eZ80® CPU

Zilog TCP/IP Stack API

Reference Manual

RM004012-0707

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Revision History

Each instance in the Revision History reflects a change to this document from its previous revision. For more details, refer to the corresponding pages or appropriate links given in the table below.

Date	Revision Level	Description	Page No
July 2007	12	Globally updated ZiLOG as Zilog.	All
July 2007	11	Globally updated for ZTP v2.1.0 release.	All
June 2007	10	Updated document as per Zilog Style Guide. Updated ioctlsocket, ftp_connect, do_programatic_login, do_a_ftp_command, Http_Request Structure, accept, listen, hgleave, name2ip, xc_ascdate, Table 15, Table 16. Removed Kernel API's, Process Manipulation Functions, Semaphore Functions, Mailbox Messaging Functions, Message Port Functions, Miscellaneous Operating System Functions, Kernel Macros, Sample usage in `.C` and `.asm` Files sections. Removed Appendix B, Appendix C, Appendix D.	All
July 2006	09	Globally updated for ZTP v2.0.0 release.	All
April 2006	08	Globally updated for ZTP v1.7.0 release. Added the registered trademark symbol (®) for eZ80Acclaim! and eZ80.	All

Table of Contents

Introduction

This Reference Manual describes the APIs associated with Zilog's TCP/IP (ZTP) Stack v2.1.0 for Zilog's eZ80® CPU-based microprocessors and microcontrollers. This ZTP release supports the eZ80 family of devices, which includes eZ80L92 microprocessor, and eZ80Acclaim!® family of devices (that is, eZ80F91, eZ80F92, and eZ80F93 microcontrollers).

About This Manual

Zilog® recommends that you read and understand everything in this manual before using the product. We have designed this manual to be used as a reference guide for ZTP APIs.

Intended Audience

This document is written for Zilog customers who are familiar with real-time operating systems and are experienced at working with microprocessors, in writing assembly code, or in writing higher level languages such as C.

Manual Organization

This Reference Manual is divided into fifteen sections and an appendix. A brief description of each section and appendix is provided below.

ZTP API Reference

This chapter describes the ZTP APIs in detail. It also comprises of the following sub-sections.

- ZTP Networking APIs

- HTTP Function
- SNMP Functions
- SMTP Function
- Telnet Functions
- TimeP Protocol Function
- DNS Functions
- RARP Function
- IGMP Functions
- TFTP Functions
- FTP Functions
- Ping Functions
- SNTP Functions

Appendix A—Definitions and Codes

This appendix lists the enumerations and different data type definitions used in ZTP.

Related Documents

Table 1 lists the related documents that you must be familiar with to use ZTP efficiently.

Table 1. Related RZK Documents

Document Title	Document Number
eZ80L92 Product Specification	PS0130
eZ80F91 Product Specification	PS0192
eZ80F92/eZ80F93 Flash MCU Product Specification	PS0153

Table 1. Related RZK Documents (Continued)

Document Title	Document Number
eZ80F92/eZ80F93 Ethernet Module Product Specification	PS0186
eZ80F92/eZ80F93 Flash Module Product Specification	PS0189
eZ80 CPU User Manual	UM0077
Zilog Real-Time Kernel Reference Manual	RM0006

Manual Conventions

The following convention is adopted to provide clarity and ease of use:

Courier Typeface

Code lines and fragments, functions, and various executable items are distinguished from general text by appearing in the Courier typeface. For example, `#include <socket.h>`.

Safeguards

When you use ZTP along with one of Zilog's development platforms, always use a grounding strap to prevent damage resulting from electrostatic discharge (ESD) to avoid permanent damage to the development platform.

ZTP API Reference

Zilog TCP/IP Stack consists of a rich-set of APIs for accessing the TCP/IP protocol stack. This section provides a description of each ZTP API including inputs and outputs. Each API is classified according to the protocol or command that it is associated with.

Table 2 provides a quick reference to ZTP APIs based on its protocol.

Table 2. ZTP API Quick Reference

ZTP Networking APIs
HTTP Function
HTTPS Function
SNMP Functions
SMTP Function
Telnet Functions
TimeP Protocol Function
DNS Functions
RARP Function
IGMP Functions
TFTP Functions
FTP Functions
Ping Function
SNTP Functions

ZTP Networking APIs

This section describes the user interfaces to the ZTP stack. All the APIs listed in this section return a negative value if an error occurs. Positive values are considered to be the expected output.

Table 3 provides a quick reference to ZTP Networking APIs.

Table 3. ZTP Networking APIs Quick Reference

socket	recvfrom
bind	sendto
accept	ioctlsocket
listen	getsockname
connect	getpeername
recv	inet_addr
send	inet_ntoa
close_s	

socket

Include

```
#include <socket.h>
```

Prototype

```
INT16 socket (
 INT16 af,
 INT16 type,
 INT16 protocol
);
```

Description

The `socket` function creates a socket that is bound to a specific service provider.

Argument(s)

`af`	An address family specification. ZTP supports only the `AF_INET` internet address family.
`type`	A `type` specification for the new socket. ZTP supports the following two types of sockets: SOCK_STREAM—Provides sequenced, reliable, two-way, connection-based byte streams with an out-of-band data transmission mechanism. Uses TCP for the Internet address family. SOCK_DGRAM—Supports datagrams, which are connectionless, unreliable buffers of a fixed (typically small) maximum length. Uses UDP for the Internet address family. Socket type definitions appear in the `socket.h` header file.
`protocol`	The `protocol` function is a particular protocol to be used with sockets that are specific to an indicated address family. As this parameter is not used, the value passed must be zero across all versions of ZTP.

The `socket` function causes a socket descriptor and any related resources to be allocated and bound to a specific transport service provider.

Return Value(s)

If successful, the `socket` function returns the socket descriptor, the value of which must be greater than or equal to 0.

If the returned value is less than 0, one of the following errors is returned.

EPROTONOSUPPORT	Protocol not supported
ENOBUFS	Buffer not available

bind

Include

```
#include <socket.h>
```

Prototype

```
INT16                bind (
 INT16               s,
 struct sockaddr * name,
 INT16               namelen
);
```

Description

The sockets' `bind` function associates a local address with a socket.

Argument(s)

`s`	A descriptor identifying an unbound socket.
`name`	The address to assigned to the socket from the `sockaddr` structure.
`namelen`	The length of the name parameter.

Note: *The* `bind` *function is used on an unconnected socket before subsequent calls to the* `connect` *and* `listen` *functions. It is used to bind either connection-oriented (stream) or connectionless (datagram) sockets. Use* `bind` *function to establish a local association of the socket by assigning a local name to an unnamed socket.*

ReturnValue(s)

If successful, the `bind` function returns `ZTP_SOCK_OK`.

If less than 0, one of the following errors is returned.

EFAULT	Address family not supported.

EINVAL	Invalid socket descriptor (descriptor already in use).
EBADF	Invalid socket descriptor (not allocated).

See Also

sockaddr Structure

accept

Include

```
#include <socket.h>
```

Prototype

```
INT16                accept
(
 INT16               s,
 struct sockaddr     *peername,
 INT16               *peernamelen
);
```

Description

The sockets' `accept` function accepts an incoming connection attempt on a socket.

Argument(s)

`s`	A descriptor identifying a socket that has been placed in a listening state with the `listen` function. The connection is made with the socket that is returned by `accept`.
`peername`	An optional pointer to a buffer that receives the address of the connecting entity, as known to the communications layer. The exact format of the `peername` parameter is determined by the address family established when the socket connection was created.
`peernamelen`	An optional pointer to an integer that contains the length of the `peernamelen`.

Notes: 1. *The* `accept` *function extracts the first connection on the queue of pending connections on socket* `s`*. It then creates a new socket and returns a handle to the new socket. The newly-created socket is the socket that handles the actual connection. The* `accept` *function can block the caller until a connection is present if no pending connec-*

tions are present in the queue, and the socket is marked as blocking. If the socket is marked nonblocking and no pending connections are present in the queue, `accept` *returns an error, see* Return Value(s) *below. After successful completion,* `accept` *returns a new socket handle. The original socket remains open and listens for new connection requests.*

2. The `addr` parameter is a result parameter that is filled in with the address of the connecting entity, as known to the communications layer. `addrlen` is a value-result parameter that should initially contain the amount of space pointed to by `addr`; upon return, it contains the actual length
(in bytes) of the returned address.

3. *The* `accept` *function is used with connection-oriented socket types such as* `SOCK_STREAM`.

Return Value(s)

Success	If no error occurs, `accept` returns a value of type `INT16` that is a descriptor for the new socket. The integer referred to by `addrlen` initially contains the amount of space pointed to by `addr`. Upon return, it contains the actual length in bytes of the address returned.
Failure	One of the following error codes is returned.
	EOPNOTSUPP—Socket type not supported.
	EBADF—Invalid socket descriptor.
	EINVL—Invalid socket descriptor.
	ENOCON—Connection not arrived.
	EFAULT—Error accepting new socket.

See Also

sockaddr Structure

listen

Include

```
#include <socket.h>
```

Prototype

```
INT16 listen (
INT16 s,
INT16 backlog
);
```

Description

The sockets' `listen` function places a socket into a state within which it listens for an incoming connection.

Argument(s)

`s`	A descriptor identifying a bound, unconnected socket.
`backlog`	The maximum length of the queue of pending connections. If this value is MAXSOCKS, then the underlying service provider responsible for socket `s` sets the backlog to a maximum *reasonable* value.

Notes: 1. *The socket* `s` *is placed into passive mode in which incoming connection requests are acknowledged and queued pending acceptance by the process.*

2. *Servers that can facilitate more than one connection request at a time use the* `listen` *function.*

Return Value(s)

Success	If no error occurs, `listen` returns a 0.

Failure	One of the following values is returned. EINVAL—Invalid socket descriptor. EBADF—Invalid socket descriptor (not allocated). EOPNOTSUPP—Socket type not supported. EFAULT—backlog exceeding MAXSOCKS.

connect

Include

```
#include <socket.h>
```

Prototype

```
INT16               connect
(
 INT16              s,
 struct sockaddr    *peername,
 INT16              peernamelen
);
```

Description

The sockets' `connect` function establishes a connection to a specified socket.

Argument(s)

`s`	A descriptor identifying an unconnected socket.
`peername`	A pointer to the socket structure specifying the host to connect to.
`peernamelen`	The size of the `peername` parameter structure.

Notes: 1. *The* `connect` *function is used to create a connection to a specified destination. If the socket* `s` *is unbound, unique values are assigned to the local association by the system, and the socket is marked as bound.*

2. *By default,* `connect` *is a blocking call and is not returned unless connection is established or is refused.*

ReturnValue(s)

Success	If no error occurs, `connect` returns `ZTP_SOCK_OK`.
Failure	One of the following errors is returned.
	EAFNOSUPPORT—Address family not supported.
	EINVAL—Invalid descriptor.
	ECONNREFUSED—Connection refused by peer.

See Also

sockaddr Structure

recv

Include

```
#include <socket.h>
```

Prototype

```
INT16               recv
(
 INT16              s,
 INT8               * buf,
 INT16              nbyte,
 INT16              flags
);
```

Description

The sockets' `recv` function receives data from a connected socket.

Argument(s)

`s`	A descriptor identifying a connected socket.
`buf`	A pointer to a buffer for the incoming data.
`nbyte`	The length of `buf`.
`flags`	Reserved for future use.

Notes: 1. *The* `recv` *function reads incoming data on connection-oriented sockets. The sockets must be connected before calling* `recv`*. For a connected socket, the* `recv` *function restricts the addresses from which received messages are accepted. The function only returns messages from the remote address specified in the connection. Messages from other addresses are silently discarded.*

2. *For connection-oriented sockets (type* `SOCK_STREAM` *for example), calling recv returns as much information as is currently available (up to the size of the buffer supplied).*

3. *Zilog recommends not using* `recv()` *with datagram sockets.*

ReturnValue(s)

Success	If no error occurs, `recv()` returns the number of bytes received. If the connection has been gracefully closed, the return value is EFAULT.
Failure	One of the following error codes is returned: EDEADSOCK—Socket is closed. EBADF—Invalid descriptor. EPIPE—Invalid socket type. ZTP_ALREADY_BLOCKED (-18)—One thread is already blocked.

send

Include

```
#include <socket.h>
```

Prototype

```
INT16 send
(
 INT16 s,
 INT8 *buf,
 INT16 nbyte,
 INT16 flags
);
```

Description

This sockets' `send` function sends data on a connected socket.

Argument(s)

`s`	A descriptor identifying a connected socket.
`buf`	A buffer containing the data to be transmitted.
`nbyte`	The length of the data in `buf`.
`flags`	An indicator specifying the method in which a call is made. If used, `tcp_FlagPUSH`, the appropriate outbound TCP segment, contains a PSH flagset in code bits.

Notes: 1. *The* `send` *function is used to write outgoing data on a connected socket. The successful completion of a* `send` *does not indicate that the data was successfully delivered.*

2. *If no buffer space is available within the transport system to contain the data to be transmitted,* `send` *blocks unless the socket is placed in a nonblocking mode.*

3. *On non-blocking stream-oriented sockets, the number of bytes written is between one and the requested length, depending on buffer availability on both client and server.*

Return Value(s)

Success	If no error occurs, `send` returns the total number of bytes sent, which can be less than the number indicated by `len` for nonblocking sockets.
Failure	One of the following errors is returned: EDEADSOCK—The socket is closed. EBADF—Invalid descriptor. EPIPE—Invalid socket type. ZTP_ALREADY_BLOCKED (-18)—One thread is already blocked.

See Also

ZTP Core Macros

close_s

Include

```
#include <socket.h>
```

Prototype

```
INT16 close_s (INT16 s);
```

Description

The sockets' `close_s` function closes an existing socket.

Argument(s)

`s`	A descriptor identifying a socket to close.

Notes: 1. *The* `close_s` *function closes an active socket. This function is used to release the socket descriptor* `s` *so that further references to* `s` *fail. Any pending asynchronous or blocking calls issued by any thread in this process are cancelled without any notification messages displayed. To return any socket resources to the system, an application must contain a matching call to* `close_s` *for each successful call to the socket.*

2. *If* `close_s` *is issued on a master socket (a socket used in TCP server application and passed to the accept call as a parameter), all listening sockets on the same port are closed to accept those sockets that are already in the established state.*

Return Value(s)

Success	ZTP_SOCK_OK
Failure	EBADF—Invalid socket descriptor (not allocated).

recvfrom

Include

```
#include <socket.h>
```

Prototype

```
INT16 recvfrom
(
 INT16 s,
 INT8 *buf,
 INT16 len,
 INT16 flags,
 struct sockaddr * from,
 INT16 * fromlen
);
```

Description

The sockets' `recvfrom` function receives a datagram and stores the source address.

Argument(s)

`s`	A descriptor identifying a bound socket.
`buf`	A buffer for incoming data.
`len`	The length of buf.
`flags`	An indicator specifying the way in which the call is made. As this parameter is not used, the value passed must be zero across all versions of ZTP.
`from`	An optional pointer to a buffer that will hold the source address upon return.
`fromlen`	An optional pointer to the size of the `from` buffer.

Note: *The* `recvfrom` *function reads incoming data on unconnected sockets and captures the address from which the data is sent. The*

local address of the socket must be known. For server applications, this determination is usually made explicitly via the `bind` *function. Explicit binding is discouraged for client applications.* `recvfrom` *must be used only with datagram sockets.*

Return Value(s)

Success	If no error occurs, `recvfrom` returns the number of bytes received.
Failure	If an error occurs, one of the following error codes is returned:
	EBADF—Invalid descriptor.
	EPIPE—Invalid socket type.
	ENOCON—Connection refused.
	EFAULT—Other thread already blocked on socket.

See Also

sockaddr Structure

sendto

Include

```
#include <socket.h>
```

Prototype

```
INT16 sendto
(
 INT16              s,
 INT8               *buf,
 INT16              len,
 INT16              flags,
 struct             sockaddr *to,
 INT16              tolen,
);
```

Description

The sockets' `sendto` function sends data to a specific destination.

Argument(s)

`s`	A descriptor identifying a datagram socket.
`buf`	A buffer containing the data to be transmitted.
`len`	The length of the data in `buf`.
`flags`	An indicator specifying the way in which the call is made. As this parameter is not used, the value passed must be zero.
`to`	An optional pointer to the address of the target socket.
`tolen`	The size of the addressspecified in `to`.

Notes: 1. *The* `sendto` *function is used to write outgoing data on a socket. For message-oriented sockets, the* `to` *parameter can be any valid address in the socket's address family, including a broadcast address or any multicast address.*

2. *If the socket is unbound, unique values are assigned to the local association by the system, and the socket is then marked as bound.*
3. *The successful completion of a* `sendto` *does not indicate that the data was successfully delivered.* `sendto` *must be used only with connectionless datagram sockets.*

Return Value(s)

Success	If no error occurs, `sendto` returns the total number of bytes sent, which can be less than the number indicated by `len`.
Failure	If an error occurs, one of the following error codes is returned:
	EBADF—Invalid descriptor.
	EPIPE—Invalid socket type.
	ENOCON—Connection refused.

See Also

sockaddr Structure

ioctlsocket

Include

```
#include <socket.h>
```

Prototype

```
INT16 ioctlsocket
(
 INT16              s,
 INT32              cmd,
 UINT32             *argp
);
```

Description

The sockets' `ioctlsocket` function controls the I/O mode of a socket.

Argument(s)

`s` A descriptor identifying a socket.

`cmd` One of the following supported commands to perform on socket `s`.

UDPTIMEOUT—Sets up finite time-blocking for a UDP socket. The `argp` parameter specifies the value of timeout in seconds.

TCPTIMEOUT—Sets up finite time-blocking for a TCP socket. The `argp` parameter specifies the value of timeout in seconds.

FIONBIO—Use with a `NULL` `argp` parameter to enable the non blocking mode of socket `s`. The `argp` parameter points to an `UINT32` value. When a socket is created, it operates in blocking mode by default (non-blocking mode is disabled). This operation is consistent with BSD sockets.

FCNCLBIO—This command resumes any thread blocked on the socket for `recv()`/`send()`/`connect()`/`accept()`. The `argp` parameter points to an `UINT32` value. If the thread is to be unblocked from `recv()` `*argp` must be 1, else it must be 6 if thread has to be unblocked from `send()`, `connect()` or `accept()` calls.

FUDPCKSUM—This command disables UDP checksum calculation, which is enabled by default.

FDISNAGLE—This command disables the nagle algorithm which is enabled by default (used only for TCP sockets).

FENANAGLE—This command enables the nagle algorithm if disabled using FDISNAGLE (used only for TCP sockets).

FIONREAD—This command determines the amount of data pending in the network's input buffer that can be read from socket `s` (used for TCP/UDP sockets).

FIONWRITE—This command determines the amount of data pending in the network's output buffer that is yet to be sent out by the network stack (used only for TCP sockets).

TCPKEEPALIVE_ON—This command enables the Keep Alive feature of the TCP protocol. The `argp` parameter specifies the value of Keep Alive timeout in seconds.

TCPKEEPALIVE_OFF—This command disables the Keep Alive feature of the TCP protocol.

`argp` A pointer to a parameter for `cmd`.

Notes: 1. *The* `ioctlsocket` *function can be used on any socket in any state. It is used to set or retrieve operating Argument(s) associated with the socket.*

2. *Compatibility–This* `ioctlsocket` *function performs only a subset of functions on a socket when compared to the* `ioctl` *function found in Berkeley sockets.*

Return Value(s)

Success	Returns 0 if successful.
	If `cmd` is FIONREAD then number of bytes of data present in the socket buffer to be read is returned.
	If `cmd` is FIONWRITE then number of bytes of data present in the socket buffer to be sent is returned.
Failure	One of the following error codes is returned:
	EFETNOSUPPORT—If requested command is not implemented.
	EBADF—Invalid descriptor. If `cmd` is FIONREAD/FIONWRITE then return value is the amount of data pending in the network's input/output buffer that can be read/sent from socket `s`.

getsockname

Include

```
#include <socket.h>
```

Prototype

```
INT getsockname
(
 INT16              s,
 struct             sockaddr * name,
 INT                * namelen
);
```

Description

The sockets' `getsockname` function retrieves the local name for a socket.

Argument(s)

`s`	A descriptor identifying a bound socket.
`name`	Receives the address (`name`) of the socket.
`namelen`	The size of the `name` buffer.

Notes: 1. *The* `getsockname` *function retrieves the current* `name` *for the socket descriptor specified by* `s`*. It is used on the bound or connected socket specified by the s parameter. The local association is returned. This call is especially useful when a connect call has been made without performing a bind first; the* `getsockname` *function determines the local association.*

2. *The* `getsockname` *function always does not return information about the host address when the socket has been bound to an unspecified address, unless the socket has been connected with connect or accept (for example, using* `ADDR_ANY`*).*

Return Value(s)

If no error occurs, `getsockname` returns 0; otherwise, it returns -1.

When called, the `namelen` argument contains the size of the `name` buffer, in bytes. Upon return, the `namelen` parameter contains the actual size (in bytes) of the `name` parameter.

See Also

sockaddr Structure

getpeername

Include

```
#include <socket.h>
```

Prototype

```
int getpeername
(
 short              s,
 struct             sockaddr * name,
 int                * namelen
);
```

Description

The sockets' `getpeername` function retrieves the name of the peer to which a socket is connected.

Argument(s)

`s`	A descriptor identifying a connected socket.
`name`	The structure that receives the name of the peer.
`namelen`	A pointer to the size of the `name` structure.

Note: *The* `getpeername` *function retrieves the name of the peer connected to the socket* `s` *and stores it in the* `sockaddr` *structure identified by name. The* `getpeername` *function can be used only on a connected socket. For datagram sockets, only the name of a peer specified in a previous connect call is returned—any name specified by a previous* `sendto` *call is returned by* `getpeername`.

Return Value(s)

If no error occurs, `getpeername` returns 0; otherwise, it returns -1.

When called, the `namelen` argument contains the size of the `name` buffer, in bytes. Upon return, the `namelen` parameter contains the actual size in bytes of the `name` returned.

See Also

sockaddr Structure

inet_addr

Include

```
#include <ZTPtcp.h>
```

Prototype

```
UINT32 inet_addr
(
 INT8 *charp
);
```

Description

The sockets' `inet_addr` function converts a string containing an Internet Protocol (IPv4) dotted address into a UINT32 value.

Argument(s)

`charp`	A null-terminated character string representing a number expressed in the Internet standard "." (dotted) notation.

Note: *The* `inet_addr` *function interprets the character string specified by the* `charp` *parameter. This string represents a numeric Internet address expressed in the Internet standard "." notation. The value returned is a number used as an Internet address. All Internet addresses are returned in the host byte order (little endian in the case of eZ80® devices).*

Return Value(s)

If no error occurs, `inet_addr` returns an `UINT32` value containing a suitable binary representation of the internet address given; otherwise, it returns 0.

inet_ntoa

Include

```
#include <ZTPtcp.h>
```

Prototype

```
INT8 *inet_ntoa(INT8 *s, UITN32 x)
```

Description

The `inet_ntoa` function converts an IPv4 network address into a string in Internet standard dotted format.

Argument(s)

`s` Pointer to memory buffer to hold dotted notation ("a.b.c.d") IP address.

`x` Unsigned long representation of IP address.

Note: *The* `inet_ntoa` *function takes an* `UINT32` *parameter as an IP address and returns an ASCII string representing the address in dotted (*"."*) notation as in* "a.b.c.d".

Return Value(s)

If no error occurs, `inet_ntoa` returns a `INT8` pointer to a static buffer containing the text address in standard dotted (".") notation. Otherwise, it returns `NULL`.

HTTP Function

The Zilog TCP/IP Stack supports the following three HTTP functions:

- http_init
- httpBasicAuth_init
- httpDigestAuth_init

http_init

Include

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

Prototype

```
INT16 http_init (const Http_Method*
http_defmethods,const struct header_rec *
httpdefheaders, Webpage *website, UINT16 portnum);
```

Description

The `http_init` function initializes a webserver (or website), makes a TCP connection on a specified port, and waits for a client request. Upon receiving a request from the client, the webserver provides a response according to the webserver configuration.

Argument(s)

`http_def methods`	A pointer to the supported methods structure.
`httpdef headers`	A pointer to the suppoted header structures.
`website`	A pointer to the website for which the server processes requests.
`portnum`	Port number on which the HTTP server listens.

Return Value(s)

If no error occurs, `it returns the http server port number`. Otherwise, it returns `SYSERR`.

httpBasicAuth_init

Include

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

Prototype

```
INT16 httpBasicAuth_init
(const Http_Method * http_defmethods,
const struct header_rec * httpdefheaders,
Webpage *website, UINT16 portnum);
```

Description

The `httpBasicAuth_init` function initializes a webserver (or website) with Basic Authentication support, opens a TCP connection on a specified port, and waits for a client request. Upon receiving a request from the client, the webserver requests for authentication by asking for user name and password, which will be verified against the configured values. If the user name and password are correct then it responds according to the webserver configuration.

Argument(s)

`http_def methods`	A pointer to the supported methods structure.
`httpdef headers`	A pointer to the suppoted header structures.
`website`	A pointer to the website for which the server processes requests.
`portnum`	Port number on which the HTTP server listens.

Return Value(s)

If no error occurs, `it returns the http server port number`. Otherwise, it returns `SYSERR`.

httpDigestAuth_init

Include

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

Prototype

```
INT16 httpDigestAuth _init (const Http_Method*
httpAuth_defmethods,const struct header_rec *
httpdefheaders, Webpage *website, UINT16 portnum);
```

Description

The `httpDigestAuth _init` function initializes a webserver (or website) with MD5 Digest Authentication support, opens a TCP connection on a specified port, and waits for a client request. Upon receiving a request from the client, the webserver requests for authentication by asking for user name and password, which will be verified against the configured values. If the user name and password are verified correct then it provides a response according to the webserver configuration.

Argument(s)

`http_def methods`	A pointer to the supported methods structure.
`httpdef headers`	A pointer to the suppoted header structures.
`website`	A pointer to the website for which the server processes requests.
`portnum`	Port number on which the HTTP server listens.

Return Value(s)

If no error occurs, `it returns the http server port number`. On failure, it returns `SYSERR`.

HTTP Supported Methods

http_defmethods

```
const Http_Method http_defmethods[] = {
{ HTTP_GET,          "GET",http_get },
{ HTTP_HEAD,         "HEAD",http_get },
{ HTTP_POST,         "POST",http_post },
{ HTTP_SUBSCRIBE,    "SUBSCRIBE",http_post },
{ HTTP_UNSUBSCRIBE, "UNSUBSCRIBE",http_post },
{ 0,                     NULL,       NULL },
};
const Http_Method httpAuth_defmethods[] = {
{ HTTP_GET,          "GET",httpAuth_get },
{ HTTP_HEAD,         "HEAD",httpAuth_get },
{ HTTP_POST,         "POST",http_post },
{ HTTP_SUBSCRIBE,    "SUBSCRIBE",http_post },
{ HTTP_UNSUBSCRIBE, "UNSUBSCRIBE",http_post },
{ 0,                     NULL,       NULL },
};
```

The HTTP server calls the corresponding get function, based on which HTTP is initialized whenever it encounters an HTTP_GET request. The default method handlers can be overridden by replacing these defaults with another declaration of this structure.

Notes:
1. The default handlers provided with ZTP are sufficient to handle these HTTP methods. It is not necessary to override them. Do not override the default methods unless you are familiar with the HTTP protocol.
2. *The* `http_defmethods` *array is extensible. Additional methods can be added to the list of standard HTTP methods by modifying the* `http_defmethods[]` *structure. These methods can be optional HTTP 1.1 methods such as Put, Delete, or Trace, or custom methods such as* `My_Method`.
3. *When implementing a nonstandard method, it is unlikely that a standard web browser can invoke a custom method. Describing the operation of the HTTP protocol is beyond the scope of this manual.*

4. *All method handlers follow the same function prototype, as defined in* `http.h`. *The method handler simply parses the* `http_request` *and performs the appropriate action(s), as shown in the example below.*

Example

```
void method_handler( Http_Request * )
{
//Program coded by you
}
```

HTTP Supported Header

httpdefheaders

This array of `header_rec` structures constitutes the list of HTTP headers recognized by the webserver. The default list of recognized headers is shown in the following code:

```
const struct header_rec httpdefheaders[] = {
{ "Accept",              HTTP_HDR_ACCEPT },
{ "Cache-Control",  HTTP_HDR_CACHE_CONTROL },
{ "Callback",            HTTP_HDR_CALLBACK },
{ "Connection",     HTTP_HDR_CONNECTION },
{ "Content-Length", HTTP_HDR_CONTENT_LENGTH },
{ "Content-Type",   HTTP_HDR_CONTENT_TYPE },
{ "Transfer-Encoding",HTTP_HDR_TRANSFER_ENCODING },
{ "Date",                HTTP_HDR_DATE },
{ "Location",            HTTP_HDR_LOCATION },
{ "Host",                HTTP_HDR_HOST },
{ "Server",              HTTP_HDR_SERVER },
{ "Authorization",  HTTP_HDR_SEND_CLIENT_AUTH },
{ "WWW-Authenticate",HTTP_HDR_ASK_CLIENT_AUTH},
{"Authentication-Info", HTTP_HDR_SEND_SERVER_AUTH},
{ NULL,0 },
} ;
```

Before calling a method handler, the HTTP server parses incoming HTTP requests into an `http_request` structure, and passes this structure as a parameter to the handler. This `http_request` structure is listed in Appendix A on page 83.

The HTTP server creates an entry in the `rqstheaders` field of the `http_request` structure for known headers from the `httpdefheaders` structure. Therefore, if the application requires additional headers that are not in the default `httpdefheaders` structure, you must provide the `httpdefheaders` structure before calling `http_init`.

website

A pointer to the website for which the server processes requests. The website parameter can contain both static web pages and dynamic web pages. Each element of the website array corresponds to a single static or dynamic web page. Two sample web page declarations for a Static webpage and the dynamic page are described below:

```
Webpage website[] = {
{HTTP_PAGE_STATIC, "/", "text/html",
&my_static_page_htm},
{HTTP_PAGE_DYNAMIC, "/dynamic.htm", "text/html"},
```

Static Web Pages

If the website consists of only Static webpages, the default HTTP library contains all the necessary routines to process Get and Head requests without providing any additional code. The HTTP server calls its internal `http_get` method-handling function when a Get or Head request is received for any Static webpage within the website array. The ZTP internal `http_get` method then returns the appropriate object in an HTTP response. However, if the website contains dynamic web pages, you must provide the code to complete the processing of the HTTP request.

Dynamic Web Pages

When the ZTP HTTP server encounters a request for a Dynamic page, it parses the incoming request into an `http_request` structure, then calls a helper function to complete the request. For example, see the dynamic page entry in the **website** definition provided above. When processing a Get request on the `dynamic.htm` page, the HTTP server's `http_get` function calls the MY_DYNAMIC_CGI helper function to generate the HTTP response for return to the client. A pointer to the `http_request` structure is passed to the helper function, `my_dynamic_cgi`.

Additional HTTP APIs

void http_add_header (Http_Request *request, UINT16 header, INT8 *value)

This function adds the specified {header, value} pair to the list of response headers that is sent back to the HTTP request.

INT8 *http_find_argument (Http_request *request, UINT8 *key)

This routine searches through the list of Argument(s) associated with the given HTTP request.

void http_add_header (Http_Request *request, UINT16 header, INT8 *value)

This function adds the specified {header, value} pair to the list of response headers that is sent back to the HTTP request.

INT8 *http_find_argument (Http_request *request, UINT8 *key)

This routine searches through the list of Argument(s) associated with the given HTTP request for a parameter, the name of which matches the passed key. If such a parameter is found within the parsed request structure, a pointer to its value is returned.

INT8 *http_find_header (Http_Request *rqst, UINT8 key)

This routine searches through the list of rqstheaders in the http_request structure for a header, the name of which matches the specified key. If successful, a pointer to the value of the header is returned.

INT8 *http_find_param (Http_Params *params, UINT8 *key)

This routine parses the given HTTP parameter structure for a parameter, the name of which matches the specified key. If such a parameter is found

within the passed list, the function returns a pointer to the parameter's value.

```
void http_output_headers (Http_Request *request);
```

This routine outputs the text representation of all of the instances of `httpdefheader` contained in the `resp-headers` array, along with its corresponding values.

For more information refer to website demo provided with the standard projects available at:

```
<ZTPInstall>ZTP\SamplePrograms\ZTPDemo
```

Example 1

If the CGI routine calls the function `add_header(request, HTTP_HDR_LOCATION, Jupiter)` then calls `output_headers(request)`, the following text is added to the HTTP response:

```
Location: Jupiter\r\n INT16 http_output_reply
(Http_request *request, UINT16 reply)
```

This function transmits the HTTP status line and response headers contained in the associated HTTP request structure. The status line is constructed from the passed reply code.

Example 2

A reply code of HTTP_200_OK results in the following status line being transmitted back to the requesting client:

```
HTTP/1.1 200 OK<CRLF>
```

Notes: 1. *All pages returned by the HTTP server are marked as no-cache to indicate that proxies must revalidate the request before returning a cached copy of the appropriate resource. HTTP has been interfaced with file system with which web pages can be uploaded to the eZ80® CPU at run time using either TFTP or FTP.*

2. *All of the web files should be uploaded to a directory specified by:* `INT8 httppath[] = "/"` *in the* `ZTPConfig.c` *file. HTTP searches for the requested web page both in the static web page array and also searches in the directory specified by the* `INT8 http-path[]` *variable. The order of the search is determined by the variable* `UINT8 g_DefaultSearchFS= FALSE;`*. If this variable is* `FALSE` *then first static web page array is searched, if not found then the directory specified is searched. If this variable is* `TRUE` *then it is vice-versa.*

See Also

Http_Request Structure
webpage Structure
Http_Method Structure
header_rec Structure

HTTPS Function

Zilog TCP/IP Stack supports one secure HTTP function https_init.

https_init

Include

```
#include "ssl2_server.h"
```

Prototype

```
int https_init
(
const Http_Method *methods, const struct header_rec
*headers, Webpage *webpages, int port
);
```

Description

The Secure WebServer is initialized by calling the `https_init` API. This API takes the same number and type of Argument(s) as the standard HTTP server API. It is possible to have both the secure and nonsecure webservers running at the same time; however, the two webservers must exist on different ports. The port number typically used for nonsecure HTTP servers is 80; for secure HTTP servers (HTTP over SSL or HTTPS) the port number typically used is 443.

Argument(s)

`http_methods`	A pointer to the supported methods structure.
`httpdef headers`	A pointer to the suppoted header structures.
`webpage`	A pointer to the webpage for which the server processes requests.
`port`	Port on which the HTTPS server listens.

Return Value(s)

The `https_init` function returns the port number on which SSL is listening upon successfully opening the SSL device.

See Also

Http_Request Structure
webpage Structure
Http_Method Structure
header_rec Structure

SNMP Functions

Zilog TCP/IP Stack supports four SNMP functions. Table 4 provides a quick reference to each of these functions.

Table 4. SNMP Functions Quick Reference

snmp_init
snmpv2_init
snmpv3_init
TrapGen

snmp_init

Include

```
#include "snmp.h"
```

Prototype

```
void snmp_init(SN_TRAP_NOTIFY snTrapNotifyFunc);
```

Description

The `snmp_init` API is called from the `main()` routine to enable the SNMP agent. This protocol can be used to read or write values in the MIB by using the Get, GetNext, or Set operations. Requests originate from the SNMP management entity are sent to the SNMP agent. After the SNMP agent processes the request, it returns relevant information to the Management Entity. The management entity can obtain information about objects in the MIB using the Get or GetNext requests; or, it can modify the value of an object in the MIB using the Set request. The parameter `snTrapNotifyFunc` is used to inform the application whenever a trap is generated by SNMP agent.

Argument(s)

`snTrapNotifyFunc`	Function pointer provided by the application to SNMP agent which is used to inform the application whenever a trap is generated by SNMP agent.

Return Value(s)

None.

snmpv2_init

Include

```
#include "snmp.h"
```

Prototype

```
void snmpv2_init(SN_TRAP_NOTIFY snTrapNotifyFunc);
```

Description

The `snmpv2_init` API is called from the `main()` routine to enable the SNMPv2 agent. This protocol can be used to read or write values in the MIB by using the Get, GetNext, or Set operations which are supported in SNMPv1. SNMPv2 also defines GetBulk which is used to efficiently retrieve large blocks of data. Requests from the SNMP management entity are sent to the SNMP agent. After the SNMP agent processes the request, it returns relevant information to the management entity. The management entity can obtain information about objects in the MIB using the Get or GetNext requests or Get bulk requests; or it can modify the value of an object in the MIB using the Set request. The parameter `snTrapNotifyFunc` is used to inform the application whenever a trap is generated by SNMP agent. This function creates a separate thread for SNMPv2 entity and waits for incoming requests from the SNMP manager.

Argument(s)

`snTrapNotifyFunc`	Function pointer provided by the application to SNMP agent which is used to inform the application whenever a trap is generated by SNMP agent.

Return Value(s)

None.

snmpv3_init

Include

```
#include "snmp.h"
```

Prototype

```
void snmpv3_init(SN_TRAP_NOTIFY snTrapNotifyFunc);
```

Description

`snmpv3_init` performs the same functions as `snmpv2_init` with the additional features of authentication and encryption (if enabled). It supports user security model.

Argument(s)

`snTrapNotifyFunc`	Function pointer provided by the application to SNMP agent which is used to inform the application whenever a trap is generated by SNMP agent.

Return Value(s)

None.

Note: *SNMPv2 performs the same functions as SNMPv1 with added feature of get bulk and SNMPv3 performs the same function as SNMPv2 with added functionality of authentication and encryption (if enabled).*

TrapGen

Include

```
#include "snmp.h"
```

Prototype

```
INT16 TrapGen( UINT8 Type,
 DWORD Code,
 UINT16 NumObjects,
 SN_Object_s *pObjectList
);
```

Description

The `TrapGen` function is used to send a trap to inform the SNMP manager that an event has occurred on the agent.

The SNMP library in ZTP is capable of generating the following SNMP v1 traps:

- Cold Start Trap
- Link Up Trap
- Link Down Trap
- Enterprise Specific Trap

These four Flags are defined in `snmp_conf.c` to enable/disable corresponding traps.

If the `Generate_Cold_Start_Traps` Flag is set to TRUE, a Cold Start Trap is generated when the system boots, regardless of whether the system is warm-booted (for example, executing the reboot command from the shell) or cold-booted (disconnecting and reconnecting the power supply).

If the `Generate_Link_Up_Traps` Flag is set to TRUE, the system generates a Link Up Trap whenever a network interface is (re)activated.

For example, during system initialization, the Ethernet interface becomes active and a Link Up Trap is generated.

Conversely, if the `Generate_Link_Down_Traps` Flag is set to TRUE, when a network interface changes state from active to inactive, a Link Down trap is generated. For example, a Link Down trap is generated when the PPP link is disconnected.

If the `Generate_Enterprise_Traps` Flag is set to TRUE, then an Enterprise-Specific trap is generated.

Argument(s)

`Type`	One of the following values must be used. SN_TRAP_COLD_START—Cold Start trap. SN_TRAP_LINK_DOWN—Link Down trap. SN_TRAP_LINK_UP—Link Up trap. SN_TRAP_AUTH_FAILURE—authentication failure. SN_TRAP_ENTERPRISE_SPECIFIC—user-defined trap.
`Code`	A 32-bit value unique to the application that identifies the particular trap message being generated.
`NumObjects`	This parameter specifies the number of `SN_Object_s` structures that are to be included in the body of the Trap message. If the application-specific trap does not require any objects to be included in the trap message, set this parameter to 0.
`pObjList`	This parameter is a pointer to an array of `NumObjects SN_Object_s` structures that identify the SNMP objects to be included in the body of the trap message. If the application-specific trap does not require any objects to be included in the trap message, set this parameter to `NULL`.

Return Value(s)

The `TrapGen` function returns SYSERR if the argument `Type` is not SN_TRAP_ENTERPRISE_SPECIFIC and if Generate_Enterprise_Traps is FALSE. It returns OK upon successful generation of a Trap.

See Also

SN_TRAP_ENTERPRISE_SPECIFIC

SN_Object_s Structure

SMTP Function

Zilog TCP/IP Stack supports one simple mail transport protocol (SMTP) function mail, which is described below.

mail

Include

```
#include "smtp.h"
```

Prototype

```
INT16 mail(INT8 *Addr,
UINT16 port,
INT8 *subject,
INT8 *to,
INT8 *from,
INT8 *usrname ,
INT8 *passwd,
INT8 *data,
INT8 *error,
UINT16 errorlen)
```

Description

To allow you to send email messages using the SMTP, ZTP provides the `mail` function. The `mail` function sends an SMTP mail message to a specified SMTP server or port. The function establishes a TCP connection for the mail transfer. The same API can be used for both sending SMTP mail with CRAM-MD5 algorithm authentication.

Argument(s)

`Addr`	A pointer to a character string containing the name or IP address (in decimal/dotted notation) of the SMTP server.
`port`	The SMTP port to use (normally 25).
`subject`	A pointer to a character string containing the *Subject:* text in the mail message.

`to`	A pointer to a character string containing the email address of the recipient.
`from`	A pointer to a character string containing the email address of the sender.
`usrname`	A pointer to a character string containing the user name for authentication (valid only if SMTP CRAM MD5 authentication is enabled else it is ignored).
`passwd`	A pointer to a character string containing the user password for authentication (valid only if SMTP CRAM MD5 authentication is enabled else it is ignored).
`data`	A pointer to a character string containing the body of the email, along with any additional headers.
`error`	A pointer to a buffer in which ZTP can place a text string describing the reason why the `mail` function failed to send the message.
`errorlen`	The maximum size (in bytes) of the buffer referenced by the `error` parameter.

Return Value(s)

If no error occurs, `it returns OK`. On failure, it returns `SYSERR`.

Telnet Functions

Table 5 provides quick reference to Telnet function supported by Zilog TCP/IP Stack. For more information on Telnet definitions and Enumerations, see Appendix A on page 83.

Table 5. Telnet Functions Quick Reference

telnet_init
TelnetOpenConnection
TelnetCloseConnection
TelnetSendData

telnet_init

Include

```
#include "telnet_api.h"
```

Prototype

```
void telnet_init (void)
```

Description

The `telnet_init` function initializes a Telnet server. The Telnet server thread, created as a result of this function, is used to handle requests from Telnet clients.

Argument(s)

None.

Return Value(s)

None.

TelnetOpenConnection

Include

```
#include "telnet_api.h"
```

Prototype

```
TELNET_RET TelnetOpenConnection
(
 IP_ADDRESS ipAddr,
 TELNET_HANDLE *telnetAppHandle,
 TELNETREAD telnetReadCallback
)
```

Description

ZTP provides the `TelnetOpenConnection` function to establish a TCP connection with a specified server. This function also sends the ECHO and SUPPRESSGOAHEAD options to the server.

Argument(s)

`ipAddr`	A `uint32` value which contains the IP address (in decimal/dotted notation) of the Telnet server.
`telnetAppHandle`	A pointer to a handle given by the Telnet client to the application after a connection is established successfully.
`telnetReadCallback`	A function pointer given by the application which is used by Telnet Client to notify the application when data is received from the other end.

Return Value(s)

It returns the following when it is executed:

TELNET_ALREADY_CONNECTED	Indicates that the Telnet connection already exists.
TELNET_INVALID_ARG	Indicates that one or more arguments are invalid.
TELNET_LOWER_LAYER_FAILURE	Indicates that the TCP connect failure happened.
TELNET_CONNECT_FAILURE	Indicates that unknown error occurred.
TELNET_SUCCESS	Telnet Connection has been established successfully.

See Also

Telnet Data Type Definitions

Telnet Enumerations

TelnetCloseConnection

Include

```
#include "telnet_api.h"
```

Prototype

```
TELNET_RET TelnetCloseConnection ( TELNET_HANDLE
telnetAppHandle );
```

Description

To terminate a Telnet session with the server, ZTP provides the `TelnetCloseConnection` function. It terminates the TCP connection with the specified server and cleans up connection-related information for this application.

Argument(s)

`telnetAppHandle`	Handle furnished by the Telnet client during the establishment of a successful connection.

Return Value(s)

`TELNET_NO_CONNECTION`	Indicates that the Telnet connection is not yet established.
`TELNET_INVALID_ARG`	Indicates that one or more arguments are invalid.
`TELNET_FAILURE`	Indicates that an unknown error occurred.
`TELNET_SUCCESS`	Telnet Connection has been terminated successfully.

See Also

Telnet Enumerations

Telnet Data Type Definitions

TelnetSendData

Include

```
#include "telnet_api.h"
```

Prototype

```
TELNET_RET TelnetSendData
(
 TELNET_HANDLE telnetAppHandle,
 TELNET_DATA *telnetData,
 TELNET_DATA_SIZE telnetDataSize
)
```

Description

To send required data to the server (executing server-side commands), ZTP provides the `TelnetSendData` function, which sends each character entered to the server. The character is displayed on the console when the server echoes back the character.

Argument(s)

`telnetAppHandle`	Handle given by the Telnet client to the application during the establishment of a successful connection.
`telnetData`	Actual data that must be sent to the server.
`telnetDataSize`	Size of the data to be sent.

Return Value(s)

The following values are returned when the function is executed.

`TELNET_NO_CONNECTION`	Indicates that the Telnet connection is not yet established.
`TELNET_INVALID_ARG`	Indicates that one or more arguments are invalid.

TELNET_LOWER_LAYER_FAILURE	Indicates failure at lower layers.
TELNET_SUCCESS	Data has been sent successfully.

See Also

Telnet Data Type Definitions

Telnet Enumerations

TimeP Protocol Function

Zilog TCP/IP Stack supports one TimeP protocol function time_rqest, which is described below.

time_rqest

Include

```
#include "date.h"
```

Prototype

```
INT16 time_rqest(void);
```

Description

The `time_rqest()` function sends out a time request to the time server, the IP address of which is specified in the `struct commonServers csTbl[ ]`, which is present in the `ZTPConfig.c` file. When the time request is received from the sever, the time is updated to the real-time clock (RTC). If the time server is not present or did not reply to the request, then the RTC will not be updated. The time server should be RFC 738-compliant.

Argument(s)

None.

Return Value(s)

If successful, the `time_rqest` function returns OK. If this function fails, it returns either TIMEOUT or SYSERR.

DNS Functions

Zilog TCP/IP Stack supports two DNS functions. Table 6 provides a quick reference to the DNS functions.

Table 6. DNS Functions Quick Reference

name2ip
ip2name

name2ip

include

```
"domain.h"
```

Prototype

```
UINT32 name2ip(INT8 *nam)
```

Description

The `name2ip` function resolves a host name to IP addresses. This function sends a DNS formatted in UDP datagram with the DNS IP acquired from the `cstbl` structure.

Argument(s)

`nam`	A pointer to a character string containing the host name or URL.

Return Value(s)

The `name2ip` function returns the IP addresses of the host or URL when successful. If this function fails, it returns SYSERR.

ip2name

include

```
"domain.h"
```

Prototype

```
INT8 * ip2name(UINT32 ip, INT8 *nam)
```

Description

The `ip2name` function returns the DNS name for a host when furnished its IP address. This function sends a DNS formatted in UDP datagram with the DNS IP acquired from the `cstbl` structure.

Argument(s)

`ip`	IP addresses for which name resolution is required.
`nam`	Pointer to a character buffer to hold the resolved name.

Return Value(s)

The `ip2name` function returns the pointer to the character buffer holding the resolved name when successful. If this function fails, it returns SYSERR.

RARP Function

Zilog TCP/IP Stack supports one reverse address resolution protocol (RARP) function rarpsend, which is described below.

rarpsend

Include

```
#include "rarp.h"
```

Prototype

```
INT16 rarpsend(UINT8 ifn)
```

Description

The Reverse Address Resolution Protocol provides a mechanism for a host to obtain an IP address at startup. The host obtains a RARP response with an IP address from a network server by sending the server a RARP request using the network broadcast address and its own physical address as identification. The server is required to maintain a map of hardware addresses to IP addresses.

Argument(s)

`ifn`	Interface number of the Ethernet interface for which IP addresses are required.

Return Value(s)

The `rarp` function returns OK when successful, and SYSERR upon failure.

IGMP Functions

Zilog TCP/IP Stack supports two IGMP functions. Table 7 provides a quick reference to the IGMP functions.

Table 7. IGMP Functions Quick Reference

hgjoin
hgleave

hgjoin

Include

```
#include "igmp.h"
```

Prototype

```
INT16 hgjoin
(
 UINT8 ifnum,
 UINT32 ipa,
 UINT8 ttl
);
```

Description

The `hgjoin` function joins the eZ80® CPU to a specified multicast group and sends a membership report for that particular group. If the eZ80 CPU is already a member of the group, the membership report for the group will not be sent.

Argument(s)

`ifnum`	Interface number that should be set to the interface number of the primary Ethernet interface.
`ipa`	IP addresses of the multicast group to join.
`ttl`	The parameter `ttl` is the time to live value, which is a routing parameter used to restrict the number of gateways/multicast routers through which the multicast packet can pass.

Return Value(s)

The `hgjoin` function returns OK when successful and SYSERR upon failure.

hgleave

Include

```
#include "igmp.h"
```

Prototype

```
INT16 hgleave( UINT8 ifnum, UINT32 ipa )
```

Description

The `hgleave` function removes the eZ80® CPU from the membership of the joined multicast group.

Argument(s)

`ifnum`	Interface number that should be set to the interface number of the primary Ethernet interface.
`ipa`	IP addresses of the multicast group to leave.

Return Value(s)

The `hgleave` function returns OK when successful and SYSERR upon failure.

TFTP Functions

Zilog TCP/IP Stack supports two TFTP functions. Table 8 provides a quick reference to the TFTP functions.

Table 8. TFTP Functions Quick Reference

tftp_get
tftp_put

tftp_get

Include

```
#include "tftp.h"
```

Prototype

```
INT32 tftp_get(INT8 *Addr, INT8 *filename)
```

Description

The `tftp_get` function is used to download files from the TFTP server. This file is then stored in the thread's current working directory (CWD). If the CWD contains a file with the same name as the file that is downloaded from the server, the original file will be overwritten with the new file.

Argument(s)

`Addr`	Pointer to a character string containing the IP address of TFTP server.
`filename`	Pointer to the name of the file to be downloaded.

Return Value(s)

Upon success, the `tftp_get` function returns the number of bytes that are loaded into the file system; it returns 0 upon failure.

tftp_put

Include

```
#include "tftp.h"
```

Prototype

```
INT16 tftp_put(INT8 *Addr, INT8 *filename)
```

Description

The `tftp_put` function is used to upload files from the eZ80® CPU to the TFTP server. The file to be uploaded must be present in the thread's current working directory (CWD).

Argument(s)

`Addr`	Pointer to a character string containing the IP address of TFTP server.
`filename`	Pointer to the name of the file to be uploaded.

Return Value(s)

The function returns the number of bytes sent when successful and 0 upon failure.

FTP Functions

Zilog TCP/IP Stack supports four FTP functions. Table 9 provides a quick reference to the FTP functions.

Table 9. FTP Functions Quick Reference

ftpdinit
ftp_connect
do_programatic_login
do_a_ftp_command

ftpdinit

Include

No header files needed. Declare function as `extern` before calling it.

Prototype

```
void ftpdinit(void);
```

Description

The `ftpdinit` API starts an FTP service on the ZTP Stack.

Argument(s)

None.

Return Value(s)

None.

ftp_connect

Include

```
#include “ftpclient_api.h”
```

Prototype

```
int ftp_connect
(
 INT8 * server_name,
 int server_port,
 RZK_DEVICE_CB_t * stdout
);
```

Description

The `ftp_connect` function is used to connect to a selected FTP server running on the FTP_PORT.

Argument(s)

`server_name`	Pointer to the IP address of the FTP server running on the remote machine (in dotted notation).
`server_port`	A number that identifies the TCP/IP port to use on the server.
`stdout`	Pointer to an integer value specifying the device to write to.

Return Value(s)

The `ftp_connect` function returns 0 (zero) when successful and a negative value otherwise.

do_programatic_login

Include

```
#include “ftpclient_api.h”
```

Prototype

```
int do_programatic_login
(
 RZK_DEVICE_CB_t * stdin,
 RZK_DEVICE_CB_t * stdout,
 INT8 *username,
 INT8 *passwd
);
```

Description

The `do_programatic_login` function allows the eZ80® FTP client to log into the FTP server with the specified user name and the password.

Argument(s)

`stdin`	Pointer to a console device
`stdout`	Pointer to a console device
`username`	Pointer to a username
`passwd`	Pointer to a password

Return Value(s)

The `do_programatic_login` function returns one when successful and zero otherwise.

do_a_ftp_command

Include

```
#include “ftpclient_api.h”
```

Prototype

```
INT16 do_a_ftp_command
(
 RZK_DEVICE_CB_t * device,
 UINT16 nargs,
 INT8 *args[]
);
```

Description

ZTP provides `do_a_ftp_command` function to issue FTP commands. The command name and the arguments to the command should be provided as an array of strings.

Argument(s)

`device`	Pointer to a console device
`nargs`	number of arguments the command expects.
`args`	Pointer to a command name and the arguments.

Return Value(s)

Depends on the issued command.

Note: *Zilog TCP/IP Stack supports a number of commands. The third parameter of this API,* `args[]`*, can contain any of the commands and the respective arguments listed in* Table 10 on page 76.

Table 10. `do_a_ftp_command` Commands and Arguments

Command Name	Arguments	Description
`ascii`	None	Sets the file transfer type to the network ASCII (default).
`bin`	None	Sets the file transfer type to support binary image transfer.
`bye`	None	Terminate the FTP session with the Remote Server and exit ftp. An end of file will also terminate the session and exit.
`cd`	None	Remote-directory Change the working directory on the remote machine to the remote directory.
`close`	None	Terminate the FTP session with the Remote Server, and returns to the command interpreter. Any defined macros are erased.
`delete`	remote-file	Delete the file remote-file on the remote machine.
`dir`	[remote-directory]	Print a listing of the directory contents in the directory remote directory. If no directory is specified, the current working directory on the remote machine is used.
`get`	remote-file [local-file]	Retrieve the remote-file and store it on the local machine. If the local file name is not specified, it receives the same name it has on the remote machine. The current settings for type, form, mode, and structure are used while transferring the file.
`hash`	None	Toggle hash-sign (“#”) printing for each data block transferred. The size of a data block is 512 bytes.
`help`	[command]	Print an informative message about the meaning of a command. If no argument is supplied, FTP prints a list of the known commands.

Table 10. `do_a_ftp_command` Commands and Arguments (Continued)

Command Name	Arguments	Description
`lcd`	[directory]	Change the working directory on the local machine. If no directory is specified, the user's home directory is used.
`ls`	[remote-directory]	Print a listing of the contents of a directory on the remote machine. The listing includes any system-dependent information that the server chooses to include; for example, most Unix systems will produce output from the command `ls' -l, see also `nlst`. If remote-directory remains unspecified, the current working directory is used.
`list`	[remote-directory]	Synonym for `ls`.
`mkdir`	directory-name	Create a directory on the remote machine.
`nlst`	[remote-directory]	Print a list of the files in a directory on the remote machine. If remote-directory remains unspecified, the current working directory is used.
`put`	local-file [remote-file]	Store a local file on the remote machine. If remote-file remains unspecified, the local file name is used to name the remote file. File transfer uses the current settings for type, format, mode, and structure.
`pwd`	None	Print the name of the current working directory on the remote machine.
`quit`	None	A synonym for `bye`.
`recv`	remote-file [local-file]	A synonym for `get`.
`rename`	[from] [to]	On the remote machine, rename the [from] file to [to].
`rmdir`	directory-name	Delete a directory on the remote machine.
`system`		Show the type of operating system running on the remote machine.

Return Value(s)

The `do_a_ftp_command` function returns 0 (zero) when successful and negative value otherwise.

Ping Function

Zilog TCP/IP Stack supports the ping function, which is described below.

ping

Include

```
#include <ztptcp.h>
```

Prototype

```
UINT8 ping(UINT32 dst, UINT32 count);
```

Description

An application can use the `ping` API to determine if a remote device is using a specific IP address. The `dst` parameter specifies the IP address of the device to which an **ICMP Echo Request** packet is sent. The `ping` packets is sent `count` number of times.

Argument(s)

`dst`	The target of the `ping` packet.
`count`	Specifies the number of times the `ping` packet is sent.

Return Value(s)

The API waits for a response from the target device. If a response is received, then TRUE is returned. If this API fails to receive a response, then FALSE is returned.

ICMP Functionality

ZTP supports the following ICMP error returns:

- Port Unreachable
- Redirection

Port Unreachable

One rule of UDP is that if it receives a UDP datagram and the destination port does not correspond to a port that is in use, UDP responds with an ICMP port unreachable. For example, if any host sends a UDP packet with a port number on which no application is running on eZ80® then this error is returned.

Redirection

Based on ICMP redirection message that eZ80® receives it will be redirected to next available router. Four redirection errors are supported (Redirect for Network, Host, TOS and network, TOS and Host).

SNTP Functions

Zilog TCP/IP Stack supports the SNTP Client protocol function which is described below.

ztpSNTPClient()

Include

```
#include <SNTPClient.h>
```

Prototype

```
INT16 ztpSNTPClient
(
 INT8 *targetIPAddress,
 INT16 portNum
);
```

Description

To update the system time, ZTP provides the `ztpSNTPClient` function. The function sends the time request message to the specified `targetIPAddress` and the `portNum`. The function receives the time (in seconds) from the `targetIPAddress`, converts this time into the "day, date month year hours : minutes : seconds" format and updates the system time.

Argument(s)

`targetIPAddress`	Pointer to an IP Address of the time server.
`portNum`	Port number through which the client communicates with the time server.

Return Value(s)

SNTP_SOCKET_ERROR	Indicates that the socket connection could not be established.
SNTP_IOCTLSOCKET_FAIL	Indicates that the requested command is not implemented.
SNTP_RZK_DEV_OPEN_ERROR	Indicates that the RZK device could not be opened.
SNTP_SEND_TO_ERROR	Indicates that an error occurred due to invalid descriptor or invalid socket type or the connection was refused.
SNTP_RECIEVE_FROM_ERROR	Indicates that an error occurred due to invalid descriptor or invalid socket type or the connection was refused or other thread is already blocked on this socket.
SNTP_VERSION_NUMBER_ERROR	Indicates that the version number of the client and the server mismatches.
SNTP_MODE_ERROR	Indicates that the mode is not of a server.
SNTP_MEM_ALLOC_FAILURE	Indicates that an error occurred while allocating memory.

See Also

SNTP Client Enumerations

Appendix A—Definitions and Codes

This appendix describes the Zilog TCP/IP Stack data types, structures, enumerators, constants, macros, and error codes.

Data Type Definitions

This section defines a number of data types used with ZTP, including enumerators for ZTP and data types for Telnet, SSL, and SNMP.

ZTP Data Types

Table 11 lists the number of ZTP data types and their definitions.

Table 11. ZTP Data Types

Data Type	Definition
UINT32	unsigned int 32-bit
INT32	signed int 32-bit
UINT24	unsigned int 24-bit
INT24	signed int 24-bit
UINT	unsigned int
INT	signed int
UINT16	unsigned short
INT16	signed short
INT8	signed char
UINT8	unsigned char

Table 11. ZTP Data Types (Continued)

Data Type	Definition
WORD	UINT16
DWORD	UINT32

Telnet Data Types

Table 12 lists definitions of the Telnet data types.

Table 12. Telnet Data Type Definitions

Data Type	Definition
TELNET_HANDLE	Unsigned char
TELNET_DATA_SIZE	Unsigned short
TELNET_DATA	Unsigned char
IP_ADDRESS	Unsigned long
TELNETREAD	typedef void (*TELNETREAD)(TELNET_HANDLE, UINT8 *, UINT16);

SNMP Data Types

Table 13 lists the Simple Network Management Protocol data type and its definition.

Table 13. SNMP Data Types

Data Type	Definition
OBJSUBIDTYPE	UINT16

ZTP Error Codes

This section lists the error codes defined by ZTP.

ZTP Core Error Codes

Table 14 lists a number of error codes returned by the networking APIs.

Table 14. ZTP Core Error Codes

Error	Code
#define ZTP_SOCK_OK	(INT16)0
#define ZTP_SOCK_ERR	(INT16)–1
#define EAFNOSUPPORT	(INT16)–2
#define EOPNOTSUPP	(INT16)–3
#define EFAULT	(INT16)–4
#define EISCONN	(INT16)–5
#define ECONNREFUSED	(INT16)–6
#define EPROTONOSUPPORT	(INT16)–7
#define ENOBUFS	(INT16)–8
#define EINVAL	(INT16)–9
#define EBADF	(INT16)–10
#define ENOCON	(INT16)–11
#define EMFILE	(INT16)–12
#define EINVALBKLOG	(INT16)–13
#define EPIPE	(INT16)–14
#define EFETNOSUPPORT	(INT16)–15
#define EDEADSOCK	(INT16)–16
#define EIOBINPRGRSS	(INT16)–17

Table 14. ZTP Core Error Codes (Continued)

Error	Code
`#define OK`	1
`#define SYSERR`	(–1UL)

Telnet Enumerations

The following enumerator governs Telnet Errors.

```
TELNET_RET

typedef enum{
 TELNET_SUCCESS,
 TELNET_BEGIN_ERROR_CODE = 0x400,
 TELNET_INVALID_ARG = TELNET_BEGIN_ERROR_CODE,
 TELNET_CONNECT_FAILURE,
 TELNET_CLOSE_FAILURE,
 TELNET_NO_CONNECTION,
 TELNET_ALREADY_CONNECTED,
 TELNET_OVER_SIZED_DATA,
 TELNET_ALREADY_INITIALIZED,
 TELNET_LOWER_LAYER_FAILURE,
 TELNET_FAILURE
}TELNET_RET;
```

SNTP Client Enumerations

The following enumerator governs the error values returned by `ztpSNTPClient()` API.

```
typedef enum{
  SNTP_SUCCESS = 0,
  SNTP_SERVER_RETURN_SUCCESS=0,
SNTP_SOCKET_CREATION_ERROR,
  SNTP_SEND_TO_ERROR,
  SNTP_RECIEVE_FROM_ERROR,
  SNTP_IOCTLSOCKET_FAIL,
```

```
  SNTP_RZK_DEV_OPEN_ERROR,
  SNTP_MEM_ALLOC_FAILURE
  SNTP_VERSION_NUMBER_ERROR,
  SNTP_MODE_ERROR
}SNTP_ERRORS;
```

ZTP Macros

This section lists the number of macros defined by ZTP, including macros for the ZTP core, the `ioctlsocket` API.

ZTP Core Macros

Table 15 lists the macro codes returned by the networking APIs.

Table 15. ZTP Core Macros

Macro	Code
`#define SOCK_STREAM`	0
`#define SOCK_DGRAM`	1
`#define AF_INET`	1
`tcp_FlagPUSH`	0x0008

ioctlsocket Macros

Table 16 lists the macro codes used by the ioctlsocket API.

Table 16. ioctlsocket Macros

Macro	Code
`#define FIONBIO`	1
`#define FIONREAD`	2

Table 16. ioctlsocket Macros (Continued)

Macro	Code
#define SIOCATMARK	3
#define FCNCLBIO	4
#define FUDPCKSUM	5
#define UDPTIMEOUT	6
#define FDISNAGLE	7
#define FENANAGLE	8
#define FIONWRITE	9
TCPKEEPALIVE_ON	13
TCPKEEPALIVE_OFF	14

SNMP Macros

Table 17 lists the macro codes used by the SNMP.

Table 17. SNMP Macros

Macro	Code
#define SN_TRAP_COLD_START	0
#define SN_TRAP_WARM_START	1
#define SN_TRAP_LINK_DOWN	2
#define SN_TRAP_LINK_UP	3
#define SN_TRAP_AUTH_FAILURE	4
#define SN_TRAP_EGP_NWIGHBOR_LOSS	5
#define SN_TRAP_ENTERPRISE_SPECIFIC	6

ZTP Data Structures

This section lists a number of data structures defined by ZTP, including structures for the ZTP core, the `ioctlsocket` API, and the Secure Sockets Layer.

ZTP Core Data Structures

The following data structures are used in networking APIs.

sockaddr Structure

```
struct sockaddr
{
 INT16 sa_family;
 INT8 sa_data[14];
};
```

udp_Socket structure

This structure maintains the UDP socket related information.

```
typedef struct _udp_socket {
    struct _udp_socket *next;
    UINT16                ip_type;
    INT8                  *err_msg;
    INT8                  *usr_name;
    VOID                  (*usr_yield)( VOID );
    UINT8                 rigid;
    UINT8                 stress;
    UINT16                sock_mode;
    UINT32                usertimer;
    dataHandler_t         dataHandler;
    eth_address           hisethaddr;
    UINT32                hisaddr;
    UINT16                hisport;
    UINT32                myaddr;
    UINT16                myport;
    UINT16                locflags;
    INT                   queuelen;
    UINT8                 *queue;
```

```
    INT                     rdatalen;
    UINT16                  maxrdatalen;
    UINT8                   *rdata;
    UINT8                   *rddata;
    UINT32                  safetysig;
    VOID                    * AppThread;
    UINT8                   err_code;
    UINT8                   block;
#ifdef MULTIHOMING
    UINT8                   iface;
#endif
} udp_Socket;
```

tcp_Socket structure

This structure maintains the TCP socket connection related information.

```
typedef struct _tcp_socket
{
    struct _tcp_socket      *next;
    UINT16                  ip_type;
    INT8                    *err_msg;
    INT8                    *usr_name;
    VOID                    (*usr_yield)(VOID);
    UINT8                   rigid;
    UINT8                   stress;
    UINT16                  sock_mode;
    UINT32                  usertimer;
    dataHandler_t           dataHandler;
    eth_address             hisethaddr;
    UINT32                  hisaddr;
    UINT16                  hisport;
    UINT32                  myaddr;
    UINT16                  myport;
    UINT16                  locflags;
    INT                     queuelen;
    UINT8                   *queue;
    INT                     rdatalen;
    UINT16                  maxrdatalen;
    UINT8                   *rdata;
    UINT8                   *rddata;
    UINT32                  safetysig;
```

```
    VOID                    * AppThread;
    UINT8                   err_code;
    UINT8                   block;
#ifdef MULTIHOMING
    UINT8                   iface;
#endif
    UINT16                  state;
    UINT32                  acknum;
    UINT32                  seqnum;
    INT32                   timeout;
    UINT8                   unhappy;
    UINT8                   recent;
    UINT16                  flags;
    UINT16                  window;
    INT                     datalen;
    INT                     unacked;
    UINT8                   cwindow;
    UINT8                   wwindow;

    UINT16                  vj_sa;
    UINT16                  vj_sd;
    UINT32                  vj_last;
    UINT16                  rto;
    UINT8                   karn_count;
    UINT8                   tos;
    UINT32                  rtt_lasttran;
    UINT32                  rtt_smooth;
    UINT32                  rtt_delay;
    UINT32                  rtt_time;
    UINT16                  mss;
    UINT32                  inactive_to;
    INT                     sock_delay;
    UINT8                   *data ;
    UINT32                  datatimer;
    UINT32                  frag[2];
    INT16                   sock_fd;
    UINT8                   maxRtrs;
} tcp_Socket;
```

HTTP Data Structures

The following data structures are used in the HTTP APIs.

Http_Hdr Structure

```
typedef struct http_hdr
{
 UINT8  key;
 INT8*  value;
} Http_Hdr;
```

http_params Structure

```
struct http_params
{
/** The key, typically an http header. */
 UINT8 *key;
/** The value associated with that key. */
 INT8 *value;
};
```

Http_Request Structure

```
typedef struct http_request {
  UINT8                      method;
  UINT16                     reply;
  UINT8                      numheaders;
  UINT8                      numparams;
  UINT8                      numrespheaders;
  INT16                      fd;
  const struct http_method * methods;
  const struct webpage     * website;
  const struct header_rec * headers;
  INT8  * bufstart; /* first free space */
  UINT8 *                    extraheader;
  Http_Hdr              rqstheaders[HTTP_MAX_HEADERS];
  Http_Hdr              respheaders[HTTP_MAX_HEADERS];
  Http_Params             params[HTTP_MAX_PARAMS];
  Http_Auth               *AuthParams;
  INT8                     buffer[HTTP_REQUEST_BUF];
  INT8                    keepalive;
} Http_Request;
```

Http_Method Structure

```
typedef struct http_method
{
 UINT8  key;
 INT8   *name;
 void   (*method)(Http_Request *);
} Http_Method;
```

staticpage Structure

```
struct staticpage {
/** A pointer to the actual contents of the page. This
/* could be the actual string representing the entire
/* page, or an array of bytes (e.g. the array produced
/* by the mkwebpage program). */
 UINT8 *contents;
/* The size of the above array, since it is not null
/* terminated. If this is actually a string, it would
/* be equal to strlen(array). **/
 INT32   size;
};
```

webpage Structure

```
struct webpage
{
 UINT8 type;
 INT8 *path;
 INT8 *mimetype;
/* Either a structure defining the static page, or the
/* 'cgi' function which will generate this page. **/
 union
 {
  const struct staticpage *spage;
  INT16 (*cgi)(struct http_request *);
 } content;
};
```

SNMP Data Structures

The following data structures are used in SNMP APIs.

header_rec Structure

```
struct header_rec
{
 INT8 *name;
 UINT16 val;
};
```

SN_Oid_s Structure

```
typedef struct oid
{
 OBJSUBIDTYPE sub_id[SMAXOBJID]; /** array of sub-
                            /* identifiers */
 UINT16 len;                /* length of this object
                            /* id **/
}SN_Oid_s;
```

SN_PhysAddress_s Structure

```
typedef struct sn_phys_address
{
  UINT8 Data[SN_MAX_PHYS_ADDR_SIZE];
}SN_PhysAddress_s;
```

SN_Descr_s Structure

```
typedef struct sn_descr_s
{
 void *pData;
 UINT16 Length;
 UINT16 MaxLen;
}SN_Descr_s;
```

SN_Value_s Structure

```
typedef union sn_value_s
{
 void    *pData;
 struct oid  *pOid;       // Object Identifier
 SN_Descr_s  *pDescr;     // Octet String, big
```

```
                                // Integer, Display String
                                // Octet String)
 INT8     *pInt8;
 INT16    *pInt16;
 INT32    *pInt24;
 INT32    *pInt32;
 UINT8    *pUint8;
 UINT16   *pUint16;
 DWORD    *pUint24;
 DWORD    *pUint32;          // Counter, Gauge, TimeTicks
(encoded as an Integer)
 SN_PhysAddress_s * pPhys;// Physical Address (encoded
                          // as an Octet string)
 UINT32   *pIP;
 DWORD *pCounter;
 DWORD *pGauge;
 DWORD *pTimeTicks;
} SN_Value_s;
```

SN_Object_s Structure

```
typedef struct sn_object_s
{
 SN_Oid_s      Oid;
 UINT8         Type;
 SN_Value_s    Value;
} SN_Object_s;
```

ZTP C Run-Time Library Functions

ZTP includes its own set of C run-time library functions, in addition to those available in the ZDSII C Compiler's run-time library. ZTP's C run-time routines are named differently so as to differentiate with the ZDSII C Compiler's run-time library routines.

For more information on ZDSII C Compiler's run-time library, refer to *Zilog Developer Studio II–eZ80Acclaim!® User Manual (UM0144)*.

Table 18 provides a brief description about library routines.

Table 18. Library Routines

Library Routine	Description
xc_ascdate	Convert time to ASCII.
xc_fprintf	Print formatted text to a specified device.
xc_printf	Print formatted text onto a console.
xc_sprintf	Print formatted text into a specified buffer.
xc_strcasecmp	Case-insensitive string comparison.
xc_index	Find character in a string.

xc_ascdate

Include

```
#include "xc_lib.h"
```

Prototype

```
INT16 xc_ascdate (DWORD time, INT8 *str)
```

Description

Convert time to ASCII—The `xc_ascdate` function takes its first argument as the number of seconds since midnight, January 1, 1970, and produces an ASCII string for the date and time corresponding to that time. The ASCII string is copied into the second argument, which must point to a buffer large enough to contain it (twenty characters including the terminating NULL).

Argument(s)

`time`	Time in seconds since midnight January 1st, 1970.
`str`	A pointer to a user-supplied buffer to contain output string.

Return Value(s)

This function always returns `OK`.

xc_fprintf

Include

```
#include "xc_lib.h"
```

Prototype

```
INT16 xc_fprintf (RZK_DEVICE_CB_t * descriptor, INT8
*format,...)
```

Description

Print formatted text to the device specified in the `descriptor` parameter.

The `xc_fprintf` function interprets its second argument as an ASCII format to use in printing its remaining arguments to a device identified by first argument. The format contains simple text and special format codes that are identified by a preceding percent (%) character.

`b`	Print an int as a binary number.
`c`	Print a single character.
`d`	Print an int as a decimal number.
`o`	Print an int as an octal number.
`s`	Print a string.
`u`	Print an unsigned int as a decimal number.
`x`	Print an int as a hexadecimal number.
`%`	Print a % character.

In addition, the following can be inserted between the % and the format code to modify the output:

- An integer specifying the minimum field width.
- A minus sign, indicating left justification.
- The letter `l`, indicating a long data type.

- An asterisk indicating the field width to be taken from the next unprocessed argument.
- A period followed by an integer, indicating the maximum field width for a string.

`xc_fprintf` uses the same conversion specifiers as `kprintf`.

Argument(s)

`descriptor`	A pointer to an integer value specifying the device to print to.
`format`	A pointer to a string defining what to print.
...	Arguments corresponding to the format codes, if any.

Return Value(s)

When successful, the `xc_fprintf` function returns `OK`.

xc_printf

Include

```
#include "xc_lib.h"
```

Prototype

```
INT16 xc_printf (INT8 *format,...)
```

Description

Print formatted text—The `xc_printf` function prints formatted text onto a console. It is equivalent to calling `xc_printf` with a first argument of `CONSOLE`.

Argument(s)

`format`	A pointer to a string defining what to print.
...	Arguments corresponding to the format codes, if any.

Return Value(s)

When successful, this function returns `OK`.

See Also

xc_fprintf

xc_sprintf

Include

```
#include "xc_lib.h"
```

Prototype

```
INT8 * xc_sprintf (INT8 *buffer, INT8 *format,...)
```

Description

Print formatted text—The `xc_sprintf` function prints formatted text into a specified buffer. Except for the output medium, it is identical to the `xc_fprintf` function.

Argument(s)

See the xc_fprintf function.

Return Value(s)

When successful, the `xc_sprintf` function returns `OK`.

See Also

xc_fprintf

xc_strcasecmp

Include

```
#include "xc_lib.h"
```

Prototype

```
INT16 xc_strcasecmp (INT8 *str1, INT8 *str2)
```

Description

Case-insensitive string comparison—The `xc_strcasecmp` function performs a byte-by-byte comparison of two strings, in which it looks for the first character that differs other than by case. If the first character in the first string that does not match is less than its corresponding character in the second string, or if the first string is shorter than the second string, a negative value is returned. If the character is larger than its corresponding character in the second string, or the second string is shorter than the first, a positive nonzero value returns. If the two strings are the same (except possibly in `case`), a zero is returned.

Argument(s)

`str1`	Pointer to first of the two strings in the comparison.
`str2`	Pointer to second of the two strings in the comparison.

Return Value(s)

The `xc_strcasecmp` function returns an integer that describes whether the first string is less than, equal to, or greater than the second string.

xc_index

Include

```
#include "xc_lib.h"
```

Prototype

```
INT8 *xc_index (INT8 *str, INT8 c)
```

Description

Find a character in a string—The `xc_index` function searches a string for the first occurrence of the specified character, and returns a pointer to the character.

Argument(s)

`str`	Pointer to the string to be searched
`c`	The character to search for

Return Value(s)

If the character is found, a pointer to its location in the string is returned. If no match is found, a `NULL` pointer is returned.

Customer Support

For answers to technical questions about the product, documentation, or any other issues with Zilog's offerings, please visit Zilog's Knowledge Base at http://www.zilog.com/kb.

For any comments, detail technical questions, or reporting problems, please visit Zilog's Technical Support at http://support.zilog.com.