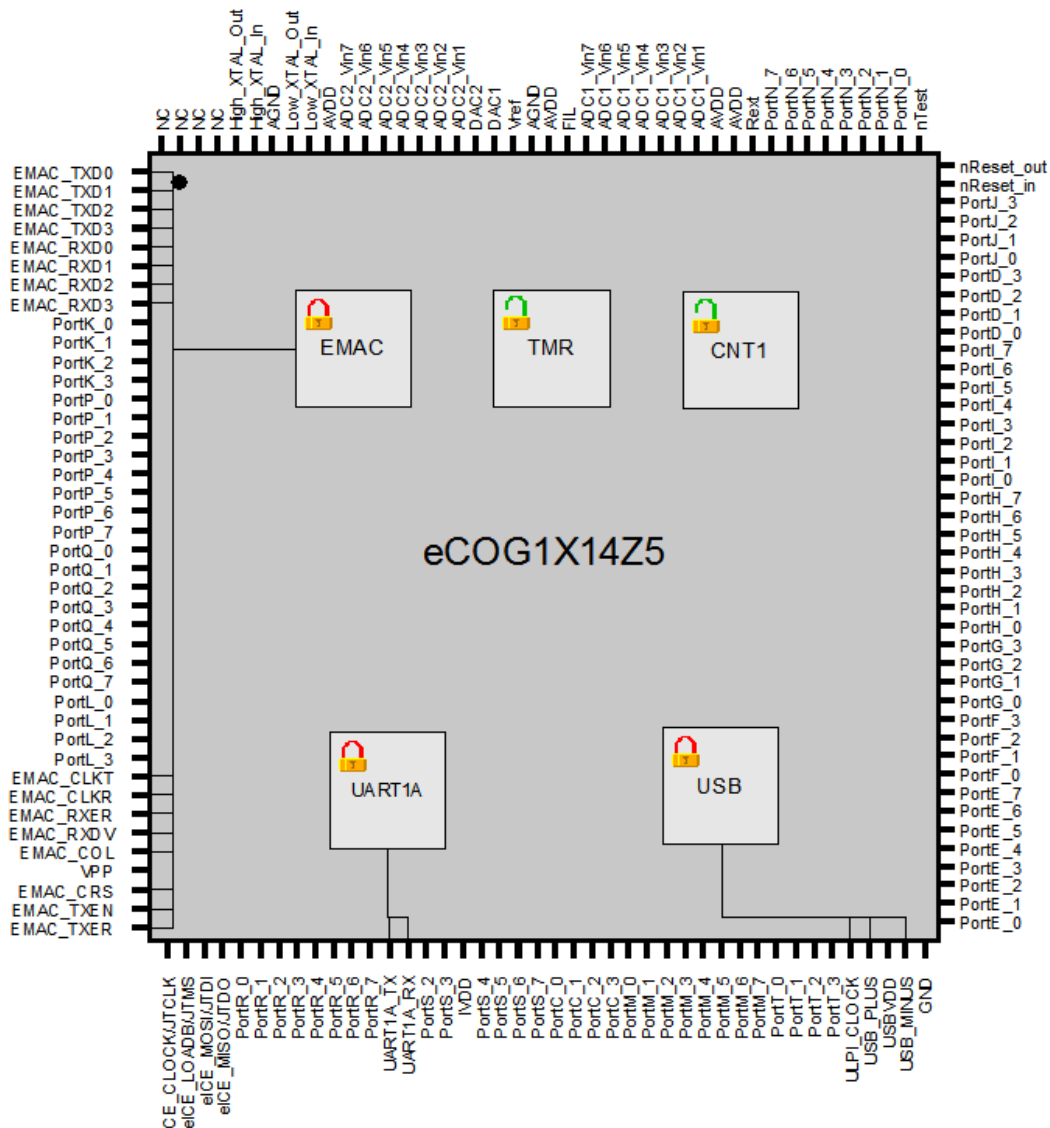


# AN065 – eCOG1X Web Server with USB File Storage

## Version 1.1

This application note describes using the eCOG1X microcontroller as a Web Server (HTTP Daemon) with a USB Mass Storage Device (such as a flash memory stick) containing the web pages to be served.



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## Revision History

Version	Date	Notes
V1.0	18/09/2007	First release.
V1.1	06/11/2007	Updated to include split output packets and improve performance.

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## 1 Introduction

This application note describes using the eCOG1X microcontroller as a Web Server (HTTP Daemon) with a USB Mass Storage Device (such as a flash memory stick) containing the web pages to be served.

## 2 Glossary

A table of abbreviations and terms used in this document.

eCOG1X	Cyan Technology target microcontroller.
EOF	End of File. Used as a marker in the FAT table.
FAT	File Allocation Table.
UART	Universal Asynchronous Receiver/Transmitter.
HTTP	Hyper Text Transfer Protocol (ref. RFC 1945)

## 3 Overview

This application note demonstrates how to combine several of the major functional blocks of the eCOG1X microcontroller to provide an embedded Ethernet web server that can serve web pages from a USB Mass Storage device, such as a flash memory stick.

## 4 Requirements

This project was developed using CyanIDE V1.4.2.

### 4.1 FAT File System Support

The software for this application note must be used in conjunction with the library software from application note AN042, "FAT File System Support for the eCOG1k and eCOG1X", contained in the zip file <AN042 FAT Libraries.zip>.

To install the FAT file system libraries:

- Download the zip file <AN042 FAT Libraries.zip> from the Cyan web site and open it.
- Click the *Extract* icon, or select *Actions->Extract* from the main menu.
- Check that the *Use folder names* option in the dialogue box is ticked.
- Set the *Extract to:* directory to the CyanIDE peripheral libraries directory. Usually this is <C:\Program Files\Cyan Technology\CyanIDE\libraries>.
- Click the *Extract* button to extract the files to the CyanIDE peripheral libraries directory.

The zip file contains two copies of the FAT library files, one for eCOG1k and one for eCOG1X. For this example, only the files for the eCOG1X are required.

### 4.2 uIP V1.0 and EMAC Library Update

The versions of the uIP V1.0 TCP/IP stack and EMAC Library used by this application note have been updated from those supplied with the CyanIDE V1.4.2 install. To obtain the updated libraries, download the library software used in conjunction with application note AN057, "uIP V1\_0 TCP-IP Stack for eCOG1k and eCOG1X", contained in the zip file <AN057LIB.zip>.

Extract the library software file <AN057LIB.zip> to the CyanIDE install directory, usually <C:\Program Files\Cyan Technology\CyanIDE>. This updates the files in the eCOG1X EMAC peripheral library and in the uIP V1.0 library directories.

### 4.3 USB Power

When acting as a USB Host, the eCOG1X must supply the VBus power to the peripheral. On the eCOG1X Development Board, this depends on which USB interface is used.

When the external ULPI PHY connection on S6 is used, the MAX5008 power supply is capable of supplying up to 125mA, which is sufficient for most flash memory based USB drives.

For the internal USB PHY connection on S5, the power supply output from the MAX3355 is capable of only 8mA. This is sufficient for OTG devices but not for most USB flash drives. To use this connection with a USB flash drive, it is recommended that a link is placed on the board to connect the USB VBus power directly to the +5V supply. For example, connect J33 pin 1 (VBus on the internal USB connector) and J18 pin 2 (+5V supply).

## 5 Using the Application

The application is based on the uIP V1.0 Web Server with DHCP example that is shipped with CyanIDE V1.4.2.

Two project files are supplied, one configured to use the Internal USB PHY on the eCOG1X, connected to the USB Socket S5 on the eCOG1X Development Board, and the other is configured to use the external ULPI PHY, connected to the USB Socket S6 on the eCOG1X Development Board. When choosing which PHY to use, please read the USB Power section above.

### 5.1 Example Web Pages

The “httpd-fs” subdirectory contains a set of example web pages. These can be copied to the root directory of the USB Mass Storage Device that is then connected to the appropriate USB port of the eCOG1X Development Board.

### 5.2 IP Address

This application note example can be used either with a DHCP Server to allocate an IP address dynamically to the web server, or with a static IP address.

The software is supplied with the configuration set to use DHCP to acquire an IP address.

To change the software to use a fixed IP address, open the project, and then open the **uip-conf.h** header file in the Headers subdirectory. At the start of this file is a definition `UIP_CONF_FIXEDADDR` that is defined as '0'. Change this to '1', and set the IP address and net mask values in the definitions immediately following it.

### 5.3 Filename restriction

Because the Fat File System Library does not support long file names, all the filenames of the web page files must be in the 8.3 (DOS) format.

### 5.4 Debug Information

If a serial terminal (such as HyperTerminal) is connected to serial port P1, at 9600 baud, 8 data bits, no parity and 1 stop bit, then debug information can be seen indicating when the server has acquired an IP address (if DHCP is used), and when a USB Mass Storage Device is attached and detached.

Note that if the Full Debug build is used, then the significant amount of debug information sent to the serial port significantly reduces the performance of the application. To mitigate this, increase the baud rate of the debug serial port.

## 5.5 Split Output Packets

This project makes use of the ability of uIP V1.0 to split large output packets into two, so as to achieve greater data throughput when sending data to a client with a TCP/IP stack using the "Nagle Algorithm" for delayed acknowledge.

The Nagle Algorithm reduces network traffic by delaying the acknowledge packets and using one single packet to acknowledge all the packets in a time interval. The algorithm is specified in RFC 896.

When uIP is used to send data to a client using this algorithm, this can significantly reduce the data throughput, as uIP can only handle a single packet at a time and must wait for the acknowledge to come back before it can move on to send another packet.

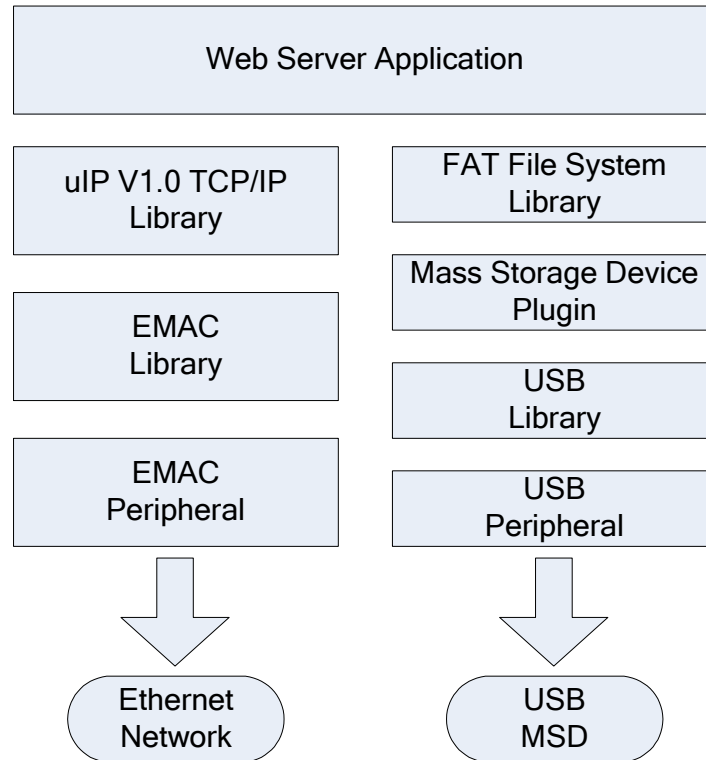
By splitting large packets (that are the maximum segment size) into two smaller packets, the client TCP/IP stack sends the acknowledge immediately on reception of the second packet, rather than waiting for the delay. This significantly improves the data throughput when sending data from uIP to a client using this algorithm, such as the Microsoft Windows™ operating systems. Typically, the data throughput is increased by an order of magnitude.

To use this split packet method, the application calls a different uIP polling function from its main loop. This function is `uip_poll_with_arp_split_output()`, instead of the `uip_poll_with_arp()` function used previously.

Note that this is applicable only to applications that send large data packets of the maximum segment size, and has no effect on applications that send packets smaller than the maximum segment size. The effect of this can be seen in the example web pages that come with this application, where the JPEG image on the main page is significantly quicker to load, but the network statistics page has not changed, as it sends the page data a line at a time.

## 6 Application Structure

The application is built on a series of libraries in the following fashion.



The main application is the Web Server itself. This is a standard uIP V1.0 application (as described in the uIP V1.0 Application Note AN057). It handles call-backs from the uIP library, which are generated when requests come in from Web Clients (such as Internet Explorer) across the network. These requests are then interpreted by the application and if a file is requested, then the FAT File System library is used to find and read the file from the USB Mass Storage Device. This is then passed back to the client through the uIP Library and across the network.

## 7 Memory Use

The application uses the following amounts of memory:

Code: 50K bytes of Flash

Constants: 2K bytes of Flash

Variables: 15K bytes of Internal RAM

Note that as this application uses the USB peripheral, a maximum of 20K Bytes of Internal RAM are available to the application, as 4K bytes are used internally by the USB peripheral.

The RAM requirements can be reduced by reducing the size of the `UIP_CONF_BUFFER_SIZE` constant defined in the *uip-conf.h* header file. This results in a three-fold reduction in the RAM usage as this defines the size of three buffers, one used by the uIP TCP/IP Library, plus one transmit buffer and one receive buffer used by the EMAC Library. Thus, if the value of the constant `UIP_CONF_BUFFER_SIZE` is reduced to 500 bytes (from its original value of 1518 bytes), then the RAM requirements of the application is reduced to 12K bytes, a saving of approximately 3K bytes.