

## Tower Camera (TWR CAM) Instrument Handbook

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March 2018



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# **Tower Camera (TWR CAM) Instrument Handbook**

Revision 1

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March 2018

Work supported by the U.S. Department of Energy,  
Office of Science, Office of Biological and Environmental Research

## **Acronyms and Abbreviations**

ARM	Atmospheric Radiation Measurement
CCD	charge-coupled device
CMOS	complementary metal oxide semiconductor
DHCP	Dynamic Host Configuration Protocol
DOE	U.S. Department of Energy
DQR	Data Quality Report
FTP	File Transfer Protocol
GMT	Greenwich Mean Time
GNDRAD	ground radiometer
GUI	graphical user interface
HDTV	high-definition television
IP	Internet Protocol
LED	light-emitting diode
NSA	North Slope of Alaska
PHP	PHP: Hypertext Preprocessor
POE	Power over Ethernet
PTZ	pan-tilt-zoom
SMTP	Simple Mail Transfer Protocol
THREDDS	Thematic Real-Time Environmental Distributed Data Services
TWR CAM	tower camera
UTC	Coordinated Universal Time

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## 1.0 Instrument Title

U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) Climate Research Facility tower camera at the 40m tower at the Barrow (known officially as Utqiāġvik) ARM North Slope of Alaska (NSA)-C1 observatory.



**Figure 1.** Tower camera at the ARM Barrow site, close-up and atop the tower.

## 2.0 Mentor Contact Information

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## 3.0 Vendor/Developer Contact Information

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Please refer to the [AXIS website](#) for a listing of more sales offices around the world.

## 4.0 Instrument Description

The NSA-C1 Utqiāġvik tower camera is installed at a height of 40 meters above the ground at the topmost boom of the meteorological tower. The camera's main field of view is directed at the tundra south of the tower, where the 10m Tip Tower is located. The camera captures images of the Tip Tower and the surrounding ground every 30 minutes. Since September 2017, the camera model is the AXIS Q6045-E Mk II PTZ Dome Network Camera.



**Figure 2.** The AXIS Q6045-E Mk II PTZ Dome Network Camera currently installed on the topmost boom of the NSA-C1 40m tower.

## 5.0 Measurements Taken

The NSA-C1 40m tower camera images, taken every 30 minutes, provide a qualitative look at the progression of the seasons at Utqiāġvik. The tower camera images are useful for determining the fractional snow or vegetation cover. Additionally, the camera provides a glimpse of on-site weather conditions, showing the changing weather and/or ground conditions.

The camera is primarily focused on the NSA-C1 10m Tip Tower, where a collection of radiometers measuring broadband reflected shortwave energy and longwave irradiances (GNDRAD) are installed. The 40m tower photos of this area offer insight into the factors affecting radiative energy exchange at the NSA-C1 site.



**Figure 3.** A sample JPG image from the 40m tower camera at NSA C-1 in Barrow.

## 6.0 Links to Definitions and Relevant Information

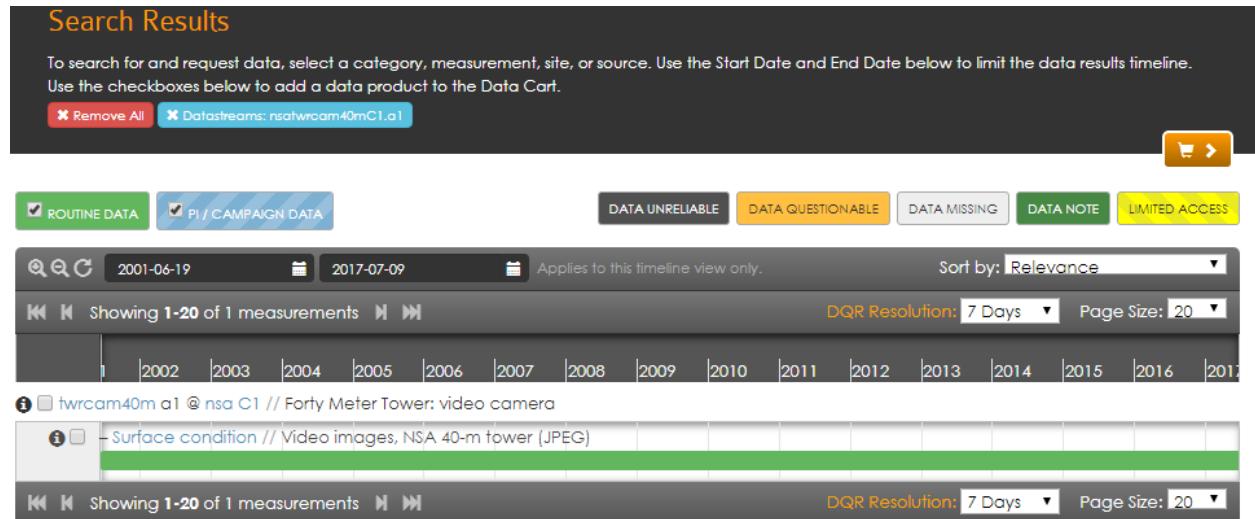
### 6.1 Data Object Description

JPG images taken every 30 minutes from the tower camera are available for download on the ARM Data Discovery website under the datastream name ‘nsatwrcam40mC1.’ This datastream has camera footage with time stamps in UTC/GMT that appear on the upper-left corner of the images.

## 6.2 Data Ordering

The tower camera snapshots can be downloaded by making a request through the ARM Data Discovery browser; the images are identified as ‘surface condition’ measurements, and are stored under the ‘surface properties’ category with the datastream name ‘twrcam40m.’

All the images from one day are zipped into a tar file with the following naming scheme:  
nsatwrcam40mC1.a1.YYYYMMDD.002701.jpg.tar. Tower camera images are available from 06/19/2001 to the present.



**Figure 4.** A search for 40m tower camera imagery on the ARM Data Discovery website shows users the date range available for download.

The user selects the dates of interest using the two black drop-down calendar buttons (see Figure 3), adds the data to the data cart with the checkbox next to the ‘twrcam40m’ datastream name, and clicks the orange button with the shopping cart image on the right side of the page. Users must log in with an ARM user account to submit the order for data. An ARM user account [must be created](#) if the user does not already have one.

After submitting the data request, the user receives an email from the ARM Data Center listing various ways to download the data (FTP, THREDDS, GLOBUS, Dropbox).

## 6.3 Data Plots

Daily NSA-C1 tower camera videos are included within the [ARM Plot Browser tool](#) for quick checks of camera operations and images.

Users can also check on 40m tower camera availability using the [ARM Data Quality Explorer](#) by selecting ‘NSA’ for the site, and ‘towercam40m’ as the datastream.

## 6.4 Data Quality

The ARM Climate Research Facility maintains a database of Data Quality Reports, or DQRs, that are used to document outages or bad image data. The [ARM Problem and Data Quality Report Search Tool](#) enables users to look for reports from a certain time range, by the facility of deployment, or by instrument.

DQRs [Select All DQRs](#) [De-Select All DQRs](#)

DQR Subm. Date Range: 07/01/1993 - 07/14/2017		Quality: All			Submitter: All	
DQR ID	Submitter	Submit Date	Subject	DQ Problem Date	Quality	
<input type="checkbox"/> D050112.1	Scott Richardson	04/24/2017	NSA/C1 - Site-wide power failure	20041213 10:00 - 20041213 23:30	Missing	
<input type="checkbox"/> D160718.4	Adam Theisen	07/25/2016	NSA/TWRCCAM/C1 - Data Missing	20160712 15:00 - 20160714 06:27	Missing	
<input type="checkbox"/> D150515.8	Martin Stuefer	05/21/2015	NSA/TWRCCAM/C1 - Processing	20150503 02:27 - 20150504 17:57	Note	
<input type="checkbox"/> D141205.2	Martin Stuefer	01/21/2015	NSA/TWRCCAM/C1 - Instrument problem	20140930 18:00 - 20141029 14:50	Missing	
<input type="checkbox"/> D081208.3	Martin Stuefer	03/09/2010	NSA/TWRCCAM/C1 - Field of view change	20081028 00:00 - 20090609 00:30	Note	
<input type="checkbox"/> D081204.1	Martin Stuefer	12/04/2008	NSA/TWRCCAM/C1 - Missing data	20081015 03:30 - 20081024 21:00 20081024 21:30 - 20081027 23:30	Missing	
<input type="checkbox"/> D040209.2	Kevin Widener	02/09/2004	NSA/TWRCCAM/C2 - Reflection on image during darkness	20020402 00:00 - 20040630 23:59	Note	

7 DQR(s) returned

**Figure 5.** Data Quality Reports filed for the 40m tower camera.

For a quick look at data quality and coverage, end users can check the [ARM Plot Browser tool](#) for the datastream ‘nsawrcam40m’ located under the NSA list.

## 6.5 Calibration Database

There is no calibration database for the tower camera.

## 7.0 Technical Specification

AXIS Q6045-E Mk II PTZ Dome Network Camera

## 7.1 Units

- Frame rate: fps
  - Horizontal angle of view: deg

- Lens measurement: mm
- Power: watts (DC), VA (AC)
- Shutter time: s
- Weight: lb/kg

## **7.2 Range**

- 32x optical zoom, 12x digital zoom, total 384x zoom
- 360° pan
- F1.6 – 4.41
- Horizontal angle of view from 62.8° to 2.23°
- Vertical angle of view from 36.8° to 1.3°
- Shutter time range from 1/33,000 s to 1/3 s with 50 Hz, and 1/33,000 s to 1/4 s with 60 Hz
- Up to 60/50 fps (60/50 Hz) in HDTV 720p and up to 30/25 fps (60/50 Hz) in HDTV 1080p
- Operational in - 58°F to 122°F

## **7.3 Accuracy**

N/A

## **7.4 Repeatability**

N/A

## **7.5 Sensitivity**

The AXIS Q6045-E Mk II, equipped with a 1/2.8" Progressive Scan CMOS sensor, can capture color video day/night in light conditions down to 0.3 lux, and black/white video in conditions down to 0.004 lux.

## **7.6 Uncertainty**

N/A

## **7.7 Input Voltage**

The AXIS Q6045-E Mk II comes with a 1-port, high PoE midspan that operates between 100-240 V AC. AXIS recommends using the supplied midspan to power the camera.

## 7.8 Input Values

N/A

## 7.9 Output Values

See section 5.0, Measurements Taken.

## 8.0 Instrument System Functional Diagram

N/A

## 9.0 Instrument/Measurement Theory

The AXIS Q6045-E Mk II PTZ Dome Network Camera, an outdoor, HDTV 1080p camera with 32x optical zoom, provides a vast improvement in resolution and zoom capabilities from the former 40m tower camera model, the AXIS 232D+. The PTZ function allows operators to make preset positions that view various site locations.

The camera contains a built-in heater that is turned on or off automatically, as it is controlled by the ambient temperature. This feature ensures that detailed site monitoring is possible even during the harshest winter conditions of the polar night.

In order to more effectively see physical changes over time, the camera is typically stationary at a view of the Tip Tower. However, operators use the 40m-tower camera for a variety of monitoring tasks.

## 10.0 Setup and Operation of Instrument

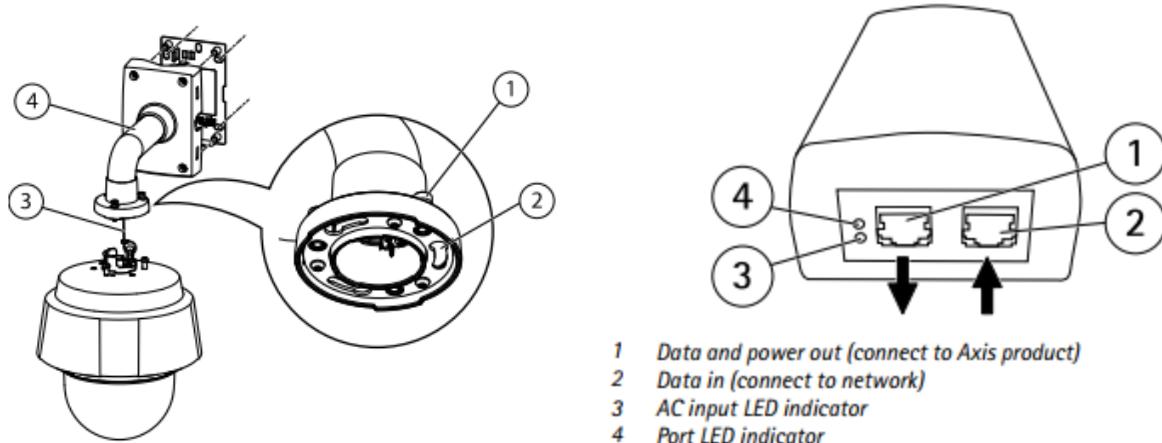
There are two major components to the installation and setup of AXIS network cameras: the physical install, and connecting the camera to the network.

### 10.1 Hardware Requirements and Installation Instructions

If mounting the camera in a position or area difficult to access (like the 40m tower), ensure that the camera is running properly and has an assigned, working IP address that you can access via a web browser *before* completing the hardware installation.

The accessories for installation of the AXIS Q6045-E camera include the [installation manual](#), the power supply (AXIS T8124 High PoE Midspan 1-port), and a RJ45, IP66-rated push-pull connector.

From the [AXIS Q60 Series installation manual](#):



**Figure 6.** Camera and midspan installation diagrams from AXIS Q6045-E Mk II Installation Guide.

The installation sequence is as follows:

1. Connect the camera.
2. Set an IP address.
3. Set a password.

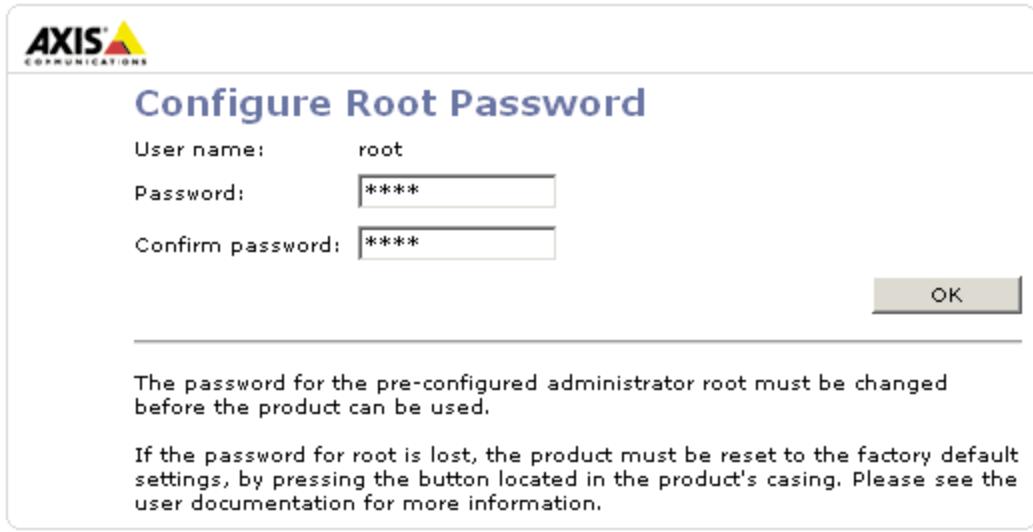
The exact series of installation steps vary depending upon the way the camera will be mounted, but the series of connections and powering process remains the same:

1. Secure the camera using the supplied safety wire.
2. Connect the RJ45 cable to the port on the back of the camera.
3. Secure the camera to the mounting bracket.
4. Connect the camera to the supplied midspan in the ‘data and power out’ port, and the midspan to the network switch (‘data in’ port). Check that the midspan LED indicators remain green, indicating that the camera is connected and operating normally.

The hardware installation is complete at this point (except for mounting). For instructions on connecting AXIS cameras to the network, see Section 11.0 on the AXIS IP Utility.

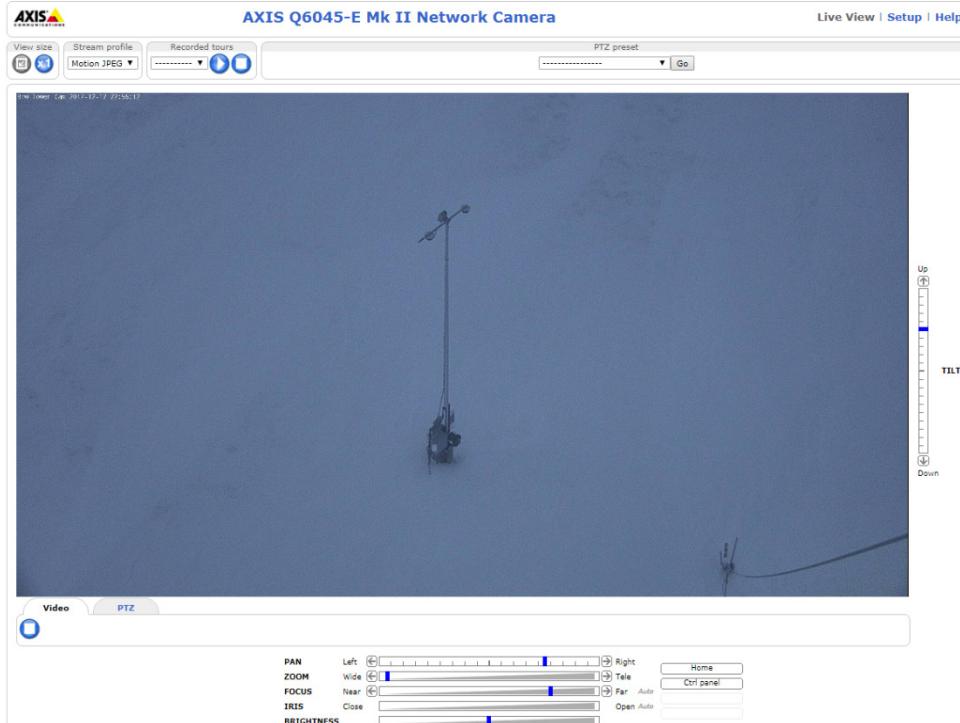
## 10.2 Operating an AXIS Dome Camera

The AXIS camera feed can be monitored and managed in real time by navigating to the camera IP or domain name (set up instructions in Section 11.0) via an internet browser. When accessing the AXIS camera for the first time, the ‘Configure Root Password’ query will display. Choose and confirm a password, then login in as the ‘root’ user. This login is important to remember for later fine-tuning of the camera display and operations within the Setup menu of the webpage.



**Figure 7.** The window that a user sees upon accessing an AXIS camera for the first time.

There are several important features to the AXIS GUI pictured below in Figure 8: the ‘Live View’ mode (the displayed page), the ‘Setup’ button (top right button beside ‘live view’), and the ‘PTZ preset’ drop-down menu (top, middle).



**Figure 8.** A screenshot of the live camera feed from the AXIS Q6045-E Mk II 40-meter tower camera at Barrow; the field of view normally stays on the 10m Tip Tower pictured here.

The live view allows for real-time monitoring and view modification using the pan, zoom, focus, tilt, iris, and brightness options. The ‘PTZ preset’ drop-down menu at the top-middle of the live view page in

Figure 8 allows viewers to navigate between preset options that force the camera to swivel to a certain focal point.

If presets are used to navigate away from the live feed of the Tip Tower, users must remember to navigate back to the view of the tower as to not interrupt the scheduled image grabbing that populates the 40m tower datastream. Additionally, to keep the cameras usable by site operations, it is important that visitors to the camera be considerate of their time spent on the web page, and do not leave their connection to the camera continuously running within their browser.

The ‘Setup’ menu (Figure 9) offers the following options: image and video settings, settings for the layout of the ‘Live View’ page, network settings, setting and managing camera presets, security options, and more. Only mentors/authorized users apply changes to this setup area.

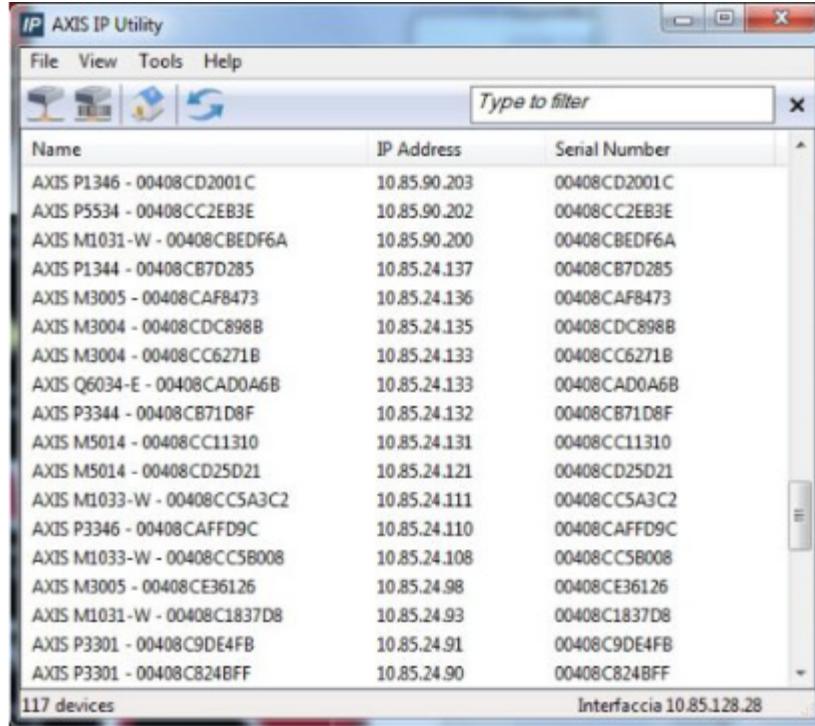


**Figure 9.** AXIS camera can be configured underneath the ‘Setup’ menu on the AXIS GUI. The toolbar on the left side of the page shows the variety of features that can be configured.

## 11.0 Software

After powering on the camera, it is recommended to install and open the AXIS IP Utility tool to connect the camera to the network.

The AXIS IP Utility tool is used to set a fixed, or static, IP address for an AXIS network camera. The software automatically discovers AXIS devices on the network, allowing users to either manually assign network parameters such as the IP address, subnet mask, and default router, or to configure the device to obtain an IP address from the DHCP server. For the software to work properly, the AXIS device and client computer must be on the same subnet/network segment.



**Figure 10.** The main window of the AXIS IP Utility software. Any devices discovered on the network will be listed here with the camera model name, IP addresses, and serial numbers.

AXIS Network Cameras use a modified Linux operating system that allows for the embedding of shell or PHP scripts that can accomplish several functions, such as triggering the buffering of images, scheduling visits on various preset positions, and automating the upload of files via FTP or SMTP.

Figure 11 is a Python script developed by the University of Alaska, Fairbanks ARM Rapid Response team. This template script enables users to capture images using presets. The images are then stored in a defined output directory path. This script can be scheduled using a crontab file to consistently take images at a particular time.

```

# Define URL for the camera preset of interest
URLPRE = 'http://192.148.94.48/axis-cgi/com/ptz.cgi?gotoserverpresetname=<preset>'

# Define, or uncomment the preferred URL for the command to capture an image
#URLCAP = 'http://192.148.94.48/axis-cgi/jpg/image.cgi?resolution=704x480' # AXIS 232D+
#URLCAP = 'http://192.148.94.221/axis-cgi/jpg/image.cgi?resolution=800x450' # AXIS Q6035-E

# Define the URL for moving the camera back to the home position (unlikely to change)
URLHOME = 'http://192.148.94.48/axis-cgi/com/ptz.cgi?move=home'

# Define the output directory for the image. Be sure to create that directory on
# nanuna and check the permissions will allow reading and writing by those who
# need to.
ARCHIVEDIR = '/products/nsadb/htdocs/data/twrcam/beo'

# Define the form of the image output file name
FILEPATTERN = 'BEO_%Y_%m_%d_%H%M.jpg'

import os.path
import urllib
from datetime import datetime
import logging
import time
logging.basicConfig(
    format='%(asctime)s - %(name)s - %(levelname)s - %(message)s',
    level=logging.DEBUG
)

def main():
    timestamp = datetime.utcnow()
    filename = os.path.join(ARCHIVEDIR, timestamp.strftime(FILEPATTERN))
    try:
        urllib.urlretrieve(URLPRE)
        time.sleep( 25 )          # Give the cam ample time to position
    except IOError as detail:
        logging.error("Could not open URL %s: %s" % (URLPRE, detail))
    try:
        fullpath, message = urllib.urlretrieve(URLCAP, filename)
        time.sleep( 15 )          # Give the cam ample time to capture
    except IOError as detail:
        logging.error("Could not open URL %s: %s" % (URLCAP, detail))
    try:
        urllib.urlretrieve(URLHOME)
    except IOError as detail:
        logging.error("Could not open URL %s: %s" % (URLHOME, detail))

if __name__ == '__main__':
    main()

```

**Figure 11.** A sample Python script for automating image capture using presets. Further documentation on this particular code can be found on the [Nanuna wiki](#) maintained by the ARM Rapid Response team at the University of Alaska, Fairbanks.

For more information on scripting capabilities with AXIS Network Cameras, consult the AXIS Scripting Guide.

## 12.0 Calibration

There are no calibration procedures for the AXIS camera.

## 13.0 Maintenance

AXIS cameras contain several maintenance functions that are available under ‘Setup’ → ‘System Options’ → ‘Maintenance.’ For example, the camera’s firmware may need to be upgraded by downloading the new files from the AXIS website, and then browsing for and running the download under ‘Setup’ → ‘System Options’ → ‘Maintenance’ → ‘Upgrade server.’

If the AXIS camera is not behaving as expected, the camera can be restarted under ‘Setup’ → ‘System Options’ → ‘Maintenance.’ A restart will not affect the camera’s current settings.

The dome case on the AXIS camera is made of transparent Plexiglass. To prevent scratching the dome cover, the dome should only be cleaned when dirty (and never polished) with a soft cloth, lukewarm water, and non-abrasive, solvent-free soap. Cleaning should not be done in direct sunlight, or at elevated temperatures. To prevent water spots, dry the dome with a soft cloth.

## **14.0 Safety**

The AXIS camera should be grounded either through a shielded network cable or another appropriate method.

Always ensure that the power is disconnected before starting any work or opening the housing.

## **15.0 Citable References**

[1] AXIS Communications AB. 2017. AXIS Q6045-E Mk II PTZ Dome Network Camera,  
<https://www.axis.com/ca/en/products/axis-q6045-e>, accessed on December 12, 2017.

[2] AXIS Communications AB. 2015. “AXIS Q6045-E Mk II PTZ Dome Network Camera.”  
[https://www.AXIS.com/files/manuals/um\\_q6045e\\_mk\\_ii\\_en\\_1463329\\_1505.pdf](https://www.AXIS.com/files/manuals/um_q6045e_mk_ii_en_1463329_1505.pdf), accessed on July 14, 2017.

[3] AXIS Communications AB. 2015. “AXIS Q6045-E Mk II PTZ Dome Network Camera.”  
<https://www.surveillance-video.com/media/lanot/attachments/customimport/0694-004.pdf> accessed on July 14, 2017.

[4] AXIS Communications AB. 2007. “Scripting Guide.” [http://www.plevenon-meteo.info/AXIS\\_scripting\\_guide\\_2\\_1\\_8.pdf](http://www.plevenon-meteo.info/AXIS_scripting_guide_2_1_8.pdf), accessed on July 14, 2017.

[5] AXIS Communications AB. 2017. “FAQ.” <https://www.axis.com/no/en/support/faq/FAQ115623>, accessed on July 14, 2017.

