
# NetBurner Runtime Libraries

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**Revision History**

| Date | Revision | Description |
|---|---|---|
| 2/25/2010 | 1.95 | Added SSL eMail functions. |
| 3/22/2010 | 1.96 | Added additional descriptions for return codes for read() and ReadWithTimeout() |
| 4/26/2010 | 1.97 | Updated SSL section to correct typo in certificate creation example with openssl.exe. |
| 7/1/2010 | 1.98 | Moved AES and SSL sections to new NetBurner Security Libraries document, which also includes SSH. |
| 7/13/2010 | 1.99 | Added text to InitializeStack explaining that it can only be called once on startup. Removed references to KillStack, since it does not close all active sockets. |
| 10/11/2010 | 2.00 | Added QSPI section |
| 11/24/2010 | 2.01 | Updated the Serial Library section to indicate support of the GetCD, GetRI, GetDSR, and SetDTR functions for the SB700EX. |
| 4/7/2011 | 2.02 | Added IPSetup password callback function, section 25. |
| 5/31/2011 | 2.03 | Added new functions to the Interrupts section for SetPinIrq, EnableIrq, and DisableIrq. |
| 7/12/2011 | 2.04 | Added new functions to the System Library section for UpdateConfigRecord_Num and RawGetConfig. |
| 1/19/2012 | 2.05 | Updated the ManualEthernetConfig() section to explicitly state that it must be called after InitializeStack(); updated the input parameter variable names to be consistent with those defined in the ethernet.h file. |
| 5/1/2012 | 2.06 | The itoa() function section has been updated to correct the units of the base-2 example (“33 bytes”, not “33 bits). Additional information has been added to make mention of base-10 to determine the size of the buffer. |

# 1. Introduction

This document is a reference manual for the NetBurner software libraries, and is intended to be used in conjunction with the NetBurner Network Programming Guide for network platforms, or the Mod5213 Programmers Guide for non-network platforms. These guides provide background, details and examples on how the functions in this document can be used in practice. All NetBurner documents are located in the documents directory created during installation. The default location is c:\nburn\docs.

This reference guide contains all the API function calls, some of which may not apply to your specific hardware platform. For example, the CAN functions are available on the Mod5213, but TCP/IP functions are not supported because it does not have a network interface. This reference manual also contains optional software APIs, such as SSL, that are purchased separately and are not part of the standard NetBurner development kit.

Hardware-specific software functions and information are provided in the c:\nburn\docs<platform> directory, where <platform> is the hardware platform you are using, such as a Mod5282. The platform documents contain schematics, memory maps, and any software features that are specific to the hardware platform you are using.

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## Additional Documentation

All NetBurner License Documentation is located by default in your C:\Nburn\docs directory.

- Eclipse Getting Started Guide
- NetBurner Runtime Libraries (this document)
- NetBurner Security Libraries (AES, SSL, SSH)
- NetBurner Network Programming Guide
- Mod5213 Programming Guide
- NetBurner PC Tools Guide
- Freescale microprocessor manuals
- Embedded Flash File System (EFFS) Programmers Guide
- Embedded Flash File System (EFFS) Reference Manual
- Platform Documents – The hardware specific documents for your device (eg Mod5282)

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# 3. CAN Library

## 3.1. Introduction

CAN or Controller Area Network is an advanced serial bus system that efficiently supports distributed control systems. CAN operates at data rates of up to 1 Megabit per second. CAN also has excellent error detection and confinement capabilities. CAN was initially developed in 1986 for the use in motor vehicles by Robert Bosch GmbH, in Germany, also holding the CAN license. For additional information, see the **CAN Homepage** of Robert Bosch GmbH. The first CAN silicon was fabricated in 1987 by Intel.

The CAN protocol is an international standard defined in ISO 11898 (for applications up to 1 Megabit per second) and ISO 11519 (for applications up to 125 Kilobits per second). The conformance test for the CAN protocol is defined in ISO 16845. ISO 16845 also guarantees the interchangeability of the CAN chips. See the **ISO** web site for additional information. CAN is also internationally standardized by the Society of Automotive Engineers (**SAE**).

The CAN communications protocol describes how information is passed between devices. CAN conforms to the Open Systems Interconnection (OSI) model (developed by the ISO - ISO 7498) which is defined in terms of layers. Each layer in a device "communicates" with the same layer in another device. Actual communication occurs between adjacent layers in each device. The devices are only connected by the physical medium via the physical layer of the OSI model.

The CAN architecture defines the lowest two layers of the OSI model - the Data Link Layer and the Physical Layer (lowest layer).

The **Data Link Layer** is the **only** layer that recognizes and understands the format of messages. This layer constructs the messages to be sent to the Physical Layer, and decodes the messages received from the Physical Layer. In CAN controllers, the Data Link Layer is usually implemented in hardware.

The **Physical Layer** specifies the physical and electrical characteristics of the CAN Bus, as well as the hardware that converts the characters of a message into electrical signals for transmitted messages, and electrical signals into characters for received messages. Although the other OSI layers may be implemented in either hardware (as chip level functions) or software, the Physical Layer is **always** "real" hardware.

The most common physical medium consists of a twisted wire pair (shielded or unshielded) with appropriate termination (i.e. 120 ohm resistance) at each end. ISO 11898 states that the impedance of the cable should be 120 +- 12 ohms. The basic CAN design specification called for a high bit rate, a high immunity to electrical interference, and an ability to detect any errors produced.

There are **no** standards for how CAN controllers are implemented, or how CAN controllers communicate with their host microcontroller.

The maximum bus length for a CAN network depends on the bit rate used. It is a requirement that the wave front of the bit signal have time to travel to the most remote node and back again (before the bit is sampled). So, if the bus length is near the maximum for the bit rate used (see the table on the next page), then the sampling point should be chosen very carefully.

| Bus Length (in meters) | Maximum Bit Rate (bits/second) |
|---|---|
| 40 | 1 Mbit/s |

| | |
|---|---|
| 100 | 500 Kbit/s |
| 200 | 250 Kbit/s |
| 500 | 125 Kbit/s |
| 6 km | 10 Kbit/s |

There are two principal CAN hardware implementations. Suitably configured, each implementation (Basic CAN and Full CAN) can handle both Normal and Extended CAN data formats. **Note:** Communication is identical for all implementations of CAN.

**Basic CAN** is used in less expensive standalone CAN controllers or in smaller microcontrollers with an integrated CAN controller. In the Basic CAN configuration, there is a strong bond between the CAN controller and the associated microcontroller. Therefore, the microcontroller, which will have other system related functions to administer, will be interrupted to deal with every (received and transmitted) CAN message.

**Full CAN** is used in more expensive, high performance CAN controllers and microcontrollers. Full CAN devices contain additional hardware to provide a separate "server" that will automatically receive and transmit CAN messages, without interrupting the associated microcontroller. Full CAN devices also service simultaneous requests, carry out extensive acceptance filtering on incoming messages, and greatly reduce the load on the microcontroller.

CAN identifiers come in two "flavors". These two "flavors" (i.e. protocol versions) define different formats of the message frame (with the main difference being the identifier length). Your Mod5234 supports both CAN versions. The two CAN protocol versions are:

**Version 2.0A** - Normal or Standard CAN - supports messages with 11 bit identifiers.

**Version 2.0B** - Extended CAN - supports messages with 29 bit identifiers (an 11 bit base identifier for compatibility with Version 2.0A and an 18 bit extension identifier).

In the NetBurner Software API, we **always** refer to **CAN identifiers** as **32 bit DWORDS**. A 32 bit DWORD is bigger than either (Normal or Extended) Identifier. A Normal identifier will always have bits 0 to 17 as zero. An Extended identifier can have bits 0 to 17 low. Extended identifiers that are received will have bit 29 set to 1. Note: Any ID input into the system will be treated as Extended if bit 29 is set, or if bits 0 to 17 are not zero.

There are **three** types of CAN controllers:

1. **Part A** (Version 2.0A)
2. **Part B Passive** (Version 2.0A)
3. **Part B** (Version 2.0B)

Version 2.0B (i.e. Part B) controllers are **completely** backward compatible with Version 2.0A (both Part A and Part B Passive) controllers. Each CAN controller is able to handle the different parts of the CAN standard as shown on the next page.

| Message Format\CAN Chip Type | Part A | Part B Passive | Part B |
|---|---|---|---|
| 11 bit ID (Normal or Standard) Ver. 2.0A | OK | OK | OK |
| 29 bit ID (Extended) Ver. 2.0B | ERROR | Tolerated– but ignored | OK |

**Note:** If 29 bit identifiers are used on a CAN bus which contains Part A (Version 2.0A) controllers the bus will not work (as shown above). However, it is possible to use both Part B Passive (Version 2.0A) and Part B (Version 2.0B) controllers on a single network (also as shown above).

CAN is a multi-master Bus with an open linear structure, consisting of one logic bus line and equal nodes. The number of nodes is **not** limited by the protocol. In either of the two CAN protocols (i.e. Version 2.0A and

Version 2.0B), the bus nodes do not have a specific address. Instead, the address information is contained in the identifiers of the transmitted messages - indicating both the message content and the priority of the message. Therefore, the number of nodes on a network may be changed dynamically without disturbing the communication of the other nodes.

A high degree of system and configuration flexibility is achieved because of CAN's content-oriented addressing scheme. Therefore, it is very easy to add additional stations (i.e. receivers) to an existing CAN network - without making any hardware or software modifications to the existing stations. This feature follows the concept of modular electronics, and permits multiple reception and synchronization of distributed processes. Data (needed as information by one or more stations) can be transmitted via the network in such a way that it is unnecessary for each station to know who produced it. This feature allows for the easy servicing and upgrading of networks (data transmission is not based on the availability of specific types of stations). Multicasting and Broadcasting are also supported by CAN.

There are two Bus states: Dominant and Recessive. The CAN Bus logic uses a "Wired-AND" mechanism. Dominant bits (logic 0) overwrite the recessive bits (logic 1). If all nodes on the network transmit recessive bits (Ones), the Bus is in the recessive state. However, as soon as one node transmits a dominant bit (Zero), the Bus state changes to dominant. A dominant state will always have precedence over a recessive state.

The CAN protocol handles Bus accesses according to an arbitration process known as Carrier Sense Multiple Access/Collision Detection (CSMA/CD). By using this non-destructive bitwise arbitration process the CAN Bus:

Avoids collisions of messages whose transmission was started by more than one node simultaneously.

Sends the most important message out first without time loss.

A message in the CAN Standard/Normal or Extended Frame format begins with a start bit called the Start Of Frame (SOF). This is a dominant bit for hard synchronization of all nodes on the network.

The Arbitration Field (12 bits) consists of the Message Identifier (11 bits) and the Remote Transmission Request (RTR) bit. The RTR bit is used to distinguish between a Data Frame (RTR bit is dominant) and a Remote Frame (RTR bit is recessive).

The Control Field (6 bits) contains the IDentifier Extension (IDE) bit (dominant to specify that the frame is a Standard Frame), a reserved dominant bit, and the Data Length Code (DLC) (4 bits). The DLC is used to indicate the number of data bytes in the Data Field. If the message is used as a Remote Frame, the DLC contains the number of requested data bytes. The Data Field that follows can hold up to 8 data bytes.

The Cyclic Redundancy Field is used detect possible transmission errors. The integrity of the frame (Remote or Data) is guaranteed by the following Cyclic Redundant Check (CRC) sum. The CRC sum contains a 15 bit cyclic redundancy check code and a recessive delimiter bit.

The ACKnowledge (ACK) Field consists of two parts: the ACK Slot and the ACK Delimiter. The bit in the ACK Slot is initially sent as a recessive bit. This recessive bit is converted to a dominant bit by those receivers on the network that have received the data correctly. Correct messages are acknowledged by the receivers regardless of the result of the acceptance test (i.e. positive acknowledgement). The ACK Delimiter is also a recessive bit.

The end of the message is indicated by the End Of Frame (EOF) Field. This field contains seven recessive bits.

The Intermission Frame Space (IFS) Field follows the EOF. This is the minimum number of bits separating consecutive messages. After a three bit Intermission period, the Bus is recognized to be free. Note: The Bus Idle time may be any arbitrary length including zero.

A message in the CAN Extended Frame format (i.e. Version 2.0B) is almost the same as a message in the CAN Standard or Normal Frame format (i.e. Version 2.0A). One obvious difference is the length of the identifier used. The Extended Frame format identifier is made up of the existing 11 bit identifier (base identifier) and an 18 bit extension (identifier extension), for a total length of 29 bits. The distinction between the CAN Standard Frame format and the CAN Extended Frame format is made by using the IDE bit. The IDE bit is recessive to specify that the frame is an Extended Frame.

A Substitute Remote Request (SRR) bit is also included in the Arbitration Field (in Version 2.0B). The SRR bit is always transmitted as a recessive bit to ensure that, in the case of arbitration between a Standard Data Frame and an Extended Data Frame, the Standard Data Frame will always have priority if both messages have the same base (11 bit) identifier.

CAN provides superior error-detection and error handling mechanisms (e.g. a CRC check and a high immunity against electromagnetic interference). Erroneous messages are automatically retransmitted. Temporary errors are recovered. Permanent errors are followed by an automatic switch-off of defective nodes (stations). There is guaranteed system-wide data consistency.

CAN implements **five** different types of error detection - three at the message level and two at the bit level.

At the **message level** the **three** types of error detection are:

**Cyclic Redundancy Check (CRC)** - As already mentioned, the CRC safeguards the information in a frame by adding redundant check bits at the transmission end. At the receiving end, these bits are re-computed and tested against the received bits. If they do not match - a CRC error has occurred.

**Frame Check** - This mechanism verifies the structure of the transmitted frame by checking the bit fields against the fixed format and the frame size. If they do not match - a frame check error has occurred. Errors detected by frame checks are called Format errors.
**ACK Errors** - As already mentioned, frames received are acknowledged by all receivers through positive acknowledgement. If no acknowledgement is received by the transmitter of the message - an ACK error has occurred.

At the **bit level** the **two** types of error detection are:

**Bit Monitoring** - The ability of the transmitter to detect errors is based on monitoring the CAN bus signals. Each transmitting station also observes the bus level, detecting differences between the bit sent and the bit received. This permits the reliable detection of global errors, and the detection of errors that are local to the individual transmitter.

**Bit Stuffing** - The coding of the individual bits is tested at bit level. The bit representation used by CAN is called "Non Return to Zero" (NRZ) coding, which guarantees maximum efficiency in bit coding. The synchronization edges are generated by means of bit stuffing. This means that after five consecutive equal bits, the transmitter inserts into the bit stream a "stuff bit" with a complementary value which is removed by the receivers.

If one or more errors are discovered (by at least one station), the current (message) transmission is aborted by sending an "error flag". This error flag prevents other stations (on the same network) from accepting the message, and ensures the consistency of data throughout the network. After the transmission of an erroneous message (that has been aborted), the sender automatically re-attempts transmission (i.e. automatic re-transmission) of the message. However, in the event of a defective station, all messages (including valid ones) could be aborted.

Therefore, the CAN protocol also provides a mechanism to distinguish between sporadic errors, permanent errors and local failures at the station. This is accomplished by the statistical assessment of station error situations. The aim is - recognizing a station's (own) defects. Then, that station could switch to another mode, so that the rest of the CAN network is not negatively affected. For example, the defective station could switch itself off to prevent valid messages from erroneously being recognized as invalid.

A CAN higher level protocol (also known as the Application Layer) is a protocol implemented "on top" of the two existing lower-level CAN layers (i.e. the Physical Layer and the Data Link Layer). The application levels are linked to the physical medium by the layers of various emerging protocols, dedicated to a particular industry plus any number of propriety schemes as defined by individual CAN users.

Many systems (e.g. the automotive industry) use a propriety Application Layer; but for many other industries, this approach is not cost-effective. Several organizations have developed standardized open Application Layers to ensure ease of system integration. See the CAN in Automation (**CiA**) web site for additional information.

Suggested Reading:

CAN System Engineering: From Theory to Practical Applications by Wolfhard Lawrenz (ISBN - 0387949399)

Controller Area Network by Konrad Etschberger (ISBN - 3000073760)

## 3.2. CanRxMessage Class

### Header File:

#include <canif.h>  // Found in C:\Nburn\<HWPlatform>\include

### Synopsis:

Class CanRxMessage

### Description:

The CanRxMessage Class will hold incoming messages. **Before** using this class, the application must have called CanInit, and be configured to **receive** incoming data on one or more ID's. There are two constructors that can be used to instantiate the class: using a FIFO and using an ID.

The NetBurner Hardware Platforms that support CAN are:

**CB34EX** (canif.h is located in C:\Nburn\CB34EX\include)
**MOD5213** (canif.h is located in C:\Nburn\MOD5213\include)
**MOD5234** (canif.h is located in C:\Nburn\MOD5234\include)
**MOD5282** (canif.h is located inC:\Nburn\MOD5282\system)

## 3.3. Constructors and Destructor

### 3.3.1. CanRxMessage - FIFO

### Synopsis:

CanRxMessage( OS_FIFO * pFifo, WORD timeout );

### Description:

This constructor builds a CanRxMessage from a FIFO. The FIFO **must be** registered to listen for incoming messages. The FIFO is a function of the RTOS. To use the FIFO, the application must:

1. Declare an OS_FIFO object
2. Initialize the FIFO with the OSFifoInit function
3. Register the FIFO to listen to a specific ID
4. Create an instance of a CanRxMessage with the FIFO constructor

### Parameters:

| Type | Name | Description |
|---|---|---|
| OS_FIFO | ***** pFifo | A pointer to the FIFO used to communicate between the CAN subsystem and the CanRxMessage Class. The FIFO **must** be initialized first. |
| WORD | timeout | How long to wait for confirmation. 0 = wait forever and 0xFFFF = don't wait at all. |

### Returns:

If **no** messages are received in the timeout interval (i.e. time ticks), then the returned CanRxMessage will be marked as **invalid**

A Timeout value of **0** (zero) **will** wait forever

**Note:** The **default** value is **1/20th** of a second

### Example:

```
OS_FIFO fifo;
OSFifoInit( &fifo );
int chan = RegisterCanRxFifo( 0x1234, &fifo );
if ( chan > 0 )
{
    CanRxMessage can_msg( &fifo, 30*TICKS_PER_SECOND );
}
```

### 3.3.2. CanRxMessage - ID

## Synopsis:

CanRxMessage( DWORD id, WORD timeout );

## Description:

This constructor sends a RTR (Remote Transmission Request) to the device at a **specified** ID and waits for a response.

## Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | id | The identifier to match on received frames. |
| WORD | timeout | How long to wait for confirmation. 0 = wait forever and 0xFFFF = don't wait at all. |

## Returns:

If **no** messages are received in the timeout interval (i.e. time ticks), then the returned CanRxMessage will be marked as **invalid**

A Timeout value of **0** (zero) **will** wait forever. **Note:** The **default** timeout value is **1/20th of a second**.

The CAN system uses **any** unused channel to send and receive the buffer. This constructor can return an **invalid** message for **two** reasons:

1. The timeout interval has **transpired**
2. There were **no** free channels available to send the request

### 3.3.3. ~CanRxMessage

## Synopsis:

~CanRxMessage( );

## Description:

The CanRxMessage destructor. This is called automatically when an instance goes out of scope.

## Parameters:

None

## 3.4. Member Functions

### 3.4.1. GetLength

#### Synopsis:

BYTE GetLength( );

#### Description:

This member function gets the amount of data stored in the message.

#### Parameters:

None

#### Returns:

The number of bytes stored as an unsigned 8 bit value

### 3.4.2. GetData

## Synopsis:

BYTE GetData( BYTE * buffer, BYTE max_len );

## Description:

This member function copies the data in a message object to the location pointed to by buffer up to a maximum of max_len in bytes.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BYTE | * buffer | A pointer to the buffer to put the data in. |
| BYTE | max_len | The maximum length to store (in bytes). |

## Returns:

The number of bytes stored

### 3.4.3. GetId

## Synopsis:

DWORD GetId( );

## Description:

This member function gets the ID of the message. In the NetBurner Software API, we **always** refer to **CAN identifiers** as **32 bit DWORDS**. A 32 bit DWORD is **bigger** than either (Normal or Extended) Identifier.

A Normal identifier will **always** have bits 0 to 17 as zero. An Extended identifier **can have** bits 0 to 17 low. Therefore, Extended identifiers that are received **will** have bit 29 set to 1. **Note:** Any ID input into the system will be treated as Extended **if** bit 29 is set, **or** if bits 0 to 17 are **not** zero.

## Parameters:

None

## Returns:

The ID of the message object

### 3.4.4. GetTimeStamp

## Synopsis:

WORD GetTimeStamp( );

## Description:

Each CAN message contains a time stamp indicating when it is sent. This member function gets the time stamp from where it was sent.

## Parameters:

None

## Returns:

The time stamp of the message object

### 3.4.5. IsValid

## Synopsis:

BOOL IsValid( );

## Description:

Each CanRxMessage object constructor has a timeout value. If a message object is created and a timeout occurs the message object contains no data, and is marked as "invalid". This member function answers the question: Is this CanRxMessage a valid message.

## Parameters:

None

## Returns:

TRUE --- If the CanRxMessage object contains a valid message
FALSE --- If the message is invalid

## 3.5. Functions

### 3.5.1. CanInit

### Synopsis:

int CanInit( DWORD bit_rate, DWORD Global_Mask, BYTE irq_level=4 );

### Description:

This function initializes the CAN system. It must be called before any other CAN functions or the creation of CanRxMessage objects.

### Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | bit_rate | The bit rate to run the CAN system at. |
| DWORD | Global_Mask | The mask used to mask received IDs. |
| BYTE | irq_level | The interrupt level you want the CAN system to operate at. |

**Note:** The system will get as close as possible, but 1000000, 500000, 250000, and 125000 are the **only** values that are known to work.

| Value | Meaning |
|---|---|
| 0 | Don't care |
| 1 | Care |

### Returns:

CAN_OK --- On success
CAN_RATE_FAIL --- If the bit rate could not be set within 1.5%
CAN_ALREAD_OPEN --- If the CAN system is already running - you must call CanShutDown first

### 3.5.2. CanShutDown

## Synopsis:

void CanShutDown( );

## Description:

This function shuts down the CAN system.

## Parameters:

None

## Returns:

Nothing --- This is a void function

### 3.5.3. ChangeGlobalMask

## Synopsis:

void ChangeGlobalMask( DWORD Global_Mask );

## Description:

This function **changes** the global receive mask **after** the CAN system is started.

Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | Global_Mask | The mask used to mask received IDs. |

## Returns:

Nothing --- This is a void function

### 3.5.4. FreeCanChannels

## Synopsis:

int FreeCanChannels( );

## Description:

The CAN system has 16 available channels. Use this function return to determine which channels are currently free.

## Parameters:

None

## Returns:

The number of channels that are currently not in use

### 3.5.5. IsChannelFree

## Synopsis:

BOOL IsChannelFree( int channel );

## Description:

This function tells you if a specific channel is currently free.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | channel | The specified channel. |

## Returns:

TRUE --- If the specified channel is currently free

### 3.5.6. RegisterCanRxFifo

## Synopsis:

int RegisterCanRxFifo( DWORD id, OS_FIFO * pFifo, int channel=-1 );

## Description:

This function tells the CAN system to start listening for a specific CAN ID. Any incoming CAN frames that match the ID as set by the appropriate mask will be placed into the FIFO. The FIFO is a function of the RTOS. To use the FIFO, the application must:

- Declare an OS_FIFO object
- Initialize the FIFO with the OSFifoInit function.
- Register the FIFO to listen to a specific ID.
- Create an instance of a CanRxMessage with the FIFO constructor.

## Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | id | The identifier to match on received frames. The id is modified by the global mask. |
| OS_FIFO | ***** pFifo | A pointer to the FIFO, used to communicate between the CAN subsystem and the CanRxMessage Class. The FIFO must be initialized first. The same FIFO can be passed to multiple receive registration functions. |
| int | channel | There are a total of 16 CAN channels. You can either specify a channel to use for the receive request, or you can specify a value of -1, which allows the system to select an unused channel. |

## Returns:

A value 0 to 15 --- The channel this request is assigned to.
**Note:** This value must be stored to later call **UnRegisterCanFifo**
CAN_CHANNEL_USED --- If the channel is used or there are no free channels

## Example:

```
OS_FIFO fifo;
OSFifoInit( &fifo );
int chan = RegisterCanRxFifo( 0x1234, &fifo );
if (chan > 0)
{
   CanRxMessage can_msg( &fifo, 30*TICKS_PER_SECOND );
}
```

### 3.5.7. RegisterCanSpecialRxFifo

## Synopsis:

int RegisterCanSpecialRxFifo( DWORD id, DWORD spl_mask, OS_FIFO * pFifo, int channel=-1 );

## Description:

This function instructs the CAN system to start listening for a specific CAN ID. Any incoming CAN frames that match the ID (as set by the appropriate mask) will be placed into the FIFO. **Note:** Some applications may require more than one channel mask. The NetBurner CAN device can have up to 3 masks:

The global mask for channels 0 -13
A mask for channel 14
A mask for channel 15

**Note:** The masks for channels 14 and 15 are set using the spl_mask parameter unique to this function.

## Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | id | The identifier to match on received frames. This is modified by the passed in mask. |
| DWORD | spl_mask | There are only two channels available for use with the special mask so use this call sparingly and only if really needed. |
| OSFifo | ***** pFifo | A pointer to the FIFO, used to communicate between the CAN subsystem and the CanRxMessage Class. The FIFO must be initialized first. The same FIFO can be passed to multiple receive registration functions. |
| int | channel | There are a total of 16 CAN channels. You can either specify a channel to use for the receive request, or you can specify a value of -1, which allows the system to select an unused channel. |

## Returns:

A value 0 to 15 --- The channel this request is assigned to.
Note: This value must be stored to later call UnRegisterCanFifo
CAN_CHANNEL_USED --- If the channel is used or there are no free channels

### 3.5.8. UnRegisterCanFifo

## Synopsis:

int UnRegisterCanFifo( int channel );

## Description:

This function disconnects a receiver channel from a FIFO.

Parameters:

| Type | Name | Description |
|---|---|---|
| int | channel | The channel to remove. |

## Returns:

CAN_OK --- If successful
CAN_CHANNEL_NOT_USED --- If the channel is not currently in use

### 3.5.9. SendMessage

## Synopsis:

int SendMessage( DWORD id, BYTE * data, BYTE len, WORD timeout, int channel = -1 );

## Description:

This function sends a message to a device with the specified id. To send a message, one of the 16 channels must be available. **Note:** The channel will automatically be freed once the message has been sent.

## Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | id | The identifier to send. |
| BYTE | ***** data | A pointer to the data to send. |
| BYTE | len | The length of the data. It **must** be less than or equal to 8 bytes. |
| WORD | timeout | How long to wait for confirmation it sent. 0 = wait forever. 0xFFFF = don't wait at all. Any other timeout value blocks until it is actually sent. |
| int | channel | The channel to use. A value of -1 will allow the system to select an unused channel. |

## Returns:

CAN_OK --- If the message was sent
CAN_CHANNEL_USED --- Can't send because the channel was already in use or no channels available
CAN_TIMEOUT --- Did not send in the time allotted

# 3.6. MACROS

## 3.6.1. CAN_EXTENDED_ID_BIT

### Synopsis:

#define CAN_EXTENDED_ID_BIT( 0x20000000 )

### Description:

This macro takes the single bit used by the API to indicate an extended ID.

## 3.6.2. ExtToNbId

### Synopsis:

#define ExtToNbId( id ) ( id | CAN_EXTENDED_ID_BIT )

### Description:

This macro will make a system recognized Extended ID from either an Extended (29 bit) CAN Identifier or from a Normal (11 bit) CAN Identifier.

## 3.6.3. NormToNbId

### Synopsis:

#define NormToNbId( id ) ( ( id & 0x7ff )<<18 )

### Description:

This macro creates a Normal ID, and also an ID set from a normal id in the range 0 to 2048.

### 3.6.4. IsNBIdExt

## Synopsis:

#define IsNBIdExt( id ) ( ( id & ( CAN_EXTENDED_ID_BIT|0x3FFFF ) )!=0 )

## Description:

This macro determines if the ID is extended.

### 3.6.5. NbToExtId

## Synopsis:

#define NbToExtId( id ) ( id & 0x1FFFFFFF )

## Description:

This macro strips the extra flag, removing the API extended flag from the ID.

### 3.6.6. NbToNormId

## Synopsis:

#define NbToNormId( id ) ( ( id >> 18 )& 0x7FF )

## Description:

This macro will shift a Normal ID so that it has a value 0 to 1023. Some CAN systems will treat normal ID's as an integer from 0 to 2048. Other CAN systems may treat normal IDs as 28 bit values where the bottom 17 bits are zero. This macro will convert our Normal ID format into the 0 to 2048 format.

# 4. Command Processor Library

## 4.1. Introduction

The Command Processor is a system program that accepts user commands and converts them into the machine commands required by the operating system. The Command Processor receives and executes operating system commands. After you enter a command, the command processor analyzes the syntax to make sure the command is valid, and then either executes the command or issues an error warning.

### Header File

#include <command.h>  // Found in C:\Nburn\include

Functions

CmdStartCommandProcessor --- Starts the command processor
CmdAddCommandFd --- Adds an established fd connection to the list of fds managed by the command processor
CmdRemoveCommandFd --- Removes an established fd
CmdListenOnTcpPort --- Listens for a connection on a TCP port
CmdStopListeningOnTcpPort --- Stops listening for connections on the specified port
*****CmdAuthenticateFunc --- Authenticates the username and password
*****CmdCmd_func --- Processes a command
*****CmdConnect_func --- Called whenever a new connection is established
*****CmdPrompt_func --- Called to display a command prompt
*****CmdDisConnect_func --- Called whenever a command is disconnected
SendToAll --- Send to all connected sockets, excluding "Listening" sockets

Globals

CmdIdleTimeout
*****Cmdlogin_prompt

## 4.2. CmdStartCommandProcessor

### Synopsis:

int CmdStartCommandProcessor( int priority );

### Description:

This function starts the Command Processor.

Parameters:

| Type | Name | Description |
|---|---|---|
| int | priority | The UCOS task priority |

### Returns:

CMD_OK --- On Success
CMD_FAIL --- On Failure

Example:

The newdemo application --- Located by default in your C:\Nburn\examples directory.

Warning: This application will not run on a SB72

## 4.3. CmdAddCommandFd

### Synopsis:

int CmdAddCommandFd( int fd, int require_auth, int time_out_conn, int local_echo=TRUE )

### Description:

This function adds an established file descriptor (fd) connection to the list of file descriptors managed by the command processor.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor |
| int | require_auth | Do we authenticate the connection on this file descriptor |
| int | time_out_conn | Do we time out the connection on this file descriptor |
| int | local_echo=TRUE | The command processor will echo the file descriptor. |

### Returns:

CMD_OK --- On Success
CMD_FAIL --- On Failure
CMD_TO_MANY_FDS --- If there are too many file descriptors

## 4.4. CmdRemoveCommandFd

### Synopsis:

int CmdRemoveCommandFd( int fd );

### Description:

This function removes an established file descriptor (either a TCP or a Serial connection).

Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor |

### Returns:

CMD_OK --- On Success
CMD_FAIL --- On Failure

# 4.5. CmdListenOnTcpPort

## Synopsis:

int CmdListenOnTcpPort( WORD port, int do_telnet_processing, int max_connections )

## Description:

This function starts listening for a connection on a TCP port. Telnet is a user command and an underlying TCP/IP protocol for accessing remote computers.

## Parameters:

| Type | Name | Description |
|---|---|---|
| WORD | port | The port number |
| int | do_telnet_processing | 1 = Negotiate a Telnet session<br>0 = Standard TCP connection |
| int | max_connections | Maximum number of connections allowed on this port (system maximum is 30). |

## Returns:

CMD_OK --- On Success
CMD_FAIL --- On Failure

## 4.6. CmdStopListeningOnTcpPort

### Synopsis:

int CmdStopListeningOnTcpPort( WORD port );

### Description:

This function stops listening for connections on the specified port. **Note:** This function also closes all open connections that were based on that specified port.

### Parameters:

| Type | Name | Description |
|---|---|---|
| WORD | port | TCP port number |

### Returns:

CMD_OK --- On Success
CMD_FAIL --- On Failure

# 4.7. *CmdAuthenticateFunc

## Synopsis:

extern int ( * CmdAuthenticateFunc )( const char * name, const char *passwd )

This function is of the form:

int AuthenticateCommand ( const char * name, const char * passwd );

## Description:

This external authentication function CALLBACK is used to verify the Username and Password. Note: If this function pointer is not NULL, then each new Telnet session will be asked to authenticate the Username and Password.

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *name | A pointer to the Username. |
| const char | *passwd | A pointer to the Password. |

## Returns:

CMD_OK --- If the authentication was OK
CMD_CLOSE --- If the authentication causes the session to terminate (i.e. close)

# 4.8. *CmdCmd_func

## Synopsis:

extern int ( * CmdCmd_func )( const char *command, FILE *fRespondto, void *pData )

This function is of the form:

int ProcessCommand( const char * command, int fd_respondeto );

## Description:

This is the command processing CALLBACK function.

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *command | A pointer to the NULL terminated ASCII text of the command. |
| FILE | *fRespondto | The file descriptor (fd) that all response should be sent to. Note: Use fprintf or fiprintf to write to the file descriptor. |
| void | *pData | The pointer to a data object. |

## Returns:

CMD_OK --- If the command was OK
CMD_CLOSE --- If the command causes the session to terminate (i.e. close)

## 4.9. *CmdConnect_func

### Synopsis:

extern void* ( * CmdConnect_func )( FILE *fRespondto );

This function is of the form:

void ConnectCommand ( FILE * fRespondto );

### Description:

This is the connect CALLBACK function. **Note:** If this function pointer is not NULL, then the system will call this function every time a new session is started.

Parameters:

| Type | Name | Description |
|---|---|---|
| FILE | *fRespondto | The file descriptor (fd) that all response should be sent to. **Note:** Use fprintf or fiprintf to write to the file descriptor. |

### Returns:

An arbitrary void * data item to be associated with this session

## 4.10. *CmdPrompt_func

### Synopsis:

extern void ( * CmdPrompt_func )( FILE *fRespondto, void *pData )

This function is of the form:

void PromptCommand( int fd_respondeto )

### Description:

This is a prompt Callback function. **Note:** If this function pointer is not NULL, then the system will call this function every time a new prompt line needs to be displayed.

### Parameters:

| Type | Name | Description |
|---|---|---|
| FILE | *fRespondto | The file descriptor (fd) that all response should be sent to. **Note:** Use fprintf **or** fiprintf to write to the file descriptor. |
| void | *pData | The pointer to a data object that can be used in the prompt. The value of pData is the value returned by *CmdConnect_func. This means that you can change the value of pData for each connection, and make that value part of the command prompt (e.g. NB:1>, NB:2>, NB:3>, etc.). |

### Returns:

Nothing --- This is a void function

### Example:

```
#include <command.h>

void ProcessPrompt( FILE *fp, void *pData )
{
   // The following code will produce the prompt: "MyPrompt> "
   fiprintf( fp, "\nMyPrompt> " );
}

void UserMain( void *pd )
{
   CmdPrompt_func = ProcessPrompt;
   while ( 1 )
      OSTimeDly( TICKS_PER_SECOND );
}
```

# 4.11. *CmdDisConnect_func

## Synopsis:

extern void ( * CmdDisConnect_func )( FILE *fRespondto, int cause, void *pData )

This function is of the form:

void DisconnectCommand( int fd_respondeto, int cause );

## Description:

This is a disconnect CALLBACK function. Note: If this function pointer is not NULL, then the system will call this function every time a session is terminated.

## Parameters:

| Type | Name | Description |
|---|---|---|
| FILE | *fRespondto | The file descriptor (fd) that all responses should be sent to. **Note:** Use fprintf **or** fiprintf to write to the file descriptor. |
| int | cause | The reason why it is disconnected. The current values of cause are:<br>#define CMD_DIS_CAUSE_TIMEOUT (1)<br>#define CMD_DIS_CAUSE_CLOSED (2)<br>#define CMD_DIS_SOCKET_CLOSED (3) --- Do not send a response for this case.<br>#define CMD_DIS_AUTH_FAILED (4) --- Do not send a response for this case. |
| void | *pData | The pointer to a data object. |

## Returns:

Nothing --- This is a void function

## 4.12. SendToAll

### Synopsis:

void SendToAll ( char *buffer, int len, BOOL include_serial_ports )

### Description:

This function will send to all connected sockets, excluding "Listening sockets".

### Parameters:

| Type | Name | Description |
|---|---|---|
| char | *buffer | Pointer to the buffer. |
| int | len | The length of what is in the buffer. |
| BOOL | include_serial_ports | Do you want to include Serial ports or just TCP ports? |

### Returns:

Nothing --- This is a void function

## 4.13. Globals

### 4.13.1. CmdIdleTimeout

### Synopsis:

extern int CmdIdleTimeout;

### Description:

The number of seconds a connection is idle before it is terminated due to inactivity.

### 4.13.2. *Cmdlogin_prompt

### Synopsis:

extern const char *Cmdlogin_prompt;

### Description:

If this is not NULL, then it will be sent to the socket on connection (before authentication is tried).

# 5. DHCP Library

## 5.1. Introduction

This Library provides a DHCP Client to dynamically get IP Addresses using the RFC1541 DHCP protocol. To use this Library you must call the StartDHCP( ) function after the IP stack is initialized. Once the DHCP Client is stared, it will automatically renew the DHCP address when necessary.

The Network Programmers Guide provides a complete section on using DHCP as a simple function call, and also a detailed implementation in which you can create your own DHCP object for more detailed control.

### Header File

#include <dhcpclient.h>  // Found in C:\Nburn\include

### Most Commonly Used Functions

| | |
|---|---|
| GetDHCPAddress | Returns DHCP_OK on success. Automatic DHCP renewal. |
| GetDHCPAddressIfNecessary | Same as GetDHCPAddress, but checks to verify EthernetIP is 0.0.0.0 so no static IP address is configured. |
| ValidDhcpLease | Returns TRUE if lease is valid |
| GetRemainingDhcpLeaseTime | Returns the number of seconds remaining on the current lease |

### Advanced Functions for DHCP Objects

The following functions require an intimate understanding of the RFC DHCP implementation. Before using any of these functions please read the Changing IP Address section of the Network Programming Guide, which provides examples on how to use these functions. If the DHCP object was created using *GetDHCPAddress* or *GetDHCPAddressIfNecessary*, it is also possible to get a hold of the DHCP object itself from the network InterfaceBlock structure as the element “dhcpClient”.

| | |
|---|---|
| StartDHCP | Starts the DHCP client |
| StopDHCP | Stops the DHCP client, and release any active DHCP lease |
| RebindDHCP | Forces a DHCP rebind |
| RenewDHCP | Forces a DHCP renew |
| GetDhcpRebindTime | Returns time at which a rebind will occur in seconds (system clock) |
| GetDhcpRenewTime | Returns time at which a renew will occur in seconds (system clock) |
| GetDhcpExpirationTime | Returns time at which a lease will expire in seconds (system clock) |
| GetDHCPState | Get the current DHCP state |
| SetDHCPDiscoverSeconds | Set the number of second to be advertised when trying to get a DHCP address |

## 5.2. Global Variables

const char *pDHCPOfferName  Pointer to define a name for the DHCP device

| Type | Name | Description |
|---|---|---|
| IPADDR | DhcpClientIP | The allocated IP Address. |
| IPADDR | DhcpClientMask | The allocated Subnet Mask. |
| IPADDR | DhcpServerIP | The Server ID. |
| IPADDR | DhcpRelayIP | The Relay Agent. |
| IPADDR | DhcpRouterIP | The Gateway IP Address. |
| IPADDR | DhcpDNSIP | The DNS IP Address. |
| Volatile DWORD | DhcpLeaseTimer | Tracks the current lease time. |
| DWORD | DhcpLeaseStart | IP Address lease start time in seconds. |
| DWORD | DhcpLeaseTime | IP Address lease time in seconds. |
| DWORD | DhcpRenewTime | Time to renewing state in seconds. |
| DWORD | DhcpRebindTime | Time to rebinding state in seconds. |
| const char | *pDHCPOfferName | The name to give this DHCP client. **Note:** This name **must** be set before calling StartDHCP. |

## 5.3. DHCP Example

The most common method of starting DHCP is with the GetDhcpAddress( ) function, which will automatically handle renewing the DHCP lease.

```
void UserMain( void *pd )
{
   iprintf( "Mod5270 Factory Demo Program\r\n" );

   InitializeStack();           // Initialize TCP/IP stack

   if ( EthernetIP == 0 )
   {
      iprintf( "Trying DHCP\r\n" );
      GetDHCPAddress();
      iprintf( "DHCP assigned the IP address of :" );
      ShowIP( EthernetIP );
      iprintf( "\r\n" );
   }

   // remainder of application

}
```

## 5.4. GetDHCPAddress

### Synopsis:

int GetDHCPAddress( int interface = 0 );

### Description:

This function encapsulates all of the code necessary to start the DHCP Client and automatically renew the lease.

### Parameters:

The network interface. If no parameter is specified, the default interface will be used.

### Return Values:

DHCP_OK (0) --- The system found a DHCP address
DHCP_FAILED (-1) --- The system failed to acquire a DHCP address

## 5.5. GetDHCPAddressIfNecessary

### Synopsis:

int GetDHCPAddressIfNecessary( int interface = 0 );

### Description:

This function encapsulates all of the code necessary to start the DHCP Client and automatically renew the lease. It is the most common way to use DHCP. It is similar to GetDHCPAddress, but adds a check to verify the Ethernet IP address is 0.0.0.0 before attempting to get a DHCP IP address. The assumption is that if a static IP address is configured, then DHCP should not be used.

### Parameters:

The network interface. If no parameter is specified, the default interface will be used.

### Return Values:

DHCP_OK (0) --- The system found a DHCP address
DHCP_FAILED (-1) --- The system failed to acquire a DHCP address

## 5.6. GetRemainingDhcpLeaseTime

### Synopsis:

DWORD GetRemainingDhcpLeaseTime( );

### Description:

DHCP uses the concept of a "lease" or amount of time that a given IP address will be valid for a computer. Therefore, call this function to retrieve the number of seconds remaining for the current valid "lease".

### Parameters:

None

### Returns:

The amount of times left (in seconds) on the current DHCP "lease"

## 5.7. ValidDhcpLease

### Synopsis:

BOOL ValidDhcpLease( );

### Description:

DHCP uses the concept of a "lease" or amount of time that a given IP Address will be valid for a computer. Therefore, call this function to determine the validity of the DHCP "lease".

### Parameters:

None

### Returns:

1 - TRUE --- If the “lease” is valid
0 - FALSE --- If the “lease” is not valid

# 5.8. StartDHCP

## Synopsis:

void StartDHCP( OS_SEM * pDhcpSemaphore );

## Description:

This function starts the DHCP client, and should only be used if you have a requirement to create your own DHCP instance. Most application will use the functions: GetDhcpAddress( ) or GetDhcpAddressIfNecessary( ) that start the DHCP service automatically.

If you point the DHCP global variable pDHCPOfferName to a name, the DHCP system will assign that name. It will return immediately, and you need to either watch the semaphore, or monitor the status of DHCP using the GetDHCPState function before you assume that the IP Address has been setup. When you use this function to start DHCP it will automatically renew the DHCP lease.

Parameters:

| Type | Name | Description |
|---|---|---|
| OS_SEM | *pDhcpSemaphore | A pointer to a Semaphore - to notify when DHCP is complete. **Note:** It may be passed in as **NULL.** |

## Returns:

Nothing --- This is a void function

## Example Code:

Refer to the Network Programming Guide for detailed information on creating your own DHCP instance.

#include <dhcpclient.h>

```
{
   OS_SEM DHCPSem;
   OSSemInit(&DHCPSem,0);// Initialize the Semaphore
   StartDHCP(&DHCPSem); // Start DHCP
   if (OSSemPend(&dhcpSem,20*TICKS_PER_SECOND)==OS_TIMEOUT) // Wait 20 sec
   {
      // DHCP did not initialize, handle the error here
   }
}
```

## 5.9. StopDHCP

### Synopsis:

void StopDHCP( );

### Description:

This function stops the DHCP client and releases any DHCP leases we own. Standard DHCP Client operation does not need to call this function, it should only be used when creating your own DHCP object.

### Parameters:

None

### Returns:

Nothing --- This is a void function

## 5.10. RebindDHCP

### Synopsis:

void RebindDHCP( );

### Description:

DHCP uses the concept of a "lease" or amount of time that a given IP Address will be valid for a computer. Therefore, calling this function will result in a "lease" rebind (i.e. a forced rebinding of the lease). Standard DHCP Client operation does not need to call this function, it should only be used when creating your own DHCP object.

### Parameters:

None

### Returns:

Nothing --- This is a void function

## 5.11. RenewDHCP

### Synopsis:

void RenewDHCP( );

### Description:

DHCP uses the concept of a "lease" or amount of time that a given IP Address will be valid for a computer. Therefore, calling this function **will** result in the "lease" being renewed (i.e. a **forced** renew of the lease). Standard DHCP Client operation does not need to call this function, it should only be used when creating your own DHCP object.

### Parameters:

None

### Returns:

Nothing --- This is a void function

## 5.12. GetDHCPState

### Synopsis:

int GetDHCPState( );

### Description:

This function returns the current state of the DHCP lease.

### Parameters:

None

### Returns:

SDHCP_DISCOVER --- The system is discovering the DHCP servers
SDHCP_OFFER --- The system has responded to an Offer
SDHCP_ACK --- The System has acknowledged the Offer
SDHCP_INIT --- The System is reinitializing
SDHCP_CMPL --- The System has completed the last transaction
SDHCP_RENEW --- The System is in the process of renewing
SDHCP_REBIND --- The System has failed the Renew and is trying to Rebind
SDHCP_RELEASE --- The System is trying to release the Lease
SDHCP_NOTSTARTED --- The System has not been initialized

## 5.13. GetDhcpRenewTime

### Synopsis:

DWORD GetDhcpRenewTime() { return DhcpRenewTime; }

### Description:

Returns time at which a renew will occur (50% of lease time), in seconds. The value is referenced to the system seconds counter: Secs.

### Parameters:

None

### Returns:

Returns time at which a renew will occur in seconds. The value is referenced to the system seconds counter: Secs.

## 5.14. GetDhcpRebindTime

### Synopsis:

DWORD GetDhcpRenewTime()

### Description:

Returns time at which a rebind will occur (approx. 87.5% of lease time) in seconds. The value is referenced to the system seconds counter: Secs.

### Parameters:

None

### Returns:

Returns time at which a rebind will occur in seconds. The value is referenced to the system seconds counter: Secs.

## 5.15. GetDhcpExpirationTime

### Synopsis:

DWORD GetDhcpExpirationTime()

### Description:

Returns time at which a lease will expire in seconds. The value is referenced to the system seconds counter: Secs.

### Parameters:

None

### Returns:

Returns time at which a lease will expire in seconds. The value is referenced to the system seconds counter: Secs.

# 6. AutoIP Library

## 6.1. Introduction

The AutoIP Library provides a client daemon (AutoIPClient) for assigning an IP address to a network interface using the Auto IP configuration process. It allows a device to configure a nonconflicting IP address dynamically without reliance on a central authority or resource (unlike DHCP). **It should be noted that there should never, under any circumstances, be a DHCP client and an AutoIP client running on the same interface.** This will lead to abarent behavior resulting in a shifting IP address and configurations for that interface.

When this library is in use, the main library is compiled to create a multihome interface off of the primary network interface that runs an AutoIP client. The intent of this feature is to allow a user to directly connect to the device, without assigning a static ip to either the device or their computer, in order to facilitate development or field access.

To disable the AutoIP library and the multihome interface, remove or comment out the #define AUTOIP in <predef.h> and then recompile the main library.

### Header File

#include <autoip.h>  // Found in C:\Nburn\include

### Functions for AutoIPClient objects

| | |
|---|---|
| start | Starts the AutoIPClient. |
| stop | Stops the AutoIPClient and resets the interface's IP and configuration. |
| restart | Resets the interface and restarts the AutoIPClient. |

## 6.2. AutoIPClient

### Synopsis:

AutoIPClient( int interface );

### Description:

Constructor for the AutoIPClient autoip client daemon.

### Parameters:

interface – The network interface number the client will be using/configuring.

### Return Values:

None.

## 6.3. start

### Synopsis:

void start( );

### Description:

This function starts the AutoIPClient state machine.

### Parameters:

None.

### Return Values:

None.

## 6.4. stop

### Synopsis:

void stop( );

### Description:

This function stops the AutoIPClient state machine and resets its network interface's IP and configuration.

### Parameters:

None.

### Return Values:

None.

## 6.5. restart

### Synopsis:

void restart( );

### Description:

This function resets its network interface's IP and configuration then restarts the AutoIPClient state machine.

### Parameters:

None.

### Return Values:

None.

# 7. FTP Client Library

## 7.1. Introduction

The FTP Client module provides code for sending and receiving files from a FTP server. Most embedded platforms, including the NetBurner embedded development environment, do not have a built-in file system (although you could implement a file system on your own). This means that the Client FTP code does not use files as you might think of them on a computer's hard drive. Instead, you will create data streams that are associated with file names. In other words, a "file" is just a collection of bytes that can be stored in Flash memory or RAM.

When you read a file from the external FTP server using the FTPGetFile function, you will receive a file descriptor (fd), not a file. If you read the bytes/data from this file descriptor you will receive the contents of the remote file as a stream of data. The received data is stored in Flash or RAM.

When you create a file on a remote FTP server using the FTPSendFile, function, then you write the stream of data that will become the remote file associated with the file descriptor. If the remote FTP server has a file system (e.g. a Unix server running a FTP daemon), then the stream of data you wrote would likely be stored as a file on a computer's hard drive.

Some basic knowledge of the inner workings of FTP will be helpful in using this module. Two recommended references are TCP/IP Illustrated Volume 1 (Chapter 27) by Richard Stevens, and/or RFC 959.

### Header File

```
#include <ftp.h>     // Found in C:\Nburn\include
```

### FTP Client Module Description

The basic procedure to use the FTP Client module is:

Open the FTP session (with the FTP_InitializeSession function)
Send commands within the FTP session (with the FTPGetList, FTPGetFileNames, FTPGetFile, and/or FTPSendFile functions)
Close the session (with the FTP_CloseSession function)

### FTP Client Functions to Initialize and/or Close a FTP Session

FTP_InitializeSession --- Create/Initialize a connection to an FTP Server
FTP_CloseSession --- Close the FTP session

## FTP Client Directory Functions

FTPGetDir --- Get the current working directory
FTPSetDir --- Set the current working directory
FTPDeleteDir --- Delete a directory
FTPMakeDir --- Make a directory
FTPUpDir --- Move up one directory level

## FTP Client Miscellaneous File Functions

FTPDeleteFile --- Delete a file on the server
FTPRenameFile --- Rename a file on the server

## FTP Client Send File Function

FTPSendFile --- Setup to send a file on an existing FTP session

## FTP Client Get File Functions

FTPGetFile --- Setup to receive a file on an existing FTP session
FTPGetList --- Setup to receive a directory on an existing FTP session
FTPGetFileNames --- Setup to receive a just the file names from the existing FTP session

## FTP Client Low Level Functions

FTPRawCommand --- Send a command and get a response from the control connection
FTPGetCommandResult --- Get a response from the control connection without sending a command
FTPRawStreamCommand --- Send a command and get a response over a stream connection

## FTP Client Example Program

See FTPClient example application in \nburn\examples\FTPClient

## 7.2. FTP_InitializeSession

### Synopsis:

int FTP_InitializeSession( IPADDR server_address, WORD port, PCSTR UserName,
PCSTR PassWord, DWORD time_out )

### Description:

This function creates and initializes a connection to an FTP server. This call creates a connection to a FTP server, and logs in with the username and password specified in the function call. The session handle returned from this call is used by the FTP file and directory functions. **Note:** The FTP_CloseSession function is used to close the session.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | server_address | The IP Address of the FTP Server. |
| WORD | port | The port number to connect to on the Server. |
| PCSTR | UserName | The account User Name. |
| PCSTR | PassWord | The account password. |
| DWORD | time_out | The number of time ticks to wait. |

### Return Values:

> 0 --- FTP session handle
FTP_TIMEOUT --- Time out
FTP_PASSWORDERROR --- Password error
FTP_CONNECTFAIL --- Network error
FTP_NETWORKERROR --- Network error

## 7.3. FTP_CloseSession

### Synopsis:

int FTP_CloseSession( int session );

### Description:

This function closes the specified FTP session. This function should be called when an FTP session is complete.

Warning: Failure to call this function will result in memory/resource leaks.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | session | The FTP session handle. |

### Return Values:

FTP_OK --- Closed successfully
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command error
FTP_NETWORKERROR --- Network error
FTP_BADSESSION --- Invalid session number

## 7.4. FTPGetDir

### Synopsis:

int FTPGetDir( int ftp_Session, char * dir_buf, int nbytes, WORD timeout )

### Description:

This function gets the current working directory name on the FTP server. This function also copies the name of the current working directory into the buffer specified by dir_buf.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| char | *dir_buf | A pointer to the buffer that will hold the directory name. |
| int | nbytes | The maximum number of bytes to copy. |
| WORD | timeout | The number of ticks to wait for timeout. |

### Return Values:

> 0 --- The number of bytes read
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Could not execute command
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## 7.5. FTPSetDir

### Synopsis:

int FTPSetDir( int ftp_Session, const char * new_dir, WORD timeout )

### Description:

This function sets the current working directory of the FTP Server.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *new_dir | The name of the directory to change to |
| WORD | timeout | The number of timer ticks to wait for timeout. |

### Return Values:

FTP_OK --- Set successfully
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## 7.6. FTPDeleteDir

### Synopsis:

int FTPDeleteDir( int ftp_Session, const char * dir_to_delete, WORD timeout )

### Description:

This function deletes a directory on the FTP server.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *dir_to_delete | The name of the directory to be deleted. |
| WORD | timeout | The number of ticks to wait for a timeout. |

### Return Values:

FTP_OK --- Deleted successfully
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## 7.7. FTPMakeDir

### Synopsis:

int FTPMakeDir( int ftp_Session, const char * dir_to_make, WORD timeout )

### Description:

This function makes a directory on the FTP server.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *dir_to_make | The name of the directory to create. |
| WORD | timeout | The number of ticks to wait for a timeout. |

### Return Values:

FTP_OK --- Created successfully
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## 7.8. FTPUpDir

### Synopsis:

int FTPUpDir( int ftp_Session, WORD timeout )

### Description:

This function moves up one directory level in the directory hierarchy on the FTP server.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| WORD | timeout | The number of ticks to wait for a timeout. |

### Return Values:

FTP_OK --- Changed directory successfully
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## 7.9. FTPDeleteFile

### Synopsis:

int FTPDeleteFile( int ftp_Session, const char * file_name, WORD timeout )

### Description:

This function deletes a file on the FTP server.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *file | The file name to be deleted. |
| WORD | timeout | The number of ticks to wait for a timeout. |

### Return Values:

FTP_OK --- Deleted successfully
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

# 7.10. FTPRenameFile

## Synopsis:

int FTPRenameFile( int ftp_Session, const char * old_file_name, const char * new_file_name,
WORD timeout )

## Description:

This function renames a file on the FTP server.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *old_file_name | The file name to be renamed. |
| const char | *new_file_name | The new file name. |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

FTP_OK --- Renamed successfully
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

# 7.11. FTPSendFile

## Synopsis:

int FTPSendFile( int ftp_Session, const char * full_file_name, BOOL bBinaryMode, WORD timeout )

## Description:

This function call initializes the send file process to send a file to a FTP server. It sets up a new TCP connection that will be used to transfer the file data. To actually send the file data, use the returned file descriptor and the standard I/O write commands, such as write, writestring, or writeall. After sending the data, close the returned file descriptor with the close function.

**Important:** After the file has been sent, you must call FTPGetCommandResult to get the result from the write. **Warning: Failing to do this will cause the system to get out of sync**. A return value of 226 is normal.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *full_file_name | The file name that the FTP server should assign to the data sent. |
| BOOL | bBinaryMode | True if the file is to be transferred in binary mode. False for ASCII. |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

> 0 --- FTP write file descriptor
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## Example:

```
// Setup to send file and get file descriptor fd
// The “ftp” session handle would has already been created by the
// FTP_Initialize Session()call
int fd = FTPSendFile(ftp,”FOOBAR.TXT”,FALSE,100);
if (fd > 0)
{
   writestring(fd,”This is a test file\r\n”);
   writestring(fd,”This is line 2 of the test file\r\n”);
   writestring(fd,”Last Line\r\n”);
   close(fd);
   rv = FTPGetCommandResult(ftp,tmp_resultbuff,255,100);
   if (rv != 226)
   iprintf(“Write Error Command result = %d
   %s\r\n",rv,tmp_resultbuff);
}
else
  iprintf(“Failed to create file FOOBAR.TXT\r\n”);
```

# 7.12. FTPGetFile

## Synopsis:

int FTPGetFile( int ftp_Session, const char * full_file_name, BOOL  bBinaryMode, WORD timeout )

## Description:

This function call initializes the receive file process used to get a file from a FTP server. It sets up a new TCP connection that will be used to transfer the file data. To actually receive the file data, use the returned file descriptor and the standard I/O read commands, such as the ReadWithTimeout function.

**Note:** It would be unwise to use the read function, because it would block forever if the connection were lost to the FTP Server. After reading the data, close the returned file descriptor with the close function.

**Important:** After the file descriptor has been returned, you must call the FTPGetCommandResult function to get the result from the read. **Warning: Failing to do this will cause the system to get out of sync.** A return value of 226 is normal.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *full_file_name | The complete file name to be transferred, including path. |
| BOOL | bBinaryMode | True if the file is to be transferred in binary mode. False for ASCII. |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

> 0 --- FTP read file descriptor
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## Example:

```
// Setup file transfer and get file descriptor fdr
int fdr = FTPGetFile( ftp, "FOOBAR.TXT", FALSE, 100 );
if (fdr > 0)
{
   // The following function reads data from the specified file until complete.
   // This is the location where you could use
   // a different mechanism to retrieve the data.
   ShowFileContents( fdr );
   close( fdr );

   // Now read the command result code from the GetFile command
   rv = FTPGetCommandResult( ftp, tmp_resultbuff, 255, 100);
   if (rv != 226)
   iprintf("Error Command result = %d %s\r\n", rv, tmp_resultbuff );
}
else
   iprintf( "Failed to get file FOOBAR.TXT\r\n" );

// This function reads the data stream from the fd and
// displays it to stdout, which is usually the com1 serial
// port on the NetBurner board.
void ShowFileContents( int fdr )
{
iprintf( "\r\n[" );
int rv;
do
{
   rv = ReadWithTimeout(fdr,tmp_resultbuff,255,20);
   if (rv < 0)
      iprintf("RV = %d\r\n",rv);
   else
   {
      tmp_resultbuff[rv] = 0;
      iprintf("%s",tmp_resultbuff);
   }
}

while (rv > 0);
iprintf("]\r\n");
}
```

# 7.13. FTPGetList

## Synopsis:

int FTPGetList( int ftp_Session, const char * full_dir_name, WORD timeout );

## Description:

This function initializes the get directory process to receive a full directory listing from the FTP server. A new TCP connection is created to receive the file listing from the server. To actually receive the list use the returned file descriptor to read the list using the standard I/O read commands, such as ReadWithTimeout. After reading the data, close the returned file descriptor with the close function.

**Important:** After you have received the list, you must call the FTPGetCommandResult function to get the result from the read. **Warning: Failing to do this will cause the system to get out of sync.** A return value of 226 is normal.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *full_dir_name | The complete directory name to be transferred. Can be NULL. |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

> 0 --- FTP read file descriptor
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

## Example:

```
int fdr = FTPGetList(ftp,NULL,100);
if (fdr > 0)
{
   //This function reads data from the fd until complete.
   ShowFileContents(fdr);

   // You would probably use a different function.
   // The source for this function is shown in the module example.
   close(fdr);

   // Now read the command result code from the GetList command
   rv = FTPGetCommandResult(ftp,tmp_resultbuff,255,100);
   if (rv != 226)
      iprintf("Error Command result = %d %s\r\n",rv,tmp_resultbuff);
}
else
   iprintf("Failed to get file list\r\n");

// This function reads the data stream from the fd and displays
// it to stdout, which is usually the com1 serial port on the
// NetBurner board.
void ShowFileContents(int fdr)
{
   iprintf("\r\n[");
   int rv;
   do
   {
      rv = ReadWithTimeout(fdr,tmp_resultbuff,255,20);
      if (rv < 0)
      {
         iprintf("RV = %d\r\n",rv);
      }
      else
      {
         tmp_resultbuff[rv] = 0;
         iprintf("%s",tmp_resultbuff);
      }
   }
   while (rv > 0);
   iprintf("]\r\n");
}
```

# 7.14. FTPGetFileNames

## Synopsis:

int FTPGetFileNames( int ftp_Session, const char * full_dir_name, WORD timeout )

## Description:

This function initializes the get directory process to receive just the file names listing from the server. It sets up a new TCP connection to receive the file listing from the server. To actually receive the list, use the returned file descriptor to read the data using the standard I/O read commands, such as ReadWithTimeout.

Warning: It would be unwise to use the read function, because it would block forever if the connection were lost to the FTP Server. After reading the data, close the returned file descriptor with the close function.

After the file connection has been established, you must call the FTPGetCommandResult function to get the result from the read. **Warning: Failing to do this will cause the system to get out of sync.** A return value of 226 is normal.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *full_dir_name | The complete file name to be transferred, including the path. |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

int --- The command success code
> 0 --- FTP read file descriptor
FTP_TIMEOUT --- Time out
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

### Example:

```
int fdr = FTPFileNames(ftp,NULL,100);
if (fdr > 0)
{
   // This function reads data from the fd until complete. You may
   // want to use a different method here.
   ShowFileContents(fdr);
   close(fdr);

   // Now read the command result code from the GetList command
   rv = FTPGetCommandResult(ftp,tmp_resultbuff,255,100);
   if (rv != 226)
   iprintf("Error Command result = %d %s\r\n",rv,tmp_resultbuff);
}
else
   iprintf("Failed to get file list\r\n");

// This function reads the data stream from the fd and
// displays it to stdout, which is usually the com1 serial
// port on the NetBurner board.
void ShowFileContents(int fdr)
{
   iprintf("\r\n[");
   int rv;
   do
   {
      rv = ReadWithTimeout(fdr,tmp_resultbuff,255,20);
      if (rv < 0) iprintf("RV = %d\r\n",rv);
      else
      {
         tmp_resultbuff[rv] = 0;
         iprintf("%s",tmp_resultbuff);
      }
   }
   while (rv > 0);
   iprintf("]\r\n");
}
```

# 7.15. FTPRawCommand

## Synopsis:

int FTPRawCommand( int ftp_Session, const char * cmd, char * cmd_buf, int nbytes, WORD timeout )

## Description:

This function sends a command and gets a response from the FTP control connection. This command is the basis for most of the FTP commands in the FTP module. It is used where a stream return is not expected. **Important:** Using this command requires that you are familiar with the FTP Protocol details.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *cmd | The command to send - **not** including the \r\n termination. |
| char | *cmd_buf | The buffer to hold the result from the server which includes a CLF/LF at the end. |
| int | nbytes | The maximum number of bytes in server response to copy (including numeric code and null terminator). |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

> 0 --- The FTP numeric response code
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

# 7.16. FTPGetCommandResult

## Synopsis:

int FTPGetCommandResult( int ftp_Session, char * cmd_buf, int nbytes, WORD timeout )

## Description:

This function gets a response from the control connection without sending a command. This command may be used after the following four functions to get the command result:

FTPGetList
FTPGetFileNames
FTPGetFile
FTPSendFile

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| char | *cmd_buf | The buffer to hold the result. |
| int | nbytes | The maximum number of bytes to copy. |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

> 0 --- The FTP read file descriptor
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

# 7.17. FTPRawStreamCommand

## Synopsis:

int FTPRawStreamCommand( int ftp_Session, const char * cmd, int  * pResult,
char * cmd_buf, int nbytes, WORD timeout )

## Description:

This function sends a command and gets a response over a stream connection. This command is the basis for functions such as FTPGetList and FTPGetFiles. It is used where a stream return is expected.

After you have received or sent the data stream you must call FTPGetCommandResult to get the result from the read or write. **Warning: Failing to do this will cause the system to get out of sync.** A return value of 226 is normal. However, other values such as 250 are also possible depending on the FTP server.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | ftp_Session | The FTP session handle returned from the FTP_InitializeSession call. |
| const char | *cmd | The command to send - **not** including the \r\n termination. |
| int | *pResult | The FTP command result code. |
| char | *cmd_buf | The buffer to hold the command connection results from the server, which includes a CR/LF at the end. |
| int | nbytes | The maximum number of bytes to copy into the cmd_buf (includes numeric response code and null terminator). |
| WORD | timeout | The number of ticks to wait for a timeout. |

## Return Values:

> 0 --- FTP data channel file descriptor (Note: The FTP server will drop the data channel after completion of sending data to the client that will cause a read error)
FTP_TIMEOUT --- Time out
FTP_COMMANDFAIL --- Command failed (e.g. a nonexistent directory)
FTP_CONNECTFAIL --- FTP failure
FTP_NETWORKERROR --- Network error

# 8. FTP Server Library

## 8.1. Introduction

Implementing an FTP server in an embedded system without a built-in file system is not a trivial undertaking. Most embedded applications do not require a file system, and a file system is not part of the standard NetBurner package. If a file system is required for a specific application, it is the responsibility of the programmer to implement the required features. A file system could be the trivially simple example of a single file, or it could be quite complex.

Using the FTP Server requires that you, the programmer, write the functions defined in the FTP documentation. These functions are "callback" functions that allow you to customize the FTP server actions to suit your particular application. **Note:** All callback functions required for your application **must** be implemented by you.

The NetBurner examples (C:\Nburn\examples) directory has three FTP server sample applications:

ftpd_trivial --- A simple example that reads and writes a single file.
ftpd_expose_html --- A more complex example that exposes all HTML served files to the FTP server.
ftpd_code_update --- This example shows you how to upgrade the NetBurner firmware and reset the system using FTP.

### Header File

#include <ftpd.h>  // Found by default in C:\Nburn\include

#### Operational Functions

FTPDStart --- Starts the FTP Server task
FTPDStopReq --- Sends a stop request to the currently running FTPD

#### FTP Session Callback typedef

(FTPDCallBackReportFunct) --- The typedef for all directory reporting callbacks

#### FTP Session Callback Functions (These functions must be implemented by the programmer)

FTPDSessionStart --- Function called to indicate the start of a user session
FTPDSessionEnd --- Function called to indicate a user session will be terminated

#### FTP Directory Callback Functions (These functions must be implemented by the programmer)

FTPD_DirectoryExists --- Function called by the FTP Server to test for the existence of a directory
FTPD_CreateSubDirectory --- Function called by the FTP Server to create a directory
FTPD_DeleteSubDirectory --- Function called by the FTP Server to delete a directory
FTPD_ListSubDirectories --- Function called by the FTP Server to list all subdirectories under the current directory

**FTP File Callback Functions (These functions must be implemented by the programmer)**

FTPD_FileExists --- Function to report on the whether or not a file exists
FTPD_SendFileToClient --- Function to send the contents of a file to a file descriptor
FTPD_AbleToCreateFile --- Function to report on the ability to create/receive a file
FTPD_GetFileFromClient --- Function to create/get a file
FTPD_DeleteFile --- Function to delete a file
FTPD_DeleteFile --- User supplied function to delete a file
FTPD_ListFile --- Lists every file in the current directory
FTPD_ListFile --- User supplied function that lists every file in the directory
FTPD_Rename --- User supplied function to rename a file

## 8.2. FTPDStart

### Synopsis:

int FTPDStart( WORD port, BYTE server_priority )

### Description:

This function starts the FTP Server task, which listens for incoming connections.

Warning: Only one instance of the FTPD is allowed.

### Parameters:

| Type | Name | Description |
|---|---|---|
| WORD | port | The TCP port to listen to for incoming FTP requests. |
| BYTE | server_priority | The uC/OS task priority for the FTP Server. |

### Return Values:

FTPD_RUNNING --- The FTPD is already running
FTPD_LISTEN_ERR --- The listen socket could not be opened
FTPD_OK --- The FTPD was successfully started
FTPD_FAIL --- The FTPD task could not be created

## 8.3. FTPDStopReq

### Synopsis:

int FTPDStopReq( )

### Description:

This function sends a stop request to the currently running FTPD.

### Parameters:

None

### Return Values:

FTPD_RUNNING --- The FTPD is still running
FTPD_NOT_RUNNING --- The FTPD is no longer running

# 8.4. ( FTPDCallBackReportFunct )

## Synopsis:

typedef void ( FTPDCallBackReportFunct )( int handle, const char * name_to_report )

## Description:

This is the typedef for all directory reporting callbacks. This callback type definition is used by the directory reporting functions.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | handle | The handle passed into the listing function. |
| const char | *name_to_report | The file name to report for use in a directory listing. |

## Return Value:

Nothing --- This is a void function

# 8.5. FTPDSessionStart

## Synopsis:

void * FTPDSessionStart( const char  * user, const char  * passwd, const IPADDR hi_ip )

## Description:

This function is called to indicate the start of a user Session. This function is called following the creation of a **new** FTP session. This function needs to determine the validity of the user/password pair. The returned void pointer **will** be passed to **all** access functions, which will then be asked to determine the validity of the operation based on the permissions associated with the return value.

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *user | The name of the user attempting to establish an FTP session. |
| const char | *passwd | The password of the user attempting to establish an FTP session. |
| const | IPADDR hi_ip | The IP Address of the Server trying to establish this connection. |

## Return Values:

NULL --- The user name/password set is invalid
(obj) --- A non-null void pointer to an object that will be associated with this login session

## 8.6. FTPDSessionEnd

### Synopsis:

void FTPDSessionEnd( void  * pSession )

### Description:

This function is called to indicate that a user session will be terminated. This callback function gives the user program the opportunity to clean up any storage associated with the void pointer returned from the FTPDSessionStart call.

### Parameters:

| Type | Name | Description |
|---|---|---|
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

### Return Value:

Nothing --- This is a void function

# 8.7. FTPD_DirectoryExists (User Defined)

## Synopsis:

int FTPD_DirectoryExists( const char * full_directory, void * pSession )

## Description:

This function called by the FTP Server to test for the existence of a directory. This function is called by the FTP Server as the result of an attempt to change to a new directory. This function can also be used to validate the permissions of the session. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *full_directory | The name of the new directory to test. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested directory exists
FTPD_FAIL --- The requested directory does not exist, or access is not permitted for the user

# 8.8. FTPD_CreateSubDirectory (User Defined)

## Synopsis:

int FTPD_CreateSubDirectory( const char * current_directory, const char * new_dir, void * pSession )

## Description:

This function is called by the FTP Server to create a directory. This function is called by the FTP Server as the result of an attempt to create a new directory. This function can also be used to validate the permissions of the session. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| const char | *new_dir | The directory to create under the current_directory. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested directory was created
FTPD_FAIL --- The requested directory could not be created

# 8.9. FTPD_DeleteSubDirectory (User Defined)

## Synopsis:

int FTPD_DeleteSubDirectory( const char  *current_directory, const char * sub_dir, void * pSession )

## Description:

This function is called by the FTP Server to delete a directory. This function is called by the FTP Server as the result of an attempt to delete a subdirectory. This function call can be used to validate the permissions of this session. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| const char | *sub_dir | The directory to delete under the current_directory |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested directory was deleted
FTPD_FAIL --- The requested directory could not be deleted

# 8.10. FTPD_ListSubDirectories (User Defined)

## Synopsis:

int FTPD_ListSubDirectories( const char * current_directory, void  * pSession,
FTPDCallBackReportFunct * pFunc, int handle )

## Description:

This function is called by the FTP Server to list all subdirectories under the current directory. This function is called by the FTP Server as the result of a client's attempt to list the contents of a directory. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |
| FTPDCallBackReportFunct | *pFunc | The pointer to the callback function to be called for each subdirectory. |
| int | handle | The handle value to be passed back into the pFunc. |

## Return Values:

FTPD_OK --- The requested listing was successfully delivered
FTPD_FAIL --- The requested directory could not be listed

## Example:

Everything inside the callback function stub must be supplied by the programmer.

The FTP server will automatically call this function and provide values for the function variables. It is the programmer's responsibility to execute pFunc( ) with the provided handle and a pointer to the string representing the subdirectory name. **Note: pFunc( ) must be executed once for each subdirectory name.** In the example below, the variables number_of_directories and DirectoryName **must** be declared **and** initialized elsewhere in the application program:

```
int FTPD_ListSubDirectories(const char *current_directory, void *pSession, FTPDCallBackReportFunct
*pFunc, int handle);
{
  for (int n = 0; n < number_of_dir; n++)
  pFunc(handle, DirectoryName[n]);
  return FTPD_OK;
}
```

# 8.11. FTPD_FileExists (User Defined)

## Synopsis:

int FTPD_FileExists( const char * full_directory, const char * file_name, void * pSession )

## Description:

This function reports on whether or not a file exists. This function checks for the existence of a file, usually just before an attempt is made to download the file. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *full_directory | The current value of the session directory. |
| const char | *file_name | The name of the file to check. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested file exists
FTPD_FAIL --- The requested file does not exist

# 8.12. FTPD_SendFileToClient (User Defined)

## Synopsis:

int FTPD_SendFileToClient( const char * full_directory, const char * file_name,
void * pSession, int fd )

## Description:

This function sends the contents of a file to a file descriptor. This function sends a file to an FTP client. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *full_directory | The current value of the session directory. |
| const char | *file_name | The name of the file to send. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |
| int | fd | The file descriptor to send to. |

## Return Values:

FTPD_OK --- The requested file was sent
FTPD_FAIL --- The requested file was not sent

# 8.13. FTPD_AbleToCreateFile (User Defined)

## Synopsis:

int FTPD_AbleToCreateFile( const char * full_directory, const char * file_name, void * pSession )

## Description:

This function will report on the ability to create/receive a file. This function determines if a file can be created.
**This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *full_directory | The current value of the session directory. |
| const char | *file_name | The name of the file to create. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested file can be written (i.e. created)
FTPD_FAIL --- The requested file could not be created

# 8.14. FTPD_GetFileFromClient (User Defined)

## Synopsis:

int FTPD_GetFileFromClient( const char * full_directory, const char * file_name,
void * pSession, int fd )

## Description:

This function is used to create/get a file or to receive a file from the FTP client. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *full_directory | The current value of the session directory. |
| const char | *file_name | The name of the file to create. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |
| int | fd | The file descriptor that will be used to receive the file. |

## Return Values:

FTPD_OK --- The requested file was written (i.e. created)
FTPD_FAIL --- The requested file was not created

# 8.15. FTPD_DeleteFile

## Synopsis:

int FTPD_DeleteFile( const char * current_directory, const char * file_name, void * pSession )

## Description:

This function is used to delete a file.

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| const char | *file_name | The name of the file to delete. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested file was deleted
FTPD_FAIL --- The requested file was not deleted

# 8.16. FTPD_DeleteFile (User Defined)

## Synopsis:

int FTPD_DeleteFile( const char * current_directory, const char  * file_name, void * pSession )

## Description:

This is a user written function to delete a file. This function must be implemented by the programmer.

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| const char | *file_name | The name of the file to delete. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested file was deleted
FTPD_FAIL --- The requested file could not be deleted

# 8.17. FTPD_ListFile

## Synopsis:

int FTPD_ListFile( const char * current_directory, void * pSession, FTPCallBackReportFunct * pFunc,
int handle )

## Description:

This is a callback function, with the name of every file in the directory.

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |
| FTPCallBackReportFunct | *pFunc | The pointer to the callback function to be called for each file name. This is a callback function provided and used by the NetBurner internal FTP code. |
| int | handle | The handle value to be passed back into the pFunc. This is a handle provided and used by the NetBurner internal FTP code. |

## Return Values:

FTPD_OK --- The requested files were listed
FTPD_FAIL --- The requested files were not listed

## 8.18. FTPD_ListFile (User Defined)

### Synopsis:

int FTPD_ListFile( const char * current_directory, void * pSession,
FTPDCallBackReportFunct * pFunc, int handle );

### Description:

This function is a user supplied function that lists all files in the current directory. **This function must be implemented by the programmer.**

### Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |
| FTPCallBackReportFunct | *pFunc | The pointer to the callback function to be called for each file name. This is a callback function provided and used by the NetBurner internal FTP code. |
| int | handle | The handle value to be passed back into the pFunc. This is a handle provided and used by the NetBurner internal FTP code. |

### Return Values:

FTPD_OK --- The requested files were listed
FTPD_FAIL --- The requested files were not listed

## Example:

**Everything inside the callback function stub must be supplied by the programmer. The FTP server will automatically call this function and provide values for the function variables.**

**Important: It is the programmer's responsibility to execute pFunc( ) with the provided handle and a pointer to the string representing the file name.**

**Note: pFunc( ) must be executed once for each file name. In the example on the next page, the variables number_of_directories and FileNames must be declared and initialized elsewhere in the application program:**

```
int FTPD_ListFile( const char *current_directory, void *pSession,
                   FTPDCallBackReportFunct *pFunc, int handle );
 {
   for (int n = 0; n < numberof_files; n++)
   pFunc(handle, FileNames[n]);
   return FTPD_OK;
 }
```

# 8.19. FTPD_Rename (User Defined)

## Synopsis:

int FTPD_Rename( const char * current_directory, const char  * cur_file_name,
const char * new_file_name, void * pSession )

## Description:

This is a user written function; this function is used to rename a file. **This function must be implemented by the programmer.**

## Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *current_directory | The current value of the session directory. |
| const char | *cur_file_name | The current name of the file to rename. |
| const char | *new_file_name | The new file name. |
| void | *pSession | The void * object returned from the FTPDSessionStart function call. |

## Return Values:

FTPD_OK --- The requested file was deleted
FTPD_FAIL --- The requested file could not be renamed

# 9. HTTP and HTML Libraries

## Header Files

#include <http.h>  // Found in C:\Nburn\include
#include <htmlfiles.h>  // Found in C:\Nburn\include

## HTTP Dameon Functions

StartHTTP --- Starts the HTTP server
StopHTTP --- Stops the HTTP subsystem
SetNewPostHandler --- Setup a custom Post Handler
SetNewGetHandler --- Setup a custom Get Handler
SetNewHeadHandler --- Setup a custom Head Handler
HTTP Password Processing --- Basic HTML Password Support
CheckAuthentication --- Checks the HTTP request for password information
RequestAuthentication --- Rejects the current HTTP request and request for a password

## HTML Header Functions

SendHTMLHeader --- Sends an html response header
SendHTMLHeaderWCookie --- Sends an html response header with a cookie
SendTextHeader --- Sends a text header
SendGifHeader --- Sends a gif header

## Other HTML Responses

RedirectResponse --- Sends a response that redirects the request to the new page
NotFoundResponse --- Sends a response that indicates the page can't be found

## Form Posting Functions

ExtractPostData --- Decodes post data
ExtractPostFile --- Extracts a file from the post data stream
EnableMultiPartForms --- Enables multipart form posts
DisableMultiPartForms --- Frees up the buffer

## Useful HTML/HTTP Functions

writesafestring --- Writes out a string while escaping all special characters
httpstricmp --- This is a special case insensitive prefix match compare

## HTML Encoded File Functions

SendFullResponse --- Sends a complete encoded file as a response
SendFileFragment --- Sends an encoded file as a part of a response

## HTTP Password Support Functions

#include <httppass.h>  // Found in C:\Nburn\include

CheckAuthentication --- Check the HTTP request for password information
RequestAuthentication --- Rejects the current HTTP request and request for password

# 9.1. StartHTTP

## Synopsis:

void StartHTTP( WORD port = 80 )

## Description:

This function starts the HTTP Server. You must have initialized the IP stack before starting the HTTP Server. If no port number is specified, the default of 80 will be used.

## Parameters:

| Type | Name | Description |
|---|---|---|
| WORD | port | The port on which to open the HTTP Server. This defaults to the standard HTTP port (i.e. port 80). |

## Returns:

Nothing --- This is a void function

## Example:

Simple Html --- Found by default in C:\Nburn\examples

## 9.2. StopHTTP

### Synopsis:

void StopHTTP( )

### Description:

Use this function to shutdown the HTTP Server.

### Parameters:

None

### Returns:

Nothing --- This is a void function

## 9.3. SetNewPostHandler

### Synopsis:

typedef int ( http_posthandler )( int sock, PSTR url, PSTR pData, PSTR rxb )

http_posthandler * SetNewPostHandler( http_posthandler * newhandler )

### Description:

When the HTTP Server receives a POST request from an HTML form that request needs to be processed by a custom function, this call sets up that function. **Note:** This custom function must be of the form:

int yourposthandler( int sock, PSTR url, PSTR pData, PSTR rxb );

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The File descriptor for the socket that this function should send a response to. |
| PSTR (char *) | url | The URL that this POST was directed at. This is used to select what form this was posted from. |
| PSTR | pData | The encoded data fields from the form. See the ExtractPostData function to decode this data. |
| PSTR | rxb | A pointer to the entire HTTP request. This is not usually needed. |

### Returns:

The function pointer to the previously registered post handler

### Example:

FlashForm --- Found by default in C:\Nburn\examples

## 9.4. SetNewGetHandler

### Synopsis:

typedef int ( http_gethandler )( int sock, PSTR url, PSTR rxb )

http_gethandler * SetNewGetHandler( http_gethandler * newhandler )

### Description:

When the HTTP Server receives a GET request, that request needs to be processed. The default GET processing looks for files stored in the compressed file data section by CompHtml. This allows **both** static and dynamic HTML responses; this is usually sufficient. If your application **needs** to have complete (program) control of GET requests (e.g. to implement Password protection), you may **replace** the **default** GET processing by registering a **new** function. **Note:** This custom function **must** be of the form:

int yourgethandler( int sock, PSTR url, PSTR rxb );

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The File descriptor for the socket that this function should send a response to. |
| PSTR (char *) | url | The URL that this GET was directed at. This is used to select what form this was posted from. |
| PSTR | rxb | A pointer to the entire HTTP request. |

### Returns:

The function pointer to the previously registered get handler

### Example:

Simple HTML --- Found by default in C:\Nburn\examples

### The Default GET Handler:

```
int BaseDoGet(int sock, PSTR url, PSTR rxBuffer)
{
   if (*url==0)   // The default value
   {
      RedirectResponse(sock,default_page);
      return 1;
   }

   if (httpstricmp(url,"ECHO"))
   {
      while (*url) url++;
      *url=' ';
      SendTextHeader(sock);
      writestring(sock,rxBuffer);
      return 1;
   }

   if(!SendFullResponse(url,sock))
   {// we failed
      NotFoundResponse(sock,url);
      DBPRINT(DB_HTTP,"Did not find:");
      DBPRINT(DB_HTTP,url);
      DBPRINT(DB_HTTP,"\r\n");
   }
   return 0;
}
```

## 9.5. SetNewHeadHandler

### Synopsis:

typedef int ( http_headhandler )( int sock, PSTR url, PSTR rxb )

http_headhandler * SetNewHeadHandler( http_headhandler * newhandle )

### Description:

When the HTTP server receives a HEAD, the default response does nothing. If you want to handle HEAD requests in any special way, you can write a custom function to do so. You **must** use this call to register this function.

The custom function **must** be of the form:

int yourheadhandler( int sock, PSTR url, PSTR rxb );

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The File descriptor for the socket that this function should send a response to. |
| PSTR (char *) | url | The URL that this GET was directed at. |
| PSTR | rxb | A pointer to the entire HTTP request. |

### Returns:

The function pointer to the previously registered head handler

# 9.6. CheckAuthentication

## Synopsis:

int CheckAuthentication( PSTR url, char ** pPassword, char ** pUser )

## Description:

This password support function checks the HTTP request for password information. This function examines the PASSWORD field stored in the HTTP request.

## Parameters:

| Type | Name | Description |
|---|---|---|
| PSTR | url | A pointer to the url as passed to the user provided get function. |
| char | **pPassword | A char pointer that will be set to point to the password in the request. |
| char | **pUser | A char pointer that will be set to point to the user name in the request. |

## Returns:

0 on Failure
1 on Success

### Example:

```
#include <http.h>
#include <httppass.h>

static http_gethandler * oldhand;

// Initialize somewhere in your application:
oldhand=SetNewGetHandler(MyDoGet);

int MyDoGet(int sock, PSTR url, PSTR rxBuffer)
{
   char * pPass;
   char * pUser;

   if (!CheckAuthentication(url,&pPass,&pUser))
   {
       RequestAuthentication(sock,"YourNameHere");
       return 1;
   }
   else
   {
      if (password is not ok)
      {
         RequestAuthentication(sock,"YourNameHere");
         return 1;
      }
   }
   // If we got here the password was acceptable
   return (* oldhand)(sock,url,rxBuffer);
}
```

# 9.7. RequestAuthentication

## Synopsis:

void RequestAuthentication( int sock, PCSTR name )

## Description:

This password support function rejects the current HTTP request and request for password. This function will send a 401 authentication requested message to the socket.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The socket file descriptor to get the request. |
| PCSTR | name | The Name that should appear in the password request. |

## Returns:

Nothing ---This is a void function

## 9.8. SendHTMLHeader

### Synopsis:

void SendHTMLHeader( int sock )

### Description:

This function sends an HTML header response to the selected socket. This function is used if you are building your own HTML response (programmatically) from scratch.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The socket that you want to send the Redirect to. |

### Returns:

Nothing --- This is a void function

## 9.9. SendHTMLHeaderWCookie

### Synopsis:

### void SendHTMLHeaderWCookie( int sock, char * cookie )

### Description:

This function sends an HTML response header and includes a cookie to be stored by the browser.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The socket that you want to send the Redirect to. |
| char | *cookie | A char pointer that will be set to point to the cookie. |

### Returns:

Nothing ---This is a void function

### Example Application:

HtmlCookie --- Found in C:\Nburn\examples

## 9.10. SendTextHeader

### Synopsis:

```
void SendTextHeader( int sock )
```

### Description:

This function is used if you want to build a plain text response from scratch. **It should be sent before any other part of the HTTP response.**

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The socket that you want to send the Redirect to. |

### Returns:

Nothing --- This is a void function

### Example:

The default GET response ECHO uses this function

## 9.11. SendGifHeader

### Synopsis:

```
void SendGifHeader( int sock )
```

### Description:

This function sends a GIF response header. This function is used to set the header type for stored GIF files in the system. This function can be used to generate a GIF header for dynamically generated GIF files.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The socket that you want to send the Redirect to. |

### Returns:

Nothing ---This is a void function

## 9.12. RedirectResponse

### Synopsis:

```
void RedirectResponse( int sock, PCSTR new_page );
```

### Description:

When an HTTP GET or POST request should be redirected to a different page, use this function to do so.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The socket that you want to send the Redirect to. |
| PCSTR (const char *) | new_page | The URL of the redirected destination. |

### Returns:

Nothing --- This is a void function

## 9.13. NotFoundResponse

### Synopsis:

```
void NotFoundResponse( int sock, PCSTR errored_page );
```

### Description:

This function responds to an HTTP GET or POST request by indicating the page does not exist.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | sock | The socket that you want to send the Redirect to. |
| PCSTR (const char *) | errored_page | The URL of the requested page that does not exist. |

### Returns:

Nothing --- This is a void function

# 9.14. ExtractPostData

## Synopsis:

```
int ExtractPostData( PCSTR name, PCSTR data, PSTR dest_buffer,
                     int maxlen );
```

## Description:

This function takes the HTML post data sent to the DoPost function, extracts the data associated with a specific name, and returns it in dest_buffer.

## Parameters:

| Type | Name | Description |
|---|---|---|
| PCSTR | name | The name of the HTML form data element to extract the data from. |
| PCSTR | data | The data pointer passed in to the process post function. |
| PCSTR | dest_buffer | The location of the data after it has been extracted. |
| int | maxlen | The maximum length of the string. |

## Returns:

-1 --- If no data of that name was found
0 --- If the data field was presented, but empty
Otherwise, the number of chars extracted and copied into dest_buffer

## Example Application:

FlashForm --- Found by default in your C:\Nburn\examples directory

## 9.15. ExtractPostFile

### Synopsis:

```
ExtractPostFile( PCSTR name, PCSTR pData );
```

### Description:

This function extracts a file from the post data stream. **Note:** The stream must be closed just like any other stream.

### Parameters:

| Type | Name | Description |
|---|---|---|
| PCSTR | name | The name of the HTML form data element to extract the data from. |
| PCSTR | pData | The encoded data fields from the form. |

### Returns:

> 0 --- If successful

# 9.16. EnableMultiPartForms

## Synopsis:

```
BOOL EnableMultiPartForms( DWORD maxfile_size );
```

## Description:

This function enables multipart form posts and set the max file size you will accept. This function also mallocs the file buffer.

## Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | maxfile_size | The maximum file size. |

## Returns:

True --- If successful

## 9.17. DisableMultiPartForms

### Synopsis:

```
void DisableMultiPartForms( );
```

### Description:

This function frees up the buffer.

### Parameters:

None

### Returns:

Nothing ---This is a void function

## 9.18. writesafestring

### Synopsis:

```
void writesafestring( int fd, PCSTR str );
```

### Description:

When sending HTML test responses certain characters (e.g. '<') are interpreted by the browser as formatting, not as text. **Note:** This function properly escapes the text so it will appear as desired, and sends it out the associated socket descriptor.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor to send the string to. |
| PCSTR (const char *) | str | The NULL terminated string to send. |

### Returns:

The number of chars sent

# 9.19. httpstricmp

## Synopsis:

```
int httpstricmp( PCSTR s1, PCSTR sisupper2 );
```

## Description:

This function is used internally to match URLs with stored file prefixes.

## Parameters:

| Type | Name | Description |
|---|---|---|
| PCSTR | s1 | The string to test. |
| PCSTR | sisupper2 | The reference string (which **must** already be all **uppercase**). |

## Returns:

0 --- If the string prefixes do not match
1 --- If the string prefixes do match

## Example:

**`httpstricmp (s1,"LED.HTML" )`** would return:

| s1 Value | Return Value |
|---|---|
| LED | 1 |
| led.HTML | 1 |
| led.html? | 1 |
| LED.HTM? | 0 |

# 9.20. SendFullResponse

## Synopsis:

```
int SendFullResponse( char * name, int fd );
```

## Description:

This function looks for the file named "name" in the files stored in the system with CompHtml. If it finds the file, it sends the proper HTTP header and renders the file to the socket. **Note:** If the stored file has embedded dynamic HTML, these functions will be filled in.

## Parameters:

| Type | Name | Description |
|---|---|---|
| char | *name | The name of the file to send. |
| int | fd | The file descriptor or socket to send the file to. |

## Returns:

1 --- If the file was found and returned
0 --- If the file was not found

## 9.21. SendFileFragment

### Synopsis:

```
int SendFileFragment( char * name, int fd );
```

### Description:

This function looks for the file named "name" in the files stored in the system with CompHtml. If it finds this file, it sends the file as a fragment. It does not send the HTTP header. If the stored file has embedded dynamic HTML, these functions will be filled in. If you want to build HTML responses with large chunks of pre-configured HTML, you can store these in the system and then send them out sequentially using this function.

### Parameters:

| Type | Name | Description |
|---|---|---|
| char | *name | The name of the file fragment to send. |
| int | fd | The file descriptor or socket to send the file to. |

### Returns:

1 --- If the file was found and returned
0 --- If the file was not found

# 10. Interrupts

## 10.1. INTERRUPT MACRO

### Header Files:

```
#include <ucos.h>       // Found in C:\Nburn\include
#include <cfinter.h>    // Found in C:\Nburn\include (must be after ucos.h)
```

### Synopsis:

```
INTERRUPT( function_name, sr_value )
```

### Description:

The INTERRUPT macro sets up an interrupt function and the code block that will do the necessary things to save and restore the CPU registers. In addition, this macro tells the RTOS that an Interrupt is happening. All level 7 interrupts are non-maskable.

### Parameters:

| Type | Description |
|---|---|
| function_name | The name of the interrupt service routine. |
| sr_value | The SR register value that the processor will have during the interrupt. |

The eight permitted SR register values are:

0x2000 - **Allows all** interrupts
0x2100 - **Blocks all** interrupts **below** level 2
0x2200 - **Blocks all** interrupts **below** level 3
0x2300 - **Blocks all** interrupts **below** level 4
0x2400 - **Blocks all** interrupts **below** level 5
0x2500 - **Blocks all** interrupts **below** level 6
0x2600 - **Blocks all** interrupts **below** level 7
0x2700 - **Blocks all** interrupts **below** level 7

**Important:** The code within an INTERRUPT macro can be called at any time. Certain OS and I/O functions cannot be called from within an Interrupt routine.

**Warning: The following functions are not legal within an interrupt routine.**

All µC/OS critical section functions:

USER_ENTER_CRITICAL
USER_EXIT_CRITICAL
UCOS_ENTER_CRITICAL
UCOS_EXIT_CRITICAL

All µC/OS init and pend functions (all OsxxPendNoWait functions are okay):

OSxxInit
OSxxPend
OSCritEnter
OSChangePrio
OSTaskDelete
OSLock
OSUnlock
OSTaskCreate
OSTimeDly

I/O functions from within the ISR (interrupt service routine):

write
writeall
read
printf
fprintf
iprintf
scanf
gets
puts

Memory management functions:

malloc
free
new
delete

Important: Once you use the INTERRUPT macro to define the interrupt function, you will need to use the SetIntc (set interrupt controller) function to set up your interrupt controller variables and point the interrupt vector at that function. Please refer to the appropriate Freescale hardware reference manual (in \Nburn\docs\FreescaleManuals) for your specific interrupt source number and controller number (only for processors that have more than one interrupt controller).

## 10.2. SetIntc (MCF5234 and MCF5282 Only)

### Synopsis:

```
void SetIntc( int intc, long func, int source, int level, int prio )
```

### Usage:

```
extern "C"
{
   void SetIntc( int intc, long func, int source, int level, int prio )
}
```

### Description:

This function sets up the interrupt controller for a specified interrupt function and source.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `intc` | The interrupt controller number: 0 or 1. This number can be found in your Freescale hardware reference manual. |
| long | `func` | The interrupt service routine function to call. |
| int | `source` | The source number that can be found in your Freescale hardware reference manual (in \Nburn\docs\FreescaleManuals). |
| int | `level` | The interrupt level you want to assign. This value can be anything from 1 to 6. |
| int | `prio` | The interrupt priority used to resolve who goes first if multiple interrupts at the same level are occurring. This value can be between 0 and 7. |

### Returns:

Nothing – this is a void function.

## 10.3. SetIntc (MCF5270 Only)

### Synopsis:

```
void SetIntc( long func, int source, int level, int prio )
```

### Usage:

```
extern "C"
{
   void SetIntc( long func, int source, int level, int prio )
}
```

### Description:

This function sets up the interrupt controller for a specified interrupt function and source.

### Parameters:

| Type | Name | Description |
|---|---|---|
| long | `func` | The interrupt service routine function to call. |
| int | `source` | The source number that can be found in your Freescale hardware reference manual (in \Nburn\docs\FreescaleManuals). |
| int | `level` | The interrupt level you want to assign. This value can be anything from 1 to 6. |
| int | `prio` | The interrupt priority used to resolve who goes first if multiple interrupts at the same level are occurring. This value can be between 0 and 7. |

### Returns:

Nothing – this is a void function.

## 10.4. Pseudo-Example for MCF5234 and MCF5282 Only

```
/*
 * Include/define the proper preprocessor statements.
 */
#include <cfinter.h>

extern "C"
{
   void SetIntc( int intc, long func, int source, int level, int prio )
}

/**
 * Define the ISR function and SR mask.  The SR mask can be 0x2N00 where 'N'
 * is a value between 0 and 7.  The SR mask indicates what interrupt levels will
 * be blocked while the ISR is running (refer to the Parameters subsection near
 * the beginning of this chapter).  The 'N' value must be at least as high as
 * the level of the interrupt define in SetIntc.  Note that level 7 is
 * un-maskable.
 */
INTERRUPT( My_ISR, 0x2N00 )
{
   /* Write your interrupt service routine here */
}

/**
 * The main task.
 */
void UserMain( void *pd )
{
   ...

   /*
    * Initialize the interrupt - the following is sets up the DMA Timer 1
    * interrupt source.
    */
   Setintc( 0,                  /* Interrupt controller 0 */
            ( long ) My_ISR,    /* The function to call */
            20,                 /* Interrupt source number from Freescale manual */
            3,                  /* Interrupt level */
            1 );                /* Interrupt priority within level */

   ...
}
```

## 10.5. SetPinIrq

### Synopsis:

```
BOOL SetPinIrq( int pin, int polarity, void ( *func )( void ) );
```

### Description:

This function helps simplify the process of setting up the interrupt service routine and initializing the interrupt controller into one call when used to set up the IRQ1 (pin J2-43), IRQ3 (pin J2-45), or IRQ5 (pin J2-47) external interrupt as the source.

**Note**: This function is only supported on the MOD5234, MOD5270, MOD5272, and MOD5282 modules.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `pin` | The external interrupt input pin to configure. Valid values are "43" (IRQ1), "45" (IRQ3), and "47" (IRQ5). |
| int | `polarity` | This determines whether the interrupt is triggered on the rising edge or falling edge of the input signal. Any positive integer sets for rising edge trigger. Any negative integer sets for falling edge trigger. |
| void | `(*func)(void)` | The address of the void function that takes no input parameters. This is the function used to define the interrupt service routine. |

### Returns:

BOOL – TRUE if the pin is valid; FALSE if the pin is not supported.

## 10.6. EnableIrq

### Synopsis:

```
void EnableIrq( int pin );
```

### Description:

After the SetPinIrq() function is called to configure the external interrupt pin, this function can be used in conjunction with the DisableIrq() function to toggle the disable and re-enable of interrupts.

**Note**: This function is only supported on the MOD5234, MOD5270, MOD5272, and MOD5282 modules.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `pin` | The external interrupt input pin to enable interrupts. Valid values are "43" (IRQ1), "45" (IRQ3), and "47" (IRQ5). SetPinIrq() must be called for the appropriate IRQ pin first before this function can be used. |

### Returns:

Nothing – this is a void function.

# 10.7. DisableIrq

## Synopsis:

```
void DisableIrq( int pin );
```

## Description:

After the SetPinIrq() function is called to configure the external interrupt pin, this function can be used in conjunction with the EnableIrq() function to toggle the disable and re-enable of interrupts.

**Note**: This function is only supported on the MOD5234, MOD5270, MOD5272, and MOD5282 modules.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | pin | The external interrupt input pin to enable interrupts. Valid values are "43" (IRQ1), "45" (IRQ3), and "47" (IRQ5). SetPinIrq() must be called for the appropriate IRQ pin first before this function can be used. |

## Returns:

Nothing – this is a void function.

## 10.8. Example of SetPinIrq Usage

For this example to work, a MOD5234, MOD5270, MOD5272, or MOD5282 module must be mounted on a MOD-DEV-100 development board. The following code takes advantage of the "IRQ1" button located next to the "Reset" button in order to manually trigger interrupts. For every time the "IRQ1" button is pressed, an interrupt will be triggered upon release. Pressing the button forces the IRQ1 signal in a low state, and upon release it transitions to a high state, resulting in a rising-edge signal. The following code is configured to trigger on the rising edge of the IRQ1 interrupt source. Every time an interrupt occurs, the 8 LEDs along the edge of the development board will toggle on and off with every release of the button.

```
#include "predef.h"
#include <stdio.h>
#include <ctype.h>
#include <startnet.h>
#include <autoupdate.h>
#include <dhcpclient.h>
#include <pin_irq.h>
#include <pins.h>

#define PIN         ( 43 )    /* J2-43 = IRQ1, J2-45 = IRQ3, J2-47 = IRQ5 */
#define POLARITY    (  1 )    /* 1 = Rising Edge, -1 = Falling Edge */


extern "C"
{
   void UserMain( void *pd );
}


const char *AppName = "MOD52XX-SetPinIrqExample";


BOOL bLedOn;    /* For indicating status of LEDs */


/**
 * The interrupt service routine.
 */
void TestISRFunction( void )
{
   if ( bLedOn )
   {
      putleds( 0x00 );
      bLedOn = FALSE;
   }
   else
   {
      putleds( 0xFF );
      bLedOn = TRUE;
   }
}


/**
 * The main task.
 */
void UserMain( void *pd )
{
   InitializeStack();
   if ( EthernetIP == 0 ) GetDHCPAddress();
```

```
    OSChangePrio( MAIN_PRIO );
    EnableAutoUpdate();

    /*
     * Initialize the 8 LEDs
     */
    putleds( 0xFF );
    bLedOn = TRUE;

    if ( SetPinIrq( PIN, POLARITY, &TestISRFunction ) )
    {
       iprintf( "STATUS -- Pin %d set for IRQ\r\n", PIN );
    }
    else
    {
       iprintf( "ERROR -- Failed to set pin %d for IRQ\r\n", PIN );
       return;
    }

    while ( 1 )
    {
       OSTimeDly( TICKS_PER_SECOND );
    }
}
```

# 11. I/O System Library

## Header File

```
#include<iosys.h>       // Found in C:\Nburn\include
```

## General File Descriptor Functions

- close --- Close open file descriptors
- read --- Read data from a file descriptor
- ReadWithTimeout --- Read from a FD with timeout
- dataavail --- Check to see if data is available for read
- charavail --- Check to see if data is available for read on stdin
- write --- Write data to a file descriptor
- writestring --- Write a string to the file descriptor
- writeall --- Write data to a file descriptor and block until complete

## FD Set and Select Related Functions

- FD_ZERO --- Zero a file descriptor set
- FD_CLR --- Clear a specific fd in a fd_set
- FD_SET --- Set a specific fd in a fd_set
- FD_ISSET --- Test to see if a specific fd is set in an fd_set
- select --- ZeroWaitSelect
- ZeroWaitSelect --- ZeroWaitSelect

## Standard I/O Modification Functions

- ioctl --- Control translation and formatting for stdio
- ReplaceStdio --- Replace (i.e. override) the stdio file descriptor with a new one

## Miscellaneous Functions

## Header File

```
#include<syslog.h>    // Found in C:\Nburn\include
```

- SysLog --- Sends output on UDP Port 514

# 11.1. close

## Synopsis:

```
int close( int fd );
```

## Description:

This function closes the resources associated with a file descriptor (fd). This can be a TCP socket or a Serial I/O port.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number |

## Returns:

0 (zero) --- On success
A resource specific error code --- On failure

## See Also:

- read --- Read data from a file descriptor
- ReadWithTimeout --- Read from a FD with timeout
- write --- Write data to a file descriptor
- writestring --- Write a string to the file descriptor

# 11.2. read

## Synopsis:

```
int read( int fd, char * buf, int nbytes );
```

## Description:

This function reads data from a file descriptor (fd), and will block forever until at least one byte is available to be read (as opposed to the ReadWithTimeout function which reads data from a file descriptor with a specified time-out value). This function can be used to read from stdio, TCP sockets, or Serial ports.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number |
| char | *buf | A pointer to the read destination. |
| int | nbytes | Maximum number of bytes to read. |

## Returns:

The number of bytes read, or
A negative number if there was an error when reading from a TCP connection:

- TCP_ERR_TIMEOUT (-1) --- Indicates that the connection has timed out.
- TCP_ERR_NOCON (-2) --- Indicates that you have attempted to read/write from a socket that does not have a connection established yet.
- TCP_ERR_CLOSING (-3) --- Indicates that you have attempted to read/write from a socket that has already been closed.
- TCP_ERR_NOSUCH_SOCKET (-4) --- Indicates that you have attempted to allocate a socket that does not exist.
- TCP_ERR_NONE_AVAIL (-5) --- Indicates that you have attempted to allocate a socket, but no socket it currently available.
- TCP_ERR_CON_RESET (-6) --- Indicates that you have attempted to read/write from a connection that has been reset by the other side.
- TCP_ERR_CON_ABORT (-7) --- This is an internal error that the client won't usually see.

## See Also:

- close --- Close open file descriptors
- ReadWithTimeout --- Read from a FD with timeout
- write --- Write data to a file descriptor
- writestring --- Write a string to the file descriptor

# 11.3. ReadWithTimeout

## Synopsis:

```
int ReadWithTimeout( int fd, char * buf, int nbytes,
                     unsigned long timeout );
```

## Description:

This function reads data from a file descriptor (fd), with a specified time-out value (as opposed to the **read function which will block forever until at least one byte is available to be read**). This function will block until **either** the time-out expires **or** at least one byte is available to be read. This function can be used to read from stdio, TCP sockets, or Serial ports.

**Important:** This function operates like a read function in that it reads all available bytes and returns. The addition of a time-out does **not** cause the function to block until the maximum number of bytes specified in the function call is available. As with read, the application must use the return value of the ReadWithTimeout function to determine how many bytes were read, and call the function again if necessary.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number |
| char | *buf | A pointer to the read destination. |
| int | nbytes | Maximum number of bytes to read. |
| unsigned long | timeout | The number of timer ticks to wait for data. |

## Returns:

0 = timeout, but TCP connection is still valid
>0 = The number of bytes read
-1 = TCP connection is no longer valid

## See Also:

- close --- Close open file descriptors.
- read --- Read data from a file descriptor
- write --- Write data to a file descriptor
- writestring --- Write a string to the file descriptor

## 11.4. dataavail

### Synopsis:

```
int dataavail( int fd );
```

### Description:

This function checks to see if data is available for read.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number |

### Returns:

1 --- If data is available
0 --- If no data is available

### See Also:

- charavail --- Is data is available for read on stdin?
- read --- Read data from a file descriptor

## 11.5. charavail

### Synopsis:

```
int charavail( );
```

### Description:

This function checks to see if data is available for read on stdin.

### Parameters:

None

### Returns:

1 --- If data is available
0 --- If no data is available

### See Also:

- dataavail --- Is data is available for read?
- read --- Read data from a file descriptor

# 11.6. write

## Synopsis:

```
int write( int fd, const char * buf, int nbytes );
```

## Description:

This function writes data to the stream associated with a file descriptor (fd). This function can be used to write data to stdio, a TCP socket, or a Serial port. Note: The write function will block until at least one byte is written, but does **not** have to write all the bytes requested. For example, if you wanted to write 100 bytes, and there was only room in the buffer for 5, then the write function would return 5.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number |
| const char | *buf | A pointer to the byte to write. |
| int | nbytes | Maximum number of bytes to write. |

## Returns:

The number of bytes written (**Note:** This value can be less than the number of bytes requested)
0 (zero) --- If the write timed out
A negative number --- If an error occurred

## See Also:

- close --- Close open file descriptors
- read --- Read data from a file descriptor
- ReadWithTimeout --- Read from a FD with timeout
- writestring --- Write a string to the file descriptor
- writesafestring --- Write out a string while escaping all special HTML characters
- writeall --- Write data to a file descriptor and block until complete

# 11.7. Writestring

## Synopsis:

```
int writestring( int fd, const char * str );
```

## Description:

This function writes null terminated string data to the stream associated with a file descriptor (fd). This function can be used to write data to stdio, a TCP socket, or a Serial port.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number |
| const char | *str | A pointer to the NULL terminated string to write. |

## Returns:

The number of bytes written (Note: This value can be less than the number of bytes requested.)
0 (zero) --- If the write timed out
A negative number --- If an error occurred

## See Also:

- close --- Close open file descriptors
- read --- Read data from a file descriptor
- ReadWithTimeout --- Read from a FD with timeout
- write --- Write data to a file descriptor
- writesafestring --- Write out a string while escaping all special HTML characters

# 11.8. writeall

## Synopsis:

```
int writeall( int fd, const char * buf, int nbytes );
```

## Description:

This function writes data to the stream associated with a file descriptor (fd). This function can be used to write data to stdio, a TCP socket, or a Serial port. It will block and wait for the fd to either send the whole requested amount or to return an error.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number |
| const char | *buf | A pointer to the byte to write. |
| int | nbytes | Maximum number of bytes to write. |

## Returns:

The number of bytes written
A negative number --- If an error occurred

## See Also:

- close --- Close open file descriptors
- read --- Read data from a file descriptor
- ReadWithTimeout --- Read from a FD with timeout
- write --- Write data to a file descriptor
- writestring --- Write a string to the file descriptor
- writesafestring --- Write out a string while escaping all special HTML characters

## 11.9. FD_ZERO

### Synopsis:

```
void FD_ZERO( fd_set * pfds );
```

### Description:

This function zero's a fd_set (file descriptor set) so that it has no file descriptors (fds) selected.

### Parameters:

| Type | Name | Description |
|---|---|---|
| fd_set | *pfds | A pointer to the fd_set |

### Returns:

Nothing --- This is a void function

### See Also:

- FD_CLR --- Clear a specific fd in a fd_set
- FD_SET --- Set a specific fd in a fd_set
- FD_ISSET --- Test to see if a specific fd is set in an fd_set
- select --- Wait for I/O events

# 11.10. FD_CLR

## Synopsis:

```
void FD_CLR( int fd, fd_set * pfds );
```

## Description:

A fd_set (file descriptor set) holds a set of file descriptors (fds). This function clears or removes a specific file descriptor in an fd_set.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number. |
| fd_set | *pfds | A pointer to the fd_set to modify. |

## Returns:

Nothing --- This is a void function

## See Also:

- FD_ZERO --- Zero a file descriptor set
- FD_SET --- Set a specific fd in a fd_set
- FD_ISSET --- Test to see if a specific fd is set in a fd_set
- select --- Wait for I/O events

# 11.11. FD_SET

## Synopsis:

```
void FD_SET( int fd, fd_set * pfds );
```

## Description:

A fd_set (file descriptor set) holds a set of file descriptors (fds). This function sets or adds a specific file descriptor to an fd_set.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number. |
| fd_set | *pfds | A pointer to the fd_set to modify. |

## Returns:

Nothing --- This is a void function

## See Also:

- FD_ZERO --- Zero a file descriptor set
- FD_CLR --- Clear a specific fd in a fd_set
- FD_ISSET --- Test to see if a specific fd is set in an fd_set
- select --- Wait for I/O events

# 11.12. FD_ISSET

## Synopsis:

```
int FD_ISSET( int fd, fd_set * pfds );
```

## Description:

A fd_set (file descriptor set) holds a set of file descriptors (fds). This function indicates whether (or not) a specific fd is in a specific fd_set.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number. |
| fd_set | *pfds | A pointer to the fd_set to test. |

## Returns:

0 (zero) --- If the fd is not in the set
A non zero --- If the fd is in the set

## See Also:

- FD_ZERO --- Zero a file descriptor set
- FD_CLR --- Clear a specific fd in a fd_set
- FD_SET --- Set a specific fd in a fd_set
- select --- Wait for I/O events

# 11.13. select

## Synopsis:

```
int select( int nfds, fd_set * readfds, fd_set * writefds,
            fd_set * errorfds, unsigned long timeout );
```

## Description:

This function waits for events to occur on one or more I/O resources associated with a set of file descriptors (fds). The user indicates his/her interest in specific fds by setting them in the fd_sets (file descriptor set) that are passed into the function. Note: This function will "unblock" when at least one byte is available for the file descriptor you add to the output set.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | nfds | The number of file descriptors to examine. **Note:** This parameter is currently ignored |
| fd_set | *readfds | A pointer to the fd_set to select for read events. **Note**: This parameter can be NULL. It is modified on exit to reflect the read availability of the selected fds in the set. |
| fd_set | *writefds | A pointer to the fd_set to select for write availability events. **Note:** This parameter can be NULL. It is modified on exit to reflect the write availability of the selected fds in the set. |
| fd_set | *errorfds | A pointer to the fd_set to select for error events. **Note:** This parameter can be NULL. It is modified on exit to reflect the error state of the selected fds in the set. |
| unsigned long | timeout | The number of time ticks to wait before timing out if no events occurred in the selected fd set. |

## Returns:

The number of fds in all of the non null fd_sets or 0 (zero) if the function timed out

## See Also:

- FD_ZERO --- Zero a file descriptor set
- FD_CLR --- Clear a specific fd in a fd_set
- FD_SET --- Set a specific fd in a fd_set
- FD_ISSET --- Test to see if a specific fd is set in an fd_set

## 11.14. ZeroWaitSelect

Synopsis:

```
int ZeroWaitSelect( int nfds, fd_set * readfds, fd_set * writefds,
                    fd_set * errorfds )
```

### Description:

This function waits for events to occur on one or more I/O resources associated with a set of file descriptors (fds). The user indicates his/her interest in specific fds by setting them in the fd_sets (file descriptor set) that are passed into the function.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | nfds | The number of file descriptors to examine. **Note:** This parameter is currently ignored |
| fd_set | *readfds | A pointer to the fd_set to select for read events. **Note**: This parameter can be NULL. It is modified on exit to reflect the read availability of the selected fds in the set. |
| fd_set | *writefds | A pointer to the fd_set to select for write availability events. **Note:** This parameter can be NULL. It is modified on exit to reflect the write availability of the selected fds in the set. |
| fd_set | *errorfds | A pointer to the fd_set to select for error events. **Note:** This parameter can be NULL. It is modified on exit to reflect the error state of the selected fds in the set. |

### Returns:

The number of fds in all of the non null fd_sets or 0 (zero) if there are no valid fds

### See Also:

FD_ZERO --- Zero a file descriptor set
FD_CLR --- Clear a specific fd in a fd_set
FD_SET --- Set a specific fd in a fd_set
FD_ISSET --- Test to see if a specific fd is set in an fd_set

# 11.15. ioctl

## Synopsis:

```
int ioctl( int fd, int cmd );
```

## Description:

This function controls the selection of three options for stdio: stdin = 0, stdout = 1 and stderr = 2. The four legal options are:

IOCTL_TX_CHANGE_CRLF (1) /* When set transmitted char \n gets converted to \r\n */
IOCTL_RX_CHANGE_CRLF (2) /* When set received \r\n get turned into \n */
IOCTL_RX_PROCESS_EDITS (4) /* When set Process backspace and do simple line editing */
IOCTL_RX_ECHO (8) /* When set echo chars received to tx*/

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor number. The three options are:<br>• 0 = stdin<br>• 1 = stdout<br>• 2 = stderr |
| int | cmd | The ioctl command consists of IOCTL_SET or IOCTL_CLR and the bit of the associated options. |

## Returns:

The old option value

## See Also:

ReplaceStdio --- Replace the stdio file descriptor with a new one.

# 11.16. ReplaceStdio

## Synopsis:

```
int ReplaceStdio( int stdio_fd, int new_fd );
```

## Description:

This function allows you to map stdio to any file descriptor (fd). If the file descriptor generates an error (like a closed TCP connection), then stdio will be remapped to a negative fd (this will cause stdio to generate errors). When this function is used to remap an errored stdio channel, then the error will be cleared.

## Parameters:

| Type | Name | Optional | Description |
|---|---|---|---|
| int | stdio_fd | • No | • The stdio file descriptor to map to<br>• (0 = stdin, 1 = stdout, and 2 = stderr). |
| int | new_fd | No | The file descriptor to replace stdio with. **Note:** A value of 0 returns stdio to the default debug monitor based traps |

## Returns:

The value of the fd for the previous stdio override
0 (zero) --- If stdio had not been mapped previously

## See Also:

ioctl --- Control translation and formatting for stdio

## 11.17. SysLog

### Header File:

```
#include<syslog.h>     // Found in C:\Nburn\include
```

### Synopsis:

```
int SysLog( const char * format, ... );
```

### Description:

This function works very similar to a standard printf function, in regards to input arguments, return values, and resulting output. The output is sent via UDP port 514, and it can be sent as either a broadcast or a unicast message. This function is useful for users who have no serial ports, are out of serial ports, or desire to send the debug output to a remote location.

If you do **not** specify an IP address to send to, then the message will be broadcasted. **Note:** If you are in crowded network, or if you desire to send a message to a particular IP address, then you will need to add the following line to your start-up code:

```
SysLogAddress = AsciiToIp( "<Destination IP Address>" );
```

For example:

```
SysLogAddress = AsciiToIp( "10.1.1.228" );
```

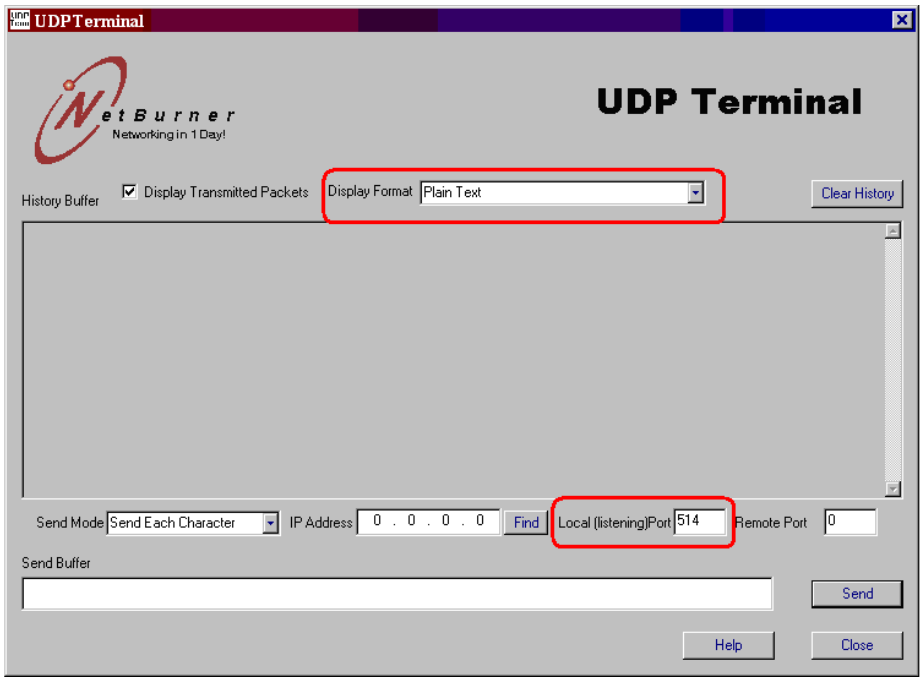
To make this function work in a normal project application, all you have to do is include the header file, and then in the program body, you use the SysLog() function as you would with an iprintf function. Some examples are:

```
SysLog( "Hello World!" );
SysLog( "This number of seconds have passed: %d\r\n", Secs );
SysLog( "%d plus %d equals %d.\r\n", num1, num2, sum );
```

To see the output generated by SysLog, open the **UDP Terminal Tool** application. From Windows: Start → Programs → Netburner NNDK → UDP Terminal Tool. By default this program is located in C:\Nburn\pcbin. Next, set the Display Format drop-down box to Plain Text and set the Local (listening) Port to 514 as shown on the next page.

If you have your NetBurner hardware connected to the network, and are periodically sending SysLog output, you will see the result in the UDP Terminal window. By default, it will broadcast whatever message is written to the network.

**Warning: If a person is on a crowded network, sending broadcast messages to the SYSLOG port (i.e. Port 514) then using this function will increase traffic.**




## Parameters:

The message (output string) to send followed by any number of variables - it works similar to the printf function.

## Returns:

The number of bytes in the output string, excluding the terminating NULL.

## Example:

```
#include <syslog.h>

void UserMain( void *pd )
{
   // your start-up code here

   SysLogAddress = AsciiToIp( "10.1.1.228" ); // Only for unicasting
   while ( 1 )
   {
      OSTimeDly( TICKS_PER_SECOND );
      SysLog( "This is only a test! %d\r\n", Secs );
   }
```

# 12. I²C Library

## 12.1. Introduction

In the early 1980's, Philips Semiconductors developed a simple bidirectional 2-wire bus for efficient inter-IC control. This bus is called the Inter-IC or I²C-bus. Its name literally explains its purpose: to provide a communication link between Integrated Circuits. Its original purpose was to provide an easy way to connect a CPU to peripheral chips in a TV-set. All I²C-bus compatible devices incorporate an on-chip interface, which allows them to communicate directly with each other via the I²C-bus. This design concept solves the many interfacing problems encountered when designing digital control circuits. I²C has become a de facto world standard. The I²C-bus is patented by Philips.

The I²C-bus physically consists of two active wires and a ground connection. The active wires are called SDA and SCL. SDA is the Serial DAta line and SCL is the Serial CLock line. Every device hooked up to the bus has its own unique address. Each of these chips can act as a receiver and/or transmitter, depending on the functionality.

Both SDA and SCL are bi-directional signals, implemented in the following way : Each device on the I²C-bus can monitor the voltage or logic level on both signals. In addition, a device may connect the line to the system ground rail through an electronic switch or it may leave it floating. (For those of you who have done a bit of digital electronics, this is known as an `open collector' output.) External resistors (typically about 4.7k ) are connected between each of the 2 signal lines and the +5V/3.3V power supply rail, so that if no device on the bus is connecting a line to ground, then that line appears to be in a logic 1 state.

The I²C-bus is a multi-master bus. This means that more than one IC capable of initiating a data transfer can be connected to it. The I²C protocol specification states that the IC that initiates a data transfer on the bus is considered the Bus Master (generally a microcontroller) and all the other ICs (at that time) are Bus Slaves. The most important thing to realize about data transfer on the I²C-bus is that the state of the SDA line can only change when the SCL line is in the logic low state. The reason for this is that the I²C protocol defines two special conditions to start and stop communications over the bus, they are:

A Start condition - defined as a change of SDA from logic 1 to logic 0 while SCL is high.
A Stop condition - defined as a change of SDA from logic 0 to logic 1 while SCL is high.

Prior to any transaction on the bus, a START condition needs to be issued on the bus by the Master. This start condition acts as a signal to all connected IC's that something is about to be transmitted on that bus. As a result, all connected chips will listen to the bus. The master controls the Clock line and always generates the Clock pulses.

Once a transmission is complete, the Master device can retain control of the bus by issuing a repeated start or RESTART condition. This gives the Master device the ability to immediately communicate with another device on the bus or to change transmission directions (read or write) with the current device.

After a message has been completed, a STOP condition is sent by the master. This is the signal for all devices on the bus that the bus is now available (i.e. idle). If a chip was accessed, and received data during the last transaction, it will now process that information (if it was not already processed during the reception of the message).

Devices on the I²C-bus are selected by an 8-bit address that is sent over the bus in the same way as data bytes. The least significant bit of this address acts as a read/write control signal and is set to 0 to make the Slave a Receiver and 1 to make the Slave a Transmitter. The address byte is the first byte transmitted after a Start condition. It is always transmitted by the master. By convention, if the slave is a receiver (and contains

several registers), then the next byte transmitted after the address byte is an internal register address for that device. However, this is not required by the I²C specification.

## 12.2. The NetBurner I²C API

The NetBurner I²C API creates an easy interface to use interrupt driven I²C communication. The API will work only on those platforms that include the I2C hardware. The NetBurner I²C API comes in two flavors, I²C master and I²C multi.

The I²C master API allows you to configure the NetBurner device to act as the sole master device on an I²C bus while the I²C multi API configures the NetBurner device to be a multi-master device.

The I²C multi API should be used any time you wish to be able to have your NetBurner device act as both a bus master and slave device. This is very useful if you wish to have multiple smart-devices (e.g. NetBurner devices, Microcontrollers, etc.) on the same I²C bus. This API includes all the functions included in the I²C master API plus extra functions to handle slave mode transmissions and arbitration when attempting to become bus master.

The I²C master API is a limited functionality version of the I²C multi interface. Note: This mode will not work properly if there are other masters or multi-master devices on the same I²C bus. The master-only mode has the benefit of using less FLASH and RAM for space sensitive projects that only need to interface with slave devices. The space saved in FLASH is around 20 KB, and the space saved in RAM is dependent on the sizes configured for the slave mode RX/TX buffers.

### Header Files:

```
#include <i2cmulti.h>     // Found in C:\Nburn\<HWPlatform>\include
#include <i2cmaster.h>    // Found in C:\Nburn\<HWPlatform>\include
```

### Simple NetBurner I²C Functions

These functions are used in both I²C multi and master modes. They are simple in the fact that they require little configuration or code to send and receive buffers over I²C. Most devices that follow Philips I²C standard will work with these functions.

- I2CInit
- I2CSendBuf
- I2CReadBuf
- I2CRestart

## Simple NetBurner Slave Mode I²C Functions

These functions can only be implemented when the I²C multi driver is being used. These functions provide both slave RX and TX ability.

- I2CRXAvail
- I2CTXAvail
- I2CGetByte
- I2CFillSlaveTXBuf

## Advanced NetBurner I²C Functions

These functions are used in both I²C multi mode and master mode. They allow the user to control all aspects of I²C communication including start, stop, restart, and sending and receiving at single BYTE level. **Note:** These functions are useful when communicating with devices that do not follow Philips I²C standard exactly.

- I2CStart
- I2CStop
- I2CSend
- I2CRead

**Note:** An example I²C application can be found in C:\Nburn\examples\<HWPlatform>.

## 12.3. Simple I²C Functions

### 12.3.1. I2CInit

### Synopsis:

```
void I2CInit( BYTE slave_Addr = 0x08, BYTE freqdiv = 0x11 );
```

**Note:** This version is used when including **i2cmulti.h**

### Synopsis:

```
void I2CInit( BYTE freqdiv = 0x15 );
```

**Note:** This version is used when including **i2cmaster.h**

### Description:

The I²C master and slave initialization routine must be called before performing any I²C functions.

### Parameters:

| Type | Name | Description |
|---|---|---|
| BYTE | slave_Addr | The 7-bit slave address assigned to NetBurner and is only used in i2cmulti API. **Note:** Phillips I²C Standard states that the two group addresses 0000XXX and 1111XXX are reserved for advanced purposes. The addresses 11110XX are also reserved for the 10-bit addressing I²C protocol. |
| BYTE | freqdiv | This value is used in the Coldfire I2FDR as a prescaler of the system clock to generate a max baud rate of the master mode I²C bus. Valid values for freqdiv are found in the I²C section of your Freescale MCF Manual (in C:\Nburn\docs). All the processors are set to be approximately 100Kbits by default, which is the max I²C standard speed. |

### Returns:

Nothing --- This is a void function

### 12.3.2. I2CSendBuf

## Synopsis:

```
BYTE I2CSendBuf( BYTE addr, PBYTE buf, int num, bool stop = true );
```

## Description:

This function sends a buffer to an address on the I²C bus in master mode without the need of a start and stop bit.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BYTE | addr | The 7-bit address you wish to send the buffer to. |
| PBYTE | buf | A pointer to the BYTE buffer you wish to write from. |
| int | num | The number of bytes to write. |
| bool | stop | True (default): Terminate communication with stop.<br>False: Do not terminate transmission. (This is useful if the user wishes to send a restart instead of a stop.) |

## Returns:

The standard NetBurner I²C return values

### 12.3.3. I2CReadBuf

## Synopsis:

```
BYTE I2CReadBuf( BYTE addr, PBYTE buf, int num, bool stop = true );
```

## Description:

This function allows a buffer to be read from an address on the I²C bus in master mode without the need of a start and stop bit.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BYTE | addr | The 7-bit address you wish to read the buffer from. |
| PBYTE | buf | A pointer to the BYTE buffer you wish to read to. |
| int | num | The number of bytes to read. |
| bool | stop | True (default): Terminate communication with stop.<br>False: Do not terminate transmission. (This is useful if the user wishes to send a restart instead of a stop.) |

## Returns:

The standard NetBurner I²C return values

### 12.3.4. I2CRestart

## Synopsis:

```
int I2CRestart( BYTE addr, BOOL Read_Not_Write,
                DWORD ticks_to_wait = I2C_RX_TX_TIMEOUT );
```

## Description:

This function will send a restart signal on the I²C bus instead of a stop. **Note:** This function should **only** be used when in master mode and you have control of the bus.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BYTE | addr | The 7-bit address you wish to send the restart to. |
| BOOL | Read_Not_Write | True to read. False to write. **Note:** You can use I2C_START_READ or I2C_START_WRITE as values. |
| DWORD | ticks_to_wait | The number of ticks to wait on restart before failing. **Note:** The default value in i2cmaster/multi.h = I2C_RX_TX_TIMEOUT. |

## Returns:

The standard NetBurner I²C return values

## 12.4. Slave I²C Functions

### 12.4.1. I2CRXAvail

### Synopsis:

```
bool I2CRXAvail( );
```

### Description:

This function determines if there is data available in the I²C slave receive buffer.

### Parameters:

None

### Returns:

True --- If there is data in slave RX buffer
False --- If slave RX buffer is empty

### 12.4.2. I2CTXAvail

## Synopsis:

```
DWORD I2CTXAvail( );
```

## Description:

This function determines the free space available in the I²C slave TX buffer.

## Parameters:

None

## Returns:

The number of bytes remaining in the I²C slave TX buffer

### 12.4.3. I2CGetByte

## Synopsis:

```
BYTE I2CGetByte( );
```

## Description:

This function will pend on a slave receive I²C semaphore.

## Parameters:

None

## Returns:

The oldest unread byte in the I²C slave RX buffer

### 12.4.4. I2CFillSlaveTXBuf

## Synopsis:

```
BYTE I2CFillSlaveTXBuf( PBYTE buf, DWORD num, bool restart = true );
```

## Description:

This function is used to fill the I²C slave TX buffer.

## Parameters:

| Type | Name | Description |
|---|---|---|
| PBYTE | buf | A pointer to the BYTE buffer that contains data for the slave TX buffer. |
| DWORD | num | The number of BYTE to send from buf to TX buffer. |
| BOOL | restart | If true then restart next TX from beginning TX buffer. (A new slave fill replaces buffer.) If false then continue next TX from last slave TX. (A new slave fill adds to buffer at last unread byte.) |

## Returns:

Returns false if it failed to copy data

## 12.5. Advanced I²C Functions

### 12.5.1. I2CRead

### Synopsis:

```
int I2CRead( PBYTE val, DWORD ticks_to_wait = I2C_RX_TX_TIMEOUT );
```

### Description:

This function reads a single byte in master mode from the I²C bus.

### Parameters:

| Type | Name | Description |
|---|---|---|
| PBYTE | val | A pointer to byte location to store read value. |
| DWORD | ticks_to_wait | The number of system time ticks before a timeout occurs. |

### Returns:

The standard NetBurner I²C return values

### 12.5.2. I2CSend

## Synopsis:

```
int I2CSend( BYTE val, DWORD ticks_to_wait = 5 );
```

## Description:

This function sends a single byte in master mode on the I²C bus.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BYTE | val | The byte to send. |
| DWORD | ticks_to_wait | The number of system time ticks before a timeout occurs. |

## Returns:

The standard NetBurner I²C return values

### 12.5.3. I2CStart

## Synopsis:

```
int I2CStart( BYTE addr, BOOL Read_Not_Write,
              DWORD ticks_to_wait = I2C_START_TIMEOUT );
```

## Description:

This function is used to obtain an I²C bus and start communication in master mode.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BYTE | addr | The 7-bit address you wish to send the start to. |
| BOOL | Read_Not_Write | True to read. False to write. **Note:** You can use I2C_START_READ or I2C_START_WRITE as values |
| DWORD | ticks_to_wait | The number of ticks to wait on restart before failing. **Note:** The default value in i2cmaster/multi.h = I2C_RX_TX_TIMEOUT |

## Returns:

The standard NetBurner I²C return values

### 12.5.4. I2CStop

## Synopsis:

```
void I2CStop( );
```

## Description:

This function ends communication and releases control of the I²C bus. This function puts your NetBurner board into idle/slave mode.

## Parameters:

None

## Returns:

Nothing --- This is a void function

# 13. Multicast Library

## 13.1. Introduction

This Module provides code for joining multicast groups. This module uses the IGMP protocol defined in RFC1112 and RFC 2236. IGMP Multicast is a method for distributing UDP packets within a group of hosts and servers.

The NetBurner Multicast functions extend the NetBurner UDP interface. Instead of using the RegisterUDPFifo function, you would use the RegisterMulticastFifo function to listen for Multicast UDP packets. **Note**: To transmit Multicast packets, just use the normal UDP Send with a multicast IP Address.

### Header File

```
#include <multicast.h>    // Found in C:\Nburn\include
```

### Multicast Group Functions

- RegisterMulticastFifo --- Register to join a Multicast group
- UnregisterMulticastFifo --- Register to leave a Multicast group

### Multicast Example

See Multicast example in c:\nburn\examples

## 13.2. RegisterMulticastFifo

### Synopsis:

```
void RegisterMulticastFifo( IPADDR group, WORD dest_port,
                            OS_FIFO *pfifo );
```

### Description:

This call initializes the Multicast system. Register to join a Multicast group. **Note:** It is **not** active until at least **one** join has taken place.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | group | The IP Address of the group to join. |
| WORD | dest_port | The UDP Port to listen on. |
| OS_FIFO | *pfifo | The fifo to put incoming packets into. |

### Returns:

Nothing --- This is a void function

## 13.3. UnregisterMulticastFifo

### Synopsis:

```
void UnregisterMulticastFifo( IPADDR group, WORD destination_port );
```

### Description:

This call removes the NetBurner device from the specified multicast group.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | group | The IP Address of the group to leave |
| WORD | dest_port | The UDP Port to listen on. |

### Returns:

Nothing --- This is a void function

# 14. NBTime Library

## 14.1. Introduction

The NBTime library allows users to set and read the system time manually, or by using an NTP server to set the system time. The system time runs internally to a core module and will be lost whenever it loses power or is reset.

For information on how to keep time running when the module loses power or is reset, refer to the section on the RTC library (the real-time clock library is only supported with modules mounted on MOD-DEV-40, -70, and -100 development boards).

### Header File

```
#include <nbtime.h>   // Found in \Nburn\include
```

### Functions

- `time` --- Reads the system time.
- `set_time` --- Sets the system time.
- `GetNTPTime` --- Reads time from an NTP server.
- `SetNTPTime` --- Sets the system time using time read from an NTP server.
- `tzsetchar` --- Sets the local time zone information for standard time and, if applicable, daylight savings time.

## 14.2. time

### Synopsis:

```
time_t time( time_t *pt )
```

### Description:

This function reads the system time and returns it as type time_t. If `pt` is not null, then it will also write the system time to its pointed location.

### Parameters:

| Type | Name | Description |
|---|---|---|
| time_t | `*pt` | A pointer to a location of type time_t that will be written with the read system time. It can be null if the user wishes not to store the read time. |

### Returns:

The read system time in time_t format.

## 14.3. set_time

### Synopsis:

```
time_t set_time( time_t time_to_set )
```

### Description:

This function sets the system time with the value given by `time_to_set`.

### Parameters:

| Type | Name | Description |
|---|---|---|
| time_t | `time_to_set` | A value of type time_t that will be used to set the system time. |

### Returns:

The set system time in time_t format.

## 14.4. GetNTPTime

### Synopsis:

```
DWORD GetNTPTime( IPADDR NTP_server_ip )
```

### Description:

This function gets time from an NTP server.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | NTP_server_ip | The IP address of the NTP server. |

### Returns:

The NTP time to the nearest second of type DWORD if successful, zero (0) if it fails.

## 14.5. SetNTPTime

### Synopsis:

```
BOOL SetNTPTime( IPADDR ntpserver )
```

### Description:

This function gets time from an NTP Server and uses it to set the system time.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | `ntpserver` | The IP address of the NTP server. |

### Returns:

TRUE --- Succeeds in getting time from an NTP server.
FALSE --- Fails to get time from an NTP server.

## 14.6. tzsetchar

### Synopsis:

```
void tzsetchar( char *tzenv )
```

### Description:

This function uses the TZ environment variable to set the local time zone conversion information for standard time and, if applicable, daylight savings time (DST) in the system. The TZ environment variable is also used by the `ctime()`, `localtime()`, `mktime()`, and `strftime()` functions of the standard `time.h` library. Once the TZ variable is set, the time library functions can use it to determine when DST is in effect when type conversions are made, or what time zone string gets outputted in the case of the `strftime()` function.

Calling this function configures the system time to the local time zone desired, relative to UTC/GMT. Therefore, `SetNTPTime()` should be called first to set the system time to UTC before calling `tzsetchar()` to set it locally.

The following is an example of a `tzsetchar()` function call:

```
tzsetchar( "PST8PDT7,M3.2.0/02:00:00,M11.1.0/02:00:00" );
```

These are also acceptable formats and perform the same function (usage of abbreviation and expansion formats for offsets and time do not have to be consistent for each segment between the commas):

```
tzsetchar( "PST08:00:00PDT07:00:00,M3.2.0/2,M11.1.0/2" );
tzsetchar( "PST8PDT7,M3.2.0/2,M11.1.0/2" );
tzsetchar( "PST8PDT,M3.2.0,M11.1.0" );
tzsetchar( "PST8PDT7" );
```

The format above is a local time zone with DST support. It sets the local time to Pacific Standard Time (PST) or Pacific Daylight Time (PDT). PDT is only set if the local time is after the second Sunday of March at 2:00 AM and before the first Sunday of November at 2:00 AM. The following is a breakdown of what each segment between the commas of the TZ string represents:

`PST8PDT7` – This provides the name of the time zone and the hour offset relative to UTC for both standard and daylight savings time. "PST" is the standard time zone name for "Pacific Standard Time" and "PDT" is the DST zone name for "Pacific Daylight time". The hour offsets '8' and '7' represent the number of hours that must be added to the PST and PDT local times respectively in order to reach UTC time. Note that time zone offsets west of UTC must be positive, and time zone offsets east of UTC must be negative (the number of hours subtracted from local time in order to reach UTC). If the hour offset for DST is omitted (for example, "PST8PDT"), then the DST is automatically calculated by advancing the standard local time by one hour.

`M3.2.0/02:00:00` – This indicates the starting date and time for daylight savings time. "M3" represents the month of March (valid values are 1-12), '2' represents the second week of the month (valid values are 1-5; '5' will always represent the last week even if there are only four weeks for a particular day selected), and '0' represents Sunday (valid values are 0-6). "02:00:00" represents the 24-hour notation or Military time in hours, minutes, and seconds. If the 24-hour notation is omitted, then 2:00 AM is used by default. If the starting and ending date/time information are omitted but still provide a standard and daylight time name and offset, then the U.S. rules (effective 2007) for starting and ending date/time are used by default.

M11.1.0/02:00:00 – This indicates the ending date and time for daylight savings time. The rules of this format is the same as the starting date and time mentioned above.

If setting the local time in an area that does not support daylight savings time is desired, then it can be written this way:

```
tzsetchar( "JST-9" );
```

In the example above, "JST" represents Japan Standard Time followed by an offset of nine hours east of UTC.

## Parameters:

| Type | Name | Description |
|---|---|---|
| char* | tzenv | The value of the TZ variable. The value can take one of two formats: 1) local time zone without DST support, and 2) local time zone with DST support. |

## Returns:

This is a void function – there is nothing to return.

# 15. The POP3 Client Library

## 15.1. Introduction

This module provides functions for receiving and managing mail from a Post Office Protocol version 3 (POP3) server. POP3 is defined in RFC1939. For sending mail, please see the SendMail section.

### Header Files

```
#include<pop3.h>                // Found in C:\Nburn\include
```

### POP3 Client Functions

POP3_InitializeSession --- Initialize the POP3 network connection
POP3_CloseSession --- Close the POP3 network connection
POP3_StatCmd --- Get the status of the Mailstore on the POP3 server
POP3_ListCmd --- Get the size of the specified message
POP3_DeleteCmd --- Delete a specific message on the server
POP3_RetrieveMessage --- Retrieve a specific message from the server
GetPOPErrorString --- Returns the Error text for a specific code

## POP3 Example

```
#include <pop3.h>
#include <dns.h>
#define USERID "username"
#define USERPASS "password"
#define SERVERNAME "pop.yourserver.com"
#define POP_PORT (110)

int StartSession()
{
    IPADDR srvr_addr;
    if (GetHostByName(SERVERNAME,&srvr_addr,0,TICKS_PER_SECOND*10)==DNS_OK)
    {
        iprintf("Got Server IP = ");
        ShowIP(srvr_addr);
        printf("\r\n");
        // Create the POP 3 session with the server
        int session = POP3_InitializeSession( srvr_addr, POP_PORT, USERID,
                                              USERPASS, TICKS_PER_SECOND*10 );
        return session;
    }
    else
    {
        iprintf("Failed to get Server IP Address\n");
        return 0;
    }
}

#define MSG_BUF_SIZ (16000)
static char messagebuffer[MSG_BUF_SIZ];
void GetMessages()
{
    DWORD num_mess;
    DWORD num_bytes;
    int session = StartSession();
    if ( session > 0 )
    {
        int rv = POP3_StatCmd(session, &num_mess, &num_bytes,
                              10*TICKS_PER_SECOND);
        if ( rv == POP_OK )
        {
            iprintf( "The server has %ld messages and %ld bytes\r\n",
                     num_mess, num_bytes );
            if ( num_mess == 0 )
                return;

            for ( DWORD nmsg = 1; nmsg <= num_mess; nmsg++ )
            {
                char * psub;
                char * pbody;
                DWORD predict_size;
                rv = POP3_ListCmd(session,nmsg, &predict_size,
                                  TICKS_PER_SECOND*10);
                iprintf( "Predicted message size is %ld\r\n", predict_size );
                rv = POP3_RetrieveMessage(session,nmsg,messagebuffer,
                                          &psub, &pbody,MSG_BUF_SIZ-1,
                                          TICKS_PER_SECOND*20 );
                if ( rv > 0 )
                {
                    iprintf( "Received a message of %d bytes\r\n", rv );
                    messagebuffer[rv] = 0;
                    if ( pbody )
```

```
                    {
                       iprintf("Body Size %ld\r\n, <Start of Message:>\r\n
                               %s\r\n<End of Message>\r\n", strlen(pbody), pbody );
                    }
                    else
                    {

                        iprintf("Unable to locate body.\r\nPrinting the entire
                                 message\r\n<Start of Message:>\r\n %s\r\n<End
                                 of Message>\r\n",pbody);
                    }
                    char c;
                    do
                    {
                        iprintf( "Delete this message (Y/N?)" );
                        c = toupper(getchar());
                    }

                    while ( (c != 'N') && (c != 'Y') );

                    if ( c == 'Y' )
                    {
                        rv = POP3_DeleteCmd( session,nmsg, TICKS_PER_SECOND*10 );
                        if (rv == POP_OK)
                            iprintf("Message deleted\r\n");
                        else
                            iprintf("Delete command processing failed with
                                     error:%s\r\n", GetPOPErrorString(rv));
                    }
                    else
                        iprintf("Message not deleted\r\n");
                }
                else
                    iprintf("Retrieve command processing failed with error:%s\r\n",
                            GetPOPErrorString(rv));
            }
        }
        else
        {
            iprintf("STAT command processing failed with error:%s\r\n",
                    GetPOPErrorString(rv));
        }
        POP3_CloseSession(session);
    }
    else
    {
        iprintf("Failed to create session with error:%s\r\n",
                GetPOPErrorString(session));
    }
}
```

## 15.2. POP3_InitializeSession

### Synopsis:

```
int POP3_InitializeSession( IPADDR server_address, WORD port,
                            PCSTR UserName, PCSTR PassWord, DWORD time_out )
```

### Description:

This function initializes the POP3 network connection. This call makes the connection to the POP Server and logs in with the Username and Password.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | server_address | The IP Address of the Server. |
| WORD | port | The port to connect to on the Server. |
| PCSTR | UserName | The account Username. |
| PCSTR | PassWord | The account Password. |
| DWORD | time_out | The number of ticks to wait. |

### Return Values:

int --- The command success code
> 0 --- Mail session
POP_TIMEOUT --- Time out
POP_PASSWORDERROR --- Network error
POP_CONNECTFAIL--- Password error
POP_NETWORKERROR --- Network error

## 15.3. POP3_CloseSession

### Synopsis:

```
Int POP3_CloseSession( int session );
```

### Description:

This function closes the POP3 network connection. This function also flushes deleted messages. (See RFC1939 for additional information.)

Parameters:

| Type | Name | Description |
|---|---|---|
| int | session | The POP3 session |

### Return Values:

int --- The command success code
POP_OK --- Closed successfully
POP_TIMEOUT --- Time out
POP_COMMANDFAIL --- Command error
POP_NETWORKERROR --- Network error
POP_BADSESSION--- Bad session number

# 15.4. POP3_StatCmd

## Synopsis:

```
int POP3_StatCmd( int session, DWORD * num_messages,
                  DWORD * total_bytes, DWORD time_out );
```

## Description:

This function gets the status of the Mailstore on the POP3 server and retrieves the state of the mail store associated with this session.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | session | The POP3 session. |
| DWORD | *num_messages | The DWORD variable to hold the number of pending messages. |
| DWORD | *total_bytes | The DWORD variable to hold the total number of bytes in the pending messages. |
| DWORD | time_out | The number of ticks to wait. |

## Return Values:

int --- The command success code
POP_OK --- Command OK
POP_TIMEOUT --- Time out
POP_COMMANDFAIL --- Command error
POP_NETWORKERROR --- Network error
POP_BADSESSION--- Bad session number

## 15.5. POP3_ListCmd

### Synopsis:

```
int POP3_ListCmd( int session, DWORD message_number, DWORD * total_bytes,
                  DWORD time_out );
```

### Description:

This function gets the size of the specified message and retrieves the size of the message.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | session | The POP3 session. |
| DWORD | message_number | Retrieves the size of the message. |
| DWORD | *total_bytes | The DWORD variable to hold the total number of bytes in the pending messages. |
| DWORD | time_out | The number of ticks to wait. |

### Return Values:

int --- The command success code
POP_OK --- Command OK
POP_TIMEOUT --- Time out
POP_COMMANDFAIL --- Command error
POP_NETWORKERROR --- Network error
POP_BADSESSION--- Bad session number

## 15.6. POP3_DeleteCmd

### Synopsis:

```
int POP3_DeleteCmd( int session, DWORD message_number,
                    DWORD time_out )
```

### Description:

This function deletes a specific message on the server. **Note:** The message is **not** actually deleted until the session is closed.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | session | The POP3 session. |
| DWORD | message_number | The message to delete. |
| DWORD | time_out | The number of ticks to wait. |

### Return Values:

int --- The command success code
POP_OK --- Command OK
POP_TIMEOUT --- Time out
POP_COMMANDFAIL --- Command error
POP_NETWORKERROR --- Network error
POP_BADSESSION--- Bad session number

# 15.7. POP3_RetrieveMessage

## Synopsis:

```
int POP3_RetrieveMessage( int session, DWORD message_number, char * buffer,
                          char ** subject_ptr, char ** body_ptr,
                          int max_bufferlen, DWORD time_out );
```

## Description:

This function retrieves a specific message from the server. The message is retrieved as a large block with all of the headers first. Note: The message is left on the server and will not be deleted until you call POP3_DeleteCmd.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | session | The POP3 session. |
| DWORD | message_number | The message to retrieve. |
| char | *buffer | The buffer to hold the message. |
| char | **subject_ptr | If not NULL, the char pointer will be left pointing at the message subject. |
| char | **body_ptr | If not NULL, the char pointer will be left pointing at the message body. |
| int | max_bufferlen | The maximum size of the retrieved message. |
| DWORD | time_out | The number of ticks to wait. |

## Return Values:

int --- The command success code
> 0 --- The length of the message retrieved
POP_TIMEOUT --- Time out
POP_COMMANDFAIL --- Command error
POP_NETWORKERROR --- Network error
POP_BADSESSION --- Bad session number

## 15.8. GetPOPErrorString

### Synopsis:

```
PCSTR GetPOPErrorString( int err );
```

### Description:

This function returns the error text for a specific code.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | err | The error code |

### Return Value:

The text string

# 16. QSPI Library

## 16.1. Introduction

The Queued Serial Peripheral Interface (QSPI) is a full duplex synchronous serial data link that operates in master/slave mode. Note that Freescale microprocessors do not provide support for slave mode; they must always be the QSPI master. The QSPI is functionally the same as SPI, but also provided a hardware queue for data and commands. Up to 16 transfers can be queued at one time, eliminating CPU intervention between transfers. The NetBurner QSPI driver and API provide interrupt driven QSPI communication.

The QSPI specification allows for sharing the QSPI bus with multiple devices. However, when desiging your system you must consider what devices are connected and the desired throughput. For example, if you are using the Embedded Flash File System (EFFS) with external SD flash cards, or the WiFi module, they will require exclusive use of the QSPI.

The QSPI uses the following hardware signals:

| | |
|---|---|
| SCLK | Serial clock output from master |
| MOSI | Master data output (transmit), slave data input (receive) |
| MISO | Master data input (receive), slave data output (transmit) |
| QSPI_CS | Optional QSPI chip selects |

Programming tip: If you are new to QSPI and require a chip select for your device, we recommend using a GPIO signal during initial development to simplify your application code. Once proper operation has been achieved, modify the code to use the QSPI chip selects.

### Header File

```
#include <qspi.h>          // Located in \nburn\include
```

### Function Summary

| | |
|---|---|
| QSPIInit() | Initialize QSPI subsystem. |
| QSPIStart() | Start a QSPI transfer using the transmit, receive and control queues. |
| QSPIdone() | Returns TRUE when a QSPI transfer is complete. Used only for single threaded applications in place of a semaphore. |

## 16.2. QSPI Configuration and Initialization

Use of the QSPI requires:

1. Identify which pins on your NetBurner device provide primary or seconday QSPI functionality.Use the NetBurner Pins class functions to configure these pins for QSPI operation.
2. Single task applications: you can choose to call the QSPIdone() function to determine when the QSPI transfer is complete, or use a semaphore and pend for completion.
3. Multitask applications: If your application has more than one task that will access the QSPI, your must create a semaphore to control access to the QSPI resource.
4. Initialize the QSPI with the QSPIInit() function.
5. When you have data to send, or want to read data from the QSPI slave device, call the QSPIStart() function to initiate the data transfer.
6. The semaphore will post when the data transfer is complete.

## 16.3. Example Program

The QSPI example programs are located in the c:\nburn\examples\<platform> directory, where <platform> represents your specific NetBurner device, such as Mod5270. The following example is for a Mod5270 core module. The example is a serial to QSPI converter, in which all data received by the QSPI is sent to the debug serial port, and all data received from the debug serial port is sent out the QSPI interface.

```
void UserMain( void * pd)
{
    InitializeStack();
    if (EthernetIP==0)GetDHCPAddress();
    OSChangePrio( MAIN_PRIO );
    EnableAutoUpdate();

    //Initialize buffers
    static BYTE RXBuffer[10000], TXBuffer[10000];

    // Initialize pins needed for QSPI
    J2[25].function(PINJ2_25_SPI_CLK);
    J2[27].function(PINJ2_27_SPI_DIN);
    J2[28].function(PINJ2_28_SPI_DOUT);
    // The QSPI functionality can be tested with a simple jumper from J2[27] to J2[28]

    // Create and initialize semaphore for QSPI (optional)
    OS_SEM QSPI_SEM;
    OSSemInit(& QSPI_SEM, 0);

    /* Initialize QSPI options
       void QSPIInit( DWORD Baudrate = 2000000, BYTE QueueBitSize = 0x8, BYTE CS = 0x0,
                      BYTE CSPol = 0x1, BYTE ClkPolarity = 0x0, BYTE ClkPhase = 0x1,
                      BOOL DoutHiz = FALSE )

   */
    QSPIInit();  // Keep overloaded defaults

    // Open UART1 and get FD
    int U1FD = OpenSerial( 1, 115200, 1, 8, eParityNone );
```

```
    while ( 1 )
    {
       if(dataavail(U1FD))
       {
          int num = read(U1FD, (char*)TXBuffer, 10000);  // Read data from UART1
          QSPIStart(TXBuffer, RXBuffer, num, &QSPI_SEM); // Send data via QSPI
          OSSemPend( &QSPI_SEM, 0 );                     // Wait for QSPI to complete
          writeall(U1FD, (char*)RXBuffer, num);             // Send QSPI RX via UART1
       }
    }
}
```

The default/overloaded QSPI configuration settings are used because QSPIInit() is called with no parameters. Custom settings can be configured by calling QSPIInit() with all the parameters as shown in the example comment above the QSPIInit() call.

A semaphore is used to determine when the transfer is complete. This may be more than is necessary for a simple single threaded application, but is used to demonstrate the most common usage. Alternatively the OSSemPend() call could be replaced with a while loop waiting for QSPIdone() to return TRUE.

## 16.4. Additional Information

Please refer to the Freescale Users Manual for for detailed information on QSPI chip selects, polarity, phase and delay settings. The Freescale manuals are located in the \nburn\docs directory.

## 16.5. QSPIInit

### Synopsis:

```
BYTE QSPIInit( DWORD baudRateInBps = 2000000, BYTE transferSizeInBits = 8,
      BYTE peripheralChipSelects = 0x0F, BYTE chipSelectPolarity = 1,
      BYTE clockPolarity = 0, BYTE clockPhase = 1, BOOL doutHiz = TRUE,
      BYTE csToClockDelay = 0, BYTE delayAfterTransfer = 0 );

BYTE QSPIInit()   // Uses default parameters
```

### Description:

Initialize the QSPI hardware and software driver.

### Parameters:

| Type | Name | Description |
|---|---|---|
| DWORD | baudRateInBps | Maximum requested baud rate in bits per second. The maximum possible baud rate is determined by the system clock. The function will select the highest possible baud rate if the specified value cannot be achieved. |
| BYTE | transferSizeInBits | Size of data values to be transferred. Values can be 8, 16 or 32 bits. Note that 16 and 32 bit size values must be word (16-bit) aligned (16-bit). |
| BYTE | PeripheralChipSelects | Peripheral chip select drive level. Used to select an external device for serial data transfer. More than one chip select may be active at once, and more than one device can be connected to each chip select. Bits 3–0 map directly to QSPI_CS[3:0], respectively. For each bit:<br>0 = Chip select is 0 during a transfer.<br>1 = Chip select is 1 during a transfer. |
| BYTE | chipSelectPolarity | Peripheral chip select inactive level (no transfer in progress). Applies to all chip selects.<br>0 = 0 when inactive<br>1 = 1 when inactive |
| BYTE | clockPolarity | Clock polarity:<br>0 = The inactive state value of QSPI_CLK is logic level 0.<br>1 = The inactive state value of QSPI_CLK is logic level 1. |
| BYTE | clockPhase | Clock phase:<br>0 = Data captured on the leading edge of QSPI_CLK and changed on the following edge of QSPI_CLK.<br>1 = Data changed on the leading edge of QSPI_CLK and captured on the following edge of QSPI_CLK. |
| BOOL | doutHiz | Data output high impedance enable. Selects QSPI_DOUT mode of operation. |

| | | |
|---|---|---|
| | | 0 = Default value after reset. QSPI_DOUT is actively driven between transfers.<br>1 = QSPI_DOUT is high impedance between transfers. |
| BYTE | csToClockDelay | QCD, QSPICLK delay. When the DSCK bit in the command RAM is set this field determines the length of the delay from assertion of the chip selects to valid QSPI_CLK transition. |
| BYTE | delayAfterTransfer | Delay after transfer. When the DT bit in the command RAM is set this field determines the length of delay after the serial transfer. |

## Returns:

Current QSPI state:  QSPI_OK on success or QSPI_BUSY

## 16.6. QSPIStart

### Synopsis:

```
BYTE QSPIStart( PBYTE transmitBufferPtr, volatile BYTE* receiveBufferPtr,
                DWORD byteCount, OS_SEM* finishedSem = NULL );
```

### Description:

Initiate a QSPI data transfer

### Parameters:

| Type | Name | Description |
|---|---|---|
| PBYTE | transmitBufferPtr | Pointer to the buffer to use in the transfer. Specify NULL for receive only. |
| BYTE * | receiveBufferPtr | Pointer to buffer to store received data. NULL for transmit only. |
| DWORD | byteCount | Number of bytes to send or receive. If the data size is greater than 8-bit, you must provide the total numer of bytes. |
| FinishedSem * | OS_SEM | Pointer to pre-initialized semaphore to post to when transfer is complete. A value of NULL disables the semaphore function. |

### Returns:

Current QSPI state:  QSPI_OK on success or QSPI_BUSY

## 16.7. QSPIdone

### Synopsis:

```
BOOL QSPIdone()
```

### Description:

Can be called after QSPIStart(). Returns TRUE when transfer is complete. This is an alternative to using a semaphore.

### Parameters:

None

### Returns:

TRUE when transfer is complete. Otherwise returns FALSE.

# 17. The SendMail SMTP Library

## 17.1. Introduction

This Module provides code for sending email using Simple Mail Transfer Protocol (SMTP). You can send mail with or without plain text password authentication. Attachments can be sent in MIME format as plain text or binary.

### Header Files

```
#include <mailto.h>            // Found in C:\Nburn\include
```

### SendMail Functions

SendMail ---Send a message without authentication
SendMailEx --- Send an E-Mail using the selected POP server
SendMailAuth --- Send an E-Mail using the selected POP server and a password
SendMailAuthStartMIME --- Initiate a MIME session
SendMailAuthAddMIME --- Call one or more times to add MIME parts
SendMailAuthEndMIME --- Send the MIME message and close session

### Error Reporting Functions

int IsMailError() --- returns 0 or error code
void PrintNBError( int FDout = 0 ) --- Prints NB Error string of last mail transaction to FD, or stdio if parameter not included
void PrintServerLog( int FDout = 0 ) --- Prints Server Log of last mail transaction to FD, or stdio if parameter not included

### Error Reporting Variables

int NB_Mail_Error_Code --- Contains 0 or error code
char NB_Mail_Error_String[] --- Last error string reported by NetBurner mail library. This is usually displayed on the debug serial port.
char Server_Mail_Log_String[] --- Last error string received from SMTP server

### Error Codes (located in c:\nburn\include\mailto.h)

#define STATUS_OK (0)
#define CONNECT_TO_SMTP_SERVER_FAILED (-1)
#define INITIAL_SERVER_REPLY_FAILED (-2)
#define HELO_SERVER_REPLY_FAILED (-3)
#define MAIL_FROM_SERVER_REPLY_FAILED (-4)
#define RCPT_TO_SERVER_REPLY_FAILED (-5)
#define DATA_SERVER_REPLY_FAILED (-6)
#define DATA_END_SERVER_REPLY_FAILED (-7)
#define AUTH_LOGIN_SERVER_REPLY_FAILED (-8)
#define USER_ID_SERVER_REPLY_FAILED (-9)
#define PASSWORD_SERVER_REPLY_FAILED (-10)
#define CONNECT931_SMTP_SERVER_FAILED (-11)

## 17.2. SendMail

### Synopsis:

```
int SendMail( IPADDR smtp_server, PCSTR userid, PCSTR from_addr,
              PCSTR to_addr, PCSTR subject, PCSTR textbody );
```

### Description:

Send an email message. The function will open a TCP connection to the specified SMTP server, create a message based on the parameters, and send the message.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | smtp_server | Name or IP Address of the SMTP Server |
| PCSTR | userid | The ASCII string to provide for RFC931 Identification. |
| PCSTR | from_addr | The "from" E-Mail address. |
| PCSTR | to_addr | The "to" E-Mail address (i.e. where to send the E-Mail). |
| PCSTR | subject | The E-Mail subject. |
| PCSTR | textbody | The body of the E-Mail. |

### Return Values:

0 --- If it fails
1 --- If successful

## 17.3. SendMailEx

### Synopsis:

```
int SendMailEx( IPADDR smtp_server, PCSTR userid, PCSTR from_addr_rev_path,
                PCSTR from_addr_memo_hdr, PCSTR to_addr, PCSTR subject,
                PCSTR textbody );
```

### Description:

Send an email message with extended parameters. The function will open a TCP connection to the specified SMTP server, create a message based on the parameters, and send the message. This function is identical to SendMail( ), with the addition of the from_addr_rev_path and from_addr_memo_hdr parameters.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | pop_server | Name or IP Address of the SMTP Server |
| PCSTR | userid | The ASCII string to provide for RFC931 Identification. |
| PCSTR | from_addr_rev_path | The "from" E-Mail address - RFC 821 - <reverse-path>. |
| PCSTR | from_addr_memo_hdr | The "from" E-Mail address - RFC 821- memo header. |
| PCSTR | to_addr | "Send To" E-Mail address |
| PCSTR | subject | The E-Mail subject. |
| PCSTR | textbody | The body of the E-Mail. |

### Return Values:

0 --- If it fails
1 --- If successful

## 17.4. SendMailAuth

### Synopsis:

```
int SendMailAuth( IPADDR smtp_server, PCSTR userid, PCSTR pass,
                  PCSTR from_addr, PCSTR to_addr, PCSTR subject,
                  PCSTR textbody );
```

### Description:

Send an email message with SMTP plain text authentication per RFC 931. The function will open a TCP connection to the specified SMTP server, authenticate the connection with the specified user name and password, create a message based on the parameters, and send the message.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | pop_server | Name or IP Address of the SMTP Server |
| PCSTR | userid | The ASCII string to provide for RFC931 Identification. |
| PCSTR | pass | The ASCII String to provide for AUTH Identification. |
| PCSTR | from_addr | The "from" E-Mail |
| PCSTR | to_addr | The "to" E-Mail address (i.e. where to send the E-Mail). |
| PCSTR | subject | The E-Mail subject. |
| PCSTR | textbody | The body of the E-Mail. |

### Return Values:

0 --- If it fails
1 --- If successful

## 17.5. Sending MIME Attachments

Sending an E-Mail message with Multipurpose Internet Mail Extensions (MIME) is a multi step process:

- Call SendMailAuthStartMIME( ) to begin a Session with the SMTP server
- Call SendMailAuthAddMIME( ) for each MIME attachment you want to add
- Call SendMailAuthEndMIME( ) to send the email message and close the Session

The following MIME types are supported by default. The binary attachment should cover most types such as jpg, gif, etc. The type are defined in \nburn\include\mailto.h, and the functions are implemented in \nburn\system\mailto.cpp.

```
// MIME Content Types defined in mailto.h
extern enum CONTENT_TYPE_ENUM
{
        CONTENT_TYPE_PLAIN_TEXT,                    // for message body
        CONTENT_TYPE_PLAIN_TEXT_ATTACH,
        CONTENT_TYPE_BINARY_ATTACH,
        // Add additional types above CONTENT_TYPE_END
        CONTENT_TYPE_END
} CONTENT_TYPE;
```

### 17.5.1. SendMailAuthStartMIME

## Synopsis:

```
int SendMailAuthStartMIME( IPADDR smtp_server, PCSTR userid, PCSTR pass,
                           PCSTR from_addr, PCSTR to_addr, PCSTR subject,
                           int &fd )
```

## Description:

Start a MIME session with plain text password authentication. This function will open a TCP connection to the SMTP server, authenticate, then return while leaving the TCP connection open. The Session file descriptor is returned in the “int &fd” reference variable. This function must be called before any other SendMail MIME function.

## Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | pop_server | Name or IP Address of the SMTP Server |
| PCSTR | userid | The ASCII string to provide for RFC931 Identification. |
| PCSTR | pass | The ASCII String to provide for AUTH Identification. |
| PCSTR | from_addr | The "from" E-Mail |
| PCSTR | to_addr | The "to" E-Mail address (i.e. where to send the E-Mail). |
| PCSTR | subject | The E-Mail subject. |
| Int | & fd | A “reference” (or pointer) to an integer value of the calling function. The value of fd is modified by this function and will contain the file descriptor for the open SMTP Session. This value must always be checked to be greater than 0 for a valid Session. The fd is passed to other MIME functions to identify the open Session. |

## Return Values:

0 --- If it fails
1 --- If successful

### 17.5.2. SendMailAuthAddMIME

## Synopsis:

```
int SendMailAuthAddMIME( int fd, int ContentType, const char *pContent,
                         const char *FileName )
```

## Description:

Add a MIME part or attachment to an open MIME Session. This function should be called for each part/attachment you wish to add to the email message.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor of the open MIME Session returned by SendMailAuthStartMIME( ). |
| int | ContentType | MIME Content Type, such as : CONTENT_TYPE_PLAIN_TEXT, CONTENT_TYPE_PLAIN_TEXT_ATTACH, CONTENT_TYPE_BINARY_ATTACH |
| const char * | pContent | A pointer to the MIME content |
| const char * | FileName | File name for the attachment |

## Return Values:

0 --- If it fails
1 --- If successful

### 17.5.3. SendMailAuthEndMIME

## Synopsis:

```
int SendMailAuthEndMIME( int fd, PCSTR userid )
```

## Description:

Send a MIME email message and close the SMTP Session.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor of the open MIME Session returned by SendMailAuthStartMIME( ). |
| PCSTR | Userid | The user id used to open the Session in SendMailAuthStartMIME( ) |

## Return Values:

0 --- If it fails
1 --- If successful

# 18. RTC Library

## 18.1. Introduction

The RTC (real-time clock) library allows users to set and read the real-time clock manually, or use the current system time to set the RTC time or use the current RTC time to set the system time. The RTC is external to the core module and is located on the MOD-DEV-40, -70, and -100 development boards. While the system time inside a core module can be lost when it loses power or is reset, the RTC is sustained by a supercapacitor which is also located on the development boards. This library acts as an interface between the system and RTC time clocks.

### Header File

```
#include <rtc.h>    // Found in \Nburn\<HardwarePlatform>\include
```

### Parameters

The following chart defines the contents of struct tm, as it is utilized by the RTCGetTime and RTCSetTime functions.

| Type | Name | Description |
|---|---|---|
| int | `tm_sec` | Seconds (0-59). |
| int | `tm_min` | Minutes (0-59). |
| int | `tm_hour` | Hour (0-23). |
| int | `tm_mday` | Day of the month (1-31). |
| int | `tm_mon` | Month of the year: January (0) to December (11). |
| int | `tm_year` | Years since 1900. |
| int | `tm_wday` | Day of the week: Sunday (0) to Saturday (6). |
| int | `tm_yday` | Days since January 1st (0-365). |
| int | `tm_isdst` | Daylight Saving Time flag (greater than zero if in effect; zero if not in effect; less than zero if information not available). |

### Functions

- RTCGetTime --- Gets the current RTC time.
- RTCSetTime --- Sets the RTC time with a given `tm` structure.
- RTCSetSystemFromtRTCTime --- Sets the system time with the current RTC time.
- RTCSetRTCfromSystemTime --- Sets the RTC time using the current system time.

## 18.2. RTCGetTime

### Synopsis:

```
int RTCGetTime( struct tm &bts )
```

### Description:

This function gets the current RTC time.

### Parameters:

| Type | Name | Description |
|---|---|---|
| struct tm | &bts | The basic time structure used to store the current time read from the RTC clock. |

### Returns:

0 if successful, 1 if failed.

## 18.3. RTCSetTime

### Synopsis:

```
int RTCSetTime( struct tm &bts )
```

### Description:

This function sets the RTC time with a given time structure.

### Parameters:

| Type | Name | Description |
|---|---|---|
| struct tm | &bts | The basic time structure used to set the RTC time. |

### Returns:

0 if successful, 1 if failed.

## 18.4. RTCSetSystemFromRTCTime

### Synopsis:

```
int RTCSetSystemFromRTCTime()
```

### Description:

This function sets the system time with the current RTC time.

### Parameters:

None.

### Returns:

0 if successful, 1 if failed.

## 18.5. RTCSetRTCfromSystemTime

### Synopsis:

```
int RTCSetRTCfromSystemTime()
```

### Description:

This function sets the RTC time with the current system time.

### Parameters:

None.

### Returns:

0 if successful, 1 if failed.

# 19. Serial Library

## 19.1. Introduction

All available I/O functions in the NetBurner I/O system library work with serial ports. When the NetBurner device boots up, the serial ports are running in a polled mode. Calling either the `OpenSerial()` or `SimpleOpenSerial()` function will open the serial port in an interrupt-driven and buffered mode that will result in an increase in performance.

In order to enable the interrupt-driven mode for the default debug port (UART 0), `SerialClose()` needs to be called, followed by either `OpenSerial()` or `SimpleOpenSerial()`. Once the serial port is closed, UART 0 will no longer be connected to stdio (stdin, stdout, stderr). If stdio calls such as `iprintf()`, `printf()`, `siprintf()`, and `sprintf()` are used, then stdio must be reconnected to the appropriate serial port with `ReplaceStdio()`. For example, assuming "fdSerial" is the return value from `OpenSerial()`:

```
SerialClose( 0 );
fdSerial = OpenSerial( 0, 115200, 1, 8, eParityNone );
ReplaceStdio( 0, fdSerial );   // stdin via UART 0
ReplaceStdio( 1, fdSerial );   // stdout via UART 0
ReplaceStdio( 2, fdSerial );   // stderr via UART 0
```

### Header File:

```
#include <serial.h>          // Found in C:\Nburn\include
```

### Applicable to All NetBurner Platforms

- `OpenSerial` – Opens a serial port
- `SimpleOpenSerial` – Shortcut macro to open a serial port
- `SerialClose` – Closes a serial port [using `close()` works as well]
- `SerialEnableTxFlow` – Enables software flow control on transmit (XON/XOFF)
- `SerialEnableRxFlow` – Enables software flow control on receive (XON/XOFF)
- `SerialEnableHwTxFlow` – Enables hardware flow control on transmit (RTS/CTS)
- `SerialEnableHwRxFlow` – Enables hardware flow control on receive (RTS/CTS)
- `Serial485HalfDupMode` – Configures for RS-485 half- or full-duplex mode
- `SendBreak` – Sets a break in the transmission for a given period of time
- `serwriteaddress` – Writes address values (used only with multidrop parity setting)
- `GetUartErrorReg` – Reads the status of the UART error register

### Applicable to the CB34EX, SB72EX, and SB700EX Platforms

- `GetCD` – Reads the state of the Carrier Detect (CD) pin of a serial port
- `GetRI` – Reads the state of the Ring Indicator (RI) pin of a serial port
- `GetDSR` – Reads the state of the Data Set Ready (DSR) pin of a serial port
- `SetDTR` – Writes the state of the Data Terminal Ready (DTR) pin of a serial port

## 19.2. OpenSerial

### Synopsis:

```
int OpenSerial( int portnum, unsigned int baudrate, int stop_bits,
                int data_bits, parity_mode parity );
```

### Description:

This function opens a serial port.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | portnum | The UART to open; valid values are ‘0’, ‘1’, and ‘2’ (not available on all platforms). MOD5441X adds valid values ‘4’, ‘5’, ‘7’, ‘8’, and ‘9’. NANO54415 adds valid values ‘4’, ‘5’, ‘6’, ‘8’, and ‘9’. |
| unsigned int | baudrate | The speed of the serial port in bits per second. |
| int | stop_bits | The number of stop bits to append to character data; valid values are ‘1’ and ‘2’. |
| int | data_bits | The number of data bits sent per character or frame; valid values are 5, 6, 7, and 8. |
| parity_mode | parity | The type of parity checking to use; valid values are eParityNone, eParityEven, eParityOdd, and eParityMulti. |

### Returns:

The file descriptor of the initialized port if successful; otherwise, one of the error codes is returned:

- SERIAL_ERR_NOSUCH_PORT (-1)
- SERIAL_ERR_PORT_ALREADYOPEN (-3)
- SERIAL_ERR_PARAM_ERROR (-4) – This error will be returned if either the number of stop bits or data bits are outside a valid range.

## 19.3. SimpleOpenSerial

### Synopsis:

```
int SimpleOpenSerial( int portnum, unsigned int baudrate );
```

### Description:

This is a macro that opens a serial port with the most common default values for the stop bit (1), data bits (8), and parity (no parity) already provided; all that is required in the call is the UART to open and the configuring baud rate.

The following provides an example between calling the normal `OpenSerial()` function and the `SimpleOpenSerial()` function:

```
int fd = OpenSerial( 0, 115200, 1, 8, eParityNone );
int fd = SimpleOpenSerial( 0, 115200 );
```

Both statements above perform the same operation in configuring UART 0 to operate at 115,200 bps, 1 stop bit, 8 data bits, and no parity, with the difference being that the `SimpleOpenSerial()` already provides the last three parameters by default.

If one needs to use different parameters other than what the last three input parameters provide by default, then the `OpenSerial()` function must be used.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `port` | The UART to open; valid values are ‘0’, ‘1’, and ‘2’ (not available on all platforms). |
| unsigned int | `baudrate` | The speed of the serial port in bits per second. |

### Returns:

The file descriptor of the initialized port if successful; otherwise, one of the error codes is returned:

- SERIAL_ERR_NOSUCH_PORT (-1)
- SERIAL_ERR_PORT_ALREADYOPEN (-3)

## 19.4. SerialClose

### Synopsis:

```
int SerialClose( int portnum );
```

### Description:

This function closes a UART serial port. It is valid to close a serial port that is not open, and allows a port in an unknown state to be closed. Port settings can be changed by closing and reopening the port. The `close`() function can also be used in place of this function.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `portnum` | The UART port to close; valid values are '0', '1', and '2' (not available on all platforms). |

### Returns:

'0' if successful; otherwise, one of the following error codes is returned:

- SERIAL_ERR_NOSUCH_PORT (-1)
- SERIAL_ERR_PORT_NOTOPEN (-2)

## 19.5. SerialEnableTxFlow

### Synopsis:

```
void SerialEnableTxFlow( int port, int enab );
```

### Description:

Enables or disables software flow control (XON/XOFF) on transmit. The NetBurner device will recognize the special XON and XOFF characters being sent from another device in order to throttle the output when enabled.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | port | The UART whose flow control will be toggled; valid values are '0', '1', and '2' (not available on all platforms). |
| int | enab | '0' disables flow control; '1' (or any non-zero number) will enable it. |

### Returns:

Nothing --- This is a void function.

## 19.6. SerialEnableRxFlow

### Synopsis:

```
void SerialEnableRxFlow( int port, int enab );
```

### Description:

Enables or disables software flow control (XON/XOFF) on receive. The NetBurner device will send special XON and XOFF characters to another device in order to control the flow of incoming data when enabled.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `port` | The UART whose flow control will be toggled; valid values are '0', '1', and '2' (not available on all platforms). |
| int | `enab` | '0' disables flow control; '1' (or any non-zero number) will enable it. |

### Returns:

Nothing --- This is a void function.

# 19.7. SerialEnableHwTxFlow

## Synopsis:

```
void SerialEnableHwTxFlow( int port, int enab );
```

## Description:

This function enables or disables transmitter hardware flow control for the specified serial port number. The transmitter is throttled via the CTS (Clear-to-Send) input signal line, which would be linked to the RTS (Request-to-Send) output line on the receiver. The transmitter starts sending data to the receiver when it receives a request on its CTS line from the receiver.

Note: Calling this function to disable Tx hardware flow control after enabling RS-485 full-duplex mode configures the port for RS-422 mode (Tx stays actively driven).

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | `port` | The UART whose flow control will be toggled; valid values are '0', '1', and '2' (not available on all platforms). |
| int | `enab` | '0' disables flow control; '1' (or any non-zero number) will enable it. |

## Returns:

Nothing --- This is a void function.

## 19.8. SerialEnableHwRxFlow

### Synopsis:

```
void SerialEnableHwRxFlow( int port, int enab );
```

### Description:

This function enables or disables receiver hardware flow control for the specified serial port number. The receiver controls the flow of incoming data via the RTS (Request-to-Send) output signal line, which would be linked to the CTS (Clear-to-Send) input line on the transmitter. The receiver sets RTS when it is ready to receive data, thereby enabling the transmitter to start sending information to the receiver.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `port` | The UART whose flow control will be toggled; valid values are '0', '1', and '2' (not available on all platforms). |
| int | `enab` | '0' disables flow control; '1' (or any non-zero number) will enable it. |

### Returns:

Nothing --- This is a void function.

# 19.9. Serial485HalfDupMode

## Synopsis:

```
void Serial485HalfDupMode( int port, int enab );
```

## Description:

Enables or disables RS-485 half-duplex mode. Full-duplex mode is automatically enabled when half-duplex mode is disabled. This must be explicitly called before RS-485 functionality can be used.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | `port` | The UART port to use; the UART that can only be used for RS-485 depends on the platform. |
| int | `enab` | '0' disables half-duplex (enables full-duplex); '1' enables half-duplex (disables full-duplex). |

## Returns:

Nothing --- This is a void function.

## 19.10. SendBreak

### Synopsis:

```
void SendBreak( int port, DWORD time );
```

### Description:

Sets a break in the UART transmission for a given period of time. The break starts when character transmission completes. The break is delayed until any character in the transmitter shift register is sent. Any character in the transmitter holding register is sent after the break.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | port | The UART whose transmitter will be forced low (start break). |
| DWORD | time | Specifies the amount of time in ticks that the break will hold; when time expires, the break will be stopped; 20 ticks equal 1 second by default. |

### Returns:

Nothing --- This is a void function.

## 19.11. serwriteaddress

### Synopsis:

```
int serwriteaddress( int fd, const char c );
```

### Description:

Sends an address character via the UART port number associated with the given file descriptor. This function can only be utilized if the UART is initialized in multidrop mode.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The file descriptor associated with the UART serial port that will be used. |
| const char | c | The address character to be sent. |

### Returns:

'1' if successful; otherwise, one of the following error codes is returned (note that SERIAL_ERR_PORT_NOTOPEN is also returned if UART is not initialized to be in multidrop mode):

- SERIAL_ERR_NOSUCH_PORT (-1) – The file descriptor is associated with a serial port that does not exist, therefore the file descriptor is invalid.
- SERIAL_ERR_PORT_NOTOPEN (-2) – The file descriptor is associated with a closed serial port.

# 19.12. GetUartErrorReg

## Synopsis:

```
int GetUartErrorReg( int fd );
```

## Description:

Gets the UART error register. Any errors are added to this register in a logical OR operation. Calling this function to read the error status will clear the register. The meaning of each bit in the error status register is shown in the table below.

| Bit | Description |
|---|---|
| 3 | Received break |
| 2 | Framing error |
| 1 | Parity error |
| 0 | Overrun error |

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | `fd` | The file descriptor associated with the UART serial port whose error register is to be retrieved. |

## Returns:

The value of the read error register if successful; otherwise, one of the error codes is returned:

- SERIAL_ERR_NOSUCH_PORT (-1) – The file descriptor is associated with a serial port that does not exist, therefore the file descriptor is invalid.
- SERIAL_ERR_PORT_NOTOPEN (-2) – The file descriptor is associated with a closed serial port.

## 19.13. GetCD

### Synopsis:

```
BOOL GetCD( int port );
```

### Description:

This function gets the current state of the Carrier Detect signal from the specified serial port (CB34EX, SB72EX, and SB700EX platforms only).

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | port | The UART port whose CD signal will be read. |

### Returns:

‘TRUE’ if set, ‘FALSE’ if cleared; ‘0’ is returned if port number is invalid.

## 19.14. GetRI

### Synopsis:

```
BOOL GetRI( int port );
```

### Description:

This function gets the current state of the Ring Indicator signal from the specified serial port (CB34EX, SB72EX, and SB700EX platforms only).

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | port | The UART port whose RI signal will be read. |

### Returns:

‘TRUE’ if set, ‘FALSE’ if cleared; ‘0’ is returned if port number is invalid.

## 19.15. GetDSR

### Synopsis:

```
BOOL GetDSR( int port );
```

### Description:

This function gets the current state of the Data Set Ready signal from the specified serial port (CB34EX, SB72EX, and SB700EX platforms only).

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | port | The UART port whose DSR signal will be read. |

### Returns:

‘TRUE’ if set, ‘FALSE’ if cleared; ‘0’ is returned if port number is invalid.

## 19.16. SetDTR

### Synopsis:

```
void SetDTR( int port, BOOL val );
```

### Description:

Sets or clears the Data Terminal Ready signal for the specified serial port (CB34EX, SB72EX, and SB700EX platforms only).

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | `port` | The UART port whose DTR signal will be set or cleared. |
| BOOL | `val` | The Boolean value to configure the signal; ‘TRUE’ sets it, while ‘FALSE’ clears it. |

### Returns:

Nothing --- This is a void function.

# 20. SNMP Library

## 20.1. Introduction

Simple Network Management Protocol (SNMP) is a system for exposing a number of variables to a Network Management System. These variables are grouped together into SNMP MIB's (Management Information Bases). It is common to underestimate the complexity and time required to implement SNMP for a product. The purpose of this section is to provide a general idea of the complexity and effort required to implement SNMP, and to describe the provisions of the NetBurner SNMP package.

The NetBurner SNMP package is sold as a licensed option only, and is not part of the standard development kit package. Please contact our **Sales** Department to purchase the SNMP package.

SNMP is complex, and the standard NetBurner SNMP package is intended for customers that have a SNMP expert on staff. If you do not know how to use and configure SNMP tools such as SNMPWALK, SNMPGET, and SNMPSET, you **must** acquire that capability before you attempt to implement SNMP on your system. If you do not know what a MIB is and do not know how to write one, you must acquire that capability before you attempt to implement a custom SNMP MIB. For additional information, please read the SNMP FAQ (http://www.faqs.org/faqs/snmpfaq/).

Implementation Requirements
- The Provisions of the NetBurner SNMP Package
- Items Not Included in the NetBurner SNMP Package
- Additional Support for SNMP

A Short Startup Guide for using NetBurner's SNMP Library
- Level 0 - Basic instructions on using the SNMP tools provided with the NetBurner SNMP package
- Level 1 - Enable SNMP at the absolute minimum level without custom MIBs
- Level 2 - A simple custom MIB to set/clear community names and trap destinations

Notes
- Note 1 - Custom tables (no external example code provided)
- Note 2 - Custom community name parsing and protection
- Note 3 - Traps and custom traps

### Header File

```
#include <snmp.h>     // Found in C:\Nburn\include
```

Functions
- Snmpget - Get a single SNMP variable
- Snmpgetnext - Get the next variable following the specified variable
- Snmpset - Set a single SNMP variable
- Snmpwalk - Walk the SNMP tree

# 20.2. SNMP Implementation Requirements

## Provisions of the NetBurner SNMP Package

MIB-II (RFC 1213) implementation reports network usage variables from MIB-II. MIB-II is supported 100% with the following exceptions:

- The PPP interface does not support SNMP.
- The ipForwarding variable is read only and set to non-forwarding.
- The ipRouteTable - since the forwarding gateway is fixed; the route table is read only and set to a single value. The table will reflect the current state of the IP connections and routes stored in the ARP table, but it is not writable.
- The egp table and values are not applicable because NetBurner hardware is not a router and does not do egp.

SNMP requires the maintenance and storage of a number of persistent variables

- The methods to set or modify variables such as SysLocation are defined in the MIB-II specification. The mechanisms to set or modify other variables (such as community names and trap destination IP addresses) are not defined and require the implementation of a custom mechanism. NetBurner provides a trivial NetBurner custom MIB to accomplish this task, but it should be part of your custom MIB. You will also have to write code that will take a structure containing this information and store it in nonvolatile memory so the names will be persistent (otherwise the SNMP community names will be hard coded to default values and traps will not be sent.).

Tools for implementing a custom MIB on the NetBurner platform

- The tools provided will parse a custom MIB input file and produce a .CPP output file that implements the MIB. You will be responsible for hand editing this source file to populate the data in the MIB.

## Items NOT Included in the NetBurner SNMP Package

The NetBurner SNMP License Package explicitly does **not** provide:

Education on the SNMP protocol and how to use it
Technical support for writing your own custom MIB

## Additional Support for SNMP

NetBurner can provide this support on an hourly consulting basis. Given a group of experienced embedded developers with no SNMP knowledge or experience, the effort required to implement a custom SNMP MIB and learn to use the SNMP tools can easily exceed 100 hours of consulting time. In the extreme case of a complex implementation, it can exceed 300 hours. For more information on purchasing this support option, please contact our **Sales** Department.

## 20.3. Level 0 --- Basic Instructions Using the SNMP Tools

NetBurner provides a set of SNMP tools with its SNMP package. They are intended to assist in your SNMP development, but we consider them to be a convenience and not part of the core SNMP package. It is expected that anyone needing to develop SNMP application will already have some basic SNMP tools in-house. The four functions provided are:

- Snmpget --- Get a single SNMP variable
- Snmpgetnext --- GetNext a single SNMP variable
- Snmpset --- Set a single SNMP variable
- Snmpwalk --- Walk the SNMP tree

The SNMP protocol knows nothing about human readable names. The protocol only knows about variables identified by OIDs (Object Identifiers). For instance, the variable commonly referred to as sysDescr is really the OID 1.3.6.1.2.1.1.1.0.

The protocol on the wire will never know that .1.3.6.1.2.1.1.1.0 is usually called sysDescr. The SNMP tools do all of the translation from OID to human readable names by parsing MIB text files. Important: The NetBurner tools assume that these MIB's are stored in the C:\Nburn\mibs directory.

**Caution:** By convention, MIBS are never supposed to change. If you change the data stored in a MIB, then you are supposed to release a new MIB with a different OID. The meaning of a single OID and the contents of a specific MIB file, are never supposed to change. This is what the tools expect. This is completely unrealistic for a development environment, and hence developers typically use the following workaround: If you ever change the contents in any of the textual MIB files in the C:\Nburn\mibs directory, you must erase the file .index as that keeps a parsed and cached copy of the MIB information. Otherwise, the changes you made will seem to have no effect.

## 20.4. Level 1 --- Enable SNMP at the Absolute Minimum Level without Custom MIBs

To enable SNMP at the absolute minimum level (without custom MIBs), you need to do two things:

- Provide system identification information
- Provide storage and recall for the SYSInfo structure

You will find an example of this in your C:\Nburn\examples\snmp\simplesnmp directory.

### Providing System Identification Information

Every model of SNMP device is supposed to have a unique system identifier or OID. It is also supposed to have a human readable name. These are reported in the SNMP MIB-II standard variables sysDescr and sysObjectID. To define these constants you must define the following two variables in your application:

```
const char * SYSDESC="NetBurner SNMP Test application";

const char * SYSOID="1.3.6.1.4.1.8174.2.40";
```

The number sequence 1.3.6.1.4.1 is the SNMP tree pointing to the custom MIB area. **Warning: The number sequence 8174 is the Private Enterprise Number uniquely issued to NetBurner.** You should create a SYSOID that starts with 1.3.6.1.4 followed by your own company identifier. **You can obtain an identifier from the Internet Assigned Numbers Authority (http://www.iana.org/protocols/forms.htm).**

### Providing Storage and Recall for the SYSInfo Structure

The SNMP system needs to store and recall information that will be nonvolatile. This will usually be done by storing data in the UserFlash area. However, this was not done by default, as it is expected that the Users will probably be using this data area for their own storage structures. This SNMP storage is encapsulated in a SysInfo structure defined in snmp.h (found in C:\Nburn\include):

```
struct SysInfo
 {
   char SysContact[256];
   char SysName[256];
   char SysLocation[256];
   unsigned char ReadCommunity[40];
   unsigned char WriteCommunity[40];
   IPADDR trap_destination;
   DWORD trap_enable_flags;
   DWORD valid;
 };
```

This data is accessed and stored using two user written functions:

```
const SysInfo * GetSysInfo( );    /* Returns a SysInfo structure */
```

```
void SetSysInfo( SysInfo si );    /* Saves a SysInfo structure */
```

**Note:** Simple examples of these functions can be found in C:\Nburn\examples\snmp\main.cpp. If this structure has never been initialized it is suggested that SysContact, SysName, and SysLocation default to either the empty string or to Not Set. The two community names should default to what ever you want your default read and write SNMP community names to be. (Think of community names as passwords.)

## 20.5. Level 2 --- A Simple Custom MIB to Set/Clear Community Names

SNMP specifies that community names are to be used for access control, but it does **not** specify how they are to be changed. The typical solution is to change them as part of your custom MIB. The example below will create an absolutely trivial custom MIB, and implement the ability to change the community name settings using this MIB. You **will** find a completed version of this project in your C:\Nburn\examples\snmp\nburnmib directory. There are five parts to this process.

### 1. Writing your Custom MIB

For this example we are going to implement the absolute minimal MIB. You can copy this text into a text file. We will assume that this is named NburnCnameMib.txt for the purposes of this discussion. The full text is shown below.

Beginning of MIB file

```
NBURNSAMPLE-MIB DEFINITIONS ::= BEGIN
IMPORTS
     mgmt, enterprises, IpAddress
        FROM RFC1155-SMI
     OBJECT-TYPE
           FROM RFC-1212;
netburner   OBJECT IDENTIFIER ::= { enterprises 8174 }
READCOMMUNITY OBJECT-TYPE
SYNTAX OCTET STRING (SIZE(1..255))
ACCESS read-write
STATUS mandatory
DESCRIPTION
"Description: ReadCommunity name"
::= {netburner 1}
WRITECOMMUNITY OBJECT-TYPE
SYNTAX OCTET STRING (SIZE(1..255))
ACCESS read-write
STATUS mandatory
DESCRIPTION
"Description: ReadCommunity name"
::= {netburner 2}
TRAPDESTINATION OBJECT-TYPE
SYNTAX IpAddress
ACCESS read-write
STATUS mandatory
DESCRIPTION
"Description: The Trap destination IP address”
::= {netburner 3 }
END
```

End of MIB file

## 2. Compiling your Custom MIB

The NetBurner SNMP tools provide a utility SNMPTRANSLATE that will convert a custom MIB into a cpp source file to implement the MIB. Important: The MIB requires several inputs, specifically RFC1155-SMI. Just copy this file from the C:\Nburn\mibs directory to the directory where your custom MIB is located. To do this (copy) from the command line:

```
snmptranslate -M yourmibdir -Tn > yourmibfile.cpp
```

Therefore, the example below generates the cpp file that will be the new custom MIB.

```
snmptranslate -M ./ -Tn > Nburn_Cname_Mib.cpp
```

## 3. Implementing your Custom MIB Functions

This auto generated file only has the outline for what you want to do, you will need to go everyplace there is a #warning in the file and add your custom code for implementing the actual SNMP variables. In this case there are six functions to fill in:

```
/* Read function prototypes */
     snmp_typeString ReadFuncREADCOMMUNITY();
     snmp_typeString ReadFuncWRITECOMMUNITY();
     snmp_typeIpAddr ReadFuncTRAPDESTINATION();

/* Write function prototypes */
     int WriteFuncREADCOMMUNITY(snmp_typeString var, int bTest);
     int WriteFuncWRITECOMMUNITY(snmp_typeString var, int bTest);
     int WriteFuncTRAPDESTINATION(snmp_typeIpAddr var, int bTest);
```

We want these functions to report and set the variables we have defined. The bodies of these functions can be found in C:\Nburn\examples\snmp\Nburn_Cname_Mib.cpp

**Special Note:** We normally allow you to read SNMP variables with the read community name, and set them with the write community name. (Think passwords.) However, it would be a bit stupid if we could read the value of the write community name using only a READCOMMUNITY name; so one additional modification is made to the auto generated cpp file. We must change the read permissions of the WRITECOMMUNITY variable from READ_COMMUNITY_MASK to WRITE_COMMUNITY_MASK

## 4. Add your Custom MIB file to your Project

Now edit your makefile to add the mib cpp file (adding Nburn_Cname_Mib.cpp in the example case.).

## 5. Add your Custom MIB File to the MIB Tools

The MIB text file you created must be located where the MIB tools can find it. Copy the MIB text file you just created to your C:\Nburn\mibs directory, and delete the .index file (so a new index will automatically be created by the MIB tools). Your new MIB is now ready to be used.

# 20.6. Note 1 --- Custom Tables

## Implementing Tables

The general process for implementing your own custom MIB closely follows the steps outlined in the Level 2. One area that is somewhat different is tables. If you do not already know what an SNMP table is, you need to research the topic before reading this section. When the SNMP translate utility parses a MIB definition for a table, it generates a different set of functions. This will be illustrated with the udpEntry table from MIB-II.

```
/* Function definitions for udpEntry */
void AddTableElementudpEntry( void * data_el, snmp_typeIpAddr
udpLclAddress, snmp_typeINTEGER, udpLocalPort );
void RemoveTableElementudpEntry( void * data_el );
void PutTableElementsudpEntry( SNMP_Request & req, void * data_el, int subid );
```

These three functions allow you to do three things:

- Add a table entry/element
- Remove a table entry/element
- Provide the values for a table entry/element

The first two functions are completely written by the snmptranslate utility. The final function needs to be filled in by the programmer. The programmer has three responsibilities:

- Call AddTableElementudpEntry when a new UDP table element is created. This **must** include a **(void *) data_el** that encapsulates whatever data is needed to access this element.
- Call RemoveTableElementudpEntry when ever a UDP table element is to be destroyed. **Important:** This **must** include the same **(void *) data_el** passed in when the table was **created**.
- Fill in the code to convert the **(void *) data_el** into the specific MIB variables that make up the table element.

This function as generated by **SNMPTRANSLATE** is shown below:

```
void PutTableElementsudpEntry( SNMP_Request & req, void * data_el, int
subid )
{
switch(subid)
{
case 1: req.put_asn.PutIPAddr ( /* You must provide a conversion
from the data_el for udpLocalAddress */ );
break;
case 2: req.put_asn.PutInt ( /* You must provide a conversion from
the data_el for udpLocalPort */ );
break;
default: req.put_asn.PutNullObject();
}
}
```

The example on the previous page is implemented in the C:\Nburn\system\bcls.cpp and C:\Nburn\system\udp.cpp code set.

**Important:** At this time, the NetBurner SNMP system does not implement writing to dynamically created table elements. However, table elements can be created using the standard SNMP write variable definitions. If you have a specific need for dynamic writable tables, please contact NetBurner **Support** and we will assist you.

## 20.7. Note 2 --- Custom Community Name Parsing and Protection

The default NetBurner implementation provides two community names: read and write. It is often desirable to have multiple community names providing multiple levels of access and object visibility.

The NetBurner SNMP implementation can support 32 different access classes. All visibility and access decisions are based on a 32 bit mask. Each SNMP element includes a mask parameter. This is the last element in the variable definitions:

```
SNMPREADFUNC( sysDescr, "1.3.6.1.2.1.1.1.0", ASN_typeString,
ReadFuncsysDescr, READ_COMMUNITY_MASK );
```

The present code defines:

```
#define READ_COMMUNITY_MASK (0x0001)
#define WRITE_COMMUNITY_MASK (0x0002)
```

You could easily define an additional mask:

```
#define CUSTOM_COMMUNITY_MASK (0x0004)
```

To connect these mask values to the community name you would have to write a function to convert community names to mask values, and to place a pointer to that function in the function pointer:

```
DWORD (*SnmpCommunityDecodeFunc) (const unsigned char * name);
```

### Example Code

```
DWORD MyCustomCommunityDecode( const unsigned char cname )
{
if ( strcmp ( cname,”MySecretW0rd” )==0 ) return
CUSTOM_COMMUNITY_MASK;
/* Otherwise return the default community name mask stuff */
return DefaultCommunityDecode( cname );
}
```

Then someplace in your system initialization you will need to setup the function pointer:

```
SnmpCommunityDecodeFunc=MyCustomCommunityDecode;
```

## 20.8. Note 3 --- Traps and Custom Traps

The NetBurner SNMP system provides for three types of traps

- Auto generated traps within the SNMP system - The Authentication fail trap and warm start traps are auto generated within the SNMP system at the appropriate times. These traps are sent to the destination defined in the trap_destination variable in the SysInfo structure (the same structure that maintains community names).

- Basic predefined traps without additional variables as generated by the application code - If you pass in a destination of 0; it uses the value stored in the SysInfo structure for trap_destination. This is done with the following function:

```
SnmpBasicTrap( IPADDR dest, const char * community_name,
               int generic_trap, int specific_trap );
```

- Custom traps with additional OID values attached - This feature uses the function:

```
void SnmpTrapWithData       /* As defined in snmp.h */
```

Important: This requires that you write a call-back function that will actually put the variables into the trap.

### Example Code

```
/* The callback function that fills in extra varbind defined in
your custom trap variables */
void TrapVarFunction(ASN * put_asn)
{
  put_asn->PutHeader(0x30); /* Var Bind */
  put_asn->PutOidFromString("1.3.6.1.4.1.8174.1");
  put_asn->PutOctetString("This is test message number 1");
  put_asn->FixUpHeader(); /* Var Bind */
  put_asn->PutHeader(0x30); /* Var Bind */
  put_asn->PutOidFromString("1.3.6.1.4.1.8174.2");
  put_asn->PutOctetString("This is test message number 2");
  put_asn->FixUpHeader(); /* Var Bind */
}
/* The function that actually sends the trap */
void SendTestTrap()
{
   SnmpTrapWithData(0, "public", SNMP_ENTERPRISE_TRAP, 1, TrapVarFunction);
}
```

## 20.9. Snmpget

### Usage:

```
Snmpget device_address community_name object_name
```

### Description:

This function gets a single SNMP variable.

### Parameters:

| Name | Description |
|---|---|
| device_address | The device IP Address (e.g. 10.1.1.77) or DNS name. |
| community_name | The community name used to access the device. (The rough equivalent of a password.) |
| object_name | The textual or OID name of the object to be retrieved. |

### Examples:

```
Snmpget 10.1.1.77 public sysDescr.0
Snmpget 10.1.1.77 public .1.3.1.2.1.1.1.0
```

# 20.10. Snmpgetnext

## Usage:

```
Snmpgetnext device_address community_name object_name
```

## Description:

This function gets the **next** variable **following** the **specified** variable. The entire MIB of a device could be obtained by executing a getnext on .1.3.1 followed by a getnext on each returned variable. Essentially, this would walk down the entire MIB tree the same way as Snmpwalk.

## Parameters:

| Name | Description |
|---|---|
| device_address | The device IP Address (e.g. 10.1.1.77) or DNS name. |
| community_name | The community name used to access the device. (The rough equivalent of a password.) |
| object_name | The textual or OID name of the object preceding the object to be retrieved. |

## Examples:

```
Snmpgetnext 10.1.1.77 public sysDescr
Snmpgetnext 10.1.1.77 public .1.3.1.2.1.1.1
```

## 20.11. Snmpset

### Usage:

```
Snmpset device_address community_name object_name object_type
```

### Description:

This function sets a single SNMP variable.

### Parameters:

| Name | Description |
|---|---|
| device_address | The device IP Address (e.g. 10.1.1.77) or DNS name. |
| community_name | The community name used to access the device. (The rough equivalent of a password.) |
| object_name | The textual or OID name of the object to be set. |
| object_type | The type of the object. (See the “Types” description below.) |

### Types:

One of: i, u, t, a, o, s, x, d, n

i --- INTEGER
u --- unsigned INTEGER
t --- TIMETICKS
a --- IPADDRESS
o --- OBJID
s --- STRING
x --- HEX STRING
d --- DECIMAL STRING
U --- unsigned int64
I --- signed int64
F --- float
D --- double

### Example:

```
Snmpset 10.1.1.77 public sysLocation.0 s “At NetBurner HQ”
```

## 20.12. Snmpwalk

### Usage:

```
Snmpwalk device_address community_name
```

### Description:

This function walks the SNMP tree. Essentially it does a repetitive getnext until it runs out of SNMP variables to retrieve.

### Parameters:

| Name | Description |
|---|---|
| device_address | The device IP Address (e.g. 10.1.1.77) or DNS name. |
| community_name | The community name used to access the device. (The rough equivalent of a password.) |

### Example:

```
Snmpwalk 10.1.1.77 public
```

# 21. Stream Update Library

## 21.1. Introduction

The functions supplied in this module are intended to be used in conjunction with FTP Server and FTP Client implementations. Functions are provided to access the user parameter storage area of the flash memory, and to update the application code in flash memory.

### Header File

```
#include <StreamUpdate.h>         // Found in C:\Nburn\include
```

### User Parameter Flash Data Functions

- SendUserFlashToStreamAsBinary --- Send User Parameter Flash data as a binary output stream
- SendUserFlashToStreamAsS19 --- Send User Parameter Flash data as a S19 ASCII record to an output stream
- ReadS19UserFlashFromStream --- Read User Parameter Flash data from a S19 ASCII input stream
- ReadBinaryUserFlashFromStream --- Read User Parameter Flash data from a binary input stream

### Application Code Function

- ReadS19ApplicationCodeFromStream --- Read a new application in _APP.S19 format from an ASCII input stream

### Example Application

- ftpd_code_update (found in C:\Nburn\examples)

## 21.2. SendUserFlashToStreamAsBinary

### Synopsis:

```
int SendUserFlashToStreamAsBinary( int fd );
```

### Description:

This function sends User Parameter Flash data as a binary output stream. This function sends the User Parameter Flash data to the specified fd output stream as a binary record.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor (fd) to send the data to. |

### Return Values:

STREAM_UP_OK --- The system was able to send the data
STREAM_UP_FAIL --- The system failed to send the data

## 21.3. SendUserFlashToStreamAsS19

### Synopsis:

```
int SendUserFlashToStreamAsS19( int fd );
```

### Description:

This function sends User Parameter Flash data as a S19 ASCII record to an output stream. This function sends the User Parameter Flash data to the specified fd output stream as a S19 text record.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor (fd) to send the data to. |

### Return Values:

STREAM_UP_OK --- The system was able to send the data
STREAM_UP_FAIL --- The system failed to send the data

# 21.4. ReadS19UserFlashFromStream

## Synopsis:

```
int ReadS19UserFlashFromStream( int fd );
```

## Description:

This function reads User Parameter Flash data from a S19 ASCII input stream. This function reads ASCII S19 records from the specified fd input stream and programs the data in the User Parameter Flash area.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor (fd) to read data from. |

## Return Values:

STREAM_UP_OK --- The system was able to read the data and update flash
STREAM_UP_FAIL ---The system failed to read or update

# 21.5. ReadBinaryUserFlashFromStream

## Synopsis:

```
int ReadBinaryUserFlashFromStream( int fd );
```

## Description:

This function reads User Parameter Flash data from a binary input stream. This function reads binary data from the specified input stream and programs the data into the User Parameter Flash area.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor (fd) to read data from. |

## Return Values:

STREAM_UP_OK --- The system was able to read the data and update flash
STREAM_UP_FAIL --- The system failed to read or update

# 21.6. ReadS19ApplicationCodeFromStream

## Synopsis:

```
int ReadS19ApplicationCodeFromStream( int fd );
```

## Description:

This function reads a new application in _APP.S19 format from an ASCII input stream. This function reads ASCII S19 records from a _APP.s19 format application file and reprograms the Flash memory with the new application. **Note:** The Flash memory will **not** be modified unless the **entire** application is received **without** error.

Since applications are run from RAM, your NetBurner device **must** be rebooted **before** the new application code becomes active. One way to accomplish a reboot is to use the **ForceReboot** function (located in the NetBurner System Library section of this manual).

**Note:** The items that you **will** need to clean up and/or close before a reboot are dependant on your particular application. At a minimum, you should clean up and/or close any FTP Client or Server sessions **before** calling this function.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor (fd) to read data from. |

## Return Values:

STREAM_UP_OK --- The system was able to read the data and update the Flash
STREAM_UP_FAIL --- The system failed to read or update Flash

## Example Application:

- ftpd_code_update --- Located (by default) in C:\Nburn\examples

# 22. System Library

## Header Files

```
#include <system.h>         // Found in C:\Nburn\include
#include <utils.h>          // Found in C:\Nburn\include
```

## System Constants

```
#include <constants.h>      // Found in C:\Nburn\include
```
ConfigRecord --- The configuration storage structure

## Global Variables

- gConfigRec --- The global configuration record
- Secs --- Seconds since the board booted
- TimeTick --- Time ticks since the board booted

## Code Update Functions/Capabilities

- Code Update Overview
- EnableAutoUpdate
- UpdateShutdown Hook
- UpdatePassword Hook

## Configuration Functions

- UpdateConfigRecord --- Change the configuration record stored in Flash
- SetupDialog --- Change system configuration by prompting the user over stdio

## User Flash Parameter Functions

- SaveUserParameters --- Save a blob of data to Flash
- GetUserParameters --- Get a read only pointer to the user defined data blob stored in Flash

## LED and Switch Functions

- putleds --- Set the system board LEDs
- getdipsw --- Read the DIP switches on the board

## Utility I/O Functions

- ShowData --- Show a data block in ASCII and hex
- ShowMac --- Show a MAC address on stdio
- outbyte --- Output a byte on stdio
- print --- Output a zero terminated string
- putnum --- Output a hexadecimal number to stdio
- AsciiToIp --- Convert a dotted decimal IP string to an IP address
- ShowIP --- Show an IP address as dotted decimal on stdio
- itoa --- An integer to ASCII function

## Diagnostic Function

- ShowCounters --- Show all system counters on stdio

## Counter Function

- GetPreciseTime --- Gets time ticks at a smaller resolution since the board booted

## Reboot Function

## Header File

```
#include <bsp.h>            // Found in C:\Nburn\include
```

- ForceReboot --- Reboot your NetBurner device

## Ethernet Functions

```
#include <ethernet.h>      // Found in C:\Nburn\include
```

- EtherLink --- Reports the status of the Ethernet link
- EtherSpeed100 --- Reports if the Ethernet link is operating at 100 MB
- EtherDuplex --- Reports if the Ethernet link is in Full Duplex mode
- ManualEthernetConfig --- Controls the speed and duplex of the Ethernet connection
- EtherLinkCallback – Callback function pointer for Ethernet link status changes

## 22.1. Constants

### Synopsis:

These constants control the system configuration.

**Warning: If you change these constants, then you must rebuild the system libraries.**

### Interrupt Priorities:

- `#define TICK_IRQ_LEVEL (5)`
- `#define SERIAL_IRQ_LEVEL (4)`
- `#define SERIAL_VECTOR_BASE (64)`

### Time Related Functions:

- `#define TICKS_PER_SECOND (20)`

### Ethernet Buffer Definitions:

- `#define ETHER_BUFFER_SIZE 1548`
- `#define ETH_MAX_SIZE (1500)`
- `#define ETH_MIN_SIZE (64)`
- `#define MAX_UDPDATA (ETHER_BUFFER_SIZE-(20+8+14))`

### uCOS OS Setting:

- `#define OS_MAX_TASKS 20    // Max number of system tasks`

### System Task Priorities:

- `#define MAIN_PRIO (50)`
- `#define HTTP_PRIO (45)`

### Any User Tasks that call I/O should have a Priority Number higher than the TCP_PRIO:

- `#define TCP_PRIO (40)`
- `#define IP_PRIO (39)`
- `#define ETHER_SEND_PRIO (38)`

## Stack Size Definitions:

```
// If you add big structures in user functions you should
// increase the value of the USER_TASK_STK_SIZE
   • #define USER_TASK_STK_SIZE (2048)
// If you add big structures in your dynamic HTML code
// you need to increase the value of HTTP_STK_SIZE
   • #define HTTP_STK_SIZE (2048)
   • #define IP_STK_SIZE (2048)
   • #define TCP_STK_SIZE (2048)
   • #define IDLE_STK_SIZE (2048)
   • #define ETHER_SEND_STK_SIZE (2048)
```

## TCP Constants:

- #define DEFAULT_TCP_MSS (512)
- // See RFC 1122 for a 50msec tick 60 ticks=3 sec 4*15=60
- #define DEFAULT_TCP_RTTVAR ((TICKS_PER_SECOND*3)/4)
- (Note: The 4 comes from Stevens Vol. 1 page 300)
- // 75 seconds Min
- #define TCP_CONN_TO (75 * TICKS_PER_SECOND)
- // 200 msec delayed ACK timer
- #define TCP_ACK_TICK_DLY (TICKS_PER_SECOND /5)
- #define DEFAULT_INITAL_RTO (TICKS_PER_SECOND*3)
- #define TCP_MAX_RTO (64 * TICKS_PER_SECOND)
- #define TCP_MIN_RTO (1 * TICKS_PER_SECOND)
- #define TCP_2MSL_WAIT (60 * TICKS_PER_SECOND)
- #define MAX_TCP_RETRY (12)
- #define TCP_WRITE_TIMEOUT (TICKS_PER_SECOND*10)
- // Store 3 segments max in tx and rx buffers
- #define TCP_BUFFER_SEGMENTS (3)
- // 10 idle Seconds and a partially received request is abandoned
- #define HTTP_TIMEOUT (TICKS_PER_SECOND*10)

## FD Offset Values:

- #define SERIAL_SOCKET_OFFSET (3)
- #define TCP_SOCKET_OFFSET (5)
- #define MAX_IP_ERRS 3
- #define BUFFER_POOL_SIZE (64)
- #define UDP_DISPATCH_SIZE (10)
- #define ARP_ENTRY_SIZE (256)
- #define TCP_SOCKET_STRUCTS (32)
- #define UDP_NETBURNERID_PORT (0x4E42) /*NB*/
- #define TFTP_RX_PORT (1414)

## 22.2. ConfigRecord

### Synopsis:

```
typedef struct
{
unsigned long recordsize; /* The stored size of the struct*/
unsigned long ip_Addr; /* The device IP Address */
unsigned long ip_Mask; /* The IP Address Mask */
unsigned long ip_GateWay; /* The address of the IP Gateway */
unsigned long ip_TftpServer;/* The address of the TFTP server to load
data from for debugging */
unsigned long baud_rate; /* The initial system baud rate */
unsigned char wait_seconds; /* The number of seconds to wait before
booting */
unsigned char bBoot_To_Application; /* True - if we boot to the
application, not the monitor */
unsigned char bException_Action; /* What should we do when we have an
exception? */
unsigned char m_FileName[80]; /* The file name of the TFTP file to
load */
unsigned char mac_address[6]; /* The Ethernet MAC address */
unsigned long ip_DNS_server; /* The DNS Server address */
unsigned long m_Unused[7];
unsigned short checksum; /* A Checksum for this structure */
} ConfigRecord;
```

### Description:

This structure is stored in the system FLASH and records default values for the system operation. Note: This structure can be manipulated with the IP Setup program and the Debug monitor.

## 22.3. gConfigRec

### Synopsis:

```
extern ConfigRecord gConfigRec;
```

### Description:

This is a **read only copy** of the system configuration record.

## 22.4. Secs

### Synopsis:

```
extern VDWORD Secs;
```

### Description:

The number of seconds since the device rebooted.

## 22.5. TimeTick

### Synopsis:

```
extern VDWORD TimeTick;
```

### Description:

The number of time ticks since the device booted. There are TICKS_PER_SECOND ticks in each second.
**Note:** At the time this document was written, this value is 20.

# 22.6. Code Updates with AutoUpdate Utility

## Description:

The AutoUpdate utility provides the ability to update your application code in flash memory over a network connection. The utility consists of the following parts:

1. The EnableAutoUpdate() function must be called in your application code. Calling this function will tell the TCP/IP Stack to listen for AutoUpdate requests from the Windows AutoUpdate.exe utility.
2. The Windows AutoUpdate.exe utility. When executed a dialog box will appear that enables you to search for NetBurner devcies, select a _APP.s19 application image to download, and specify if you wish the device to reboot once the update is complete.

**AutoUpdate FAQ**

- The EnableAutoUpdate() function uses the UDP protocol. UDP can only be run on a local network, as you cannot route UDP packets through a router/firewall from the Internet. If you need that capability your can use the StartTcpUpdate() function in your application and the TcpUpdate.exe Windows utility. Note that you will need to use port forwarding on your router.
- You can password protect the update feature by using the update_authenticate_func callback.
- You can do a controlled shutdown of your device before an update occurs by using the update_shutdown_func callback.

## Example Code:

```
#include <autoupdate.h> /* Required for AutoUpdate capability */

int MyPasswordTest(const char * user, const char * pass)
{
  /* Check password and user here */
  if (/*passwordok*/)
     return 1;
  else
     return 0;
}

int MyShutdownTest( void )
{
  if (/* It is OK to shutdown */)
  {
      /* Do your shutdown processing here */
      return 1;
   }
   else
      return 0;
 }

void UserMain(void * pd)
{
   update_authenticate_func = MyPasswordTest;
   update_shutdown_func = MyShutdownTest;
   EnableAutoUpdate(); /* Required for AutoUpdate capability */
}
```

### 22.6.1. EnableAutoUpdate

## Synopsis:

```
void EnableAutoUpdate( );
```

## Description:

Enables application updates via the network using the Windows AutoUpdate utility.

Once EnableAutoupdate() is called it cannot be disabled. If you do need to enable/disable this feature dynamcilly during your application execution, use the update_shutdown_func to abort a code update.

## Parameters:

None

## Returns:

Nothing

### 22.6.2. AutoUpdate Shutdown Hook

## Synopsis:

```
extern int ( *update_shutdown_func )( void );
```

## Description:

When the update_shutdown_func is assigned to a function, that function will be called before AutoUpdate is allowed to proceed with an application update. In other words, it is a callback function. If your shutdown function returns 0 the update process is aborted. If your shutdown function returns 1 the update is allowed to proceed.

Common uses for this featue are:

- To put your device in a safe state before an update/reboot is allowed to occur, such as if mechanical devices are being controlled.
- To enable/disable the AutoUpdate feature dynamically.

Your function must be of the form:

```
int YourShutdownTest(void)
{
   if (/* It is OK to shutdown */)
   {
      /* Do your shutdown processing here */
      return 1;
   }
   else
      return 0; /* If you want to abort AutoUpdate */
}
```

You assign the function to the shutdown hook by:

```
update_shutdown_func = MyShutdownTest;
```

### 22.6.3. AutoUpdate Password Protection

## Synopsis:

```
extern int ( *update_authenticate_func )
           ( const char *name, const char *passwd );
```

## Description:

When the update_authenticate_func is assigned to a function, that function will be called before AutoUpdate is allowed to proceed with an application update. In other words, it is a callback function. The user running the AutoUpdate.exe utility will be presented with a dialog box requesting a user name and password, which are then passed to your function for processing and authentication. You function can do the authentication in any manor you wish. Returning 1 allows AutoUpdate to proceed, returning 0 aborts the process. There is a similar function pointer named ipsetup_authenticate_func for password protection on the IPSetup utility.

Your password function must be of the form:

```
int MyPasswordTest(const char * user, const char * pass)
  {
     /* Check password and user here */
     if (/* password ok */)
        return 1;
     else
        return 0;
  }
```

You assign the function to the password hook by:

```
update_authenticate_func = MyPasswordTest;
```

# 22.7. UpdateConfigRecord

## Synopsis:

```
void UpdateConfigRecord( ConfigRecord *pNewRec );
```

## Description:

This updates the stored configuration record. It can be used to change system configuration settings from witin an application, such as the IP address, mask, gateway, DNS server, etc. It is recommended you do not call this function immediately upon power-up of your device to avoid a situation in which a user is cycling power on/off rapidly, which could cause flash memory corruption if the application was in the process of a flash write cycle.

Note: The mac_address and checksum values are ignored in the passed-in structure, and the proper system values are used before storing the record.

## Parameters:

| Type | Name | Description |
|---|---|---|
| ConfigRecord* | pNewRec | |

## Returns:

Nothing --- This is a void function.

# 22.8. UpdateConfigRecord_Num

## Synopsis:

```
void UpdateConfigRecord_Num( ConfigRecord *pNewRec, int num );
```

## Description:

This function is similar to the "UpdateConfigRecord" function, with the added option to indicate the desired record number to update.

Warning: Take care not to confuse interface number with record number. For example, the primary Ethernet has an interface number of '1' and a record number of '0'. If an invalid or non-existent record is read and written back into flash, you may risk rendering Ethernet and serial communication inoperable.

## Parameters:

| Type | Name | Description |
|---|---|---|
| ConfigRecord* | pNewRec | A pointer to a structure of type "ConfigRecord" whose contents will be used to update the ConfigRecord structure associated with a record number stored in flash. |
| int | num | The configuration record number to write to. Valid record numbers are:<br>0 (CONFIG_IF_ID_ETHERNET),<br>1 (CONFIG_IF_ID_WIFI), and<br>2 (CONFIG_IF_ID_ETHERNET2). |

## Returns:

Nothing --- This is a void function.

## 22.9. RawGetConfig

### Synopsis:

```
ConfigRecord * RawGetConfig( int num );
```

### Description:

This function returns a pointer of type "ConfigRecord" to the location of the configuration record associated with the desired record number provided in the input parameter.

Warning: Take care not to confuse interface number with record number. For example, the primary Ethernet has an interface number of '1' and a record number of '0'. If an invalid or non-existent record is read and written back into flash, you may risk rendering Ethernet and serial communication inoperable.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | num | The configuration record number to read. Valid record numbers are:<br>0 (CONFIG_IF_ID_ETHERNET),<br>1 (CONFIG_IF_ID_WIFI), and<br>2 (CONFIG_IF_ID_ETHERNET2). |

### Returns:

A pointer to the "ConfigRecord" structure.

## 22.10. SetupDialog

### Synopsis:

```
void SetupDialog( );
```

### Description:

This function will cause an interactive exchange on stdio. Note: This exchange will allow the user to change both the IP Address and Baudrate values.

### Parameters:

None

### Returns:

Nothing --- This is a void function

# 22.11. SaveUserParameters

## Synopsis:

```
int SaveUserParameters( void *pCopyFrom, int len );
```

## Description:

This function stores up to 8kB of arbitrary data in the user configuration space. The type and format of the stored data is entirely up to the individual developer. The system stores this as a blob, and provides no protection from uninitialized data. Note: The developer needs to add some uninitialized data protection to his stored structure.

## Parameters:

| Type | Name | Description |
|---|---|---|
| void | *pCopyFrom | A pointer to the data to store. |
| int | len | The length in bytes of the data to store. **Note:** This value must be less than or equal to 8192. |

## Returns:

0 (zero) --- Failure
len --- Returns the length in bytes of the data stored on success.

## 22.12. GetUserParameters

### Synopsis:

```
void * GetUserParameters( );
```

### Description:

This function returns a pointer to the user parameter area. This area is intended for storage of non-volatile configuration parameters. The type and format of the stored data is entirely up to the individual developer. The system stores this as a blob, and provides no protection from uninitialized data. Note: The developer needs to add some uninitialized data protection to his stored structure.

### Parameters:

None

### Returns:

A read only pointer to the user parameter area

### Example Application:

FlashForm --- Found in C:\Nburn\examples

## 22.13. putleds

### Synopsis:

```
void putleds( unsigned char b );
```

### Description:

This function is specific to the NetBurner development boards and turns the LEDs on or off. The function is located in the c:\nburn\<platform>\system\iobard.c file, where <platform> represents the NetBurner hardware platform you are using (eg Mod5270). You may modify this function to support any external hardware you design for your product. Depending on the development board, the hardware interface can be GPIO signals or use a Xylinx FPGA.

Note: The Mod-Dev-70 that is part of the Mod5270LC development kit, requires that a function called BOOL OnModDev70() be called before using the LEDs. This function is located in the ioboard.c platform system file.

- 0x00 = all OFF
- 0xFF = all ON
- 0x01 = LED 1
- 0x02 = LED 2
- 0x04 = LED 3
- 0x08 = LED 4
- 0x10 = LED 5
- 0x20 = LED 6
- 0x40 = LED 7
- 0x80 = LED 8

### Returns:

Nothing --- This is a void function

### Example Application:

TicTacToe --- Found in C:\Nburn\examples

## 22.14. getdipsw

### Synopsis:

```
unsigned char getdipsw( );
```

### Description:

This function reads the dip switches.

### Parameters:

None

### Returns:

The bit of the DIP switches:

- SW1 = 1
- SW2 = 2
- SW3 = 4
- SW4 = 8

### Example Application:

TicTacToe --- Found in C:\Nburn\examples

## 22.15. ShowData

### Synopsis:

```
void ShowData( PBYTE fromptr, WORD len );
```

### Description:

This function dumps a block of memory to stdio. It displays this block as hexadecimal and ASCII where appropriate.

### Returns:

Nothing --- This is a void function

## 22.16. ShowMac

### Synopsis:

```
void ShowMac( MACADR * ma );
```

### Description:

This function displays the MAC Address on stdout, which is UART 0 by default.

### Returns:

Nothing --- This is a void function

## 22.17. outbyte

### Synopsis:

```
void outbyte( char c );
```

### Description:

This function outputs a single character on stdout. Note**:** This is a very low overhead call.

### Returns:

Nothing --- This is a void function

## 22.18. print

### Synopsis:

```
void print( char * );
```

### Description:

The output of print is a NULL terminated string to stdout. **Note:** This is a much lower overhead call than printf.

### Returns:

Nothing --- This is a void function

## 22.19. putnum

### Synopsis:

```
void putnum( int i );
```

### Description:

The output of putnum is a hexadecimal number of stdout. **Note:** This is a much lower overhead call than printf.

### Returns:

Nothing --- This is a void function

## 22.20. AsciiToIp

### Synopsis:

```
IPADDR AsciiToIp( char * p );
```

### Description:

This function converts an ASCII representation of an IP Address to type IPADDR.

### Returns:

An IP address of type IPADDR.

### Example:

```
IPADDR IpAddr = AsciiToIp("10.1.1.12");
```

# 22.21. ShowIP

## Synopsis:

```
void ShowIP( IPADDR ia );
```

## Description:

This function displays an IP address variable of type IPADDR in ASCII text (eg 10.1.1.1) and sends it to stdout, which is the debug serial port 0 by default.

Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | ia | IPADDR variable to be displayed |

## Returns:

Nothing --- This is a void function

## Examples:

```
IPADDR IpAddr = AsciiToIp("10.1.1.12");

ShowIP( IpAddr ); // Sends ASCII "10.1.1.12" to stdio
```

# 22.22. itoa

## Synopsis:

```
char * itoa( int value, char * buffer, int radix )
```

## Description:

This function converts an integer value to a null-terminated string using the specified radix and stores the result in the buffer specified by **buffer**. If the radix is 10 and the value is negative, the string is preceded by a minus sign ('-'). With any other radix, the value is always considered unsigned.

**Note:** The buffer should be large enough to contain the largest possible value used in your application. For example:

- For **radix** = 2: **( sizeof( int ) * 8 + 1 )** = 33 bytes
- For **radix** = 10:
  - Unsigned integer = 11 bytes: Largest possible value is 4,294,967,296 (10 digits, each represented by a byte character, plus one additional byte for null).
  - Signed integer = 12 bytes: Lowest possible value is -2,147,483,648 and largest possible value is 2,147,483,647 (10 digits, each represented by a byte character, plus one additional byte for null, and another for the sign).

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | value | The value to be represented as a string. |
| char * | buffer | The buffer where the resulting string will be stored. |
| int | radix | The numerical base by which the value will be represented as a string; valid values are between 2 and 36, inclusive. |

## Return:

A pointer to the string

## 22.23. ShowCounters

### Synopsis:

```
void ShowCounters( );
```

### Description:

This diagnostic function will dump all of the system counters to stdout.

### Parameters:

None

### Returns:

Nothing --- This is a void function

# 22.24. GetPreciseTime

## Synopsis:

```
DWORD GetPreciseTime( void );
```

## Description:

Gets the number of time ticks since the system booted at a smaller resolution in comparison to using the global variable TimeTick (TimeTick has a resolution of about 50 milliseconds when TICKS_PER_SECOND = 20). This function is only accessible for the MOD5234, MOD5270, and MOD5282 platforms. The number of ticks returned by this function has a resolution of about 0.868 microseconds for the MOD5234 and MOD5270, and 1.929 microseconds for the MOD5282.

Note: This function is used to get a more precise time from the system clock; it is not intended to work as a time delay function like OSTimeDly().

## Parameters:

None.

## Returns:

The number of higher precision time ticks since system start.

## 22.25. ForceReboot

### Header File:

```
#include <bsp.h>          // Found in C:\Nburn\include
```

### Synopsis:

```
void ForceReboot( );
```

### Description:

This function will reboot your NetBurner device.

### Parameters:

None

### Returns:

Nothing --- This is a void function

### 22.25.1. Example

### Mod5270, Mod5272, and/or Mod5282 only

```
#include "predef.h"
#include "..\mod5272\system\sim5272.h"  // For Mod5272
                                       // For Mod5282 use: #include "..\mod5282\system\sim5282.h"
                                       // For Mod52270 use: #include "..\mod5282\system\sim5270.h"
#include <stdio.h>
#include <startnet.h>
#include <autoupdate.h>
#include <dhcpclient.h>
#include <bsp.h>

extern "C"
  {
    void UserMain(void * pd);
  }

/*-------------------------------------------------------------------------------------------
  User Main
 -------------------------------------------------------------------------------------------*/

const char * AppName="Software Reset";

void UserMain(void * pd)

{
      InitializeStack();
      OSChangePrio(MAIN_PRIO);
      EnableAutoUpdate();
      iprintf("\r\nStarting NetBurner Software Reset Example v1.0\r\n");
      iprintf("-------------------------------------------------\r\n");
      iprintf("To Software reset after 3 seconds press any key.\r\n\r\n");
      getchar();
      iprintf("\r\n");

      for(int i=0; i<3; i++)
           {
             OSTimeDly((WORD)(TICKS_PER_SECOND));
             iprintf("%d\r\n",i+1);
            }

     iprintf("\r\n\r\n\r\n\r\n\r\n\r\n\r\n\r\n\r\n");

     ForceReboot();  // Reboot your Mod5272, Mod5270, or Mod5282 Module

     iprintf("This will NOT print!\r\n");

}
```

## 22.26. EtherLink

### Header File:

```
#include <ethernet.h>     // Found in C:\Nburn\include
```

### Synopsis:

```
BOOL EtherLink( );
```

### Description:

This function reports the status of the Ethernet link.

### Parameters:

None

### Returns:

True --- If the Ethernet link is valid
False --- If there is no Ethernet connection

## 22.27. EtherSpeed100

### Header File:

```
#include <ethernet.h>      // Found in C:\Nburn\include
```

### Synopsis:

```
BOOL EtherSpeed100( );
```

### Description:

This function reports if the Ethernet link is operating at 100 MB.

### Parameters:

None

### Returns:

True --- If the Ethernet link is operating at 100 Mbps
Flase – 10Mbps mode.
**Important:** The EtherLink function must return true for this value to be valid.

## 22.28. EtherDuplex

### Header File:

```
#include <ethernet.h>     // Found in C:\Nburn\include
```

### Synopsis:

```
BOOL EtherDuplex( );
```

### Description:

This function reports if the Ethernet link is in Full Duplex mode.

### Parameters:

None

### Returns:

True --- If the Ethernet link is in full duplex mode
False – Half duplex mode
**Important:** The EtherLink function **must** return **true** for this value to be **valid**.

# 22.29. ManualEthernetConfig

## Header File:

```
#include <ethernet.h>   // Found in C:\Nburn\include
```

## Synopsis:

```
void ManualEthernetConfig( BOOL speed100Mbit, BOOL fullDuplex,
                           BOOL autoNegotiate )
```

## Description:

This function allows you to configure the speed and duplex mode of the device's Ethernet connection only if auto-negotiation is disabled (`autoNegotiate` = FALSE). If an application is also calling the `InitializeStack()` function, then `ManualEthernetConfig()` should be called after `InitializeStack()`. Otherwise, `InitializeStack()` will always override the manual configuration and use auto-negotiation by default.

If `autoNegotiate` = TRUE, then auto-negotiation will be used and the `speed100Mbit` and `fullDuplex` settings will have no effect.

If `autoNegotiate` = FALSE, then the `speed100Mbit` and `fullDuplex` settings will take effect:

- `speed100Mbit` = TRUE: 100Base-T
- `speed100Mbit` = FALSE: 10Base-T
- `fullDuplex` = TRUE: Full-duplex mode
- `fullDuplex` = FALSE: Half-duplex mode

Note: Manually setting both speed and duplex modes are usually required for establishing a connection to a device that does not support auto-negotation.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BOOL | `speed100Mbit` | 100 or 10 megabit connection speed – valid setting only if auto-negotiation is disabled. |
| BOOL | `fullDuplex` | Full or half-duplex mode – valid setting only if auto-negotiation is disabled. |
| BOOL | `autoNegotiate` | Enable or disable auto-negotiation. |

## Returns:

Nothing --- This is a void function.

# 22.30. EtherLinkCallback

## Header File:

```
#include <ethernet.h>   // Found in C:\Nburn\include
```

## Synopsis:

```
void (*EtherLinkCallback)( BOOL linkStatus )
```

## Description:

This function pointer is used to assign callback functions for Ethernet link status changes. When the pointer is non NULL, it will be called whenever `bEthLink` changes. It should be noted that whatever callback is assigned will be run as the Ethernet Task, in the Ethernet task's priority and stack. Therefore care must be taken to make such callbacks small in both time and space. The functions must take a single BOOL argument and return `void`.

**NOTE:** This callback is  not active in the debug Ethernet driver.

## Parameters:

| Type | Name | Description |
|---|---|---|
| BOOL | `linkStatus` | The new linkStatus for the Ethernet interface (TRUE = up, FALSE = down) |

## Returns:

Nothing --- This is a void function.

# 23. High Resolution Timer

**Processor Note: MCF5272 devices are not compatible with this library**

## 23.1. Itroduction

The High Resolution Timer class is designed to facilitate delays and triggers in the submillisecond range. The class is based on the hardware DMA timers and operates using interrupts to achieve such levels of accuracy. All timers use a level 6 interrupt.

The class is designed as an object wrapper around the hardware DMA timers, and as such has no public facing methods for creating objects. There is a direct mapping between instances of the class and DMA Timers on the module.

The classes functions can be broken into the categories: Setup, Stopwatch functions, Delays, and Other.

### Header Files

```
#include <HiResTimer.h>     // Found in <platform>\include
```

### Setup Functions

- getHiResTimer --- Obtain a pointer to one of the timers
- releaseTimer --- Releases the current timer back into the pool
- init --- Initializes the timer
- setInterruptFunction --- Sets the function to trigger when the timer's delay/period expires
- clearInterruptFunction --- Removes the trigger function

### Stopwatch Functions

- start --- Start the timer
- stop --- Stop the timer
- stopClear --- Stop and reset the timer
- readTime --- Gives the runtime since the timer started
- readLow --- Returns the current value of the hardware timer register.
- readHigh --- Returns the current cycle count

### Delay Functions

- delay --- Switch tasks and delay the current task by the specified number of seconds
- pollingDelay --- (Busy wait) Delay the current task by the specified number of seconds

### Other Functions

- getPrescaler --- Returns the active value for the hardware timer's prescaler
- clockGenerator --- Sets the timer to fire the timer's Interrupt Function at a given frequency
- toString --- Returns a pointer to a cstring of the timer object's data

### Macros

- DEFAULT_TIMER --- Sets the default timer to return, when no label is given
- TIMER_COUNT --- Sets the number of timer objects to create
  DO NOT EXCEED THE HARDWARE COUNT!

## 23.2. getHiResTimer

### Synopsis:

```
HiResTimer* getHiResTimer( int timer );
```

### Description:

This function returns a pointer to one of the HiResTimer objects. The object's labels are 0 indexed.

- If the timer selected has not been used before, it will first be initialized and the initialization flag will be set to TRUE. The pointer to the object will then be returned.
- If the timer selected DOES NOT EXIST, either because a negative value or value that exceeds the maximal timer, then the function will return a NULL pointer.

### Parameters:

| Type | Name | Description |
|---|---|---|
| Int | timer=0 | The timer ID to select (0 based |

### Returns:

Pointer to the selected HiResTimer

### See Also:

- TIMER_COUNT --- Sets the number of timer objects to create

### Example Applications:

HiResTimerDemo --- Located by default in C:\Nburn\examples\utils

## 23.3. Init

### Synopsis:

```
void init( double InterrputTime = 0 );
```

### Description:

This method initializes the timer it is called upon. If an argument is supplied, it will set the timer to trigger the interruptFunction periodically, with the period given by the argument, in seconds.

### Parameters:

| Type | Name | Description |
|---|---|---|
| double | InterruptTime=0 | The delay period between triggers |

### Returns:

Nothing. This method is void.

## 23.4. setInterruptFunction

### Synopsis:

```
void setInterruptFunction( void (*interruptFunction)() );
```

### Description:

This method sets the timer's interruptFunction. The interruptFunction is called when a timer triggers.

### Parameters:

| Type | Name | Description |
|---|---|---|
| void (*f)() | interruptFunction | The function to call when the timer triggers |

### Returns:

Nothing. This method is void.

## 23.5. clearInterruptFunction

### Synopsis:

```
void clearInterruptFunction();
```

### Description:

This method clears (sets to NULL) the timer's interruptFunction.

### Parameters:

None.

### Returns:

Nothing. This method is void.

## 23.6. start

### Synopsis:

```
void start();
```

### Description:

Starts the timer.

### Parameters:

None

### Returns:

Nothing. This method is void.

## 23.7. stop

### Synopsis:

```
void stop();
```

### Description:

Stops the timer. All data will remain stored.

### Parameters:

None

### Returns:

Nothing. This method is void.

## 23.8. stopClear

### Synopsis:

```
void stopClear();
```

### Description:

Stops the timer and clears the timer data.

### Parameters:

None

### Returns:

Nothing. This method is void.

## 23.9. readTimer

### Synopsis:

```
double readTimer();
```

### Description:

Reads the amount of time in seconds that has passed since the timer was started.

### Parameters:

None

### Returns:

double --- the total number of seconds that the timer has been running.

## 23.10. readLow

### Synopsis:

```
DWORD readLow();
```

### Description:

Reads the actual timer register and returns its count.

### Parameters:

None

### Returns:

DWORD --- the hardware timer's count at the time of the call.

## 23.11. readHigh

### Synopsis:

```
DWORD readHigh();
```

### Description:

Reads the number of hardware timer overflows.

### Parameters:

None

### Returns:

DWORD --- the number of hardware timer overflows

## 23.12. delay

### Synopsis:

```
void delay( double delayTime);
```

### Description:

Starts a precise task delay that will have the OS switch tasks while waiting.
**NOTE:** This method is not recommended for delays less than ~150 microseconds. For this, use `pollingDelay`.

### Parameters:

| Type | Name | Description |
|---|---|---|
| double | delayTime | Number of seconds to delay |

### Returns:

Nothing. This method is void.

## 23.13. pollingDelay

### Synopsis:

```
void pollingDelay( double delayTime);
```

### Description:

Starts a precise task delay that will busy wait while waiting.
**NOTE:** This method is not recommended for long delays as it consumes system resources. For longer delays, use `delay`.

### Parameters:

| Type | Name | Description |
|---|---|---|
| double | delayTime | Number of seconds to delay |

### Returns:

Nothing. This method is void.

## 23.14. getPrescaler

### Synopsis:

```
DWORD getPrescaler();
```

### Description:

Returns the value of the hardware timer prescaler. This is primarily to be used in concert with `readLow`.

### Parameters:

None

### Returns:

DWORD --- the value of the hardware time prescaler

## 23.15. clockGenerator

### Synopsis:

```
void clockGenerator( double frequency );
```

### Description:

Configures DMA Timer peripheral to toggle DMA Timer Output signal at given frequency. User is responsible for configuring GPIO multiplexor for DMA Timer Output Function.

### Parameters:

| Type | Name | Description |
|---|---|---|
| double | frequency | Frequency to set the clock to |

### Returns:

Nothing. This method is void.

## 23.16. toString

### Synopsis:

```
char* toString();
```

### Description:

Returns a **char** buffer that contains a string representation of the timer object.

### Parameters:

None

### Returns:

char* --- **char** buffer that contains a string representation of the timer object.

# 24. TCP/IP Library

## 24.1. Introduction

The TCP/IP Stack is a high performance TCP/IP Stack for embedded applications. The TCP/IP Stack is integrated with the RTOS, Web Server, and I/O System providing easy development of network applications.

The NetBurner Web Server is integrated with the TCP/IP Stack and RTOS, enabling you to quickly develop dynamic web pages and content.

This section covers the TCP/IP specific functions (i.e. the creation and setup of sockets) in the NetBurner system. Important: This section does not cover the read/write operations on these sockets. The read/write operations are covered in the I/O System Library. For UDP specific functions please refer to the UDP Library.

## Header Files

```
#include <ip.h>             // Found in C:\Nburn\include
#include <tcp.h>            // Found in C:\Nburn\include
#include <udp.h>            // Found in C:\Nburn\include
#include <multihome.h>      // Found in C:\Nburn\include
```

## IP Stack Start, Stop, and Add Functions

- InitializeStack --- Start the IP and TCP stack
- AddInterface --- (MULTIHOME) Add an additional IP interface to the system

## Socket Creation Functions

- listen --- Start listening to accept connections
- accept --- Accept a connection on a listening socket
- connect --- Connect initiate a connection to another host
- connectvia --- Connect initiate a connection to another host via a specific interface

## Socket Option Functions

- setsockoption --- Set a socket option
- clrsockoption --- Clear a socket option
- getsockoption --- Get a socket option

## Get Socket Information Functions

- GetSocketRemoteAddr --- Get the IP address of the remote host associated with a socket
- GetSocketLocalAddr --- Get the IP address of local interface associated with a socket (Warning: This only works with MULTIHOME)
- GetSocketRemotePort --- Get the remote port associated with a socket
- GetSocketLocalPort --- Get the local port associated with a socket

## Get Host by Name Function

- GetHostByName --- Look up an IP address using DNS

## Ping Functions

- Ping --- Sends an ICMP echo to an address and waits for a response
- PingViaInterface --- Sends an ICMP echo through a specified interface and waits for a response

## TFTP Functions

- GetTFTP --- Read a file from a TFTP server
- SendTFTP --- Send a file to a TFTP server

## Diagnostic Functions

- ShowArp --- Dump the ARP cache to stdio
- DumpTcpDebug --- Dump the TCP debugging log to stdio
- EnableTcpDebug --- Enable the TCP debug log
- ShowIPBuffer --- Dump a pool pointer to stdio, interpreting it as a packet
- GetFreeCount --- Get number of free buffer available
- ShowBuffer --- Show the raw data in a poolptr

## TCP Error Codes

```
#define TCP_ERR_NORMAL              (0)
#define TCP_ERR_TIMEOUT             (-1)
#define TCP_ERR_NOCON               (-2)
#define TCP_ERR_CLOSING             (-3)
#define TCP_ERR_NOSUCH_SOCKET       (-4)
#define TCP_ERR_NONE_AVAIL          (-5)
#define TCP_ERR_CON_RESET           (-6)
#define TCP_ERR_CON_ABORT           (-7)
```

## Byte Order Translation (not needed on ColdFire) Functions

- HTONS --- Translate a WORD from host order to network order
- HTONL --- Translate a DWORD from host order to network order
- NTOHS --- Translate a WORD from network order to host order
- NTOHL --- Translate a DWORD from network order to host order

## 24.2. InitializeStack

### Synopsis:

```
void InitializeStack( IPADDR ipaddr=0, IPADDR ipMask=0, IPADDR ipGate=0 );
```

### Description:

This function initializes the IP stack.

- If no values are passed in for the addresses, the default values are copied from the system configuration record.
- This function can only be called once on startup. It should never be called a second time in your application. If you want to change IP address, mask, gateway or DNS settings at runtime, you must first close all active and listening sockets, modify the EthernetIPxxx runtime variables, save to flash if you wish them to active at the next boot/reset, then reopen your listening sockets. The ChangeIP example in the Network Programmers Guide, and the associated example source code in the \nburn\examples directory describe how to update settings at runtime. These steps are not necessary if you change the settings using the IPSetup utility.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | ipaddr=0 | The IP Address |
| IPADDR | ipMask=0 | The IP (Network) Mask |
| IPADDR | ipGate=0 | The IP Gateway |

### Returns:

Nothing --- This is a void function

### See Also:

ConfigRecord --- The configuration storage structure

### Example Applications:

Simple Html --- Located by default in C:\Nburn\examples
tcp2Serial --- Located by default in C:\Nburn\examples

## 24.3. AddInterface (Multihome)

### Header File:

```
#include<multihome.h>     // Found in C:\Nburn\include
```

### Synopsis:

```
int AddInterface( IPADDR addr, IPADDR mask, IPADDR gateway );
```

### Description:

This function creates/initializes a new IP interface. This call adds a new interface to the system.

Warning: This call only works if you have defined the variable MULTIHOME in C:\Nburn\include\predef.h and rebuilt all of the system libraries.

### Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | addr | The IP Address of the new interface. |
| IPADDR | mask | The IP (Network) Mask of the new interface |
| IPADDR | gateway | The IP Gateway of the new interface. |

### Returns:

Any value greater than 0 --- Equals the interface number
-1 --- Failed too many interfaces

# 24.4. listen

## Synopsis:

```
int listen( IPADDR addr, WORD port, BYTE maxpend=5 );
```

## Description:

This function starts listening for connections on a TCP port. You must accept connections from this socket before you can use them. **Note:** You may use select to wait for connections on multiple listening sockets, by putting a listening socket in the readfds.

## Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | addr | The address from which to accept connections. **Note:** If you want to accept connections from anywhere pass in the value INADDR_ANY. |
| WORD | port | The port to listen to. |
| BYTE | maxpend | The maximum number of pending connections to store on this listening socket. |

## Returns:

A file descriptor for the listening socket

A negative number if there was an error:

- TCP_ERR_NOCON (-2) --- Indicates that you have attempted to read/write from a socket that does not have a connection established yet.
- TCP_ERR_NONE_AVAIL (-5) --- Indicates that you have attempted to allocate a socket, but no socket it currently available.

## See Also:

accept --- Accept a connection on a listening socket
close --- Close open file descriptors (In the I/O section of this manual)

## Example Application:

tcp2serial --- Located by default in C:\Nburn\examples

## 24.5. accept

### Synopsis:

```
int accept( int listening_socket, IPADDR * address, WORD * port,
            WORD timeout );
```

### Description:

This function accepts a connection from a listening socket.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | listening_socket | The listening socket to accept from. |
| IPADDR | *address | A pointer to the IPADDR that will receive the IPADDR of the connection. **Note:** This parameter can be NULL. |
| WORD | *port | A pointer to the WORD that will receive the port number of the connection. **Note:** This parameter can be NULL |
| WORD | timeout | The number of time ticks to wait for a connecting socket. **Note:** 0 waits forever. |

### Returns:

The file descriptor of the connected socket

A negative number if there was an error:

- TCP_ERR_TIMEOUT (-1) --- Indicates that the connection has timed out.
- TCP_ERR_NOCON (-2) --- Indicates that you have attempted to read/write from a socket that does not have a connection established yet.
- TCP_ERR_CLOSING (-3) --- Indicates that you have attempted to read/write from a socket that has already been closed.
- TCP_ERR_NOSUCH_SOCKET (-4) --- Indicates that you have attempted to allocate a socket that does not exist.
- TCP_ERR_NONE_AVAIL (-5) --- Indicates that you have attempted to allocate a socket, but no socket it currently available.
- TCP_ERR_CON_RESET (-6) --- Indicates that you have attempted to read/write from a connection that has been reset by the other side.
- TCP_ERR_CON_ABORT (-7) --- This is an internal error that the client won't usually see.

### See Also:

listen ---Start listening to accept connections.
close ---Close open file descriptors (In the I/O section of this manual)

# 24.6. connect

## Synopsis:

```
int connect( IPADDR addr, WORD localport, WORD remoteport,
             DWORD timeout );
```

## Description:

This function connects to another host.

## Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | addr | The address to connect to. |
| WORD | localport | The local port to use for the connection. **Note:** A value of 0 causes the stack to select an unused port. |
| WORD | remoteport | The remote port to connect to. |
| DWORD | timeout | The number of time ticks to wait for a connecting socket. **Note:** A value of 0 waits forever. |

## Returns:

The file descriptor of the connected socket

A negative number if there was an error:

- TCP_ERR_TIMEOUT (-1) --- Indicates that the connection has timed out.
- TCP_ERR_NOCON (-2) --- Indicates that you have attempted to read/write from socket that does not have a connection established yet.
- TCP_ERR_CLOSING (-3) --- Indicates that you have attempted to read/write from a socket that has already been closed.
- TCP_ERR_NONE_AVAIL (-5) --- Indicates that you have attempted to allocate a socket, but no socket it currently available.
- TCP_ERR_CON_RESET (-6) --- Indicates that you have attempted to read/write from a connection that has been reset by the other side.
- TCP_ERR_CON_ABORT (-7) --- This is an internal error that the client won't usually see.

## See Also:

connectvia --- Initiate a connection to another host via a specific MULTIHOME interface
accept --- Accept a connection on a listening socket
listen --- Start listening to accept connections
close --- Close open file descriptors (In the I/O section of this manual)

# 24.7. connectvia

## Synopsis:

```
int connectvia( IPADDR addr, WORD localport, WORD remoteport,
                DWORD timeout, IPADDR ipa );
```

## Description:

This function connects to another host via a specific IP interface.

## Parameters:

| Type | Name | Description |
|---|---|---|
| IPADDR | addr | The address to connect to. |
| WORD | localport | The local port to use for the connection. **Note:** A value of 0 causes the stack to select an unused port. |
| WORD | remoteport | The remote port to connect to. |
| DWORD | timeout | The number of time ticks to wait for a connecting socket. **Note:** A value of 0 waits forever. |
| IPADDR | ipa | The IP address of the interface to use for making this connection. |

## Returns:

The file descriptor of the connected socket

A negative number if there was an error:

- TCP_ERR_TIMEOUT (-1) --- Indicates that the connection has timed out.
- TCP_ERR_NOCON (-2) --- Indicates that you have attempted to read/write from socket that does not have a connection established yet.
- TCP_ERR_CLOSING (-3) --- Indicates that you have attempted to read/write from a socket that has already been closed.
- TCP_ERR_NONE_AVAIL (-5) --- Indicates that you have attempted to allocate a socket, but no socket it currently available.
- TCP_ERR_CON_RESET (-6) --- Indicates that you have attempted to read/write from a connection that has been reset by the other side.
- TCP_ERR_CON_ABORT (-7) --- This is an internal error that the client will not (usually) see.

## See Also:

connect --- Initiate a connection to another host via default interface
accept --- Accept a connection on a listening socket
listen --- Start listening to accept connections
close --- Close open file descriptors (In the I/O section of this manual)

## 24.8. setsockoption

### Synopsis:

```
int setsockoption( int fd, int option );
```

### Description:

This function sets a socket option.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |
| int | option | The option to set. |

### Options:

SO_NONAGLE --- Disables the NAGLE algorithm for this socket.
SO_NOPUSH --- Does not send packets with every write. It holds the data for larger packets.

### Returns:

The bitmask of all the options for this socket

### See Also:

clrsockoption --- Clears a specific socket option
getsockoption --- Get a socket option

## 24.9. clrsockoption

### Synopsis:

```
int clrsockoption( int fd, int option );
```

### Description:

This function clears a specific socket option.

### Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |
| int | option | The option to clear. |

### Options:

SO_NONAGLE --- Disables the NAGLE algorithm for this socket
SO_NOPUSH --- Does not send packets with every write. It holds the data for larger packets

### Returns:

The bit of all enabled options

### See Also:

setsockoption --- Set a socket option
getsockoption --- Get a socket option

# 24.10. getsockoption

## Synopsis:

```
int getsockoption( int fd );
```

## Description:

This function gets the current options for this socket.

Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |

## Options:

SO_NONAGLE --- Disables the NAGLE algorithm for this socket.
SO_NOPUSH --- Does not send packets with every write. It holds the data for larger packets.

## Returns:

The bit of all enabled options for the selected socket

## See Also:

setsockoption --- Set a socket option
clrsockoption --- Clear a socket option

# 24.11. GetSocketRemoteAddr

## Synopsis:

```
IPADDR GetSocketRemoteAddr( int fd );
```

## Description:

This function gets the IP address of the remote host associated with this socket.

Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |

## Returns:

The IP Address of the remote host

## See Also:

GetSocketLocalAddr --- Get the IP address of local interface associated with a socket
GetSocketRemotePort --- Get the remote port associated with a socket
GetSocketLocalPort --- Get the local port associated with a socket

# 24.12. GetSocketLocalAddr

## Synopsis:

```
IPADDR GetSocketLocalAddr( int fd );
```

## Description:

This function gets the IP address of the interface associated with this socket.

Warning: This call only works if you have defined the variable MULTIHOME in C:\Nburn\include\predef.h and rebuilt all of the system libraries

Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |

## Returns:

The IP Address of the associated interface

## See Also:

GetSocketRemoteAddr --- Get the IP address of the remote host associated with a socket
GetSocketRemotePort --- Get the remote port associated with a socket
GetSocketLocalPort --- Get the local port associated with a socket

# 24.13. GetSocketRemotePort

## Synopsis:

```
WORD GetSocketRemotePort( int fd )
```

## Description:

This function gets the remote port associated with this socket.

Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |

## Returns:

This function returns the (WORD) remote port of the remote host.

## See Also:

GetSocketRemoteAddr --- Get the IP address of the remote host associated with a socket
GetSocketLocalAddr --- Get the IP address of local interface associated with a socket
GetSocketLocalPort --- Get the local port associated with a socket

# 24.14. GetSocketLocalPort

## Synopsis:

```
WORD GetSocketLocalPort( int fd );
```

## Description:

This function gets the local port associated with this socket.

Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |

## Returns:

This function returns the (WORD) local port of the remote host.

## See Also:

GetSocketRemoteAddr --- Get the IP address of the remote host associated with a socket
GetSocketLocalAddr --- Get the IP address of local interface associated with a socket
GetSocketRemotePort --- Get the remote port associated with a socket

## 24.15. GetHostByName

### Header File:

```
#include <dns.h>           // Found in C:\Nburn\include
```

### Synopsis:

```
int GetHostByName( const char * name, IPADDR * pIpaddr,
                   IPADDR dns_server, DWORD timeout );
```

### Description:

This function looks up the IP address of the named host. Note that you will need to configure the NetBurner device to have a valid DNS IP address and Gateway IP address.

### Parameters:

| Type | Name | Description |
|---|---|---|
| const char | *name | The name to resolve (e.g. www.netburner.com). |
| IPADDR | *pIpaddr | A pointer to the IPADDR variable. (Used to store the retrieved address.) |
| IPADDR | dns_server | The IPADDR of the DNS server to query. **Note:** 0 uses the stored system default. |
| WORD | timeout | The number of time ticks to wait for a response. **Note:** A value of 0 waits forever. |

### Returns:

DNS_OK --- On Success
DNS_TIMEOUT --- If the DNS Server does not respond
DNS_NOSUCHNAME --- If the DNS Server can not find the name
DNS_ERR --- If the received DNS response has errors

### See Also:

AsciiToIp --- Convert a dotted decimal IP string to an IP address
ShowIP --- Show an IP address as dotted decimal on stdio

## 24.16. Ping

### Synopsis:

```
int Ping( IPADDR to, WORD id, WORD seq, WORD maxwaitticks );
```

### Description:

This function "pings" the selected address and waits for a response. Ping (i.e. **P**acket **IN**ternet **G**roper) is an Internet utility used to determine whether a particular IP address is online by sending out a packet and waiting for a response. Ping is also used to test and debug a network as well as see if a user is online. Ping can also function like a DNS (Domain Name Server) because "pinging" a domain name will return its IP address. The Ping function is used for the primary ethernet interface. **Note:** If you need to ping through another specified interface, you **must** use the **PingViaInterface** function.

### Returns:

The number of ticks the response took
-1 --- If it timed out

### See Also:

PingViaInterface --- Sends an ICMP echo through a specified interface and waits for a response
SendPing --- Sends an ICMP echo to an address

### Example:

```
/* This function pings the address given in buffer */
void ProcessPing(char * buffer)
{
   IPADDR addr_to_ping;
   char * cp = buffer; /* Trim leading white space */

   /* Get the address or use the default */
   while ((*cp) && (isspace(*cp))) cp++;
   if ( cp[0] )
      addr_to_ping = AsciiToIp(cp);
   else
      addr_to_ping = IpGate;
   iprintf( "\nPinging :" );
   ShowIP( addr_to_ping );
   iprintf("\n");
   int rv = Ping( addr_to_ping, 1/*Id */, 1 /*Seq */, 100/*Max Ticks*/ );
   if ( rv == -1 )
      iprintf(" Failed! \n" );
   else
      iprintf(" Response Took %d ticks\n", rv );
}
```

# 24.17. PingViaInterface

## Synopsis:

```
int PingViaInterface( IPADDR to, WORD id, WORD seq, WORD maxwaitticks,
                      int interface );
```

## Description:

This function "pings" the selected address through a specified interface and waits for a response. Ping (i.e. **P**acket **IN**ternet **G**roper) is an Internet utility used to determine whether a particular IP address is online by sending out a packet and waiting for a response. Ping is also used to test and debug a network as well as see if a user is online. Ping can also function like a DNS (Domain Name Server) because "pinging" a domain name will return its IP address. **Note:** If pinging over WiFi (or if any other alternate IP interface is desired), then this function is required in lieu of the Ping function.

## Returns:

The number of ticks the response took
-1 --- If it timed out

## See Also:

Ping --- Sends an ICMP echo to an address and waits for a response
SendPing --- Sends an ICMP echo to an address

# 24.18. SendPing

## Synopsis:

```
void SendPing( IPADDR to, WORD id, WORD seq, int interface );
```

## Description:

This function "pings" the selected address. Ping (i.e. **P**acket **IN**ternet **G**roper) is an Internet utility used to determine whether a particular IP address is online by sending out a packet and waiting for a response. Ping is also used to test and debug a network as well as see if a user is online. Ping can also function like a DNS (Domain Name Server) because "pinging" a domain name will return its IP address. The Ping function is used for the primary ethernet interface. **Note:** If you need to ping through another specified interface, you must use the **PingViaInterface** function.

## Returns:

Nothing --- This is a void function

## See Also:

Ping --- Sends an ICMP echo to an address and waits for a response
PingViaInterface --- Sends an ICMP echo through a specified interface and waits for a response

# 24.19. GetTFTP

## Synopsis:

```
int GetTFTP( PCSTR fname, PCSTR mode, PBYTE buffer, int & len,
             DWORD timeout, IPADDR server, WORD opening_port );
```

## Description:

This function reads a file from a TFTP Server and put it in the passed in buffer. Important: TFTP (i.e. Trivial File Transfer Protocol) is a version of the TCP/IP FTP protocol that has no directory or password capability.

## Parameters:

| Type | Name | Description |
|---|---|---|
| PCSTR | fname | The name of the file to retrieve. |
| PCSTR | mode | The opening mode: b (binary) or t (text). |
| PBYTE | buffer | A pointer to the memory area to hold the received file. |
| int | &len | A reference to the buffer length. It holds the maximum length when the function is called and holds the number of bytes actually copied on return. |
| DWORD | timeout | The number of ticks to wait for the operation to complete. |
| IPADDR | server | The IP Address to send the TFTP request to. |
| WORD | opening_port | The port to send the TFTP request to. |

## Returns:

TFTP_OK (0)
TFTP_TIMEOUT (1)
TFTP_ERROR (2)

## See Also:

SendTFTP --- Send a file to a TFTP server
NBTFTP --- A TFTP Server for Win32

# 24.20. SendTFTP

## Synopsis:

```
int SendTFTP( PCSTR fname, PCSTR mode, PBYTE buffer, int & len,
      DWORD timeout, DWORD pkttimeout, IPADDR server, WORD opening_port );
```

## Description:

This function sends a file to a TFTP server. Important: TFTP (i.e. Trivial File Transfer Protocol) is a version of the TCP/IP FTP protocol that has no directory or password capability.

## Parameters:

| Type | Name | Description |
|---|---|---|
| PCSTR | fname | The name of the file to put on the TFTP Server. |
| PCSTR | mode | The opening mode: b (binary) or t (text). |
| PBYTE | buffer | A pointer to the memory area that holds the file to be sent. |
| int | &len | A reference to the buffer length. It holds the maximum length when the function is called, and holds the number of bytes actually copied on return. |
| DWORD | timeout | The total number of ticks to wait for the operation to complete. |
| DWORD | pkttimeout | The number of ticks to wait for timeout on each packet sent. |
| IPADDR | server | The IP Address to send the TFTP request to. |
| WORD | opening_port | The port to send the TFTP request to. |

## Returns:

TFTP_OK (0)
TFTP_TIMEOUT (1)
TFTP_ERROR (2)

## See Also:

NBTFTP --- A TFTP Server for Win32
GetTFTP --- Read a file from a TFTP server

# 24.21. ShowArp

## Synopsis:

```
void ShowArp( );
```

## Description:

This function dumps the ARP cache to stdio. ARP (**A**ddress **R**esolution **P**rotocol) is a protocol for mapping an Internet Protocol address (IP address) to a physical machine address that is recognized in the local network. The physical machine address is also known as a Media Access Control (MAC) address. A table, usually called the ARP cache, is used to maintain a correlation between each MAC address and its corresponding IP address. ARP provides the protocol rules for making this correlation and providing address conversion in both directions.

When an incoming packet destined for a host machine on a particular local area network arrives at a gateway, the gateway asks the ARP program to find a physical host or MAC address that matches the IP address. The ARP program looks in the ARP cache and, if it finds the address, provides it so that the packet can be converted to the right packet length and format and sent to the machine. If no entry is found for the IP address, ARP broadcasts a request packet in a special format to all the machines on the LAN to see if one machine knows that it has that IP address associated with it. A machine that recognizes the IP address as its own returns a reply so indicating. ARP updates the ARP cache for future reference and then sends the packet to the MAC address that replied.

Since protocol details differ for each type of local area network, there are separate ARP Requests for Comments (RFC) for Ethernet, ATM, Fiber Distributed-Data Interface, High-Performance Parallel Interface (HIPPI), and other protocols. There is also a Reverse ARP (RARP) for host machines that do not know their IP address. RARP enables them to request their IP address from the gateway's ARP cache.

## Parameters:

None

## Returns:

Nothing --- This is a void function

## See Also:

ShowIPBuffer --- Dump a pool pointer to stdio, interpreting it as a packet

## 24.22. DumpTcpDebug

### Synopsis:

```
void DumpTcpDebug( );
```

### Description:

This function dumps the TCP debugging log to stdio.

### Parameters:

None

### Returns:

Nothing ---This is a void function

### See Also:

EnableTcpDebug --- Enable the TCP debug log

## 24.23. EnableTcpDebug

### Synopsis:

```
void EnableTcpDebug( WORD db );
```

### Description:

This function enables the TCP debug log.

### Returns:

Nothing --- This is a void function

### See Also:

DumpTcpDebug --- Dump the TCP debugging log to stdio

## 24.24. ShowIPBuffer

### Synopsis:

```
void ShowIPBuffer( PoolPtr rp );
```

### Description:

This function dumps a pool pointer to stdio, interpreting it as a packet.

### Returns:

Nothing --- This is a void function.

### See Also:

ShowBuffer --- Show the raw data in a pool pointer
GetFreeCount --- Get number of free buffer available
ShowArp --- Dump the ARP cache to stdio

# 24.25. GetFreeCount

## Synopsis:

```
#include <buffers.h>

WORD GetFreeCount( );
```

## Description:

This function returns the number of free pool buffers, which are used for network and serial communication. The buffers.h include file is normally already included, so you do not usually need to add it yourself. The maximum number of buffers is defined in \nburn\include\constants.h as:
#define BUFFER_POOL_SIZE  (256).
The size of each buffer is defined as: #define ETHER_BUFFER_SIZE 1548.

A number of buffers must be allocated to the Ethernet driver for receiving packets. The number will vary by platform, but is typically 10 buffers. If your number of free buffers reaches zero, then no further network communication will be possible until some buffers are freed.

Serial port buffers are defined as a number of buffers allocated from this buffer pool for serial use only. In constants.h the default definitions are:

#define SERIAL_TX_BUFFERS (2)
#define SERIAL_RX_BUFFERS (2)

Each serial port buffer is equal in size to an Ethernet buffer.

## Parameters:

None

## Returns:

Number of free buffers.

## See Also:

ShowIPBuffer --- Dump a pool pointer to stdio, interpreting it as a packet
ShowBuffer --- Show the raw data in a pool pointer

## 24.26. ShowBuffer

### Synopsis:

```
void ShowBuffer( PoolPtr p );
```

### Description:

This function shows the raw data in a buffer referenced by a pool pointer.

### Returns:

Nothing --- This is a void function

### See Also:

ShowIPBuffer --- Dump a pool pointer to stdio, interpreting it as a packet
GetFreeCount --- Get number of free buffer available

# 24.27. TcpGetLastRxTime

## Synopsis:

```
DWORD TcpGetLastRxTime(int fd);
```

## Description:

Each TCP connection has a corresponding Socket_struct. One of the elements of this struct is a variable called LastRxTime, which stores the current time tick every time a packet is received. This function allows you to find out when the last packet was received by returning this variable.

- This function, along with TcpSendKeepAlive, is used to implement keepalive.
- If LastRxTime is the same before and after a keepalive packet is sent, the client has not responded to the keepalive packet and it can be assumed that connection is lost.
- Make sure to allow time for the client to respond to the keep alive packet
- Do not call TcpGetLastRxTime more often than once every second.

## Parameters:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |

## Returns:

Time (in ticks) of last TCP packet received on the corresponding socket.

## See Also:

TcpSendKeepAlive --- Send KeepAlive packet

# 24.28. TcpSendKeepAlive

## Synopsis:

```
void TcpSendKeepAlive (int fd);
```

## Description:

This function checks to see if the other end of a TCP connection is still responding by sending it an empty packet with a decremented sequence number (the sequence number of the last packet it sent). This causes the other end to send an ACK even though the packet was empty.

**Parameters**:

| Type | Name | Description |
|---|---|---|
| int | fd | The socket file descriptor. |

## Returns:

Nothing

## See Also:

TcpGetLastRxTime --- get time of last packet received

# 24.29. HTONS

## Synopsis:

```
WORD HTONS( WORD x );
```

## Description:

This function translates a WORD from host order to network order.

## See Also:

HTONL --- Translate a DWORD from host order to network order
NTOHS --- Translate a WORD from network order to host order
NTOHL --- Translate a DWORD from network order to host order

# 24.30. HTONL

## Synopsis:

```
DWORD HTONL( DWORD x );
```

## Description:

This function translates a DWORD from host order to network order.

## See Also:

HTONS --- Translate a WORD from host order to network order
NTOHS --- Translate a WORD from network order to host order
NTOHL --- Translate a DWORD from network order to host order

# 24.31. NTOHS

## Synopsis:

```
WORD NTOHS( WORD x );
```

## Description:

This function translates a WORD from network order to host order.

## See Also:

HTONL --- Translate a DWORD from host order to network order
HTONS --- Translate a WORD from host order to network order
NTOHL --- Translate a DWORD from network order to host order

# 24.32. NTOHL

## Synopsis:

```
DWORD NTOHL( DWORD x );
```

## Description:

This function translates a DWORD from network order to host order.

## See Also:

HTONL --- Translate a DWORD from host order to network order
HTONS --- Translate a WORD from host order to network order
NTOHS --- Translate a WORD from network order to host order

# 25. UDP Library

The UDP protocol is implemented as a C++ class. You can implement UDP functionality in your application using the C++ class interface, or you can use wrapper functions that implement a UDP sockets type interface. For background on UDP and example programs, please refer to the NetBurner Network Programming Guide.

### Header File

```
#include <udp.h>          // Found in C:\Nburn\include
```

## 25.1. UPD C++ Class API

### Constructors and Destructor

- UDPPacket --- Construct a UDP object by waiting on a FIFO
- UDPPacket --- Make a UDP packet from a pool buffer
- UDPPacket --- Make an empty UDP packet
- ~UDPPacket --- UDP packet destructor

### Check Packet Validity

- Validate --- Returns true if the packet is valid

### Packet Element Access

- SetSourcePort --- Set the source port for the packet
- GetSourcePort --- Read source port
- SetDestinationPort --- Set the destination port
- GetDestinationPort --- Get the destination port

### Data Access Functions

- GetDataBuffer --- Get a pointer to the data buffer
- SetDataSize --- Set the size of the data section
- GetDataSize ---Get the size of the data section
- ResetData --- Zero the data buffer length

### Append Data Functions

- AddData --- Add data on the end
- AddData --- Add a zero terminated string
- AddDataWord --- Add a WORD
- AddDataByte --- Add a Byte

## Pool Pointer Access Functions

- ReleaseBuffer --- Release the UDP objects captive buffer
- GetPoolPtr --- Get a handle to the UDP objects captive buffer

## Send Functions

- SendAndKeep --- Send a copy of the attached pool pointer
- SendAndKeepVia --- Send a copy of the attached pool ptr via a specific interface
- Send --- Send and free the attached pool buffer
- SendVia --- Send and free the attached pool buffer via a specific interface

## Related Class Functions

- RegisterUDPFifo --- Register to listen to a specific UDP port
- UnregisterUDPFifo --- Unregister a listening UDP Fifo

### 25.1.1. UDP Class Example

The following example is taken from the NetBurner Network Programmers Guide, which provides detailed information on UDP.

```
/*****************************************************************************
 UDP Packet C++ Class Example
 This application will send/receive UDP packets with another host on a network,
 such as a PC. Use the MTTTY serial port program to access the menu and
 prompts to specify the destination IP address and port number.

 NetBurner supplies an API for handling UDP as a C++ Class using UDPPacket, or
 you can use a UDP sockets API (see UDP socket example).

 For an external UDP host you can use the NetBurner java example, or the
 NetBurner UDP terminal program.
*****************************************************************************/
#include "predef.h"
#include <stdio.h>
#include <stdlib.h>
#include <ctype.h>
#include <startnet.h>
#include <ucos.h>
#include <udp.h>
#include <autoupdate.h>
#include <string.h>
#include <taskmon.h>
#include <dhcpclient.h>
#include <networkdebug.h>

const char *AppName = "UDP C++ Packet Class Example";

extern "C"
{
   void UserMain( void *pd );
}


// Declare a task stack for the UDP Reader task
DWORD UdpReaderStack[USER_TASK_STK_SIZE];


/*-------------------------------------------------------------------
 * This task will wait for incoming UDP packets and process them.
 -------------------------------------------------------------------*/
void UdpReaderTask( void *pd )
{
   int port = ( int ) pd;
   iprintf( "UdpReaderTask monitoring port %d\r\n", port );

   // Create FIFO to store incoming packets and initialize it
   OS_FIFO fifo;
   OSFifoInit( &fifo );

   // Register to listen for UDP packets on port number 'port'
   RegisterUDPFifo( port, &fifo );

   while ( 1 )
   {
      // We construct a UDP packet object using the FIFO.
      // This constructor will only return when we have received a packet
```

```
      UDPPacket upkt( &fifo,
                      0 /* Replace this 0 with a tick count to have a time out
delat */ );

      // Did we get a valid packet or just time out?
      if ( upkt.Validate() )
      {
         WORD len = upkt.GetDataSize();
         iprintf( "\r\nReceived a UDP packet with %d bytes from :", ( int ) len );
         ShowIP( upkt.GetSourceAddress() );
         iprintf( "\r\n" );
         ShowData( upkt.GetDataBuffer(), len );
         iprintf( "\r\n" );
      }
   }
}


/*****************************************************************
 * UserMain Task
 * This is the first task to be executed and will create the UDP
 * Reader Task.
 *****************************************************************/
void UserMain( void *pd )
{
   int              portnum;
   IPADDR     ipaddr;
   char       buffer[80];

   InitializeStack();
   EnableAutoUpdate();
   EnableTaskMonitor();

   if ( EthernetIP == 0 )
   {
      iprintf( "Trying DHCP\r\n" );
      GetDHCPAddress();
      iprintf( "DHCP assigned the IP address of :" );
      ShowIP( EthernetIP );
      iprintf( "\r\n" );
   }

   OSChangePrio( MAIN_PRIO );

   #ifdef _DEBUG
   InitializeNetworkGDB();
   #endif

   iprintf( "Starting UDP Packet C++ Class Example\r\n" );

   // Get desination IP address
   iprintf( "Enter the destination IP address: " );
   buffer[0] = '\0';
   while ( buffer[0] == '\0' )  // Keep looping until something is entered
   {
      gets( buffer );
   }
   ipaddr = AsciiToIp( buffer );
   iprintf("\r\n");

   /* Get the port number. This application uses the same
    * port number for send and receive.
    */
```

```
   iprintf( "Enter the source/destination port number: " );
   gets( buffer );
   portnum = atoi( buffer );
   iprintf("\r\n");

   // Display informational message
   iprintf( "Sending/Recieving with host ");
   ShowIP( ipaddr );
   iprintf( ": %d\r\n", portnum );

   /* Create task to recieve UDP packets. We will pass the destination
    * port number in the optional second parameter field, and set the
    * priority to 1 less than the UserMain priority so packets get
    * processed as they are received.
    */
   OSTaskCreate( UdpReaderTask,
                 ( void * ) portnum,
                 &UdpReaderStack[USER_TASK_STK_SIZE],
                 UdpReaderStack,
                 MAIN_PRIO - 1 );

   // Loop forever displaying UDP data
   while ( 1 )
   {
      iprintf( "Enter a string to send: " );
      gets( buffer );
      iprintf("\r\n");
      iprintf( "Sending \"%s\" using UDP to ", buffer );
      ShowIP( ipaddr );
      iprintf(" : %d\r\n", portnum );

      // Note that the UDPPacket instance below is enclosed by '{'
      // braces to handle the scope of the data buffers used by
      // the C++ class instance.
      {
         UDPPacket pkt;
         pkt.SetSourcePort( portnum );
         pkt.SetDestinationPort( portnum );
         pkt.AddData( buffer );
         pkt.AddDataByte( 0 );
         pkt.Send( ipaddr );
      }
      iprintf( "\r\n" );
   };
}
```

### 25.1.2. UDPPacket

## Synopsis:

```
UDPPacket( );
```

## Description:

This function creates a UDP packet with no data. Member functions are then used to configure the packet and send it.

## Parameters:

None

## Returns:

No value returned

### 25.1.3. UDPPacket (FIFO)

## Synopsis:

```
UDPPacket( OS_FIFO * fifo, DWORD wait );
```

## Description:

UDP packets are received in a OS_FIFO. Once received, this function can be used to create a UDP packet from the FIFO entry, which removes the entry from the FIFO. This function will block until a FIFO entry is available, or the specified timeout occurs. If the FIFO times out, then an invalid UDP packet will be created. The UDP Validate( ) function must always be called after this function to verify a valid UDP packet has been received.

## Returns:

A UDP Packet, which then must be verified Validate( ) function

### 25.1.4. UDPPacket (Pool Buffer)

## Synopsis:

```
UDPPacket( PoolPtr p );
```

## Description:

This creates a UDP packet from a pool buffer. This is a reserved function for internal use.

## Returns:

A UDP Packet, which then must be verified Validate( ) function

### 25.1.5. ~UDPPacket

## Synopsis:

```
~UDPPacket( );
```

## Description:

This function is the UDPPacket destructor, which will be called automatically when an instance of UDPPacket goes out of scope.

## Parameters:

None

## Returns:

No value returned

### 25.1.6. Validate

## Synopsis:

```
BOOL Validate( );
```

## Description:

Verifies a received UDP packet has data and validates the checksum. This function should only be called when receiving a UDP packet.

## Parameters:

None

## Returns:

True --- If the packet is valid
False --- If you try to validate a packet before it has been sent

### 25.1.7. SetSourcePort

## Synopsis:

```
void SetSourcePort( WORD );
```

## Description:

Sets the UDP Packet source port number.

## Returns:

Nothing --- This is a void function

### 25.1.8. GetSourcePort

## Synopsis:

```
WORD GetSourcePort( );
```

## Description:

Returns a received UDP packet's source port number.

## Parameters:

None

## Returns:

The 16-bit source port number

### 25.1.9. SetDestinationPort

## Synopsis:

```
void SetDestinationPort( WORD );
```

## Description:

Sets the UDP Packet destination port number.

## Returns:

Nothing --- This is a void function

### 25.1.10. GetDestinationPort

## Synopsis:

```
WORD GetDestinationPort( );
```

## Description:

Returns a UDP packet's destination port number.

## Parameters:

None

## Returns:

The 16-Bit destination port number

### 25.1.11. GetDataBuffer

## Synopsis:

```
PBYTE GetDataBuffer( );
```

## Description:

This function gets a pointer to the UDP packet's data buffer.

## Parameters:

None

### 25.1.12. SetDataSize

## Synopsis:

```
void SetDataSize( WORD );
```

## Description:

Specifies the UDP Packet's data size as a number of bytes.

## Returns:

Nothing --- This is a void function

### 25.1.13. GetDataSize

## Synopsis:

```
WORD GetDataSize( );
```

## Description:

Returns the number of data bytes in a UDP packet.

## Returns:

Number of data bytes.

### 25.1.14. ResetData

## Synopsis:

```
void ResetData( );
```

## Description:

This function zero's the data buffer length.

## Parameters:

None

## Returns:

Nothing --- This is a void function

### 25.1.15. AddData

## Synopsis:

```
void AddData( PBYTE pData, WORD len );
```

## Description:

This function appends data to an existing UDP packet.

## Returns:

Nothing --- This is a void function

### 25.1.16. AddData (Add a Zero Terminated String)

## Synopsis:

```
void AddData( PCSTR pData );
```

## Description:

Appends data to an existing UDP packet. The length is determined by the null character at the end of the parameter string.

## Returns:

Nothing --- This is a void function

### 25.1.17. AddDataWord

## Synopsis:

```
void AddDataWord( WORD w );
```

## Description:

Appends a 16-bit unsigned value to an existing UDP packet.

## Returns:

Nothing --- This is a void function

### 25.1.18. AddDataByte

## Synopsis:

```
void AddDataByte( BYTE b );
```

## Description:

Appends a byte of data to an existing UDP packet.

## Returns:

Nothing --- This is a void function

### 25.1.19. ReleaseBuffer

## Synopsis:

```
void ReleaseBuffer( );
```

## Description:

Releases UDP objects captive buffer (a pool pointer). This function is for internal use only.

## Parameters:

None

## Returns:

Nothing --- This is a void function

### 25.1.20. GetPoolPtr

## Synopsis:

```
PoolPtr GetPoolPtr( );
```

## Description:

This function gets a handle to the UDP objects captive buffer. This function is for internal use only.

## Parameters:

None

### 25.1.21. SendAndKeep

## Synopsis:

```
void SendAndKeep( IPADDR to, BYTE ttl );
```

## Description:

This function sends a copy of the attached pool pointer.

## Returns:

Nothing --- This is a void function

### 25.1.22. SendAndKeepVia

## Synopsis:

```
void SendAndKeepVia( IPADDR to, IPADDR from_ip, BYTE ttl );
```

## Description:

This function sends a copy of the attached pool pointer via a specified interface.

## Returns:

Nothing --- This is a void function

### 25.1.23. Send

## Synopsis:

```
void Send( IPADDR to, BYTE ttl=0 );
```

## Description:

This function sends the UDP packet and frees the attached pool buffer.

## Returns:

Nothing --- This is a void function

### 25.1.24. SendVia

## Synopsis:

```
void SendVia( IPADDR to, IPADDR from_ip, BYTE ttl );
```

## Description:

This function sends and frees the attached pool buffer via the specified interface.

## Returns:

Nothing --- This is a void function

## 25.1.25. RegisterUDPFifo

### Synopsis:

```
void RegisterUDPFifo( WORD dest_port, OS_FIFO *pfifo );
```

### Description:

A OS_FIFO is used to receive incoming UDP Packets. This function registers a OS_FIFO to listen to a specific UDP port.

### Returns:

Nothing --- This is a void function

### 25.1.26. UnregisterUDPFifo

## Synopsis:

```
void UnregisterUDPFifo( WORD destination_port );
```

## Description:

This function will unregister a listening UDP FIFO.

## Returns:

Nothing --- This is a void function

## 25.2. UDP Socket Interface

### Definitions

```
#define  UDP_ERR_NOSUCH_SOCKET    (-1)
#define  UDP_ERR_NOTOPEN_TO_WRITE (-2)
#define  UDP_ERR_NOTOPEN_TO_READ  (-3)
```

### Open a UDP Socket

```
int CreateRxUdpSocket(WORD listening_port )
```
Open a UDP socket that can be used by the select( ) function to receive UDP datagrams.

```
int CreateTxUdpSocket(IPADDR send_to_addr, WORD remote_port,
                      WORD local_port)
```
Open a UDP socket that can use write functions such as: write( ), writestring( ), etc. to send data.

```
int CreateRxTxUdpSocket(IPADDR send_to_addr, WORD send_to_remote_port,
                        WORD local_port)
```
Open a UDP socket that can send and receive.

These functions return a standard file descriptor, or a negative number if a socket cannot be created.

### Send a UDP Packet

```
int sendto(int sock, PBYTE what_to_send, int len_to_send,IPADDR to_addr,
           WORD  remote_port)
```
Returns the number of bytes sent or error as defined above

```
int sendtovia(int sock, PBYTE what_to_send, int len_to_send,IPADDR to_addr,
              WORD remote_port, int intfnum)
```
This is the same function as above, but specifies the interface as the last parameter. It returns the number of bytes sent, or an error as defined above.

### Receive a UDP Packet

```
int recvfrom(int sock, PBYTE buffer, int len, IPADDR * pAddr,
             WORD * pLocal_port, WORD * pRemote_port)
```

Returns the number of bytes read, or UDP_ERR_NOSUCH_SOCKET (-1)

### 25.2.1. UDP Sockets Example

The following example is taken from the NetBurner Network Programmers Guide, which provides detailed information on UDP.

```
/*****************************************************************************
 UDP Sockets Example
 This application will send/receive UDP packets with another host on a network,
 such as a PC. Use the MTTTY serial port program to access the menu and
 prompts to specify the destination IP address and port number.

 NetBurner supplies an API for handling UDP as a C++ Class using UDPPacket, or
 you can use a UDP sockets API (see UDP socket example).

 For an external UDP host you can use the NetBurner java example, or the
 NetBurner UDP terminal program.
*****************************************************************************/
#include "predef.h"
#include <stdio.h>
#include <stdlib.h>
#include <ctype.h>
#include <startnet.h>
#include <ucos.h>
#include <udp.h>
#include <autoupdate.h>
#include <string.h>
#include <taskmon.h>
#include <dhcpclient.h>
#include <networkdebug.h>

const char *AppName = "UDP Sockets Example";

extern "C"
{
   void UserMain( void *pd );
}


// Declare a task stack for the UDP Reader task
DWORD UdpReaderStack[USER_TASK_STK_SIZE];


/*-------------------------------------------------------------------
 * This task will wait for incoming UDP packets and process them.
 -------------------------------------------------------------------*/
void UdpReaderTask( void *pd )
{
   int port = ( int ) pd;
   iprintf( "UdpReaderTask monitoring port %d\r\n", port );

   // Create a UDP socket for receiving
   int UdpFd = CreateRxUdpSocket( port );
   if ( UdpFd <= 0 )
   {
      iprintf("Error Creating UDP Listen Socket: %d\r\n", UdpFd);
      while (1)
         OSTimeDly(TICKS_PER_SECOND);
   }
   else
   {
      iprintf( "Listening for UDP packets on port %d\r\n", port );
```

```
   }

   while (1)
   {
      IPADDR SrcIpAddr;  // UDP packet source IP address
      WORD   LocalPort;  // Port number UDP packet was sent to
      WORD   SrcPort;    // UDP packet source port number
      char   buffer[80];

      int len = recvfrom( UdpFd, (BYTE *)buffer, 80, &SrcIpAddr, &LocalPort,
&SrcPort );
      buffer[len] = '\0';

      iprintf( "\r\nReceived a UDP packet with %d bytes from :", len );
      ShowIP( SrcIpAddr );
      iprintf( "\r\n%s\r\n", buffer );
   }
}




/*-------------------------------------------------------------------
 * UserMain Task
 * This is the first task to be executed and will create the UDP
 * Reader Task.
 -------------------------------------------------------------------*/
void UserMain( void *pd )
{
   int              portnum;
   IPADDR     ipaddr;
   char       buffer[80];

   InitializeStack();
   EnableAutoUpdate();
   EnableTaskMonitor();

   if ( EthernetIP == 0 )
   {
      iprintf( "Trying DHCP\r\n" );
      GetDHCPAddress();
      iprintf( "DHCP assigned the IP address of :" );
      ShowIP( EthernetIP );
      iprintf( "\r\n" );
   }

   OSChangePrio( MAIN_PRIO );

   #ifdef _DEBUG
   InitializeNetworkGDB();
   #endif

   iprintf( "Starting UDP Sockets Example\r\n" );

   // Get desination IP address
   iprintf( "Enter the UDP Server destination IP address: " );
   buffer[0] = '\0';
   while ( buffer[0] == '\0' )  // Keep looping until something is entered
   {
      gets( buffer );
   }
   ipaddr = AsciiToIp( buffer );
```

```
   iprintf("\r\n");

   // Get the port number. This application uses the same
   // port number for send and receive.
   iprintf( "Enter the source/destination port number: " );
   gets( buffer );
   portnum = atoi( buffer );
   iprintf("\r\n");

   // Create a UDP socket for sending/receiving
   int UdpFd = CreateTxUdpSocket( ipaddr, portnum, portnum );
   if ( UdpFd <= 0 )
   {
      iprintf("Error Creating UDP Socket: %d\r\n", UdpFd);
      while (1)
         OSTimeDly(TICKS_PER_SECOND);
   }
   else
   {
      iprintf( "Sending/Recieving with host ");
      ShowIP( ipaddr );
      iprintf( ": %d\r\n", portnum );
   }

   // Create task to receive UDP packets. We will pass the destination
   // port number in the optional second parameter field, and set the
   // priority to 1 less than the UserMain priority so packets get
   // processed as they are received.
   OSTaskCreate( UdpReaderTask,
                 ( void * ) portnum,
                 &UdpReaderStack[USER_TASK_STK_SIZE],
                 UdpReaderStack,
                 MAIN_PRIO - 1 );

   // Loop forever displaying UDP data
   while ( 1 )
   {
      iprintf( "Enter a string to send: " );
      gets(buffer);
      iprintf("\r\n");
      iprintf( "Sending \"%s\" using UDP to ", buffer );
      ShowIP( ipaddr );
      iprintf(" : %d\r\n", portnum );

      sendto( UdpFd, (BYTE *)buffer, strlen(buffer), ipaddr, portnum );
      iprintf( "\r\n" );
   };
}
```

### 25.2.2. CreateRxUdpSocket

## Synopsis:

int CreateRxUdpSocket( WORD listening_port )

## Description:

Open a UDP socket that can be used by the select( ) function to receive UDP datagrams.

## Parameters:

listening_port  16-bit unsigned value of UDP port to listen to for incoming packets

## Returns:

A file descriptor, or negative number on error.

### 25.2.3. CreateTxUdpSocket

## Synopsis:

int CreateTxUdpSocket(IPADDR send_to_addr, WORD remote_port,
WORD local_port).

## Description:

Open a UDP socket that can use write functions such as: write( ), writestring, etc. to send data.

## Parameters:

| | |
|---|---|
| send_to_addr | Destination IP address |
| remote_port: | Destination port number |
| local_port : | Local port number to use. A value of 0 will automatically select a random port number. |

## Returns:

A file descriptor, or negative number on error.

### 25.2.4. CreateRxTxUdpSocket

## Synopsis:

int CreateRxTxUdpSocket(IPADDR send_to_addr, WORD send_to_remote_port,
WORD local_port)

## Description:

Open a UDP socket that can send and receive.

## Parameters:

send_to_addr Destination IP address
send_to_remote_port: Destination port number
local_port : Local port number to use. A value of 0 will automatically select a random port number.

## Returns:

A file descriptor, or negative number on error.

### 25.2.5. sendto

## Synopsis:

int sendto(int sock, PBYTE what_to_send, int len_to_send,IPADDR to_addr,  WORD remote_port)

## Description:

Send a UDP packet

## Parameters:

| | |
|---|---|
| sock | File descriptor from a previous call to CreateTxUdpSocket( )  or CreateRxTxSocket( ) |
| what_to_send | BYTE array pointer to data to send in packet |
| len_to_send : | Number of bytes of data to send |
| to_addr: | Destination IP address |
| remote_port: | Destination port number |

## Returns:

Number of bytes sent negative number on error.

### 25.2.6. sendtovia

## Synopsis:

int sendtovia(int sock, PBYTE what_to_send, int len_to_send,IPADDR to_addr,
WORD remote_port, int intfnum)

## Description:

Send a UDP packet using the specified network interface.

## Parameters:

| | |
|---|---|
| sock | File descriptor from a previous call to CreateTxUdpSocket( ) or CreateRxTxSocket( ) |
| what_to_send | BYTE array pointer to data to send in packet |
| len_to_send : | Number of bytes of data to send |
| to_addr: | Destination IP address |
| remote_port: | Destination port number |
| intfnum: | Local network interface to use from previous call to RegisterInterface( ) |

## Returns:

Number of bytes sent or a negative number on error.

### 25.2.7. receivefrom

## Synopsis:

int recvfrom(int sock, PBYTE buffer, int len, IPADDR *pAddr,
WORD *pLocal_port, WORD *pRemote_port)

## Description:

Receive a UDP packet.

## Parameters:

| | |
|---|---|
| sock | File descriptor from a previous call to CreateRxUdpSocket( ) or CreateRxTxSocket( ) |
| buffer: | Pointer to BYTE array buffer to store received UDP packet data |
| len: | Maximum number of bytes to receive |
| pAddr: | Pointer to an IPADDR variable to store the sender's IP address of the packet |
| pLocal_port: | Pointer to WORD variable to store the local port number of the packet |
| pRemote_port: | Pointer to WORD variable to store the sender's port number of the packet |

## Returns:

Number of bytes received or a negative number on error.

# 26. PPP Library

Like Ethernet, Point to Point Protocol (PPP) is a data link layer which transfers data between nodes on a network. The main difference is that PPP is used between only two network nodes. PPP can be used over many types of physical networks, including: fiber, phone line, serial cable and cellular telephone. Once you have created a PPP connection to or from your NetBurner device you can use it with all the standard network applications such as the web server, tcp, udp, ftp, email, etc.

Internet Service Providers (ISP) can implement PPP with many different options that vary from ISP to ISP. The PPP example program included in the development kit examples directory specifies the most common ISP options and can be used as a code example to specify any specific options you may need in your application.

### Header File

```
#include <ppp.h>        // Found in C:\Nburn\include
```

## 26.1. PPP Structure and Definitions

| | |
|---|---|
| pppoptions | PPP options structure |
| enum_PPPState | PPP state definitions |

## 26.2. PPP Functions

| | |
|---|---|
| StartPPPDameon | Starts the PPP daemon and initialized a modem |
| StartPPPDirect | Starts the PPP daemon for a direct connection on a Serial port |
| DialPPP | Dials out (via a modem) to create a PPP connection. |
| DirectConnectPPP | Initiates a client PPP direct connection on a Serial port. |
| GetPPPState | Reports the connection state of the PPP system. |
| StopPPPDameon | Stops listening for a PPP connection. |
| ClosePPPSesion | Stops any current PPP connection. |
| GetThatPPP_IP | Get the IP address of the other device on the PPP connection. |
| GetThisPPP_IP | Get the IP address of the NetBurner device on the PPP connection. |
| SendCHAPChallenge | Send CHAP challenge packet to PPP host |

## 26.3. PPP Options Structure

The PPP options structure is used to configure the PPP link, specify whether or not authentication is required, and supply an optional user name and password. The code below is an example of the options in tools release 2.3 rc7. Please refer to c:\nburn\include\ppp.h for the latest option structure.

```
struct pppoptions {
BYTE Restart_Interval; // The restart interval for PPP negotiations in seconds
BYTE Max_Terminate;    // The Maximum number of times to send terminate
BYTE Max_Configure;    // The Maximum number of times to send config requests
BYTE Max_Failure;      // The Maximum number of config failures (for retries)
BOOL CHAPenable;       // If TRUE then CHAP will be required for connection
BOOL Chat_Login_disable;  //If TRUE, PPP will not allow Chat_Login mode


// Callback function used for incoming connections. If you require authentication
// from the peer, crate your own authentication function that takes a user name and
// password, and set the authenticate_func pointer to it. A non-zero return value
// means the authentication was successful.
int  ( *authenticate_func )( const char *name, const char *passwd );


// Username and password used for outgoing connections during PAP or CHAP
// authentication.
const char *pUserName;
const char *pPassword;


// Set to zero to request that the other side to provide our IP address
IPADDR SetThisInterfaceAddress;

// Set to non-zero to request an IP address for the peer
IPADDR SetThatInterfaceAddress;

// The actual values after negotiation
IPADDR ActualThisInterfaceAddress;
IPADDR ActualThatInterfaceAddress;

DWORD dwflags;  // Reserved for system use

// The negotiated Maximum Receive Unit (MRU). Read only. Usually 1500 bytes.
WORD MRU;

/* Asynchronous Control Character Map (ACCM) is used to specify escape sequences
for control characters in the data stream. */
DWORD TX_DESIRED_ACCM; /* Set to any additional ACCM vaues you want to use */
DWORD RX_DESIRED_ACCM; /* Set to any additional ACCM vaues you want to use */

// The agreed-upon values after negotiation
DWORD TX_ACCM;
DWORD RX_ACCM;

};
```

## 26.4. StartPPPDameon

### Synopsis:

int StartPPPDameon( int serial_port, pppoptions * popt );

### Description:

When this function is called, the PPP system initializes the modem and prepares it to receive calls.

### Parameters:

| | |
|---|---|
| serial_port | The serial port to use for communication, 0, 1 or 2. |
| popt *pppoptions | Structure containing the PPP options. |

### Returns:

ERR_PPP_SUCESS
ERR_PPP_ALREADY_OPEN
ERR_PPP_NO_DIALTONE
ERR_PPP_NO_ANSWER
ERR_PPP_BUSY
ERR_PPP_FAIL
ERR_PPP_PASSFAIL
ERR_PPP_LOSTCARRIER

## 26.5. StartPPPDirect

### Synopsis:

int StartPPPDirect( int serial_port, pppoptions *popt );

### Description:

This function will initiate a host PPP direct connection on a serial port. StartPPPDirect is similar to StartPPPDameon, but it does not require a modem.

### Parameters:

| | |
|---|---|
| serial_port | The serial port to use for communication, 0, 1 or 2. |
| popt *pppoptions | Structure containing the PPP options. |

### Returns:

ERR_PPP_SUCCESS
ERR_PPP_ALREADY_OPEN
ERR_PPP_NO_DIALTONE
ERR_PPP_NO_ANSWER
ERR_PPP_BUSY
ERR_PPP_FAIL
ERR_PPP_PASSFAIL
ERR_PPP_LOSTCARRIER
ERR_PPP_NO_MODEM
ERR_PPP_LCP_FAILED

## 26.6. DialPPP

### Synopsis:

int DialPPP( int serial_port, pppoptions * popt, const char * dial_string );

### Description:

This function dials the provided number and attempts to establish a PPP session.

### Parameters:

| | |
|---|---|
| serial_port | The serial port to use for communication, 0, 1 or 2. |
| popt *pppoptions | Structure containing the PPP options. |
| dial_string const char * | The dial string to send to the modem. For example "ATD555-1212". |

### Returns:

ERR_PPP_SUCESS (0)
ERR_PPP_ALREADY_OPEN
ERR_PPP_NO_DIALTONE
ERR_PPP_NO_ANSWER
ERR_PPP_BUSY
ERR_PPP_FAIL
ERR_PPP_PASSFAIL
ERR_PPP_LOSTCARRIER

# 26.7. DirectConnectPPP

## Synopsis:

int DirectConnectPPP( int serial_port, pppoptions *popt, const char *dial_string );

## Description:

This function will initiate a client PPP direct connection on a serial port. DirectConnectPPP similar to DialPPP, but it does not require a modem.

## Parameters:

| | |
|---|---|
| serial_port | The serial port to use for communication, 0, 1 or 2. |
| popt *pppoptions | Structure containing the PPP options. |
| dial_string const char * | The dial string to send to the modem. For example "ATD555-1212". |

## Returns:

ERR_PPP_SUCCESS
ERR_PPP_ALREADY_OPEN
ERR_PPP_NO_DIALTONE
ERR_PPP_NO_ANSWER
ERR_PPP_BUSY
ERR_PPP_FAIL
ERR_PPP_PASSFAIL
ERR_PPP_LOSTCARRIER
ERR_PPP_NO_MODEM
ERR_PPP_LCP_FAILED

# 26.8. GetPPPState

## Synopsis:

enum_PPPState GetPPPState( );

## Description:

This function returns the current state of the PPP system as defined by the PPPState structure in ppp.h:

```
typedef enum {
   eClosed,
   eInitializingModem,
   eDialing,
   eWait4Ring,
   eAnswering,
   eWaitForTrain,
   eLCPNegotiate,
   ePAPAuthenticate,
   eCHAPAuthenticate,
   eNCPNegotiate,
   eOpen,
   eClosing
}enum_PPPState;
```

## Parameters:

None

## Returns:

The current state of the PPP system.

## 26.9. StopPPPDameon

### Synopsis:

void StopPPPDameon();

### Description:

This function stops the PPP receive daemon started with the StartPPPDameon.

### Parameters:

None

### Returns:

Nothing.

## 26.10. ClosePPPSesion

### Synopsis:

void ClosePPPSesion( );

### Description:

This function closes any active PPP sessions.

### Parameters:

None

### Returns:

Nothing. This is a void function.

## 26.11. GetThatPPP_IP

### Synopsis:

IPADDR GetThatPPP_IP( );

### Description:

Returns the IP address of the other end of the PPP connection.

### Parameters:

None

### Returns:

An IP address of type IPADDR.

## 26.12. GetThisPPP_IP

### Synopsis:

IPADDR GetThisPPP_IP( );

### Description:

Returns the IP address of the NetBurner device used in the PPP connection.

### Parameters:

None

### Returns:

An IP address of type IPADDR.

## 26.13. SendCHAPChallenge

### Synopsis:

void SendCHAPChallenge( );

### Description:

Sends a CHAP packet to the PPP connected device. Note that the #define GATHER_RANDOM must be enabled in \nburn\include\predef.h.

### Parameters:

None

### Returns:

Nothing.

# 27. IPSetup Password Protection

## Synopsis:

```
extern int ( *ipsetup_authenticate_func )
           ( const char *name, const char *passwd );
```

## Description:

When the ipsetup_authenticate_func is assigned to a function, that function will be called before the IPSetup.exe Windows utility is allowed to change any system settings. In other words, it is a callback function. The user running the IPSetup.exe utility will be presented with a dialog box requesting a user name and password, which are then passed to your function for processing and authentication. You function can do the authentication in any manor you wish. Returning 1 allows IPSetup to proceed, returning 0 aborts the process. There is a similar function pointer named update_authenticate_func for password protection on the AutoUpdate utility. You may use the same authentication function by assigning both ipsetup_authenticate_func and update_authenticate_func to the same function.

Your password function must be of the form:

```
int MyPasswordTest(const char * user, const char * pass)
  {
     /* Check password and user here */
     if (/* password ok */)
        return 1;
     else
        return 0;
  }
```

You assign the function to the password hook by:

```
ipsetup_authenticate_func = MyPasswordTest;
```

## Example Program

```
#include "predef.h"
#include <stdio.h>
#include <ctype.h>
#include <startnet.h>
#include <autoupdate.h>
#include <dhcpclient.h>
#include <taskmon.h>
#include <smarttrap.h>
#include <string.h>

extern "C"
{
   void UserMain( void * pd);
}
```

```
const char * AppName = "CallbackFeatures";

// Set TRUE for example. This would be the flag set/cleared by your
// application to enable an autoupdate.
BOOL SafeToAutoUpdate = TRUE;


/*-------------------------------------------------------------------
 * Authentication
 *-------------------------------------------------------------------*/
const char* UserName = "NetBurner";    // hardcode for example
const char* Password = "password";     // hardcode for example

int Authentication( const char *name, const char *passwd )
{
   if( strcmp( UserName, name ) != 0 )
      return 0;   // Invalid user name

   if( strcmp( Password, passwd ) != 0 )
      return 0;   // Invalid password

   return 1;   // Allow IPSetup to change params
}


/*-------------------------------------------------------------------
 * Shutdown
 *-------------------------------------------------------------------*/
int Shutdown(void)
{
   if( SafeToAutoUpdate )
      return 1;   // proceed with update
   else
      return 0;   // abort update
}



/*-------------------------------------------------------------------
 * UserMain
 *-------------------------------------------------------------------*/
void UserMain( void * pd )
{
    InitializeStack();
    if (EthernetIP==0)
       GetDHCPAddress();
    OSChangePrio( MAIN_PRIO );
    EnableAutoUpdate();

    update_authenticate_func  = Authentication;
    ipsetup_authenticate_func = Authentication;
    update_shutdown_func = Shutdown;

    while ( 1 )
    {
        OSTimeDly( TICKS_PER_SECOND );
    }
}
```