suppression. One way to accomplish this is to use a good-quality surge suppressor near the MSDAU/Camera and another at the entrance to the structure where the Ethernet cable will attach to the router. One such suppressor is shown below.



A surge suppressor is typically used with shielded Ethernet cable with the ground wire connected to the metal structure, if any, at the MSDAU/Camera end and to a good building or rod ground at the structure end. The MSDAU and Camera Mount enclosures are non-metallic and thus isolate those electronics from ground. Thus, the MSDAU or camera should not be directly tied to the mounting structure such as a metal tower. The purpose of the surge suppressors is to shunt a voltage spike induced anywhere along the Ethernet cable to ground rather than allow it to enter the outside or inside electronics.

WALL MOUNTING

Any UFODAP camera may be provided with a junction box and mounting accessories to allow it to be mounted to a vertical wall. The following steps are an example of how to mount and cable an N53AB52 fixed optics camera to a wall if no junction box-mounted Ethernet connector is provided.

The camera is provided assembled to a junction box oriented in such a way that the camera may be tilted up rather than in the usual down direction. The seal under the camera's mounting plate has been rotated to seal its side cable opening to prevent water ingress. Also, a special gland nut has been pre-installed to the box. This gland nut allows a standard Ethernet cable with RJ-45 connector to be used without field termination and waterproofs the cable. UFODAP camera cables are sized and specified to allow this and to provide long-term use in outdoor conditions.



1. Using the provided Allen wrench, remove the three screws that attach the camera to the junction box. Do not detach the safety cable from the camera or box.
2. Install the box to the wall by using the provided screws for a wooden wall. Use the provided anchors to mount to drywall or stucco. The Ethernet connector housing also shown below, left, is not needed and may make the connection too large to fit in the box.



3. Unscrew and remove the outer gland nut shroud and insert the end of the camera cable that has no boot through the shroud and the nut into the box, as shown below.



4. Plug the cable into the camera's Ethernet jack and dress the cables inside the box as shown:



5. Reinstall the shroud to the nut and tighten the shroud by hand as much as possible. Be sure that the rubber gasket under the shroud has fully tightened against the cable.

6. Reinstall the camera mounting plate to the box using the three screws previously removed. Be sure that the orientation of the camera is as shown below so that it can be tilted up.



Note that when positioning the camera field of view, it may be both rotated and angled.

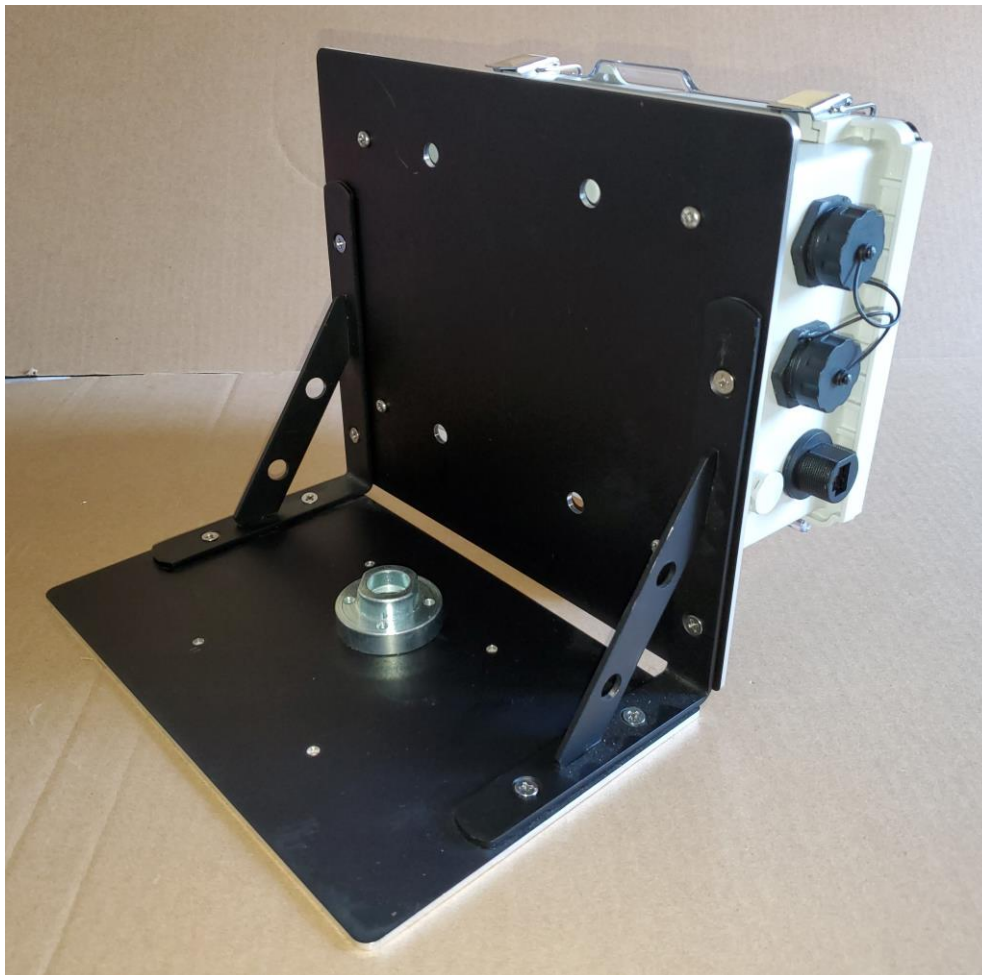
Loosen the Philips screw on the side of the camera mount. You can rotate the camera about its axis and move it left or right with a ratcheting action until it is pointing as desired. Then tighten the screw.

MSDAU INSTALLATION

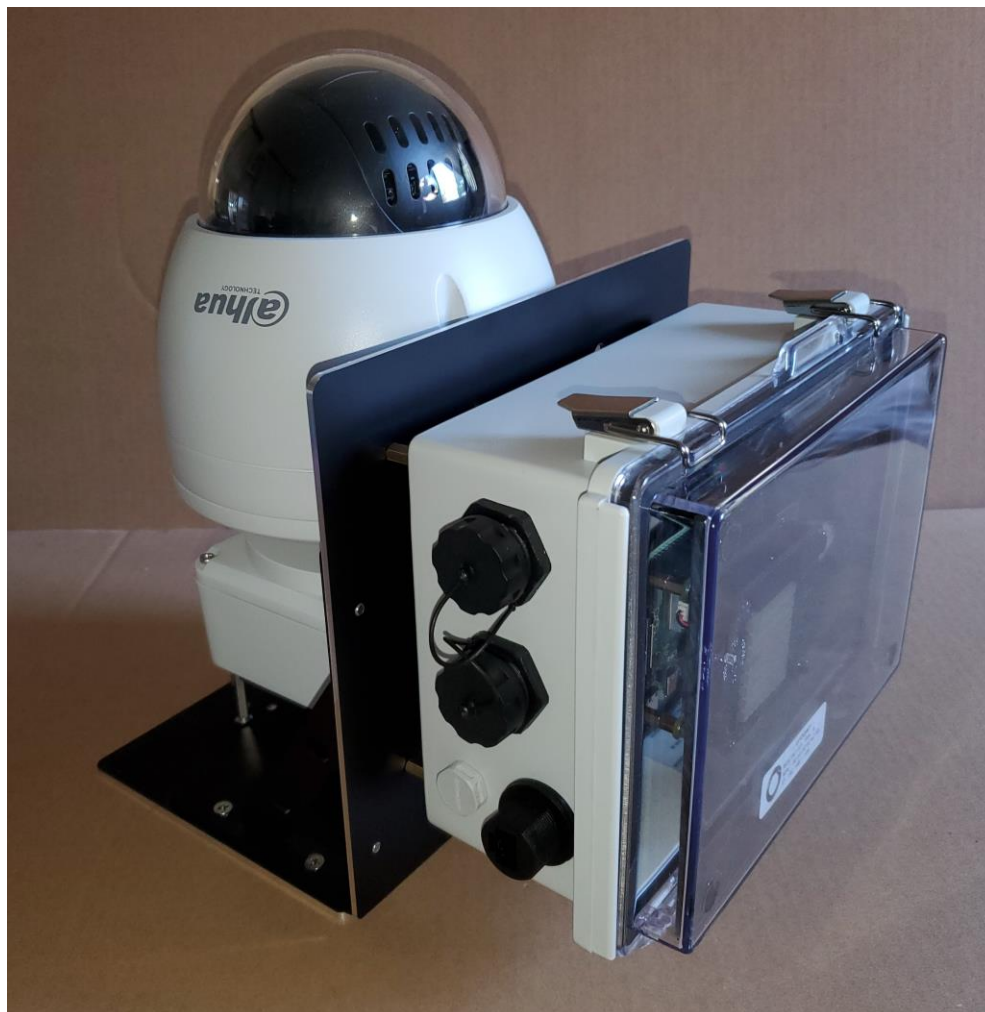
The MSDAU is designed for three methods for mounting – tripod, wall corner or pole.

An MSDAU and the passive Camera Mount share a common System Mounting Assembly. The System Mounting Assembly consists of two black plates attached to each other at a right angle. The bottom plate has a 5/8-11 threaded socket for attachment to a standard surveying-type tripod. The back plate includes four threaded holes to which either the pole mount adapter or the building corner mount adapter, shown above, may be attached.

An MSDAU mounted via the System Mounting Adapter is shown below. The mounting position shown accommodates an additional camera or other item, such as an antenna mount, on the opposite side of the plate, above the tripod threads. The MSDAU can also be mounted on the side of the plate directly above the tripod mount which may provide additional stability.



A tripod mounted MSDAU with Dahua 42212 camera and Camera Junction Box is shown below.



Any camera and the MSDAU are powered via their own Ethernet cable to PoE injector. In the above configuration, the camera and the MSDAU each require an Ethernet cable to an injector, usually located near a router.

In this tripod-mount configuration, refer to the use of the 5/8-11 tripod, above.

For pole or corner mounting, the MSDAU is provided with the System Mount backplate and the pole mount option, shown below.



Three stainless steel straps are provided to attach the pole mount to any vertical, rigid pipe. Be sure that the pipe is sufficiently supported so that, with the weight of the MSDAU, it does not move in the wind.

The mechanical configuration of these components is set by your order when purchased – you will not have to install or change any such configuration.

MSDAU RF ANTENNA

The MSDAU provides a standard SO-239 connector on the right side for an external antenna connection, as shown below with the included cable and connectors for the antenna mount.



The design of the antenna used will determine its optimum gain and frequency range.

A telescoping antenna, as shown below, may be directly connected to the antenna mount via a PL-259 to SMA adapter, included with the antenna.

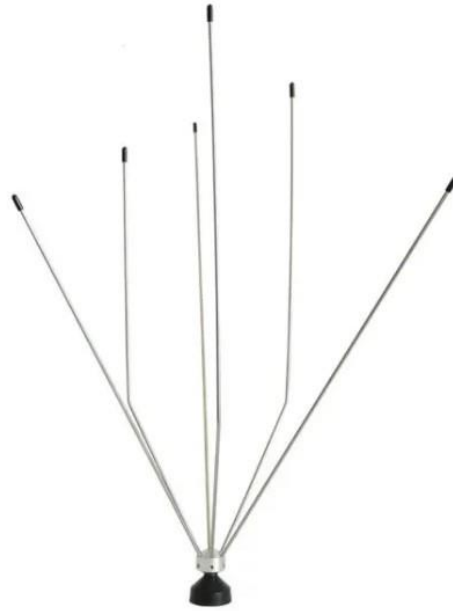


This is typically a $\frac{1}{4}$ wave whip which is omnidirectional but has no well-defined ground plane. Its gain at any particular frequency is dependent on its extended length. The optimal values may be calculated using this Whip Antenna Length and Frequency Calculator:

<http://www.csgnetwork.com/antennagenericfreqlencalc.html>

Thus, the 6.7 to 30 inch antenna, above has a range of about 187 MHz to 838 MHz but will provide signal well below and above those values but with lower gain.

An Ultra-Wide-Band (UWB) type antenna can provide higher gain throughout a broader spectrum of frequencies such as 1MHz to 6GHz in the case of the example below.



The various length elements are the primary antenna. Its response is omnidirectional, primarily in the horizontal plane.

Such an external antenna would be connected directly to the MSDAU antenna connector, shown above. It may be easily unscrewed from the mount for transport and reattached when the MSDAU is set up in the field.

POLE-MOUNTED CAMERA INSTALLATION

A pole-mounted camera utilizes a junction box between the camera mount and the pole mount adapter, as shown below.



The junction box provides a waterproof transition from the camera's Ethernet connector to a box-mounted connector you use to attach the Ethernet cable.



PREPARING A DOME CAMERA FOR OPERATION

The Dahua 50230 and 42212 PTZ cameras are shipped with a protective cap over the internal lens, taped to the sides of the pan-tilt mechanism. This cap must be removed prior to use.

1. Locate the L-shaped star wrench tool provided with the camera.
2. Loosen the three screws on the top of the camera dome until they are free (they are captive and will not fall out of the dome).
3. Lift the dome off of the camera body, taking care not to dislodge the o-ring under the dome.
4. Peel the tape off both sides of the pan-tilt mechanism, taking the plastic lens cap with it, taking care not to touch the lens.
5. Set aside the cap/tape for reuse if the camera ever needs to be shipped a long distance.

6. Place the dome back on the camera body, locating the three screws into the three sockets, making sure that the o-ring is in place.
7. Use the star tool to tighten the three screws.
8. Verify that the camera dome is dust-free. If it is dirty, clean it with a slightly damp, soft cloth.

The Dahua NK8BR4 360 degree camera and the N51BD22 bullet camera or other fixed cameras do not require any mechanical preparation for use.

ETHERNET CABLE CONNECTIONS

1. Connect the waterproof Ethernet cable to the connector on the mounting box as shown below. To do this, start with all parts of the connector housing unscrewed. Plug the Ethernet cable connector into the box connector until the latch snaps in. Move the larger connector housing toward the connector and screw it all the way onto the box connector. Verify that the rubber cable gland is fully inserted into the back of the housing. Then move the farther portion of the connector housing toward the cable box and screw it onto the connector body. Be careful not to cross-thread this connector. If it does not screw in exactly straight, then unscrew it and try again. Cables provided by UFODAP come with this backshell installed on the cable.



2. Your PoE Injector passes the Ethernet signals thru it to your router while “injecting” DC power on two unused cable wire pairs to power the camera. To install it, place the PoE injector near your router. For a four-port injector, plug the injector barrel power connector into the rear of the injector. Plug the injector line cord into the injector’s power supply and plug the line cord into a source of AC power. The power supply is rated for 110/240 VAC – 50/60 Hz power so if the

installation is not in the US, just use an AC adapter or a different line cord in accordance with your AC power wall socket.

3. Using a second, short Ethernet cable, plug one end into the LAN connector on your PoE injector. For a 4-port injector, this is the right connector on the front of the PoE injector labeled “5 - Uplink”. For a single-port injector, it is labeled “LAN”. We will connect the other end in a subsequent step.
4. Route the unconnected end of a long camera cable from the camera assembly or MSDAU to the PoE injector, by some convenient route and avoiding creating a tripping hazard.
5. As shown below, plug the routed end of the camera or MSDAU cable into any of the four unused ports of a four-port PoE+ injector or the “POE” port on a single-port injector. This cable may be a bit stiff so bend it near the injector so that the connector goes straight into the injector socket, relieving stress on the connection.



6. There are two options for connecting the camera via the injector to your router – hardwired or by WiFi.

If the injector can be located near the router, then plug the other end of the short Ethernet cable into an unused router port.

If the camera and injector will be used in a location remote from the router and AC power is available at that location, then a WiFi Extender that includes a wired Ethernet port may be used to provide a wireless connection from the injector to the router. As shown below, plug the short cable into the Extender and the Extender into a wall outlet. Plug the injector's power cord into the AC outlet as well. The Extender should have been setup previously to communicate with the router per its manufacturer's instructions.

7. If the Extender and Injector are outside, be sure that they are protected from moisture. The camera assembly is waterproof but the Extender and Injector are not.



8. If the camera will only be used by a computer directly connected to the router, either by an Ethernet cable or by WiFi, the software will address the camera by its native IP address and port number. For example:

192.168.1.108 is the standard initial IP address for all Dahua cameras.

The initial, default address for an MSDAU is 192.168.1.144. If there are more than one MSDAU on the same LAN, then this address may be increased or decreased on other MSDAUs by the following steps:

1. Open the MSDAU enclosure
 2. Press the joystick button to display the current address
 3. Push the joystick up to increase or down to decrease the address by one
 4. Press the joystick again to set the address and continue normal operation
9. In addition to or instead of using a computer connected to the camera's router, the camera may also be made accessible to any computer that is not directly connected to the camera's router. That is, at a different location, no matter how remote, via the internet. To enable this, the camera's router must be setup to "port forward" the camera's IP address. Each type of router has a bit different means to do this so consult the router's documentation or obtain help. The resulting forwarded IP address and port number will be required for setup of an OTDAU software configuration for your camera.

Another somewhat simpler method to accomplish port forwarding is to use your router's UpNP feature. Enable UpNP in the router and also in the camera via the camera's WEB interface.


SETTING UP AN INSTALLED CAMERA

Perform the following steps before you mount the camera at its permanent, perhaps inaccessible location.

Before attempting to use the camera with operational software such as OTDAU, it is wise to verify that it and the injector/router are all operating correctly. This can be accomplished by using either:

- The Dahua Config Tool and Microsoft Internet Explorer (IE) -- **RECOMENDED**
- The Google Chrome browser with the IE Tab add-in

To use Chrome:

1. Open Chrome and in the search box, type IE Tab.
2. Select the web page for the IE Tab extension. Add it to Chrome.
3. Click on this symbol found on the upper right, next to the Address bar: 
4. That will open an Options and Settings page. Scroll down until you find IE Compatibility Mode and select the "IE 10 Forced Standards Mode" setting.
5. You can now close the Tab Options tab.
6. In the tab labeled "IE Tab – Chrome Web Store", on the Address line, enter your camera's IP address, such as: "192.168.1.108" and press Enter.
7. Enter Username "admin" and password you have been provided for your camera and press Enter or click Login.

To use Config Tool:

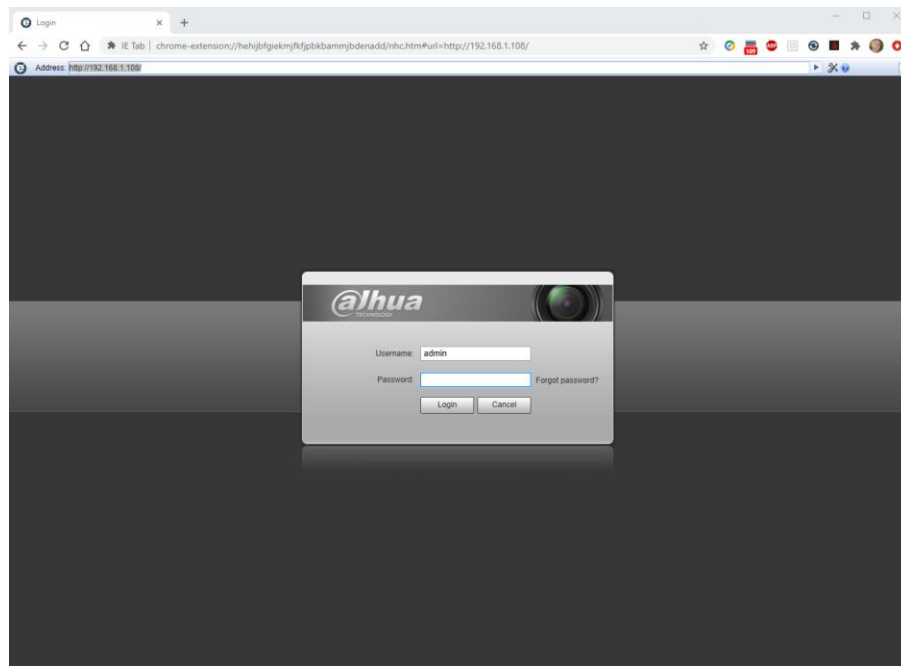
1. The Dahua Wiki has loads of information on their cameras – See the home page of dahuawiki.com.
2. Scroll down to the bottom of the home page and you will find their Config Tool. Download and install the version for your computer (Windows or Apple).

3. When you run it, it discovers and displays all Dahua IP cameras on your LAN. You can then modify the IP address if necessary.
4. Click on the WEB symbol on the right to run Internet Explorer to access the camera's Settings options.

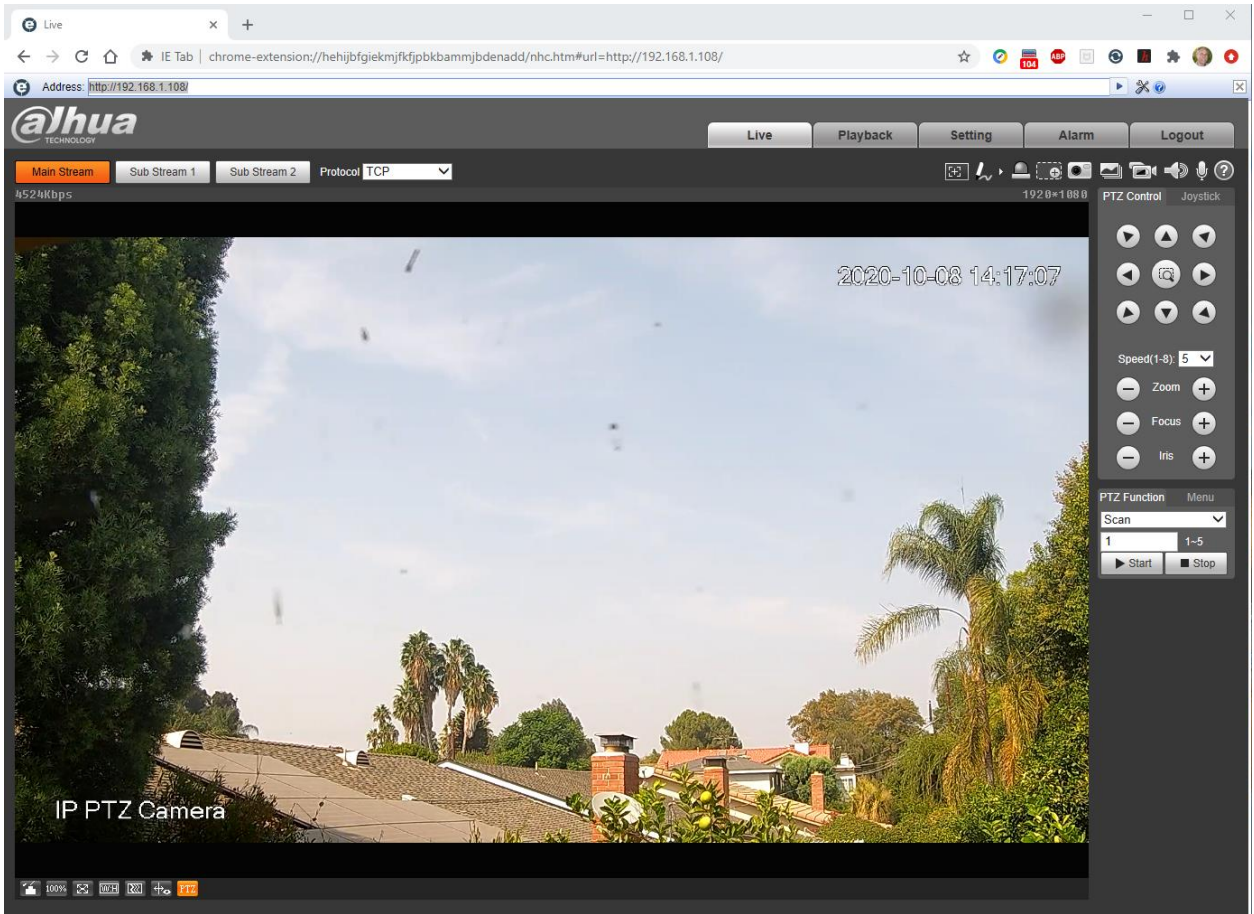
With either method, you may see the message:

“Please click her to download and install the plug-in”

Click on that link and install the plug-in. You may then need to close the IE window and restart IE via Config Tool again. This time, you should see video from the camera and have access to all of the camera's settings and manual controls.



You should now have a Live view of what the camera sees and a set of PTZ controls on the right side. Check that the camera's PTZ functions are working by clicking on the various PTZ buttons to move the camera, zoom and manually adjust focus and iris settings. Follow the OTDAU User's Guide instructions for the Dahua camera to check or adjust the various camera controls via the Setting tab on the top of the display.



Click on the Setting tab to access all of the camera's adjustments, as referenced below.

All necessary settings have already been adjusted prior to delivery of your system. If you change any of the Network settings, then the default configurations provided with OTDAU and Mission Control software will not work and would have to also be adjusted to match.

In case you need to check or redo them, they are the factory defaults except as follows:

| Dahua Camera Setup | | | | | | |
|--------------------------------------|------------|--------------------|--------------------|--------------|---------------------|---------------------------------|
| Menu levels under Setting --- | | | | | | |
| Top | 1 | 2 | 3 | 4 | Value | Notes |
| Camera | Conditions | Conditions | Flip | | 180 | Not for N51BD22 camera |
| | | | Picture | Profile | Normal | |
| | | | Exposure | Profile | Day | |
| | | | Backlight | Mode | Off | |
| | | | WB | Profile | Normal | |
| | | | | Mode | Auto | |
| | | | Day & Night | Profile | Day | |
| | | | | Mode | Color | |
| | | | Focus & Zoom | Profile | Day | |
| | | | | Digital Zoom | Off | |
| | | | | Zoom Speed | 100 | |
| | | | | Mode | Manual | |
| | | | | Focus Level | Auto | |
| | | | | Sensitivity | High | |
| | | | Defog | Profile | Day | |
| | | | | Mode | Auto | |
| | | Profile Management | Profile Management | | Normal | |
| | Video | Overlay | Channel Title | | Enable | |
| | | | | | "Available" | |
| | | | Time Title | | Disable | |
| | | | OSD Info | Preset | Disable | Not for N51BD22 camera |
| | | | | Pattern | Disable | Not for N51BD22 camera |
| | | ROI | | | Disable | |
| Network | TCP/IP | Host Name | | | <enter host name> | |
| | | IP Address | | | <enter IP adds> | Restart Web Service from Chrome |
| | Port | HTTP Port | | | <enter port number> | Camera will reboot |
| | | ONVIF | Authentication | | Off | |
| PTZ | Function | PTZ Speed | | | High | Not for N51BD22 camera |
| System | General | Date&Time | Time Zone | | <enter time zone> | |
| | | Current Time | | | Sync PC | |

The following section illustrates how to change these settings.

DAHUA CAMERA CONFIGURATION

When you purchase a camera from UFODAP, all the following settings have already been implemented when the camera was tested, prior to shipment to you. The username and password were also set to match the sample configurations included with OTDAU software.

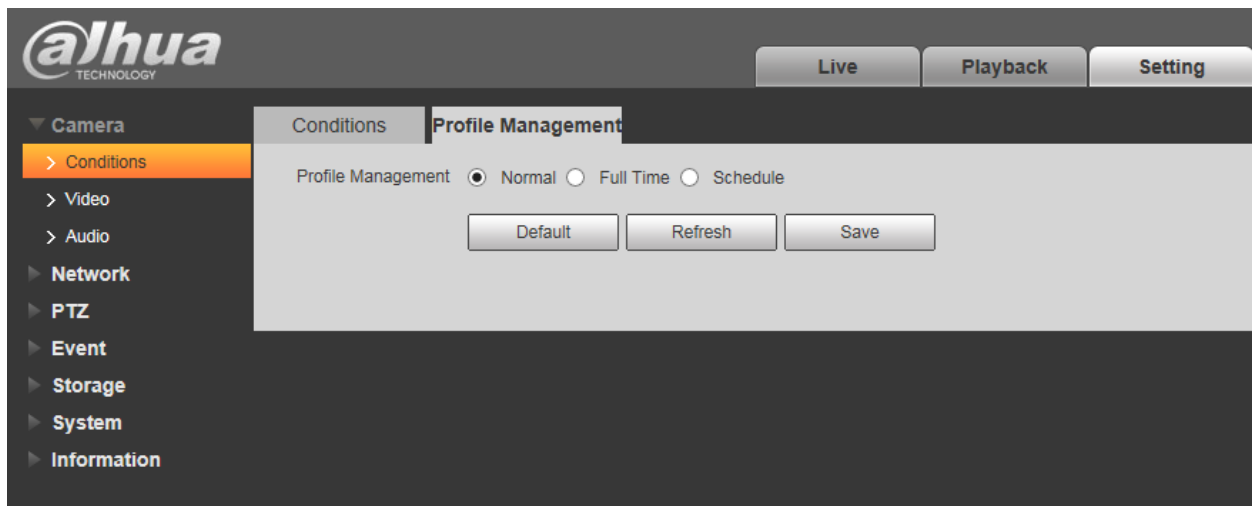
The following steps may be taken to check or change the settings. Some Setting screens may look a bit different, depending on the camera model and its software updates.

Please refer to the Dahua manual “Dahua Speed Dome Web3.0 Operation Manual” for complete instructions for camera setup operations. The latest version of this manual as of this time is 4.2.0. It may be downloaded from the Dahua Wiki at:

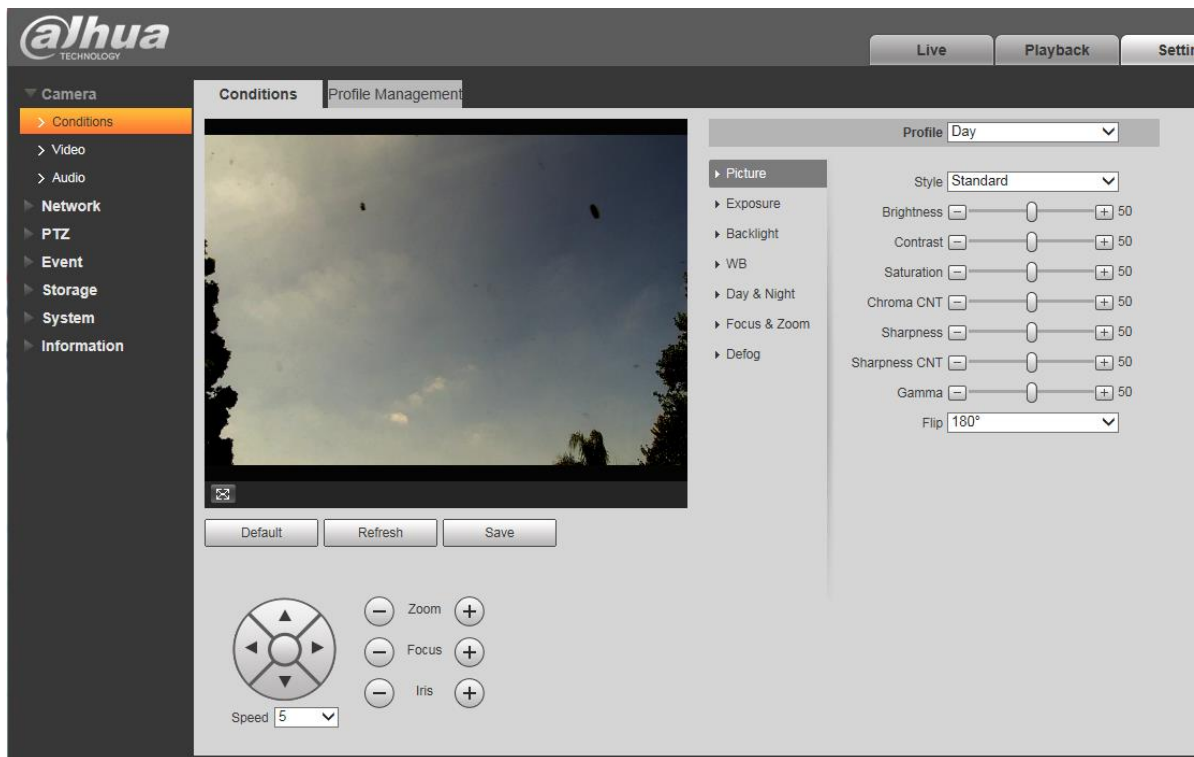
<https://dahuawiki.com/Template:Manuals>

The following screen shots were captured using Internet Explorer (IE) to setup and control Dahua 50A230 or 50230 cameras. Other Dahua cameras are similar. They show initial settings suggested for OTDAU operation. Leave all other settings per factory default.

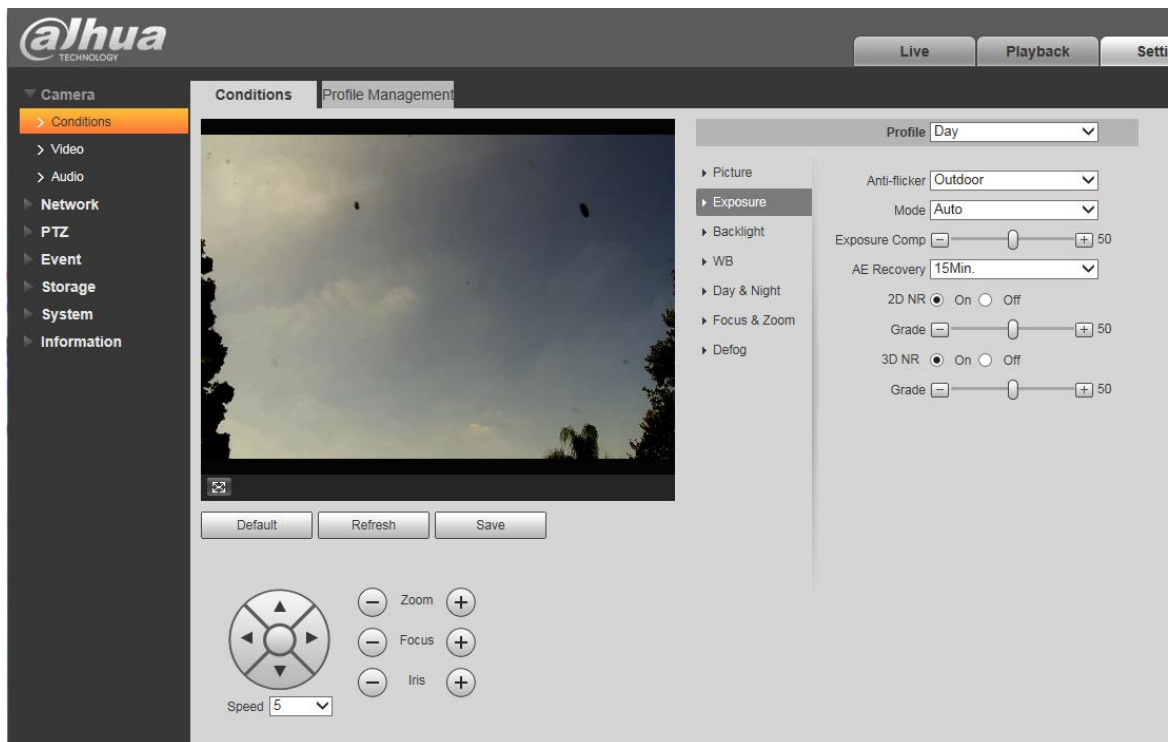
Be sure to click on Save after each setting.



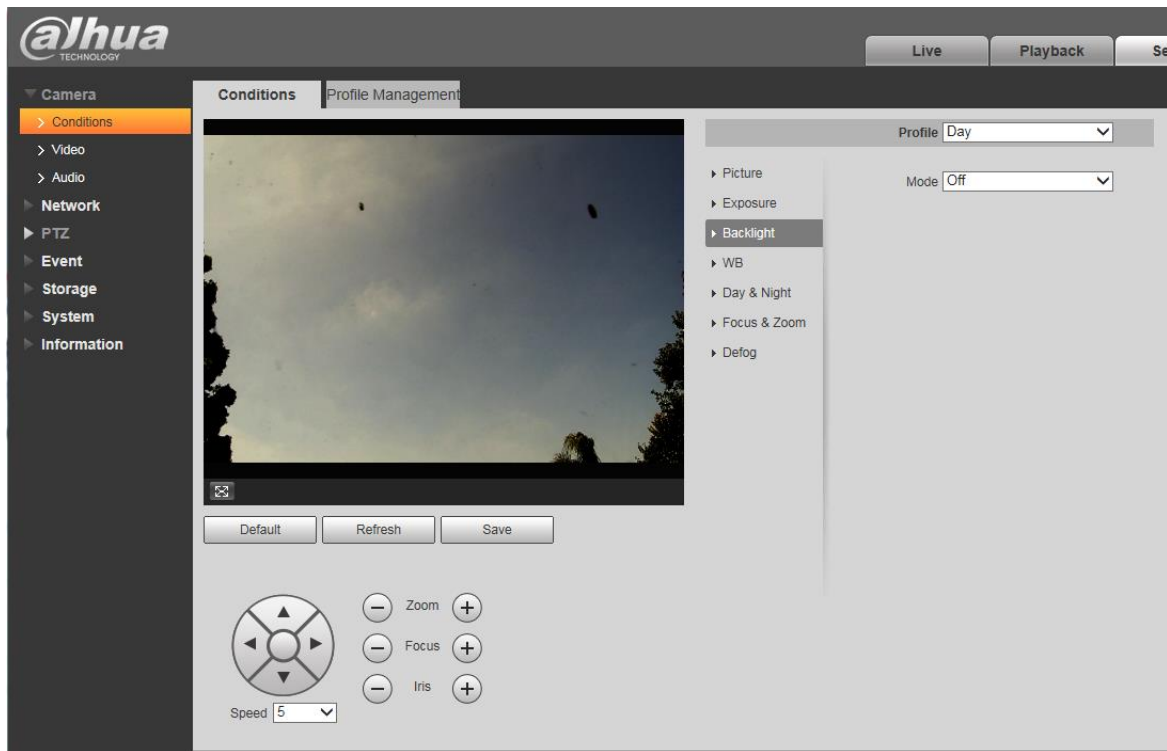
Set Profile Management to Normal. Otherwise, other settings may revert to prior values if you Save, go to Live and back to Setting > Conditions.



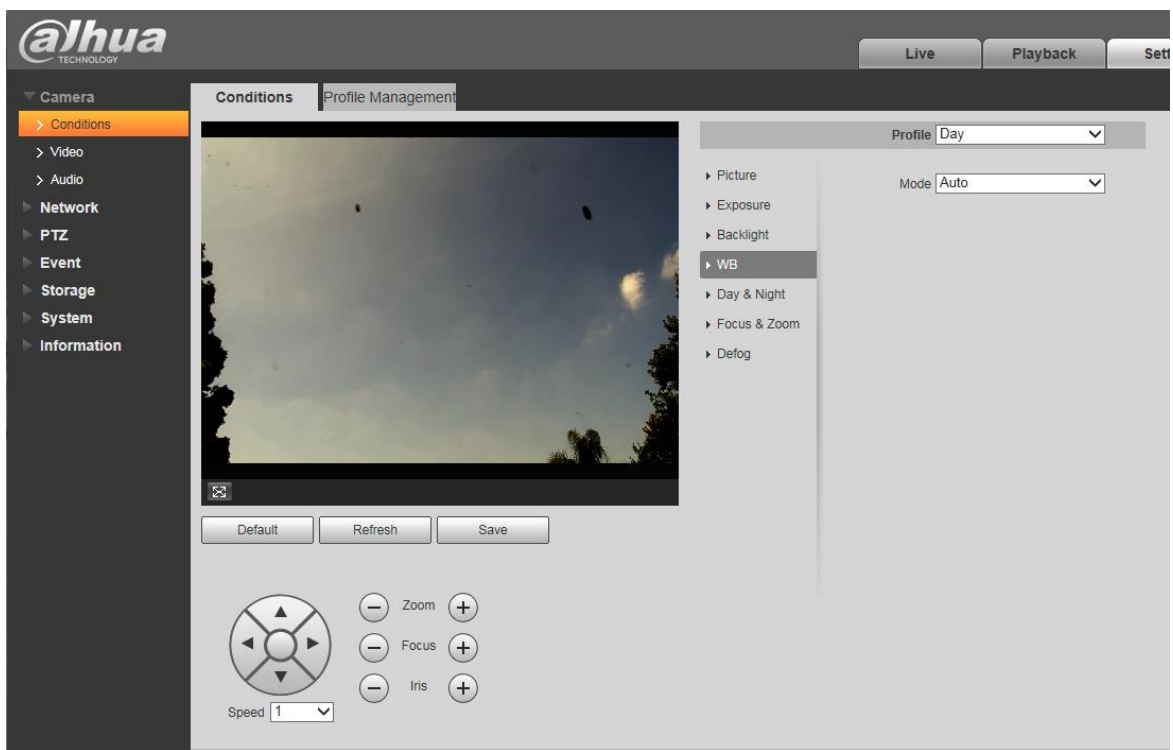
Set Picture settings to Profile Normal and leave others as shown above. Set Flip to 180 degrees.



Set Exposure settings as shown above.



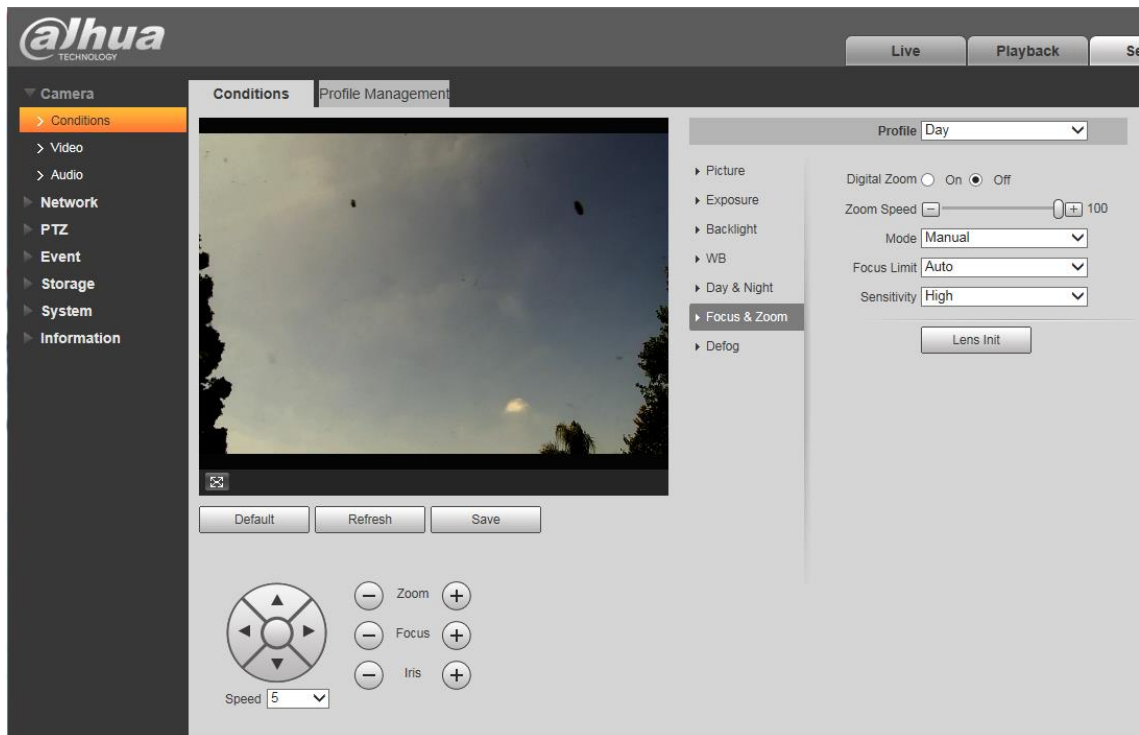
Set Backlight Profile to Normal and Mode Off.



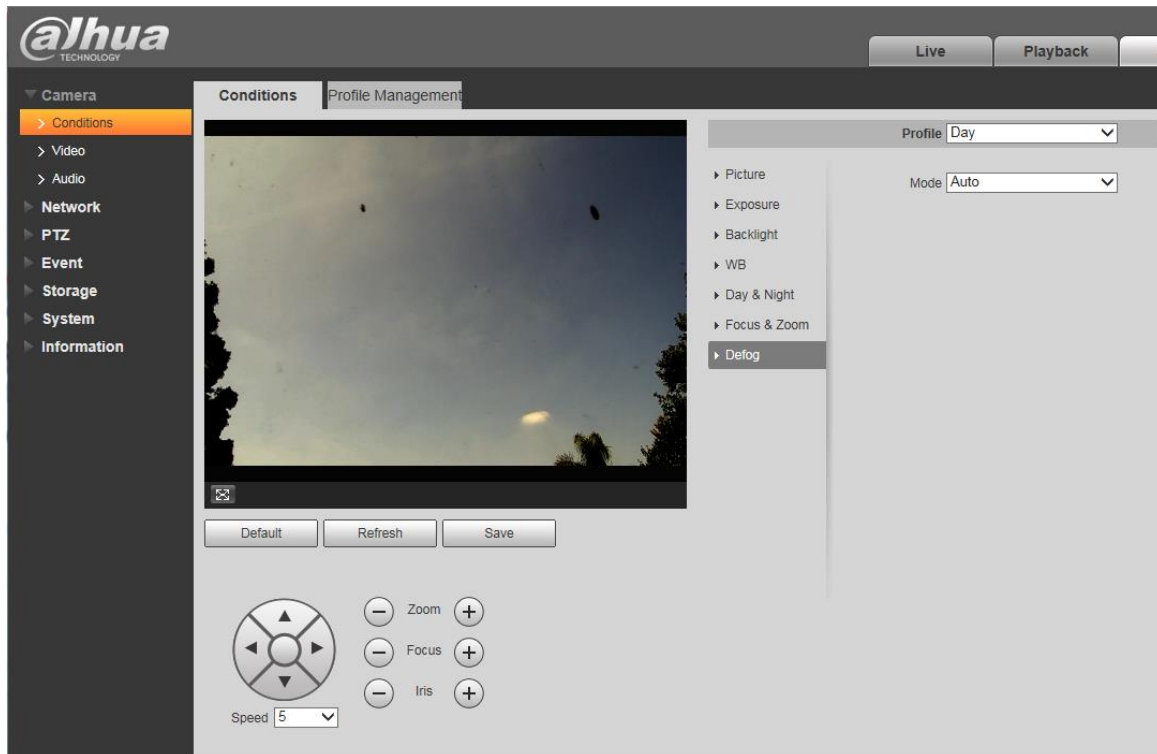
Set WB to Profile Normal and Mode Auto.



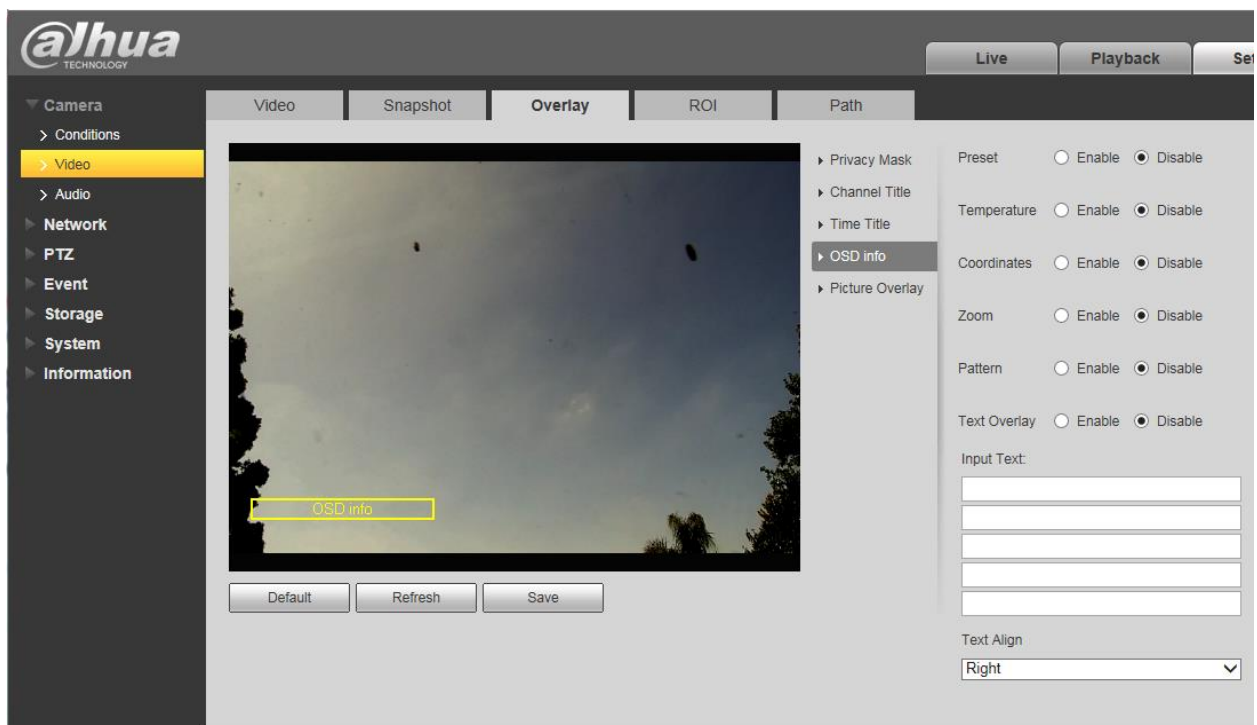
Set Day & Night settings as shown above.



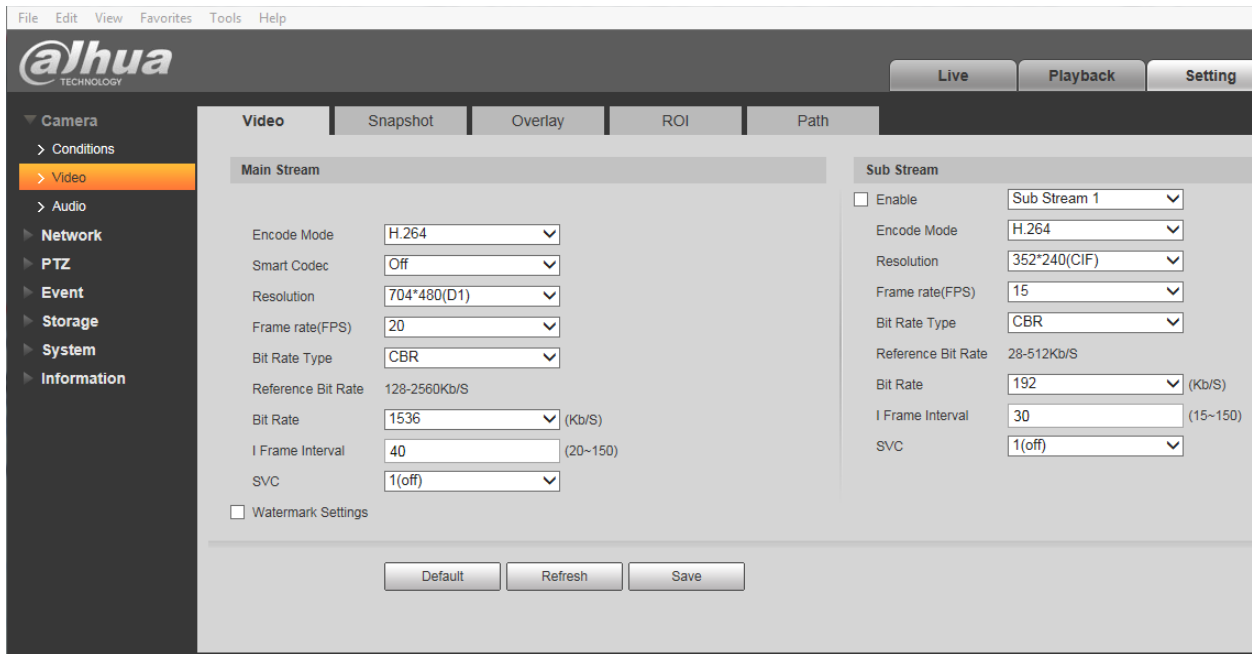
Set Focus & Zoom settings as shown above.



Set Defog Profile to Normal and Mode to Auto.

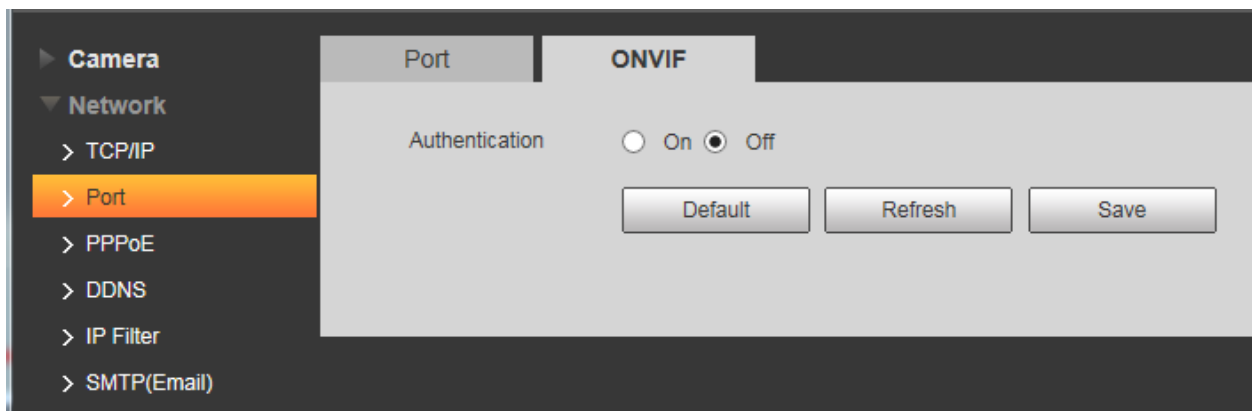


Disable all OSD info options.



Above shows frame resolution for 704 x 480, 20 frames per second.

1280 x 720 or 1920 x 1080 at up to 30 FPS could also be selected depending on OTDAU computer capacity.



ONVIF Authentication should be set to Off for no authentication.



Set a Static IP address as desired. Leave the other setting as is.

192.168.1.108 is the Dahua standard default address. You can leave this as is if it does not conflict with another device address.

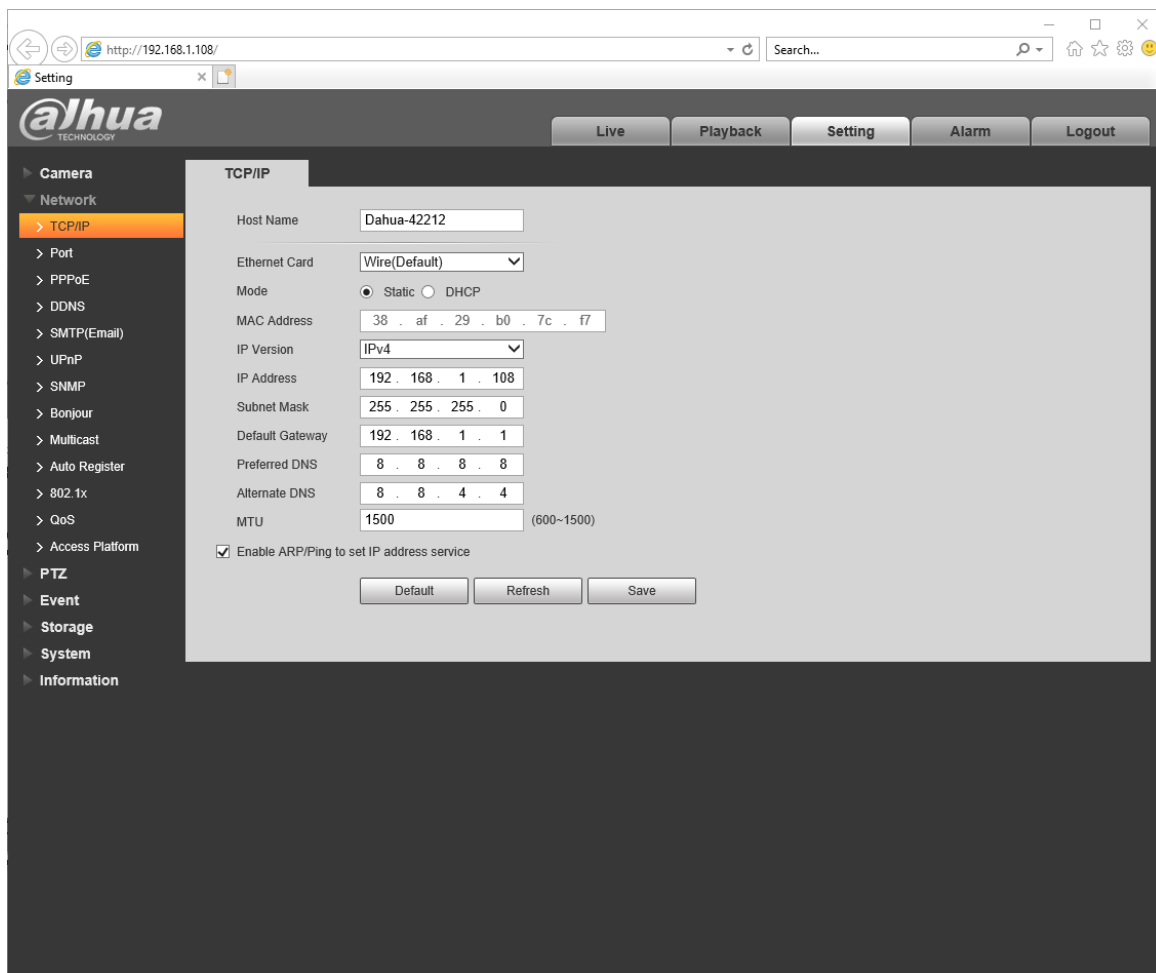
NOTE: If you have difficulty connecting to the camera or it seems intermittent, then you may have an address conflict. Check and correct this as follows:

1. Open your router's user interface, typically by entering the address 192.168.1.1 in the search bar of your browser.
2. Log into your router. The User Name is usually "admin". The Password may be "password" unless you changed one or both. (Check your router's manual for the actual default values).
3. Check your router's subnet (IP or LAN) address. It is usually factory set to 192.168.1.1 or 192.168.0.1. For your camera(s) to be able to connect to your router, it must be on the same LAN as the router. That is, the first three parts of its address must match that of the router, e.g., 192.168.1.x. Any device on your router that has a static address, such as a camera must match in this way. The last of the four sets

of digits is the device's unique address, such as 108. If your camera and router are not on the same LAN, then correct that by changing the IP address of the router or that of the camera, as shown below. It may be easier to change the router if all your other devices use DHCP addressing (not static). When you reset the router or cycle power, it will reassign all DHCP addresses transparently and none of the example Camera configurations that are provided with OTDAU software will need to be changed.

4. Navigate to the router's DHCP settings. Change the address range used by the DHCP Server Pool to avoid assigning an address that is the same as your camera's. Do this by changing the Ending Address to some value below that of your camera(s), such as 100.

5. Click Apply to implement any changes.





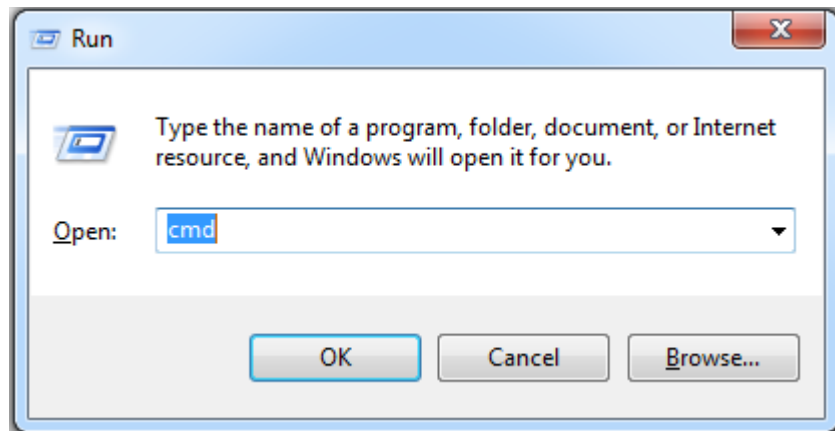
Select a HTTP Port number other than the default of 80 if the camera is needs to be port-forwarded on your router. Leave it as 80 otherwise.

SETUP FOR OPERATION WITHOUT A ROUTER

You can setup an OTDAU/MC system where the camera(s) connect directly to a computer, without going through a router. This configuration may be required, for instance, when setting up a system that has to operate stand-alone, independent of any direct internet connection.

To do this, you will need to modify the PC's IPv4 address to static instead of DHCP. This change will place the camera(s) and the PC on a common LAN by setting the PC's IP address and that of the camera to have the same first three parts of the LAN address (192.168.1.x). Despite this change, the PC will still have internet access when connected to a router.

- 1) Press the Windows + R keyboard shortcut to bring out the Run box.
- 2) Enter "cmd" and press Enter to open a system command window.



- 3) Type "ipconfig" and Enter to find your computer's IPv4 address.

```
C:\Windows\system32\cmd.exe
C:\Users\Ron>ipconfig
Windows IP Configuration

Ethernet adapter Local Area Connection 2:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Ethernet adapter Local Area Connection:

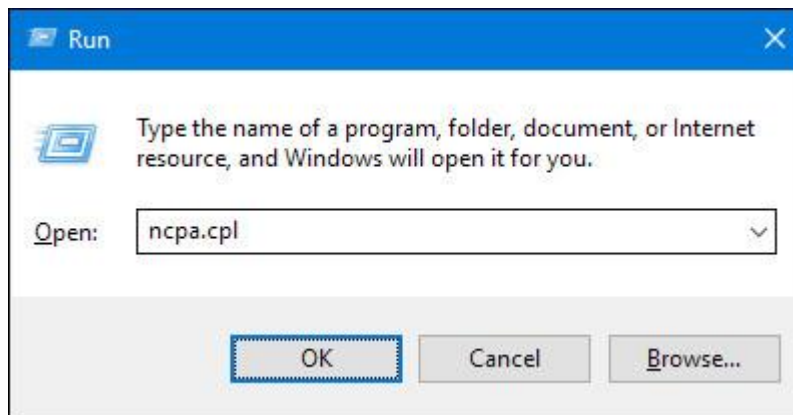
    Connection-specific DNS Suffix  . :
    Link-local IPv6 Address . . . . . : fe80::82a:2e5c:e328:596%12
    IPv4 Address. . . . . : 192.168.1.50
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Tunnel adapter isatap.{6F11C0D6-C39C-4276-A472-F0E1ABC304BE}:

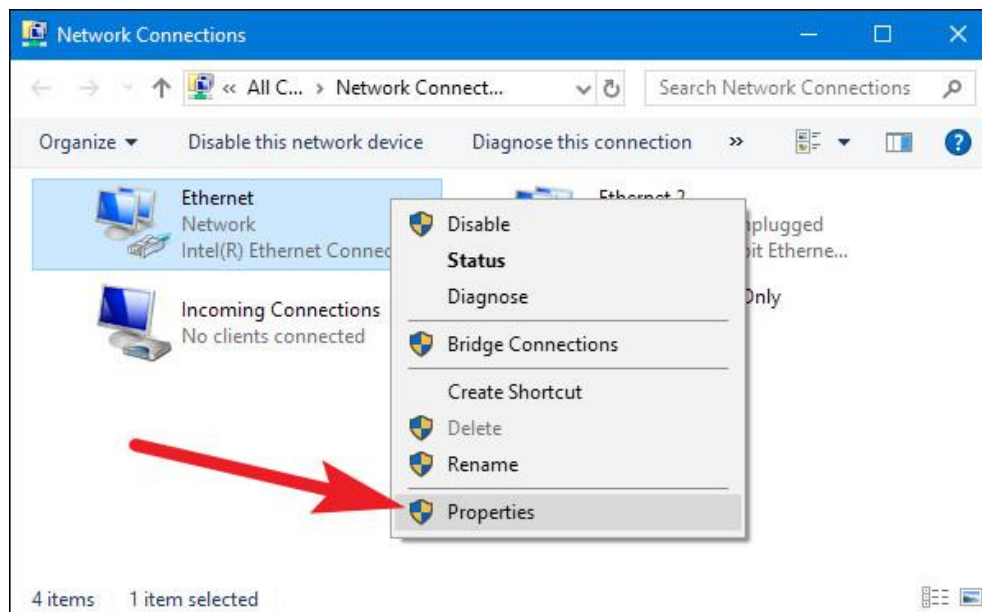
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

C:\Users\Ron>
```

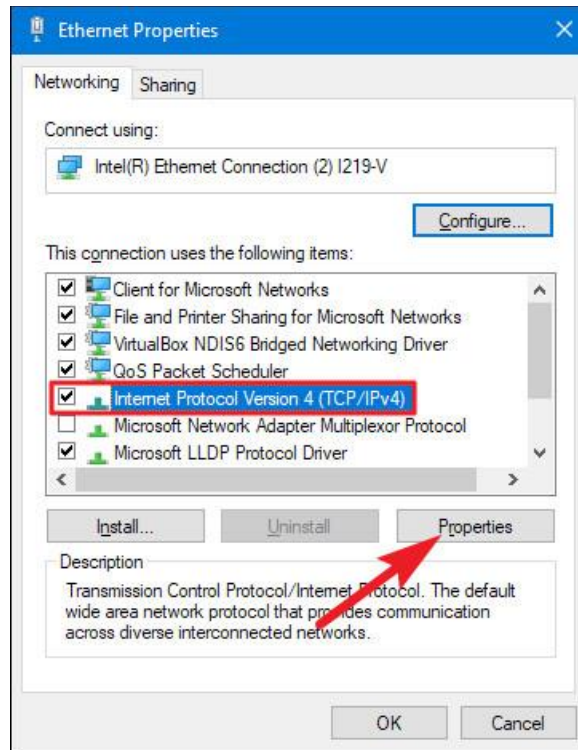
- 4) Press the Windows + R keyboard shortcut to bring out the Run box.
- 5) Enter “ncpa.cpl” and open the “Network Connections” window.



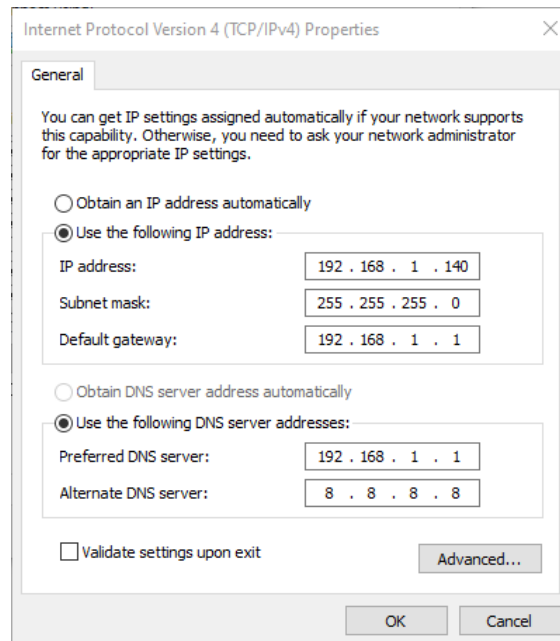
- 6) Right-click your computer's network adapter and select “Properties”.



7) Select your computer's Internet Protocol Version 4 and click "Properties".



5) Select "Use the following IP address" and change the IP address to the desired IPv4 address such as 192.168.1.50 as shown in this example. **NOTE:** This address must match the one in the IP field of the OTDAU Configuration when using an instance of OTDAU with Mission Control software.



IMPORTANT -- Use whatever means are provided by your router to:

- Change the range of addresses that the router uses for DHCP so that DHCP will use IP addresses (192.168.1.xx) such that xx is always smaller than the highest DAU address. For example, set the DHCP address range to 10 to 100.
- Verify that all of your DAU IP addresses are greater than the top of the DHCP range, e.g., greater than 100.

These steps will prevent conflict between automatic assignments of addresses by your router conflicting with the static addresses of your DAUs.

NOTE: The IP address of your computer is shown above as x.x.x.140. It can be any value that does not conflict with any other statically addressed device on your computer, such as a camera. 140 is shown above because that is the default address supplied with Mission Control software in the OTDAU Configurations.

DUAL CAMERA SETUP FOR TRIANGULATION

Triangulation of a tracked object's geolocation, altitude, speed and size requires two running copies of OTDAU, each with one or two cameras.

Triangulation calculations and display is performed by the Mission Control (MC) software. MC derives the data it needs to do that by communicating with two OTDAUs via the LAN or WAN. Each OTDAU camera is setup as described above, possibly sharing a single PoE injector/switch.

Minimum and maximum distance between such cameras is dependent on camera fields of view (FOV), the distance between them and their relative azimuths (rotation towards each other). As shown in the figure below, this distance, along with the FOV governs the minimum distance an object can be to an observer half way between them. Anything farther will also be in view.

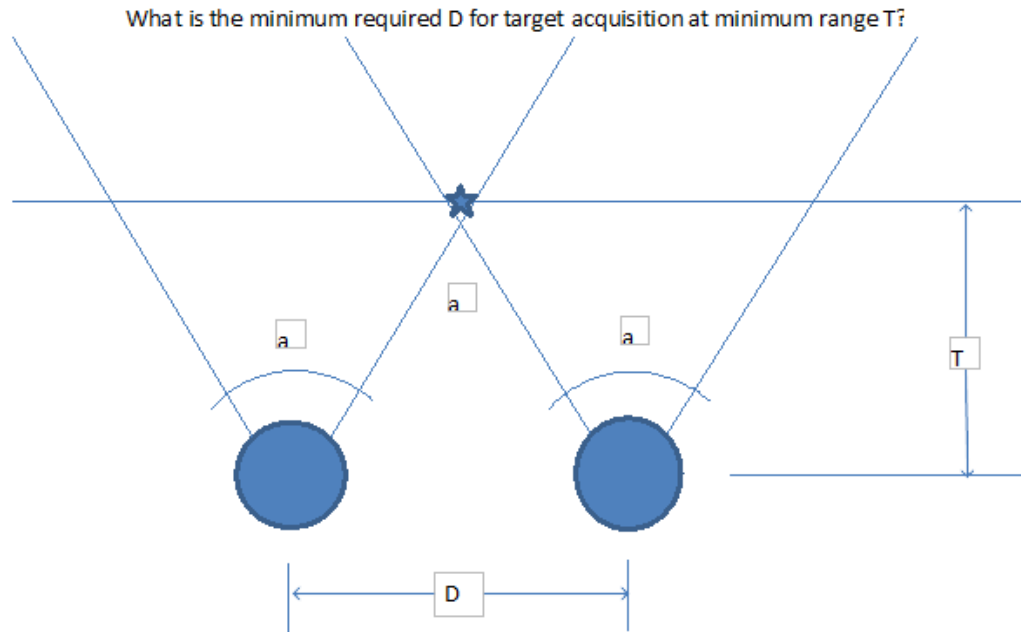
The answer to the question "what is the farthest object that can be seen?" is a complex function of several factors such as:

- The size of the object
- The amount of optical zoom in use
- The amount of self-illumination of the object
- The contrast ratio of the object vs the sky/background
- The resolution of the camera imager

OTDAU is capable of triggering and thus recording an object if it has a sufficient contrast difference covering only a few pixels of the camera imager. The ability to capture this minimal image must be traded off against OTDAU settings for blur, threshold and minimum contour size that may result in false triggering from other small, weaker points of light. This situation is usually much easier at night due to elimination of the effects of clouds and foliage as well as a better contrast ratio for self-illuminated objects.

CAMERA SEPARATION FOR TRIANGULATION

Camera separation vs target distance



- a Horizontal Field of View of each camera
- D Distance between cameras
- T Minimum overlapping LOS distance to target

If two cameras are D feet apart then they can capture a target if it is T feet from the cameras or far
 $\cos(a/2) = T / (D/2)$ -----> $D = 2 * T / \cos(a/2)$

Typical fixed camera FOV

| a | D | T |
|---------|----------|------|
| degrees | feet | feet |
| 96 | 2.99 | 1 |
| 96 | 29.89 | 10 |
| 96 | 298.90 | 100 |
| 96 | 2988.95 | 1000 |
| 96 | 5977.91 | 2000 |
| 96 | 8966.86 | 3000 |
| 96 | 14944.77 | 5000 |

Typical PTZ camera FOV

| a | D | T |
|---------|----------|------|
| degrees | feet | feet |
| 60 | 2.31 | 1 |
| 60 | 23.09 | 10 |
| 60 | 230.94 | 100 |
| 60 | 2309.40 | 1000 |
| 60 | 4618.80 | 2000 |
| 60 | 6928.20 | 3000 |
| 60 | 11547.01 | 5000 |

For example, two 96 degree OFV cameras about 300 feet apart can see a common object as close as 100 feet

MAXIMUM TARGET DETECTION DISTANCE

In general, the maximum altitude that a UFODAP camera might see a target would not depend on the absolute altitude, per se, but rather the size, brightness and contrast of the target.

"Seeing" might be defined as the target just covering enough pixels, with enough brightness so that the tracking settings of the OTDAU software detect it. Those settings can be as sensitive as about 3 pixels and very low contrast.

Another way one might want to quantify the ability to see a target is to specify its resolution vs distance. The following calculations reference the image resolution document listed below.

- Assume a 30' diameter target object.
- Assume the nominal 1920x1080 pixel camera image, with no zoom to start for initial target detection.
- Using the 50232XANR camera (32x zoom), focal length of 4.9 to 156mm, Sony Starvis sensor (IMX290LLR) which is 4.56mm/side.
- Rearranging the equations to get camera distance = $((\text{pixels} / (3 \text{ pixels}/30')) * (\text{focal length} / \text{chip size}) = ((1920 / (3/30)) * (4.9/4.56) = 20,631 \text{ feet or } 3.9\text{mi}.$

Of course, after target detection, with incremental zoom while staying on target, the focal length and thus the distance greatly increases, thus putting more pixels on target. As long as it is bright enough, even the initial target point of light would be adequate for measurement by the Tracking Spectrometer.

Theia Technologies, a maker of lenses for security cameras similar to those specified for UFODAP has published several useful guides on this subject:

Image resolution simulator and lens calculator -- <https://www.theiatech.com/calculator>

White papers, including "How to calculate image resolution" from which the calculations above are derived -- <https://www.theiatech.com/white-papers>

CAMERA CALIBRATION FOR TRIANGULATION

For MC to calculate the location, altitude, etc. of a triangulated target from the position of a target in the FOV of two cameras, the pan and tilt (azimuth and elevation) angles of each of the two cameras must be setup in advance. The setup assumes that each of two instances of OTDAU software is controlling one PTZ camera. One set of steps to accomplish this is as follows:

1. For each camera, in its instance of OTDAU software, open the Setup menu and disable the "Set Pan and Tilt offsets" option.
2. Using the manual controls, move the camera's azimuth so that it points due North.
3. Move the camera's elevation to a height such that the FOV covers the best initial target acquisition area. Note the value of EL in the Wide-Angle display.
4. In Setup Options, enter the EL value at the Elevation offset and enable Set Pan and Tilt offsets. AZ will be zeroed and EL will be the entered value.
5. Draw an appropriate Bounding Box.
6. Do the same for the other camera, elevating it to approximately the same tilt angle as the first camera.

Notice that after closing the camera configuration and reopening by clicking Load, the camera will return to the above saved position.

Note that this setup assumes that one camera will acquire a target first and as it tracks, if the target moves to enter the bounding box of the second camera, both will track the same target and triangulation will occur.

After the above OTDAU setup, open Mission Control and select a Mission that includes both cameras, such as mission-pccam1-pscam2. After initial checkout of your triangulation configuration, you may want to add other DAUs such as MSDAUs.

Load this Mission and verify that data from both cameras is displayed. As a demonstration/test of triangulation, open the MC Setup menu and select "Enable Test Mode" (and Save). In this mode, after Run is selected, MC will display triangulation calculations using the two cameras without requiring a trigger condition. Thus, you can manually move the camera pointing angles and observe the effect on the calculation. Use the Map Display Controls to better visualize the location of the DAUs and the intersection point of the camera pointing angles.

Stop, disable Test Mode and Run again for actual triangulation use. Be sure to enable any recording options needed prior to Run.

TIPS AND TECHNIQUES

The following are some guidelines for common problems and questions UFODAP users have had while setting up or using UFODAP hardware or software or planning for a new system.

TELESCOPE CONTROL

It should be possible to control a GoTo telescope via the OTDAU software. However, the software interface (driver) to do that has not been developed.

For that to be possible, the following conditions would have to be met:

- Use a GoTo to WiFi interface such as the SkyFi 3 controller (<https://skysafariastromy.com/skyfi-3-professional-astronomy-telescope-control.html>) to get commands from your PC to the GoTo mount.
- The telescope GoTo interface must be Celestron NexStar hand controller-compatible as defined in the document: NexStarCommunicationProtocolV1.2.pdf
- You would have to provide the WiFi interface and a compatible GoTo controller (perhaps without the telescope) for software/hardware integration and testing.
- You would need to provide some type of telescope camera that results in the image available via either a USB or Ethernet interface.

If all of that could be arranged, then I may be able to develop the driver. If so, then OTDAU would detect and track moving targets in the field of view and slew the telescope to maintain track

MSDAU ANTENNA FUNCTION

The UFODAO MSDAU antenna that is of a type intended for scanner use, and covers ultra wideband frequencies from 1MHz to 6000MHz and does it without the band gaps found in antennas meant for similar applications. Thus, it covers all practical frequencies the SDR is capable of receiving without changing the antenna.

Its data sheet and dimensions may be found in the Downloads section of ufodap.com.

This antenna is mounted to a standard NMO (New Motorola) adapter attached to an assembly that fastens to the vertical plate that holds the MSDAU, high enough to clear the camera.

The antenna can be simply unscrewed from the NMO mount for transport without affecting the mount or cable connections.

CAMERA SEPARATION FOR TRIANGULATION

See the section of the System Installation Guide "Camera Separation for Triangulation".

If you assume that T is 50 miles (264000 ft) and your camera FOV is 60 degrees, then the minimum distance between cameras needs to be about $\text{COS}(60/2) * (264000/2) = 114315$ ft or 21 miles.

So that would require remote, internet-connected cameras. Note that the wider the FOV, the closer the cameras can be to triangulate a target at a given distance.

See also the following section on maximum usable target distance.

INITIAL INSTALLATION ISSUES

The Operating System (OS) under which the OTDAU and Mission Control software run must be Windows 10 or 11.

They can also run on an Apple MAC computer with a Windows emulator running on top of their iOS, although this results in rather slow performance.

Those requirements and others are listed in the beginning of the UFODAP User Guide which you can download/view from the Downloads tab of ufodap.com.

If you have a problem initially running OTDAU, you might try the following:

1. Uninstall OTDAU
2. Delete the folder C:\Program Files (x86)\OTDAU
3. Install the new version from the download you got via SendOwl

No need to copy any license files because the new version incorporates all prior users, which includes you.

Open OTDAU and complete the verification process either with an IP camera, if you have one, or using the USB camera option.

MSDAU MOUNTING ON A VEHICLE

One issue may be that the 3-DOF magnetometer (compass) in the MSDAU would be affected by the metal of the vehicle which would also shield it from fluctuating magnetic anomalies.

Thus, I would suggest finding a way to mount it externally when in use. Note that the wall plate is the same as the vertical plate portion of the System Mounting assembly used for the camera tripod mount.

You could either: a) mount the plate horizontally on top of the truck (using wing nuts?), b) Use the System mount (both plates) and the 5/8-11 tripod mount on the truck (MSDAU vertical) or c) Your own L-brackets or plate to attach to the wall plate

CAMERA/RESOLUTION TRADEOFFS

A moving target may not be slow enough or hang around long enough to be able to zoom to 32x. If you make that assumption, then you would save money using a 12x zoom camera such as the 42212.

A higher resolution is good as well but the tradeoff there is that the higher the resolution the more data must move from camera to computer which uses more CPU resources.

If your field of view is limited to less than a fixed camera, such as the N53AB52 with an FOV of 98 degrees and max resolution of 2592x1944, then that may be good enough and cost less.

See the various cameras offered in the UFODAP Shop and the comparison table found there.

PC HARDWARE SELECTION

One possible error message you may encounter while installing UFODAP software may be from the software installer noticing a very low amount of system RAM you have, e.g., 2GB.

The UFODAP User Guide specifies a minimum system of:

- Windows 10 OS on a PC Computer with Core i5 processor, 16GB memory and 2GB free disk memory. A faster computer, e.g., an i7 or i9 or with higher speed ratings may provide higher analysis frame rates and thus better tracking of faster targets.

A slower PC, e.g., and i5, may work but process frame rates may be reduced, especially at higher camera resolutions.

That is also a rather slow CPU. For a comparison to a minimal i5 see:

<https://versus.com/en/intel-atom-z3735f-vs-intel-core-i5-8250u>

TRACKING PROBLEMS

If you have difficult tracking problems, please share data about those issues as follows:

- Verify correct operation without P/T or Zoom enabled
- Then verify if there is a problem with only P/T enabled
- Only if that works, enable zoom

To share data on this, please send me the avi of the Wide camera and a screenshot of the Tracking and Camera parameters used at the time.

However, one probable cause of this behavior is that the PID proportional value in the Camera parameters is set too high for your camera -- try setting it to 5 and run a test.

If that works for you, then increase it a bit with each test until you notice overshoot or hunting during tracking, then back it off.

CAMERA SETUP FOR FOCUS AND ZOOM

- Suppressing noise in dark conditions may require adjusting (one at a time) increasing the Delta threshold, increasing Blur or increasing Min area.
- The focusing method is:

Get into the camera's Setup menus via IE (easiest via Dahua's ConfigTool, found at the bottom of the home page of dahuawiki.com)

Go to Focus and Zoom settings and set to Manual focus -- Any auto focus tends to lose tracking as it adjusts while tracking

- Center some structured object or tree branches at the CFOV
- Incrementally zoom into the object while adjusting to get the best focus
- Keep doing that until fully zoomed out and in focus -- Save the settings
- Now you will find that you can zoom from x1 to x32 and always stay in focus
- Check that focus is still good before you start each long run

-- The software does not do focusing

-- You can create a System configuration that uses a fixed camera as the Wide camera and a PTZ camera as the Tele camera. Then, calibrate the two together by enabling FOV calibration marks in the Setup Options and attempt to move the PTZ camera to have the same CFOV as the fixed camera. You then Enable Handoff in Setup and Run. The system then will attempt to point the PTZ at a target initially acquired by the fixed camera and perform a new detection and continuous tracking via the PTZ while recording (if enabled) both cameras. Mission Control software is not used for this function. Note, that if you do not enable Handoff, then tracking will still be performed by the fixed camera, but the PTZ direction will be simply slaved to the computed location of the target and continuously move to it in steps. The Wide camera can be any type -- USB or IP, PTZ or not with P/T disabled.

In case you need it, there is now available via the Accessories portion of the UFODAP shop a junction box with a 5/8-11 tripod mount for any compatible camera. It is part number ASSY-MT-TRIPOD.

TESTING OTDAU SETUP AND TRACKING

In addition to trying the various "test-x" System configurations, using a laser to test tracking is a great thing to do.

However, the problem is the following:

-- OTDAU uses a process of predictive location to determine where to make the initial absolute move upon detection (the PID loop continuous velocity control is used after that).

-- The predicted position is derived from measuring the vector velocity of a potential target during the number of frames specified by the Tracking, "Min events" parameter. After that number of detections are measured, it uses the estimated lag time of the software/camera to derive what the target location will be in the future and move to that point.

-- So if while the system sees the laser you make some quick motions (high velocity), then it predicts what may seem to be odd future locations some distance from the laser spot.

-- Thus, to do that kind of testing requires a very steady hand. What I do is sit in a swivel chair (I see you have one), point the laser at the wall outside of the bounding box and then turn in the chair so that the laser spot emulates a moving object in the FOV. That method tends to eliminate the dithering problem.

The purpose of the resolution entry is to tell the system what the camera is actually set to. You cannot use it to set the camera's resolution.

You may also want to reduce the initial zoom speed, for example, from 2.0 to 1.0.

Generally, the process to validate system operation is to:

1. Check operation with P/T and Zoom disabled and use the Default settings. Look for proper detection and tracking and adjust settings such as Crop, Blur, Delta, Min and Max areas if necessary.
2. Enable only P/T and check again. Look for proper detection, initial move and continuous tracking of the sort of targets that were detectable in step 1. Adjust camera Proportional constant larger if there is no hunting (unstable motion), then back it down a bit.
3. If that works, then enable Zoom. Look for the largest number of zoom-in increments without losing the target.

It would be best to try all this on daytime aircraft as test targets. At night, you may find that you want to make the Min area a bit larger to avoid triggering on twinkling stars.

For feedback, the best sort of files to provide is just a Wide video plus a screenshot of your Wide and Camera configurations.

Note the following:

-- The configured FPS should match whatever the camera is set to, which has various options depending on resolution.

If they don't match that will affect two things: Displayed frame rates will be inaccurate; The length of recordings will not match actual times. It should not affect tracking.

-- Pan/Tilt values are actual when a camera is a PTZ type. If not, then the P/T values are emulations based on the location of a detected target in the frame. Thus, if no target has been detected, then there are no PT values to change until then.

-- Performance of the various Dahua cameras varies a bit depending on optical sensor sensitivity, P/T rate, etc.

SYSTEM SETUP FOR TRIANGULATION

Setting up two tripod-mounted systems involves the following steps:

-- Open the tripods and mount the cameras with optional MSDAUs on them. Connect an antenna to the MSDAU(s)

-- Plug one end of a CAT6 cable into each camera and MSDAU

-- Plug the other end of the cables into a common PoE injector

-- Connect a short cable from the injector to a computer or router-- Run two copies of OTDAU and one of Mission Control on the computer

-- Select per-defined configurations for the OTDAU System configuration and MC Mission. Select recording and sharing options.

-- Execute Run on each OTDAU and the MC.

Doing all this requires no mechanical skill. If one had previously practiced on the software, then getting it going like this takes perhaps two minutes. The whole process might take 20 minutes +/- given variability in issues of unpacking and layout.

INITIAL CAMERA AND MSDAU SETUP AND TEST

-- The camera IP address, as on the label on the unit, is 192.168.1.108, port 80. A new UFODAP camera will have all camera parameters set to values useful for OTDAU

including an initial focus setting. You can review them using the Dahua software found at dahauwiki.com: "configtool". Use ConfigTool to test that your camera/injector/router is functioning properly. Use it to load IE to display the camera's web page by clicking on "web" on the right of the line showing your camera. Note that the IP address implies a LAN address of 192.168.1.x. Unless you have some reason not to, it would be easiest to be sure that your router conforms to that LAN address.

-- The camera username is "admin". For a 50232XANR camera, the password is "dahua50232". The camera configurations supplied with OTDAU assume that, so it would be best not to change them and there is no security issue involved.

-- For first tests of OTDAU, try the various test configurations, such as "test-aerobatics.json". This is convenient to learn the effect of the various Tracking parameters. Then try your camera using the System configuration "dahua-50232-108-80-1920x1080.json".

-- The MSDAU IP address is initially 192.168.1.144. If you had a second MSDAU, it would be modified via its joystick to ...145. To test it, use the Mission Control software and select the Mission "mission-ms1.json", then click Load. To use MS with OTDAU, load your camera configuration, then select a mission such as "mission-pccam1.json". You can also use the various combinations of ms1 and pccam1 missions. NOTE: Be sure to set your PC to have a static IP address, such as that used in the given configurations: 192.168.1.140. Your PC should still be able to access the internet as with DHCP addressing.

For additional help, please refer to the System Installation Guide and User Guide and also get back in touch when they come up.

INITIAL CAMERA CONNECTION AND TESTING

If you have any problems making your camera work with OTDAU, check the following steps:

- Connect the PoE injector via one of the two non-PoE ports to your router
- Verify that your router subnet address is 192.168.1.x.
- Connect one of the PoE ports to the camera

-- Install ConfigTool from dahuawiki.com on your PC. Run it to verify that it detects your camera and shows it as IP address 192.168.1.108.

-- One the line showing the camera in ConfigTool, start the IE browser via the "web" icon.

-- The camera web page should start. Enter the login as user: admin and password: dahua50432 (or similar for other camera part numbers).

-- After a short delay, the video from the camera should appear. You can use the pan/tilt/zoom controls to move the camera image.

Your WiFi or your system firewall should not have any effect on this.

CAN A CAMERA BE USED WITH OTHER SOFTWARE AS WELL AS OTDAU AND MC AT THE SAME TIME?

MC acquires triangulation-related data from the computer running the OTDAU software, not from the camera itself. Thus, the normal way this works is for OTDAU to operate the camera and pass info such as azimuth and elevation (pan and tilt) to MC.

MC also receives a reduced resolution image for display and storage from OTDAU. In any case, an IP camera stream may be viewed on several applications at once. For example, you can view and manually control an IP camera from the IE browser while OTDAU is using it. The only constraint is you would not want some other application to be sending PTZ motion commands to the same camera as OTDAU is controlling. MC and multiple instances of OTDAU can all run on the same computer or different computers since they communicate via TCP/IP within your LAN or the internet.

OTDAU can operate with any USB camera. In fact, it can use two at a time for purposes of creating a wider field of view although only one (the "Wide-angle" camera) will be used for target acquisition and tracking. OTDAU software is provided with a large number of System configurations, each of which defines what cameras are in use among other parameters. Besides various IP cameras, it includes those for cameras on USB0, USB1 and USB2. Each System configuration calls out what Camera configurations it uses for the "Wide" and "Telephoto" cameras. Thus, there are Camera configurations for various resolutions of cameras for each USB port. You can also modify or create any needed System or Camera configuration you need.

Here is what you need to do to get the system installed (see also the System Installation Guide, downloadable from ufodap.com):

- Pry out and save the gold pin from the top of the antenna connector. Then you can screw the whip antenna adapter into the connector.
- Screw the gold SMA cable connector into the HackOne Antenna connector. The CLK connectors are not used in our application.
- Turn the HackRF 180 degrees so the Antenna connector is on the right side and place it on the bottom of the enclosure with the black Ethernet cable on top of it.
- Using the short Ethernet cable, connect the PoE injector port 5 or 6 to an unused port on your router.
- Using any length Ethernet cable, connect any PoE injector port 1-4 to the Extender In port.
- Using a short Ethernet cable, connect one of the Extender Out ports to MSDAU.
- Using another short cable, connect the other Extender port to the camera.
- Remove the camera dome and take off the lens shipping protective cap and the dome protection plastic film. When you replace the dome, be sure that the o-ring is in place.
- Power up the PoE injector and note fan noise and motion in the camera and display illumination in the MSDAU.

Software --

Use the Dahua ConfigTool to verify camera operation. When you open it, it should discover the camera. Then click the WEB icon on the right to run IE to see the camera's display. Login using admin / dahua50432.

You can then use the Setting tab to, for instance, get to the focus adjustments (Conditions > Focus & Zoom).

Start up OTDAU and connect to the camera using the dahua-50432-108-1920x1080 System configuration. Verify correct operation.

Start up MC and Load the mission-pccam1 mission and verify camera data displayed

Close the MC mission above and instead, Load the mission-ms1 mission and verify that MSDAU data is displayed. There may be some delay due to installation of a new version of MSDAU firmware.

Close that mission and Load mission-pccam1-ms1 to see both DAUs at the same time.

Please tell me how that goes and if you have any other questions.