BAT-433 Installation Guide

V.0515

trafficnet

Contents

List of Figures

List of Tables

AWAM Traffic Monitoring Concept

AWAM travel time monitoring technology is based on the use of *Bluetooth™*, a robust, low power, and low cost wireless communications method. *Bluetooth* technology is standardized and used worldwide, so that AWAM travel time monitoring technology may be deployed anywhere.

The AWAM system detects vehicles equipped with enabled *Bluetooth* networking devices, including cellular phones, mobile GPS systems, telephone headsets, and in-vehicle navigation and hands-free systems.

Every *Bluetooth* device has a unique 48-bit address, known as a MAC address, used to identify it to other network devices. Each AWAM field processor senses MAC addresses emitted by enabled devices as they pass the reader station. The AWAM field processor then transmits the time and location of the device to the AWAM host software. As addresses are detected at successive AWAM field processors, the AWAM host system calculates average travel times and speeds for a roadway segment.

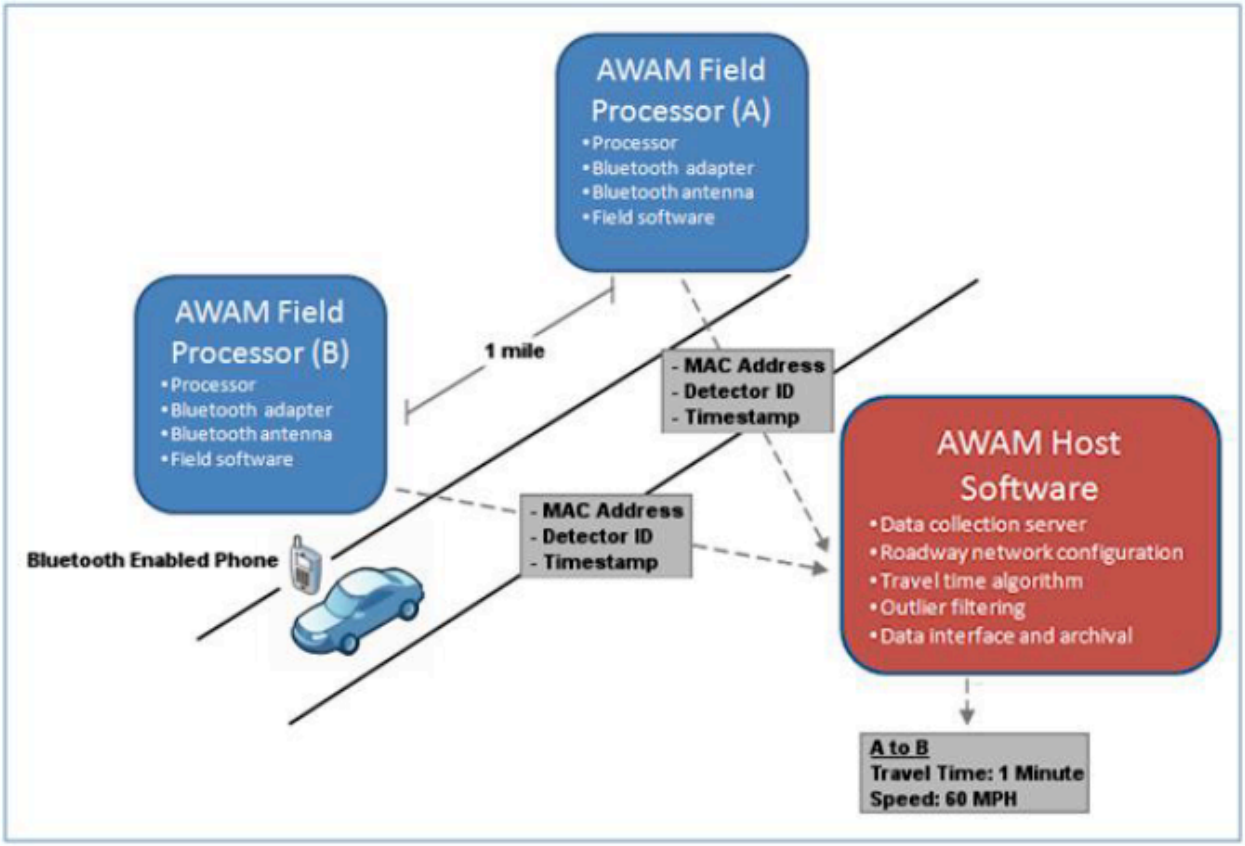

Figure 1. AWAM Traffic Monitoring Concept

BAT-433 Overview

The BAT-433, an Anonymous Wireless Address Matching (AWAM) Process Controller, is the system that resides on the roadside and detects wireless *Bluetooth* MAC addresses from passing vehicles. The addresses are immediately relayed to the AWAM Host software at a central location for the purpose of estimating vehicle travel times on roadway segments instrumented with AWAM Process Controllers.

The BAT-433 is responsible for running the AWAM Field Software and for providing connectivity for the peripherals necessary to detect and relay *Bluetooth* MAC addresses. Detailed specifications of the BAT-433 are shown in Figure 2.

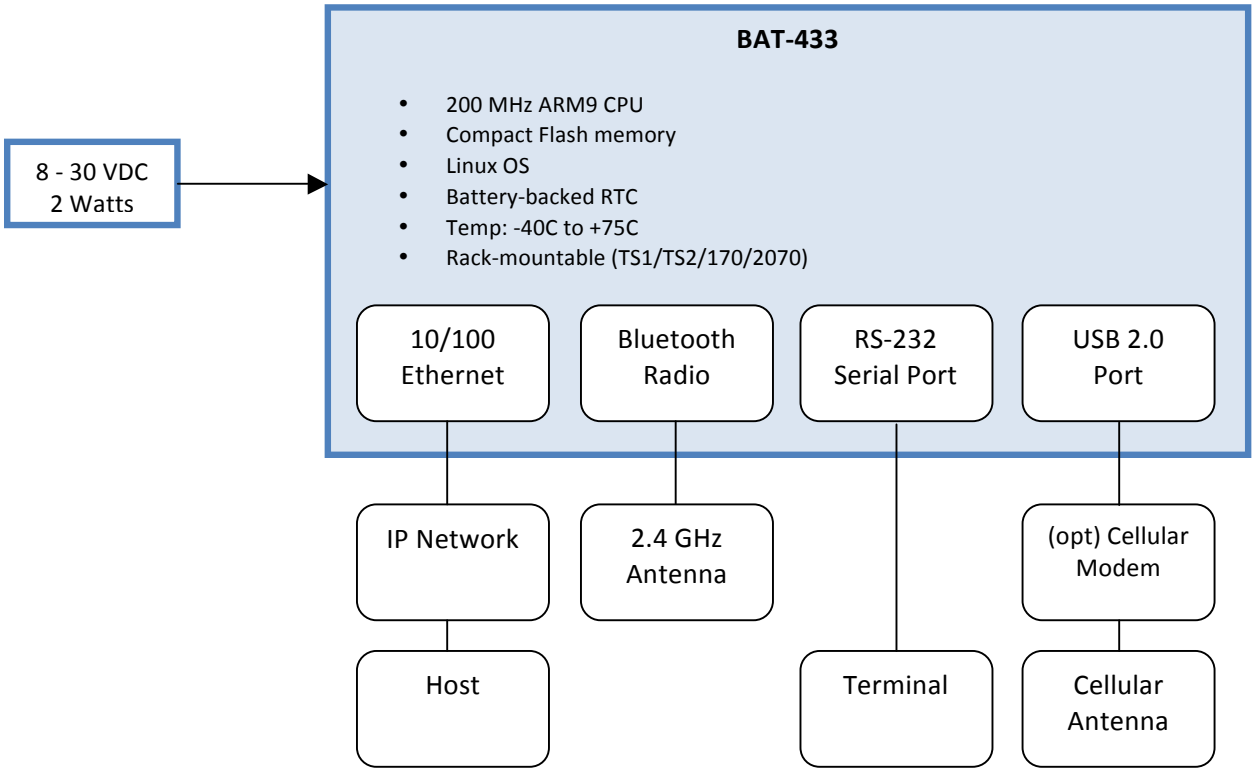

Figure 2. BAT-433 Overview

Connections

To begin using the AWAM Process Controller, 3 connections are necessary.

1) Power, 8 - 30 VDC. This can be connected by inserting the BAT-433 into a card rack, or plugging the supplied power adapter into the back of the optional enclosure.

2) The *Bluetooth* antenna. The standard antenna shipped with the device is 2.4 GHz, 3 db gain with a Type N bulkhead connector. Connect the antenna to the BAT-433 with the supplied cable. For remote antenna locations, TrafficNet recommends the use of a lightning arrestor.

3) Communications, which can be established via the Ethernet port or the USB port using a cellular modem.

The RS-232 port (labeled *Console*) on the device can be used to connect with a terminal program (such as HyperTerminal, Putty, Realterm, etc).

Figure 3. BAT-433 Connections

Antenna Placement

The supplied antenna should be mounted approximately five feet above the road surface and no more than 100' from the first travel lane. The antenna should be mounted on a horizontal, metal surface. For best performance, avoid placing the antenna where objects may attenuate the signal.

Different antenna gains and types may be used to increase or decrease the range.

Spacing between BAT-433 locations should typically be no closer than one minute of travel time apart. A general rule of thumb is that readers should be no closer than one mile apart on freeways and a half mile apart on arterials.

Figure 4. Antenna Mounted on Cabinet

Software Setup

Web Configuration

The BAT-433 can be configured using a web browser such as Mozilla Firefox or Microsoft Internet Explorer. Out of the factory, the controller is given an IP address of 192.168.1.103. To access the configuration interface using your computer, connect the BAT-433 to a router, switch, or your computer using a standard Ethernet cable. Verify that your computer's network adapter is set to an IP address on the 192.168.1.* network. Then, enter the following URL in your web browser.

http://192.168.1.103:8089

The number 8089 is the port number that the web configuration interface resides on. If you change the IP address of the device, the port number of 8089 will still be valid. For example, if the IP address changes to 10.1.0.2, the URL of the web configuration interface would be *http://10.1.0.2:8089*.

Software Settings

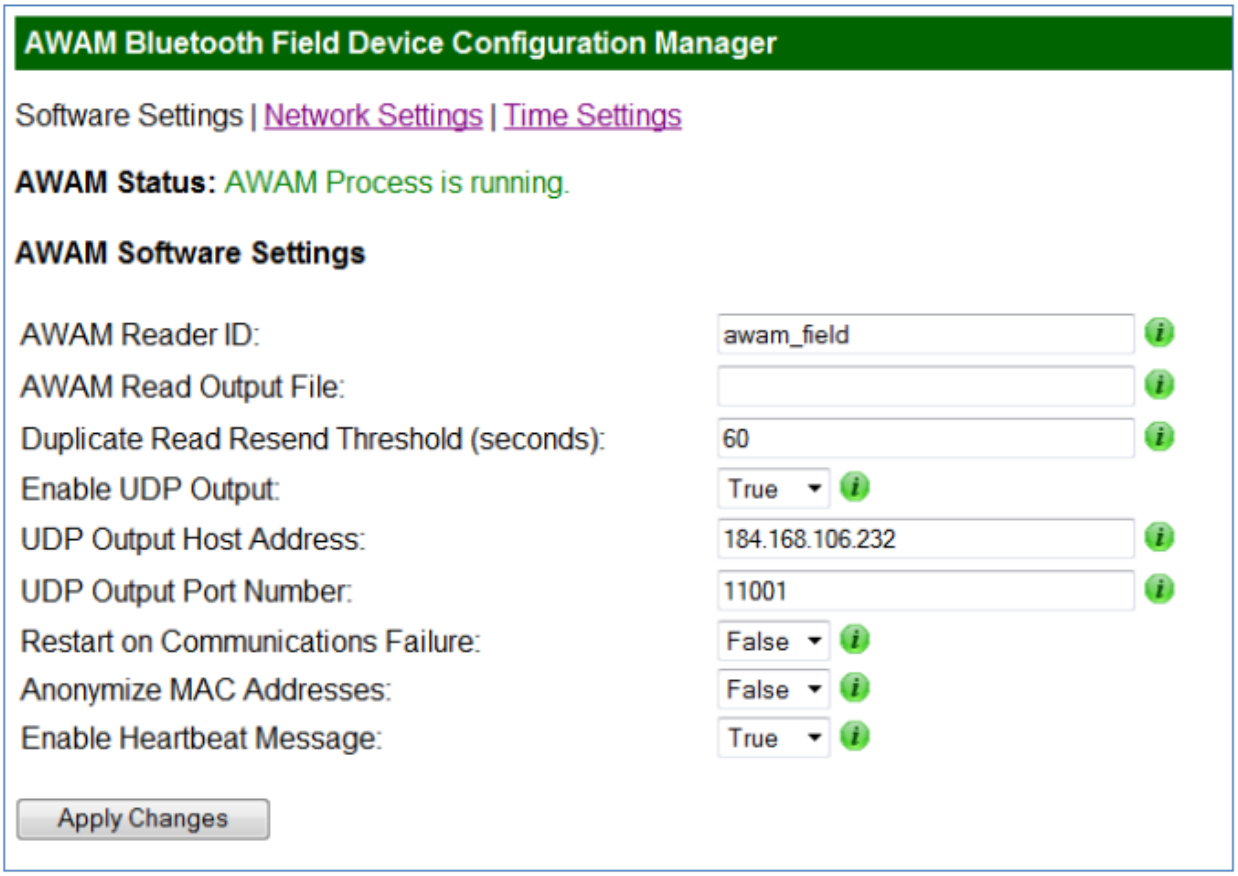

Figure 5. Software Settings Screen

Table 1. Configuration Settings

Setting	Description
AWAM Reader ID	This is the identifier that contains the name of the reader device. This identifier is used by the host software to determine where the Bluetooth MAC addresses have originated from. It is typically named based on the device's location but can be generic if the reader is to be mobile. This string must be exactly specified in the host software for traffic data to be collected. *Example: mainst_crossst* *Example: i45_mainst*
AWAM Read Output File	If left blank, data will not be stored locally on the reader. If not left blank, this is the path and file name that the application will output the raw Bluetooth MAC address data to. This can be used for data collection if there is no real-time communication to the device or to store data on the device as a backup. Note that it is critical for the time to be exactly synchronized across devices to produce accurate travel times. See the section on *Downloading Stored Data* for more information. *Example: data.txt* ** The software on the device implements an archival method that prevents the device from running out of space. The archival method renames the address file when it reaches a certain size threshold. Each device will typically store at least 30 days worth of data when the Duplicate Read Resend Threshold (described below) is set to 60 seconds or more. A more frequent Duplicate Read Resend Threshold will require more space.*
Duplicate Read Resend Threshold (seconds)	This field sets the time in seconds that the software will wait to send duplicate Bluetooth MAC addresses to the host software. The AWAM field software will typically read identical MAC addresses multiple times in a roadside environment. This is the time in seconds that the software will wait to send duplicate Bluetooth MAC addresses to the host software. This should typically be set to 60 seconds or more to avoid sending duplicate MAC address reads to the host software. This value may be set at 0 to send all MAC address reads back to the host. However, depending on the host software configuration, typically on the first MAC address read at a location will be used to match reads at subsequent locations. Setting this value at greater than 0 will not only

	eliminate duplicate MAC address reads but will eliminate the bandwidth necessary to transmit the duplicates.
Enable UDP Output	This is a *True* or *False* value that tells the software whether to send the Bluetooth MAC addresses to a host server using the User Datagram Protocol (UDP). This is typically always set to "True" when network connectivity is available. If there is no network connectivity, this should be set to *False*.
UDP Output Host Address	The IP address of the UDP host to send the Bluetooth MAC addresses to when Enable UDP Output is set to *True*.
UDP Output Port Number	The IP port of the UDP host to send the Bluetooth MAC addresses to when Enable UDP Output is set to *True*.
Restart On Communications Failure	This is a *True* or *False* value that tells the AWAM field software whether to direct the device to restart when network communications failures occur. Many times, device restarts will reinitiate and/or correct failures. The device typically takes less than a minute to restart.
Anonymize MAC Addresses	This is a *True* or *False* value that tells the software to anonymize each MAC address as it is read. Assigning this value to True will encode each MAC address so the actual MAC address is not transmitted over a communications network or stored locally. Note: the host system matches actual MAC addresses (or the anonymized MAC addresses) between separate field devices. If this value is *True* on one reader, all readers should be assigned the same value. *Example of MAC address: 00:00:00:01:01:01* *Example of anonymized MAC address: MDA6MDA6MDA6MDE6MDE6MDE=*
Enable Heartbeat Message	This is a *True* or *False* value that tells the software to send a small message to the host software every minute to allow the host to easily monitor the status of the reader. The message is a standard AWAM message with a MAC address of 00:00:00:00:00:00

Network Settings

The Network Settings page allows users to configure the network interface to the BAT-433. The BAT-433 is capable of using USB cellular modems or the Ethernet port for network communications. Selecting the appropriate option on the Network Settings page configures the BAT-433 with that option. Clicking *Apply Changes* forces the system to save the settings and restart. Once the BAT-433 reboots, the web configuration page must be accessed using the new network settings.

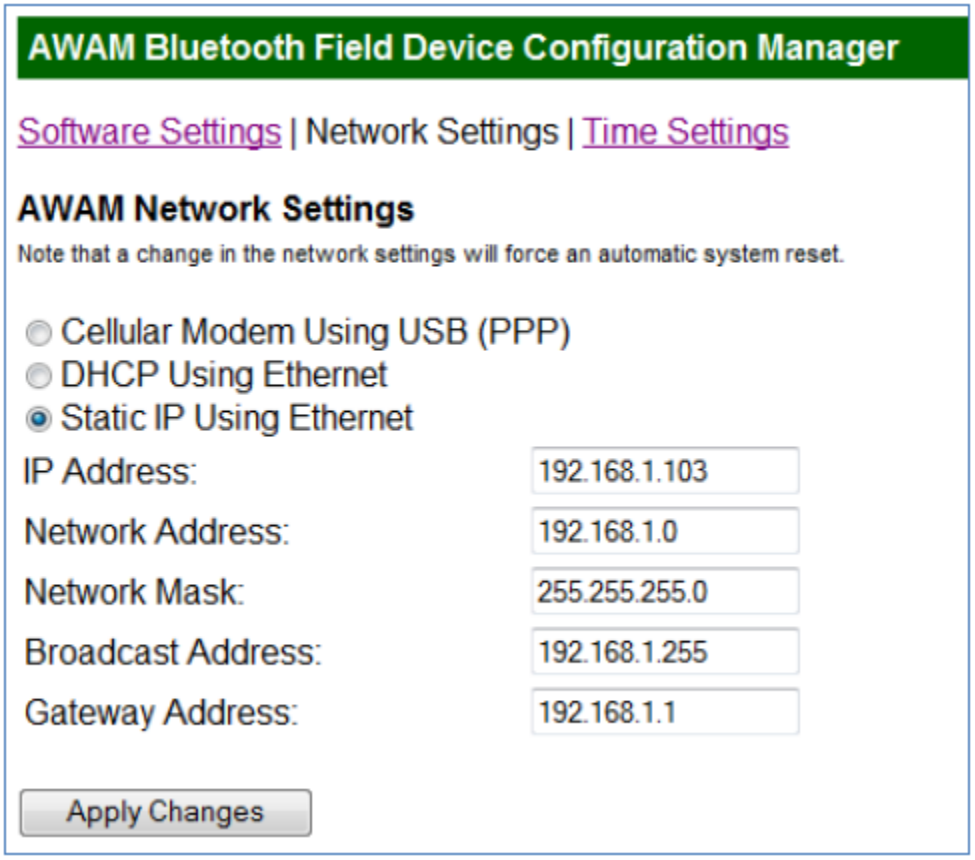

Figure 6. Network Settings Screen

Time Settings

When using the timestamp on the field device to determine travel times and speeds, time synchronization among AWAM devices is critical. The best practice is to synchronize all devices with a reliable time source using the NTP protocol. Using the Time Settings screen, the time zone can be configured along with synchronization to a NTP server (Coordinated Universal Time (UTC) can also be specified as the time zone). Once an NTP server is specified, the device will attempt to synchronize its time every six hours. A successful time synchronization will also force the device to program its battery backed hardware clock so that time is kept through power interruptions.

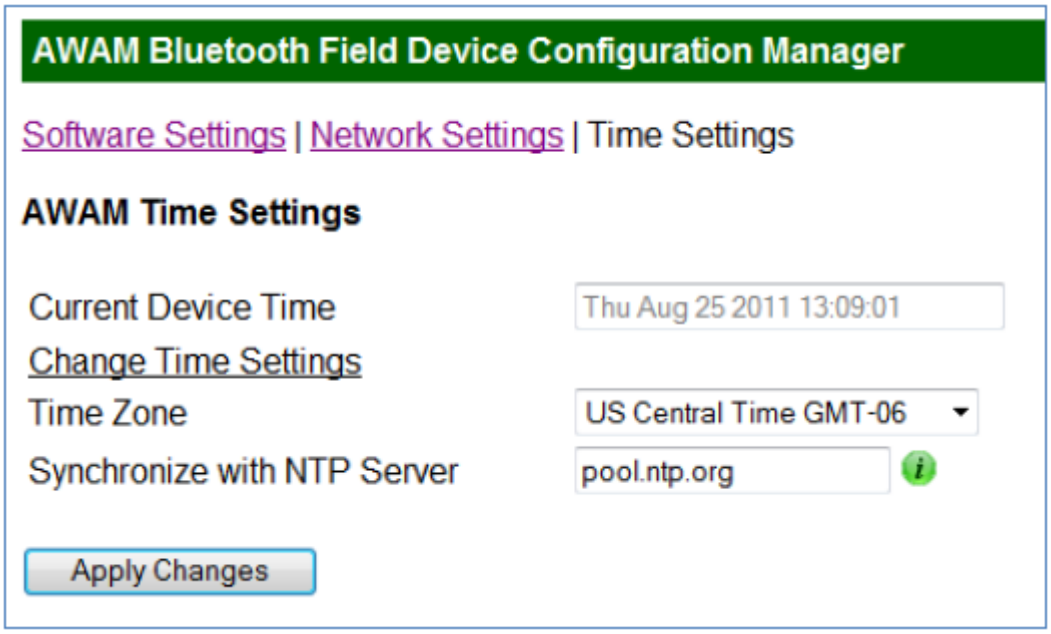

Figure 7. Time Settings Screen

Downloading Stored Data

When there is a filename specified in *the AWAM Read Output File* setting, the controller will save all address reads to a comma delimited file on the device. Users may download the data saved on the device using the web configuration interface. Whenever data is being saved to the device, a *Download Reads* hyperlink will appear next to the *AWAM Read Output File* textbox on the Software Settings Configuration screen.

Figure 8. Download Reads Link

The downloaded data will be in a comma delimited format and is described in the *AWAM Protocol* section below.

AWAM Protocol

Each individual field device sends the addresses it detects to a central host software component for the purpose of travel time and speed estimation. If the *AWAM Read Output File* setting includes a filename, the address records are also saved to the device. The host software determines the "matching" of addresses between locations to derive traffic data. Each individual record is sent as a single UDP (User Datagram Protocol) packet to a specified network host and port. To accept a record as valid, the host software requires that each detection record obtained from the field devices conform to a specific format. The format is an ASCII string of text with each data element separated by a comma. Note each record is terminated by a linefeed character (0x0A). Each data element is described in the Table 2.

Table 2. Protocol Descriptions

Element	Description
Detection Timestamp	The exact time that the address was detected as determined by the field device. The format is "mm/dd/yyyy hh:mm:ss p". Host software should have the option of either using this timestamp or the reception timestamp of each packet for travel time estimation. If the timestamp on each packet is used, it is critical that the time is synchronized frequently among the field devices to provide accurate travel time estimation. The AWAM controller does have a method for using the Network Time Protocol (NTP) for synchronizing it's time. Conversely, if the timestamp on the host is used, efforts should be made to ensure that minimal delay (less than a second) is present between the time the packet is sent by the device and received by the host software.
Reader Location	Specifies the defined location of the field device. The current standard is to utilize the primary street and the nearest cross street with the street names separated by the underscore character. For example, a reader located at the corner of Westheimer and Dairy-Ashford would be defined as `Westheimer_DairyAshford`. The order of the streets is not relevant to the calculation of travel times and is only used to identify the location.
Address Identifier	The unique identifier for each device detected. This is the 48-bit MAC identifier used by each wireless device. For example, `00:1E:7D:E7:6E:6D`. Note that the hexadecimal numbers are separated by the ":" character. To address privacy issues, the field software also has the option of encoding each MAC address upon reception at the field controller. If encoding is enabled on the field software, each address will comprise of a base64 encoded string. For instance the address `00:1E:7D:E7:6E:6D`, will be encoded and sent to the host as `MDA6MUU6N0Q6RTc6NkQ=`.

```
01/01/2010 10:00:00 AM,Westheimer_Kirkwood,00:1E:7D:E7:6E:6D[line feed
character 0x0A]
01/01/2010 10:00:01 AM,BriarForest_SH-6,04:1E:74:E7:6E:64[line feed
character 0x0A]
01/01/2010 10:00:07 AM,IH-10_Bingle,01:14:7D:E7:6E:6D0x0A[line feed
character 0x0A]
```

Figure 9. Example of Detection Output