DeviceNet

NI-DNET™ Programmer Reference Manual

April 2006
370376C-01

NATIONAL INSTRUMENTS™

Worldwide Technical Support and Product Information

ni.com

National Instruments Corporate Headquarters

11500 North Mopac Expressway Austin, Texas 78759-3504 USA Tel: 512 683 0100

Worldwide Offices

Australia 1800 300 800, Austria 43 0 662 45 79 90 0, Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599, Canada 800 433 3488, China 86 21 6555 7838, Czech Republic 420 224 235 774, Denmark 45 45 76 26 00, Finland 385 0 9 725 725 11, France 33 0 1 48 14 24 24, Germany 49 0 89 741 31 30, India 91 80 41190000, Israel 972 0 3 6393737, Italy 39 02 413091, Japan 81 3 5472 2970, Korea 82 02 3451 3400, Lebanon 961 0 1 33 28 28, Malaysia 1800 887710, Mexico 01 800 010 0793, Netherlands 31 0 348 433 466, New Zealand 0800 553 322, Norway 47 0 66 90 76 60, Poland 48 22 3390150, Portugal 351 210 311 210, Russia 7 095 783 68 51, Singapore 1800 226 5886, Slovenia 386 3 425 4200, South Africa 27 0 11 805 8197, Spain 34 91 640 0085, Sweden 46 0 8 587 895 00, Switzerland 41 56 200 51 51, Taiwan 886 02 2377 2222, Thailand 662 278 6777, United Kingdom 44 0 1635 523545

For further support information, refer to the *Technical Support and Professional Services* appendix. To comment on National Instruments documentation, refer to the National Instruments Web site at ni.com/info and enter the info code feedback.

Important Information

Warranty

The media on which you receive National Instruments software are warranted not to fail to execute programming instructions, due to defects in materials and workmanship, for a period of 90 days from date of shipment, as evidenced by receipts or other documentation. National Instruments will, at its option, repair or replace software media that do not execute programming instructions if National Instruments receives notice of such defects during the warranty period. National Instruments does not warrant that the operation of the software shall be uninterrupted or error free.

A Return Material Authorization (RMA) number must be obtained from the factory and clearly marked on the outside of the package before any equipment will be accepted for warranty work. National Instruments will pay the shipping costs of returning to the owner parts which are covered by warranty.

National Instruments believes that the information in this document is accurate. The document has been carefully reviewed for technical accuracy. In the event that technical or typographical errors exist, National Instruments reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should consult National Instruments if errors are suspected. In no event shall National Instruments be liable for any damages arising out of or related to this document or the information contained in it.

EXCEPT AS SPECIFIED HEREIN, NATIONAL INSTRUMENTS MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AND SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER'S RIGHT TO RECOVER DAMAGES CAUSED BY FAULT OR NEGLIGENCE ON THE PART OF NATIONAL INSTRUMENTS SHALL BE LIMITED TO THE AMOUNT THERETOFORE PAID BY THE CUSTOMER. NATIONAL INSTRUMENTS WILL NOT BE LIABLE FOR DAMAGES RESULTING FROM LOSS OF DATA, PROFITS, USE OF PRODUCTS, OR INCIDENTAL OR CONSEQUENTIAL DAMAGES, EVEN IF ADVISED OF THE POSSIBILITY THEREOF. This limitation of the liability of National Instruments will apply regardless of the form of action, whether in contract or tort, including negligence. Any action against National Instruments must be brought within one year after the cause of action accrues. National Instruments shall not be liable for any delay in performance due to causes beyond its reasonable control. The warranty provided herein does not cover damages, defects, malfunctions, or service failures caused by owner's failure to follow the National Instruments installation, operation, or maintenance instructions; owner's modification of the product; owner's abuse, misuse, or negligent acts; and power failure or surges, fire, flood, accident, actions of third parties, or other events outside reasonable control.

Copyright

Trademarks

Patents

For patents covering National Instruments products, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your CD, or `ni.com/patents`.

WARNING REGARDING USE OF NATIONAL INSTRUMENTS PRODUCTS

(1) NATIONAL INSTRUMENTS PRODUCTS ARE NOT DESIGNED WITH COMPONENTS AND TESTING FOR A LEVEL OF RELIABILITY SUITABLE FOR USE IN OR IN CONNECTION WITH SURGICAL IMPLANTS OR AS CRITICAL COMPONENTS IN ANY LIFE SUPPORT SYSTEMS WHOSE FAILURE TO PERFORM CAN REASONABLY BE EXPECTED TO CAUSE SIGNIFICANT INJURY TO A HUMAN.

(2) IN ANY APPLICATION, INCLUDING THE ABOVE, RELIABILITY OF OPERATION OF THE SOFTWARE PRODUCTS CAN BE IMPAIRED BY ADVERSE FACTORS, INCLUDING BUT NOT LIMITED TO FLUCTUATIONS IN ELECTRICAL POWER SUPPLY, COMPUTER HARDWARE MALFUNCTIONS, COMPUTER OPERATING SYSTEM SOFTWARE FITNESS, FITNESS OF COMPILERS AND DEVELOPMENT SOFTWARE USED TO DEVELOP AN APPLICATION, INSTALLATION ERRORS, SOFTWARE AND HARDWARE COMPATIBILITY PROBLEMS, MALFUNCTIONS OR FAILURES OF ELECTRONIC MONITORING OR CONTROL DEVICES, TRANSIENT FAILURES OF ELECTRONIC SYSTEMS (HARDWARE AND/OR SOFTWARE), UNANTICIPATED USES OR MISUSES, OR ERRORS ON THE PART OF THE USER OR APPLICATIONS DESIGNER (ADVERSE FACTORS SUCH AS THESE ARE HEREAFTER COLLECTIVELY TERMED "SYSTEM FAILURES"). ANY APPLICATION WHERE A SYSTEM FAILURE WOULD CREATE A RISK OF HARM TO PROPERTY OR PERSONS (INCLUDING THE RISK OF BODILY INJURY AND DEATH) SHOULD NOT BE RELIANT SOLELY UPON ONE FORM OF ELECTRONIC SYSTEM DUE TO THE RISK OF SYSTEM FAILURE. TO AVOID DAMAGE, INJURY, OR DEATH, THE USER OR APPLICATION DESIGNER MUST TAKE REASONABLY PRUDENT STEPS TO PROTECT AGAINST SYSTEM FAILURES, INCLUDING BUT NOT LIMITED TO BACK-UP OR SHUT DOWN MECHANISMS. BECAUSE EACH END-USER SYSTEM IS CUSTOMIZED AND DIFFERS FROM NATIONAL INSTRUMENTS' TESTING PLATFORMS AND BECAUSE A USER OR APPLICATION DESIGNER MAY USE NATIONAL INSTRUMENTS PRODUCTS IN COMBINATION WITH OTHER PRODUCTS IN A MANNER NOT EVALUATED OR CONTEMPLATED BY NATIONAL INSTRUMENTS, THE USER OR APPLICATION DESIGNER IS ULTIMATELY RESPONSIBLE FOR VERIFYING AND VALIDATING THE SUITABILITY OF NATIONAL INSTRUMENTS PRODUCTS WHENEVER NATIONAL INSTRUMENTS PRODUCTS ARE INCORPORATED IN A SYSTEM OR APPLICATION, INCLUDING, WITHOUT LIMITATION, THE APPROPRIATE DESIGN, PROCESS AND SAFETY LEVEL OF SUCH SYSTEM OR APPLICATION.

Contents

About This Manual

Chapter 1
NI-DNET Data Types

Chapter 2
NI-DNET Functions

Chapter 3
NI-DNET Objects

Appendix A
Technical Support and Professional Services

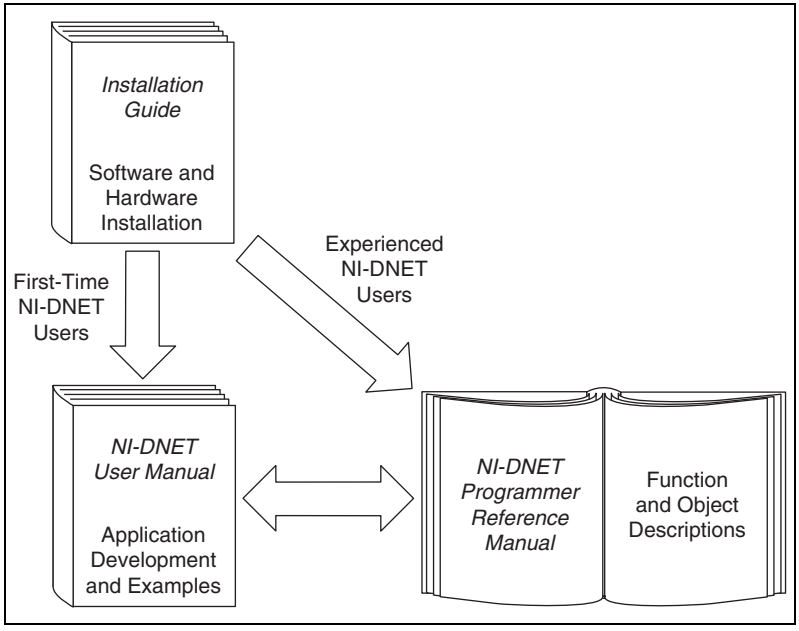
Glossary

Index

About This Manual

This manual is a programming reference for functions, objects, and data types in the NI-DNET software for Windows. This manual assumes that you are already familiar with the Windows system.

How to Use the Manual Set



Use the installation guide 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 information about DeviceNet hardware.

Use this *NI-DNET Programmer Reference Manual* for specific information about each NI-DNET function and object.

Conventions

The following conventions appear in this manual:

»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
	This icon denotes a note, which alerts you to important information.
bold	Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.
italic	Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text 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.
`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	unsigned char	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	unsigned long	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	unsigned long	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	unsigned long	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	unsigned long	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	unsigned long	U32	N/A	Operation code used with ncOperateDnetIntf function.
NCTYPE_STATE	unsigned long	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	signed long	I32	N/A	For ANSI C, this represents the status returned from NI-DNET functions. Refer to ncStatusToString for more information. For LabVIEW, NI-DNET functions use the standard error clusters for status information.

2

NI-DNET Functions

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

All the NI-DNET functions are reentrant to achieve good multitasking performance. 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 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.

Examples

Each function description includes sample LabVIEW and C code showing how to use the function. For more detailed examples, refer to the *NI-DNET User Manual* for information regarding the location of example programs for LabVIEW and C.

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
`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)
`ncGetDnetAttribute` (Get DeviceNet Attribute)	Get an attribute value from a DeviceNet device using an Explicit Messaging Object
`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

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

Function	Purpose
`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

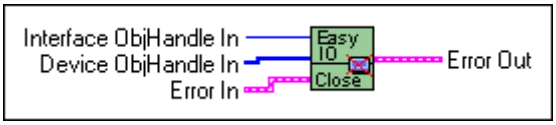
EasyIOClose (Easy IO Close)

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. You pass the outputs from `EasyIOConfig` as inputs to `EasyIOClose`.

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.

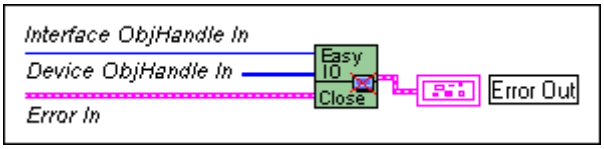
Device ObjHandle In

Description	Array of I/O object handles to be closed. You pass in the array returned from Easy IO Config.
Values	The encoding of object handles is internal to NI-DNET.

Examples

LabVIEW

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



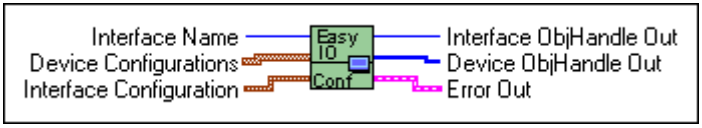
EasyIOConfig (Easy IO Config)

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 clusters
`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, you must configure all the strobe connections with the same EPR and all the poll connections with 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.

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. You associate DeviceNet interface names with physical ports using Measurement and Automation Explorer (MAX).
Values	`"DNET0"`, `"DNET1"`, … `"DNET31"` 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.

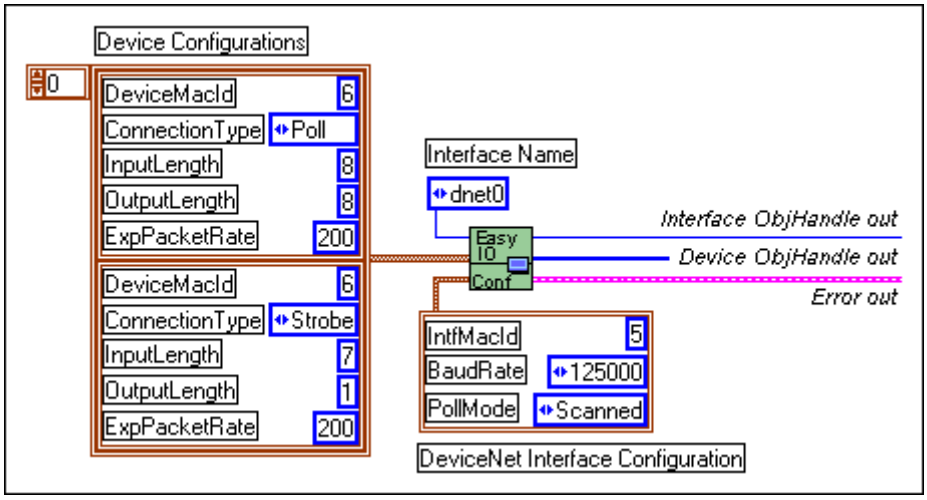
Device ObjHandle Out

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.

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.



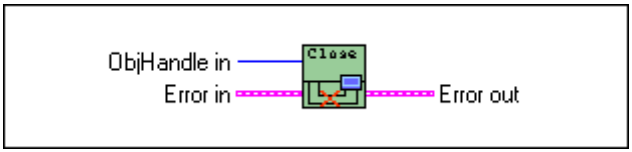
ncCloseObject (Close)

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 `ncCreateNotification` 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

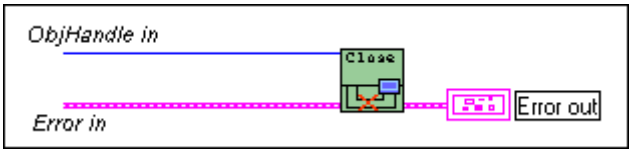
ObjHandle

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.

Examples

LabVIEW

Close an NI-DNET object.



C

Close an NI-DNET object.

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

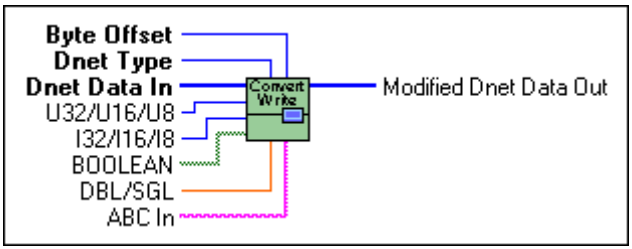
ncConvertForDnetWrite (Convert For DeviceNet Write)

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

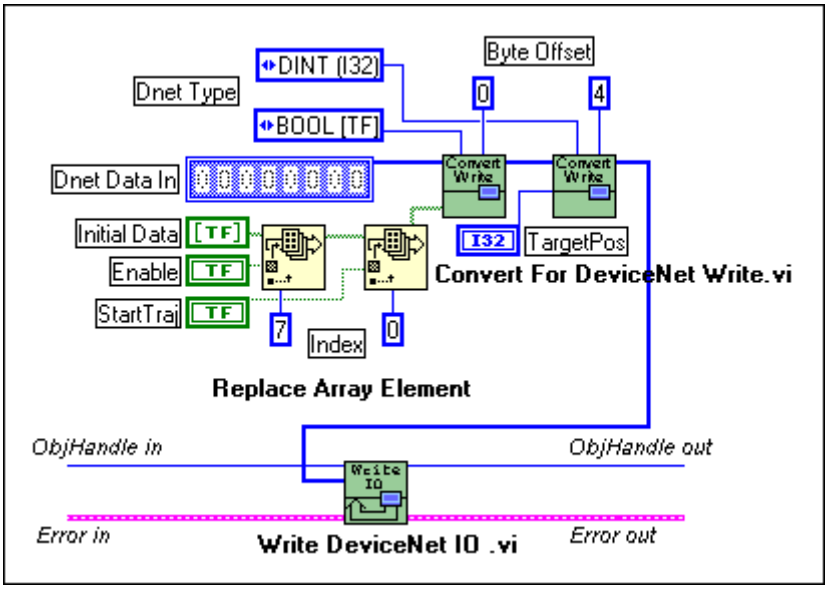
DnetData out

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

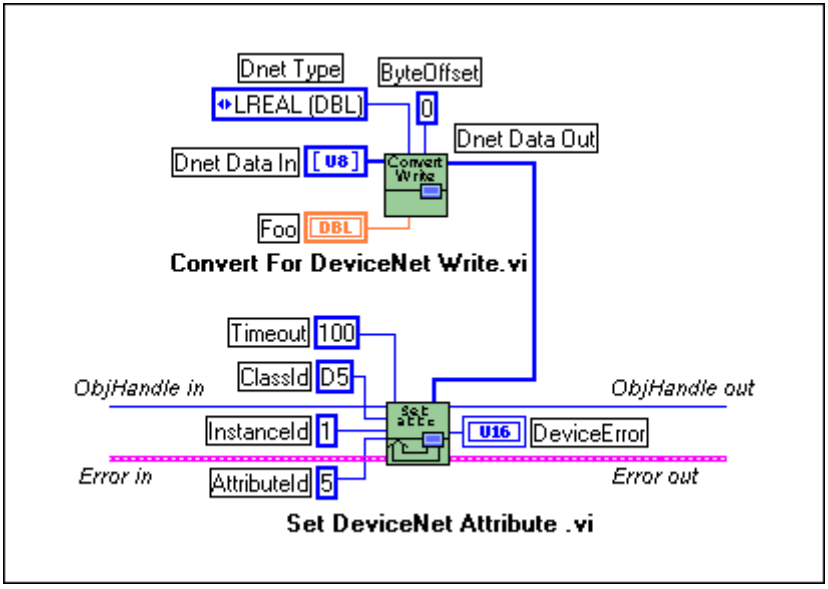
Examples

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);
```

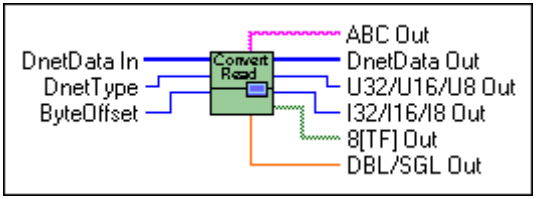
ncConvertFromDnetRead (Convert From DeviceNet Read)

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

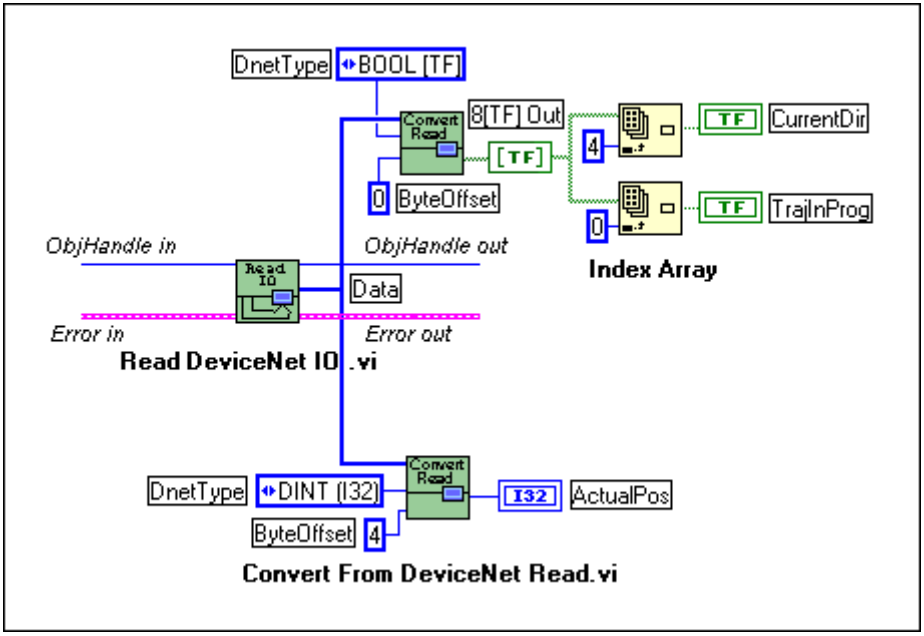
abc out

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

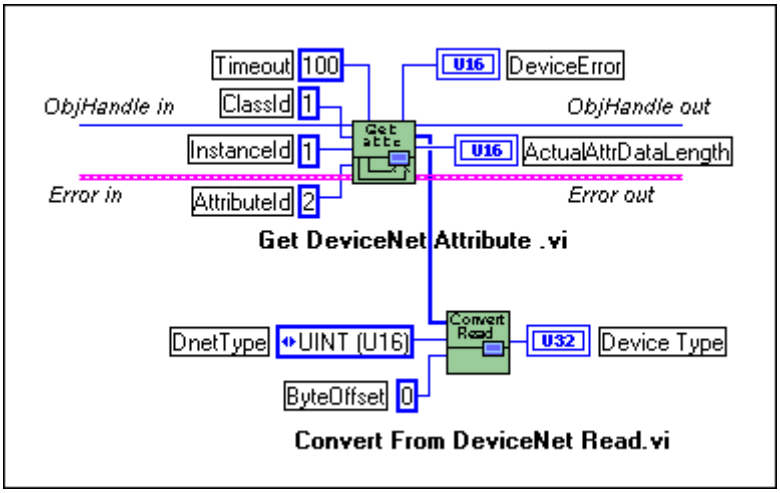
Examples

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

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.

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.

This function is not supported for Visual Basic 6.

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 `CanErrNotStarted`. 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 (`CanErrFunctionTimeout`), 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 `CanErrFunctionTimeout`. 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` (`DnetSuccess`). If the `Timeout` expires before one of the desired states occurs, it has the value `BFF62001` hex (`CanErrFunctionTimeout`).
	
	`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.

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 == DnetSuccess) {
           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);
    .
    .
    .
}
```

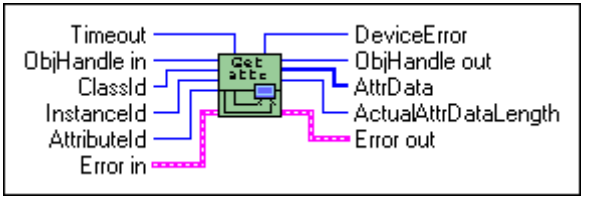
ncGetDnetAttribute (Get DeviceNet Attribute)

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 `BFF62001` hex (`CanErrFunctionTimeout`). 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`

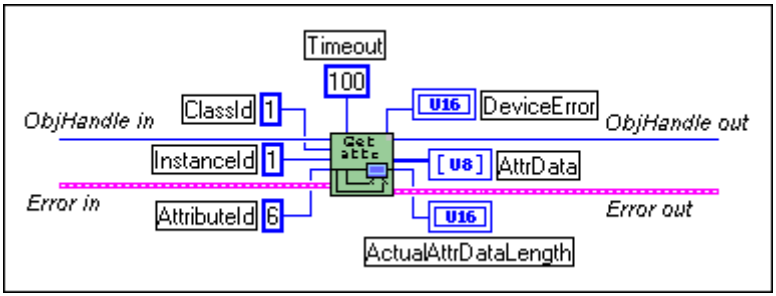
DeviceError

Description	Error codes from device's error response. If the remote device responds successfully to the Get Attribute Single service, the return status is `0` (`DnetSuccess`), and `DeviceError` returns `0`. If the remote device returns an error response for the Get Attribute Single service, the return status is `BFF62014` hex (`DnetErrErrorResponse`), 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.

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);
```

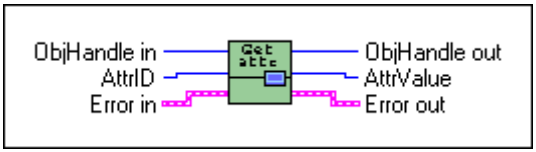
ncGetDriverAttr (Get Driver Attribute)

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`)

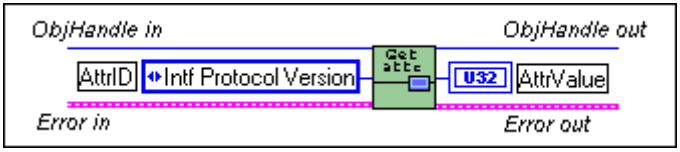
Attr

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

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);
```

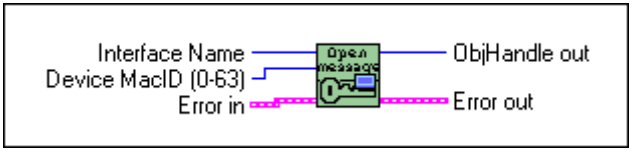
ncOpenDnetExplMsg (Open DeviceNet Explicit Messaging)

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 "`DNETx`", where *x* is a decimal number starting at zero that indicates which DeviceNet interface is being used. You associate DeviceNet interface names with physical ports using Measurement & Automation Explorer (MAX).
Values	"`DNET0`", "`DNET1`", …"`DNET31`" 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, `Configurator`, is described in the *NI-DNET User Manual*.
Values	`0` to `63`

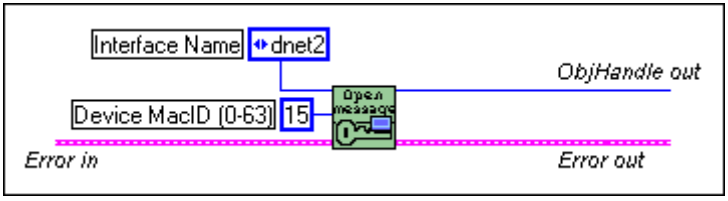
ObjHandle

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.

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. You associate DeviceNet interface names with physical ports using Measurement & Automation Explorer (MAX).
Values	`"DNET0"`, `"DNET1"`, ...`"DNET31"` 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). If you use `Automatic`, you cannot call the `ncOpenDnetIO` function while communicating (after `ncOperateDnetIntf` with `Start`), because the automatic rate calculation occurs during `Start`. Use `Scanned` or `Individual` if you need to open I/O connections while communicating.

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.

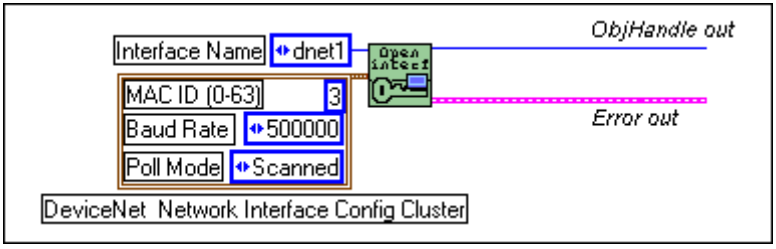
ObjHandle

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.

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);
```

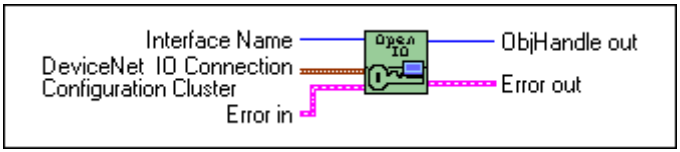
ncOpenDnetIO (Open DeviceNet I/O)

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. You associate DeviceNet interface names with physical ports using Measurement & Automation Explorer (MAX).
Values	`"DNET0"`, `"DNET1"`, ...`"DNET31"` 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, `Configurator`, 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, `Configurator`, 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`

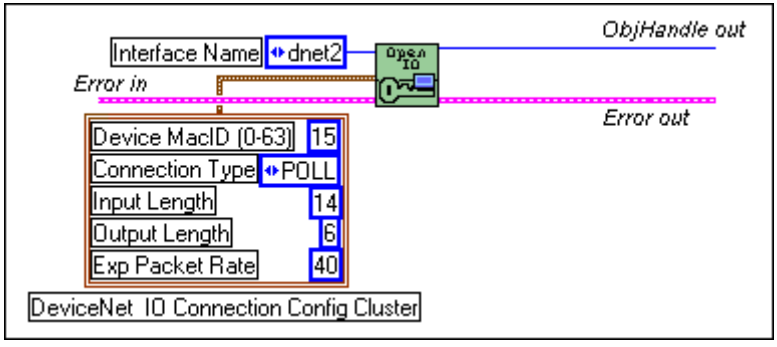
ObjHandle

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.

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);
```

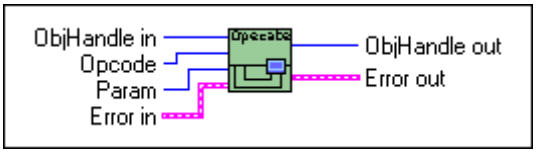
ncOperateDnetIntf (Operate DeviceNet Interface)

Purpose

Perform an operation on an NI-DNET Interface Object.

Format

LabVIEW



C

```
NCTYPE_STATUS    ncOperateDnetIntf    (NCTYPE_OBJH   ObjHandle,
                                       NCTYPE_UINT32 Opcode,
                                       NCTYPE_UINT32 Param);
```

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.

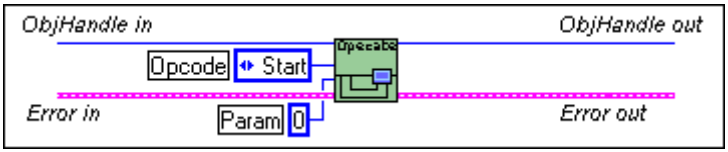
Param

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`

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);
```

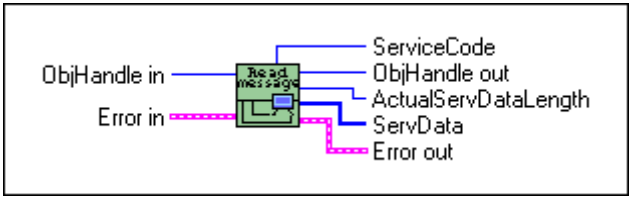
ncReadDnetExplMsg (Read DeviceNet Explicit Message)

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

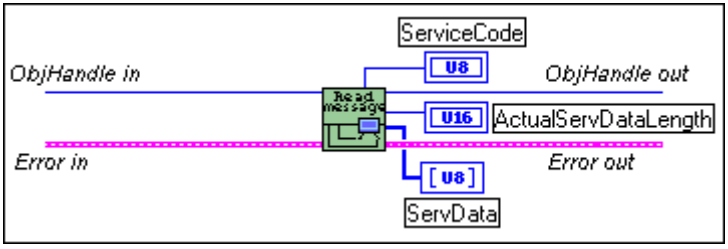
ActualServDataLength

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`

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);
```

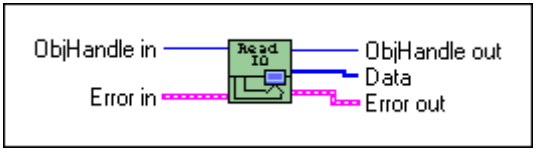
ncReadDnetIO (Read DeviceNet I/O)

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) 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`)

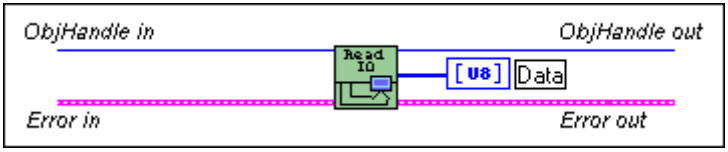
Data

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

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);
```

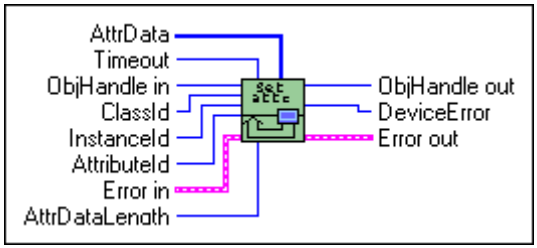
ncSetDnetAttribute (Set DeviceNet Attribute)

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 `BFF62001` hex (`CanErrFunctionTimeout`). 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.

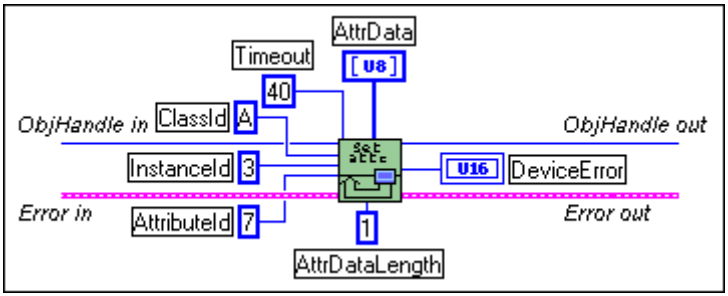
DeviceError

Description	Error codes from device's error response. If the remote device responds successfully to the Set Attribute Single service, the return status is `0` (`DnetSuccess`), and `DeviceError` returns `0`. If the remote device returns an error response for the Set Attribute Single service, the return status is `BFF62014` hex (`DnetErrErrorResponse`), 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.

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);
```

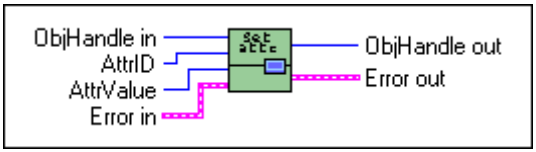
ncSetDriverAttr (Set Driver Attribute)

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)

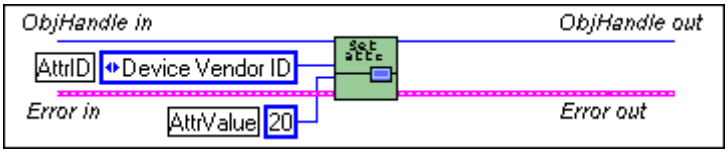
Attr

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

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

For LabVIEW, NI-DNET functions use the standard error in and error out clusters for status information. You can view error descriptions using built-in LabVIEW features such as **Explain Error** in the **Help** menu, or the **Simple Error Handler** VI in your diagram.

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

For applications written in C, C++, or Visual Basic, each NI-DNET function returns a status code as a signed 32-bit integer. Table 2-2 summarizes the NI-DNET use of this status:

Table 2-2. NI-DNET Status Codes

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

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 the numeric code to debug the problem.

The ncStatustoString function is not applicable to LabVIEW programming. For LabVIEW, NI-DNET functions use the standard error in and error out clusters for status information. You can view error descriptions using built-in LabVIEW features such as **Explain Error** in the **Help** menu, or the **Simple Error Handler** VI in your diagram.

If you want to avoid displaying error messages while debugging your application, you can use the Explain.exe utility. This console application is in the Utilities subfolder of the NI-DNET installation folder, which is typically \Program Files\National Instruments\NI-DNET\Utilities. You enter an NI-DNET status code in the command line (such as Explain 0xBFF62001), and the utility displays the description.

Your application code should check the status returned from every NI-DNET function. If an error is detected, you should close all NI-DNET handles, then exit the application. If a warning is detected, you can display a message for debugging purposes, or simply ignore the warning.

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 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, a 512-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.
Values	Textual string which describes the function status

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[1024];
status = ncOpenDnetIntf("DNET0", 0, 125000, NC_POLL_AUTO,
                            &objh);
if (status != DnetSuccess) {
                        ncStatustoString(status, sizeof(descr),
                        descr);
                        printf("ncOpenDnetIntf: %s\n", descr);
}
```

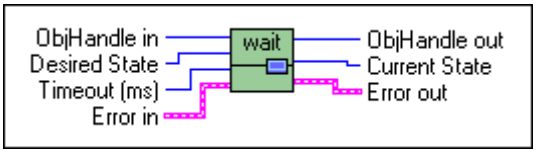
ncWaitForState (Wait For State)

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) function.

The functions ncWaitForState and ncCreateNotification use the same underlying implementation. Therefore, for each object handle, only one of these functions can be pending at a time. For example, you cannot invoke ncWaitForState twice from different threads for the same object. For different object handles, these functions can overlap in execution.

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, C only). Use of a notification callback 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 `CanErrNotStarted`. 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 (`CanErrFunctionTimeout`), 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 BFF62001 hex (CanErrFunctionTimeout). 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)

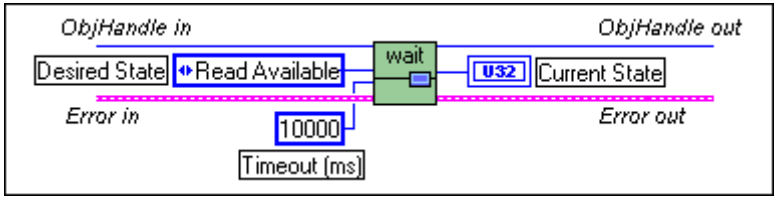
CurrentState

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)

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);
```

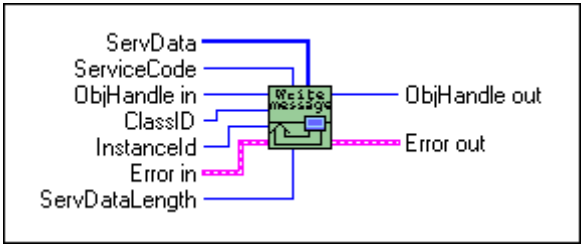
ncWriteDnetExplMsg (Write DeviceNet Explicit Message)

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`

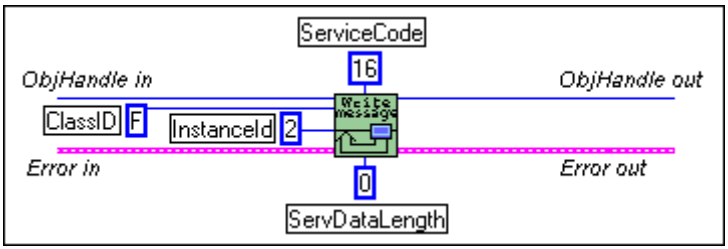
ServData

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

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);
```

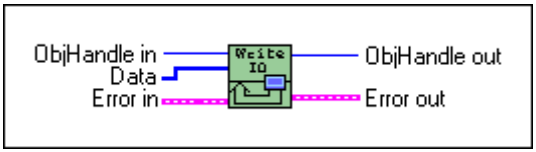
ncWriteDnetIO (Write DeviceNet I/O)

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`)

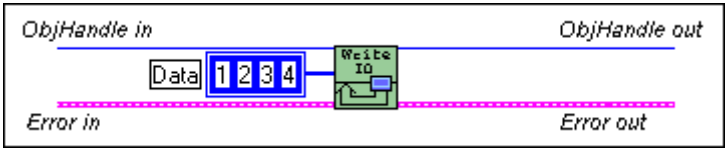
Data

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

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
`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)
`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
`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)

Functions (Continued)

Function Name	Function Description
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 and Established 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.

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 error DnetErrDevInitDevType. 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.

Keep Explicit Messaging

Attribute ID	NC_ATTR_KEEP_EXPL_MSG
Hex Encoding	80000099
Data Type	NCTYPE_BOOL
Permissions	Set
Description	To properly close I/O connections in the remote device when ncCloseObject is called, NI-DNET must ensure that an explicit messaging connection to the device remains open. When this attribute is set to NC_TRUE (the default), NI-DNET sends a nonoperational request (a “ping”) to the device every few seconds, to ensure that the explicit messaging connection does not timeout. When this attribute is NC_FALSE, NI-DNET does not ping the explicit messaging connection. If you are certain that your application sends a request on a periodic basis, you can set this attribute to NC_FALSE. This attribute must be set prior to starting communication.

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 error DnetErrDevInitProdCode. 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 error DnetErrDevInitVendor. 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
`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
`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
`ncConvertFromDnetRead`	Convert data read from the DeviceNet network into an appropriate LabVIEW data type
`ncCreateNotification`	Create a notification callback for an object (C only)

Functions (Continued)

Function Name	Function Description
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 and Established states as described in ncWaitForState.

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 error DnetErrDevInitDevType. 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.

Keep Explicit Messaging

Attribute ID	NC_ATTR_KEEP_EXPL_MSG
Hex Encoding	80000099
Data Type	NCTYPE_BOOL
Permissions	Set
Description	To properly close I/O connections in the remote device when ncCloseObject is called, NI-DNET must ensure that an explicit messaging connection to the device remains open. When this attribute is set to NC_TRUE (the default), NI-DNET sends a nonoperational request (a “ping”) to the device every few seconds, to ensure that the explicit messaging connection does not timeout. When this attribute is NC_FALSE, NI-DNET does not ping the explicit messaging connection. If you are certain that your device can internally close its own I/O connections (deferred delete), you can set this attribute to NC_FALSE. This attribute must be set prior to starting communication.

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 error DnetErrDevInitProdCode. 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 error DnetErrDevInitVendor. 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

Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at ni.com for technical support and professional services:

- **Support**—Online technical support resources at ni.com/support include the following:
  - **Self-Help Resources**—For answers and solutions, visit the award-winning National Instruments Web site for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on.
  - **Free Technical Support**—All registered users receive free Basic Service, which includes access to hundreds of Application Engineers worldwide in the NI Developer Exchange at ni.com/exchange. National Instruments Application Engineers make sure every question receives an answer.

    For information about other technical support options in your area, visit ni.com/services or contact your local office at ni.com/contact.
- **Training and Certification**—Visit ni.com/training for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit ni.com/alliance.

If you searched ni.com and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of ni.com/niglobal to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Glossary

Symbol	Prefix	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

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

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.

Index

I

K

N

O

P

R

S

T

W