Outpour Firmware Bootloader Usage and Overview

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Glossary of Terms

Firmware Upgrade Message	An OTA message sent by the cloud server to the Outpour unit. It contains a complete Application firmware code set.
Bootloader	An independent and self-contained code image that runs when the MSP430 first starts.
Application	An independent and self-contained code image that runs on the MSP430. The Bootloader starts Application. It performs all water flow algorithm and data storage processing.
SOS Recovery Mode	A mode the Bootloader will drop into if it detects that there is not a valid Application to jump to.
SOS Recovery Message	A message the Bootloader will send to the Cloud every 12 hours when in SOS Recovery Mode.

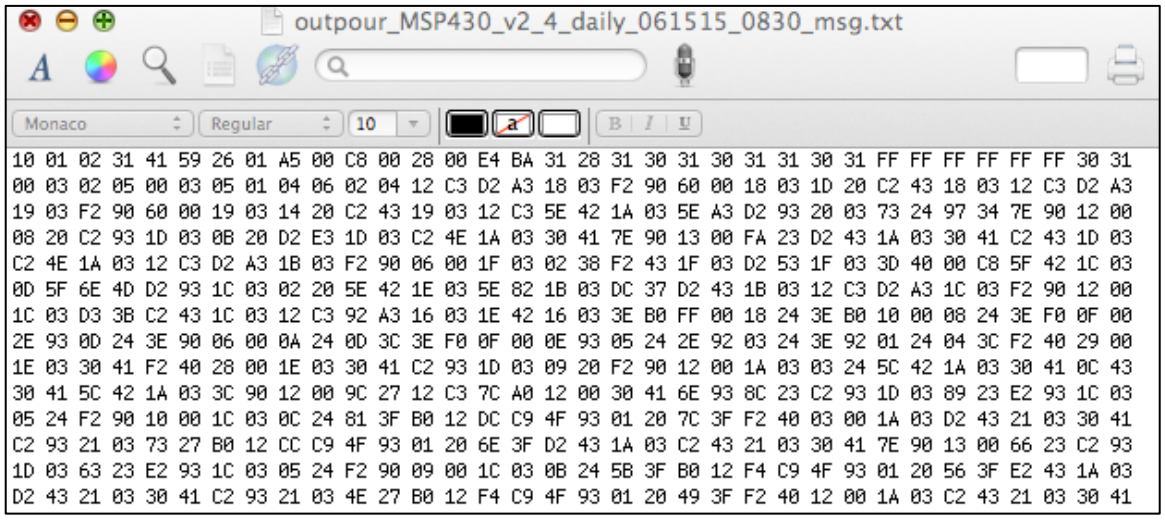
1 Overview

- The Bootloader is a standalone firmware module that runs on the Outpour MSP430 microcontroller
- The Bootloader coexists in the MSP430 flash memory with the Outpour Application code
- The Bootloader is a small program that runs every time the MSP430 reboots
- The purpose of the Bootloader is to provide in-field software upgrade capability
- The Bootloader logic supports three operational scenarios:
  - Standard Boot
  - Firmware Upgrade
  - SOS Recovery Mode

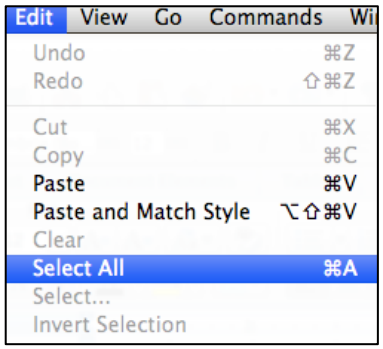
2 Performing a Firmware Upgrade

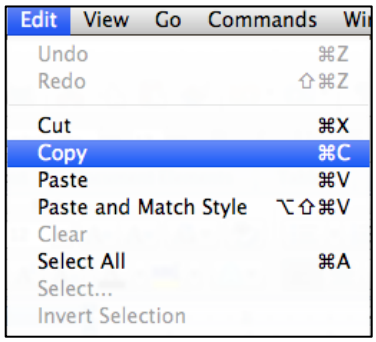
1. Obtain the Firmware Upgrade Message file. This is a text file that contains a complete Application image wrapped in a Firmware Upgrade Message. For example, with the version 1.4 release, this file is called: "outpour_MSP430_v1_4_daily_061515_0830_msg.txt"

2. Using a Text Editor, open the Firmware Upgrade Message:



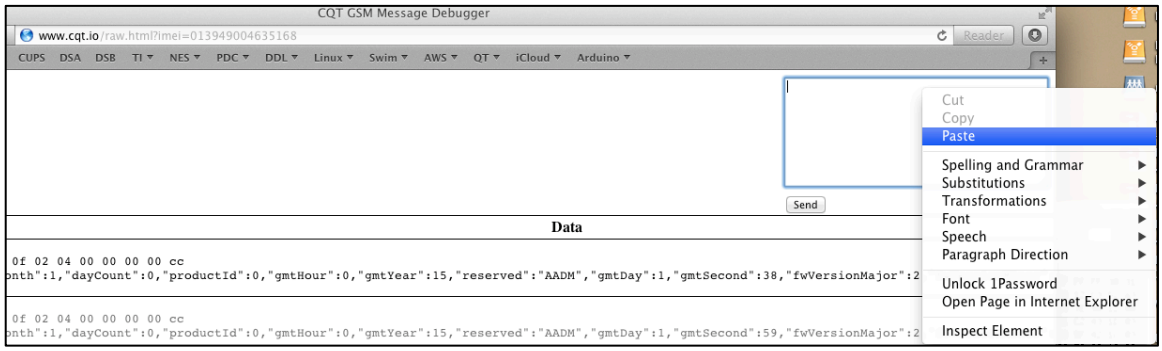
3. Perform a “Select ALL” and “Copy” operation, copying the complete message to the clipboard or equivalent.

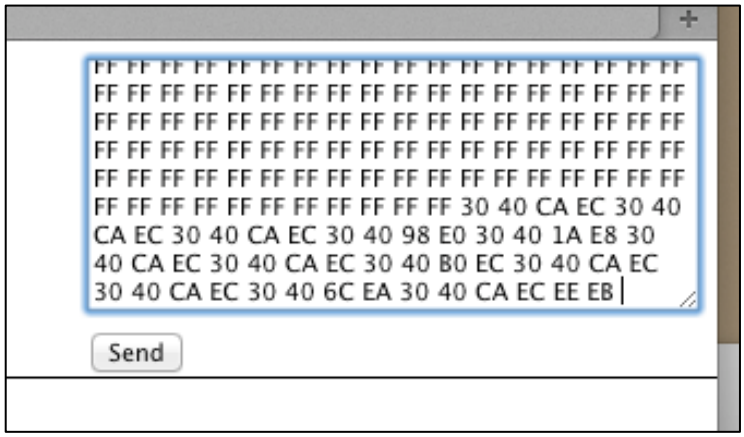




4. Go to the CQT web site for the Outpour unit

5. In the Message window, perform a paste and send of the Firmware Upgrade Message





Then next time the Outpour unit performs a Final Assembly, Water Data or Monthly Check-In message, a firmware upgrade will be performed.

3 Firmware Upgrade Message

Two new Outpour messages have been added to support the Firmware Upgrade process.

3.1 OTA Firmware Upgrade Message (0x10)

This message is sent by the Cloud to the Outpour unit and contains an Application Firmware Image. When the unit receives this message, it will initiate a Firmware Upgrade sequence.

Message Details:

Byte Location	Name	Description
0	Message Number	0x10
1-2	Message ID	2 byte ID
3-6	Message Keys	key0 = 0x31 key1 = 0x41 key2 = 0x59

		key3 = 0x26
7	Number of Code Sections	For Outpour, this will always be 1
8	Code Section Start Byte	0xA5
9	Code Section Number	For Outpour, this will always be 0
10-11	Code Section Start Flash Address	For Outpour, this will always be 0xC800
12-13	Code Section Length	Length in Bytes
14-15	Code Section CRC16	Polynomial: 0x8005
16+	Application Image	The application ROM image.

3.2 SOS Recovery Message (0x6)

This message is sent by the Bootloader every 12 hours should it detect a failed Firmware upgrade.

4 Bootloader Design Overview

5 Standard Boot

When the MSP430 boots, the Bootloader runs. The first thing the Bootloader always does is check if the modem has a Firmware Upgrade Message available. If no Firmware Upgrade Message is available, the Bootloader jumps to the start of the existing Application code.

6 Modem Firmware Upgrade Message Download

For the standard firmware upgrade sequence, the Bootloader does not download the Firmware Upgrade Message, but rather only checks if the modem already has a Firmware Upgrade Message downloaded. For this case, the Application code performs the process of downloading the firmware upgrade message from the cloud as part of it standard OTA processing. This will occur when the Application code connects to the network to send a final assembly packet, water data packet or monthly check in packet. When the Application identifies that the modem has downloaded a Firmware Upgrade Message, it goes into a shutdown sequence and forces the MSP430 to reboot. The Bootloader will run after the reboot and perform the firmware upgrade.

7 Firmware Upgrade

When the Bootloader detects that a Firmware Upgrade Message is available from the modem, it will sequence into its Firmware Upgrade mode. In this mode, the Bootloader performs the following:

- Downloads the Firmware Upgrade Message Header to verify it
- Downloads the Firmware Upgrade Message Section Header
- The Section Header identifies the Starting Address, Length and CRC16 of the Code Section
- Using the Starting Address and Length, the Bootloader erases that code section area in flash
- The Bootloader starts downloading the code section from the Modem. It retrieves 128 bytes at time from the modem and writes that buffer to flash.
- Once all bytes of the Code Section has been read from the Modem and written to flash, the Bootloader verifies the code in flash by calculating a CRC16 sum and comparing to the CRC16 provided in the Section Header
- If the Code Section is verified, the Bootloader exits the Firmware Upgrade mode and jumps to the new Application

8 SOS Recovery Mode

The Bootloader is designed with a recovery scheme. The Bootloader contains a series of checks to provide a "best effort" to detect a bad upgrade file or failed upgrade attempt. The two scenarios where this can occur are:

1. The Application Image in the Firmware Upgrade Message contains an error
2. The Application contains a bug, causing the Application to reboot after the upgrade

Should the Bootloader detect that either of these cases has occurred, it will fall into the SOS Recovery Mode. In this mode, the Bootloader sends an "SOS" message to the Cloud every 12 hours. This provides the opportunity for the Cloud to identify that a failure has occurred, and allows the Outpour unit to download and program a new Application Firmware image.

The Bootloader SOS message is as follows (as shown on the CQT site):

Time	
2015-06-15 09:39:56	01 06 00 55 55 55 55 55 55 01 00 55 55 55 55 55 –