

# **ASE2000 Version 2 DNP3 Outstation Certification Tests**

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## DNP3 Certification Test Procedures

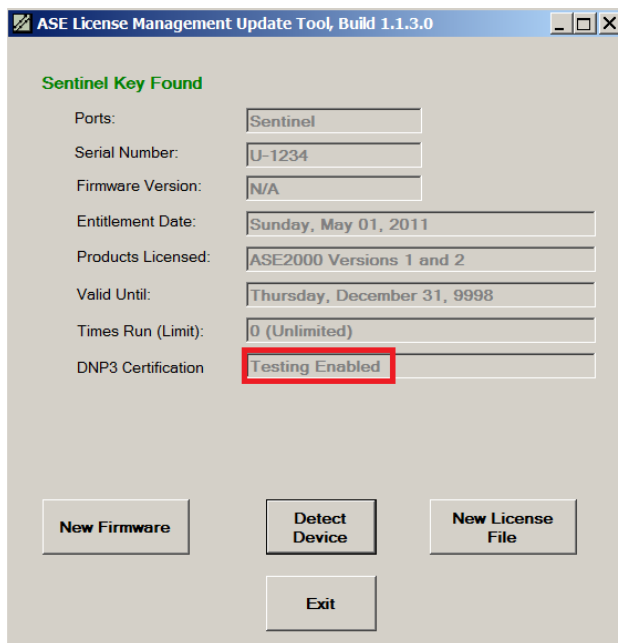
This document, an addendum to the ASE2000 Version 2 Users Guide, provides details on operation of the automated DNP3 Certification Test Procedures. The reader is assumed to be familiar with basic ASE2000 V2 operations.

### Permissions

The ability to run DNP3 Certification Tests is defined by the ASE2000 Version 2 License in the product's BCOM-USB device or Sentinel USB Dongle. You can install the ASE License Management Updater (version 1.1.3 or later) to find out if the testing is enabled. This is available at

<http://www.ase-systems.com/ASE2000-test-set/ase2000-downloads.asp#updater>.

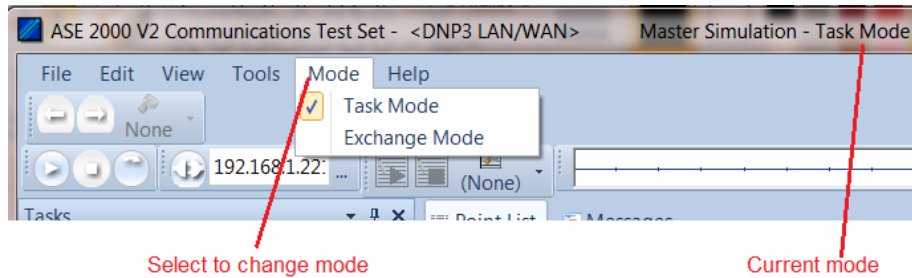
Install, insert the BCOM-USB device or Sentinel Security Dongle, and run the Updater.



## DNP3 Certification Setup

### Task Mode

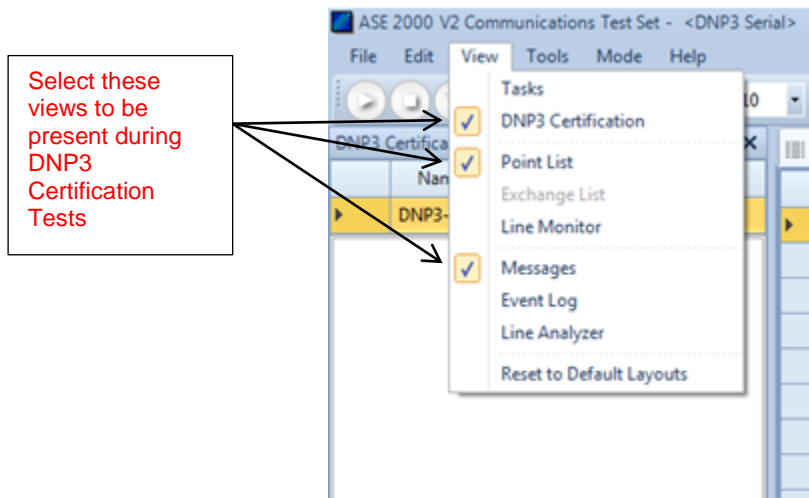
DNP3 Certification procedures operate in Task Mode. The current mode is shown in the ASE2000 V2 title line and can be changed by selecting the **Mode** pull-down target. If not already in Task Mode, select Task Mode



### Screen Setup

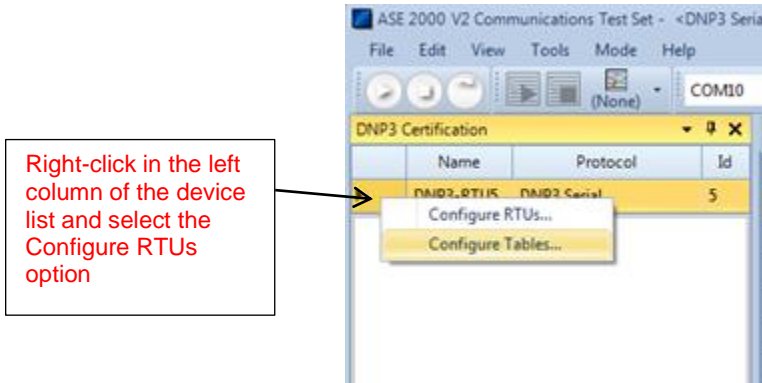
Before proceeding with the test setup steps and test execution, it is best to enable those views, and only those views, required for this process. This is to maximize the viewing area for the test displays. The following views are suggested.

- DNP3 Certification
- Point List is useful to display input point values
- Messages and/or Line Monitor can be enabled to show communication messages. Either or both may be enabled depending on preferences.



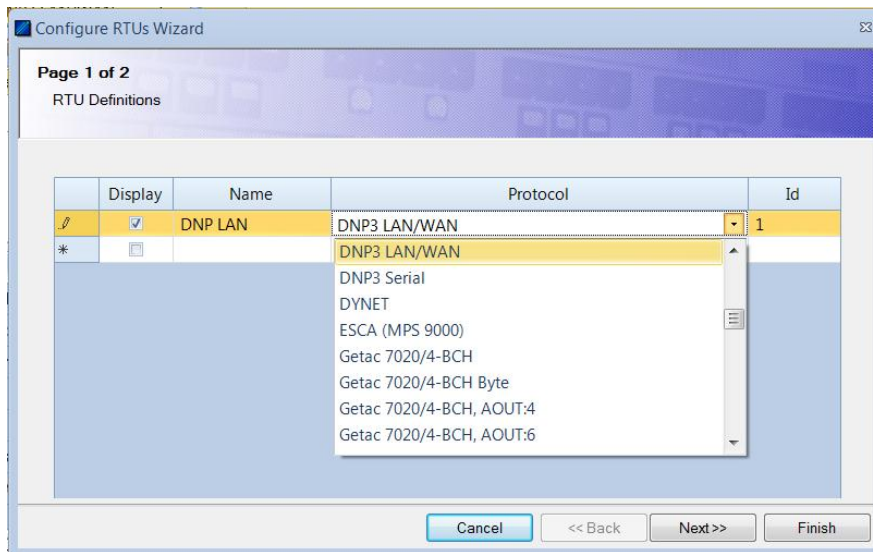
### Device Definition

A RTU (device) configuration must be created for the DUT (Device Under Test). If it does not already exist, it can be created from the *DNP3 Certification* view.



Selecting *Configure RTUs* presents a list of previously user-defined RTU devices or, if none have been previously defined, an empty list. Device definitions are persistent so, once defined, they are retained until deleted by the user.

The menu below appears when the *Configure RTUs* option is selected.



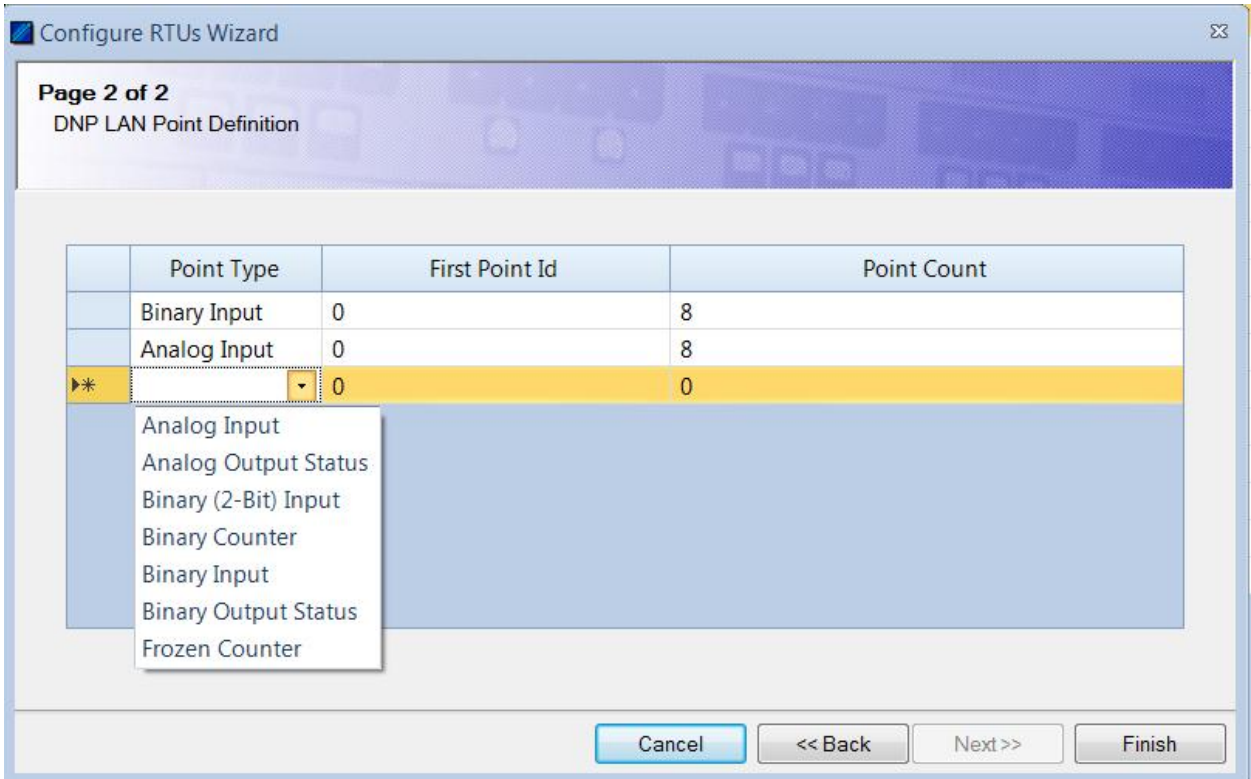
To define a new RTU:

- Enter a unique name to identify the RTU device
- Select either *DNP3 LAN/WAN* or *DNP3 Serial* from the protocol pull-down list
- Enter the Device ID, which is the Destination ID for messages sent to the device
- Make sure that the Display option is checked

A point definition may be manually created, if desired, but is not required. The ASE2000 V2 automatically adds input points to the Points List view as detected during data scan operations.

To enter a Point Definition manually:

- Select *Next>>* from the RTU Definition display to enter the point configuration



**Configure RTUs Wizard** Page 2 of 2  
DNP LAN Point Definition

	Point Type	First Point Id	Point Count
	Binary Input	0	8
	Analog Input	0	8
▶*	▼	0	0

Analog Input  
 Analog Output Status  
 Binary (2-Bit) Input  
 Binary Counter  
 Binary Input  
 Binary Output Status  
 Frozen Counter

For each contiguous block of input points, select an object/point type from the **Point Type** pull-down list and enter the ID of the first point in the block and the number of points. Possible point types are shown in the list above.

When done, select **Finish**. The RTU device definition process is complete.

### **Loading Certification Procedures**

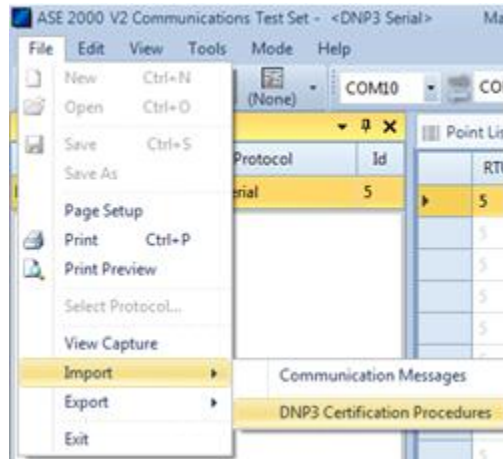
DNP3 Certification procedures are provided as XML files. As of the writing of this document, there are two files.

- DNP3Certification2009L1.XML are the 2009 procedures for Level 1 devices. ***These tests were released by the DNP3 Users group in 2009***
- DNP3Certification2009L2.XML are the 2009 procedures for Level 2 devices. ***These tests were released by the DNP3 Users group in 2009***
- AseDnp3CertificationSA2.XML is an ASE designed set of tests for DNP3 Secure Authentication version 2 (SA2). ***These tests are NOT approved by the DNP3***

*Users group or the DNP3 Technical Committee. They were developed by ASE and may be used with the understanding that they do not provide a comprehensive or authorized set of tests. They can be useful in verification of an Outstation's basic security implementation*




If and when new procedure documents are released by the DNP3 Users Group, new Certification procedure files will be made available.

To access a Certification file, select File, Import, and DNP3 Certification Procedures.



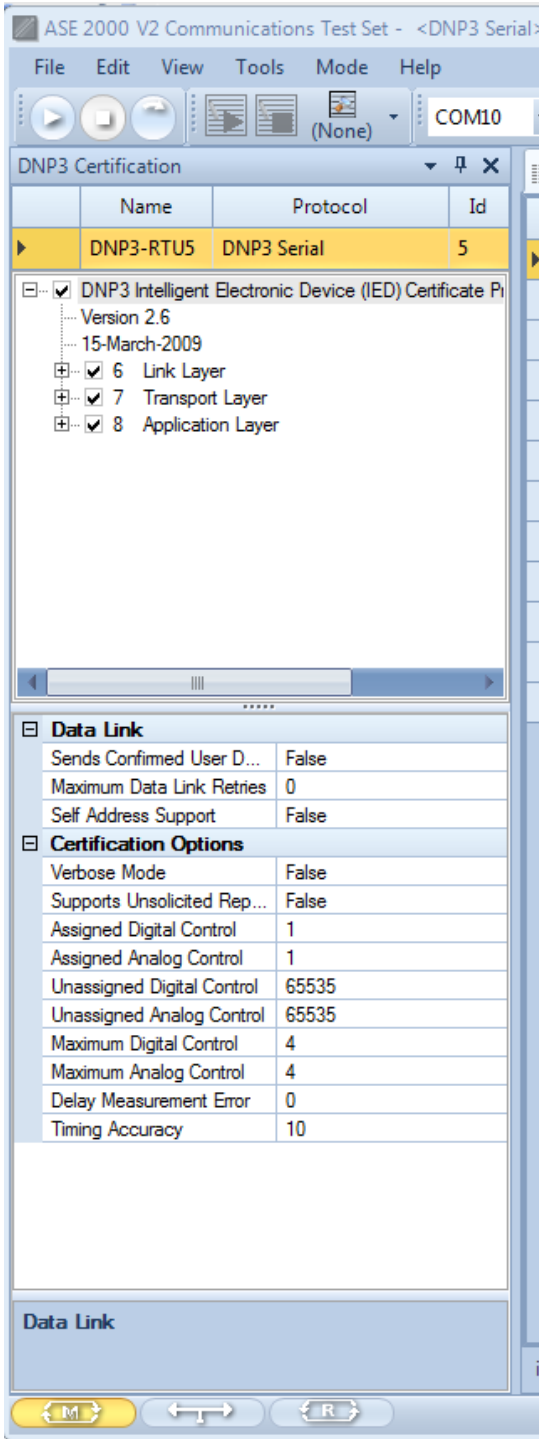
If the DNP3 Certification Procedures option does not appear, then your license file does not have this feature enabled. At the time this document was written, there was no additional charge for DNP3 Certification Testing. If the option does not appear, please contact ASE.

After selecting **Import > DNP3 Certification Procedures**, a file browsing windows will open to facilitate browsing to the Dnp3Certification subfolder under the ASE2000 installation folder. The list of available certification files will be displayed.

Name	Date modified	Type	Size
 AseDnp3CertificationSA2.xml	7/12/2011 12:17 PM	XML Document	589 KB
 Dnp3Certification2009L1.xml	5/26/2011 10:58 AM	XML Document	794 KB
 Dnp3Certification2009L2.xml	5/26/2011 10:58 AM	XML Document	1,077 KB

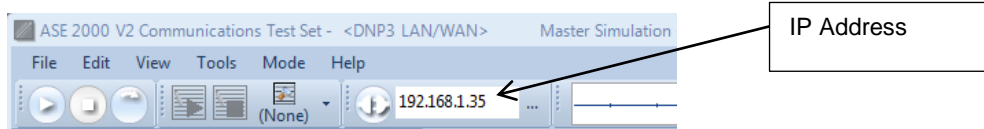
Select the desired file and **Open**.

When the file is opened, the DNP3 Certification view will be updated with the list of tests in the top portion of the view and test configuration options in the bottom portion of the screen.

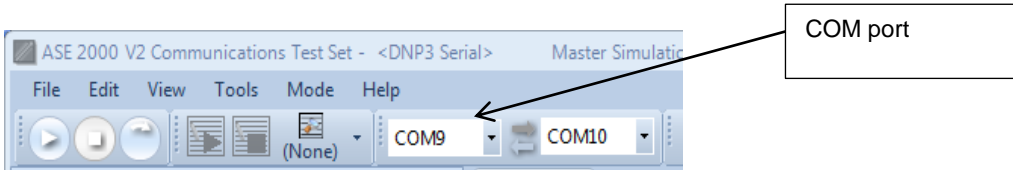


### **Device Setup**

If testing a DNP3 LAN/WAN protocol device, enter its IP address as shown.



If testing a DNP3 serial device, connect the device as if it were being accessed in Master Simulation Mode.



### **Data Link and Certification Options**

Prior to running the certification test, the Data Link and Certification Options should be reviewed and modified, if necessary, to be correct for the Device Under Test.

Data Link	
Sends Confirmed User Data Frames	False
Maximum Data Link Retries	0
Self Address Support	False
Certification Options	
Verbose Mode	False
Supports Unsolicited Reporting	False
Assigned Digital Control	1
Assigned Analog Control	1
Unassigned Digital Control	65535
Unassigned Analog Control	65535
Maximum Digital Control	4
Maximum Analog Control	4
Delay Measurement Error	0
Timing Accuracy	10

### **Data Link**

- **Sends Confirmed Use Data Frames** – Set True/False according to the device capability
- **Maximum Data Link Retries** – On communication errors, maximum number of attempts before hard failure is declared.
- **Self Address Support** – Set True/False according to the device capability

### **Certification Options**

- **Verbose Mode** – The ASE2000 divides prompts into normal and verbose. While the division is somewhat arbitrary, most significant prompts are always generated. Those that are more repetitive, are required to check features that most likely pass, and slow down the certification process are categorized as *Verbose*. If the

Verbose Mode option is set to *False*, then verbose mode prompts are disabled. The test proceeds as if any skipped, verbose prompt was answered to indicate that the test *Passed*. In the interest of expediency, ASE suggests running the certification procedures initially with the *Verbose* mode set to *False*. Once initial issues have been solved, change the setting to *True* for a detailed run.

- ***Supports Unsolicited Reporting*** – Set True/False according to the device capability
- ***Assigned Digital Control*** – Index of Binary Output point to use for control operation during the test.
- ***Assigned Analog Control*** – Index of Analog Output point to use for control operation during the test.
- ***Unassigned Digital Control*** – Invalid index for use during the test.
- ***Unassigned Analog Control*** – Invalid index for use during the test.
- ***Maximum Digital Control*** – Maximum number of Binary points to control in a single command
- ***Maximum Analog Control*** – Maximum number of Binary points to control in a single command
- ***Delay Measurement Error*** –
- ***Timing Accuracy*** – Allowed tolerance, in milliseconds, between expected time stamp on an event and received time stamp.

### ***Time Synchronization***

The DNP3 Certification process validates time synchronization by generating a contact closure at a specified time. The contact must be wired to a digital input on the DUT. The ASE2000 synchronizes the DUT, generates a contact closure, scans for binary events, and verifies the correct time stamp on the event generated, within tolerances defined in the device profile document.

Currently, ASE supports this test process with an ECON DT9817 DIO device from TurnKey Solutions. In April 2011, these devices were available for \$255 each. Please see <http://www.datatranslation.com/products/dataacquisition/usb/dt9817.asp>.

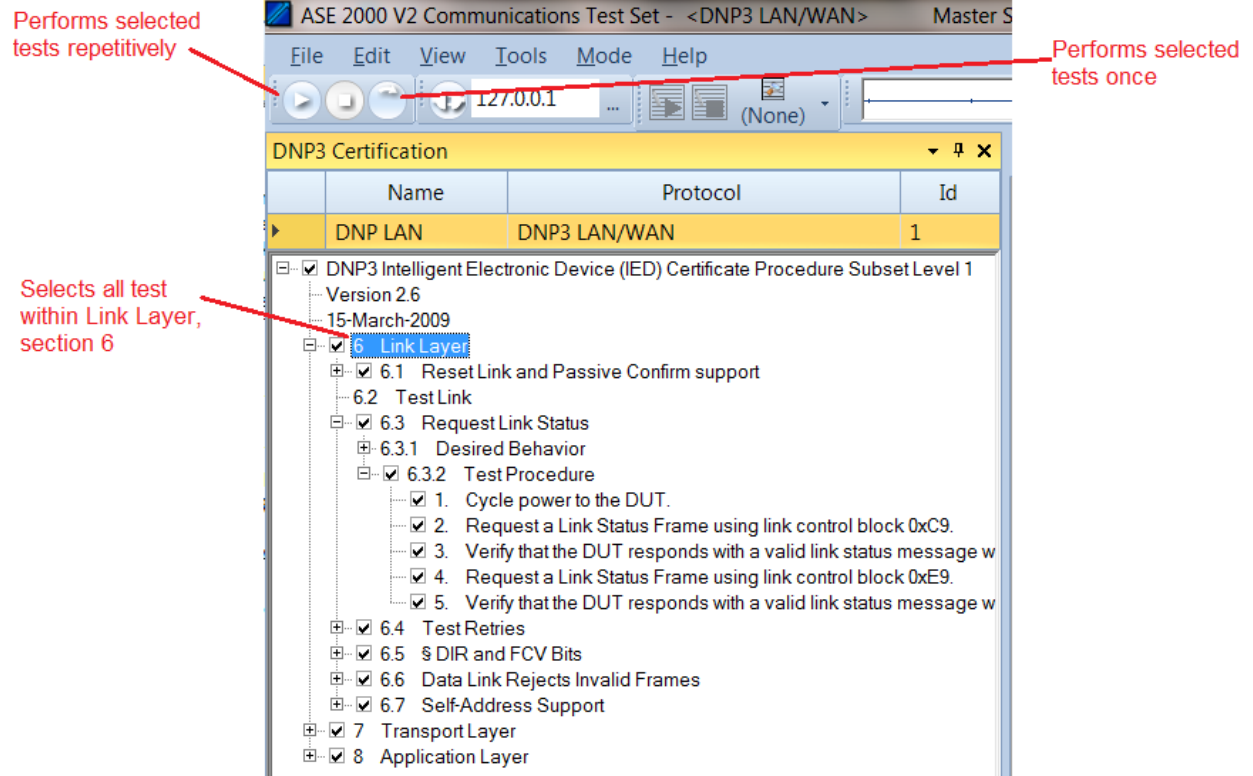
## DNP3 Certification - Running the Procedures

### ***Test Selection***

The DNP3 Certification View is a tree-structured presentation of all tests in the selected certification procedure document as published by the DNP3 Users group. Each section, subsection, and test can be expanded by selecting the [+] target at the left edge of the section/step description. The highest level identifies the test document, Level 1 or Level2. The lowest level presents individual steps. The diagram below shows a Level 1 test with expansions at selected levels.

To start testing:

- Select any test section or step in the expanded tree to run the selected test and all tests contained within the selected test. The example below selects the Link Layer so, when testing starts, all Link Layer tests will be run, but no Transport or Application Layer tests.
- Clarify device capabilities and parameters from data entry fields below the test step tree. Optional tests for capabilities not supported by your device are automatically skipped. For example, if your device does not support self-addressing, an optional capability, set the self-address option to false.
- Remove the checkmark for any other subtests or steps you want to skip. In the example shown, all tests are enabled
- Select the ***Once*** target to run the tests one time, or the ***Start*** target to run all tests repetitively

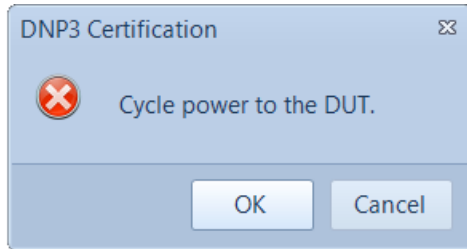


<b>Data Link</b>	
Sends Confirmed User Data Frames	False
Maximum Data Link Retries	0
Self Address Support	False
<b>Certification Options</b>	
Verbose Mode	False
Supports Unsolicited Reporting	False
Assigned Digital Control	1
Assigned Analog Control	1
Unassigned Digital Control	65535
Unassigned Analog Control	65535
Maximum Digital Control	4
Maximum Analog Control	4
Delay Measurement Error	0
Timing Accuracy	10

### **Prompts**

As the tests run, prompts appear corresponding to those described in the published Test Procedures. There are two types of prompts.

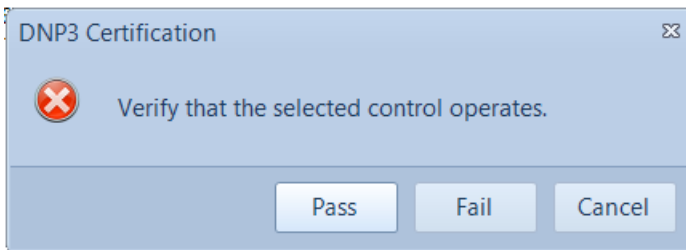
The first type requests a specific action.



Select **OK** after the requested action has been performed and the ready to proceed, or Select **Cancel** to stop the test at this point.

**NOTE:** *After cycling power, do not select **OK** until the DUT is operational and able to respond to communication messages*





The second type asks whether or not the DUT has completed an action successfully.

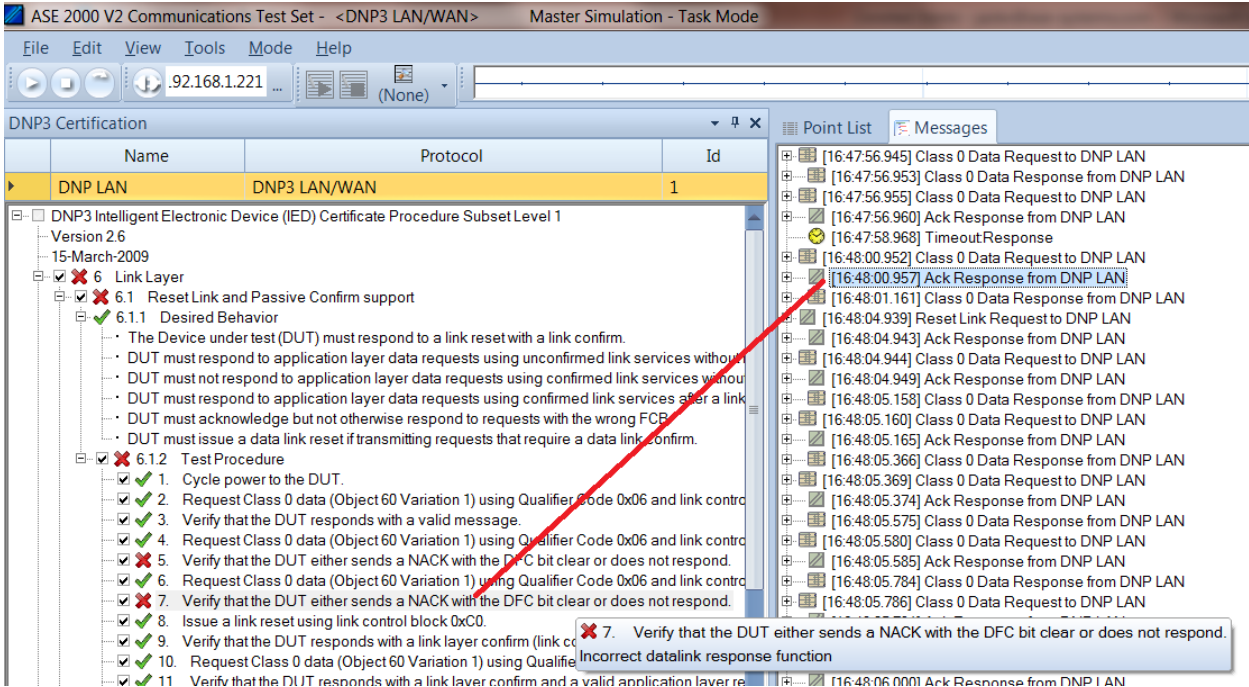


Select **Pass** or **Fail** to record the corresponding result in the test record, or Select **Cancel** is to stop the test at this point.

### **As Test Are Being Run**

Test results appear dynamically as tests are being run.

- The Messages (and Line Monitor) views are updated as messages are sent and received
- The DNP3 Certification view expands as selected test steps complete, inserting  to the left of each test step that completes successfully, and  to the left of any test that fails
- Test results are propagated to higher levels. An  indication at any level implies that all test steps and sections contained therein completed successfully. A  implies that at least one sub-test failed



ASE 2000 V2 Communications Test Set - <DNP3 LAN/WAN> Master Simulation - Task Mode

File Edit View Tools Mode Help

.92.168.1.221 (None)

DNP3 Certification

Name	Protocol	Id
DNP LAN	DNP3 LAN/WAN	1

DNP3 Intelligent Electronic Device (IED) Certificate Procedure Subset Level 1

- Version 2.6
- 15-March-2009
- 6 Link Layer
  - 6.1 ResetLink and Passive Confirm support
    - 6.1.1 Desired Behavior
      - The Device under test (DUT) must respond to a link reset with a link confirm.
      - DUT must respond to application layer data requests using unconfirmed link services without a link confirm.
      - DUT must not respond to application layer data requests using confirmed link services without a link confirm.
      - DUT must respond to application layer data requests using confirmed link services after a link confirm.
      - DUT must acknowledge but not otherwise respond to requests with the wrong FCB.
      - DUT must issue a data link reset if transmitting requests that require a data link confirm.
    - 6.1.2 Test Procedure
      - 1. Cycle power to the DUT.
      - 2. Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block.
      - 3. Verify that the DUT responds with a valid message.
      - 4. Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block.
      - 5. Verify that the DUT either sends a NACK with the DFC bit clear or does not respond.
      - 6. Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block.
      - 7. Verify that the DUT either sends a NACK with the DFC bit clear or does not respond.
      - 8. Issue a link reset using link control block 0xC0.
      - 9. Verify that the DUT responds with a link layer confirm (link control block).
      - 10. Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block.
      - 11. Verify that the DUT responds with a link layer confirm and a valid application layer response.

Messages

- [16:47:56.945] Class 0 Data Request to DNP LAN
- [16:47:56.953] Class 0 Data Response from DNP LAN
- [16:47:56.955] Class 0 Data Request to DNP LAN
- [16:47:56.960] Ack Response from DNP LAN
- [16:47:58.968] TimeoutResponse
- [16:48:00.952] Class 0 Data Request to DNP LAN
- [16:48:00.957] Ack Response from DNP LAN
- [16:48:01.161] Class 0 Data Response from DNP LAN
- [16:48:04.939] Reset Link Request to DNP LAN
- [16:48:04.943] Ack Response from DNP LAN
- [16:48:04.944] Class 0 Data Request to DNP LAN
- [16:48:04.949] Ack Response from DNP LAN
- [16:48:05.158] Class 0 Data Response from DNP LAN
- [16:48:05.160] Class 0 Data Request to DNP LAN
- [16:48:05.165] Ack Response from DNP LAN
- [16:48:05.366] Class 0 Data Response from DNP LAN
- [16:48:05.369] Class 0 Data Request to DNP LAN
- [16:48:05.374] Ack Response from DNP LAN
- [16:48:05.575] Class 0 Data Response from DNP LAN
- [16:48:05.580] Class 0 Data Request to DNP LAN
- [16:48:05.585] Ack Response from DNP LAN
- [16:48:05.784] Class 0 Data Response from DNP LAN
- [16:48:05.786] Class 0 Data Request to DNP LAN
- [16:48:06.000] Ack Response from DNP LAN

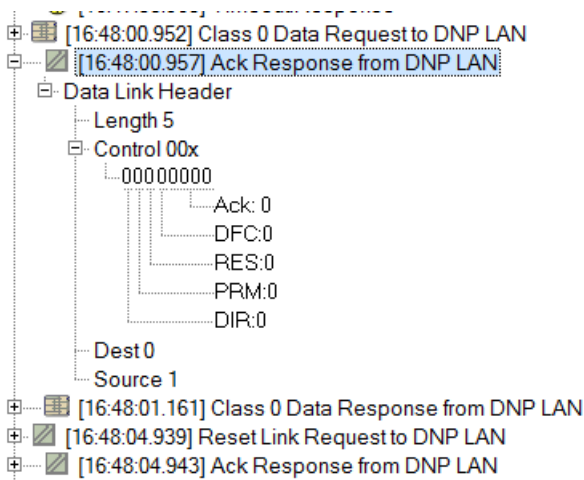
Incorrect data link response function

### Test Result Analysis

To obtain more details on a failed test, click or mouse-over the failed step in the DNP3 Certification view.

A mouse-over provides more detail on the failure cause. In the screen shot above, step 7 failed because the response message contained an incorrect data link function code.

Clicking on the failed step highlights the test step in the DNP3 Certification Window and the corresponding communication message or action in the Messages window. More information on the communication message is available by expanding the errant message in the Messages view.



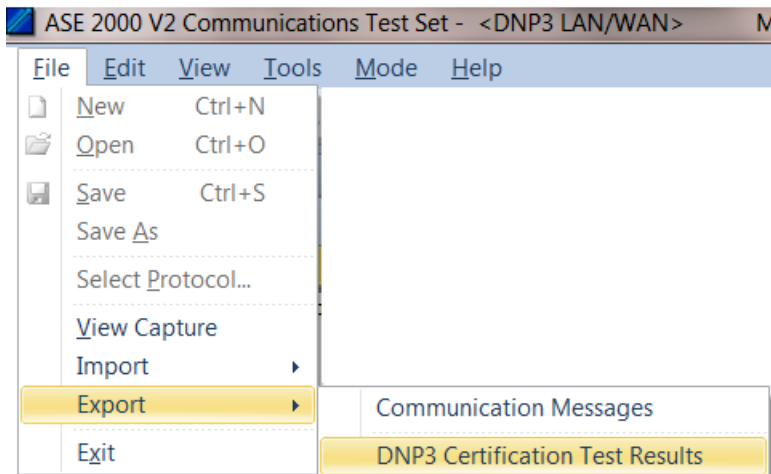
- [16:48:00.952] Class 0 Data Request to DNP LAN
- [16:48:00.957] Ack Response from DNP LAN
  - Data Link Header
    - Length 5
    - Control 00x
      - 00000000
        - Ack: 0
        - DFC: 0
        - RES: 0
        - PRM: 0
        - DIR: 0
    - Dest 0
    - Source 1
- [16:48:01.161] Class 0 Data Response from DNP LAN
- [16:48:04.939] Reset Link Request to DNP LAN
- [16:48:04.943] Ack Response from DNP LAN

The DNP3 description for this step requires the DUT to either respond with a NACK and DFC of 0, or to not respond. The expansion shows an ACK data link function code, which is an error.

## DNP3 Certification Test Report

### ***Saving Test Results***

A test results report viewable with your local browser can be generated by exporting the test results to a XML file. To do so, Select ***File, Export,*** and ***DNP3 Certification Test Results.***



Selection generates a browser window to locate a save location. You may not have privileges to write to the default location, which may be within the ASE2000 V2 installation folder. Browse to a folder with write permissions and save. The saved file should have an extension of XML.

**Note:** *Saved DNP3 Certification Test Result files can be imported later as described in the **Loading Certification Procedures** section. The result is similar to loading the original test procedures file. In this case, the results of all previously run tests will be set as they were when the file was saved.*

### ***Viewing Test Results in a Browser***

To view the test results, you must first move a XLST file from the ASE2000 V2 folder to the folder where the test results were saved.

File **DNP3Certification.xslt** is located within the ASE2000 V2 installation folder in the same place from which the DNP3 Certification procedures were opened. The default location is:

**C:\Program Files or C:\Program Files (x86)  
  \ASE\ASE2000 V2 Communication Test Set\Dnp3Certification\  
  DNP3Certification.xslt**

Copy this file to the same folder as the test results and then open the test results file with your Internet browser. You should see a complete report of all tests with identifications as passed, failed, skipped, or N/A. Failed tests include a failure reason.

A **skipped** test is one not performed, but contained within a section where other tests or steps were performed. A test could be skipped because it was deselected by the user, or because it tested capabilities not supported by the DUT. For example, if a device does not support self-addressing, then those tests are skipped.

If an entire test section was not selected, then all tests within that section are flagged as **N/A**. In the example above, only Data Link tests were run, so all Transport and Application layer tests appear as N/A.

**DNP3 Certification Procedures**  
 Subset Level 1  
 Version 2.6  
 15-March-2009

Certification Procedures  
 Publication Date

**Data Link Certification Test Results**

Test Number	Title	State	Failure Reason
6	Link Layer	Fail	
6.1	Reset Link and Passive Confirm support	Fail	
6.1.2	Test Procedure	Fail	
1.	Cycle power to the DUT.	Pass	
2.	Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block 0xC4.	Pass	
3.	Verify that the DUT responds with a valid message.	Pass	
4.	Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block 0xF3.	Pass	
5.	Verify that the DUT either sends a NACK with the DFC bit clear or does not respond.	Fail	Incorrect datalink response function
6.	Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block 0xD3.	Pass	
7.	Verify that the DUT either sends a NACK with the DFC bit clear or does not respond.	Fail	Incorrect datalink response function
8.	Issue a link reset using link control block 0xC0.	Pass	
9.	Verify that the DUT responds with a link layer confirm (link control block 0x00).	Pass	
10.	Request Class 0 data (Object 60 Variation 1) using Qualifier Code 0x06 and link control block 0xF3.	Pass	