Network Camera System Lab Guide

This guide will lead the student through the process of configuring the TTC-based network system housed in a movable 19-inch rack. The overall goal is to view video on the monitors and record data to the nREC-4000 recorder.

Network Telemetry Background

Traditional aircraft instrumentation required the installation of a data acquisition system (DAS) with a variety of signal conditioning cards to monitor and record both digital and analog signals. In the case of a Chapter 10 recorder-based system all wiring would connect to the recorder itself. This has its own issues when maximum cable length requirements must be maintained.

Older CAIS (Common Airborne Instrumentation System) systems used a single box containing a variety of interface cards to connect to both analog and digital signals onboard an aircraft. This could also be interfaced to a unit which would format and transmit PCM data over an RF link to the ground.

The primary goal behind the push to move to network-based telemetry systems was to utilize industry-standard protocols for communicating between data acquisition units (DAUs) which would be small and located near the physical system to be instrumented. These would then communicate to other devices via Ethernet.

Goals and Objectives

- Configure all TTC hardware using TTCWare
- Properly calibrate thermocouple inputs
- Record video and camera temperature data to the nREC-4000
- View recorded video and data

Reference Material

TTC Manuals including the following:

- CCP-2000-1_MAN_DR
- nGWY-2000B-1_MAN_E
- nHSC-31-S1(M)-X Manual 946502431-00X_A
- nMGR-2000-1_MAN_K
- nREC-4000S-2_MAN_C
- NSW-8GT-TG-D-1_MAN_940000831-001_E
- PPC-520_MAN_DR

Network Equipment Setup

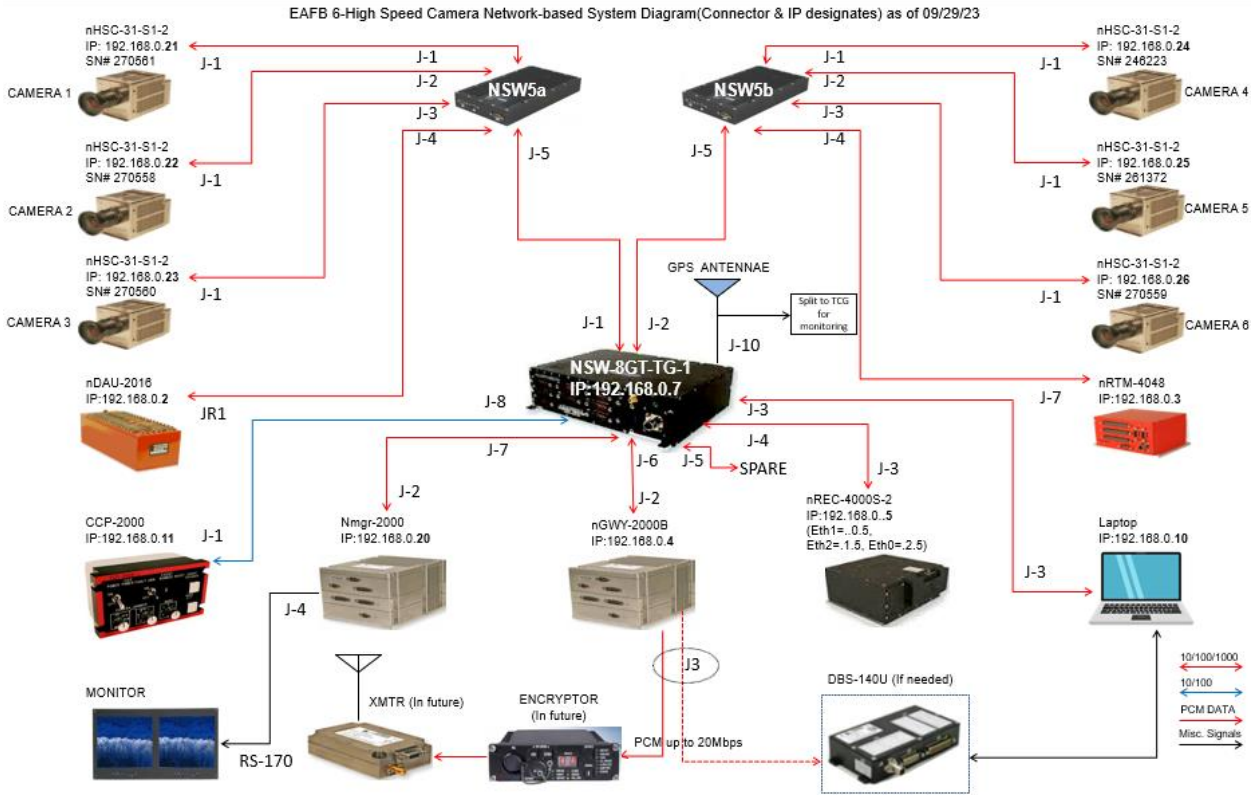


Figure 1 Network Diagram

Initial configuration of the rack consists of creating a new project in TTCWare and adding the equipment show in Figure 1. Table 1 lists the equipment and the IP addresses for each box. Some boxes, such as the nREC-4000, require multiple IP addresses. Steps to set these addresses and for configuring each box are in the TTCWare section below.

Item	Serial Number	IP Address	Firmware Ver
nDAU-2016 (PPC-520E-2)	255559	192.168.0.2	6526
nRTM-4048 (PPC-2048-1)	250679	192.168.0.3	6526
nGWY-2000B	254085	192.168.0.4	6842
nREC-4000S-2 (Eth1)	241652	192.168.0.5	6839
Eth0, Eth2		..2.5, ..1.5	
NSW-8GT-TG-1	255487	192.168.0.7	7021
nMGR-2000	246377	192.168.0.20	6842
nHSC-31-S1-2 Camera 1	270561	192.168.0.21	6839
nHSC-31-S1-2 Camera 2	270558	192.168.0.22	6839
nHSC-31-S1-2 Camera 3	270560	192.168.0.23	6839
nHSC-31-S1-2 Camera 4	246223	192.168.0.24	6839
nHSC-31-S1-2 Camera 5	261372	192.168.0.25	6839
nHSC-31-S1-2 Camera 6	270559	192.168.0.26	6839

Table 1 Equipment IP addresses

TTCWare

The bulk of the work to be performed in the configuration of this system must be accomplished using TTCWare. Screenshots are taken from version 3.64 patch B. Launching TTCWare will present a screen as shown in Figure 2.

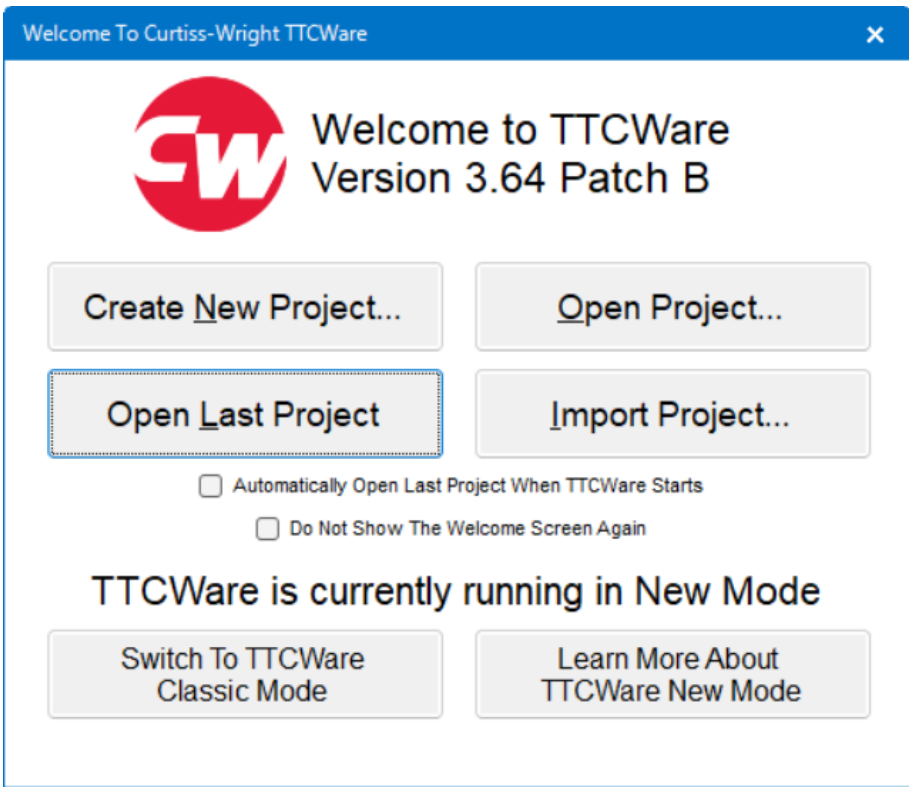


Figure 2. TTCWare opening dialog

Clicking New Project will begin the process of defining our system. The dialog shown in Figure 3 will pop up allowing you to name the project. For this lab guide we will use the name "Camera Network Rack" and a description as shown in Figure 3.

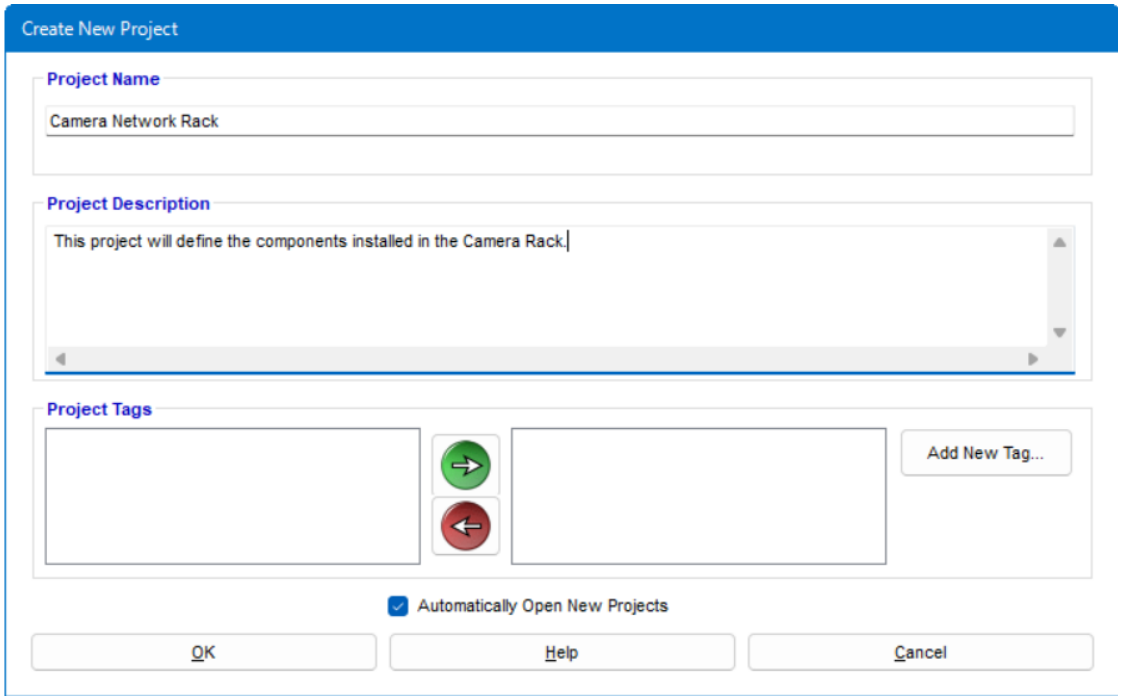


Figure 3 Create New Project dialog

Clicking the OK button will create the project and present the Select New Device dialog shown in Figure 4. Several fields on this dialog page need to be edited for our system including the device name and the IP address of 192.168.0.7.

This guide will not attempt to address subjects such as IEEE-1588 time and the configuration of individual components. For this demonstration it is appropriate to choose all default settings to accomplish our objectives.

When choosing devices from the Select New Device dialog it can be helpful when searching for the appropriate name to enter text in the Device Type Filter box. This will greatly reduce the number of available choices. To search for the 8-port switch we entered 8gt.

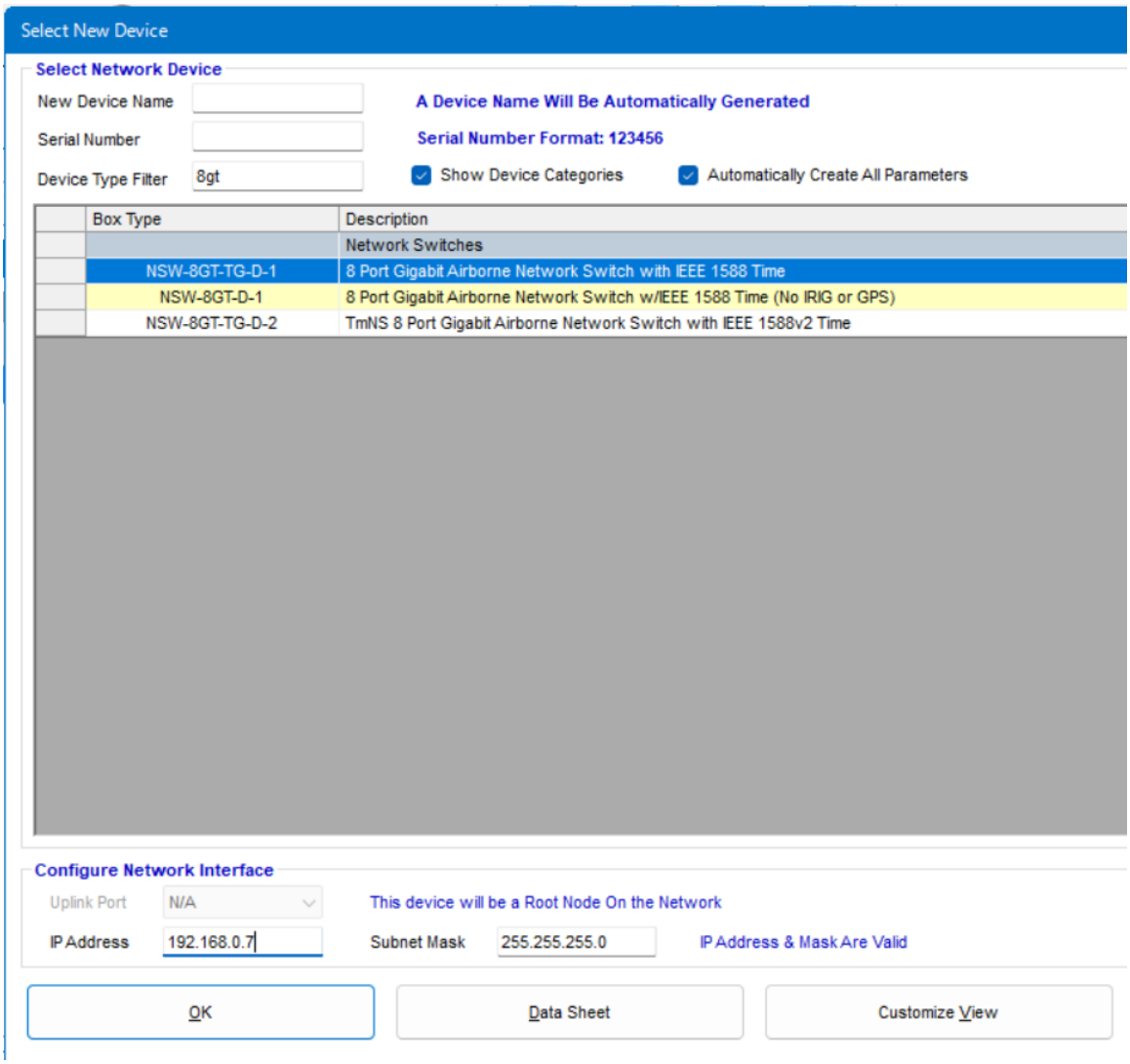


Figure 4 Select New Device dialog

The first device to add will be the 8-Port switch as it sits in the middle of the network diagram shown in Figure 1. IP addresses for each piece of equipment is listed in Table 1 which shows 192.168.0.7 for the NSW-8GT-TG-1.

Once the first switch has been added as a root node we can proceed to add the two 5-port switches which have the cameras attached. To add these devices right-click on the connector listed under the NSW-8GT as show in Figure 5.

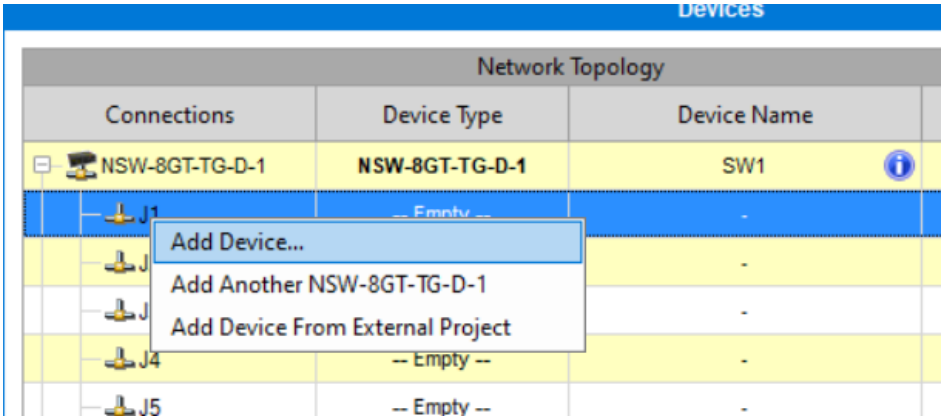


Figure 5 NSW-8GT Switch shown in Network Topology diagram

From the network topology diagram shown in Figure 1 the first 5-port switch is connected to J-1 and the second switch to J-2. The device model number for the 5-port switch is NSW-5GT-1 which is an unmanaged switch with no IP address. With this step complete the dialog should look like the one in Figure 6.

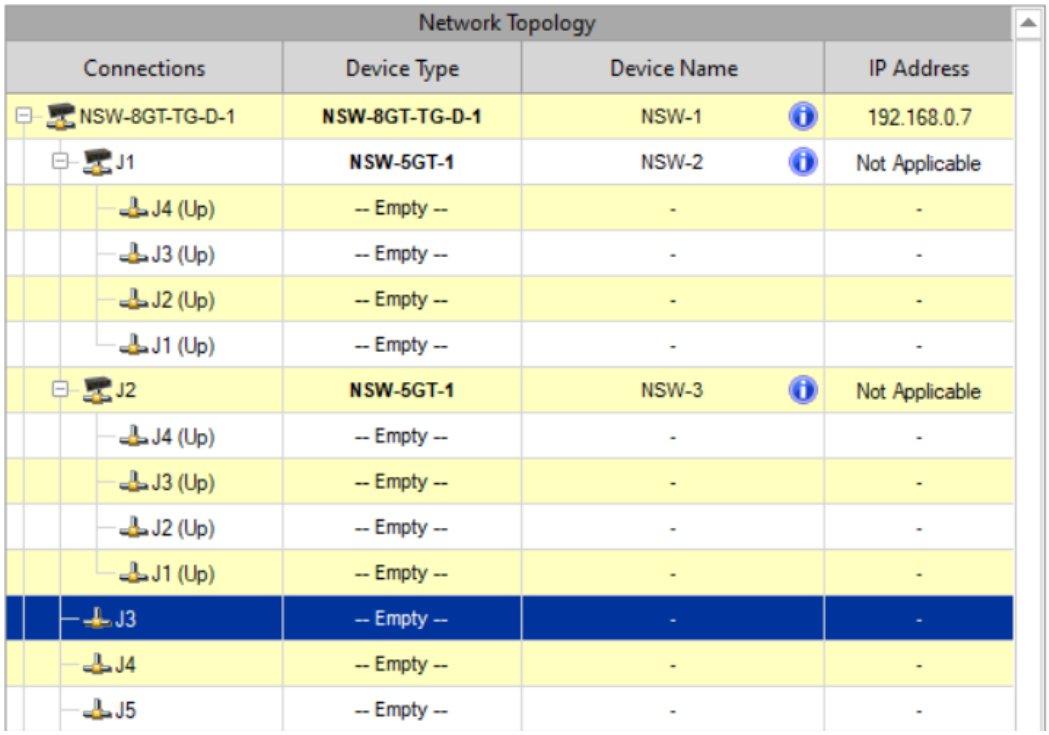


Figure 6 Network Topology with 5-port switches added

The J3 port connects to our management PC on IP address 192.168.1.10. It's important to add the Instrumentation Workstation PC (All Data Will Be Routed To This PC) shown in Figure 7 as this selection affects the multicast rules.

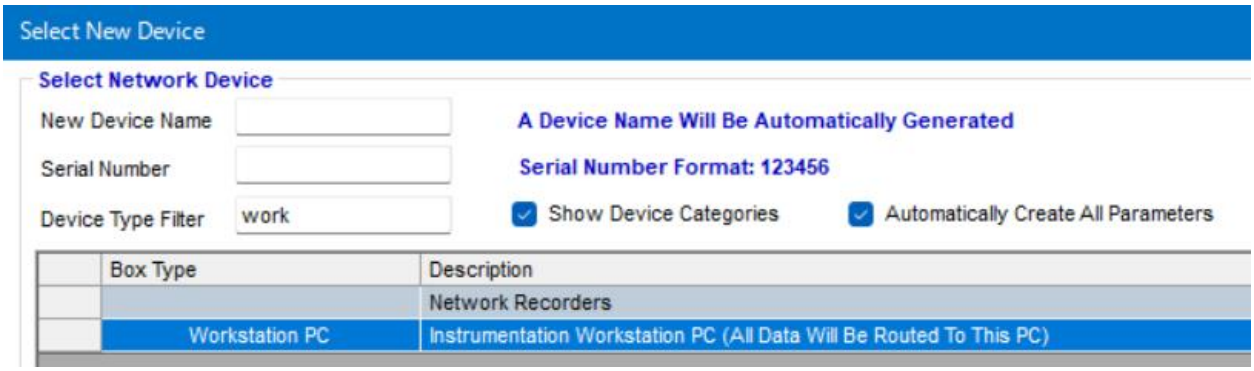


Figure 7 Instrumentation Workstation PC

Port J4 is used to connect to the nREC-4000 recorder and uses three unique IP addresses on different sub-nets. The primary management IP address is 192.168.0.5 and is assigned to Eth1. Eth2 is assigned 192.168.1.5 while Eth0 is assigned 192.168.2.5. Figure 8 shows the New Device dialog with the appropriate fields set.

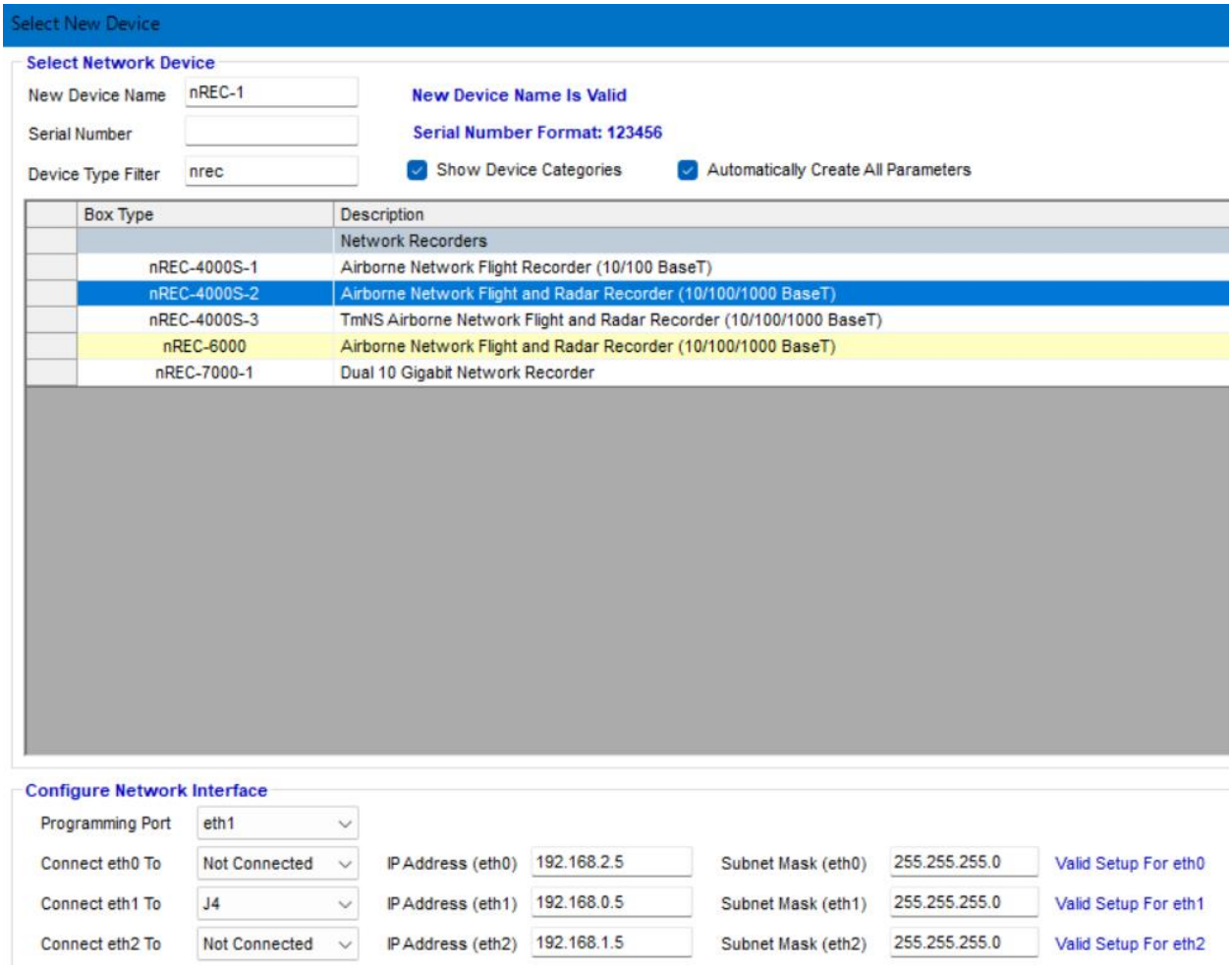


Figure 8 nREC-4000 configuration settings

Port J-5 is a spare. Port J-6 is connected to the nGWY-200B PCM Gateway box. This would allow the rack to transmit PCM should a radio be attached. No further configuration for this device will be needed for this lab.

Port J-7 on our 8-port switch is connected to the nMGR-2000 device as it controls all the cameras. Per Table 1 it is assigned IP address 192.168.0.20. Figure 9 shows our network diagram with all devices added so far.

The final port on our 8-port switch is connected to a CCP-2000 camera control module. It is assigned IP address 192.168.0.11.

Network Topology			
Connections	Device Type	Device Name	IP Address
NSW-8GT-TG-D-1	**NSW-8GT-TG-D-1**	NSW-1	192.168.0.7
J1	**NSW-5GT-1**	NSW-2	Not Applicable
J2	**NSW-5GT-1**	NSW-3	Not Applicable
J3	**Workstation PC**	PC-1	192.168.0.10
J4 to eth1	**nREC-4000S-2**	nREC-1	192.168.0.5 (eth1*)
J5	-- Empty --	-	-
J6	**nGWY-2000**	nGWY-1	192.168.0.4
J7	**nMGR-2000**	nMGR-1	192.168.0.20
J8	**CCP-2000-1**	CCP-1	192.168.0.11

Figure 9 Network Diagram with all devices added so far

The final configuration steps involve adding devices to the two 5-port switches. Each of these have three of the nHSC-31-S1 cameras attached to connectors J-1 through J-3. Connecting the cameras consists of right clicking on J1 thru J3 and selecting nHSC-31-S1. After the first device the software will offer to add another identical device. The only update required is to change the default IP address by clicking in the IP Address field under Device Properties in the middle of the page.

The first switch connects to the nDAU-2016 at IP address 192.168.0.2. To add this device you must right click on the appropriate connector which is J4. Figure 10 shows this card as it appears in the Network Topology page.

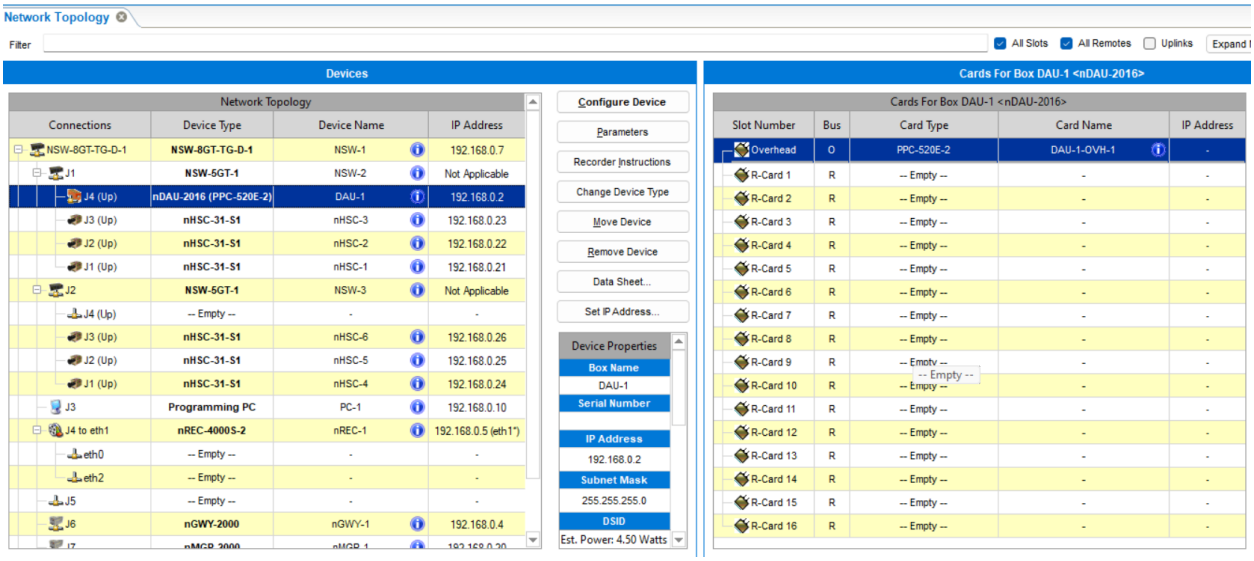


Figure 10 nDAU with associated cards

The final device to add is the nRTM-4048 thermocouple DAU. This device will give us a way to monitor the temperature of the cameras.

Network Topology			
Connections	Device Type	Device Name	IP Address
NSW-8GT-TG-D-1	**NSW-8GT-TG-D-1**	NSW-1	192.168.0.7
J1	**NSW-5GT-1**	NSW-2	Not Applicable
J4 (Up)	**nDAU-2016 (PPC-520-1)**	nDAU-1	192.168.0.2
J3 (Up)	**nHSC-31-S1**	nHSC-3	192.168.0.23
J2 (Up)	**nHSC-31-S1**	nHSC-2	192.168.0.22
J1 (Up)	**nHSC-31-S1**	nHSC-1	192.168.0.21
J2	**NSW-5GT-1**	NSW-3	Not Applicable
J4 (Up)	**nRTM-4048-1**	nRTM-1	192.168.0.3
J3 (Up)	**nHSC-31-S1**	nHSC-6	192.168.0.26
J2 (Up)	**nHSC-31-S1**	nHSC-5	192.168.0.25
J1 (Up)	**nHSC-31-S1**	nHSC-4	192.168.0.24
J3	**Programming PC**	PC-1	192.168.0.10
J4 to eth1	**nREC-4000S-2**	nREC-1	192.168.0.5 (eth1*)
eth0	-- Empty --	-	-
eth2	-- Empty --	-	-
J5	-- Empty --	-	-
J6	**nGWY-2000**	nGWY-1	192.168.0.4
J7	**nMGR-2000**	nMGR-1	192.168.0.20
J8	**CCP-2000-1**	CCP-1	192.168.0.11

Figure 11 Final version with all devices configured

During the process of adding devices the default is to add parameters where appropriate. We can use the Parameter Manager to view the definitions of these parameters. Figure 12 shows a list including parameters for the DAU and the nRTM devices.

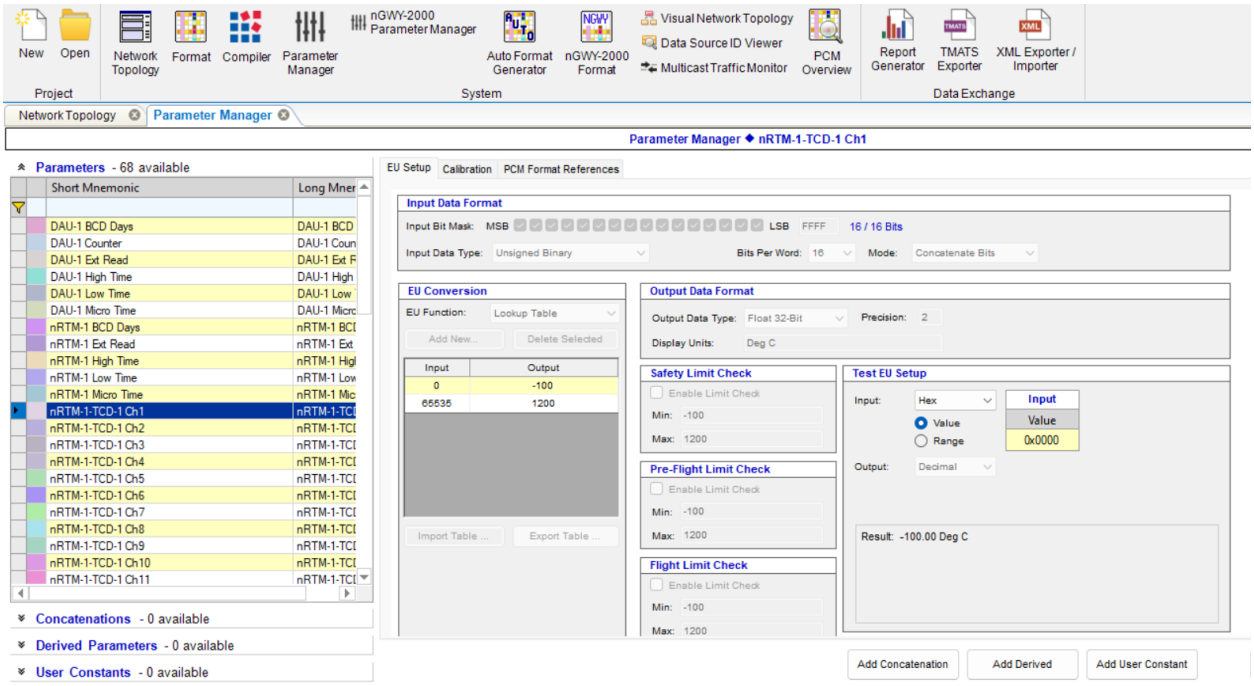
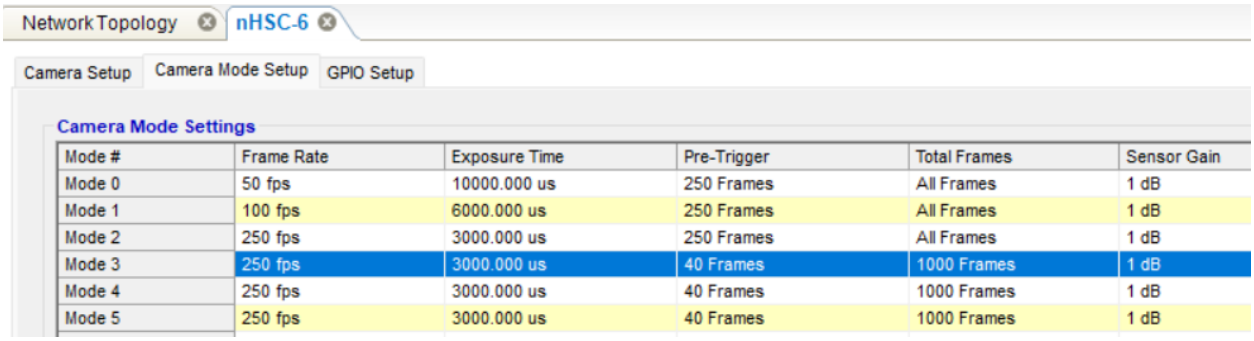


Figure 12 Defined parameters

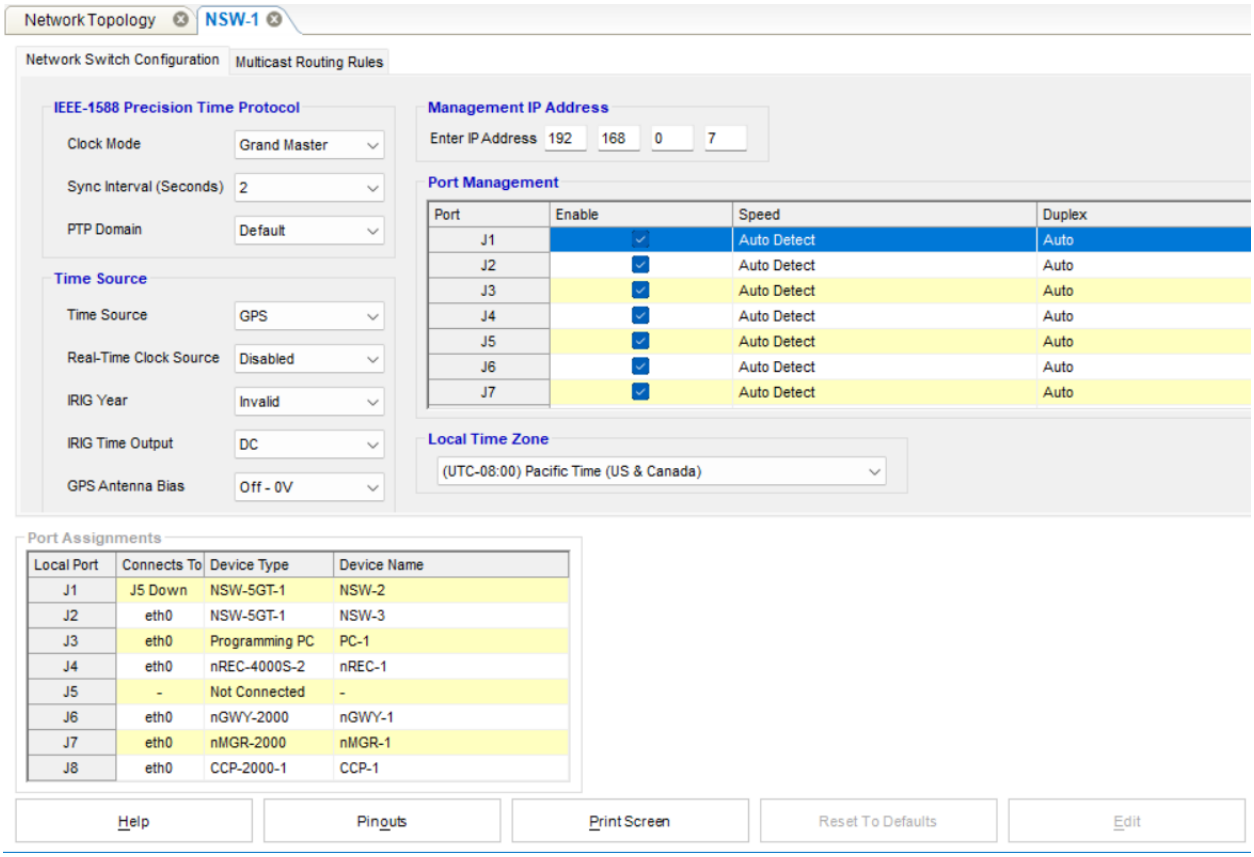
To configure each camera change the first 3 modes to match what is shown in Figure 13.



Mode #	Frame Rate	Exposure Time	Pre-Trigger	Total Frames	Sensor Gain
Mode 0	50 fps	10000.000 us	250 Frames	All Frames	1 dB
Mode 1	100 fps	6000.000 us	250 Frames	All Frames	1 dB
Mode 2	250 fps	3000.000 us	250 Frames	All Frames	1 dB
Mode 3	250 fps	3000.000 us	40 Frames	1000 Frames	1 dB
Mode 4	250 fps	3000.000 us	40 Frames	1000 Frames	1 dB
Mode 5	250 fps	3000.000 us	40 Frames	1000 Frames	1 dB

Figure 13 Camera Frame Rate, Exposure Time, and Pre-Trigger changes

An additional step is required to configure the 8-port switch for operation. Figure 14 shows the device configuration page which will display when you select the NSW-8GT-TG-D-1 device in the Network Topology page and then clicking on the Configure Device button.



Port	Enable	Speed	Duplex
J1	✓	Auto Detect	Auto
J2	✓	Auto Detect	Auto
J3	✓	Auto Detect	Auto
J4	✓	Auto Detect	Auto
J5	✓	Auto Detect	Auto
J6	✓	Auto Detect	Auto
J7	✓	Auto Detect	Auto

Local Port	Connects To	Device Type	Device Name
J1	J5 Down	NSW-5GT-1	NSW-2
J2	eth0	NSW-5GT-1	NSW-3
J3	eth0	Programming PC	PC-1
J4	eth0	nREC-4000S-2	nREC-1
J5	-	Not Connected	-
J6	eth0	nGWY-2000	nGWY-1
J7	eth0	nMGR-2000	nMGR-1
J8	eth0	CCP-2000-1	CCP-1

Figure 14 NSW-8GT configuration page

Click on the Edit button at the bottom of the page to change any of the values. Of particular interest is the IEEE-1588 Clock Mode which should be set to Grand Master and the Time Source fields.

Finally, the thermocouple DAU must be configured in order to properly read the temperatures. The first step is to select the nRTM-4048-1 card on the Network Topology tree and then click Configure Card. This will show the dialog in Figure 15.

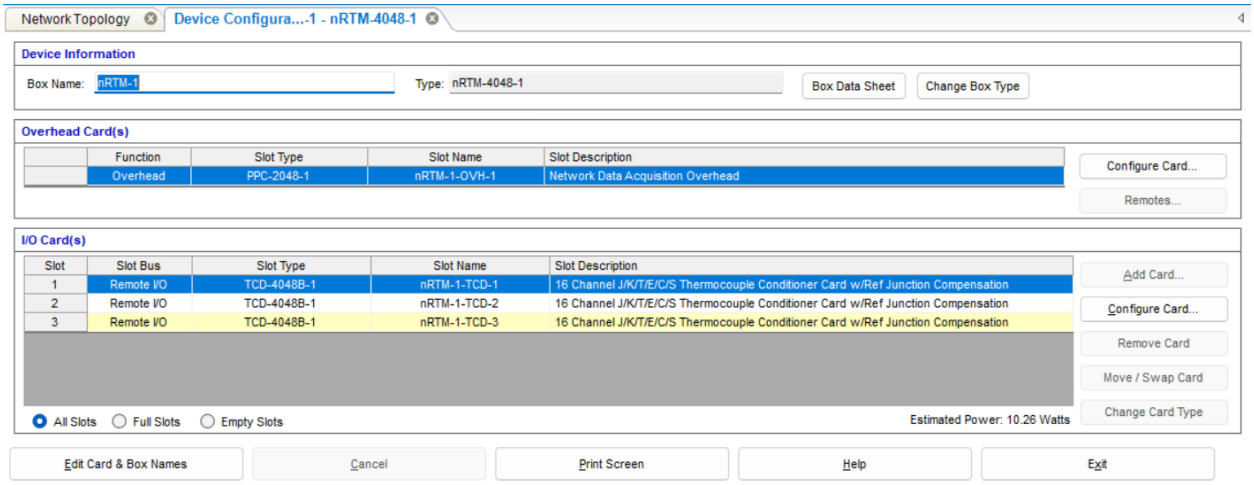


Figure 15 RTM configuration

Verify the settings on the PCM page match those in Figure 16.

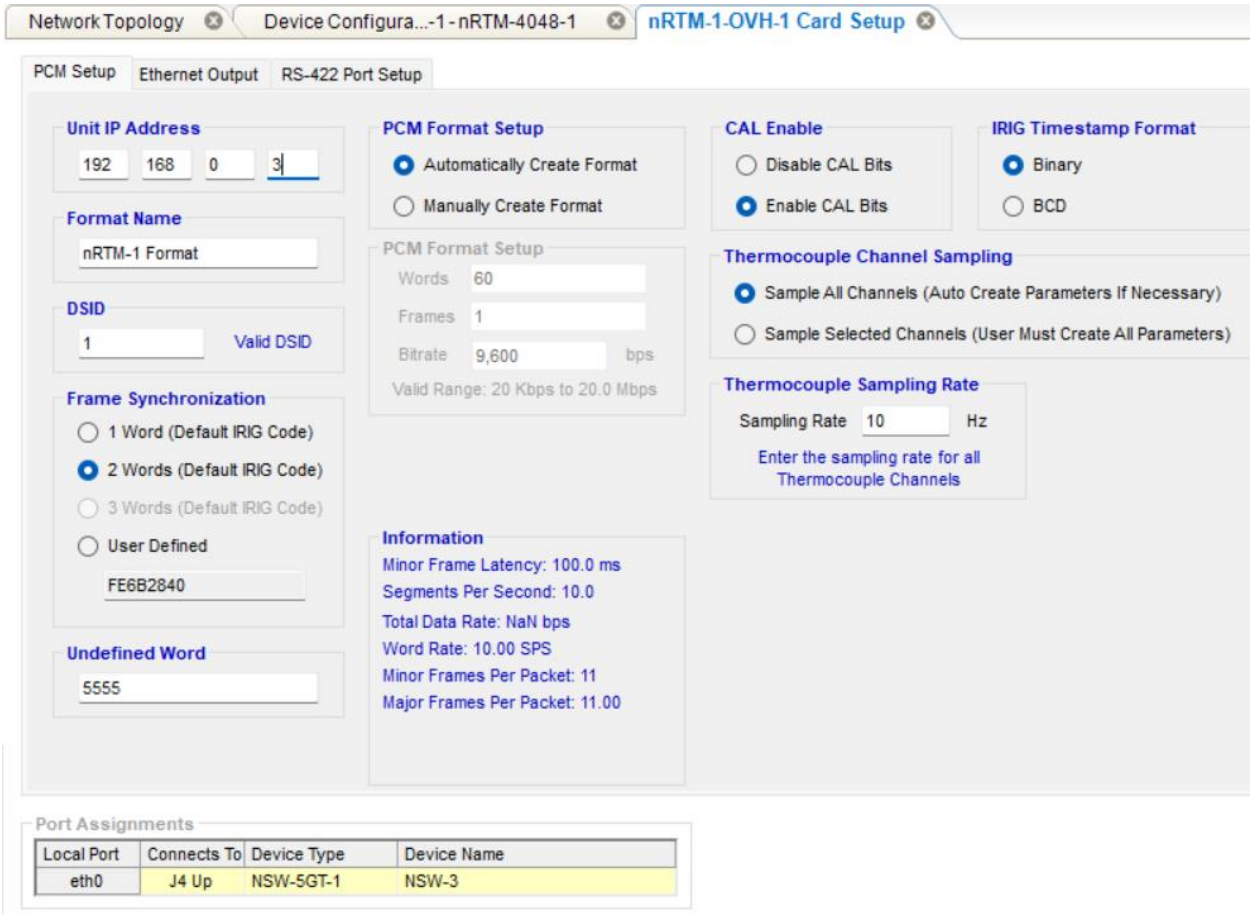


Figure 16 PCM Setup page for nRTM overhead card

Click on the configure channel button and change the Channel 1 settings to scale from 3 deg C to 506 deg C for a K Type thermocouple. Click the Set All Channels to Channel 1 button at the bottom of the page. This page should match that of Figure 17.

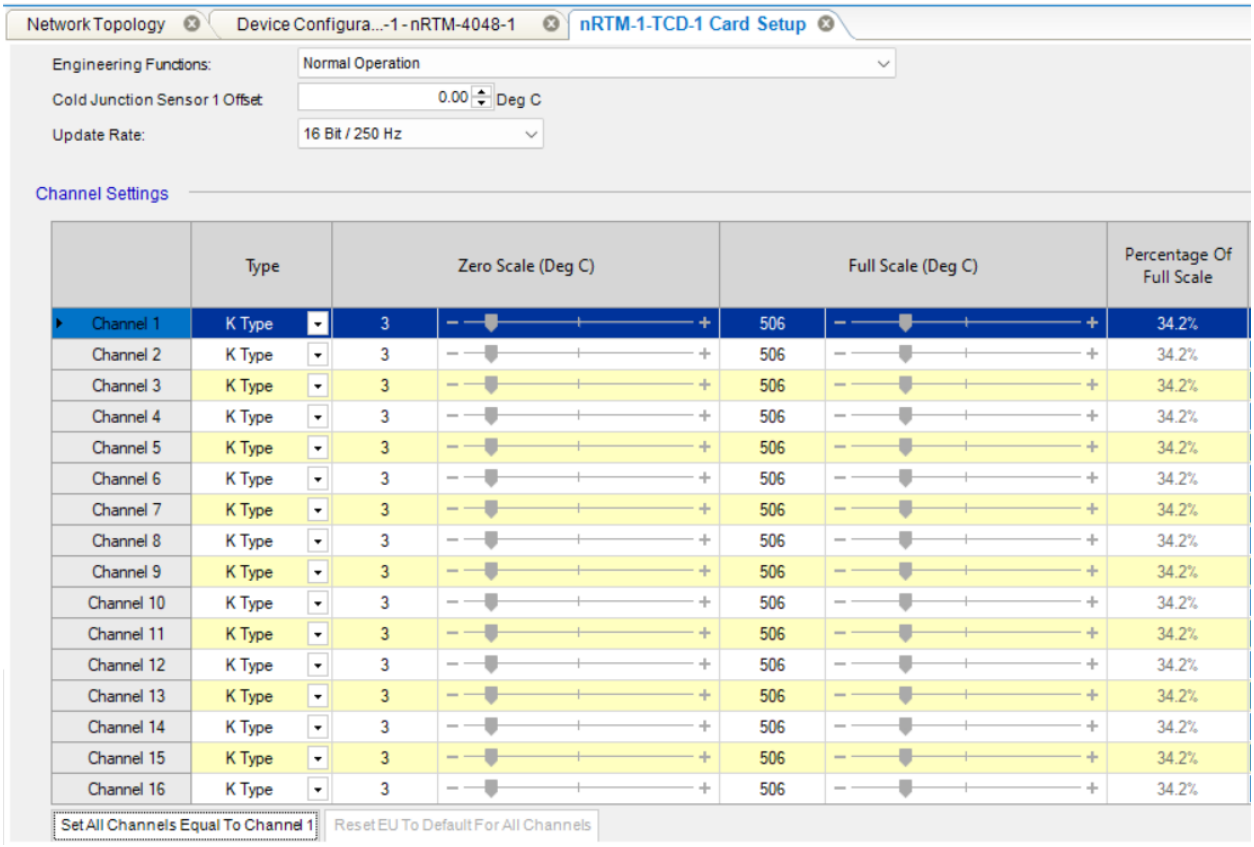


Figure 17 Channel Configuration page

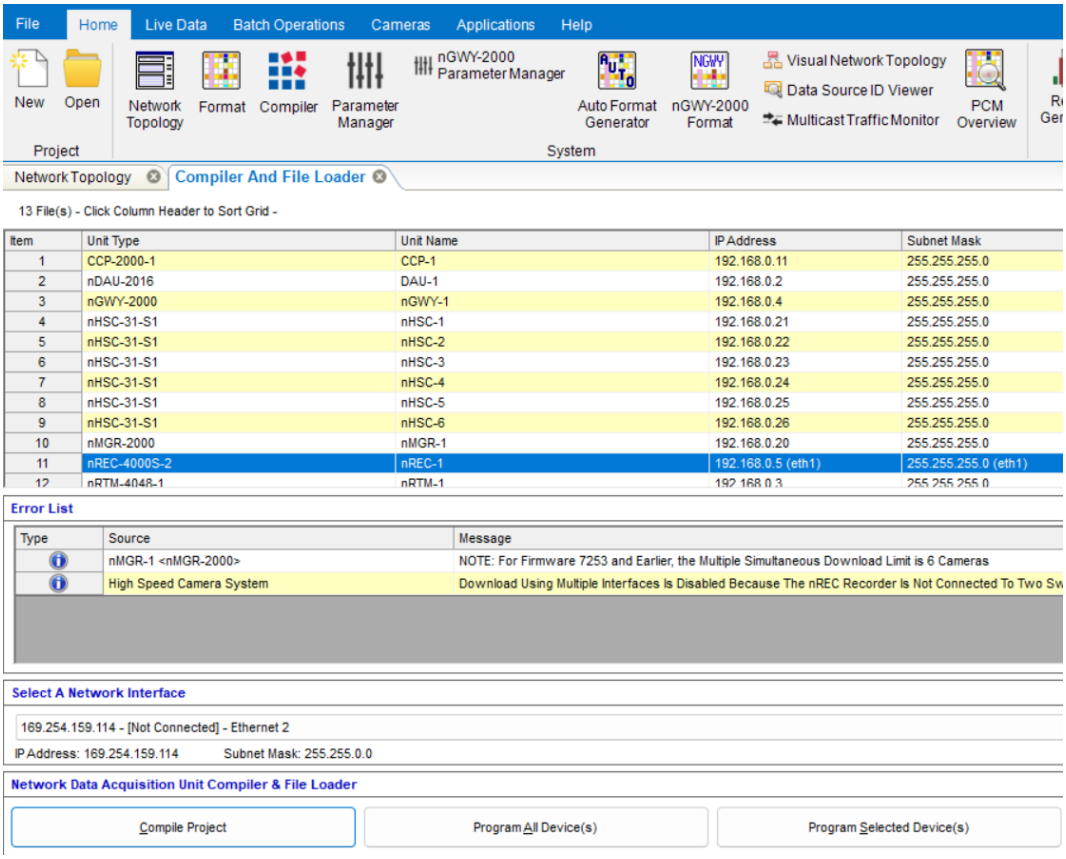
Exercise 1: Analyzing Output

Setup:

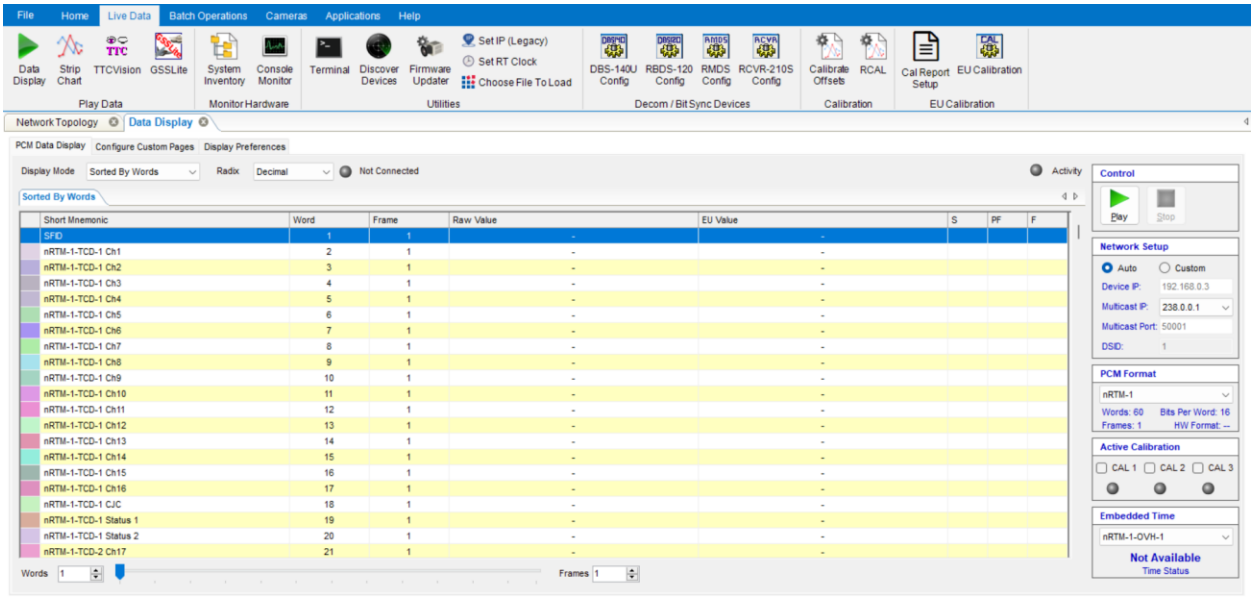
Configure the system according to the setup procedures presented on the previous pages.

Procedure:

1. To ensure that our project has been compiled and loaded on the system navigate to the Home tab and click on the Compiler Icon followed by Compile Project. Next we click on the Program All Devices button as shown in the figure below:



2. Navigate in TTCWare to the Live Data tab as shown in the figure below:



3. Click on the Data Display green arrow icon to launch the screen shown and then on the Green Play button to start the display.
4. Record the both counts and temperatures for Cameras 1, 2, 4, and 5
   Camera 1 Counts: _____ Temperature: _____
   Camera 2 Counts: _____ Temperature: _____
   Camera 4 Counts: _____ Temperature: _____
   Camera 5 Counts: _____ Temperature: _____
5. Remove the connector to the thermocouple on Camera 1 and verify that the value changes to zero counts.
6. Reattach the thermocouple connector and confirm that the temperature returns to a reasonable reading.
7. Observe the Multicast Traffic Monitor from the Home tab to identify the traffic coming from the RTM module.

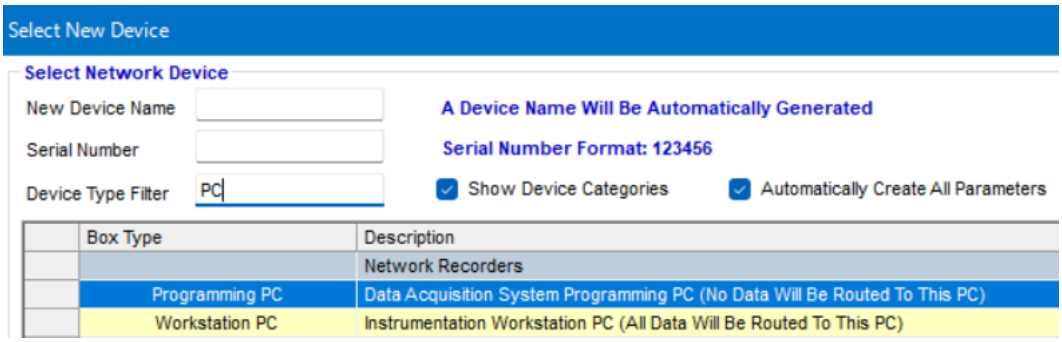
Exercise 2: Troubleshooting Multicast Issues

Setup:

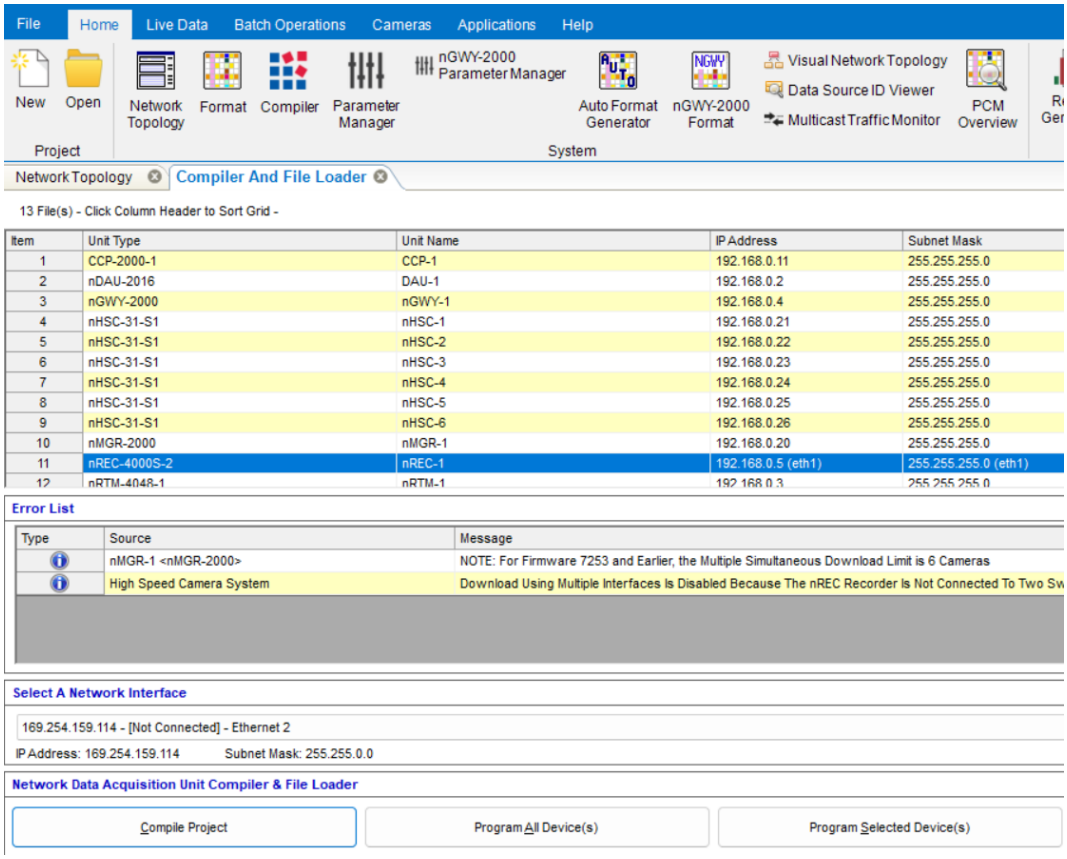
Configure the workstation to not receive data and observe what happens on the multicast monitor.

Procedure:

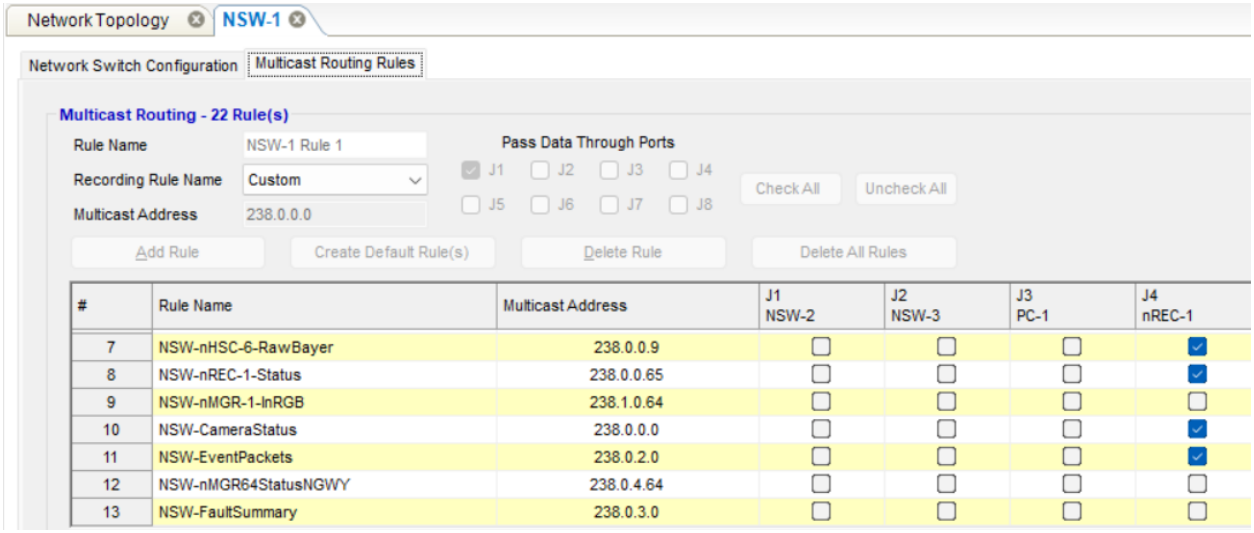
1. To demonstrate what happens when the wrong type of PC is selected delete the Workstation connected to port J3 and add back a Programming PC selected in the figure below:



2. Next you must compile the project and (re)program the 8-Port switch. Do this by clicking on the Compiler Icon on the Home tab followed by Compile Project and then either Program All Devices or Program Selected Devices with the switch selected as shown in the figure below:



3. Repeat steps 1 and 2 from exercise 1 above and verify that no data appears on the display.
4. The problem can be seen on the 8-Port Switch configuration page. Double click on the NSW-8GT-TG-D-1 icon under Connections on the Network Topology page to bring up the configuration page. Next click on the Multicast Routing Rules tab to see how the ports are configured. You should see something similar to the figure below:



Notice that none of the boxes in the J3 PC-1 column are checked. This essentially tells the switch to not forward any multicast traffice to that port.