DeviceNet™
CONFORMANCE TESTED

NI-DNET™ Programmer Reference Manual

NATIONAL INSTRUMENTS™

April 2001 Edition
Part Number 370376A-01

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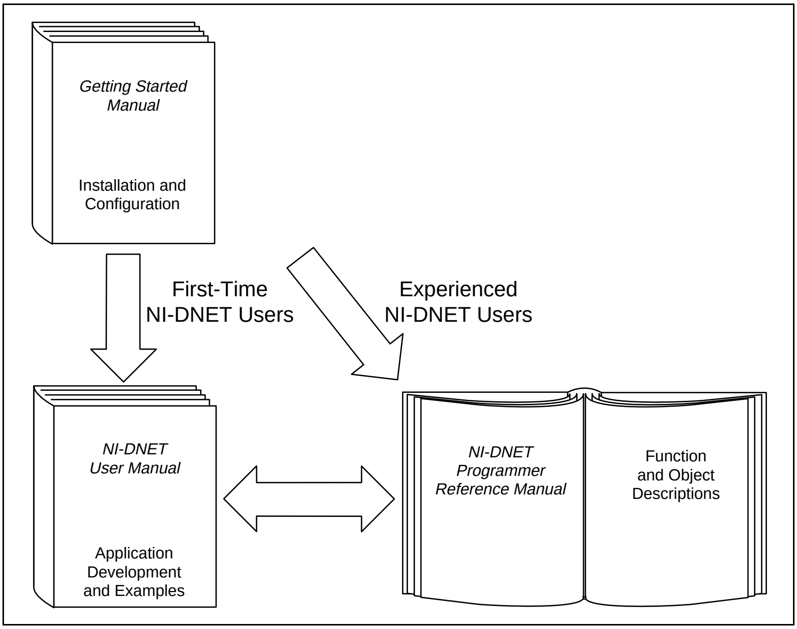
About This Manual

This manual is a programming reference for functions, objects, and data types in the NI-DNET software for Win32, the 32-bit programming environment of Windows NT/98/95. The NI-DNET software is meant to be used with either Windows 98/95 or Windows NT version 3.51 or later. This manual assumes that you are already familiar with the Windows system you are using.

How to Use the Manual Set


Getting Started Manual
Installation and Configuration
First-Time NI-DNET Users
Experienced NI-DNET Users
NI-DNET User Manual
Application Development and Examples
NI-DNET Programmer Reference Manual
Function and Object Descriptions

Use the getting started manual to install and configure your DeviceNet hardware and NI-DNET software.

Use the *NI-DNET User Manual* to learn the basics of NI-DNET and how to develop an application. The user manual also contains detailed examples.

Use this *NI-DNET Programmer Reference Manual* for specific information about each NI-DNET function and object, including format, parameters, and possible errors.

Conventions Used in This Manual

The following conventions appear in this manual:

✎

This icon denotes a note, which alerts you to important information.

italic

Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

`monospace`

Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

`monospace italic`

Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

Related Documentation

The following documents contain information that you might find helpful as you read this manual:

- *CAN Specification Version 2.0*, 1991, Robert Bosch Gmbh., Postfach 500, D-7000 Stuttgart 1
- *DeviceNet Specification, Volumes 1 and 2, Version 2.0*, Open DeviceNet Vendor Association
- LabVIEW online reference
- Microsoft Win32 Software Development Kit (SDK) online help

1

NI-DNET Data Types

This chapter describes the data types used by NI-DNET functions and objects.

The NI-DNET data types provide consistency for various programming environments and facilitate access to the DeviceNet network. In general, all NI-DNET data types begin with NCTYPE_.

Table 1-1 lists each NI-DNET data type, its equivalent data type in ANSI C, LabVIEW, and DeviceNet, and a brief description.

Table 1-1. NI-DNET Data Types

NI-DNET Data Type	ANSI C	LabVIEW	DeviceNet	Description
NCTYPE_*type*_P	NCTYPE_*type* *	N/A	N/A	Pointer to a variable with type *type*
NCTYPE_INT8	signed char	I8	SINT	8-bit signed integer
NCTYPE_INT16	signed short	I16	INT	16-bit signed integer
NCTYPE_INT32	signed long	I32	DINT	32-bit signed integer
NCTYPE_UINT8	unsigned char	U8	USINT	8-bit unsigned integer
NCTYPE_UINT16	unsigned short	U16	UINT	16-bit unsigned integer
NCTYPE_UINT32	unsigned long	U32	UDINT	32-bit unsigned integer
NCTYPE_BOOL	NCTYPE_UINT8	TF (boolean)	BOOL	Boolean value. In ANSI C, constants NC_TRUE (1) and NC_FALSE (0) are used for comparisons
NCTYPE_STRING	char *, array of characters terminated by null character \0	abc (string)	STRING	ASCII character string
NCTYPE_REAL	float	SGL	REAL	32-bit floating point
NCTYPE_LREAL	double	DBL	LREAL	64-bit floating point

Table 1-1. NI-DNET Data Types (Continued)

NI-DNET Data Type	ANSI C	LabVIEW	DeviceNet	Description
NCTYPE_ANY_P	void *	N/A	N/A	Reference to variable of unknown type, used in cases where actual data type can vary depending on particular context.
NCTYPE_OBJH	NCTYPE_UINT32	Type definition ncObjHandle.ctl (U32)	N/A	Handle referring to an NI-DNET object. Refer to ncOpenDnetExplMsg, ncOpenDnetIntf, and ncOpenDnetIO in Chapter 2, *NI-DNET Functions*.
NCTYPE_VERSION	NCTYPE_UINT32	U32	N/A	Version number. Major, minor, subminor, and beta version numbers are encoded in unsigned 32-bit integer from high byte to low byte. Letters are encoded as numeric equivalents (‘A’ is 1, ‘Z’ is 26, and so on). Version 2.0B would be hexadecimal 02000200, and Beta version 1.4.2 beta 7 would be hex 01040207.
NCTYPE_DURATION	NCTYPE_UINT32	U32	N/A	Time duration indicating elapsed time between two events. Time is expressed in 1 ms increments. (For example, 10 s is 10,000.) Special constant NC_DURATION_NONE(0) is used for zero duration, and NC_DURATION_INFINITE (FFFFFFFF hex) is used for infinite duration.
NCTYPE_ATTRID	NCTYPE_UINT32	U32	N/A	Identifier used to access internal attributes in the NI-DNET device driver (not attributes in DeviceNet devices). Refer to Chapter 3, *NI-DNET Objects*.

Table 1-1. NI-DNET Data Types (Continued)

NI-DNET Data Type	ANSI C	LabVIEW	DeviceNet	Description
`NCTYPE_OPCODE`	`NCTYPE_UINT32`	`U32`	N/A	Operation code used with `ncOperateDnetIntf` function.
`NCTYPE_STATE`	`NCTYPE_UINT32`	`U32`	N/A	Object states, encoded as 32-bit mask (one bit for each state). For information, refer to `ncWaitForState` in Chapter 2, *NI-DNET Functions.*
`NCTYPE_STATUS`	`NCTYPE_INT32`	`I32`	N/A	Status returned from all NI-DNET functions. Status is zero for success, less than zero for an error, and greater than zero for a warning. Refer to Appendix A, *Status Handling and Error Codes*.

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NI-DNET Functions

This chapter lists all NI-DNET functions and describes the purpose, format, parameters, and return status for each function.

Unless otherwise stated, each NI-DNET function suspends execution of your program until it completes.

Using the Function Descriptions

This chapter lists the NI-DNET functions alphabetically. The description of each function is structured as follows:

Purpose

States the function's purpose.

Format

Describes the function's format for the LabVIEW (and BridgeVIEW) and C (including C++) programming languages.

Input

Lists the function's input parameters (values passed into the function).

Output

Lists the function's output parameters (values passed out of the function).

Function Description

Provides details about the function's purpose and effect.

Parameter Description

Provides details about each input/output parameter, including allowed values and their meanings.

Return Status

Lists all possible return status codes. For complete information on status format and the qualifiers used with each status code, refer to Appendix A, *Status Handling and Error Codes*.

For LabVIEW, the `Error in` and `Error out` parameters are not described in the function lists of this chapter. For information on status handling for LabVIEW, refer to Appendix A, *Status Handling and Error Codes*.

Examples

Each function description includes sample LabVIEW and C code showing how to use the function. For more detailed examples, refer to the example programs included with your NI-DNET software. The example programs are described in the *NI-DNET User Manual*.

List of NI-DNET Functions

Table 2-1 contains an alphabetical list of the NI-DNET functions.

Table 2-1. NI-DNET Functions

Function	Purpose
`DeviceNet Error Handler`	Convert status returned from an NI-DNET function into a descriptive string (LabVIEW only)
`EasyIOClose` (Easy IO Close)	Close multiple NI-DNET objects (LabVIEW only)
`EasyIOConfig` (Easy IO Config)	Configure and open multiple NI-DNET objects (LabVIEW only)
`ncCloseObject` (Close)	Close an NI-DNET object
`ncConvertForDnetWrite` (Convert for DeviceNet Write)	Convert an appropriate LabVIEW data type for writing data bytes on the DeviceNet network
`ncConvertFromDnetRead` (Convert From DeviceNet Read)	Convert data from the DeviceNet network into an appropriate LabVIEW data type
`ncCreateNotification` (Create Notification)	Create a notification callback for an object (C only)
`ncCreateOccurrence` (Create Occurrence)	Create a notification occurrence for an object (LabVIEW only)
`ncGetDnetAttribute` (Get DeviceNet Attribute)	Get an attribute value from a DeviceNet device using an Explicit Messaging Object

Table 2-1. NI-DNET Functions (Continued)

Function	Purpose
`ncGetDriverAttr` (Get Driver Attribute)	Get the value of an attribute in the NI-DNET driver
`ncOpenDnetExplMsg` (Open DeviceNet Explicit Messaging)	Configure and open an NI-DNET Explicit Messaging Object
`ncOpenDnetIntf` (Open DeviceNet Interface)	Configure and open an NI-DNET Interface Object
`ncOpenDnetIO` (Open DeviceNet I/O)	Configure and open an NI-DNET I/O Object
`ncOperateDnetIntf` (Operate DeviceNet Interface)	Perform an operation on an NI-DNET Interface Object
`ncReadDnetExplMsg` (Read DeviceNet Explicit Message)	Read an explicit message response from an Explicit Messaging Object
`ncReadDnetIO` (Read DeviceNet I/O)	Read input from an I/O Object
`ncSetDnetAttribute` (Set DeviceNet Attribute)	Set an attribute value for a DeviceNet device using an Explicit Messaging Object
`ncSetDriverAttr` (Set Driver Attribute)	Set the value of an attribute in the NI-DNET driver
`ncStatusToString` (Status to String)	Convert status returned from an NI-DNET function into a descriptive string (C only)
`ncWaitForState` (Wait for State)	Wait for one or more states to occur in an object
`ncWriteDnetExplMsg` (Write DeviceNet Explicit Message)	Write an explicit message request using an Explicit Messaging Object
`ncWriteDnetIO` (Write DeviceNet I/O)	Write output to an I/O Object

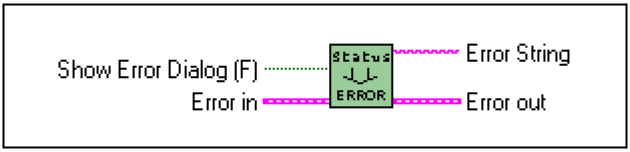
DeviceNet Error Handler

Purpose

Convert status returned from an NI-DNET function into a descriptive string.

Format

LabVIEW



C

Not applicable; see *ncStatusToString (Status To String)*

Input

`Error in`	NI-DNET Error Cluster input
`Show Error Dialog (F)`	Boolean indicating whether to show a dialog box for an error (default is false)

Output

`Error String`	Textual string which describes the contents of the NI-DNET Error Cluster
`Error out`	NI-DNET Error Cluster output

Function Description

Each LabVIEW NI-DNET function uses an Error Cluster to indicate the status of the function call. This Error Cluster encodes the severity of the error (success, warning, or error), a primary error code, and a qualifier for the error code. For example, if NI-DNET cannot initialize communication with a device, the `Status` field is true (indicating an error severity), the lower bits of `code` indicate the `NC_ERR_DEVICE_INIT` error code, and the higher bits of `code` indicate the exact cause of the initialization problem.

Within your LabVIEW block diagram, you wire the `Error in` and `Error out` terminals of NI-DNET functions together in succession. When `DeviceNet Error Handler` detects an error in an NI-DNET function (`Status` field true), all NI-DNET functions wired together are skipped except for `ncCloseObject`. The `ncCloseObject` function executes regardless of whether an error occurred, thus ensuring that all NI-DNET objects are closed properly when execution stops due to an error. Depending on how you want to handle errors, you can wire the `Error in` and `Error out` terminals together per-object (group a single open/close pair), per-device (group together Explicit Messaging and I/O Objects for a given device), or per-network (group all functions for a given interface).

The `DeviceNet Error Handler` function converts an NI-DNET Error Cluster into a descriptive string. By displaying this string when `DeviceNet Error Handler` detects an error or warning, you can avoid interpretation of individual fields of the Error Cluster to debug the problem. You normally wire the `Error in` terminal of this function from the `Error out` terminal of an `ncCloseObject` function.

To display an NI-DNET Error Cluster description without interrupting execution of other code, you normally wire the `Error out` and `Error String` output terminals of `DeviceNet Error Handler` to front panel indicators. If you want to interrupt execution and display a dialog box describing the error, set `Show Error Dialog` to true instead of using front panel indicators.

The `DeviceNet Error Handler` function does not apply to C language programming. Use the C language `ncStatusToString` function to convert an NI-DNET status value into a descriptive string.

For more information on NI-DNET status, including overall status handling, the encoding of fields in the Error Cluster, and problem resolutions for each error, refer to Appendix A, *Status Handling and Error Codes*.

Parameter Descriptions

Error in

Description	This NI-DNET Error Cluster input is used much like other NI-DNET functions. You normally wire it from the `Error out` terminal of an `ncCloseObject` function.
Values	NI-DNET Error Cluster

Show Error Dialog (F)

Description	Boolean indicating whether to show a dialog box for an error or warning. To display an NI-DNET Error Cluster description without interrupting execution of other code, set `Show Error Dialog` to false (or unwired), and wire the `Error out` and `Error String` output terminals of this function to front panel indicators. If you want to interrupt execution and display a dialog box describing the error or warning, set `Show Error Dialog` to true instead of using front panel indicators. This causes a dialog box to display a description of any error or warning that occurs.
Values	`T` or `F` (`F` is default if unwired)

Error out

Description	Use this NI-DNET Error Cluster output much like other NI-DNET functions. It is unchanged from the `Error in` terminal and is normally wired to a front panel indicator.
Values	NI-DNET Error Cluster

Error String

Description	Textual string which describes the contents of the NI-DNET Error Cluster. You usually wire this string to a front panel indicator.
Values	Textual string which describes the contents of the NI-DNET Error Cluster

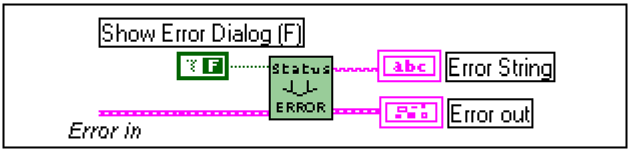
Return Status

The NI-DNET Error Cluster passes through `DeviceNet Error Handler` unchanged.

Example

LabVIEW

Check the NI-DNET Error Cluster returned from the `ncCloseObject` function, and display the Error Cluster and a descriptive string using front panel indicators.



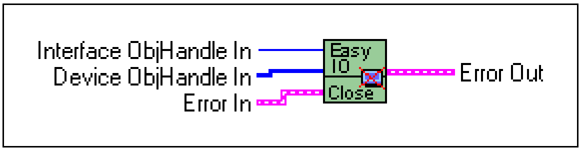
EasyIOClose (Easy IO Close)

Purpose

Close multiple NI-DNET objects in one call.

Format

LabVIEW



C

Not applicable

Input

`Interface ObjHandle In`	Object handle of an open Interface Object, returned from either Easy IO Config or Open DeviceNet Interface function
`Device ObjHandle In`	Array of I/O and/or Explicit Messaging object handles
`Error in`	NI-DNET Error Cluster input

Output

`Error out`	NI-DNET Error Cluster output

Function Description

`EasyIOClose` stops the Interface Object, closes all the object handles passed in the `Device ObjHandle In` parameter, and then closes the Interface Object. You normally call `EasyIOClose` near the end of your application to ensure that all objects are properly deallocated.

`EasyIOClose` accepts `Interface ObjHandle In` and `Device ObjHandle In` as input parameters. Generally, you pass the outputs from `EasyIOConfig` as inputs to `EasyIOClose`. However, if you have opened other I/O or Explicit Messaging Objects in your application, you could add their handles to the `Device ObjHandle In` array before calling this function, instead of calling `CloseObject.vi` for each handle.

Internally, the `EasyIOClose` function makes use of `OperateDeviceNetInterface.vi` (`ncOperateDnetIntf`) and `CloseObject.vi` (`ncCloseObject`). To learn more about these functions, refer to the corresponding function description sections.

Parameter Descriptions

Interface ObjHandle In

Description	Contains an interface object handle returned from the Easy IO Config or Open DeviceNet Interface function.
Values	The encoding of object handle is internal to NI-DNET.

Device ObjHandle In

Description	Array of I/O and EM object handles to be closed. You can pass in the array returned from Easy IO Config call, or you can modify that array to add any EM object handles or other I/O object handles that you want to close.
Values	The encoding of object handles is internal to NI-DNET.

Error out

Description	Return status of Easy IO Close is passed in this parameter.
Values	See return status below.

Return Status

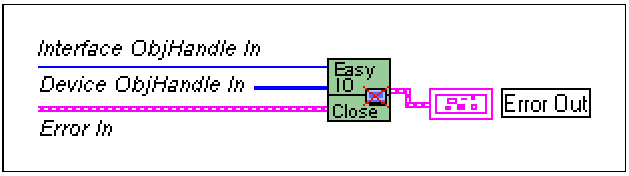
For information about converting the `Error out` value into a descriptive string, refer to `DeviceNet Error Handler`. For details on individual error codes, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_BAD_PARAM`	Invalid parameter

Examples

LabVIEW

Close Interface Object and I/O Objects opened with Easy IO Config.



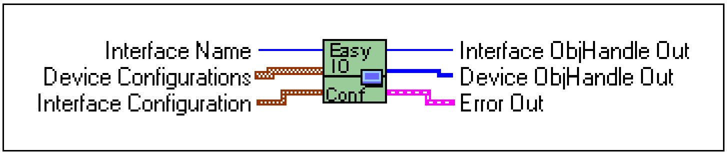
EasyIOConfig (Easy IO Config)

Purpose

Configure and open an NI-DNET Interface Object and multiple NI-DNET I/O Objects.

Format

LabVIEW



C

Not applicable

Input

`Interface Name`	Name of DeviceNet interface
`Device Configurations`	Array of I/O Object configuration cluster
`DeviceMacId`	MAC ID of the remote device
`ConnectionType`	Type of I/O connection
`InputLength`	Number of input bytes
`OutputLength`	Number of output bytes
`ExpPacketRate`	Expected rate of I/O message (packet) production
`Interface Configuration`	Interface Object configuration cluster
`IntfMacId`	MAC ID of the DeviceNet interface
`BaudRate`	Baud rate
`PollMode`	Communication scheme for all polled I/O connections

Output

`Interface ObjHandle Out`	Object handle you use with all subsequent function calls for the Interface Object
`Device ObjHandle Out`	Array of object handles you index to reference a particular I/O Object
`Error out`	NI-DNET Error Cluster output

Function Description

`EasyIOConfig` configures, opens, and starts an Interface and multiple I/O Objects, and returns object handles for the newly created objects.

Internally, the `EasyIOConfig` function makes use of `ncOpenDnetIntf`, `ncOpenDnetIO`, `ncOperateDnetIntf`, and `ncWaitForState`. If you are not familiar with the input clusters mentioned above, refer to ncOpenDnetIntf and/or ncOpenDnetIO parameter descriptions before reading this section. For more details on any of these functions, please refer to the corresponding function description given in this chapter.

Use EasyIOConfig to open multiple devices (I/O connections) with one VI call. This high-level function accepts Interface Configuration and an array of Device Configurations as its inputs. The Device Configurations can contain any number of I/O connections that you want to open. Remember, however, that you can only have one instance of a particular connection per device. For example, you cannot open two poll connections on the same device. Similarly, opening COS and cyclic connections simultaneously on a device will result in an error, since these two connections are mutually exclusive.

The relationship between expected packet rate (EPR) and the PollMode parameter of the Interface Object is the same as discussed in the ncOpenDnetIntf and ncOpenDnetIO function descriptions. For example, if you configure the Interface Object in Scanned mode, then all the strobe connections will have the same EPR and all the poll connections will have either the same EPR value or an integer multiple of it. If this is not the case, you will see an Inconsistent Parameter error.

Since the EasyIOConfig function also starts the interface, a call to ncOperateDnetIntf (for Start) is only needed if the communication needs to be interrupted in the middle of your application to set some driver attributes for an object. To do so, call ncOperateDnetIntf with Stop as the Opcode after calling EasyIOConfig, make necessary calls to ncSetDriverAttr, and then call ncOperateDnetIntf with Start as the Opcode to restart the communication.

To open an Explicit Messaging Object, call ncOpenDnetExplMsg separately after a call to EasyIOConfig to open the Interface and I/O Objects.

Note For any NI-DNET LabVIEW application, make sure that all the open calls are matched by an equal number of close calls. For example, if you have called the Open DeviceNet Interface function twice, you must call the Close Object function twice as well, passing in the handles returned from the open interface calls. Also, to ensure proper closure of all NI-DNET objects, create your own stop button to stop your application, instead of using the LabVIEW stop button from the menu bar.

Parameter Descriptions

Interface Name

Description	Name of the DeviceNet interface as an ASCII string with format `"DNETx"`, where *x* is a decimal number starting at zero that indicates which DeviceNet interface is being used. Use the NI-DNET Hardware Configuration utility to associate DeviceNet interface names with physical DeviceNet ports (by double-clicking on a port name). If you only have one DeviceNet interface in you computer, this name is usually `DNET0`. For more information on the Hardware Configuration utility, refer to your getting started manual.
Values	`"DNET0"`, `"DNET1"`, … `"DNET63"` In LabVIEW, you select the interface name from an enumerated list.

Device Configurations

Description	Array of NI-DNET I/O Object configuration clusters. For a description of individual elements within the I/O cluster, refer to the `ncOpenDnetIO` parameter description.
Values	Refer to the `ncOpenDnetIO` input parameters description for value range applicable to each configuration parameter.

Interface Configuration

Description	Configuration cluster for NI-DNET Interface Object. For a description of individual elements within the interface cluster, refer to the `ncOpenDnetIntf` parameter description.
Values	Refer to the `ncOpenDnetIntf` input parameters description for allowed values for each cluster element.

Interface ObjHandle Out

Description	If the Easy IO Config function is successful, a handle to the newly opened Interface Object is returned in `Interface ObjHandle Out`. This handle is used with all subsequent function calls for that Interface Object.
Values	The encoding of object handles is internal to NI-DNET.

Device ObjHandle Out

Description	If the Easy IO Config function is successful, an array of I/O Object handles is returned in `Device ObjHandle Out`. This array can be indexed to retrieve individual I/O handles for data read and write.
Values	The encoding of object handles is internal to NI-DNET.

Error out

Description	Return status of the Easy IO Config function is passed in this parameter.
Values	See return status below.

Return Status

For information about converting the `Error out` value into a descriptive string, refer to the DeviceNet Error Handler function description. For details on individual error codes, refer to Appendix A, *Status Handling and Error Codes*.

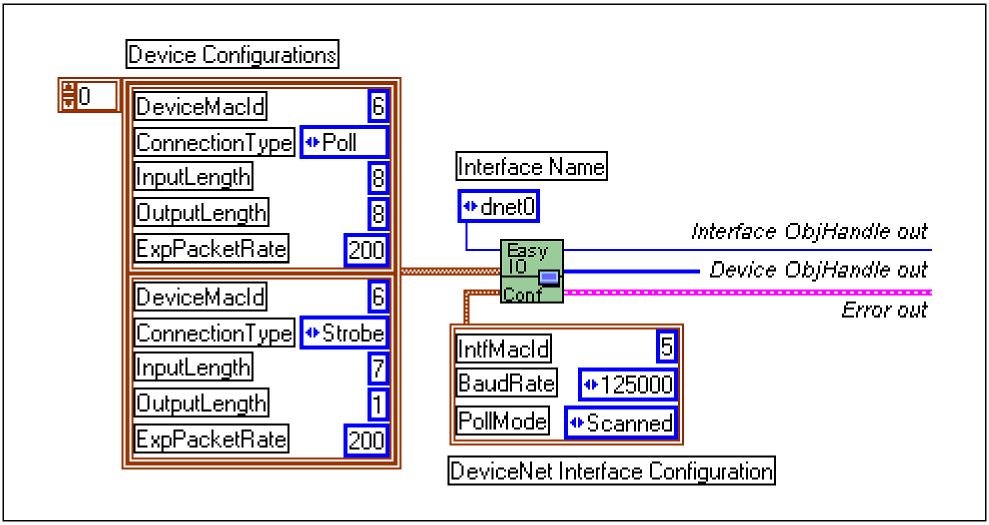
`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_TIMEOUT`	Timeout expired before the first I/O Object in the array was established. If the first I/O Object in the array is configured as an NI-DNET slave I/O for a remote master (for example, the `DeviceMacId` is the same as the `IntfMacId`), you can ignore this error, since the connection will be established when the remote master starts communication with the slave.
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_DEVICE_INIT`	Problem initializing remote device for communication
`NC_ERR_DEVICE_MISSING`	One of the remote devices in the `Device Configurations` array is missing from your network
`NC_ERR_BAD_NET_ID`	Interface Object MAC ID conflicts with another DeviceNet device
`NC_ERR_CAN_COMM`	Low-level communication errors, often caused by bad cabling
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_RSRC_LIMITS`	Configuration exceeds NI-DNET resource limits
`NC_ERR_ALREADY_OPEN`	One of the objects (Interface or I/O) is already open with different configuration

The error code returned from `EasyIOConfig` could be returned from any of the component VIs. If the function was successful in opening only a few objects, make sure these object are closed when you exit your application, even if you do not use them.

Examples

LabVIEW

Open Interface Object `"DNET0"` using baud rate `125000`, MAC ID `5`, and poll mode `Scanned`. Open two I/O Objects, with MAC ID `6` and `9`, and start the communication.



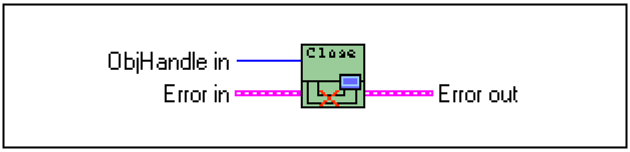
ncCloseObject (Close)

Purpose

Close an NI-DNET object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncCloseObject(NCTYPE_OBJH ObjHandle)
```

Input

`ObjHandle`	Object handle of an open Interface Object, Explicit Messaging Object, or I/O Object

Output

None

Function Description

The `ncCloseObject` function closes an NI-DNET object when it no longer needs to be in use, such as when the application is about to terminate. When an object is closed, NI-DNET stops all pending operations for the object, and you can no longer use the `ObjHandle` in your application.

If the object specified by `ObjHandle` has a notification pending, `ncCloseObject` disables the notification by implicitly calling either `ncCreateNotification` or `ncCreateOccurrence` with `DesiredState` zero.

When `ncCloseObject` has been called for all open NI-DNET objects, NI-DNET stops all DeviceNet communication (`ncCloseObject` issues an implicit call to `ncOperateDnetIntf` with `Opcode` `NC_OP_STOP`).

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from the `ncOpenDnetIntf`, `ncOpenDnetExplMsg`, or `ncOpenDnetIO` function.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

Return Status

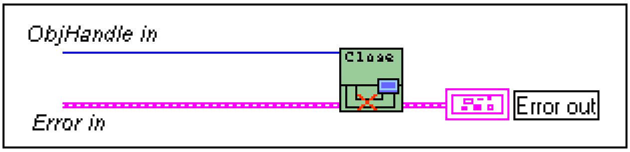
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver

Examples

LabVIEW

Close an NI-DNET object.



C

Close an NI-DNET object.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
status = ncCloseObject (objh);
```

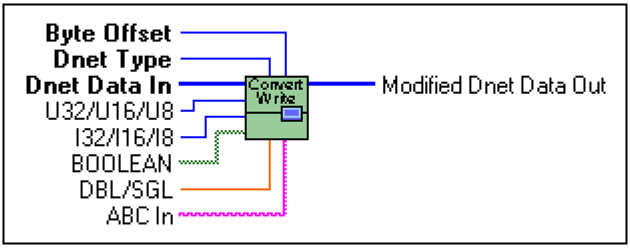
ncConvertForDnetWrite (Convert For DeviceNet Write)

Purpose

Convert an appropriate LabVIEW data type for writing data bytes on the DeviceNet network.

Format

LabVIEW



C

Not applicable, but see *Examples* at the end of this section

Input

`DnetData in`	Initial data bytes to write on the DeviceNet network
`DnetType`	DeviceNet data type to convert into
`ByteOffset`	Byte offset of the DeviceNet member to convert into
`8[TF] in`	LabVIEW array of 8 `TF` to convert from
`I32/I16/I8 in`	LabVIEW `I32`, `I16`, or `I8` to convert from
`U32/U16/U8 in`	LabVIEW `U32`, `U16`, or `U8` to convert from
`DBL/SGL in`	LabVIEW `DBL` or `SGL` to convert from
`abc in`	LabVIEW string to convert from

Output

`DnetData out`	DeviceNet data bytes (with member inserted)

Function Description

Many fundamental differences exist between the encoding of a DeviceNet data type and its equivalent data type in LabVIEW. For example, for a 32-bit integer, the DeviceNet `DINT` data type uses Intel byte ordering (lowest byte first), and the equivalent LabVIEW `I32` data type uses Motorola byte ordering (highest byte first).

`ncConvertForDnetWrite` takes an initial sequence of bytes to write on the DeviceNet network, and given the byte offset and DeviceNet data type for a specific data member, converts an appropriate LabVIEW data type for placement into those data bytes. You provide initial data bytes using `DnetData in`, convert a LabVIEW data type for each data member changed by your LabVIEW program (possibly replacing all initial bytes with LabVIEW data), then write the bytes onto the DeviceNet network.

You typically use `ncConvertForDnetWrite` with the following NI-DNET functions:

- `ncWriteDnetIO`—Convert a LabVIEW data type for placement into the output assembly.
- `ncSetDnetAttribute`—Convert a LabVIEW data type to set as the attribute value.
- `ncWriteDnetExplMsg`—Convert a LabVIEW data type for placement into the service request.

Since DeviceNet data types are similar to C language data types, C programming does not need a function like `ncConvertForDnetWrite`. By using standard C language pointer manipulations, you can convert an appropriate C language data type for writing as a DeviceNet data member. For more information about converting C language data types, refer to the *Examples* at the end of this section.

Parameter Descriptions

DnetData in

Description	Initial data bytes to write on the DeviceNet network. These data bytes are normally created as a constant array of `U8` then given valid default values. If you need to convert multiple DeviceNet data members, you can wire this input terminal from the `DnetData out` output terminal of a previous use of this function. If you replace all initial data bytes using this function, the default values are unimportant, and you can leave them as zero.
Values	Initial data bytes to write on the DeviceNet network or `DnetData out` output terminal of a previous use of this function

DnetType

Description	An enumerated list from which you choose the DeviceNet data type to convert into. For each DeviceNet data type, the appropriate LabVIEW data type is listed in parentheses. When you select the DeviceNet data type `BOOL`, `ncConvertForDnetWrite` converts the byte indicated by `ByteOffset` from an array of eight LabVIEW booleans. You can index into this array to change specific boolean members. The boolean at index zero is the least significant bit (bit 0), the boolean at index one is the next least significant (bit 1), and so on.

Values	`BOOL (8[TF])`
	`SINT (I8)`
	`INT (I16)`
	`DINT (I32)`
	`USINT (U8)`
	`UINT (U16)`
	`UDINT (U32)`
	`REAL (SGL)`
	`LREAL (DBL)`
	`SHORT_STRING (abc)`
	`STRING (abc)`

ByteOffset

Description	Byte offset of the DeviceNet member to convert into. For the DeviceNet data member you want to replace, this is the byte offset in `DnetData in` where the member begins. Byte offsets start at zero. You can find information on the format of your DeviceNet data in the following functions: • `ncWriteDnetIO`—Specification for your device's output assembly. • `ncSetDnetAttribute`—Data type of the attribute. Unless the attribute's DeviceNet data type is a structure or array, the value for `ByteOffset` is always `0`. • `ncWriteDnetExplMsg`—Specification for the service data of the explicit message request.
Values	`0` to `255`

8[TF] in

Description	If the selected `DnetType` is `BOOL`, this input terminal provides the LabVIEW data to convert into a DeviceNet data member. The LabVIEW data type for this input terminal is an array of eight LabVIEW booleans, indicated as `8[TF]`. You can index into this array to change specific boolean members. The boolean at index zero is the least significant bit (bit 0), the boolean at index one is the next least significant (bit 1), and so on.
Values	LabVIEW data to convert into a DeviceNet data member

I32/I16/I8 in

Description	If the selected `DnetType` is `SINT`, `INT`, or `DINT`, this input terminal provides the LabVIEW data to convert into a DeviceNet data member. Although the LabVIEW data type for this input terminal is `I32`, it can be coerced automatically from `I16` or `I8`.
Values	LabVIEW data to convert into a DeviceNet data member

U32/U16/U8 in

Description	If the selected `DnetType` is `USINT`, `UINT`, or `UDINT`, this input terminal provides the LabVIEW data to convert into a DeviceNet data member. Although the LabVIEW data type for this input terminal is `U32`, it can be coerced automatically from `U16` or `U8`.
Values	LabVIEW data to convert into a DeviceNet data member

DBL/SGL in

Description	If the selected `DnetType` is `REAL` or `LREAL`, this input terminal provides the LabVIEW data to convert into a DeviceNet data member. Although the LabVIEW data type for this input terminal is `DBL`, it can be coerced automatically from `SGL`.
Values	LabVIEW data to convert into a DeviceNet data member

abc in

Description	If the selected `DnetType` is `SHORT_STRING` or `STRING`, this input terminal provides the LabVIEW data to convert into a DeviceNet data member. The LabVIEW data type for this input terminal is `abc`.
Values	LabVIEW data to convert into a DeviceNet data member

DnetData out

Description	DeviceNet data bytes (with member inserted). These data bytes are written on the DeviceNet network using the `ncWriteDnetIO`, `ncSetDnetAttribute`, or `ncWriteDnetExplMsg` function. If you need to convert multiple DeviceNet data members, you can also wire this output terminal into the `DnetData in` input terminal of a subsequent use of this function.

Values	`Data` input terminal of `ncWriteDnetIO`
	or
	`AttrData` input terminal of `ncSetDnetAttribute`
	or
	`ServData` input terminal of `ncWriteDnetExplMsg`
	or
	`DnetData in` input terminal of a subsequent use of this function

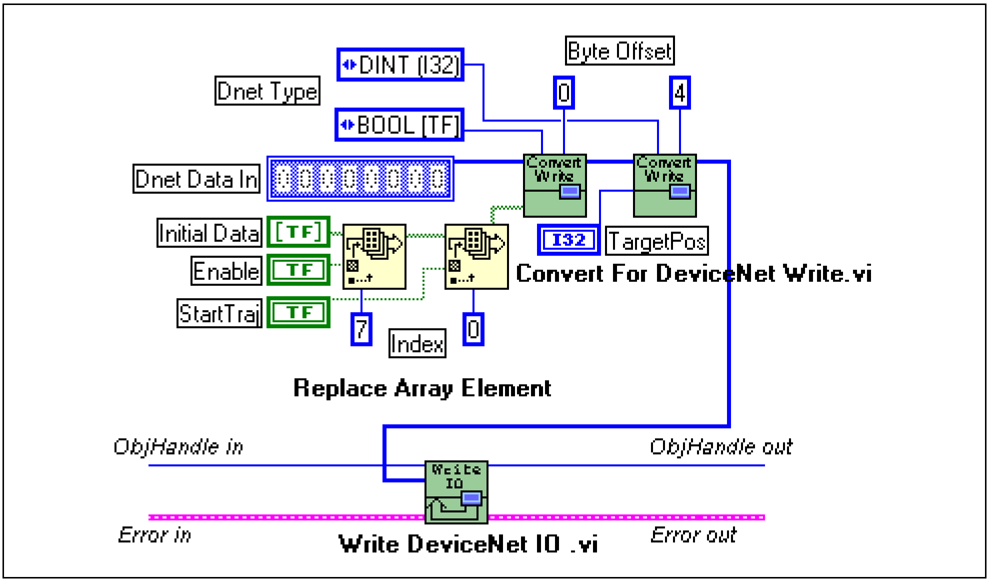
Return Status

`ncConvertForDnetWrite` does not return status because this function cannot encounter errors.

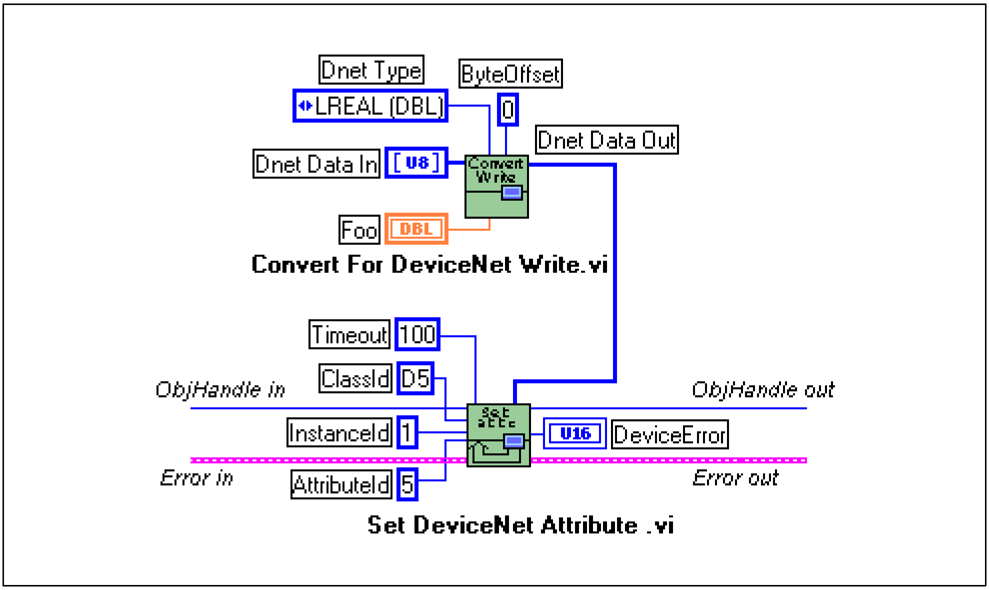
Examples

LabVIEW

1. Use `ncWriteDnetIO` to write Command Assembly 1 to a Position Controller. In this output assembly, the byte at offset 0 consists of 8 `BOOL` and the bytes at offset 4–7 consist of a Target Position of type `DINT`. Use `ncConvertForDnetWrite` to convert appropriate LabVIEW data types for these DeviceNet data members.



2. Set an attribute Foo using the `ncSetDnetAttribute` function. The attribute Foo is contained in an object with class ID `D5` hex, instance ID `1`, attribute ID `5`, and its DeviceNet data type is `LREAL`. Use `ncConvertForDnetWrite` to convert the appropriate LabVIEW data type for Foo.



C

1. Demonstrate the same conversions as LabVIEW example 1.

```
NCTYPE_UINT8           data[8];
NCTYPE_UINT8           I;
NCTYPE_INT32           TargetPos;   /* DINT */
NCTYPE_BOOL            Enable;      /* BOOL */
NCTYPE_BOOL            StartTraj;   /* BOOL */

   /* Initialize default values of zero.  */
for (I = 0; I < 8; I++)
   data[I] = 0;

   /* If Enable is true, set bit 7 of byte 0.  If StartTraj is
   true, set bit 0 of byte 0.  */
if (Enable == NC_TRUE)
   data[0] |= 0x80;
if (StartTraj == NC_TRUE)
   data[0] |= 0x01;

   /* Take the address of the data byte at offset 4, cast that
   address to point to the appropriate C language data type, then
   dereference the pointer in order to store the value.  */
*(NCTYPE_INT32 *)(&(data[4])) = TargetPos;

status = ncWriteDnetIO(objh, sizeof(data), data);
```

2. Demonstrate the same conversion as LabVIEW example 2.

```
NCTYPE_LREAL           foo;
   /* Conversion is performed automatically simply by passing in
   a pointer to the appropriate C language data type.  */
foo = 354654.4543;
status = ncSetDnetAttribute(objh, 0xD5, 0x01, 0x05, 100,
                       sizeof(foo), &foo);
```

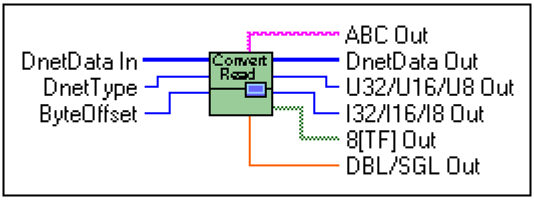
ncConvertFromDnetRead (Convert From DeviceNet Read)

Purpose

Convert data read from the DeviceNet network into an appropriate LabVIEW data type.

Format

LabVIEW



C

Not applicable, but see *Examples* at the end of this section

Input

`DnetData in`	Data bytes read from the DeviceNet network
`DnetType`	DeviceNet data type to convert from
`ByteOffset`	Byte offset of the DeviceNet member to convert

Output

`DnetData out`	DeviceNet data bytes (unchanged)
`8[TF] out`	Converted LabVIEW array of 8 `TF`
`I32/I16/I8 out`	Converted LabVIEW `I32`, `I16`, or `I8`
`U32/U16/U8 out`	Converted LabVIEW `U32`, `U16`, or `U8`
`DBL/SGL out`	Converted LabVIEW `DBL` or `SGL`
`abc out`	Converted LabVIEW string

Function Description

Many fundamental differences exist between the encoding of a DeviceNet data type and its equivalent data type in LabVIEW. For example, for a 32-bit integer, the DeviceNet `DINT` data type uses Intel byte ordering (lowest byte first), and the equivalent LabVIEW `I32` data type uses Motorola byte ordering (highest byte first).

`ncConvertFromDnetRead` takes a sequence of bytes read from the DeviceNet network, and given the byte offset and DeviceNet data type for a specific data member in those bytes, converts that DeviceNet data member into an appropriate LabVIEW data type.

You typically use `ncConvertFromDnetRead` with the following NI-DNET functions:

- `ncReadDnetIO`—Convert a member of the input assembly to its LabVIEW data type.
- `ncGetDnetAttribute`—Convert the attribute to its LabVIEW data type.
- `ncReadDnetExplMsg`—Convert a member in the service response to its LabVIEW data type.

Since DeviceNet data types are similar to C language data types, C programming does not need a function like `ncConvertFromDnetRead`. By using standard C language pointer manipulations, you can convert a DeviceNet data member into its appropriate C language data type. For more information about converting DeviceNet data members into C language data types, refer to the *Examples* at the end of this section.

Parameter Descriptions

DnetData in

Description	Data bytes read from the DeviceNet network. These data bytes are read from the DeviceNet network using `ncReadDnetIO`, `ncGetDnetAttribute`, or `ncReadDnetExplMsg`. If you need to convert multiple DeviceNet data members, you can wire this input terminal from the `DnetData out` output terminal of a previous use of this function.

Values	`Data` output terminal of `ncReadDnetIO`
	or
	`AttrData` output terminal of `ncGetDnetAttribute`
	or
	`ServData` output terminal of `ncReadDnetExplMsg`
	or
	`DnetData out` output terminal of a previous use of this function

DnetType

Description	An enumerated list from which you select the DeviceNet data type to convert. For each DeviceNet data type, the list displays the resulting LabVIEW data type in parentheses. When you select the DeviceNet data type `BOOL`, `ncConvertFromDnetRead` converts the byte indicated by `ByteOffset` into an array of eight LabVIEW booleans. You can index into this array to use specific boolean members. The boolean at index zero is the least significant bit (bit 0), the boolean at index one is the next least significant (bit 1), and so on.

Values	`BOOL (8[TF])`
	`SINT (I8)`
	`INT (I16)`
	`DINT (I32)`
	`USINT (U8)`
	`UINT (U16)`
	`UDINT (U32)`
	`REAL (SGL)`
	`LREAL (DBL)`
	`SHORT_STRING (abc)`
	`STRING (abc)`

ByteOffset

Description	Byte offset of the DeviceNet member to convert. For the DeviceNet data member you want to convert, this is the byte offset in `DnetData in` where the member begins. Byte offsets start at zero. You can find information on the format of your DeviceNet data in the following functions: • `ncReadDnetIO`—Specification for your device’s input assembly. • `ncGetDnetAttribute`—Data type of the attribute. Unless the attribute’s DeviceNet data type is a structure or array, the value for `ByteOffset` is always `0`. • `ncReadDnetExplMsg`—Specification for the service data of the explicit message response.
Values	`0` to `255`

DnetData out

Description	DeviceNet data bytes (unchanged). The data bytes of `DnetData in` are passed through the VI to this output terminal unchanged. To convert another DeviceNet data member, this data can be passed on to another call to this function.
Values	Same as `DnetData in`

8[TF] out

Description	If the selected `DnetType` is `BOOL`, this output terminal provides the converted DeviceNet data member. The LabVIEW data type for this output terminal is an array of eight LabVIEW booleans, indicated as `8[TF]`. You can index into this array to use specific boolean members. The boolean at index zero is the least significant bit (bit 0), the boolean at index one is the next least significant (bit 1), and so on.
Values	Converted DeviceNet data member

I32/I16/I8 out

Description	If the selected `DnetType` is `SINT`, `INT`, or `DINT`, this output terminal provides the converted DeviceNet data member. Although the LabVIEW data type for this output terminal is `I32`, it can be coerced automatically to `I16` or `I8`.
Values	Converted DeviceNet data member

U32/U16/U8 out

Description	If the selected `DnetType` is `USINT`, `UINT`, or `UDINT`, this output terminal provides the converted DeviceNet data member. Although the LabVIEW data type for this output terminal is `U32`, it can be coerced automatically to `U16` or `U8`.
Values	Converted DeviceNet data member

DBL/SGL out

Description	If the selected DnetType is REAL or LREAL, this output terminal provides the converted DeviceNet data member. Although the LabVIEW data type for this output terminal is DBL, it can be coerced automatically to SGL.
Values	Converted DeviceNet data member

abc out

Description	If the selected DnetType is SHORT_STRING or STRING, this output terminal provides the converted DeviceNet data member. The LabVIEW data type for this output terminal is abc.
Values	Converted DeviceNet data member

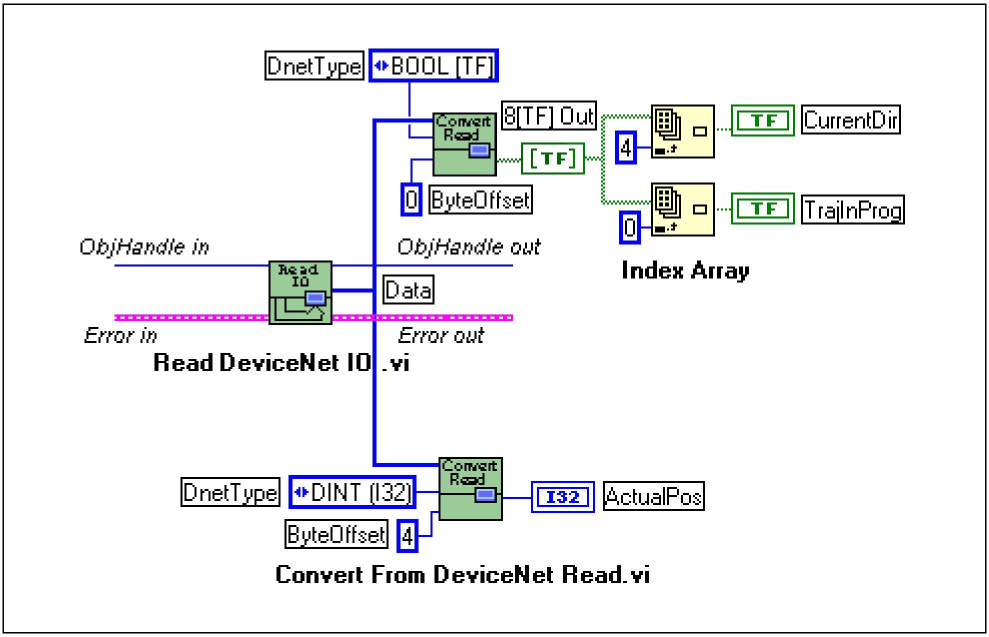
Return Status

ncConvertFromDnetRead does not return status because this function cannot encounter errors.

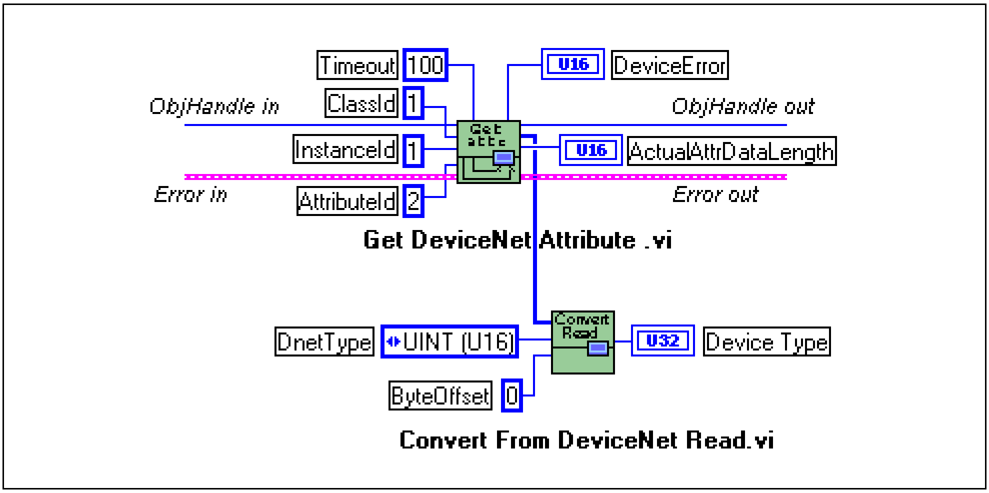
Examples

LabVIEW

1. Use ncReadDnetIO to read Response Assembly 1 from a Position Controller. In this input assembly, the byte at offset 0 consists of 8 BOOL, and the bytes at offset 4-7 consist of an Actual Position of type DINT. Use ncConvertFromDnetRead to convert these DeviceNet data members into appropriate LabVIEW data types.



2. Get the Device Type attribute using the `ncGetDnetAttribute` function. The Device Type is contained in the Identity Object (class ID `1`, instance ID `1`, attribute ID `2`), and its DeviceNet data type is `UINT`. Use `ncConvertFromDnetRead` to convert the Device Type into an appropriate LabVIEW data type.



C

1. Demonstrate the same conversions as LabVIEW example 1.

```
NCTYPE_UINT8           data[8];
NCTYPE_INT32           ActualPos;   /* DINT */
NCTYPE_BOOL            CurrentDir;  /* BOOL */
NCTYPE_BOOL            TrajInProg;  /* BOOL */
status = ncReadDnetIO(objh, sizeof(data), data);


   /* Take the address of the data byte at offset 4, cast that
   address to point to the appropriate C language data type, then
   dereference the pointer.  */
ActualPos = *(NCTYPE_INT32 *)(&(data[4]));


   /* If bit 4 of byte 0 is set, then CurrentDir is true. If bit
   0 of byte 0 is set, the TrajInProg is true.  */
CurrentDir = (data[0] & 0x10) ? NC_TRUE : NC_FALSE;
TrajInProg = (data[0] & 0x01) ? NC_TRUE : NC_FALSE;
```

2. Demonstrate the same conversion as LabVIEW example 2.

```
NCTYPE_UINT16          device_type;
NCTYPE_UINT16          actual_length;
   /* Conversion is performed automatically simply by passing in
   a pointer to the appropriate C language data type.  */
status = ncGetDnetAttribute(objh, 0x01, 0x01, 0x02, 100,
                       sizeof(device_type), &device_type,
                       &actual_length);
```

ncCreateNotification (Create Notification)

Purpose

Create a notification callback for an object (C only).

Format

LabVIEW

Not applicable; see *ncCreateOccurrence (Create Occurrence)*

C

```
NCTYPE_STATUS    ncCreateNotification(NCTYPE_OBJH ObjHandle,
                                      NCTYPE_STATE DesiredState,
                                      NCTYPE_DURATION Timeout,
                                      NCTYPE_ANY_P RefData,
                                      NCTYPE_NOTIFY_CALLBACK
                                         Callback)
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object or I/O Object
`DesiredState`	States for which notification is called
`Timeout`	Number of milliseconds to wait for one of the desired states
`RefData`	Pointer to user-specified reference data
`Callback`	Address of your callback function

Output

None

Function Description

`ncCreateNotification` creates a notification callback for the object specified by `ObjHandle`. The NI-DNET driver uses the notification callback to communicate state changes to your application. The `ncCreateNotification` function does not apply to LabVIEW programming. Use the `ncCreateOccurrence` function to receive notifications within LabVIEW.

You commonly use `ncCreateNotification` to receive notifications when new input data is available for an I/O Object. Within your notification callback function, you call `ncReadDnetIO` to read the new input data, perform any needed calculations for that data, call `ncWriteDnetIO` to provide output data, then return from the callback function.

You normally use ncCreateNotification when you want to let other code to execute while waiting for NI-DNET states, especially when the other code does not call NI-DNET functions. If you do not need such background execution, ncWaitForState offers better overall performance. You cannot use ncWaitForState at the same time as ncCreateNotification.

The Status parameter of your callback function indicates any error detected by NI-DNET. You should always check this Status parameter prior to checking the CurrentState parameter of your callback function.

When ncCreateNotification returns successfully, NI-DNET calls your notification callback function whenever one of the states specified by DesiredState occurs in the object. If DesiredState is 0, NI-DNET disables notifications for the object specified by ObjHandle.

Parameter Descriptions

ObjHandle

Description	ObjHandle must contain an object handle returned from ncOpenDnetExplMsg or ncOpenDnetIO.
Values	The encoding of ObjHandle is internal to NI-DNET.

DesiredState

Description	States for which notification is called. So that notification can be enabled for multiple states simultaneously, a single bit represents each state. For example, if NI-DNET provides states with values of hex 1 and hex 4, `DesiredState` of hex 5 enables notification for both states. `ReadAvail` for the I/O Object For the I/O Object, the `ReadAvail` state sets when a new input message is received from the network. The `ReadAvail` state clears when you call `ncReadDnetIO`. For example, for a change-of-state (COS) I/O connection, the notification occurs when a COS input message is received. The typical behavior for your callback function is to call `ncReadDnetIO` to read the new input data, perform any calculations needed, call `ncWriteDnetIO` to provide output data, then return from the callback function. `ReadAvail` for the Explicit Messaging Object For the Explicit Messaging Object, the `ReadAvail` state sets when an explicit message response is received from the network. The `ReadAvail` state clears when you call `ncReadDnetExplMsg`. An explicit message response is received only after you send an explicit message request using `ncWriteDnetExplMsg`. Although using a notification for an explicit message response allows for execution of other code while waiting, it is often more straightforward to use the following sequence of calls: `ncWriteDnetExplMsg`, `ncWaitForState`, `ncReadDnetExplMsg`. This is the sequence used internally by `ncGetDnetAttribute` and `ncSetDnetAttribute`. The `ReadAvail` state is not needed when using the explicit messaging functions `ncGetDnetAttribute` and `ncSetDnetAttribute` because both of these functions wait for the explicit message response internally.

DesiredState (Continued)

Description (Continued)	Established for the Explicit Messaging Object For the Explicit Messaging Object, the Established state is clear (not established) before you start communication using ncOperateDnetIntf. After you start communication, the Established state remains clear until the explicit message connection has been successfully established with the remote DeviceNet device. After the explicit message connection has been established, the Established state sets and remains set for as long as the explicit message connection is open. Until the Established state is set for the Explicit Messaging Object, all calls to ncGetDnetAttribute, ncSetDnetAttribute, or ncWriteDnetExplMsg return the error NC_ERR_NOT_STARTED. Before you call any of these functions in your application, you must first wait for the Established state to set. After the Established state is set, unless communication problems occur with the device (NC_ERR_TIMEOUT), it remains set until you stop communication using ncOperateDnetIntf. While waiting for one of the above states, if an error occurs (such as a communication error or an initialization error), the notification returns immediately with the appropriate error code. For example, if you call ncCreateNotification with DesiredState of ReadAvail, the notification function will return when data is available for a read, or when a DeviceNet communication error (such as connection timeout) is detected.
Values	A combination of the following bit values: 1 hex (ReadAvail state, constant NC_ST_READ_AVAIL) 8 hex (Established, constant NC_ST_ESTABLISHED) In the LabWindows/CVI function panel, to facilitate combining multiple states, you can select a combination from an enumerated list of all valid combinations. This list contains the names of each state in the combination, such as ReadAvail or Established.

Timeout

Description	Number of milliseconds to wait for one of the desired states. If the timeout expires before one of the desired states occurs, your notification function is called with CurrentState of 0 and Status of NC_ERR_TIMEOUT. Use the special timeout value of FFFFFFFF hex to wait indefinitely.
Values	1 to 200000 or FFFFFFFF hex (infinite duration, constant NC_DURATION_INFINITE)

RefData

Description	RefData provides a pointer that is passed to all calls of your notification callback function. It is typically used to provide the address of globally declared reference data for use within the notification callback. For example, for the ReadAvail state, RefData is often the data buffer which you pass to ncReadDnetIO to read available data. If the notification callback does not need reference data, you can set RefData to NULL.
Values	Pointer to any globally declared data variable or NULL

Callback

Description	This is the address of a callback function within your application source code. Within the code for the callback function, you can call any of the NI-DNET functions except for `ncCreateNotification` and `ncWaitForState`.
	Declare this function using the following C language prototype.
	`NCTYPE_STATE _NCFUNC_ Callback(`
	`NCTYPE_OBJH ObjHandle,`
	`NCTYPE_STATE CurrentState,`
	`NCTYPE_STATUS Status,`
	`NCTYPE_ANY_P RefData);`
	In the declaration for your callback, the constant `_NCFUNC_` is required for your compiler to declare the function such that it can be called by the NI-DNET device driver.
	Parameter descriptions for `Callback`
	`ObjHandle`
	Object handle originally passed to `ncCreateNotification`. This identifies the object generating the notification, which is useful when you use the same callback function for multiple objects.
	`CurrentState`
	Current state of the object. If one of the desired states occurs, it provides the current value of the `ReadAvail` and `Established` states. If the `Timeout` expires before one of the desired states occurs, it has the value `0`.
	`Status`
	Current status of the object. If one of the desired states occurs, it has the value `0` (`NC_SUCCESS`). If the `Timeout` expires before one of the desired states occurs, it has the value `80000001` hex (`NC_ERR_TIMEOUT` with an error qualifier of `NC_QUAL_TIMO_FUNCTION`).
	`RefData`
	Pointer to your reference data as originally passed to `ncCreateNotification`.

Callback (Continued)

Description (Continued)	`Return Value from Callback` The value you return from the callback indicates the desired states to re-enable for notification. If you want to continue to receive notifications, return the same value as the original `DesiredState` parameter. If you no longer want to receive notifications, return a value of `0`. If you return a nonzero value from the callback, and one of those states is still set, the callback is invoked again immediately after you return. For example, if you return `ReadAvail` from the callback without calling `ncReadDnetIO` to read the available data, the callback is invoked again. Information Specific to LabWindows/CVI When the NI-DNET device driver calls your notification callback, it does so in a separate thread within the LabWindows/CVI process. Your application's front panel indicators and controls can only be accessed within the main thread of the LabWindows/CVI process. Although you can call NI-DNET functions and perform generic C calculations in your notification callback, you cannot call LabWindows/CVI functions which access the front panel (the User Interface Library). To use the LabWindows/CVI User Interface Library, save any data needed for front panel indicators using global variables, then register a deferred callback using the LabWindows/CVI `PostDeferredCall` function. Since a LabWindows/CVI deferred callback executes in the main thread of the LabWindows/CVI process, you can call any LabWindows/CVI function, including the User Interface Library. Information Specific to Microsoft, Borland, and Other C Compilers When the NI-DNET device driver calls your notification callback, it does so in a separate thread within your process. Therefore, it has access to any process global data, but not thread local data. If your callback function needs to access global variables, you must protect that access using synchronization primitives (such as semaphores) because your callback is running in a different thread context. For an explanation of these concepts and other multithreading issues, refer to the online help of the Microsoft Win32 Software Development Kit (SDK).

Callback (Continued)

Values	Address of a callback function within your application source code. For example, if your function is declared with the name `MyReadCallback`, you would pass `MyReadCallback` as the `Callback` parameter.

Return Status

For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

NC_SUCCESS	Success (no warning or error)
NC_ERR_BAD_PARAM	Invalid parameter
NC_ERR_DRIVER	Implementation-specific error in the NI-DNET driver
NC_ERR_NOT_SUPPORTED	Only one pending wait or notification is allowed at any given time.

Example

C

Create a notification for the `ReadAvail` state. Use a timeout of 10 seconds.

```
NCTYPE_UINT8          DataBuffer[20];
NCTYPE_STATE          _NCFUNC_ MyReadCallback (
                             NCTYPE_OBJH ObjHandle,
                             NCTYPE_STATE CurrentState,
                             NCTYPE_STATUS Status,
                             NCTYPE_ANY_P RefData) {
   if (Status == NC_SUCCESS) {
         Status = ncReadDnetIO(ObjHandle, 20, RefData);
         .
         .
         .
   }
   .
   .
   .
   return(NC_ST_READ_AVAIL);
}
```

```
void main() {
   NCTYPE_STATUS        status;
   NCTYPE_OBJH          objh;

   .
   .
   .
   status = ncCreateNotification(objh, NC_ST_READ_AVAIL,
                        10000, DataBuffer, MyReadCallback);
   .
   .
   .
}
```

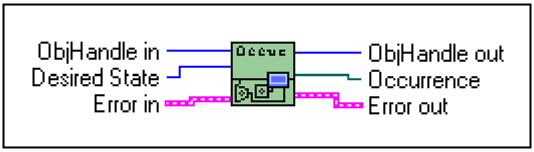
ncCreateOccurrence (Create Occurrence)

Purpose

Create a notification occurrence for an object (LabVIEW only).

Format

LabVIEW



C

Not applicable; see *ncCreateNotification (Create Notification)*

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object or I/O Object
`DesiredState`	States for which notification occurs

Output

`Occurrence`	Occurrence that can be used with LabVIEW `Wait on Occurrence` VI.

Function Description

`ncCreateOccurrence` creates a notification occurrence for the object specified by `ObjHandle`. The NI-DNET driver uses the occurrence to communicate state changes to your application. The `ncCreateOccurrence` function is not applicable to C programming. Use `ncCreateNotification` to receive notifications within C.

The most common use of `ncCreateOccurrence` is to receive an occurrence when new input data is available for an I/O Object. When the occurrence is received, you call `ncReadDnetIO` to read the new input data, perform any calculations needed, call `ncWriteDnetIO` to provide output data, then wait for the occurrence again. By using the occurrence with I/O Objects, your application executes at the same rate as the DeviceNet I/O communication.

When `ncCreateOccurrence` returns successfully, the notification occurrence is set whenever one of the states specified by `DesiredState` occurs in the object. If `DesiredState` is `0`, notifications are disabled for the object specified by `ObjHandle`.

The LabVIEW occurrence will trigger for any error detected by NI-DNET. When the occurrence triggers, your application normally calls a read or write function to access DeviceNet data. If the occurrence triggers due to an error instead of an actual `ReadAvail` or `Established` state, the read or write function will return the error in its outgoing error cluster (`Error out`).

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from `ncOpenDnetExplMsg` or `ncOpenDnetIO`. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

DesiredState

Description	States for which notification occurs. Each state is represented by a single bit so that you can enable notification for multiple states simultaneously. For example, if NI-DNET provides states with values of hex 1 and hex 4, `DesiredState` of hex 5 enables notification for both states. `ReadAvail` for the I/O Object For the I/O Object, the `ReadAvail` state sets when a new input message is received from the network. The `ReadAvail` state clears when you call `ncReadDnetIO`. For example, for a change-of-state (COS) I/O connection, the notification occurs when a COS input message is received. When the occurrence is received, the typical behavior is to call `ncReadDnetIO` to read the new input data, perform any calculations needed, call `ncWriteDnetIO` to provide output data, then wait for the occurrence again.

DesiredState (Continued)

Description (Continued)	`ReadAvail` for the Explicit Messaging Object For the Explicit Messaging Object, the `ReadAvail` state sets when an explicit message response is received from the network. The `ReadAvail` state clears when you call `ncReadDnetExplMsg`. You receive an explicit message response only after you send an explicit message request using `ncWriteDnetExplMsg`. Although using a notification for an explicit message response allows for execution of other code while waiting, it is often more straightforward to use the following sequence of calls: `ncWriteDnetExplMsg`, `ncWaitForState`, `ncReadDnetExplMsg`. This is the sequence used internally by `ncGetDnetAttribute` and `ncSetDnetAttribute`. The `ReadAvail` state is not needed when using the explicit messaging functions `ncGetDnetAttribute` and `ncSetDnetAttribute` because both of these functions wait for the explicit message response internally. `Established` for the Explicit Messaging Object For the Explicit Messaging Object, the `Established` state is clear (not established) before you start communication using `ncOperateDnetIntf`. After you start communication, the `Established` state remains clear until the explicit message connection has been successfully established with the remote DeviceNet device. After the explicit message connection has been established, the `Established` state sets and remains set for as long as the explicit message connection is open. Until the `Established` state is set for the Explicit Messaging Object, all calls to `ncGetDnetAttribute`, `ncSetDnetAttribute`, or `ncWriteDnetExplMsg` return the error `NC_ERR_NOT_STARTED`. Before you call any of these functions in your application, you must first wait for the `Established` state to set. After the `Established` state is set, unless communication problems occur with the device (`NC_ERR_TIMEOUT`), it remains set until you stop communication using `ncOperateDnetIntf`.

DesiredState (Continued)

Description (Continued)	While waiting for one of the above states, if an error occurs (such as a communication error or an initialization error), the occurrence returns immediately with the appropriate error code. For example, if you call `ncCreateOccurrence` with `DesiredState` of `ReadAvail`, the occurrence function will return when data is available for a read, or when a DeviceNet communication error (such as connection timeout) is detected.
Values	A combination of the following bit values. `1` hex (`ReadAvail` state, constant `NC_ST_READ_AVAIL`) `8` hex (`Established`, constant `NC_ST_ESTABLISHED`) To facilitate combining multiple states, you can select a combination from an enumerated list of all valid combinations. This list contains the names of each state in the combination, such as `ReadAvail` or `Established`.

Occurrence

Description	This output is wired into the LabVIEW `Wait on Occurrence` VI. The `Wait on Occurrence` VI takes the `Occurrence`, a timeout in milliseconds, and a flag indicating whether to ignore a pending state. For more information on `Wait on Occurrence`, refer to the LabVIEW online reference. After the occurrence is created successfully, it sets each time one of the desired states goes from false to true. When you no longer want to wait on the occurrence (such as when terminating your application), call `ncCreateOccurrence` with `DesiredState` zero (constant `Clear Occurrence`).
Values	The encoding of `Occurrence` is internal to LabVIEW.

Return Status

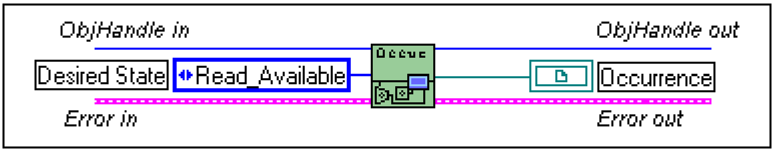
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_NOT_SUPPORTED`	Only one pending wait or notification is allowed at any given time.

Example

LabVIEW

Create an occurrence for the `ReadAvail` state.



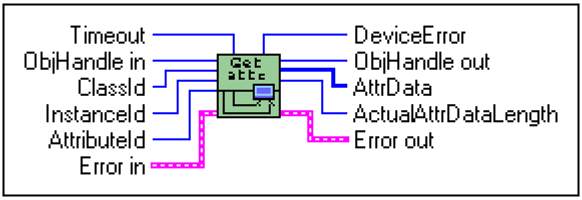
ncGetDnetAttribute (Get DeviceNet Attribute)

Purpose

Get an attribute value from a DeviceNet device using an Explicit Messaging Object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncGetDnetAttribute(
                     NCTYPE_OBJH         ObjHandle,
                     NCTYPE_UINT16       ClassId,
                     NCTYPE_UINT16       InstanceId,
                     NCTYPE_UINT8        AttributeId,
                     NCTYPE_DURATION     Timeout,
                     NCTYPE_UINT16       SizeofAttrData,
                     NCTYPE_ANY_P        AttrData,
                     NCTYPE_UINT16_P     ActualAttrDataLength
                     NCTYPE_UINT16_P     DeviceError);
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object
`ClassId`	Identifies the class which contains the attribute
`InstanceId`	Identifies the instance which contains the attribute
`AttributeId`	Identifies the attribute to get
`Timeout`	Maximum time to wait for response from device
`SizeofAttrData`	Size of `AttrData` buffer in bytes (C only)

Output

`AttrData`	Attribute value received from device
`ActualAttrDataLength`	Actual number of attribute data bytes returned
`DeviceError`	Error codes from device error response

Function Description

`ncGetDnetAttribute` gets the value of an attribute from a DeviceNet device using an Explicit Messaging Object.

`ncGetDnetAttribute` executes the Get Attribute Single service on a remote DeviceNet device.

The format of the data returned in `AttrData` is defined by the DeviceNet data type in the attribute's description. When using LabVIEW, the `ncConvertFromDnetRead` function can convert this DeviceNet data type into an appropriate LabVIEW data type. When using C, `AttrData` can point to a variable of the appropriate data type as specified in Chapter 1, *NI-DNET Data Types*.

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from the `ncOpenDnetExplMsg` function. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

ClassId

Description	Identifies the class which contains the attribute. For descriptions and identifiers for each standard DeviceNet class, refer to the DeviceNet Specification (Volume 2, Chapter 6, *The DeviceNet Object Library*). Vendor-specific classes are documented by the device vendor. Although the DeviceNet Specification allows 16-bit class IDs, most class IDs are 8-bit. NI-DNET automatically uses the class ID size (16-bit or 8-bit) that is appropriate for your device.
Values	`00` to `FFFF` hex

InstanceId

Description	Identifies the instance which contains the attribute. Instance ID `0` is used to get an attribute from the class itself. Other instance IDs typically are numbered starting at `1`. For example, the primary Identity Object in a device uses instance ID `1`. Although the DeviceNet Specification allows 16-bit instance IDs, most instance IDs are 8-bit. NI-DNET automatically uses the instance ID size (16-bit or 8-bit) that is appropriate for your device.
Values	`00` to `FFFF` hex

AttributeId

Description	Identifies the attribute to get. Attribute IDs are listed in the class and instance descriptions in the DeviceNet Specification. The attribute's description also lists the DeviceNet data type for the attribute's value.
Values	`00` to `FF` hex

Timeout

Description	Maximum time to wait for response from device. To get the attribute from the device, an explicit message request for the Get Attribute Single service is sent to the device. After sending the service request, this function must wait for the explicit message response for Get Attribute Single. `Timeout` specifies the maximum number of milliseconds to wait for the response before giving up. If the timeout expires before the response is received, this function returns a status of `80000001` hex (`NC_ERR_TIMEOUT` with an error qualifier of `NC_QUAL_TIMO_FUNCTION`). For most DeviceNet devices, a `Timeout` of `100` ms is appropriate. The special timeout value of `FFFFFFFF` hex is used to wait indefinitely.
Values	`1` to `1000` or `FFFFFFFF` hex (infinite duration, constant `NC_DURATION_INFINITE`)

SizeofAttrData

Description	For C, this is the size of the buffer referenced by `AttrData`. It is used to verify that you have enough bytes available to store the attribute data. This size is normally obtained using the C language `sizeof` function and has no direct relation to the number of bytes received on the network. For LabVIEW, since the buffer for `AttrData` is allocated automatically by NI-DNET, this size is not needed. The number of bytes allocated for `AttrData` should be large enough to hold the maximum number of data bytes defined for the attribute.
Values	`sizeof` (buffer referenced by `AttrData`)

AttrData

Description	Attribute value received from device. The format of the data returned in `AttrData` is defined by the DeviceNet data type in the attribute's description. When using LabVIEW, the `ncConvertFromDnetRead` function can convert this DeviceNet data type into an appropriate LabVIEW data type. When using C, `AttrData` can point to a variable of the appropriate data type as specified in Chapter 1, *NI-DNET Data Types*. The number of attribute data bytes returned is the smaller of `SizeofAttrData` and `ActualAttrDataLength`.
Values	Attribute data bytes

ActualAttrDataLength

Description	Actual number of attribute data bytes returned. This length is obtained from the actual Get Attribute Single response message. If this length is greater than `SizeofAttrData`, only `SizeofAttrData` bytes are returned in `AttrData`. If this length is less than or equal to `SizeofAttrData`, `ActualAttrDataLength` bytes are valid in `AttrData`.
Values	`0` to `240`

DeviceError

Description	Error codes from device's error response. If the remote device responds successfully to the Get Attribute Single service, the return status is `NC_SUCCESS`, and `DeviceError` returns `0`. If the remote device returns an error response for the Get Attribute Single service, the return status is `NC_ERR_DNET_ERR_RESP`, and `DeviceError` returns the error codes from the response. The General Error Code from the device's error response is returned in the low byte of `DeviceError`. Common values for General Error Code include Attribute Not Supported (`14` hex), Object Does Not Exist (`16` hex), and Invalid Attribute Value (`09` hex). The Additional Code from the device's error response is returned in the high byte of `DeviceError`. The Additional Code provides additional information that further describes the error. If no additional information is needed, the value `FF` hex is placed into this field. Values for the General Error Code and Additional Code are documented in the DeviceNet Specification. Common error code values are found in Appendix H, *DeviceNet Error Codes*, in the DeviceNet Specification. Object-specific error codes are listed in the object description. Vendor-specific error codes are listed in your device's documentation.
Values	Error codes from the device's error response.

Return Status

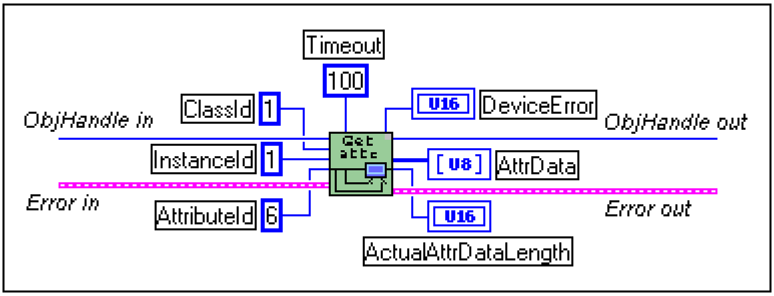
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_TIMEOUT`	Timeout expired before response received from device
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_RSRC_LIMITS`	Response received with more than 240 attribute data bytes
`NC_ERR_NOT_STARTED`	Call made prior to starting communication
`NC_ERR_CAN_COMM`	Low-level communication errors, often caused by bad cabling
`NC_ERR_BAD_NET_ID`	Interface Object's MAC ID conflicts with another DeviceNet device.
`NC_ERR_DNET_ERR_RESP`	Error response received from remote DeviceNet device (see `Device Error`)
`NC_ERR_DEVICE_INIT`	Problem initializing remote device for communication
`NC_ERR_DEVICE_MISSING`	Remote device is missing from network
`NC_ERR_FRAGMENTATION`	Fragment received out of sequence

Examples

LabVIEW

Get the Serial Number attribute using an Explicit Messaging Object. The Serial Number is contained in the Identity Object (class ID 1, instance ID 1, attribute ID 6). The DeviceNet data type for Device Type is UDINT, for which the LabVIEW data type U32 should be used. The Timeout is 100 ms.



C

Get the Device Type attribute using the Explicit Messaging Object referenced by objh. The Device Type is contained in the Identity Object (class ID 1, instance ID 1, attribute ID 2). The DeviceNet data type for Device Type is UINT, for which the NI-DNET data type NCTYPE_UINT16 should be used.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_UINT16           device_type;
NCTYPE_UINT16           actual_length;
NCTYPE_UINT16           device_error;
status = ncGetDnetAttribute(objh, 0x01, 0x01, 0x02, 100,
                        sizeof(device_type), &device_type,
                        &actual_length, &device_error);
```

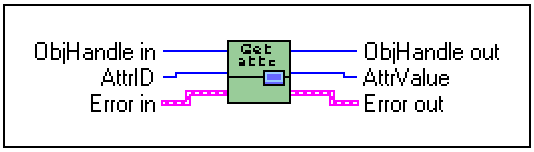
ncGetDriverAttr (Get Driver Attribute)

Purpose

Get the value of an attribute in the NI-DNET driver.

Format

LabVIEW



C

```
NCTYPE_STATUS   ncGetDriverAttr  (NCTYPE_OBJH     ObjHandle,
                                   NCTYPE_ATTRID  AttrId,
                                   NCTYPE_UINT32  SizeofAttr,
                                   NCTYPE_ANY_P   Attr)
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object, I/O Object, or Interface Object
`AttrId`	Identifier of the attribute to get
`SizeofAttr`	Size of the `Attr` buffer in bytes (C only)

Output

`Attr`	Returned attribute value

Function Description

`ncGetDriverAttr` gets the value of an attribute in the NI-DNET driver software. Within NI-DNET objects, attributes represent configuration settings, status, and other information.

Since you only need to access NI-DNET driver attributes under special circumstances, `ncGetDriverAttr` is seldom used. For information about the attributes of each NI-DNET object, refer to Chapter 3, *NI-DNET Objects*.

`ncGetDriverAttr` only applies to the NI-DNET software on your computer and cannot be used to get an attribute from a remote DeviceNet device. To get an attribute from a remote DeviceNet device, use the `ncGetDnetAttribute` function.

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from `ncOpenDnetExplMsg`, `ncOpenDnetIntf`, or `ncOpenDnetIO`. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

AttrId

Description	Identifier of the NI-DNET attribute. Supported attribute identifiers for each NI-DNET object are listed in Chapter 3, *NI-DNET Objects*.
Values	`80000000` to `8000FFFF` hex (high bit differentiates from DeviceNet IDs)

SizeofAttr

Description	For C, this is the size of the buffer referenced by `Attr`. It is used to verify that you have enough bytes available to store the attribute’s value. This size is normally obtained using the C language `sizeof` function. For LabVIEW, since the buffer for `Attr` is allocated automatically by NI-DNET, this size is not needed.
Values	`sizeof` (buffer referenced by `Attr`)

Attr

Description	Returned attribute value. The value is usually returned in an unsigned 32-bit integer (and thus `Attr` is of type `NCTYPE_UINT32_P`).
Values	Value of NI-DNET attribute

Return Status

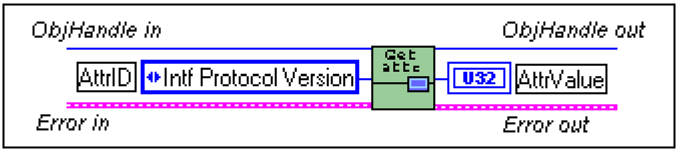
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_NOT_SUPPORTED`	Driver attribute not supported for this NI-DNET object

Examples

LabVIEW

Get the DeviceNet protocol version supported by NI-DNET.



C

Get the version of the NI-DNET software using the Interface Object referenced by `objh`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_VERSION          swver;
status = ncGetDriverAttr(objh, NC_ATTR_SOFTWARE_VERSION,
                        sizeof(swver), &swver);
```

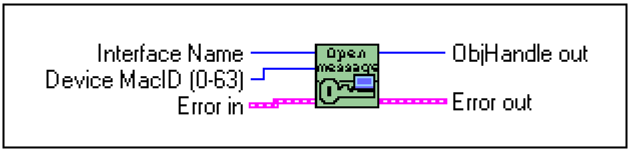
ncOpenDnetExplMsg (Open DeviceNet Explicit Messaging)

Purpose

Configure and open an NI-DNET Explicit Messaging Object.

Format

LabVIEW



C

```
NCTYPE_STATUS   ncOpenDnetExplMsg( NCTYPE_STRING  IntfName,
                                   NCTYPE_UINT32  DeviceMacId,
                                   NCTYPE_OBJH_P  ObjHandle);
```

Input

`IntfName`	Name of DeviceNet interface
`DeviceMacId`	MAC ID of the remote device

Output

`ObjHandle`	Object handle you use with all subsequent function calls for the Explicit Messaging Object

Function Description

`ncOpenDnetExplMsg` configures and opens an NI-DNET Explicit Messaging Object and returns a handle that you use with all subsequent function calls for that object.

The Explicit Messaging Object represents an explicit messaging connection to a remote DeviceNet device. Since only one explicit messaging connection is created for a given device, the Explicit Messaging Object is also used for features which apply to the device as a whole.

Use the Explicit Messaging Object to do the following:

- Execute the DeviceNet Get Attribute Single service on the remote device (`ncGetDnetAttribute`).
- Execute the DeviceNet Set Attribute Single service on the remote device (`ncSetDnetAttribute`).

- Send any other explicit message request to the remote device and receive the associated explicit message response (`ncWriteDnetExplMsg`, `ncReadDnetExplMsg`).
- Configure NI-DNET settings that apply to the entire remote device.

Parameter Descriptions

IntfName

Description	Name of the DeviceNet interface as an ASCII string with format "`DNET`*x*", where *x* is a decimal number starting at zero that indicates which DeviceNet interface is being used. You use the NI-DNET Hardware Configuration utility to associate DeviceNet interface names with physical DeviceNet ports (by double-clicking on a port's name). If you only have one DeviceNet interface in your computer, this name is usually `DNET0`. For more information about the Hardware Configuration utility, refer to your getting started manual.
Values	"`DNET0`", "`DNET1`", …"`DNET63`" In LabVIEW, the interface name is selected from an enumerated list. The LabWindows/CVI function panel also provides an enumerated list.

DeviceMacId

Description	MAC ID (device address) of the remote DeviceNet device. Many devices use physical switches to set their MAC ID. For such devices, you can usually determine the device's MAC ID by examining those switches. MAC ID `63` is usually reserved for new devices (many devices use `63` as the factory default). If you do not know the MAC ID of your DeviceNet device, NI-DNET provides a utility which can display the MAC ID for you. This utility, `SimpleWho`, is described in the *NI-DNET User Manual*.
Values	`0` to `63`

ObjHandle

Description	If the `ncOpenDnetExplMsg` function is successful, a handle to the newly opened Explicit Messaging Object is returned in `ObjHandle`. This handle is used with all subsequent function calls for that Explicit Messaging Object. The functions most commonly used with the Explicit Messaging Object are `ncGetDnetAttribute` and `ncSetDnetAttribute`.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

Return Status

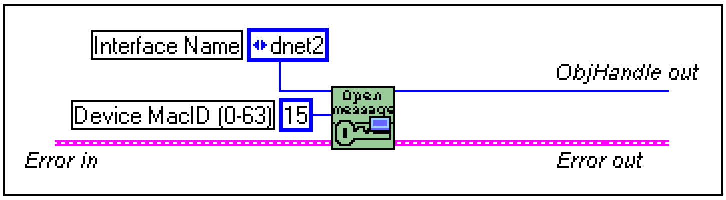
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_NOT_STOPPED`	Objects cannot be opened while communicating
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver

Examples

LabVIEW

Open an Explicit Messaging Object using interface `"DNET2"` and device MAC ID `15`.



C

Open an Explicit Messaging Object using interface `"DNET0"` and device MAC ID `12`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
status = ncOpenDnetExplMsg("DNET0", 12, &objh);
```

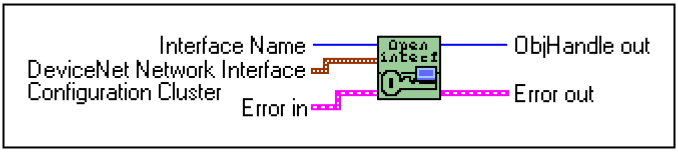
ncOpenDnetIntf (Open DeviceNet Interface)

Purpose

Configure and open an NI-DNET Interface Object.

Format

LabVIEW



C

```
NCTYPE_STATUS   ncOpenDnetIntf( NCTYPE_STRING   IntfName,
                                NCTYPE_UINT32   IntfMacId,
                                NCTYPE_UINT32   BaudRate,
                                NCTYPE_UINT32   PollMode,
                                NCTYPE_OBJH_P   ObjHandle);
```

Input

`IntfName`	Name of DeviceNet interface
`IntfMacId`	MAC ID of the DeviceNet interface
`BaudRate`	Baud rate
`PollMode`	Communication scheme for all polled I/O connections

Output

`ObjHandle`	Object handle you use with all subsequent function calls for the Interface Object

Function Description

`ncOpenDnetIntf` configures and opens an NI-DNET Interface Object and returns a handle that you use with all subsequent function calls for that object.

The Interface Object represents a DeviceNet interface. Since this interface acts as a device on the DeviceNet network much like any other device, it is configured with its own MAC ID and baud rate.

Use the Interface Object to do the following:

- Configure NI-DNET settings which apply to the entire interface.
- Start and stop communication for all NI-DNET objects associated with the interface.

The Interface Object must be the first NI-DNET object opened by your application, and thus `ncOpenDnetIntf` must be the first NI-DNET function called by your application.

Parameter Descriptions

IntfName

Description	Name of the DeviceNet interface as an ASCII string with format "`DNET`*`x`*," where *`x`* is a decimal number starting at zero that indicates which DeviceNet interface is being used. Use the NI-DNET Hardware Configuration utility to associate DeviceNet interface names with physical DeviceNet ports (by double-clicking on a port's name). If you only have one DeviceNet interface in your computer, this name is usually `DNET0`. For more information on the Hardware Configuration utility, refer to your getting started manual.
Values	`"DNET0"`, `"DNET1"`, ...`"DNET63"` In LabVIEW, the interface name is selected from an enumerated list. The LabWindows/CVI function panel also provides an enumerated list.

IntfMacId

Description	MAC ID (device address) of the DeviceNet interface. This is the MAC ID used by your DeviceNet interface for communication with other DeviceNet devices. A device's MAC ID indicates the priority of its DeviceNet messages on the network, with lower numbered MAC IDs having higher priority. If your DeviceNet interface is the only master in the network (the usual case), this MAC ID is often set to `0`.
Values	`0` to `63`

BaudRate

Description	Baud rate used for communication on the network connected to the DeviceNet interface. The DeviceNet protocol supports baud rates of 125,000, 250,000, and 500,000 b/s.
Values	`125000`, `250000`, or `500000` In LabVIEW, you select the baud rate from an enumerated list. The LabWindows/CVI function panel also provides an enumerated list.

PollMode

Description	Determines the communication scheme used for all polled I/O connections in which the interface acts as a master. The poll mode determines the overall scheme used to transmit poll requests to slave devices. `Automatic` The default poll mode is `Automatic`. Use this mode if you do not want to specify exact timing for polled and strobed I/O connections. In `Automatic` mode, the NI-DNET software automatically calculates a safe rate for production of all poll requests and strobe requests. This mode is similar to `Scanned` mode, except that you do not need to specify a valid `ExpPacketRate` for each polled/strobed I/O Object (`ExpPacketRate` is ignored).

PollMode (Continued)

Description (Continued)	`Scanned` This mode enables the traditional scanned I/O scheme for polled and strobed I/O connections. In `Scanned` mode, all poll requests and strobe requests are produced in quick succession, then NI-DNET waits to receive individual responses. The benefits of scanned I/O are reduced overhead and improved overall determinism on the DeviceNet network. When using `Scanned` mode, since all poll and strobe requests are produced at the same time, you normally set the `ExpPacketRate` for all polled and strobed I/O Objects to a common value. If you need to isolate devices that are slow to respond to poll requests, it is possible to use different `ExpPacketRate` values while still maintaining the benefits of scanned I/O. You can set all `ExpPacketRate` values for polled I/O Objects as two groups: one foreground group, and a second background group whose `ExpPacketRate` is an exact multiple of the foreground group's. All strobed I/O must use the same rate as the foreground group for polled I/O. For example, you can set some polled I/O (and all strobed I/O) to a common foreground rate of 100 ms, and other polled I/O to a background rate of 500 ms. To maintain overall network determinism, the background poll requests are interspersed evenly among each foreground scan.

PollMode (Continued)

Description (Continued)	`Individual` This mode enables you to configure poll rates individually for each polled I/O connection. In `Individual` mode, poll requests are not produced as a group, but instead each polled I/O connection communicates at an independent rate. The rate at which each poll request is produced is determined solely by the `ExpPacketRate` of that connection's I/O Object. Use individual polling when you have detailed knowledge of the time it takes each device to perform its physical measurement or control function. For example, if you have a discrete input device capable of acquiring a new measurement every 10 ms, an analog input device with a measurement rate of 45 ms, and a temperature sensor with a measurement rate of 200 ms, you could use individual polling to communicate with each device at its exact measurement rate. Since communication occurs only at the actual rate needed for each device, individual polling often provides optimum network usage. For additional information on `PollMode` and `ExpPacketRate`, refer to the *NI-DNET User Manual*.
Values	`Automatic` (constant `NC_POLL_AUTO`, value `0`) `Scanned` (constant `NC_POLL_SCAN`, value `1`) `Individual` (constant `NC_POLL_INDIV`, value `2`) In LabVIEW, you select the poll mode from an enumerated list. The LabWindows/CVI function panel also provides an enumerated list.

ObjHandle

Description	If the `ncOpenDnetIntf` function is successful, a handle to the newly opened Interface Object is returned in `ObjHandle`. This handle is used with all subsequent function calls for that Interface Object. The function most commonly used with the Interface Object is `ncOperateDnetIntf`.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

Return Status

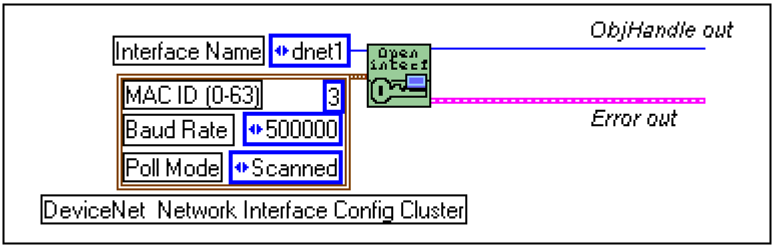
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_NOT_STOPPED`	Objects cannot be opened while communicating
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver

Examples

LabVIEW

Open Interface Object `"DNET1"` using baud rate `500000`, MAC ID `3`, and poll mode `Scanned`.



C

Open Interface Object `"DNET0"` using baud rate `125000`, MAC ID `0`, and poll mode `Automatic`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
status = ncOpenDnetIntf("DNET0", 0, 125000, NC_POLL_AUTO, &objh);
```

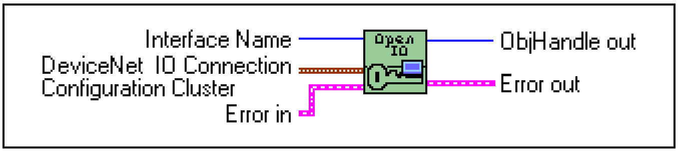
ncOpenDnetIO (Open DeviceNet I/O)

Purpose

Configure and open an NI-DNET I/O Object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncOpenDnetIO(    NCTYPE_STRING    IntfName,
                                  NCTYPE_UINT32    DeviceMacId,
                                  NCTYPE_UINT32    ConnectionType,
                                  NCTYPE_UINT32    InputLength,
                                  NCTYPE_UINT32    OutputLength,
                                  NCTYPE_UINT32    ExpPacketRate,
                                  NCTYPE_OBJH_P    ObjHandle);
```

Input

`IntfName`	Name of DeviceNet interface
`DeviceMacId`	MAC ID of the remote device
`ConnectionType`	Type of I/O connection
`InputLength`	Number of input bytes
`OutputLength`	Number of output bytes
`ExpPacketRate`	Expected rate of I/O message (packet) production

Output

`ObjHandle`	Object handle you use with all subsequent function calls for the I/O Object

Function Description

`ncOpenDnetIO` configures and opens an NI-DNET I/O Object and returns a handle that you use with all subsequent function calls for that object.

The I/O Object represents an I/O connection to a remote DeviceNet device. The I/O Object usually represents I/O communication as a master with a remote slave device. If your computer is essentially being used as the primary controller of your DeviceNet devices, you should configure I/O communication as a master.

You can also configure the I/O Object for I/O communication as a slave with a remote master. If your computer is essentially being used as a peripheral device for another primary controller, you can configure I/O communication as a slave. This is done by setting the I/O Object's `DeviceMacId` to the same MAC ID as the Interface Object (`IntfMacId` parameter of `ncOpenDnetIntf`).

The I/O Object supports as many master/slave I/O connections as currently allowed by the DeviceNet Specification (version 2.0). This means that you can use polled, strobed, and COS/cyclic I/O connections simultaneously for a given device. As specified by the DeviceNet Specification, you can only use one master/slave I/O connection of a given type for each device (MAC ID). For example, you cannot open two polled I/O connections for the same device.

Use the I/O Object to do the following:

- Read data from the most recent message received on the I/O connection (`ncReadDnetIO`).
- Write data for the next message produced on the I/O connection (`ncWriteDnetIO`).

Parameter Descriptions

IntfName

Description	Name of the DeviceNet interface as an ASCII string with format `"DNETx"`, where *x* is a decimal number starting at zero that indicates which DeviceNet interface is being used. Use the NI-DNET Hardware Configuration utility to associate DeviceNet interface names with physical DeviceNet ports (by double-clicking on a port's name). If you only have one DeviceNet interface in your computer, this name is usually `DNET0`. For more information on the Hardware Configuration utility, refer to your getting started manual.
Values	`"DNET0"`, `"DNET1"`, …`"DNET63"` In LabVIEW, you select the interface name from an enumerated list. The LabWindows/CVI function panel also provides an enumerated list.

DeviceMacId

Description	MAC ID (device address) of the remote DeviceNet device. Many devices use physical switches to set their MAC ID. For such devices, you can usually determine the device's MAC ID by examining those switches. MAC ID `63` is usually reserved for new devices (many devices use `63` as the factory default). If you do not know the MAC ID of your DeviceNet device, NI-DNET provides a utility which can display the MAC ID for you. This utility, `SimpleWho`, is described in the *NI-DNET User Manual*. For I/O communication as a master to a remote slave device (the usual case), `DeviceMacId` is the MAC ID of the remote DeviceNet slave device, and thus must be different than the MAC ID of your DeviceNet interface. If you want to configure I/O communication as a slave with a remote master, set `DeviceMacId` to the same MAC ID as your DeviceNet interface (the `IntfMacId` parameter of your previous call to `ncOpenDnetIntf`). By associating the I/O Object with your DeviceNet interface in this manner, you indicate that it represents I/O communication as a slave.
Values	`0` to `63`

ConnectionType

Description	Type of master/slave I/O connection. The connection type is either `Polled`, `Strobed`, change-of-state (`COS`), or `Cyclic`. As specified by the DeviceNet Specification, you can use only one master/slave I/O connection of a given type for each device (MAC ID). For example, you cannot open two polled I/O connections for the same device. If you do not know the I/O connection types supported by your DeviceNet device, NI-DNET provides a utility which queries the device for both this information and the device's supported input and output lengths. This utility, `SimpleWho`, is described in the *NI-DNET User Manual*. Change-of-state (COS) and cyclic I/O connections are acknowledged by default. If you want to suppress acknowledgments for these I/O connections, set the `Ack Suppress` driver attribute to true prior to starting communication. For more information, refer to the description of the I/O Object in Chapter 3, *NI-DNET Objects*.
Values	`Poll` (constant `NC_CONN_POLL`, value `0`) `Strobe` (constant `NC_CONN_STROBE`, value `1`) `COS` (constant `NC_CONN_COS`, value `2`) `Cyclic` (constant `NC_CONN_CYCLIC`, value `3`) In LabVIEW, you select the connection type from an enumerated list. The LabWindows/CVI function panel also provides an enumerated list.

InputLength

Description	Number of input bytes for the I/O connection. This is the number of bytes read from the I/O connection using the `ncReadDnetIO` function. The following information is specific to the `ConnectionType` setting. `Poll`, `COS`, and `Cyclic` For these I/O connection types, the input length is the same as the number of bytes consumed from the remote device. `Strobe` as master (`DeviceMacId` not equal to `IntfMacId`) For this I/O connection, the input length is the same as the number of bytes consumed from the strobe response message, and must have a value from `0` to `8`. `Strobe` as slave (`DeviceMacId` equal to `IntfMacId`) For this I/O connection, the input length must have a value of `1`. The input data consists of a single boolean value (bit) obtained from the master's strobe command message using `IntfMacId`. This boolean value is returned from the `ncReadDnetIO` function as a single byte.

Values	`Poll`, `COS`, and `Cyclic`: `0` to `255`
	`Strobe` as master (`DeviceMacId` not equal to `IntfMacId`): `0` to `8`
	`Strobe` as slave (`DeviceMacId` equal to `IntfMacId`): `1`

OutputLength

Description	Number of output bytes for the I/O connection. This is the number of bytes written to the I/O connection using the `ncWriteDnetIO` function. The following information is specific to the `ConnectionType` setting. `Poll`, `COS`, and `Cyclic` For these I/O connections types, the output length is the same as the number of bytes produced to the remote device. `Strobe` as master (`DeviceMacId` not equal to `IntfMacId`) For this I/O connection, the output length must have a value of `1`. The output data consists of a single boolean value (bit) which is placed into the strobe command message using `DeviceMacId`. This boolean value is provided to the `ncWriteDnetIO` function as a single byte. `Strobe` as slave (`DeviceMacId` equal to `IntfMacId`) For this I/O connection, the output length must have a value from `0` to `8`. The output length is the same as the number of bytes produced in the strobe response message.

Values	`Poll`, `COS`, and `Cyclic`: `0` to `255`
	`Strobe` as master (`DeviceMacId` not equal to `IntfMacId`): `1`
	`Strobe` as slave (`DeviceMacId` equal to `IntfMacId`): `0` to `8`

ExpPacketRate

Description	Expected rate of I/O message (packet) production in milliseconds. As specified in the DeviceNet Specification, the expected packet rate is used to trigger data productions. The expected packet rate is also used for the watchdog timer to verify that the device on the other side of the I/O connection still exists and is producing data as expected. The expected packet rate of each I/O connection is a major factor in determining the overall performance of your DeviceNet network. The following information is specific to the `ConnectionType` setting and the `PollMode` setting of your Interface Object. `Strobe` with `Automatic` poll mode When using the `Automatic` poll mode, the `ExpPacketRate` setting is ignored for strobed I/O Objects. The rate of production for the strobe command message is determined automatically by NI-DNET. `Strobe` with `Scanned` or `Individual` poll mode When using the `Scanned` or `Individual` poll mode, you must set the `ExpPacketRate` to the same value for all strobed I/O Objects. Since a single strobe command message is produced for all strobed I/O connections, the rate of production for that message must be identical for all strobed I/O Objects. `Poll` with `Automatic` poll mode When using the `Automatic` poll mode, the `ExpPacketRate` setting is ignored for polled I/O Objects. NI-DNET automatically determines the rate of production for the poll command messages.

ExpPacketRate (Continued)

Description (Continued)	`Poll` with `Scanned` poll mode When using the `Scanned` poll mode, since all poll and strobe requests are produced at the same time, you normally set the `ExpPacketRate` for all polled/strobed I/O Objects to a common value. If you need to isolate devices that are slow to respond to poll requests, it is possible to use different `ExpPacketRate` values while still maintaining the benefits of scanned I/O. You can set all `ExpPacketRate` values for polled I/O Objects as two groups, one foreground group, and a second background group whose `ExpPacketRate` is an exact multiple of the foreground group's. All strobed I/O must use the same rate as the foreground group for polled I/O. For example, you can set some polled I/O (and all strobed I/O) to a common foreground rate of 100 ms, and other polled I/O to a background rate of 500 ms. To maintain overall network determinism, the background poll requests are interspersed evenly among each foreground scan. `Poll` with `Individual` poll mode When using the `Individual` poll mode, the `ExpPacketRate` determines the rate at which the poll request of each polled I/O Object is produced. Although all strobed I/O Objects must still use the same rate, each polled I/O Object communicates at a rate which is independent of all other I/O connections. Change-of-state (`COS`) with any poll mode For COS I/O Objects, the `ExpPacketRate` is used solely to verify that the I/O connection still exists. If no change in data produces I/O message within the expected packet rate, the previous data is produced again to maintain the I/O connection. Since this rate is used solely to maintain the I/O connection, it is often set to a large value, such as `10000` (10 seconds). In addition to the expected packet rate, COS I/O connections also produce an I/O message when a change is detected in the data. These I/O change messages do not occur at a predetermined rate. The time between each I/O change message depends on when an actual change takes place and how fast the device can measure new data and detect changes.

ExpPacketRate (Continued)

Description (Continued)	`Cyclic` with any poll mode For cyclic I/O Objects, the `ExpPacketRate` determines the rate at which the I/O message is produced. Each cyclic I/O Object communicates at a rate which is independent of all other I/O connections. Note regarding I/O as a slave (`DeviceMacId` equal to `IntfMacId`) The `ExpPacketRate` setting applies only to I/O Objects used for communication as a master (the usual case). For I/O Objects used for communication as a slave, this setting is ignored because the remote master determines the expected packet rate on behalf of your slave I/O connection.
Values	`1` to `60000`

ObjHandle

Description	If the `ncOpenDnetIO` function is successful, a handle to the newly opened I/O Object is returned in `ObjHandle`. This handle is used with all subsequent function calls for that I/O Object. The functions most commonly used with the I/O Object are `ncReadDnetIO` and `ncWriteDnetIO`.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

Return Status

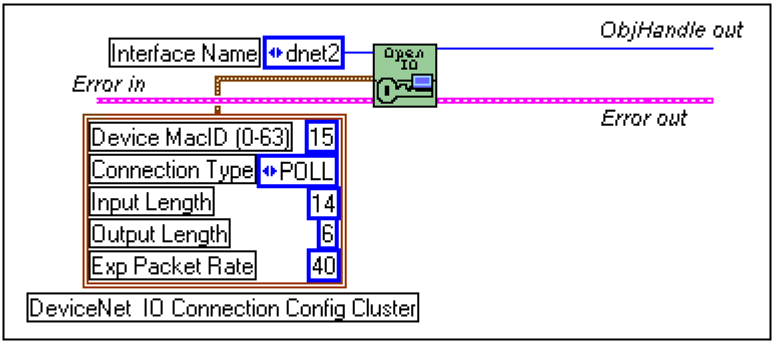
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_NOT_STOPPED`	Objects cannot be opened while communicating
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_RSRC_LIMITS`	Configuration exceeds NI-DNET resource limits

Examples

LabVIEW

Open an I/O Object using interface "DNET2", device MAC ID 15, connection type Poll, input length 14, output length 6, and expected packet rate 40 ms.



C

Open an I/O Object using interface "DNET0", device MAC ID 12, connection type Strobe, input length 2, output length 1, and expected packet rate 100 ms.

```
NCTYPE_STATUS            status;
NCTYPE_OBJH              objh;
status = ncOpenDnetIO("DNET0", 12, ,NC_CONN_STROBE, 2, 1, 100, &objh);
```

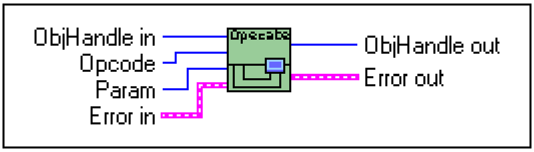
ncOperateDnetIntf (Operate DeviceNet Interface)

Purpose

Perform an operation on an NI-DNET Interface Object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncOperateDnetIntf   (NCTYPE_OBJH  ObjHandle,
                                      NCTYPE_UINT32Opcode,
                                      NCTYPE_UINT32Param);
```

Input

`ObjHandle`	Object handle of an open Interface Object
`Opcode`	Operation code indicating which operation to perform
`Param`	Parameter whose meaning is defined by `Opcode`

Output

None

Function Description

`ncOperateDnetIntf` operates on an NI-DNET Interface Object.

Use `ncOperateDnetIntf` to start and stop all DeviceNet communication for the associated interface, including all explicit messaging and I/O connections. After you open the Explicit Messaging Objects and I/O Objects required by your application, you must use `ncOperateDnetIntf` to start communication. You must also use `ncOperateDnetIntf` to stop communication before terminating your application.

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from the `ncOpenDnetIntf` function. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the Interface Object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

Opcode

Description	Determines which operation to perform on the Interface Object.
	`Start`
	Start all DeviceNet communication for the associated interface. For each Explicit Messaging Object and I/O Object which has been opened for the interface (same `IntfName`), this operation establishes the DeviceNet connection with the remote device. When the operation establishes I/O connections, it places outputs into active mode (data is produced on the network). If the default output data (all bytes zero) is not valid for your application, use `ncWriteDnetIO` for each I/O Object to initialize valid output data prior to starting communication. If the interface has already been started, this operation has no effect.
	`Stop`
	Stop all DeviceNet communication for the associated interface. For each Explicit Messaging Object and I/O Object which has been opened for the interface, this operation closes the DeviceNet connection with the remote device. Although closing all NI-DNET objects implicitly stops communication, you should perform this operation prior to calling `ncCloseObject`. If the interface has already been stopped, this operation has no effect.
	`Active`
	Place the outputs of all I/O connections into active mode. When an I/O connection is in active mode, it produces data in its outgoing I/O message. This operation is used after a previous `Idle` to restore normal communication on all I/O Objects associated with the interface. If the interface has already been placed into active mode or is stopped, this operation has no effect.

Opcode (Continued)

Description (Continued)	`Idle` Place the outputs of all I/O connections into the idle mode. When an I/O connection is in the idle mode, it does not produce data in its outgoing I/O message, but the I/O connection is kept open by producing an I/O message with zero data bytes. Use this operation when valid output data is no longer available from your application, such as when a control algorithm has been paused. If the interface has already been placed into idle mode or is stopped, this operation has no effect. **Note:** The DeviceNet Specification does not clearly define the behavior of a slave device on reception of an idle (zero length) I/O message. Many slave devices exhibit unexpected behavior when the `Idle` operation is used. If you need to suspend your application, but want to keep I/O connections open, you should provide valid idle values for outputs using `ncWriteDnetIO` rather than use the `Idle` operation.
Values	`Start` (constant `NC_OP_START`, value `1`) `Stop` (constant `NC_OP_STOP`, value `2`) `Active` (constant `NC_OP_ACTIVE`, value `4`) `Idle` (constant `NC_OP_IDLE`, value `5`) In LabVIEW, you select the operation code from an enumerated list. The LabWindows/CVI function panel also provides an enumerated list.

Param

Description	The meaning of `Param` is defined by each operation code (`Opcode`). Since none of the operations currently use this additional parameter, it is ignored and you should normally set it to zero. In the future, if new operations require some form of qualifying information, this parameter might be used.
Values	`0`

Return Status

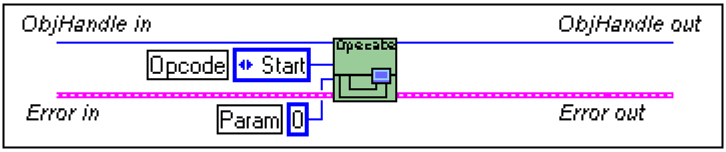
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver

Examples

LabVIEW

Start communication using an Interface Object.



C

Stop communication for the Interface Object referenced by `objh`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
status = ncOperateDnetIntf(objh, NC_OP_STOP, 0);
```

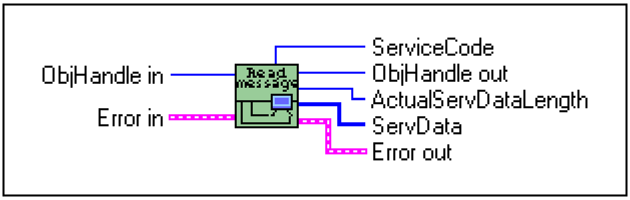
ncReadDnetExplMsg (Read DeviceNet Explicit Message)

Purpose

Read an explicit message response from an Explicit Messaging Object.

Format

LabVIEW



C

```
NCTYPE_STATUS  ncReadDnetExplMsg(  NCTYPE_OBJH      ObjHandle,
                                   NCTYPE_UINT8_P   ServiceCode,
                                   NCTYPE_UINT16    SizeofServData,
                                   NCTYPE_ANY_P     ServData,
                                   NCTYPE_UINT16_P  ActualServ
                                                    DataLength);
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object
`SizeofServData`	Size of `ServData` buffer in bytes (C only)

Output

`ServiceCode`	DeviceNet service code from response
`ServData`	Service data from response
`ActualServDataLength`	Actual number of service data bytes in response

Function Description

`ncReadDnetExplMsg` reads an explicit message response from an Explicit Messaging Object.

The two most commonly used DeviceNet explicit messages are the Get Attribute Single service and the Set Attribute Single service. The easiest way to execute the Get Attribute Single service on a remote device is to use the NI-DNET `ncGetDnetAttribute` function. The easiest way to execute the Set Attribute Single service on a remote device is to use the NI-DNET `ncSetDnetAttribute` function.

To execute services other than Get Attribute Single and Set Attribute Single, use the following sequence of function calls: `ncWriteDnetExplMsg`, `ncWaitForState`, `ncReadDnetExplMsg`. The `ncWriteDnetExplMsg` function sends an explicit message request to a remote DeviceNet device. The `ncWaitForState` function waits for the explicit message response, and the `ncReadDnetExplMsg` function reads that response.

Some of the DeviceNet services which use `ncReadDnetExplMsg` are Reset, Save, Restore, Get Attributes All, and Set Attributes All. Although the DeviceNet Specification defines the overall format of these services, in most cases their meaning and service data are object-specific or vendor-specific. Unless your device requires such services and documents them in detail, you probably do not need them for your application. For more information, refer to the *NI-DNET User Manual*.

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from `ncOpenDnetExplMsg`. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

ServiceCode

Description	Identifies the service response as either success or error. If the response is success, this value is the same as the `ServiceCode` of the request (`ncWriteDnetExplMsg`), and the `ServData` bytes are formatted as defined by the service. If the response is error, this value is `14` hex, `ServData[0]` contains a General Error Code, and `ServData[1]` contains an Additional Code. Either the DeviceNet Specification or the object itself define the error codes. Although the DeviceNet Specification requires the high bit of the service code (hex 80) to be set in all explicit message responses, NI-DNET clears this response indicator so that you can compare the actual service code to the value used with `ncWriteDnetExplMsg`.
Values	Same as the `ServiceCode` of `ncWriteDnetExplMsg` (success response) or `14` hex (error response)

SizeofServData

Description	For C, this is the size of the buffer referenced by `ServData`. Use it to verify that you have enough bytes available to store the service data from the response. This size is normally obtained using the C language `sizeof` function and has no direct relation to the number of bytes received on the network. For LabVIEW, since the buffer for `ServData` is allocated automatically by NI-DNET, this size is not needed. The number of bytes allocated for `ServData` should be large enough to hold the maximum number of service data response bytes defined for the service.
Values	`sizeof` (buffer referenced by `ServData`)

ServData

Description	Service data bytes from response. If the response is success, these bytes are formatted as defined by the service. If the response is error, the first byte (`ServData[0]`) contains a General Error Code, and the second byte (`ServData[1]`) contains an Additional Code. Either the DeviceNet Specification or the object itself define the error codes. The number of service data bytes returned is the smaller of `SizeofServData` and `ActualServDataLength`.
Values	Service data bytes from response

ActualServDataLength

Description	Actual number of service data bytes in response. This length is obtained from the actual response message. If this length is greater than `SizeofServData`, only `SizeofServData` bytes are returned in `ServData`. If this length is less than or equal to `SizeofServData`, `ActualServDataLength` bytes are valid in `ServData`.
Values	`0` to `240`

Return Status

For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

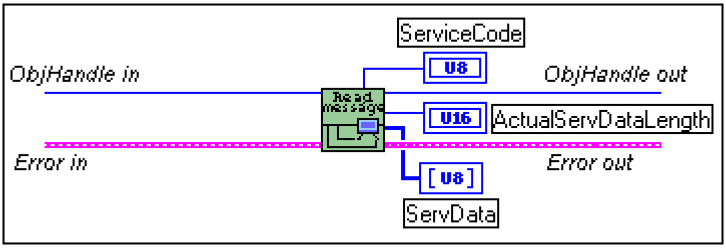
`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver

`NC_ERR_NOT_STARTED`	Call made prior to starting communication
`NC_ERR_READ_NOT_AVAIL`	Call made prior to receiving explicit message response (`ReadAvail`)
`NC_ERR_CAN_COMM`	Low-level communication errors, often caused by bad cabling
`NC_ERR_BAD_NET_ID`	Interface Object’s MAC ID conflict with another DeviceNet device
`NC_ERR_DEVICE_INIT`	Problem initializing remote device for communication
`NC_ERR_DEVICE_MISSING`	Remote device is missing from your network
`NC_ERR_FRAGMENTATION`	Fragment received out of sequence
`NC_ERR_RSRC_LIMITS`	Response received with more than 240 bytes of service data
`NC_ERR_TIMEOUT`	Connection to remote device timed out

Examples

LabVIEW

Read an explicit message response from an Explicit Messaging Object.



C

Read an explicit message response from the Explicit Messaging Object referenced by `objh`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_UINT8            servcode;
NCTYPE_UINT8            servdata[20];
NCTYPE_UINT16           actual_len;
status = ncReadDnetExplMsg(objh, &servcode, 20, servdata,
                        &actual_len);
```

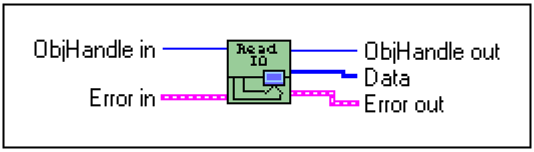
ncReadDnetIO (Read DeviceNet I/O)

Purpose

Read input data from an I/O Object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncReadDnetIO(    NCTYPE_OBJH      ObjHandle,
                                  NCTYPE_UINT32    SizeofData,
                                  NCTYPE_ANY_P     Data);
```

Input

`ObjHandle`	Object handle of an open I/O Object
`SizeofData`	Size of `Data` buffer in bytes (C only)

Output

`Data`	Input data

Function Description

`ncReadDnetIO` reads input data from an NI-DNET I/O Object.

Since each I/O Object continuously acquires input data from the DeviceNet network, you normally wait for new input to become available prior to calling `ncReadDnetIO`. By waiting for new input data, your application can handle I/O data at the same rate as the DeviceNet I/O communication. You can use the function `ncCreateNotification` (C only), `ncCreateOccurrence` (LabVIEW only), or `ncWaitForState` (C or LabVIEW) to wait for new input data.

`ncReadDnetIO` normally returns input data bytes obtained from the input assembly of a remote DeviceNet slave device. The format of this input assembly is normally documented either by the device vendor or within the DeviceNet Specification itself.

The bytes of a device's input assembly often consist of multiple data members rather than a single value. For C, you can often obtain each data member from the input bytes by using typecasting. For LabVIEW, you can often obtain each data member from the input bytes using the ncConvertFromDnetRead function. For more information on input assemblies and how to obtain individual data members, refer to the *NI-DNET User Manual*.

Parameter Descriptions

ObjHandle

Description	ObjHandle must contain an object handle returned from ncOpenDnetIO. In LabVIEW, ObjHandle passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of ObjHandle is internal to NI-DNET.

SizeofData

Description	For C, SizeofData is the size of the buffer referenced by Data. Use it to verify that you have enough bytes available to store the input bytes. This size is normally obtained using the C language sizeof function and has no direct relation to the number of bytes received on the network. For LabVIEW, since the buffer for Data is allocated automatically by NI-DNET, this size is not needed. The actual number of bytes received on the I/O connection is determined by the InputLength parameter of ncOpenDnetIO and not this size.
Values	sizeof (buffer referenced by Data)

Data

Description	Input data. The format of these input bytes is specific to your DeviceNet device.
Values	Input data bytes

Return Status

For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

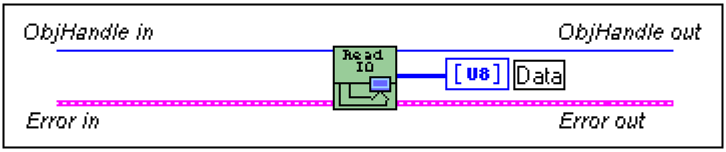
NC_SUCCESS	Success (no warning or error)
NC_ERR_BAD_PARAM	Invalid parameter
NC_ERR_OLD_DATA	Data returned from read is the same as the data returned from the previous read. This warning occurs if you do not wait for new input data prior to the read.

`NC_ERR_CAN_COMM`	Low-level communication errors, often caused by bad cabling
`NC_ERR_DEVICE_INIT`	Problem detected in initialization of the remote DeviceNet device when establishing the I/O connection
`NC_ERR_DEVICE_MISSING`	The remote DeviceNet device is missing from your network
`NC_ERR_FRAGMENTATION`	The remote DeviceNet device sent fragments of an input message out of sequence
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_BAD_NET_ID`	Interface Object's MAC ID conflicts with another DeviceNet device
`NC_ERR_TIMEOUT`	Connection to remote device timed out

Examples

LabVIEW

Read 20 input bytes from an I/O Object.



C

Read 10 input bytes from the I/O Object referenced by `objh`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_UINT8            input[10];
status = ncReadDnetIO(objh, 10, input);
```

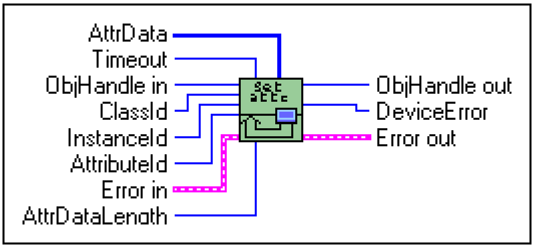
ncSetDnetAttribute (Set DeviceNet Attribute)

Purpose

Set an attribute value for a DeviceNet device using an Explicit Messaging Object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncSetDnetAttribute(
                     NCTYPE_OBJH         ObjHandle,
                     NCTYPE_UINT16       ClassId,
                     NCTYPE_UINT16       InstanceId,
                     NCTYPE_UINT8        AttributeId,
                     NCTYPE_DURATION     Timeout,
                     NCTYPE_UINT16       AttrDataLength,
                     NCTYPE_ANY_P        AttrData
                     NCTYPE_UINT16_P     DeviceError);
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object
`ClassId`	Identifies the class which contains the attribute
`InstanceId`	Identifies the instance which contains the attribute
`AttributeId`	Identifies the attribute to set
`Timeout`	Maximum time to wait for response from device
`AttrDataLength`	Number of attribute data bytes to set
`AttrData`	Attribute value to set in device

Output

`DeviceError`	Error codes from device’s error response

Function Description

`ncSetDnetAttribute` sets the value of an attribute for a DeviceNet device using an Explicit Messaging Object.

`ncSetDnetAttribute` executes the Set Attribute Single service on a remote DeviceNet device.

The DeviceNet data type in the attribute's description defines the format of the data provided in `AttrData`. When using LabVIEW, the `ncConvertForDnetWrite` function can convert this DeviceNet data type from an appropriate LabVIEW data type. When using C, `AttrData` can point to a variable of the appropriate data type as specified in Chapter 1, *NI-DNET Data Types*.

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from the `ncOpenDnetExplMsg` function. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

ClassId

Description	Identifies the class which contains the attribute. You can find descriptions and identifiers for each standard DeviceNet class in the DeviceNet Specification (Volume 2, Chapter 6, *The DeviceNet Object Library*). The device vendor documents vendor-specific classes. Although the DeviceNet Specification allows 16-bit class IDs, most class IDs are 8-bit. NI-DNET automatically used the class ID size (16-bit or 8-bit) that is appropriate for your device.
Values	`00` to `FFFF` hex

InstanceId

Description	Identifies the instance which contains the attribute. Instance ID 0 sets an attribute in the class itself. Other instance IDs typically are numbered starting at 1. For example, the primary Identity Object in a device uses instance ID 1. Although the DeviceNet Specification allows 16-bit instance IDs, most instance IDs are 8-bit. NI-DNET automatically uses the instance ID size (16-bit or 8-bit) that is appropriate for your device.
Values	00 to FFFF hex

AttributeId

Description	Identifies the attribute to set. The class and instance descriptions list attribute IDs. The attribute's description also lists the DeviceNet data type for the attribute's value.
Values	00 to FF hex

Timeout

Description	Maximum time to wait for response from device. To set the attribute in the device, an explicit message request for the Set Attribute Single service is sent to the device. After sending the service request, this function must wait for the explicit message response for Set Attribute Single. Timeout specifies the maximum number of milliseconds to wait for the response before giving up. If the timeout expires before the response is received, this function returns a status of 80000001 hex (NC_ERR_TIMEOUT with an error qualifier of NC_QUAL_TIMO_FUNCTION). For most DeviceNet devices, a Timeout of 100 ms is appropriate. The special timeout value of FFFFFFFF hex is used to wait indefinitely.
Values	1 to 1000 or FFFFFFFF hex (infinite duration, constant NC_DURATION_INFINITE)

AttrDataLength

Description	Number of attribute data bytes to set. This length also specifies the number of bytes provided in AttrData.
Values	0 to 239

AttrData

Description	Attribute value to set in device. The DeviceNet data type in the attribute's description defines the format of the data provided in `AttrData`. When using LabVIEW, the `ncConvertForDnetWrite` function can convert this DeviceNet data type from an appropriate LabVIEW data type. When using C, `AttrData` can point to a variable of the appropriate data type as specified in Chapter 1, *NI-DNET Data Types*. The `AttrDataLength` parameter specifies the number of attribute data bytes to set.
Values	Attribute value to set in device.

DeviceError

Description	Error codes from device's error response. If the remote device responds successfully to the Set Attribute Single service, the return status is `NC_SUCCESS`, and `DeviceError` returns `0`. If the remote device returns an error response for the Set Attribute Single service, the return status is `NC_ERR_DNET_ERR_RESP`, and `DeviceError` returns the error codes from the response. The General Error Code from the device's error response is returned in the low byte of `DeviceError`. Common values for General Error Code include Attribute Not Supported (`14` hex), Object Does Not Exist (`16` hex), and Invalid Attribute Value (`09` hex). The Additional Code from the device's error response is returned in the high byte of `DeviceError`. The Additional Code provides additional information that further describes the error. If no additional information is needed, the value `FF` hex is placed into this field. The DeviceNet Specification documents values for the General Error Code and Additional Code. You can find common error code values in Appendix H, *DeviceNet Error Codes,* in the DeviceNet Specification. The object description lists object-specific error codes. Your device's documentation lists vendor-specific error codes.
Values	Error codes from the device's error response.

Return Status

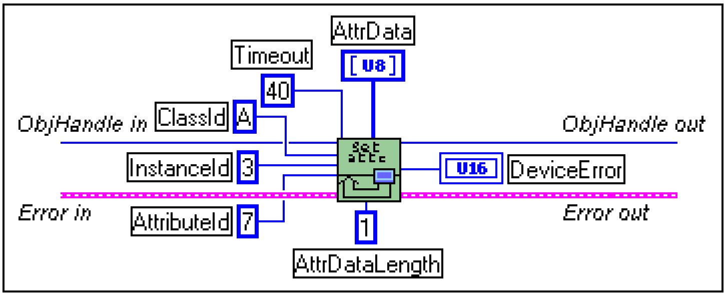
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

NC_SUCCESS	Success (no warning or error)
NC_ERR_BAD_PARAM	Invalid parameter
NC_ERR_TIMEOUT	Timeout expired before response received from device
NC_ERR_DRIVER	Implementation-specific error in the NI-DNET driver
NC_ERR_NOT_STARTED	Call made prior to starting communication
NC_ERR_CAN_COMM	Low-level communication errors, often caused by bad cabling
NC_ERR_BAD_NET_ID	Interface Object's MAC ID conflict with another DeviceNet device
NC_ERR_DEVICE_INIT	Problem initializing remote device for communication
NC_ERR_DEVICE_MISSING	Remote device is missing from your network
NC_ERR_FRAGMENTATION	Fragment received out of sequence
NC_ERR_DNET_ERR_RESP	Error response received from remote DeviceNet device (see Device Error)

Examples

LabVIEW

Set the Input Range attribute of an Analog Input Object. The Input Range is contained in instance 3 of an Analog Input Object (class ID 0A hex, instance ID 3, attribute ID 7). The DeviceNet data type for Input Range is USINT, for which the LabVIEW data type U8 should be used. The Timeout is 40 ms.



C

Set the MAC ID attribute of a remote DeviceNet device using the Explicit Messaging Object referenced by objh. The MAC ID is contained in the DeviceNet Object (class ID 3, instance ID 1, attribute ID 1). The DeviceNet data type for Device Type is USINT, for which the NI-DNET data type NCTYPE_UINT8 should be used.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_UINT8            mac_id;
NCTYPE_UINT16           device_error;
mac_id = 12;
status = ncSetDnetAttribute(objh, 0x03, 0x01, 0x01, 100, 1, &mac_id,
                        &device_error);
```

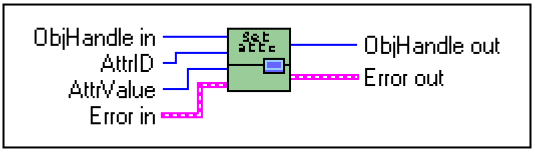
ncSetDriverAttr (Set Driver Attribute)

Purpose

Set the value of an attribute in the NI-DNET driver.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncSetDriverAttr  (NCTYPE_OBJH ObjHandle,
                                   NCTYPE_ATTRID AttrId,
                                   NCTYPE_UINT32 SizeofAttr,
                                   NCTYPE_ANY_P Attr)
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object, I/O Object, or Interface Object
`AttrId`	Identifier of the attribute to set
`SizeofAttr`	Size of the `Attr` buffer in bytes (C only)
`Attr`	New attribute value

Output

None

Function Description

`ncSetDriverAttr` sets the value of an attribute in the NI-DNET driver software. NI-DNET objects use attributes to represent configuration settings, status, and other information.

Since you only need to access NI-DNET driver attributes under special circumstances, you seldom need to use `ncSetDriverAttr`. For information about the attributes of each NI-DNET object, refer to Chapter 3, *NI-DNET Objects*.

`ncSetDriverAttr` only applies to the NI-DNET software on your computer and cannot be used to set an attribute in a remote DeviceNet device. To set an attribute in a remote DeviceNet device, use `ncSetDnetAttribute`.

Parameter Descriptions

ObjHandle

Description	ObjHandle must contain an object handle returned from ncOpenDnetExplMsg, ncOpenDnetIntf, or ncOpenDnetIO. In LabVIEW, ObjHandle passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of ObjHandle is internal to NI-DNET.

AttrId

Description	Identifier of the NI-DNET attribute. For each NI-DNET object, a list of supported attribute identifiers is provided in Chapter 3, *NI-DNET Objects*.
Values	80000000 to 8000FFFF hex (high bit differentiates from DeviceNet IDs)

SizeofAttr

Description	For C, SizeofAttr is the size of the buffer referenced by Attr. It is used to verify that the Attr buffer is large enough to hold the attribute's new value. This size is normally obtained using the C language sizeof function. For LabVIEW, since Attr is obtained directly as an input, this size is not needed.
Values	sizeof (buffer referenced by Attr)

Attr

Description	New attribute value. The value is usually provided in an unsigned 32-bit integer (and thus Attr is of type NCTYPE_UINT32_P).
Values	New value of NI-DNET attribute

Return Status

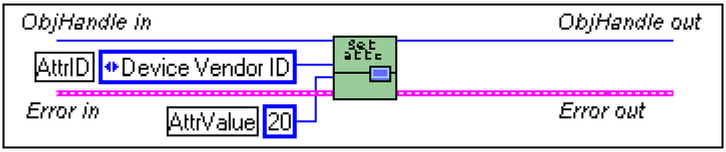
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_NOT_SUPPORTED`	Driver attribute not supported for this NI-DNET object
`NC_ERR_NOT_STOPPED`	Attempted to set driver attribute while communicating

Examples

LabVIEW

Verify vendor ID `20` for the DeviceNet device referenced by an Explicit Messaging Object.



C

Suppress acknowledgments for the COS I/O Object referenced by `objh`.

```
NCTYPE_STATUS               status;
NCTYPE_OBJH                 objh;
NCTYPE_BOOL                 ack_sup;
ack_sup = NC_TRUE;
status = ncSetDriverAttr(objh, NC_ATTR_ACK_SUPPRESS, sizeof(ack_sup),
                            &ack_sup);
```

ncStatusToString (Status To String)

Purpose

Convert status returned from an NI-DNET function into a descriptive string.

Format

LabVIEW

Not applicable (see *DeviceNet Error Handler*)

C

```
void            ncStatustoString(
                    NCTYPE_STATUS    Status,
                    NCTYPE_UINT32    SizeofString,
                    NCTYPE_STRING    String);
```

Input

`Status`	Status returned from a previous function call
`SizeofString`	Size of `String` buffer in bytes

Output

`String`	Textual string which describes the function status

Function Description

Each C language NI-DNET function returns a value which indicates the status of the function call. This status value encodes the severity of the error (success, warning, or error), a primary error code, and a qualifier for the error code. For example, if NI-DNET cannot initialize communication with a device, the `status` field is true (indicating an error severity), the lower bits of `code` indicate the `NC_ERR_DEVICE_INIT` error code, and the higher bits of `code` indicate the exact cause of the initialization problem.

`ncStatusToString` converts a status value returned from an NI-DNET function into a descriptive string. By displaying this string when an error or warning is detected, you can avoid interpretation of individual bit fields to debug the problem.

The `ncStatustoString` function is not applicable to LabVIEW programming. Use the LabVIEW `DeviceNet Error Handler` function to convert an NI-DNET status value into a descriptive string.

For more information on NI-DNET status, including overall status handling, the encoding of bit fields in status, and problem resolutions for each error, refer to Appendix A, *Status Handling and Error Codes*.

Parameter Descriptions

Status

Description	`Status` must contain a status value returned from a previous call to an NI-DNET function. You normally call `ncStatustoString` only when the status is nonzero, indicating an error or warning condition.
Values	Value of data type `NCTYPE_STATUS`, returned from an NI-DNET function call

SizeofString

Description	`SizeofString` is the size of the buffer referenced by `String`. The `ncStatustoString` function copies at most 80 `SizeofString` bytes into the string and cuts off the text as needed. You can normally obtain this size using the C language `sizeof` function. Although you can often obtain an adequate description with fewer bytes, an 80-byte buffer is large enough to hold any NI-DNET status description.
Values	`sizeof` (buffer referenced by `String`)

String

Description	Textual string which describes the function status. The string is NULL terminated like any other C language string. The number of bytes returned is the smaller of `SizeofString` and the number of bytes contained in the actual description (maximum 80).
Values	Textual string which describes the function status

Return Status

No status is returned because `ncStatusToString` cannot encounter errors.

Example

C

Check the status returned from the ncOpenDnetIntf function, and if not success, print a descriptive string.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
char                    descr[80];
status = ncOpenDnetIntf("DNET0", 0, 125000, NC_POLL_AUTO,
                           &objh);
if (status != NC_SUCCESS) {
                        ncStatustoString(status, sizeof(descr),
                        descr);
                        printf("ncOpenDnetIntf: %s\n", descr);
}
```

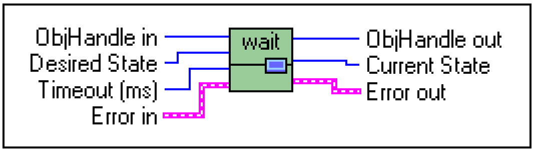
ncWaitForState (Wait For State)

Purpose

Wait for one or more states to occur in an object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncWaitForState(
                   NCTYPE_OBJH       ObjHandle,
                   NCTYPE_STATE      DesiredState,
                   NCTYPE_DURATION   Timeout,
                   NCTYPE_STATE_P    CurrentState)
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object or an I/O Object
`DesiredState`	States to wait for
`Timeout`	Number of milliseconds to wait for one of the desired states

Output

`CurrentState`	Current state of object

Function Description

Use `ncWaitforState` to wait for one or more states to occur in the object specified by `ObjHandle`.

`ncWaitforState` is commonly used to wait for the `Established` state of an Explicit Messaging Object, or else to wait for an explicit message response resulting from a call to `ncWriteDnetExplMsg` then read that response using `ncReadDnetExplMsg`.

While waiting for the desired states, `ncWaitForState` suspends the current execution. For C, this could suspend your front panel user interface. For LabVIEW, you can still access your front panel and functions that are not directly connected to `ncWaitForState` can still execute. If you want to allow other code in your application to execute while waiting for NI-DNET states, refer to the `ncCreateNotification` (C only) and `ncCreateOccurrence` (LabVIEW only) functions. You cannot use the `ncWaitForState` function at the same time as `ncCreateNotification`.

The status returned from `ncWaitForState` indicates any error detected by NI-DNET. You should always check this return status prior to checking the `CurrentState` value returned from `ncWaitForState`.

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from `ncOpenDnetExplMsg` or `ncOpenDnetIO`. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

DesiredState

Description	States to wait for. Each state is represented by a single bit so that you can wait for multiple states simultaneously. For example, if NI-DNET provides states with values of hex 1 and hex 4, `DesiredState` of hex 5 waits for either state to occur. `ReadAvail` for the I/O Object For the I/O Object, the `ReadAvail` state is set when a new input message is received from the network. The `ReadAvail` state clears when you call `ncReadDnetIO`. For example, for a change-of-state (COS) I/O connection, the `ReadAvail` state sets when a COS input message is received. Although you can use `ncWaitForState` with an I/O Object, it is often preferable to use a notification (`ncCreateNotification` or `ncCreateOccurrence`). Use of a notification callback or occurrence for the `ReadAvail` state allows your application to handle multiple I/O connections independently.

DesiredState (Continued)

Description (Continued)	`ReadAvail` for the Explicit Messaging Object For the Explicit Messaging Object, the `ReadAvail` state sets when an explicit message response is received from the network. The `ReadAvail` state clears when you call `ncReadDnetExplMsg`. An explicit message response is received only after you send an explicit message request using `ncWriteDnetExplMsg`. The following sequence of calls is typical: `ncWriteDnetExplMsg`, `ncWaitForState`, `ncReadDnetExplMsg`. This sequence is used internally by `ncGetDnetAttribute` and `ncSetDnetAttribute`. The `ReadAvail` state is not needed when using the explicit messaging functions `ncGetDnetAttribute` and `ncSetDnetAttribute` because both of these functions wait for the explicit message response internally. `Established` for the Explicit Messaging Object For the Explicit Messaging Object, the `Established` state is clear (not established) before you start communication using `ncOperateDnetIntf`. After you start communication, the `Established` state remains clear until the explicit message connection has been successfully established with the remote DeviceNet device. After the explicit message connection has been established, the `Established` state sets and remains set for as long as the explicit message connection is open. Until the `Established` state sets for the Explicit Messaging Object, all calls to `ncGetDnetAttribute`, `ncSetDnetAttribute`, or `ncWriteDnetExplMsg` return the error `NC_ERR_NOT_STARTED`. Before you call any of these functions in your application, you must first wait for the `Established` state to set. After the `Established` state is set, unless communication problems occur with the device (`NC_ERR_TIEMOUT`), it remains set until you stop communication using `ncOperateDnetIntf`. While waiting for one of the above states, if an error occurs (such as a communication error or an initialization error), the wait returns immediately with the appropriate error code. For example, if you call `ncWaitforState` with `DesiredState` of `ReadAvail`, the wait function will return when data is available for a read, or when a DeviceNet communication error (such as connection timeout) is detected.

DesiredState (Continued)

Values	A combination of one or more of the following bit values. 1 hex (ReadAvail, constant NC_ST_READ_AVAIL) 8 hex (Established, constant NC_ST_ESTABLISHED) In LabVIEW and the LabWindows/CVI function panel, to facilitate combining multiple states, you can select a valid combination from an enumerated list of all valid combinations. This list contains the names of each state in the combination, such as ReadAvail or Established.

Timeout

Description	Number of milliseconds to wait for one of the desired states. If the timeout expires before one of the desired states occurs, ncWaitForState returns a status of 80000001 hex (NC_ERR_TIMEOUT with an error qualifier of NC_QUAL_TIMO_FUNCTION). The special timeout value of FFFFFFFF hex is used to wait indefinitely.
Values	1 to 200000 or FFFFFFFF hex (infinite duration, constant NC_DURATION_INFINITE)

CurrentState

Description	Current state of the object. If one of the desired states occurs, it provides the current value of the ReadAvail and Established states. If the Timeout expires before one of the desired states occurs, it has the value 0.
Values	0 (desired states did not occur) or A combination of one or more of the following bit values. 1 hex (ReadAvail, constant NC_ST_READ_AVAIL) 8 hex (Established, constant NC_ST_ESTABLISHED)

Return Status

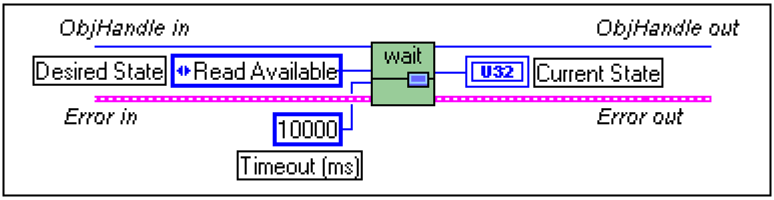
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_TIMEOUT`	Timeout expired before desired states occurred
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_SUPPORTED`	Only one pending wait or notification is allowed at any given time
`NC_ERR_CAN_COMM`	Low-level communication errors, often caused by bad cabling
`NC_ERR_BAD_NET_ID`	Interface Object's MAC ID conflicts with another DeviceNet device
`NC_ERR_DEVICE_INIT`	Problem initializing remote device for communication
`NC_ERR_DEVICE_MISSING`	Remote device is missing from your network
`NC_ERR_FRAGMENTATION`	Fragment received out of sequence

Examples

LabVIEW

Wait up to 10 seconds for the `ReadAvail` state of an Explicit Messaging Object.



C

Wait up to 10 seconds for the `ReadAvail` state of the Explicit Messaging Object referenced by `objh`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_STATE            currstate;
status = ncWaitForState(objh, NC_ST_READ_AVAIL, 10000, &currstate);
```

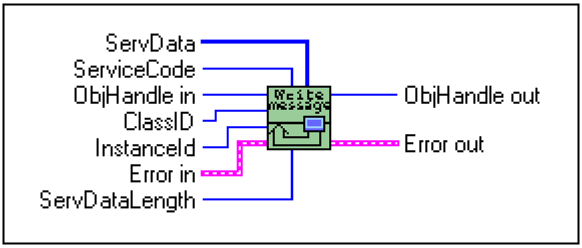
ncWriteDnetExplMsg (Write DeviceNet Explicit Message)

Purpose

Write an explicit message request using an Explicit Messaging Object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncWriteDnetExplMsg(
                   NCTYPE_OBJH          ObjHandle,
                   NCTYPE_UINT8         ServiceCode,
                   NCTYPE_UINT16        ClassId,
                   NCTYPE_UINT16        InstanceId,
                   NCTYPE_UINT16        ServDataLength,
                   NCTYPE_ANY_P         ServData);
```

Input

`ObjHandle`	Object handle of an open Explicit Messaging Object
`ServiceCode`	Identifies the service being requested
`ClassId`	Identifies the class to which service is directed
`InstanceId`	Identifies the instance to which service is directed
`ServDataLength`	Number of service data bytes for request
`ServData`	Service data for request

Output

None

Function Description

`ncWriteDnetExplMsg` writes an explicit message request using an Explicit Messaging Object.

The two most commonly used DeviceNet explicit messages are the Get Attribute Single service and the Set Attribute Single service. The easiest way to execute the Get Attribute Single service on a remote device is to use the NI-DNET `ncGetDnetAttribute` function. The easiest way to execute the Set Attribute Single service on a remote device is to use the NI-DNET `ncSetDnetAttribute` function.

To execute services other than Get Attribute Single and Set Attribute Single, use the following sequence of function calls: `ncWriteDnetExplMsg`, `ncWaitForState`, `ncReadDnetExplMsg`. The `ncWriteDnetExplMsg` function sends an explicit message request to a remote DeviceNet device. The `ncWaitForState` function waits for the explicit message response, and the `ncReadDnetExplMsg` function reads that response.

Some DeviceNet services that use `ncWriteDnetExplMsg` are Reset, Save, Restore, Get Attributes All, and Set Attributes All. Although the DeviceNet Specification defines the overall format of these services, in most cases their meaning and service data are object-specific or vendor-specific. Unless your device requires such services and documents them in detail, you probably do not need them for your application. For more information, refer to the *NI-DNET User Manual*.

Parameter Descriptions

ObjHandle

Description	`ObjHandle` must contain an object handle returned from `ncOpenDnetExplMsg`. In LabVIEW, `ObjHandle` passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of `ObjHandle` is internal to NI-DNET.

ServiceCode

Description	Identifies the service being requested. You can find service code values for the commonly used DeviceNet services in the DeviceNet Specification (Volume 1, Appendix G, *DeviceNet Explicit Messaging Services*). The device’s vendor documents vendor-specific service codes.
Values	`00` to `FF` hex

ClassId

Description	Identifies the class to which service is directed. You can find descriptions and identifiers for each standard DeviceNet class in the DeviceNet Specification (Volume 2, Chapter 6, *The DeviceNet Object Library*). The device's vendor documents vendor-specific classes. Although the DeviceNet Specification allows 16-bit class IDs, most class IDs are 8-bit. NI-DNET automatically uses the class ID size (16-bit or 8-bit) that is appropriate for your device.
Values	`00` to `FFFF` hex

InstanceId

Description	Identifies the instance to which service is directed. Instance ID `0` is used to direct the service toward the class itself. Other instance IDs typically are numbered starting at `1`. For example, the primary Identity Object in a device uses instance ID `1`. Although the DeviceNet Specification allows 16-bit instance IDs, most instance IDs are 8-bit. NI-DNET automatically uses the instance ID size (16-bit or 8-bit) that is appropriate for your device.
Values	`00` to `FFFF` hex

ServDataLength

Description	Number of service data bytes for the request. This length also specifies the number of bytes provided in `ServData`.
Values	`0` to `240`

ServData

Description	Service data bytes for the request. The format of this data is specific to the service code being used. For commonly used services which are not object-specific, the format of this data is defined in the DeviceNet Specification (Volume 1, Appendix G, DeviceNet Explicit Messaging Services). For object-specific service codes, the format of this data is defined in the object specification. For vendor-specific service codes, the format of this data is defined by the device vendor. The `ServDataLength` parameter specifies the number of service data bytes sent in the request (and provided in this buffer).
Values	Service data bytes for the request

Return Status

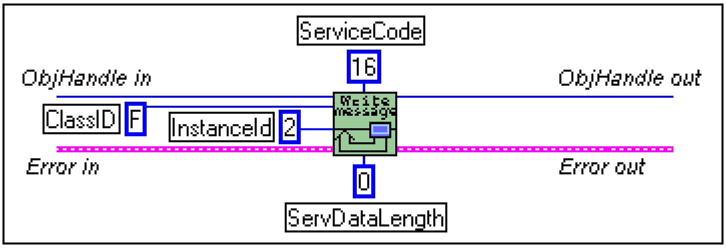
For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

`NC_SUCCESS`	Success (no warning or error)
`NC_ERR_BAD_PARAM`	Invalid parameter
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_NOT_STARTED`	Call made prior to starting communication
`NC_ERR_CAN_COMM`	Low-level communication errors, often caused by bad cabling
`NC_ERR_BAD_NET_ID`	Interface Object's MAC ID conflicts with another DeviceNet device
`NC_ERR_DEVICE_INIT`	Problem initializing remote device for communication
`NC_ERR_DEVICE_MISSING`	Remote device is missing from your network
`NC_ERR_FRAGMENTATION`	Fragment received out of sequence
`NC_ERR_TIMEOUT`	Connection to remote device timed out

Examples

LabVIEW

Save the parameters of Parameter Object instance `2` to non-volatile memory. The service code for Save is `16` hex. The Parameter Object is class ID `0F` hex. The Parameter Object does not define any service data bytes for Save.



C

Reset a DeviceNet device to its power on state using the Explicit Messaging Object referenced by `objh`. The service code for Reset is `05` hex. The Identity Object (class ID `1`, instance ID `1`) is used to reset DeviceNet devices. The Identity Object defines a single byte of service data, where `0` is used to simulate a power cycle and `1` is used to reset the device to its out-of-box state.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_UINT8            type_of_reset;
type_of_reset = 0;
status = ncWriteDnetExplMsg(objh, 0x05, 0x01, 0x01, 1,
                        &type_of_reset);
```

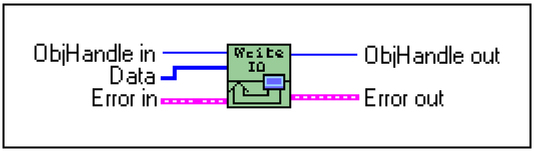
ncWriteDnetIO (Write DeviceNet I/O)

Purpose

Write output data to an I/O Object.

Format

LabVIEW



C

```
NCTYPE_STATUS  ncWriteDnetIO(  NCTYPE_OBJH      ObjHandle,
                               NCTYPE_UINT32    SizeofData,
                               NCTYPE_ANY_P     Data);
```

Input

`ObjHandle`	Object handle of an open I/O Object
`SizeofData`	Size of `Data` buffer in bytes (C only)
`Data`	Output data

Output

None

Function Description

`ncWriteDnetIO` writes output data to an NI-DNET I/O Object.

Since each I/O Object continuously produces output data onto the DeviceNet network at a specified rate, calling `ncWriteDnetIO` multiple times for each output message is redundant and can often waste valuable processor time. To synchronize calls to `ncWriteDnetIO` with each output message, you can wait for input data (see `ncReadDnetIO`), or if no input data exists for the device, you can use an idle wait (such as wait for 10 ms).

The output data bytes passed to `ncWriteDnetIO` are normally sent to the output assembly of a remote DeviceNet slave device. The format of this output assembly is normally documented either by the device vendor or within the DeviceNet Specification itself.

The bytes of a device's output assembly often consist of multiple data members rather than a single value. For C, you can often place each data member into the output bytes by using typecasting. For LabVIEW, you can often place each data member into the output bytes using the ncConvertForDnetWrite function. For more information on output assemblies and how to place individual data members into the output bytes, refer to the *NI-DNET User Manual*.

Parameter Descriptions

ObjHandle

Description	ObjHandle must contain an object handle returned from ncOpenDnetIO. In LabVIEW, ObjHandle passes through the VI as an output so that it can be used for subsequent function calls for the object.
Values	The encoding of ObjHandle is internal to NI-DNET.

SizeofData

Description	For C, SizeofData is the size of the buffer referenced by Data. It is used to verify that the Data buffer is large enough to hold the output bytes. This size is normally obtained using the C language sizeof function and has no direct relation to the number of bytes produced on the network. For LabVIEW, since Data is obtained directly as an input, this size is not needed. The actual number of bytes produced on the I/O connection is determined by the OutputLength parameter of ncOpenDnetIO and not this size.
Values	sizeof (buffer referenced by Data)

Data

Description	Output data. The format of these output bytes is specific to your DeviceNet device.
Values	Output data bytes

Return Status

For information about converting the return status into a descriptive string, refer to Appendix A, *Status Handling and Error Codes*.

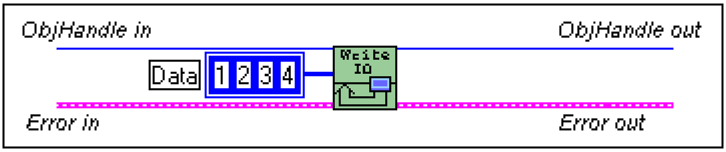
NC_SUCCESS	Success (no warning or error)
NC_ERR_BAD_PARAM	Invalid parameter
NC_ERR_CAN_COMM	Low-level communication errors, often caused by bad cabling

`NC_ERR_DEVICE_INIT`	Problem detected in initialization of the remote DeviceNet device when establishing the I/O connection
`NC_ERR_DEVICE_MISSING`	The remote DeviceNet device is missing from your network
`NC_ERR_DRIVER`	Implementation-specific error in the NI-DNET driver
`NC_ERR_BAD_NET_ID`	Interface Object's MAC ID conflicts with another DeviceNet device
`NC_ERR_TIMEOUT`	Connection to remote device timed out

Examples

LabVIEW

Write 4 output bytes to an I/O Object.



C

Write 10 output bytes to the I/O Object referenced by `objh`.

```
NCTYPE_STATUS           status;
NCTYPE_OBJH             objh;
NCTYPE_UINT8            output[10];
status = ncWriteDnetIO(objh, 10, output);
```

3

NI-DNET Objects

This chapter describes each NI-DNET object, lists the functions which can be used with the object, and describes each of the object's driver attributes. The description of each object is structured as follows:

Description

Gives an overview of the major features and uses of the object.

Functions

Lists each NI-DNET function which can be used with the object. For information on how each NI-DNET function is used with the object, refer to Chapter 2, *NI-DNET Functions*.

Driver Attributes

Lists and describes the NI-DNET driver attributes for each object. The driver attributes are listed in alphabetical order.

For each driver attribute, the description lists its data type, attribute ID, and permissions. Driver attribute permissions consist of one of the following:

Get	You can get the attribute at any time using `ncGetDriverAttr`, but never set it.
Set	You can get the attribute at any time using `ncGetDriverAttr`. You can set the attribute using `ncSetDriverAttr`, but only prior to starting communication using `ncOperateDnetIntf`.

Explicit Messaging Object

Description

The Explicit Messaging Object represents an explicit messaging connection to a remote DeviceNet device (physical device attached to your interface by a DeviceNet cable). Since only one explicit messaging connection is created for a given device, the Explicit Messaging Object is also used for features that apply to the device as a whole.

Use the Explicit Messaging Object to do the following:

- Execute the DeviceNet Get Attribute Single service on the remote device (`ncGetDnetAttribute`).
- Execute the DeviceNet Set Attribute Single service on the remote device (`ncSetDnetAttribute`).
- Send any other explicit message requests to the remote device and receive the associated explicit message response (`ncWriteDnetExplMsg`, `ncReadDnetExplMsg`).
- Configure NI-DNET settings that apply to the entire remote device.

Functions

Function Name	Function Description
`DeviceNet Error Handler`	Convert status returned from an NI-DNET function into a descriptive string (LabVIEW only)
`ncCloseObject`	Close an NI-DNET object
`ncConvertForDnetWrite`	Convert an appropriate LabVIEW data type for writing data bytes on the DeviceNet network
`ncConvertFromDnetRead`	Convert data read from the DeviceNet network into an appropriate LabVIEW data type
`ncCreateNotification`	Create a notification callback for an object (C only)
`ncCreateOccurrence`	Create a notification occurrence for an object (LabVIEW only)
`ncGetDnetAttribute`	Get an attribute value from a DeviceNet device
`ncGetDriverAttr`	Get the value of an attribute in the NI-DNET driver
`ncOpenDnetExplMsg`	Configure and open an NI-DNET Explicit Messaging Object
`ncReadDnetExplMsg`	Read an explicit message response

Functions (Continued)

Function Name	Function Description
ncSetDnetAttribute	Set an attribute value for a DeviceNet device
ncSetDriverAttr	Set the value of an attribute in the NI-DNET driver
ncStatusToString	Convert status returned from an NI-DNET function into a descriptive string (C only)
ncWaitForState	Wait for one or more states to occur in an object
ncWriteDnetExplMsg	Write an explicit message request

Driver Attributes

Current State

Attribute ID	NC_ATTR_STATE
Hex Encoding	80000009
Data Type	NCTYPE_STATE
Permissions	Get
Description	Current state of the NI-DNET object. This driver attribute provides the current ReadAvail, Established, and Error states as described in the ncWaitForState function. Use ncGetDriverAttr when you need to determine the current state of an object but you do not need to wait for a specific state. For example, if you want to determine whether an error has occurred, you can get the Current State attribute to check the Error state. Since read and write functions handle reporting of errors automatically, using ncGetDriverAttr to check for such errors is typically done only if the read and write functions are not used often.

Device Type

Attribute ID	`NC_ATTR_DEVICE_TYPE`
Hex Encoding	`80000084`
Data Type	`NCTYPE_UINT16`
Permissions	Set
Description	Device Type of the device as reported in the Device Type attribute of device's Identity Object. This attribute verifies that the device is the same one expected by your application. If the Device Type does not match, NI-DNET returns the `NC_ERR_DEVICE_INIT` error with a qualifier of `NC_QUAL_DEVI_DEVTYPE`. The Device Type indicates conformance to a specific device profile, such as Photoelectric Sensor or Position Controller. If you do not call `ncSetDriverAttr` to set the Device Type, a default value of zero is used. When Device Type is zero, NI-DNET does not verify the device's Device Type.

Mac Id

Attribute ID	`NC_ATTR_MAC_ID`
Hex Encoding	`80000080`
Data Type	`NCTYPE_UINT8`
Permissions	Get
Description	This driver attribute allows you to get the `DeviceMacId` originally passed into `ncOpenDnetExplMsg`.

Product Code

Attribute ID	`NC_ATTR_PRODUCT_CODE`
Hex Encoding	`80000083`
Data Type	`NCTYPE_UINT16`
Permissions	Set
Description	Product Code of the device as reported in the Product Code attribute of device's Identity Object. This attribute verifies that the device is the same one expected by your application. If the Product Code does not match, NI-DNET returns the `NC_ERR_DEVICE_INIT` error with a qualifier of `NC_QUAL_DEVI_PRODCODE`. The Product Code is a vendor-specific value which identifies a particular product within a device type. If you do not call `ncSetDriverAttr` to set the Product Code, a default value of zero is used. When Product Code is zero, NI-DNET does not verify the device's Product Code.

Vendor Id

Attribute ID	`NC_ATTR_VENDOR_ID`
Hex Encoding	`80000082`
Data Type	`NCTYPE_UINT16`
Permissions	Set
Description	Vendor ID of the device as reported in the Vendor ID attribute of device's Identity Object. This attribute verifies that the device is the same one expected by your application. If the Vendor ID does not match, NI-DNET returns the `NC_ERR_DEVICE_INIT` error with a qualifier of `NC_QUAL_DEVI_VENDOR`. The Vendor ID is a number assigned to the device vendor by the Open Device Vendor's Association (ODVA). If you do not call `ncSetDriverAttr` to set the Vendor ID, a default value of zero is used. When Vendor ID is zero, NI-DNET does not verify the device's Vendor ID.

Interface Object

Description

The Interface Object represents a DeviceNet interface. Since this interface acts as a device on the DeviceNet network much like any other device, it is configured with its own MAC ID and baud rate.

Use the Interface Object to do the following:

- Configure NI-DNET settings that apply to the entire interface.
- Start and stop communication for all NI-DNET objects associated with the interface.

The Interface Object must be the first NI-DNET object opened by your application, and thus the `ncOpenDnetIntf` function must be the first NI-DNET function called by your application.

Functions

Function Name	Function Description
`DeviceNet Error Handler`	Convert status returned from an NI-DNET function into a descriptive string (LabVIEW only)
`EasyIOClose`	Close multiple NI-DNET objects (LabVIEW only)
`EasyIOConfig`	Configure and open multiple NI-DNET objects (LabVIEW only)
`ncCloseObject`	Close an NI-DNET object
`ncGetDriverAttr`	Get the value of an attribute in the NI-DNET driver
`ncOpenDnetIntf`	Configure and open an NI-DNET Interface Object
`ncOperateDnetIntf`	Perform an operation on an NI-DNET Interface Object
`ncSetDriverAttr`	Set the value of an attribute in the NI-DNET driver
`ncStatusToString`	Convert status returned from an NI-DNET function into a descriptive string (C only)

Driver Attributes

Baud Rate

Attribute ID	NC_ATTR_BAUD_RATE
Hex Encoding	80000007
Data Type	NCTYPE_BAUD_RATE
Permissions	Get
Description	This driver attribute allows you to get the BaudRate originally passed into ncOpenDnetIntf.

Interface Protocol Version

Attribute ID	NC_ATTR_PROTOCOL_VERSION
Hex Encoding	80000002
Data Type	NCTYPE_VERSION
Permissions	Get
Description	This driver attribute reports the version of the DeviceNet Specification to which the NI-DNET software conforms. This version is at least 02000000 hex (version 2.0).

Interface Software Version

Attribute ID	NC_ATTR_SOFTWARE_VERSION
Hex Encoding	80000003
Data Type	NCTYPE_VERSION
Permissions	Get
Description	This driver attribute reports the version of the NI-DNET software. This version is at least 01000000 hex (version 1.0).

Mac Id

Attribute ID	`NC_ATTR_MAC_ID`
Hex Encoding	`80000080`
Data Type	`NCTYPE_UINT8`
Permissions	Get
Description	This driver attribute allows you to get the `IntfMacId` originally passed into `ncOpenDnetIntf`.

Poll Mode

Attribute ID	`NC_ATTR_POLL_MODE`
Hex Encoding	`8000009B`
Data Type	`NCTYPE_POLL_MODE`
Permissions	Get
Description	This driver attribute allows you to get the `PollMode` originally passed into `ncOpenDnetIntf`.

I/O Object

Description

The I/O Object represents an I/O connection to a remote DeviceNet device (physical device attached to your interface by a DeviceNet cable). The I/O Object usually represents I/O communication as a master with a remote slave device. If your computer is being used as the primary controller of your DeviceNet devices, you should configure I/O communication as a master.

You can also configure the I/O Object for I/O communication as a slave with a remote master. If your computer is being used as a peripheral device for another primary controller, you can configure I/O communication as a slave. To configure I/O communication as a slave, set the I/O Object's `DeviceMacId` to the same MAC ID as the Interface Object (`IntfMacId` parameter of `ncOpenDnetIntf`).

The I/O Object supports as many master/slave I/O connections as currently allowed by the DeviceNet Specification (version 2.0). This means that you can use polled, strobed, and COS/cyclic I/O connections simultaneously for a given device. As specified by the DeviceNet Specification, only one master/slave I/O connection of a given type can be used for each device (MAC ID). For example, you cannot open two polled I/O connections for the same device.

Use the I/O Object to do the following:

- Read data from the most recent message received on the I/O connection (`ncReadDnetIO`).
- Write data for the next message produced on the I/O connection (`ncWriteDnetIO`).

Functions

Function Name	Function Description
`DeviceNet Error Handler`	Convert status returned from an NI-DNET function into a descriptive string (LabVIEW only)
`EasyIOClose`	Close multiple NI-DNET objects (LabVIEW only)
`EasyIOConfig`	Configure and open multiple NI-DNET objects (LabVIEW only)
`ncCloseObject`	Close an NI-DNET object
`ncConvertForDnetWrite`	Convert an appropriate LabVIEW data type for writing data bytes on the DeviceNet network

Functions (Continued)

Function Name	Function Description
`ncConvertFromDnetRead`	Convert data read from the DeviceNet network into an appropriate LabVIEW data type
`ncCreateNotification`	Create a notification callback for an object (C only)
`ncCreateOccurrence`	Create a notification occurrence for an object (LabVIEW only)
`ncGetDriverAttr`	Get the value of an attribute in the NI-DNET driver
`ncOpenDnetIO`	Configure and open an NI-DNET I/O Object
`ncReadDnetIO`	Read input data from an I/O Object
`ncSetDriverAttr`	Set the value of an attribute in the NI-DNET driver
`ncStatusToString`	Convert status returned from an NI-DNET function into a descriptive string (C only)
`ncWaitForState`	Wait for one or more states to occur in an object
`ncWriteDnetIO`	Write output data to an I/O Object

Driver Attributes

Ack Suppress

Attribute ID	`NC_ATTR_ACK_SUPPRESS`
Hex Encoding	`8000009A`
Data Type	`NCTYPE_BOOL`
Permissions	Set
Description	This driver attribute applies only to change-of-state (COS) or cyclic I/O connections (`ConnectionType` of `COS` or `Cyclic`). It determines whether acknowledgments are used (false) or suppressed (true). Acknowledgments are used with COS or cyclic I/O connections to verify that produced data is received successfully. When `InputLength` is nonzero, the acknowledgment is produced by NI-DNET. When `OutputLength` is nonzero, the acknowledgment is consumed by NI-DNET. If you do not call `ncSetDriverAttr` to set `Ack Suppress`, a default value of false is used. When successful device operation can be verified by other means, COS or cyclic acknowledgment can often be suppressed. For example, if you open a polled I/O connection in addition to the COS or cyclic I/O connection, you can set `Ack Suppress` to true. If the `ConnectionType` of this I/O object is `Poll` or `Strobe`, the `Ack Suppress` attribute is ignored.

Current State

Attribute ID	NC_ATTR_STATE
Hex Encoding	80000009
Data Type	NCTYPE_STATE
Permissions	Get
Description	Current state of the NI-DNET object. This driver attribute provides the current ReadAvail, Established, and Error states as described in ncWaitForState. Use ncGetDriverAttr when you need to determine the current state of an object but you do not need to wait for a specific state. For example, if you want to determine whether an error has occurred, you can get the Current State attribute to check the Error state. Since reporting of errors is handled automatically by read and write functions, using ncGetDriverAttr to check for such errors is typically done only if the read and write functions are not used often.

Device Type

Attribute ID	NC_ATTR_DEVICE_TYPE
Hex Encoding	80000084
Data Type	NCTYPE_UINT16
Permissions	Set
Description	Device Type of the device as reported in the Device Type attribute of device’s Identity Object. This attribute verifies that the device is the same one expected by your application. If the Device Type does not match, NI-DNET returns the NC_ERR_DEVICE_INIT error with a qualifier of NC_QUAL_DEVI_DEVTYPE. The Device Type indicates conformance to a specific device profile, such as Photoelectric Sensor or Position Controller. If you do not call ncSetDriverAttr to set the Device Type, a default value of zero is used. When Device Type is zero, NI-DNET does not verify the device’s Device Type.

Exp Packet Rate

Attribute ID	NC_ATTR_EXP_PACKET_RATE
Hex Encoding	80000095
Data Type	NCTYPE_DURATION
Permissions	Get
Description	This driver attribute allows you to get the ExpPacketRate originally passed into ncOpenDnetIO.

Inhibit Timer

Attribute ID	NC_ATTR_EXP_INHIBIT_TIMER
Hex Encoding	80000097
Data Type	NCTYPE_DURATION
Permissions	Set
Description	This driver attribute applies only to COS I/O connections (ncOpenDnetIO with ConnectionType of COS). This driver attribute configures the minimum delay time between subsequent data productions. This attribute can limit the amount of network traffic used for COS messages from devices with frequently changing I/O. The default value for Inhibit Timer is zero, as specified in the DeviceNet Specification. Since this default is appropriate for most applications, the Inhibit Timer attribute is not included in the configuration attributes provided with ncOpenDnetIO. If you want to change the default Inhibit Timer, call ncSetDriverAttr prior to starting communication. If ConnectionType is Poll, Strobe, or Cyclic, the Inhibit Timer attribute is ignored. For these I/O connection types, the frequency of data production is controlled entirely by the ExpPacketRate attribute.

Input Length

Attribute ID	`NC_ATTR_IN_LEN`
Hex Encoding	`80000091`
Data Type	`NCTYPE_UINT32`
Permissions	Get
Description	This driver attribute allows you to get the `InputLength` originally passed into `ncOpenDnetIO`.

Mac Id

Attribute ID	`NC_ATTR_MAC_ID`
Hex Encoding	`80000080`
Data Type	`NCTYPE_UINT8`
Permissions	Get
Description	This driver attribute allows you to get the `DeviceMacId` originally passed into `ncOpenDnetIO`.

Output Length

Attribute ID	`NC_ATTR_OUT_LEN`
Hex Encoding	`80000092`
Data Type	`NCTYPE_UINT32`
Permissions	Get
Description	This driver attribute allows you to get the `OutputLength` originally passed into `ncOpenDnetIO`.

Product Code

Attribute ID	`NC_ATTR_PRODUCT_CODE`
Hex Encoding	`80000083`
Data Type	`NCTYPE_UINT16`
Permissions	Set
Description	Product Code of the device as reported in the Product Code attribute of device's Identity Object. This attribute is used to verify that the device is the same one expected by your application. If the Product Code does not match, NI-DNET returns the `NC_ERR_DEVICE_INIT` error with a qualifier of `NC_QUAL_DEVI_PRODCODE`. The Product Code is a vendor-specific value which identifies a particular product within a device type. If you do not call `ncSetDriverAttr` to set the Product Code, a default value of zero is used. When Product Code is zero, NI-DNET does not verify the device's Product Code.

Vendor Id

Attribute ID	`NC_ATTR_VENDOR_ID`
Hex Encoding	`80000082`
Data Type	`NCTYPE_UINT16`
Permissions	Set
Description	Vendor ID of the device as reported in the Vendor ID attribute of device's Identity Object. This attribute verifies that the device is the same one expected by your application. If the Vendor ID does not match, NI-DNET returns the `NC_ERR_DEVICE_INIT` error with a qualifier of `NC_QUAL_DEVI_VENDOR`. The Vendor ID is a number assigned to the device vendor by the Open Device Vendor's Association (ODVA). If you do not call `ncSetDriverAttr` to set the Vendor ID, a default value of zero is used. When Vendor ID is zero, NI-DNET does not verify the device's Vendor ID.

A

Status Handling and Error Codes

This appendix describes how to handle NI-DNET status in your applications and the encoding of NI-DNET status values.

Each NI-DNET function returns a value that indicates the status of the function call. Your application should check this status after each NI-DNET function call.

Handling Status in G (LabVIEW/BridgeVIEW)

Checking Status

For applications written in G (LabVIEW/BridgeVIEW), status checking is handled automatically. For all NI-DNET functions, the lower left and right terminals provide status information using LabVIEW Error Clusters. LabVIEW Error Clusters are designed so that status information flows from one function to the next, and function execution stops when an error occurs. For more information, refer to the Error Handling section in the LabVIEW online reference.

Within your LabVIEW block diagram, you wire the `Error in` and `Error out` terminals of NI-DNET functions together in succession. When an error is detected in an NI-DNET function (`status` field true), all NI-DNET functions wired together are skipped except for `ncCloseObject`. The `ncCloseObject` function executes regardless of whether an error occurred, thus ensuring that all NI-DNET objects are closed properly when execution stops due to an error. Depending on how you want to handle errors, you can wire the `Error in` and `Error out` terminals together per-object (group a single open/close pair), per-device (group together Explicit Messaging and I/O Objects for a given device), or per-network (group all functions for a given interface).

The `DeviceNet Error Handler` function converts an NI-DNET Error Cluster into a descriptive string. By displaying this string when an error or warning is detected, you can avoid interpretation of individual fields of the Error Cluster to debug the problem. The `Error in` terminal of this function is normally wired from the `Error out` terminal of an `ncCloseObject` function.

To display an NI-DNET Error Cluster description without interrupting execution of other code, you normally wire the `Error out` and `Error String` output terminals of the `DeviceNet Error Handler` to front panel indicators. If you want to interrupt execution and display a dialog box describing the error, set `Show Error Dialog` to true instead of using front panel indicators.

Figure A-1 shows the Error Cluster of the `ncCloseObject` function wired into the `DeviceNet Error Handler` function. Instead of showing the dialog box when an error occurs, this diagram displays the error description using a front panel indicator.

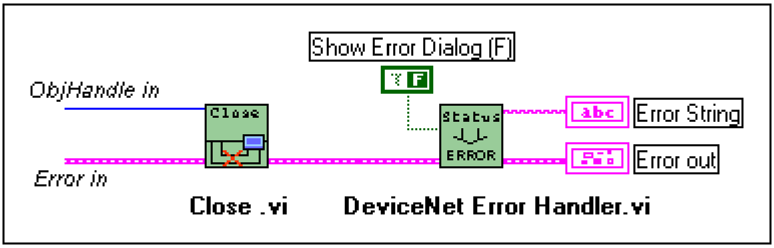


Figure A-1. NI-DNET Error Cluster Example

Status Format

When you use the `DeviceNet Error Handler` function in your diagram, a description of the error is displayed either in a dialog box or on your front panel (assuming you wire `Error String` to an indicator). When you display the error string generated by `DeviceNet Error Handler`, you do not need to interpret the individual fields of the NI-DNET Error Cluster.

In the NI-DNET implementation of Error Clusters, each field has the following meaning:

Status

This boolean field is true when an error occurs and remains false when a warning or success occurs. An error occurs when a function does not perform the expected behavior. A warning occurs when the function performed as expected but a condition exists which might require your attention. Success indicates that the function performed normally.

Code

The 32 bits of the `code` field have the format shown in Figure A-2.

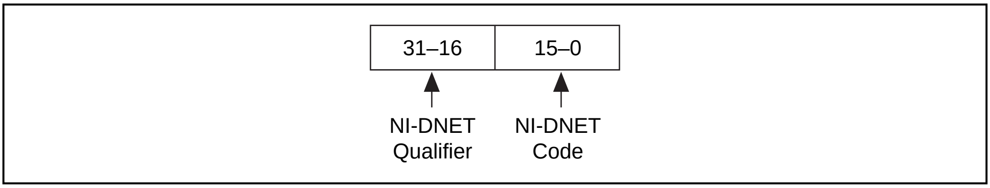


Figure A-2. Error Cluster Code Field

The lower 16 bits indicate the primary status code used for warnings or errors. For example, if NI-DNET cannot initialize communication with a device, the code `NC_ERR_DEVICE_INIT` is returned. If no warning or error exists, the Error Cluster's `code` field has the value zero.

The upper 16 bits indicate a qualifier for the primary NI-DNET warning or error code. This NI-DNET qualifier is specific to individual values for the NI-DNET code and provides additional information useful for detailed debugging. For example, if the status code is `NC_ERR_DEVICE_INIT`, the qualifier indicates the exact cause of the initialization problem. If no qualifier exists, the NI-DNET qualifier field has the value zero.

Source

When an error or warning occurs, the `source` field (a string) of the Error Cluster provides the complete VI hierarchy for the NI-DNET function in which the error or warning occurred. If no error or warning occurs in your application, `source` remains blank.

The first line in `source` displays the NI-DNET function in which the error or warning occurred. The next line displays the name of the VI that called the NI-DNET function. Subsequent lines display the next highest VI in the call chain, up to the main VI for your application.

Handling Status in C

Checking Status

Each C language NI-DNET function returns a value that indicates the status of the function call. This status value is zero for success, greater than zero for a warning, and less than zero for an error.

After every call to an NI-DNET function, your program should check to see if the return status is nonzero. If so, call `ncStatusToString` to obtain an ASCII string which describes the error/warning. You can then display this ASCII string using standard C functions such as `printf`.

The following text shows C source code for handling the status returned from `ncCloseObject`. If an error or warning is detected, call `ncStatusToString` to obtain an error description.

```
NCTYPE_STATUS       status;

charstring[80];

. . .

status = ncCloseObject(objh);

if (status != NC_SUCCESS) {
    ncStatusToString(status, sizeof(string), string);
    printf("ncCloseObject: %s\n", string);
    . . .
}
. . .
```

When accessing the NI-DNET code and qualifier within your application, you should use the constants defined in `nidnet.h`. These constants use the same names as described later in this appendix. For example, to check for a timeout after calling `ncWaitForState`, you would write C code similar to the following:

```
if (NC_STATCODE(status) == NC_ERR_TIMEOUT) {
    YourCodeToHandleTimeout();
}
```

Status Format

When you use the `ncStatusToString` function in your C source code, you can always obtain a complete description of the error, and you do not need to interpret the individual fields of the NI-DNET status.

To provide the maximum amount of information, the status returned by NI-DNET functions is encoded as a signed 32-bit integer. The format of this integer is shown in Figure A-3.

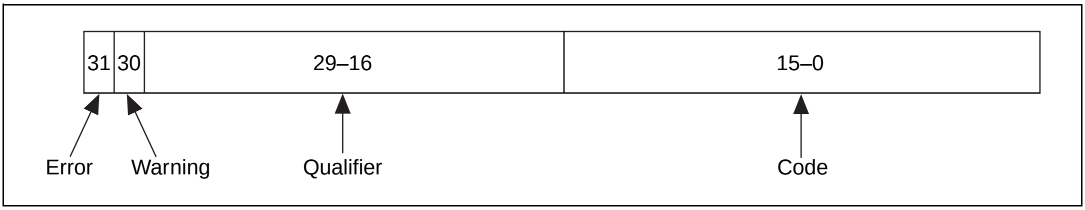


Figure A-3. Status Format in C

Error/Warning Indicators (Severity)

The error and warning bits ensure that all NI-DNET errors generate a negative status and all NI-DNET warnings generate a positive status. The error bit is set when a function does not perform the expected behavior, resulting in a negative status. The warning bit is set when the function performed as expected but a condition exists that might require your attention. If no error or warning occurs, the entire status is set to zero to indicate success. Table A-1 summarizes the behavior of NI-DNET status.

Table A-1. Determining Severity of Status

Status	Result
Negative	Error. Function did not perform expected behavior.
Zero	Success. Function completed successfully.
Positive	Warning. Function performed as expected, but a condition arose that might require your attention.

Code

The code bits indicate the primary status code used for warning or errors. For example, if NI-DNET cannot initialize communication with a device, the code `NC_ERR_DEVICE_INIT` is returned. If no warning or error exists, this field has the value zero.

Qualifier

The qualifier bits hold a qualifier for the warning or error code. It is specific to individual values for the code field and provides additional information useful for detailed debugging. For example, if the status code is `NC_ERR_DEVICE_INIT`, the qualifier indicates the exact cause of the initialization problem. If no qualifier exists, this field has the value zero.

NI-DNET Status Codes and Qualifiers

Table A-2 summarizes each NI-DNET status code (lower 16 bits). After the table, a separate section for each status code lists the valid encodings for the entire status, including the associated qualifier and severity. Each section also provides possible solutions to the problem.

Table A-2. Summary of Status Codes

Code	Hex Encoding of Code (Lower 16 Bits)	Description
`NC_SUCCESS`	0000	Success (no warning or error)
`NC_ERR_TIMEOUT`	0001	A timeout expired
`NC_ERR_DRIVER`	0002	Implementation-specific error in the NI-DNET driver
`NC_ERR_BAD_PARAM`	0004	Invalid function parameter
`NC_ERR_ALREADY_OPEN`	0006	Object already open with different configuration

Table A-2. Summary of Status Codes (Continued)

Code	Hex Encoding of Code (Lower 16 Bits)	Description
`NC_ERR_NOT_STOPPED`	0007	Attempted to set a driver attribute while communicating
`NC_ERR_OLD_DATA`	0009	Data returned from `ncReadDnetIO` matches data returned from previous call to `ncReadDnetIO`
`NC_ERR_DEVICE_INIT`	0010	Problem initializing a remote DeviceNet device for communication
`NC_ERR_NOT_SUPPORTED`	000A	A known NI-DNET feature is not supported
`NC_ERR_CAN_COMM`	000B	Error or warning indicating CAN communication errors
`NC_ERR_NOT_STARTED`	000C	You attempted to perform an operation which is only allowed when communicating
`NC_ERR_RSRC_LIMITS`	000D	Configuration specified by application exceeds NI-DNET resource limits
`NC_ERR_READ_NOT_AVAIL`	000E	Call to `ncReadDnetExplMsg` was made prior to receiving a valid explicit message response
`NC_ERR_BAD_NET_ID`	000F	Interface Object’s MAC ID conflicts with another DeviceNet device
`NC_ERR_DEVICE_MISSING`	0011	Remote DeviceNet device is missing from your network
`NC_ERR_FRAGMENTATION`	0012	Fragment received out of sequence
`NC_ERR_NO_CONFIG`	0013	Interface object not configured
`NC_ERR_DNET_ERR_RESP`	0014	Error response received from remote DeviceNet device

NC_SUCCESS (0000 Hex)

Success (no warning or error).

Hex Status Encoding 00000000

Qualifier	0
Severity	Success
Description	The qualifier is always zero.

NC_ERR_TIMEOUT (0001 Hex)

A timeout expired. The qualifier indicates the type of timeout that expired.

Hex Status Encoding 80000001

Qualifier	NC_QUAL_TIMO_FUNCTION (0)
Severity	Error
Description	The timeout of ncGetDnetAttribute, ncSetDnetAttribute, ncWaitForState, or ncCreateNotification expired before any desired states occurred.
Solutions	• Increase the value of the Timeout parameter to wait longer. • If the timeout occurs while waiting for the ReadAvail state (NC_ST_READ_AVAIL) or Established state (NC_ST_ESTABLISHED), verify your DeviceNet cable connections and ensure that remote devices are operating properly. • If you wait only for the Error state (NC_ST_ERROR), the timeout is often the expected behavior and you can ignore it.

Hex Status Encoding 80020001

Qualifier	`NC_QUAL_TIMO_CONNECTION (2)`
Severity	Error
Description	Although a connection was successfully established with the remote DeviceNet device, that connection timed out. This error occurs when the device does not respond (or acknowledge) messages sent by NI-DNET.
Solutions	• Increase the value used for the `ExpPacketRate` parameter of `ncOpenDnetIO`. • Verify that the device still exists at the configured MAC ID by running the `SimpleWho` utility described in the *NI-DNET User Manual*. • Verify that your DeviceNet cabling is correct. • Verify that your device can accept back-to-back DeviceNet messages. If DeviceNet messages can be lost in the device when NI-DNET transmits messages at a fast rate, your device might not respond properly. • Contact National Instruments with information on the failing device. National Instruments technical support might be able to work around its loss of messages.

NC_ERR_DRIVER (0002 Hex)

An implementation-specific error occurred in the NI-DNET driver, such as the inability to allocate needed memory. This error should never occur under normal circumstances.

Hex Status Encoding 8xxx0002, 9xxx0002, Axxx0002, and Bxxx0002

Qualifier	Varies
Severity	Error
Description	The qualifier holds a value that is specific to the NI-DNET driver implementation. This qualifier is encoded in bits 16-29 (`xxx` in the listing above).
Solution	Write down the status value, and contact National Instruments for technical support.

NC_ERR_BAD_PARAM (0004 Hex)

One or more function parameters is invalid.

Hex Status Encoding 80000004

Qualifier	`0`
Severity	Error
Description	A function parameter is invalid.
Solution	Read the function description in Chapter 2, *NI-DNET Functions*, to determine valid values for each parameter.

Hex Status Encoding 80010004

Qualifier	`1`
Severity	Error
Description	Although the parameters for each function call are valid, the total of all parameters passed to open functions result in an invalid system configuration.
Solution	This error occurs if you use more than two different values for `ExpPacketRate` with the `PollMode` parameter `Scanned`.

Hex Status Encoding 80020004

Qualifier	`2`
Severity	Error
Description	The `IntfName` parameter of `ncOpenDnetIntf`, `ncOpenDnetExplMsg`, or `ncOpenDnetIO` is invalid.
Solutions	• Verify that the syntax of your `IntfName` is `DNET`*`x`*, where *`x`* is a number from 0 to 9. • Run the NI-DNET Hardware Configuration utility to verify that your `IntfName` is assigned to National Instruments DeviceNet hardware.

Hex Status Encoding 81000004

Qualifier	`NC_QUAL_BAD_HANDLE (0X0100)`
Severity	Error
Description	The object handle passed to the function is invalid. This probably resulted from an unsuccessful call to one of the open functions or a handle that has already been closed.
Solution	Verify that the object was created successfully and that it is open and running.

NC_ERR_ALREADY_OPEN (0006 Hex)

The object you are trying to open is already open with a different configuration or has a conflict with one of the existing NI-DNET objects.

Hex Status Encoding 80010006

Qualifier	`NC_QUAL_OPEN_INTF_MODE (1)`
Severity	Error
Description	The Interface Object is open with a different Poll Mode. You might encounter this error if you are trying to open multiple handles for the same Interface Object with different configuration or you are trying to open an I/O connection after the communication has started and the interface is configured with the `Automatic` mode.
Solution	Close the Interface Object before reconfiguring, or change the Poll Mode in your `ncOpenDnetIntf` call to match the current mode. If you are trying to add I/O connections, stop the communication with `ncOperateDnetIntf` and retry.

Hex Status Encoding 80020006

Qualifier	`NC_QUAL_OPEN_CONNTYPE (2)`
Severity	Error
Description	You tried to open a COS I/O connection with a cyclic I/O connection for that device already open, or vice versa.
Solution	COS and cyclic connections are mutually exclusive; you can only have one type open at any given time. Close the other connection and then retry.

NC_ERR_NOT_STOPPED (0007 Hex)

You attempted to set an NI-DNET driver attribute while communicating. You can call `ncSetDriverAttr` only prior to calling `ncOperateDnetIntf` to start communication.

Hex Status Encoding 80000007

Qualifier	`0`
Severity	Error
Description	The qualifier is always zero.
Solution	Do not call `ncOperateDnetIntf` to start communication until you have completed all calls to `ncSetDriverAttr`.

NC_ERR_OLD_DATA (0009 Hex)

The data returned from `ncReadDnetIO` matches the data returned from the previous call to `ncReadDnetIO`. Because the old data is returned successfully, this status code has a warning severity, not error.

Hex Status Encoding 40000009

Qualifier	`0`
Severity	Warning
Description	The qualifier is always zero.
Solutions	• If you only want to read the most recent data, ignore this warning. • Wait for the `NC_ST_READ_AVAIL` state before calling `ncReadDnetIO`.

NC_ERR_DEVICE_INIT (0010 Hex)

This error indicates a problem in initialization of a remote DeviceNet device when preparing it for communication with NI-DNET.

Hex Status Encoding 80000010

Qualifier	`NC_QUAL_DEVI_OTHER (0)`
Severity	Error

Description	Miscellaneous device initialization error.
Solution	Verify that the configuration specified in ncOpenDnetExplMsg, ncOpenDnetIO, or ncSetDriverAttr matches the capabilities of your device.

Hex Status Encoding 80010010

Qualifier	NC_QUAL_DEVI_IO_CONN (1)
Severity	Error
Description	Device does not support the ConnectionType passed into ncOpenDnetIO. For example, if the device only supports strobed I/O and you configure polled I/O, this error is returned.
Solutions	• Determine the I/O connection types supported. Either refer to the documentation for your DeviceNet device or run the SimpleWho utility described in the *NI-DNET User Manual*. • After you determine a valid I/O connection type, use that ConnectionType with ncOpenDnetIO.

Hex Status Encoding 80020010

Qualifier	NC_QUAL_DEVI_IN_LEN (2)
Severity	Error
Description	Device does not support the InputLength passed into ncOpenDnetIO. This InputLength must match the produced_connection_size attribute within the device's internal I/O Connection Object (except for strobed, see *Solutions* below).
Solutions	• For a strobed I/O connection which communicates as a slave (DeviceMacId equals IntfMacId), InputLength must be 1. The boolean input is obtained from the 8 byte strobe command message and is returned as a single input byte to your application. • Determine the produced_connection_size for the I/O Connection. Either refer to the documentation for your DeviceNet device or run the SimpleWho utility described in the *NI-DNET User Manual*. Use that value as InputLength with ncOpenDnetIO.

Hex Status Encoding 80030010

Qualifier	`NC_QUAL_DEVI_OUT_LEN (3)`
Severity	Error
Description	Device does not support the `OutputLength` passed into `ncOpenDnetIO`. This `OutputLength` must match the `consumed_connection_size` attribute within the device's internal I/O Connection Object (except for strobed, see *Solutions* below).
Solutions	• For a strobed I/O connection which communicates as a slave (`DeviceMacId` equals `IntfMacId`). `OutputLength` must be `1`. The boolean output byte is used to determine the device's output bit within the 8 byte strobe command message. • Determine the `consumed_connection_size` for the I/O Connection. Either refer to the documentation for your DeviceNet device or run the `SimpleWho` utility described in the *NI-DNET User Manual*. Use that value as the `OutputLength` with `ncOpenDnetIO`.

Hex Status Encoding 80040010

Qualifier	`NC_QUAL_DEVI_EPR (4)`
Severity	Error
Description	Device does not support the `ExpPacketRate` passed into `ncOpenDnetIO`.
Solutions	• If you set `ExpPacketRate` as a relatively small value, try increasing it. Some devices have a lower limit for their communications rate, often determined by hardware limitations. • If you set `ExpPacketRate` as a relatively large value, try decreasing it. Some devices have an upper limit for internal timers. • For more information on I/O Connection rates, refer to the *NI-DNET User Manual*.

Hex Status Encoding 80050010

Qualifier	`NC_QUAL_DEVI_VENDOR (5)`
Severity	Error
Description	The vendor ID reported by the device (in the Vendor ID of its internal Identity Object) differs from the Vendor Id driver attribute (`NC_ATTR_VENDOR_ID`).
Solutions	• If you have knowingly replaced a previously used device with one from another vendor, use the new device's Vendor ID with `ncSetDriverAttr`. • If you are unaware of a device replacement, run the `SimpleWho` utility described in the *NI-DNET User Manual*, and determine which device now exists at the MAC ID. • If you no longer want to verify the device's Vendor ID, remove the call to `ncSetDriverAttr` for the Vendor Id driver attribute.

Hex Status Encoding 80060010

Qualifier	`NC_QUAL_DEVI_DEVTYPE (6)`
Severity	Error
Description	The device type reported by the device (in the Device Type of its internal Identity Object) differs from the Device Type driver attribute (`NC_ATTR_DEVICE_TYPE`).
Solutions	• If you have knowingly replaced a previously used device with one of a different type (device profile), use the new device's type with `ncSetDriverAttr`. • If you are unaware of a device replacement, run the `SimpleWho` utility described in the *NI-DNET User Manual*, and determine which device now exists at the MAC ID. • If you no longer want to verify the device's type, remove the call to `ncSetDriverAttr` for the Device Type driver attribute.

Hex Status Encoding 80070010

Qualifier	`NC_QUAL_DEVI_PRODCODE (7)`
Severity	Error
Description	The product code reported by the device (in the Product Code of its internal Identity Object) differs from the Product Code driver attribute (`NC_ATTR_PRODUCT_CODE`).
Solutions	• If you have knowingly replaced a previously used device with one of a different product code, use the new device's product code with `ncSetDriverAttr`. • If you are unaware of a device replacement, run the `SimpleWho` utility described in the *NI-DNET User Manual*, and determine which device now exists at the MAC ID. • If you no longer want to verify the device's product code, remove the call to `ncSetDriverAttr` for the Product Code driver attribute.

NC_ERR_NOT_SUPPORTED (000A Hex)

This error indicates that a known NI-DNET feature is not supported.

Hex Status Encoding 8000000A

Qualifier	`0`
Severity	Error
Description	A known feature is not supported.
Solutions	• For the given function, object, and parameters used, refer to the descriptions in this manual to determine which feature is unsupported. • This error is returned if you call a read or write function for an Interface Object.

NC_ERR_CAN_COMM (000B Hex)

CAN (Controller Area Network) is the low-level protocol used for DeviceNet communications. This error or warning indicates problems with CAN communication, such as bad cabling.

Hex Status Encoding 4000000B

Qualifier	0
Severity	Warning
Description	A warning indicates that CAN communication problems have been detected but communication is still proceeding. This warning corresponds to the Error Passive state referred to in the CAN Specification.
Solutions	• The most common cause of this warning is an attempt to transmit a CAN message without another CAN device connected. Connect your other DeviceNet devices prior to starting communication. • Another common cause of this problem is insufficient power on the DeviceNet bus. Verify that your power supply meets DeviceNet requirements and that your devices do not draw too much of that power. • Verify that your DeviceNet cabling is correct. For example, make sure that you wired your Combicon connector correctly on the DeviceNet interface.

Hex Status Encoding 8000000B

Qualifier	0
Severity	Error

Description	An error indicates that CAN communication problems caused all communication to stop. This error corresponds to the Bus Off state referred to in the *CAN Specification.*
Solutions	• The most common cause of this warning is an attempt to transmit a CAN message without another CAN device connected. Connect your other DeviceNet devices prior to starting communication. • Another common cause of this problem is insufficient power on the DeviceNet bus. Verify that your power supply meets DeviceNet requirements and that your devices do not draw too much of that power. • Verify that your DeviceNet cabling is correct. For example, make sure that you wired your Combicon connector correctly on the DeviceNet interface.

NC_ERR_NOT_STARTED (000C Hex)

This error is returned when you attempt to perform an operation which is allowed only when communicating.

Hex Status Encoding 8000000C

Qualifier	`0`
Severity	Error
Description	Communication must be started prior to the operation performed.
Solutions	• Perform the operation after you call `ncOperateDnetIntf` to start communication. • Do not perform the operation after you call `ncOperateDnetIntf` to stop communication. • This error is returned when you call `ncGetDnetAttribute`, `ncSetDnetAttribute`, or `ncWriteDnetExlpMsg` (send explicit message request) without first waiting for the `Established` state. • This error can occur after the `NC_ERR_CAN_COMM` error is detected, since the CAN communication error automatically stops all communication.

NC_ERR_RSRC_LIMITS (000D Hex)

The configuration specified by your application has exceeded internal NI-DNET resource limits. NI-DNET resources include the shared memory window between the host PC and interface, which is the underlying transport between your application and the DeviceNet protocol implementation.

Hex Status Encoding 8002000D

Qualifier	`NC_QUAL_RSRC_IO_LEN (2)`
Severity	Error
Description	Total shared memory space for I/O connections has been exceeded.
Solutions	• Reduce the number of devices or I/O connections used. • Reduce the `InputLength` or `OutputLength` used for a given I/O Object. The largest input/output length supported is 255 bytes.

Hex Status Encoding 8004000D

Qualifier	`NC_QUAL_RSRC_READ_SRV (4)`
Severity	Error
Description	Memory space allocated for consumed explicit message responses has been exceeded. This memory is limited to 240 service data bytes. When a larger response is received, it is discarded by NI-DNET. This error is usually returned by `ncReadDnetExplMsg`.
Solutions	• For a DeviceNet master to communicate successfully with the remote device, change its configuration so that it returns smaller responses. • If you cannot reduce the device's response length, please contact National Instruments to inform us about the device.

NC_ERR_READ_NOT_AVAIL (000E Hex)

A call to `ncReadDnetExplMsg` was made prior to receiving a valid explicit message response.

Hex Status Encoding 8000000E

Qualifier	`0`
Severity	Error
Description	The `ncReadDnetExplMsg` function was called prior to receiving a valid explicit message response.
Solutions	• A call to `ncReadDnetExplMsg` only makes sense after sending a service request using `ncWriteDnetExplMsg`. Make sure to call `ncWriteDnetExplMsg` prior to `ncReadDnetExplMsg`. • You should wait for the service response to be available prior to calling `ncReadDnetExplMsg`. This is done using `ncWaitForState` with `DesiredState` of `NC_ST_READ_AVAIL`.

NC_ERR_BAD_NET_ID (000F Hex)

When communication starts, the Interface Object verifies that its MAC ID (`IntfMacId` parameter of `ncOpenDnetIntf`) does not conflict with any other DeviceNet device. This verification is done using the Duplicate MAC ID Check sequence defined by the DeviceNet Specification. This error is returned when a MAC ID conflict is detected.

Hex Status Encoding 8000000F

Qualifier	`0`
Severity	Error
Description	Interface Object's MAC ID conflicts with another DeviceNet device.
Solution	Determine an unused MAC ID in your DeviceNet system, and use that MAC ID for the `IntfMacId` parameter of `ncOpenDnetIntf`. The `SimpleWho` utility can be used to determine unused MAC IDs. (See the *NI-DNET User Manual*.)

NC_ERR_DEVICE_MISSING (0011 Hex)

This error indicates that the DeviceNet device specified by `DeviceMacId` of `ncOpenDnetIO` or `ncOpenDnetExplMsg` is missing from your network. It results from a failure to establish an initial connection with the device.

Hex Status Encoding 80000011

Qualifier	`0`
Severity	Error
Description	After starting communication, a connection could not be established with the remote DeviceNet device.
Solutions	• This error occurs when the `DeviceMacId` parameter of `ncOpenDnetIO` or `ncOpenDnetExplMsg` is incorrect. To verify that the device exists at the configured MAC ID, run the `SimpleWho` utility described in the *NI-DNET User Manual*. • Verify that your DeviceNet cabling is correct.

NC_ERR_FRAGMENTATION (0012 Hex)

Fragmentation refers to the protocol by which a DeviceNet device breaks a large message into smaller fragments for network transmission. This error occurs when fragments are received out of sequence (such as the second fragment arriving before the first).

Hex Status Encoding 80000012

Qualifier	`0`
Severity	Error
Description	Fragment received out of sequence.
Solutions	• Verify that your DeviceNet cabling is correct. • Contact National Instruments with information on the failing device. National Instruments technical support might be able to work around its fragmentation problems.

NC_ERR_NO_CONFIG (0013 Hex)

The Interface Object must be configured before you configure any I/O or Explicit Messaging Object.

Hex Status Encoding 80010013

Qualifier	`NC_QUAL_NCFG_MASTER (1)`
Severity	Error
Description	The Interface Object is not configured.
Solution	Open the Interface Object before opening any other NI-DNET object.

NC_ERR_DNET_ERR_RESP (0014 Hex)

This error is returned from `ncGetDnetAttribute` and `ncSetDnetAttribute` when an error response is received from the remote DeviceNet device. This error response indicates that the Get Attribute Single or Set Attribute Single service failed in the device, such as when the attribute is not supported. The General Error Code and Additional Code returned in the `DeviceError` parameter indicate the reason for the device's failure.

Hex Status Encoding 80000014

Qualifier	`0`
Severity	Error
Description	The qualifier is always zero.
Solution	For information on the encoding of `DeviceError`, refer to `ncGetDnetAttribute` or `ncSetDnetAttribute`. Values for the device's error codes can be found in the DeviceNet Specification or in the device vendor's documentation.

B

Technical Support Resources

Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of `ni.com`

NI Developer Zone

The NI Developer Zone at `ni.com/zone` is the essential resource for building measurement and automation systems. At the NI Developer Zone, you can easily access the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

Customer Education

National Instruments provides a number of alternatives to satisfy your training needs, from self-paced tutorials, videos, and interactive CDs to instructor-led hands-on courses at locations around the world. Visit the Customer Education section of `ni.com` for online course schedules, syllabi, training centers, and class registration.

System Integration

If you have time constraints, limited in-house technical resources, or other dilemmas, you may prefer to employ consulting or system integration services. You can rely on the expertise available through our worldwide network of Alliance Program members. To find out more about our Alliance system integration solutions, visit the System Integration section of `ni.com`

Worldwide Support

National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of `ni.com`. Branch office Web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. Phone numbers for our worldwide offices are listed at the front of this manual.

Glossary

Prefix	Meanings	Value
m-	milli-	10^{-3}
k-	kilo-	10^{3}

A

ANSI

American National Standards Institute

Application Programming Interface (API)

A collection of functions used by a user application to access hardware. Within NI-DNET, you use API functions to make calls into the NI-DNET driver.

ASCII

American Standard Code for Information Interchange.

attribute

The externally visible qualities of an object; for example, an instance square of class geometric shapes could have the attributes length of sides and color, with the values 4 in. and blue. Also known as *property.*

B

b

Bits.

Bit strobed I/O

Master/slave I/O connection in which the master broadcasts a single strobe command to all strobed slaves then receives a strobe response from each strobed salve.

C

CAN

Controller Area Network.

Change-of-state I/O

Master/slave I/O connection which is similar to cyclic I/O but data can be sent when a change in the data is detected.

class

A classification of things with similar qualities.

connection

An association between two or more devices on a network that describes when and how data is transferred.

controller

A device that receives data from sensors and sends data to actuators to hold one or more external, real-world variables at a certain level or condition. A thermostat is a simple example of a controller.

COS I/O

See change-of-state I/O.

Cyclic I/O

Master/slave I/O connection in which the slave (or master) sends data at a fixed interval.

D

device

A physical assembly, linked to a communication line (cable), capable of communicating across the network according to a protocol specification.

device network

Multi-drop digital communication network for sensors, actuators, and controllers.

DeviceNet interface

A physical DeviceNet port on an AT-CAN, PCI-CAN, PCMCIA-CAN, or PXI-8461 interface.

E

Expected packet rate

The rate (in milliseconds) at which a DeviceNet connection is expected to transfer its data.

Explicit messaging connection

General-purpose connection used for executing services on a particular object in a DeviceNet device.

H

hex

Hexadecimal.

I

Individual polling

A polled I/O communication scheme in which each polled slave communicates at its own individual rate.

instance

A specific instance of a given class. For example, a blue square of 4 inches per side would be one instance of the class Geometric Shapes.

I/O connection

Connection used for exchange of physical input/output (sensor/activator) data, as well as other control-oriented data.

K

KB

Kilobytes of memory.

L

LabVIEW

Laboratory Virtual Instrument Engineering Workbench.

local

Within NI-DNET, anything that exists on the same host (personal computer) as the NI-DNET driver.

M

MAC ID

Media access control layer identifier. In DeviceNet, a device’s MAC ID represents its address on the DeviceNet network.

Master/slave

DeviceNet communication scheme in which a master device allocates connections to one or more slave devices, and those slave devices can only communicate with the master and not one another.

member

An individual data value within an array of DeviceNet data bytes.

method

An action performed on an instance to affect its behavior; the externally visible code of an object. Within NI-DNET, you use NI-DNET functions to execute methods for objects. Also known as *service*, *operation*, and *action*.

multi-drop

A physical connection in which multiple devices communicate with one another along a single cable.

N

NI-DNET driver

Device driver and/or firmware that implement all the specifics of a National Instruments DeviceNet interface.

notification

Within NI-DNET, an operating system mechanism that the NI-DNET driver uses to communicate events to your application. You can think of a notification of as an API function, but in the opposite direction.

O

object

See instance.

ODVA

Open DeviceNet Vendor's Association

P

Polled I/O

Master/slave I/O connection in which the master sends a poll command to a slave, then receives a poll response from that slave.

protocol

A formal set of conventions or rules for the exchange of information among devices of a given network.

R

remote

Within NI-DNET, anything that exists in another device of the device network (not on the same host as the NI-DNET driver).

resource

Hardware settings used by National Instruments DeviceNet hardware, including an interrupt request level (IRQ) and an 8 KB physical memory range (such as D0000 to D1FFF hex).

S

s Seconds.

Scanned polling A polled I/O communication scheme in which all poll commands are sent out at the same rate, in quick succession.

sensor A device that measures electrical, mechanical, or other signals from an external, real-world variable; in the context of device networks, sensors are devices that send their primary data value onto the network; examples include temperature sensors and presence sensors. Also known as transmitter.

Strobed I/O *See* bit strobed I/O.

V

VI Virtual Instrument.