

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
- Radio Frequency DAUs (RFDAUs) which collect RF spectral data from a wide-band RF receiver. **The RFDAU and possibly other DAU types are future UFODAP developments.**

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 window sill.

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 of 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 2688 x 1520 2304x1296 1920 x 1080 1280 x 960 1280 x 720 704x480 640x480 352x240	4000 x 3000 2880 x 2880 2880 x 2160 2048 x 1536	1920 x 1080 1280 x 720	1920 x 1080 1280 x 960 1280x720 704 x 480 352x240	2560 x 1440 2048 x 1536 1920 x 1080 1280 x 960 1280 x 720 704 x 480 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.



DOMES 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, set of 4

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 threads 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 may has one or more Dahua N53AB52 bullet 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 treads 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.

A number of 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.

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.

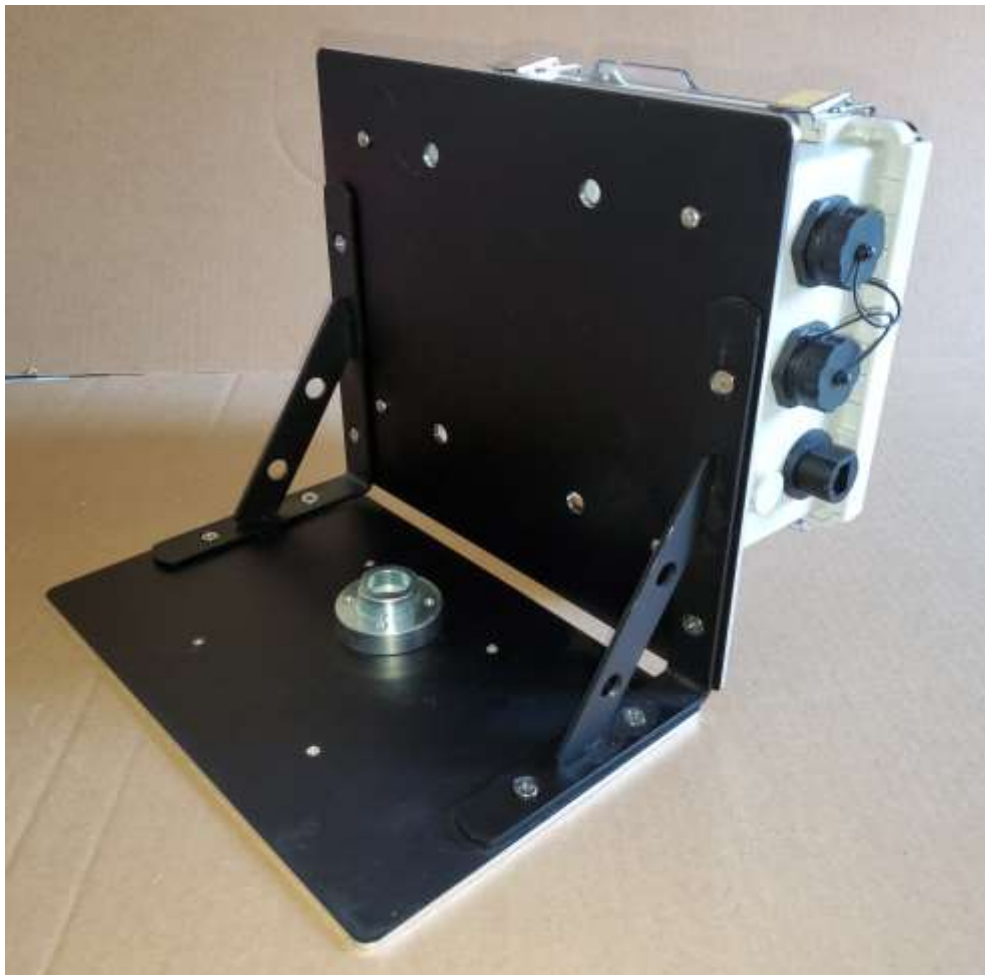
Loosen the Philips screw on the side of the camera mount. You can rotate the camera about its axis and also move it left or right with a ratcheting action until it is pointing as desired. Then tighten the screw.

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 SMA connector on the right side for an external antenna connection, as shown below.



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

A telescoping antenna, as shown below, may be directly connected.

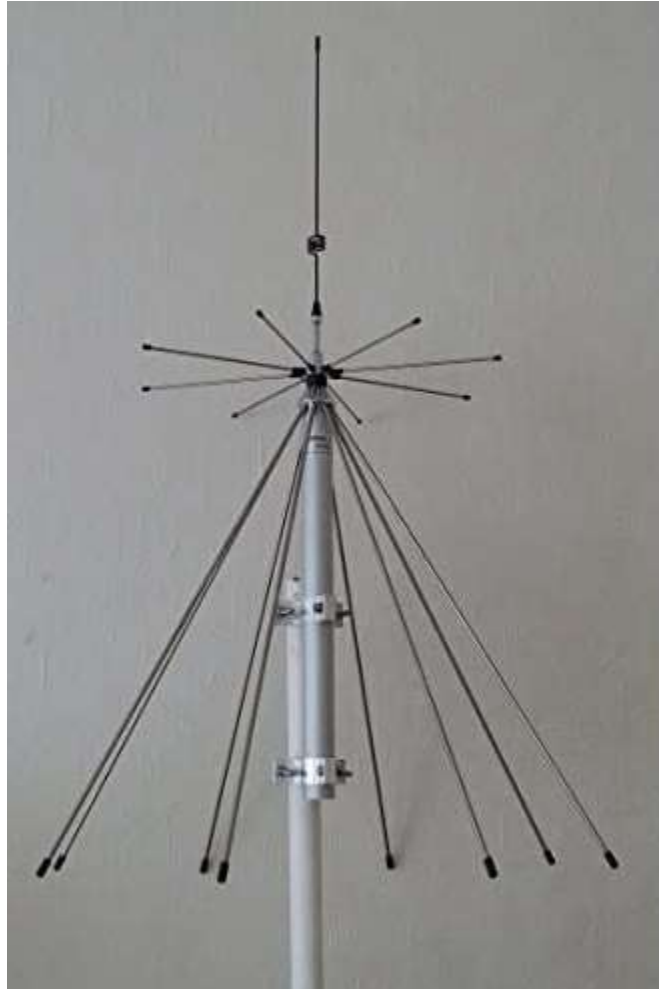


This is typically a $\frac{1}{4}$ wave whip which is omnidirectional but has no well-defined ground plane. Its gain at any particular frequency is dependent on its extended length. The optimal values may be calculated using this Whip Antenna Length and Frequency Calculator:

<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.

A discone type antenna can provide higher gain throughout a broader spectrum of frequencies such as 100MHz to 2GHz in the case of the example below.



The horizontal and conical elements are the primary antenna and the vertical element extends its low-frequency response. Its response is omnidirectional, primarily in the horizontal plane.

Such an external antenna would be connected to the MSDAU via an extension cable terminating in a male SMA connector. It is advantageous to seal the connection with a self-amalgamating or self-fusing silicone tape that stretches and seals to itself when wrapped around a connection.

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 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.



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

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:

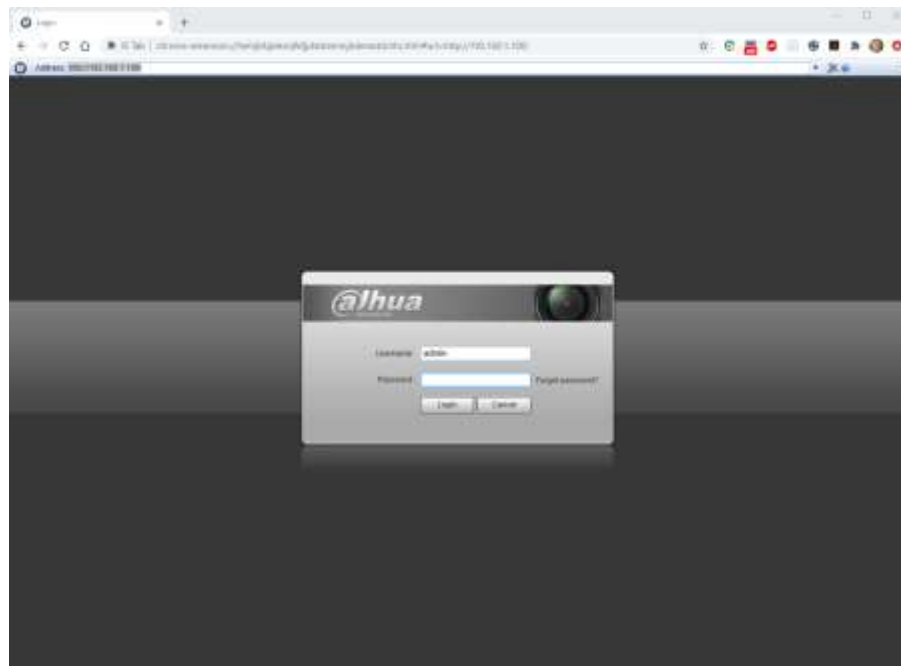
1. The Dahua Wiki has loads of information on their cameras – See the home page of dahuawiki.com.
2. In particular, scroll down to the bottom of the home page and you will find their Config Tool. Download and install the version for your computer (Windows or Apple).

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 globe symbol on the right to run Internet Explorer to access the camera's Settings options.

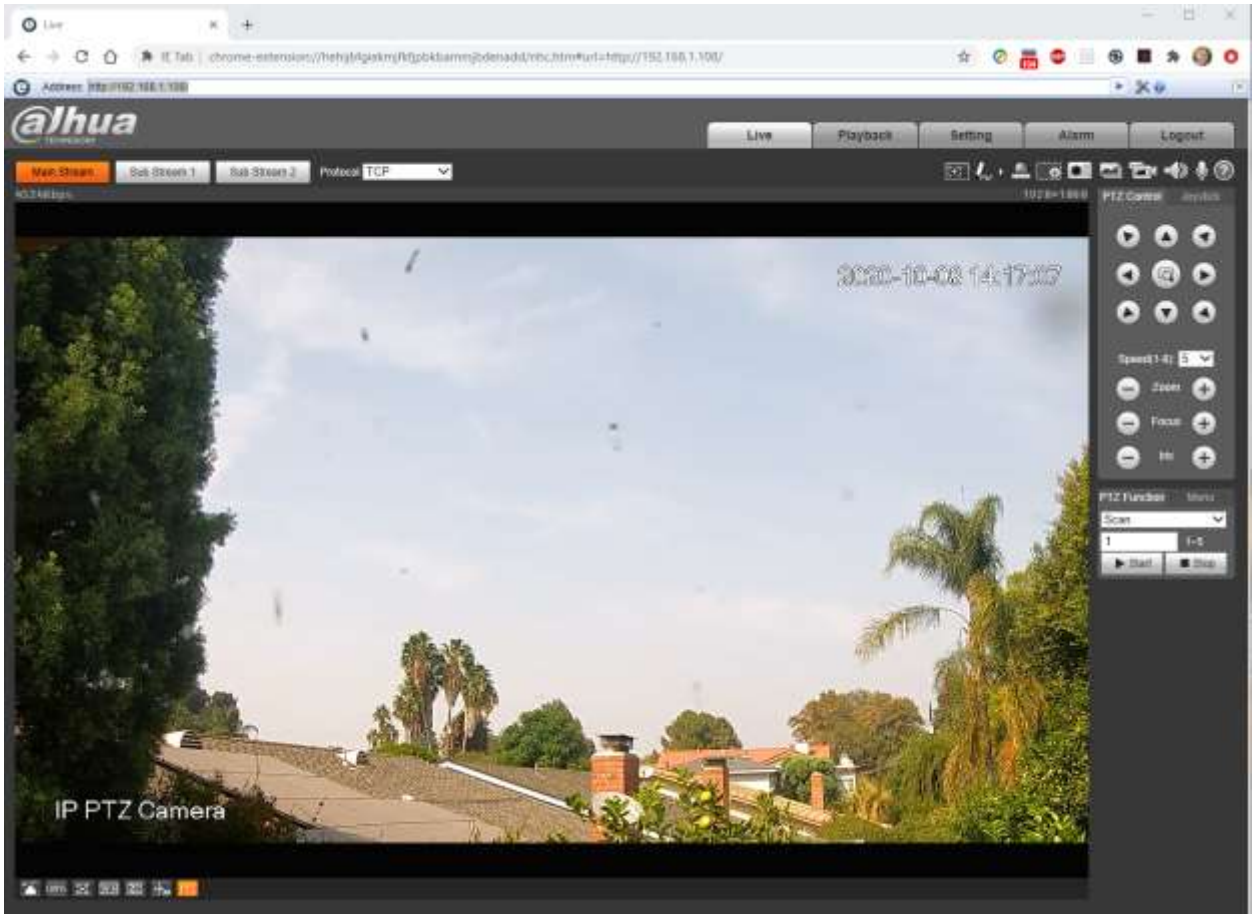
With either method, you may see the message:

“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.

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.

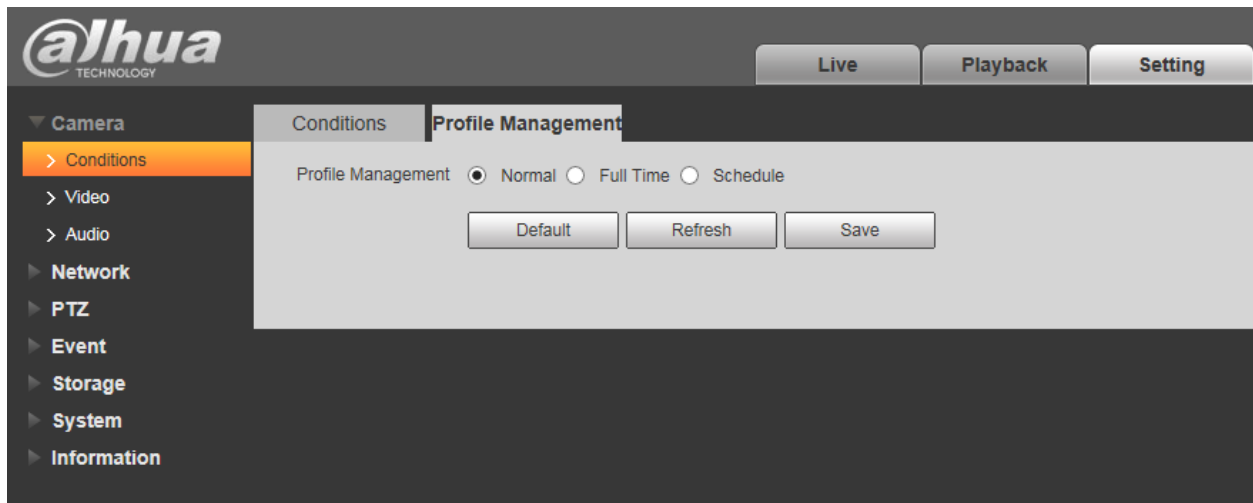
DAHUA CAMERA CONFIGURATION

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:

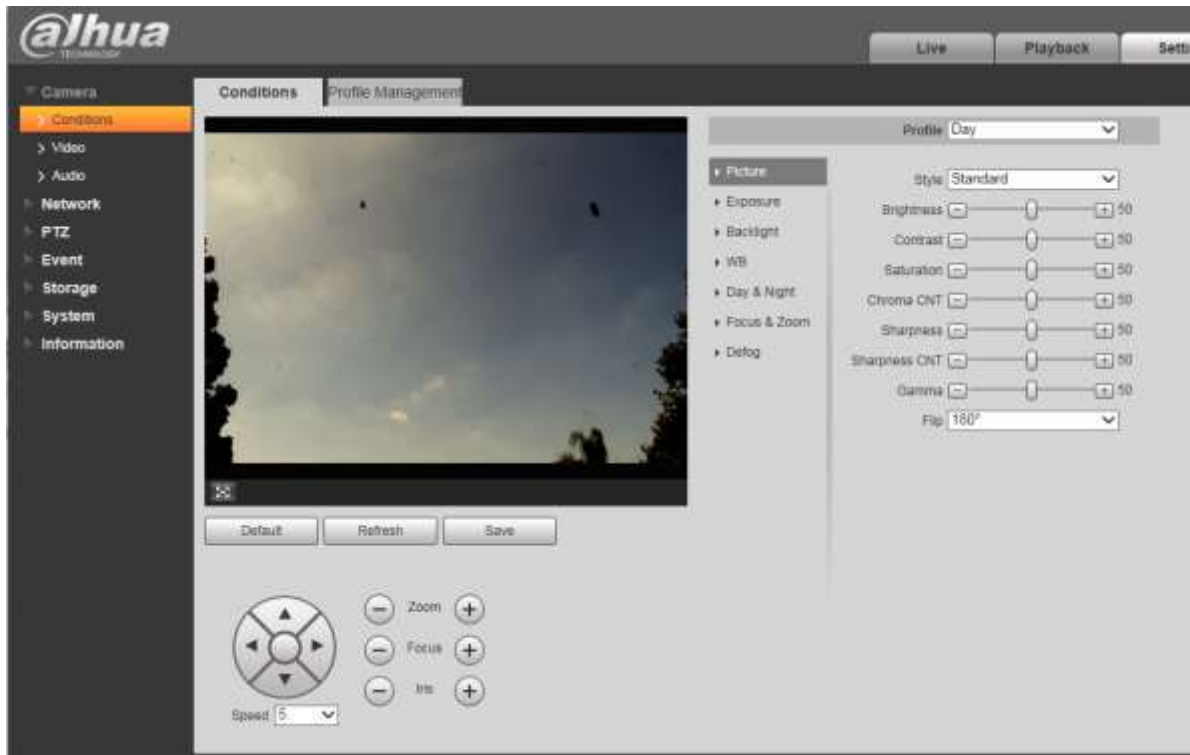
<https://dahuawiki.com/Template:Manuals>

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.

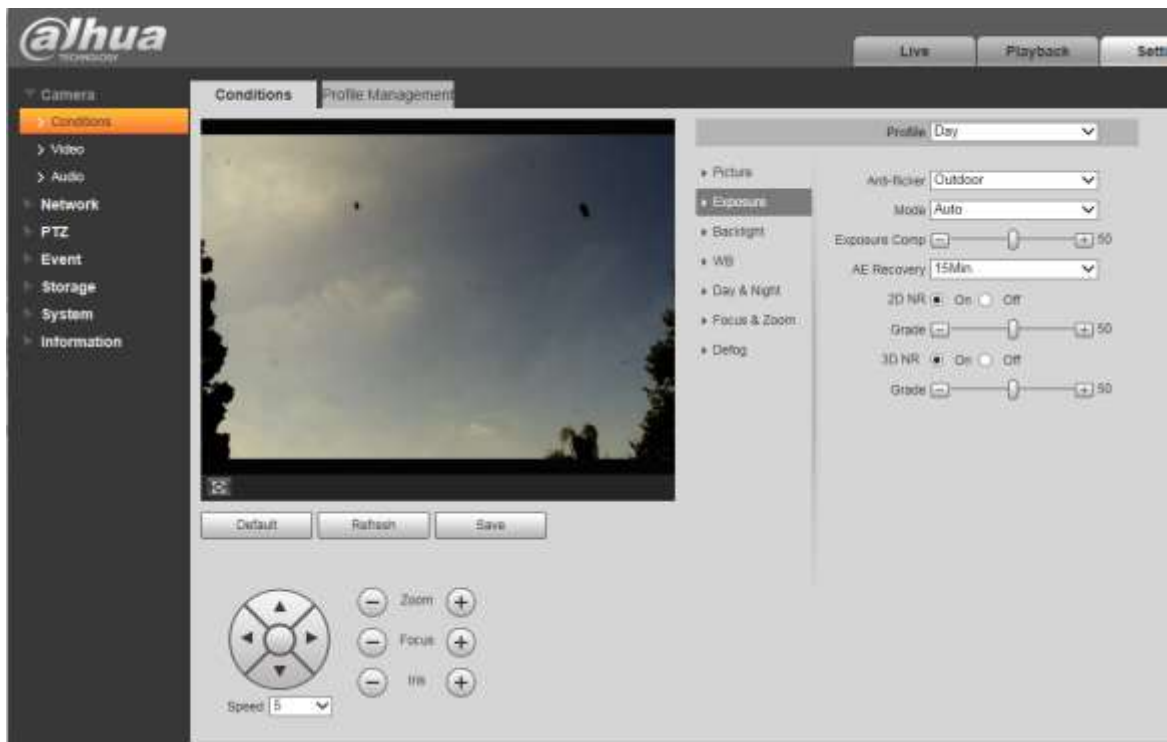
Be sure to click on Save after each setting.



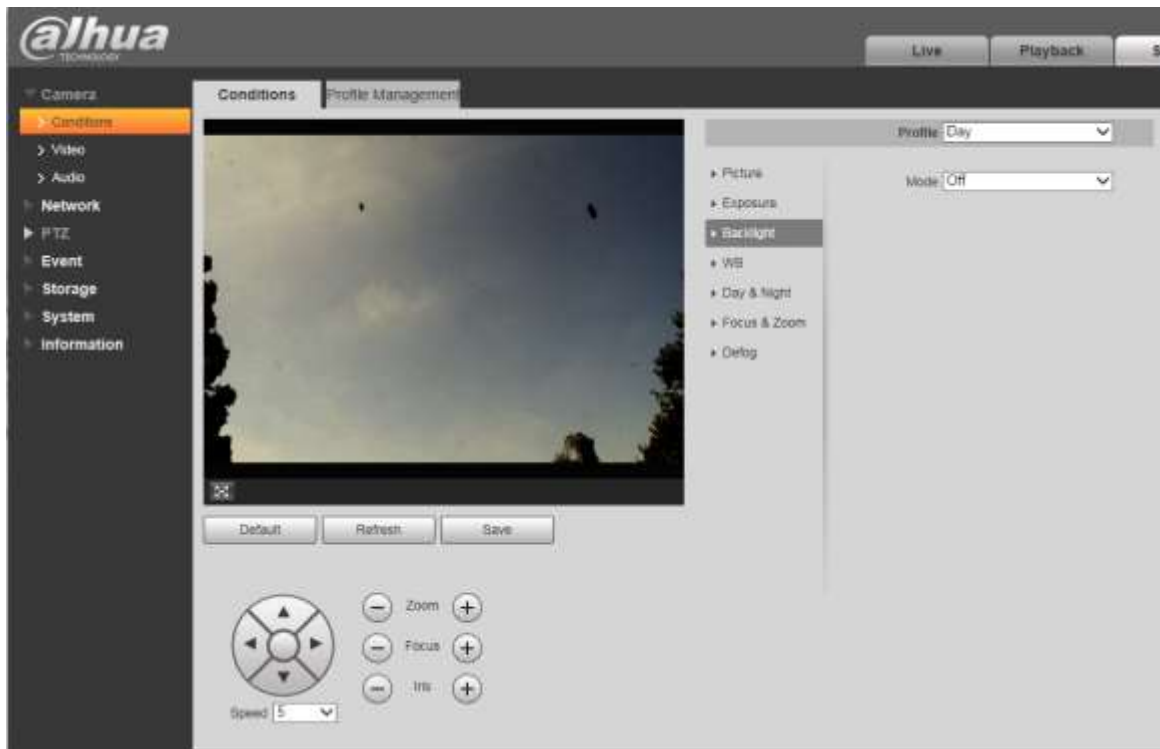
Set Profile Management to Normal. Otherwise, other settings may revert to prior values if you Save, go to Live and back to Setting > Conditions.



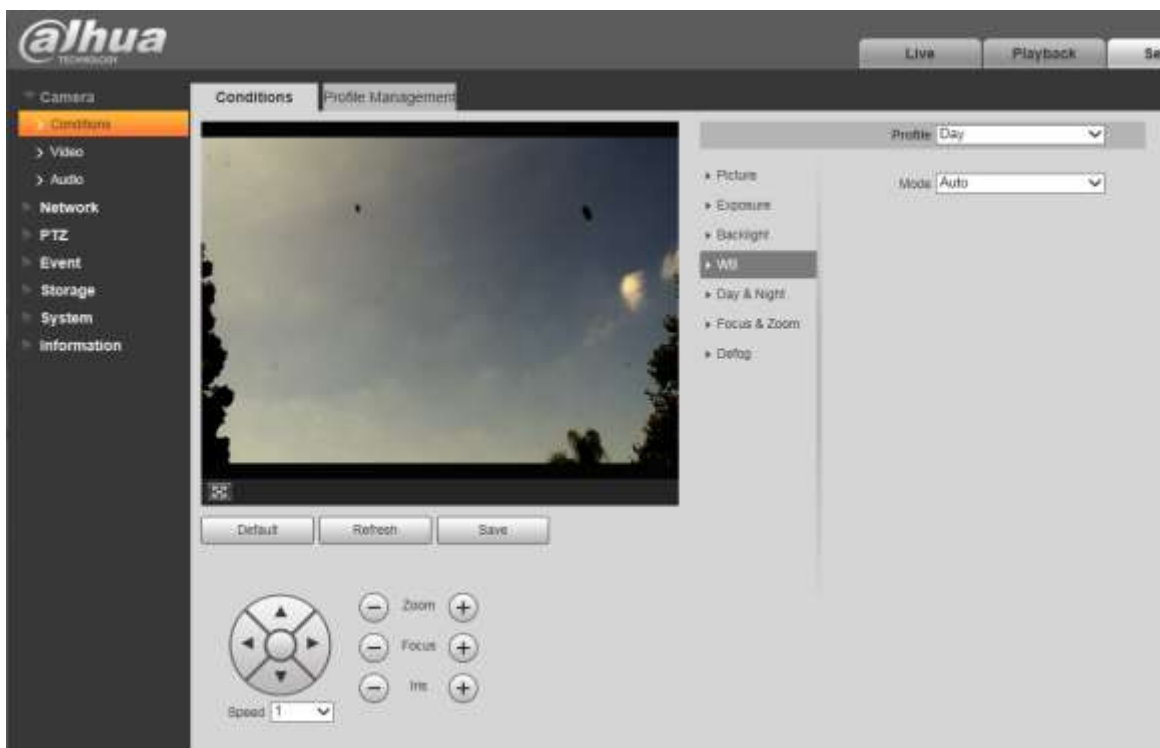
Set Picture settings to Profile Normal and leave others as shown above. Set Flip to 180 degrees.



Set Exposure settings as shown above.



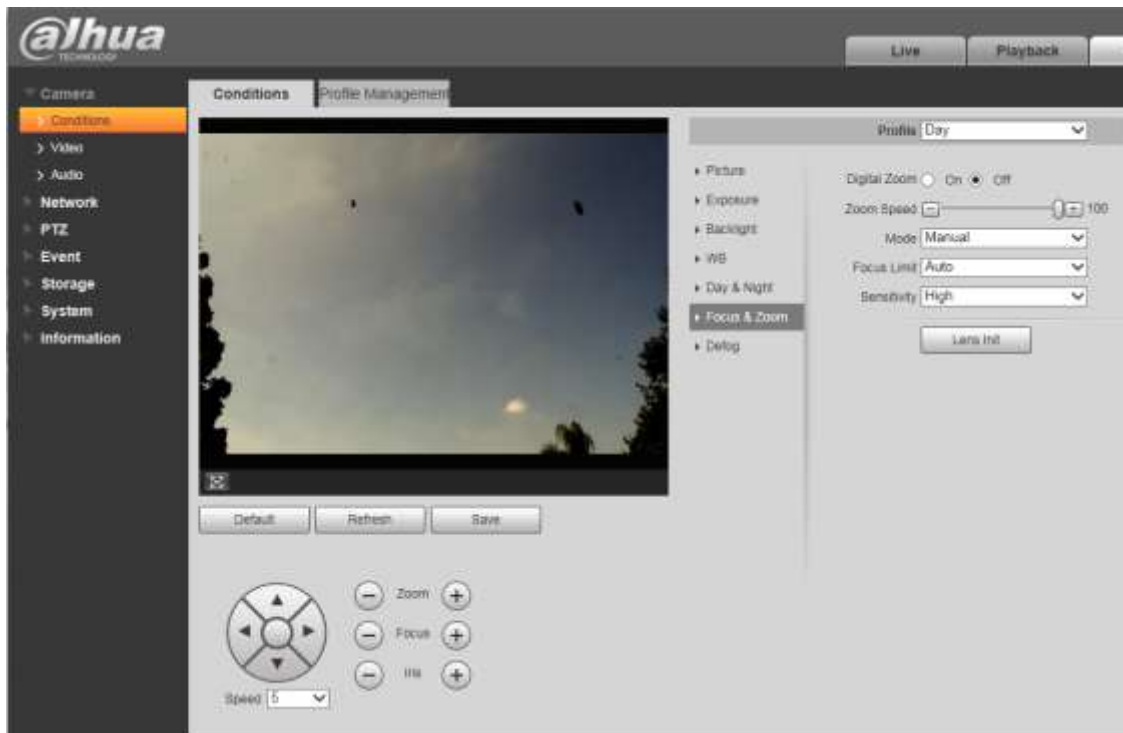
Set Backlight Profile to Normal and Mode Off.



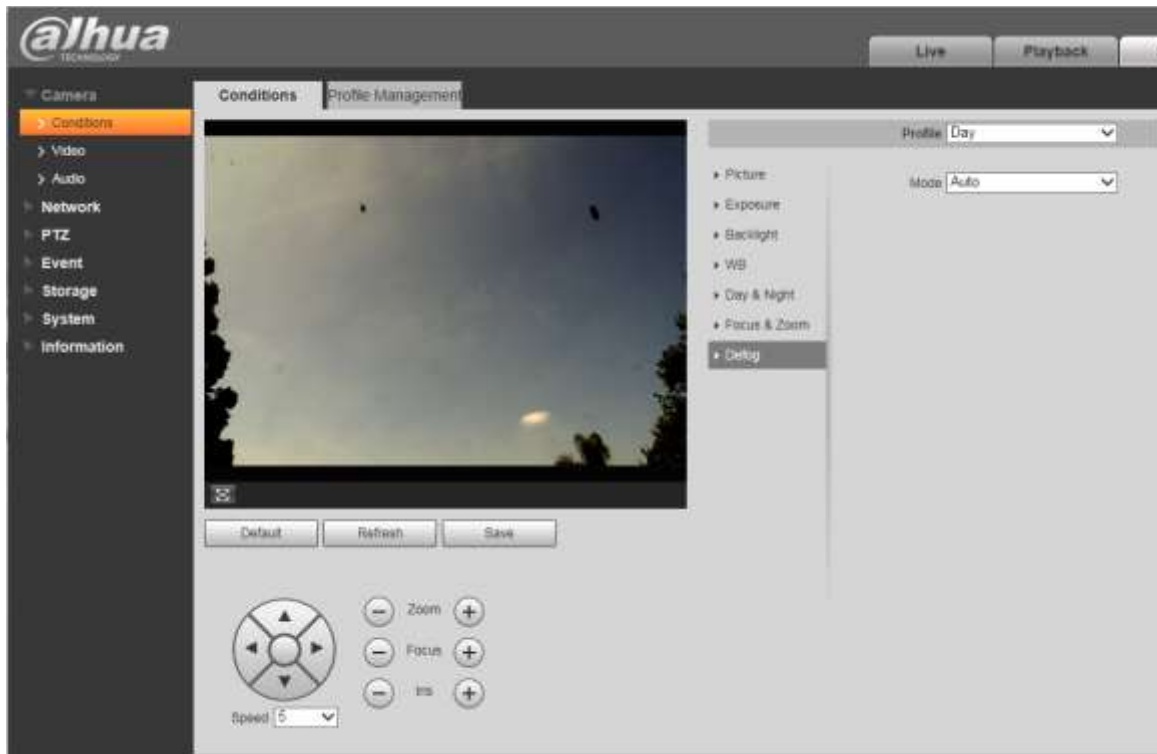
Set WB to Profile Normal and Mode Auto.



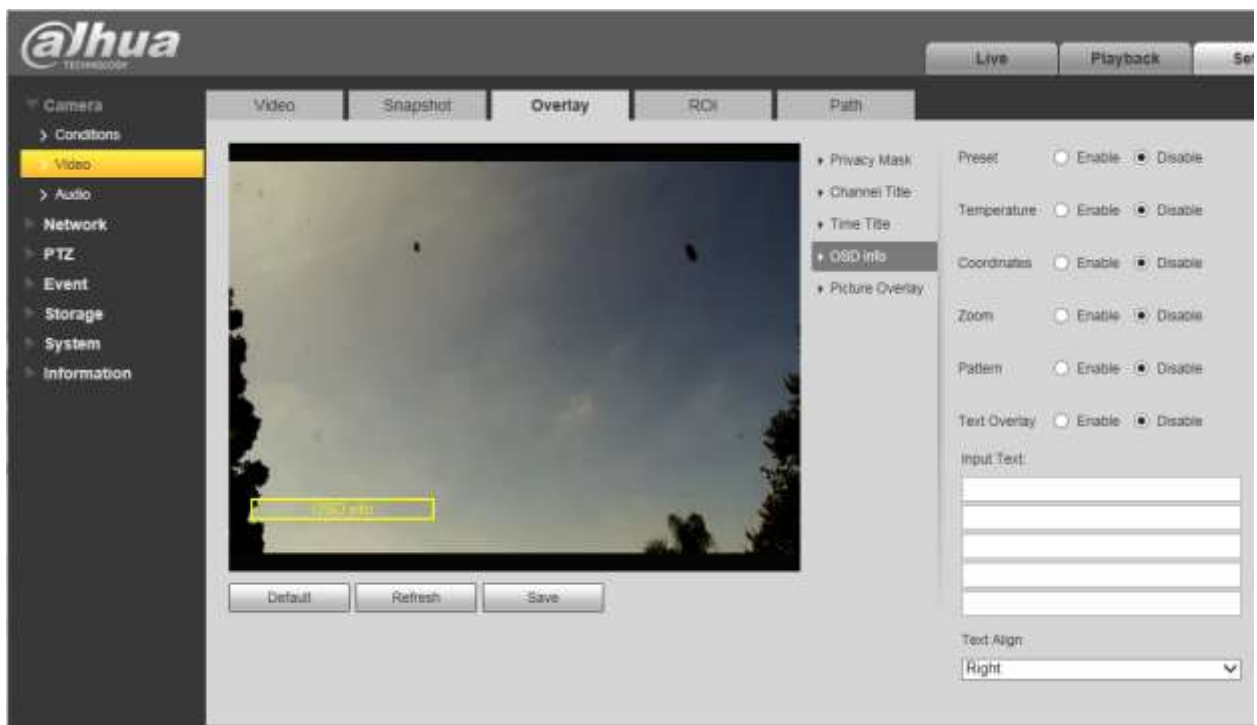
Set Day & Night settings as shown above.



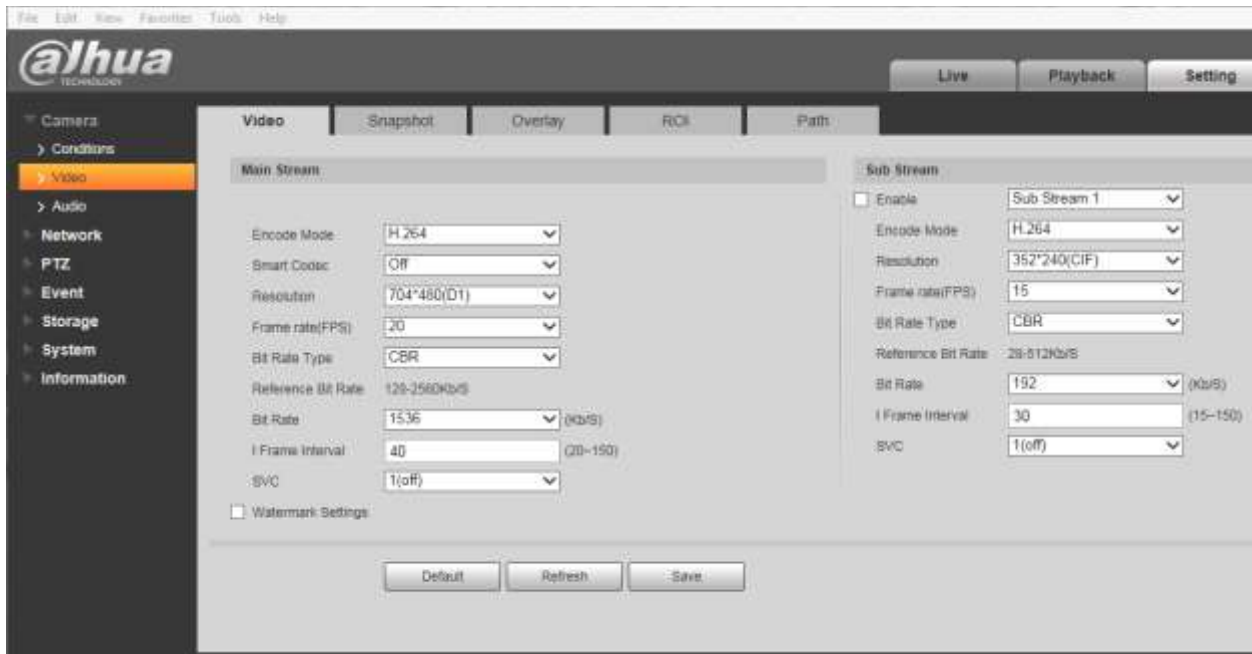
Set Focus & Zoom settings as shown above.



Set Defog Profile to Normal and Mode to Auto.

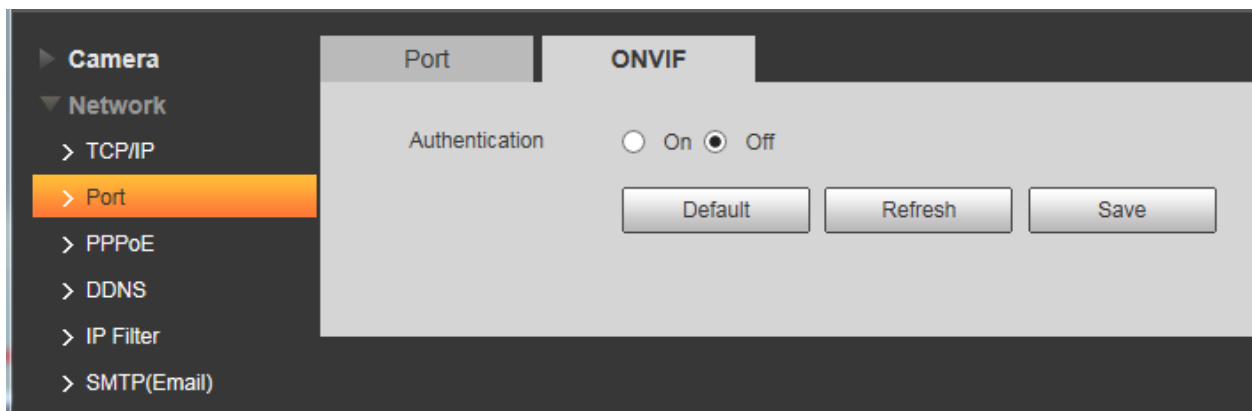


Disable all OSD info options.

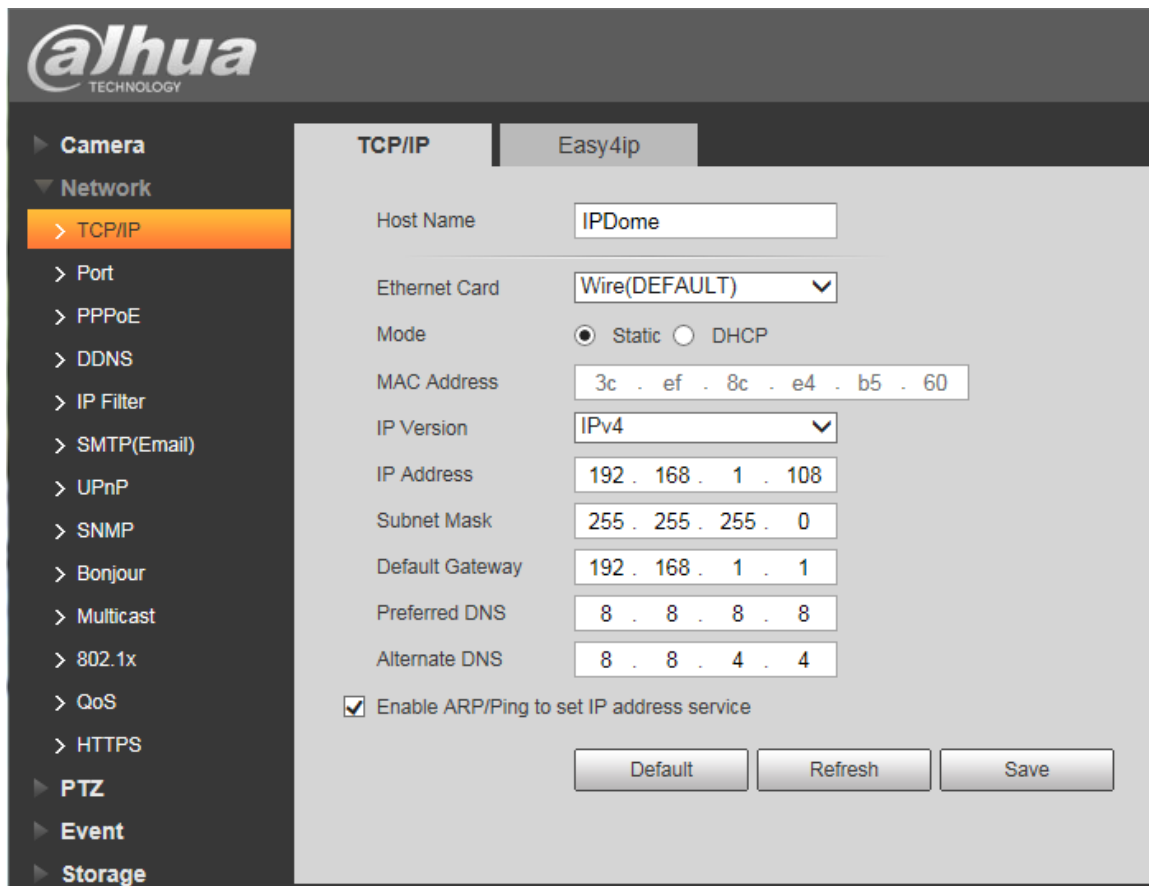


Above shows frame resolution for 704 x 480, 20 frames per second.

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.

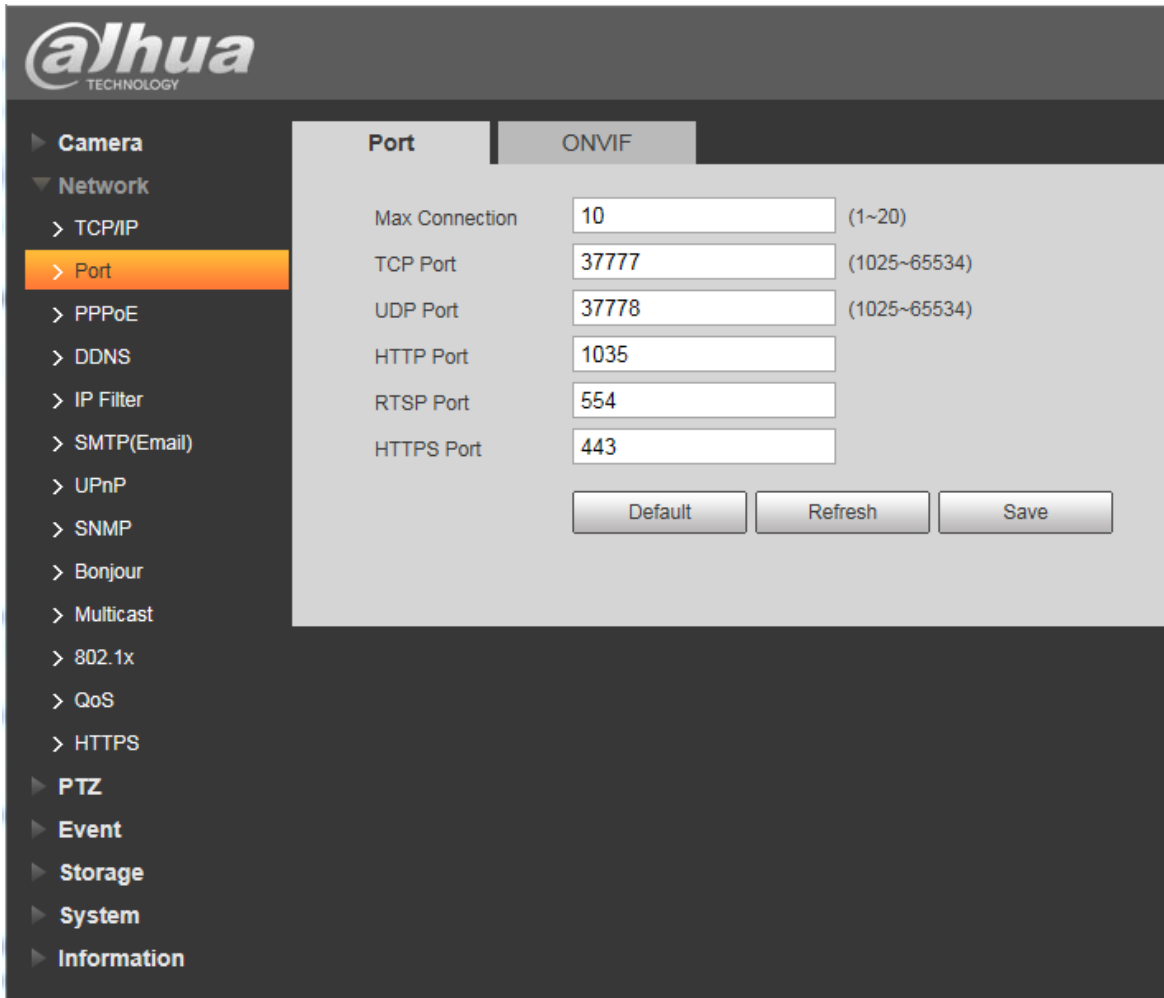


Set a Static IP address as desired. Leave the other setting as is.

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. 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.
4. Click Apply to implement the change.



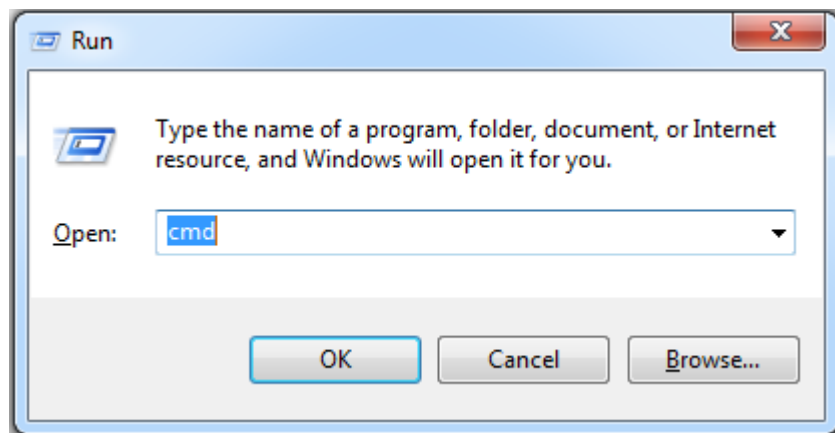
Select a HTTP Port number other than the default of 80 if the camera is needs to be port-forwarded on your router. Leave it as 80 otherwise.

SETUP FOR OPERATION WITHOUT A ROUTER

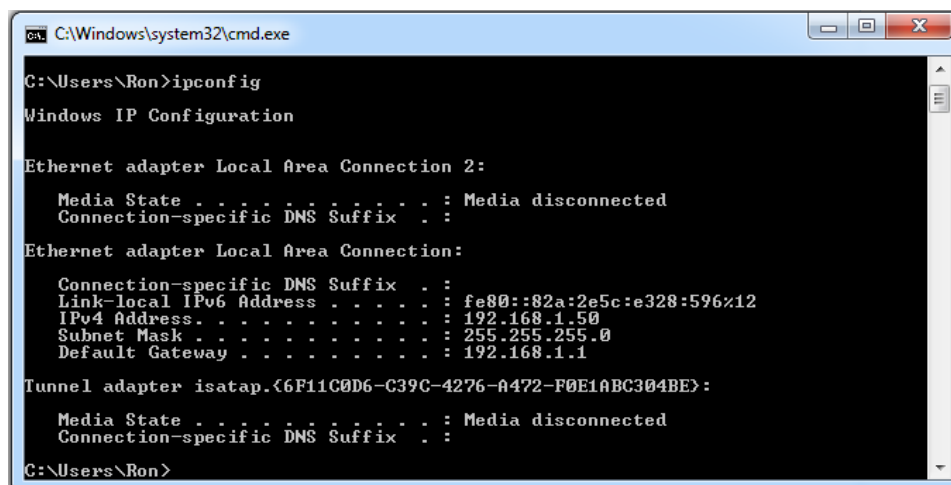
You can setup an OTDAU/MC system where the camera(s) connect directly to a computer, without going through a router. This configuration may be required, for instance, when setting up a system that has to operate stand-alone, independent of any direct internet connection.

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.

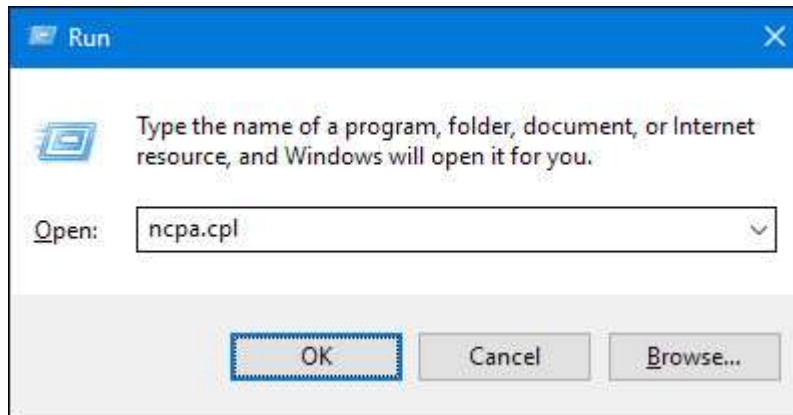
- 1) Press the Windows + R keyboard shortcut to bring out the Run box.
- 2) Enter "cmd" and press Enter to open a system command window.



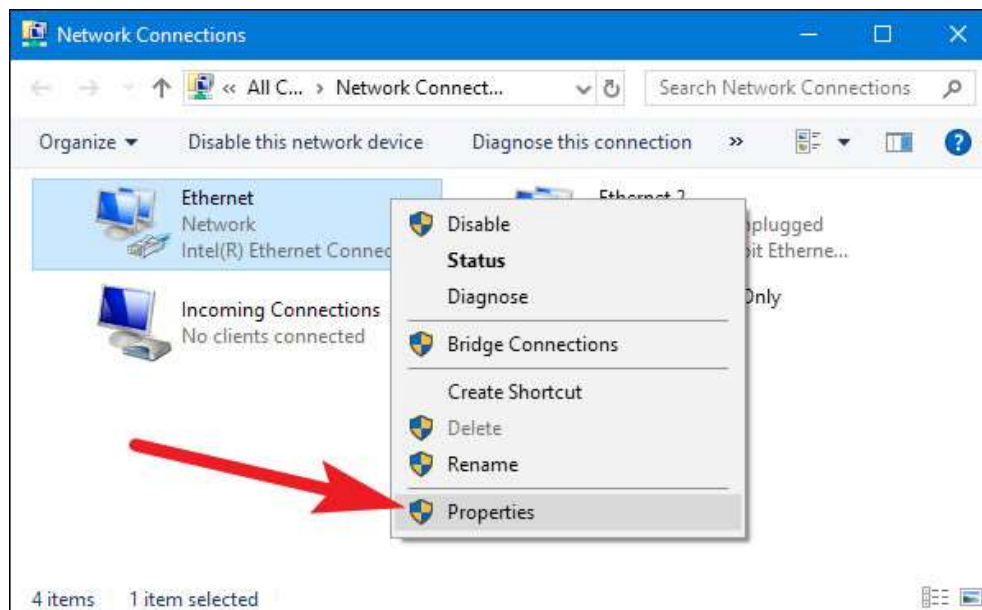
- 3) Type "ipconfig" and Enter to find your computer's IPv4 address.



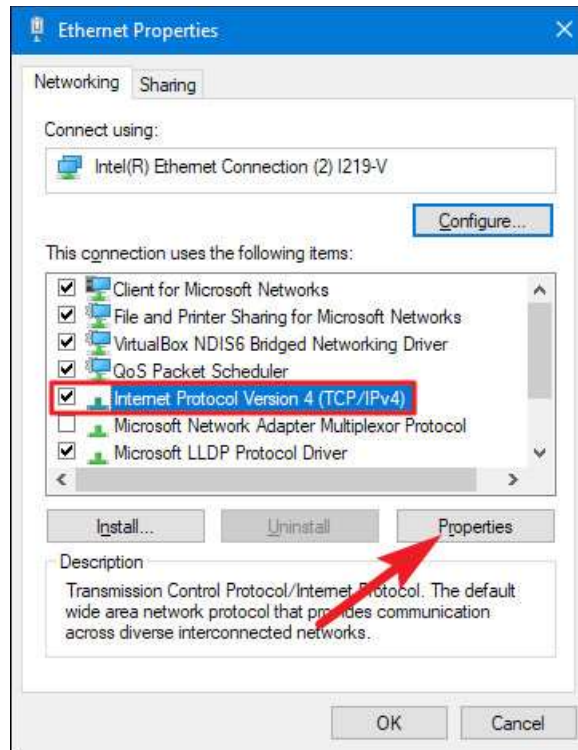
- 4) Press the Windows + R keyboard shortcut to bring out the Run box.
- 5) Enter “ncpa.cpl” and open the “Network Connections” window.



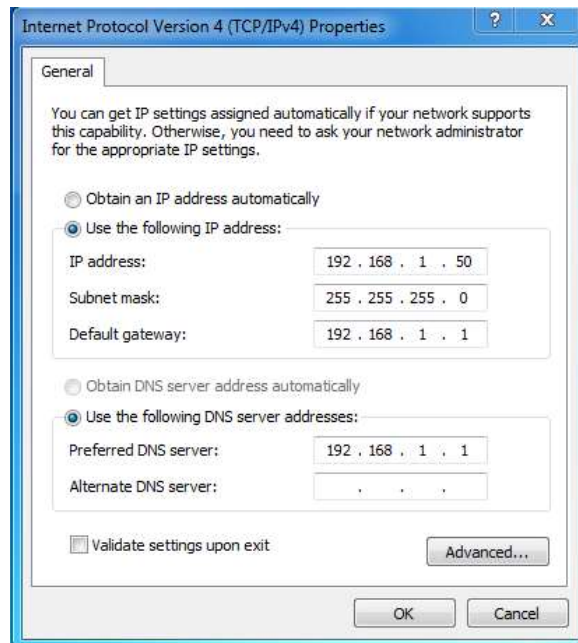
- 6) Right-click your computer' network adapter and select “Properties”.



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 your IPv4 address such as 192.168.1.50 as shown in this example.



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.

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.

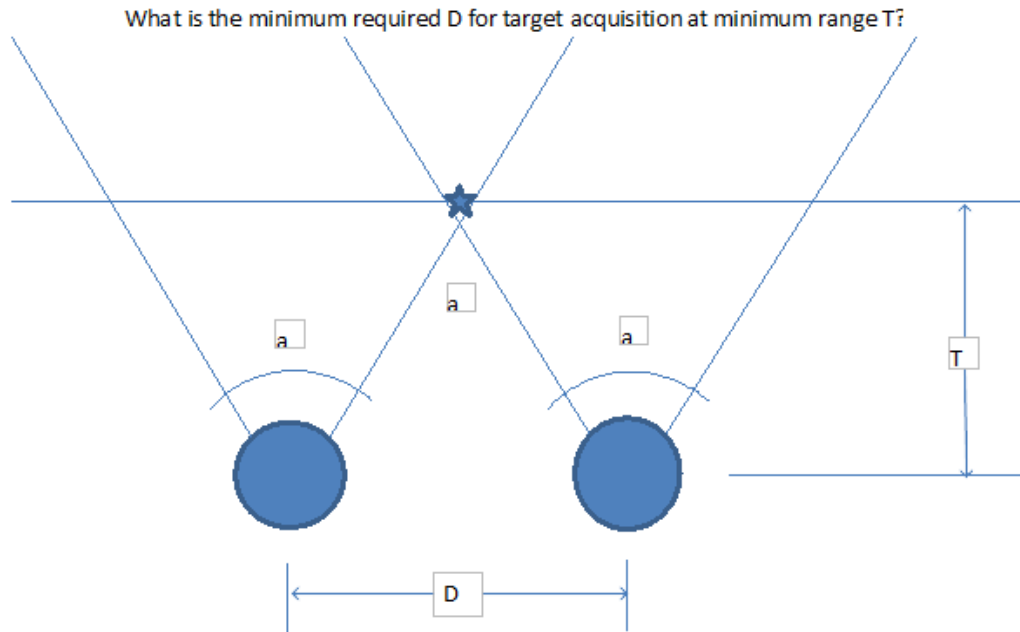
The answer to the question "what is the farthest object that can be seen?" is a complex function of a number of factors such as:

- 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 actually 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 farther
 $\cos(a/2) = T / (D/2) \rightarrow D = 2 * T / \cos(a/2)$

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>