2.5 – Understanding Bluetooth data collection with the Omega X3

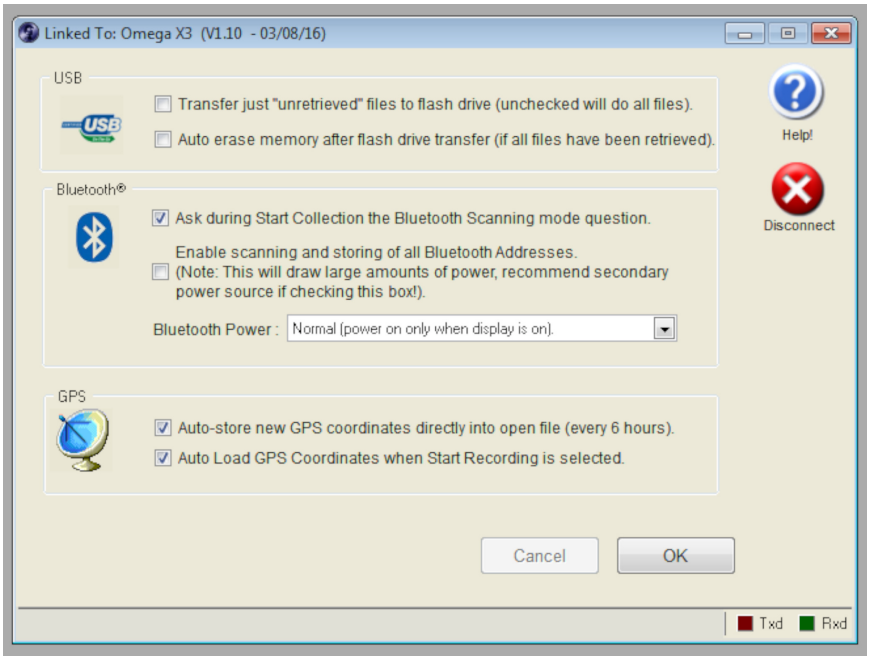
The Omega X3 is specially designed to be able to collect Bluetooth data either solely or in combination with road tube axle data collection (with or without Bicycle detection enabled). Bluetooth data collection follows these overall parameters:

1. Once enabled, the Omega X3 continuously scans for valid Bluetooth addresses within its range, which is usually a radius of around 100 feet. This range is highly dependent on (a) the quality and type of other Bluetooth device it is sensing, and (b) the physical distance and surrounding terrain characteristics. The Omega X3 is a Class I Bluetooth device, which means it is rated to sense another Class I device up to 300+ feet away, but this is not commonly seen since most Bluetooth devices are designed to be used within 10-30 feet of each other.
2. It is good practice to place the Omega X3 in as isolated place as possible when collecting Bluetooth data. For example, if you want to collect Bluetooth addresses from vehicles passing by on a street, avoid placing it too close to cross streets to keep it from picking up addresses coming in from those locations.
   Note that you may also pick up Bluetooth addresses from a phone (or other device) a pedestrian may be carrying, so that must also be taken into account. It is generally a good idea to monitor data collection for 5-10 minutes before starting collection to insure that you are not gathering Bluetooth addresses from unintended locations.
3. Once an address is received, the Omega X3 immediately stores it in memory. This is done simultaneously with axle data from road tubes (if they are connected), allowing you to collect Bluetooth and Vehicle/Bicycle data at the same time.
4. Each address is stored with the following values:
   - 12 hexadecimal digit Bluetooth address (such as “60.57.18.43.70.A5”)
   - The date and time the address was recorded (to the second).
   - The type of address as follows:
     - Standard - Traditional Bluetooth V2 type address.
     - BT LE Public - Bluetooth V4 Low Energy public address.
     - BT LE Random - Bluetooth V4 Low Energy random address (used for security).
   - The Signal Strength in dBm (decibel-milliwatts). The more positive the number, the stronger the signal, and it is often possible with some types of Bluetooth addresses to see the signal grow stronger then weaker as the vehicle comes closer and then exits.
5. Once data is collected, simply download it with Centurion. You can then directly import the data (or select the “Process Omega/RR3/OX3 Timestamp Data” function from the File menu) to bring it into the database. A new tab labeled “Bluetooth” will appear after you bring in your first Bluetooth data file. After import, you can view, edit, or export it out for further processing.
6. Note that the Omega X3 makes no attempt to block duplicate addresses (it stores everything it receives) and it has a 15 second sample period. What this means is that if there is a stationary broadcasting Bluetooth device close to the Omega X3 while it is collecting data, then every 15 seconds this same address will likely show up in the dataset. Some Bluetooth devices have rules about being sampled repeatedly, so not every local source will exhibit this behavior, but it is fairly common in many situations. For example, if a car is parked on the street with a Bluetooth device enabled inside of it, the Omega X3 may record this device’s address every about every 15 seconds.
   Centurion has options to allow you to handle duplicates and other situations when working with the Bluetooth data, refer to those instructions for more information.
7. **VERY IMPORTANT:** It is very important for users of the Omega X3 to know is that collecting Bluetooth data is *very power hungry!* While collecting Bluetooth data, the Omega X3 uses approximately one million times more power than it does when the display is off and it is waiting for an axle to strike a road tube.

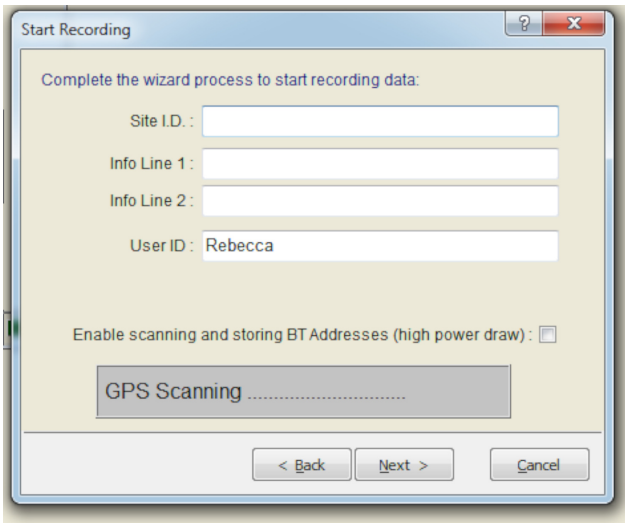
   Unless you are just testing the Bluetooth data collector for a very short period of time (less than an hour) once a year or so, **ALWAYS install eight D-Cell additional batteries into the secondary battery pack**. Failure to do this will void your battery warranty and you may have to replace them before the specified battery life. The Omega X3 also records how many times it is used for Bluetooth data collection in backup memory.

Programming the Omega X3 to collect Bluetooth Data:

1. Make sure you are using Centurion V1.42 Build #0002 (or later) before connecting to the Omega X3.
2. Plug the Omega X3 into your computer USB port and connect using Centurion.
3. First, if it is not already enabled, you must tell the Omega X3 that you either want to collect Bluetooth data all the time or to be asked to collect Bluetooth data in Start Collecting.
    - Click on **Settings** then click the **Advanced…** button. The following screen will appear:

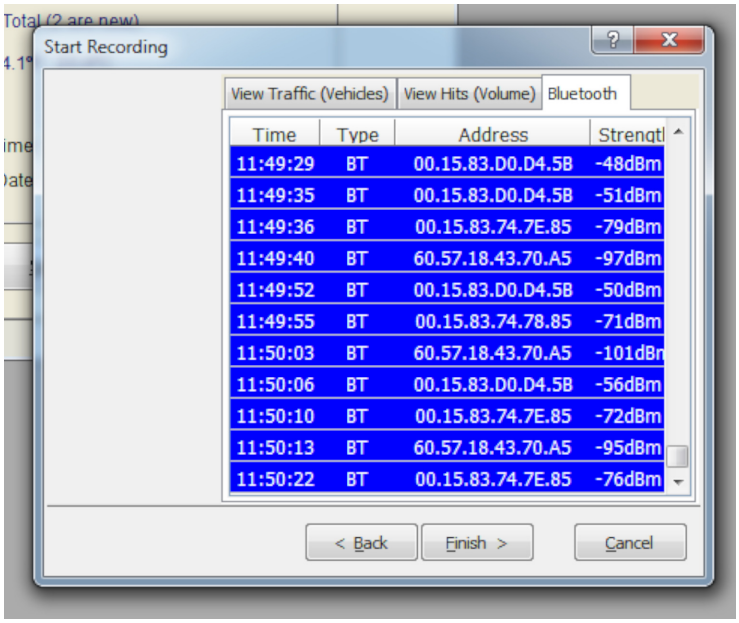


    - The middle box controls Bluetooth options. Check the box “Ask during Start Collection the Bluetooth Scanning mode question”. Once this box is checked, both Centurion and on the counter screen the Omega X3 will ask you if you want to collect Bluetooth data.
    - Note that if you always want to collect Bluetooth data, you can check the box next to “Enable scanning and storing of all Bluetooth Addresses”. This will turn on Bluetooth data collection without having to ask the user when data collection is started.
    - Click Ok.
4. To begin collecting Bluetooth data, click the **Start Recording** button. The following screen will appear:



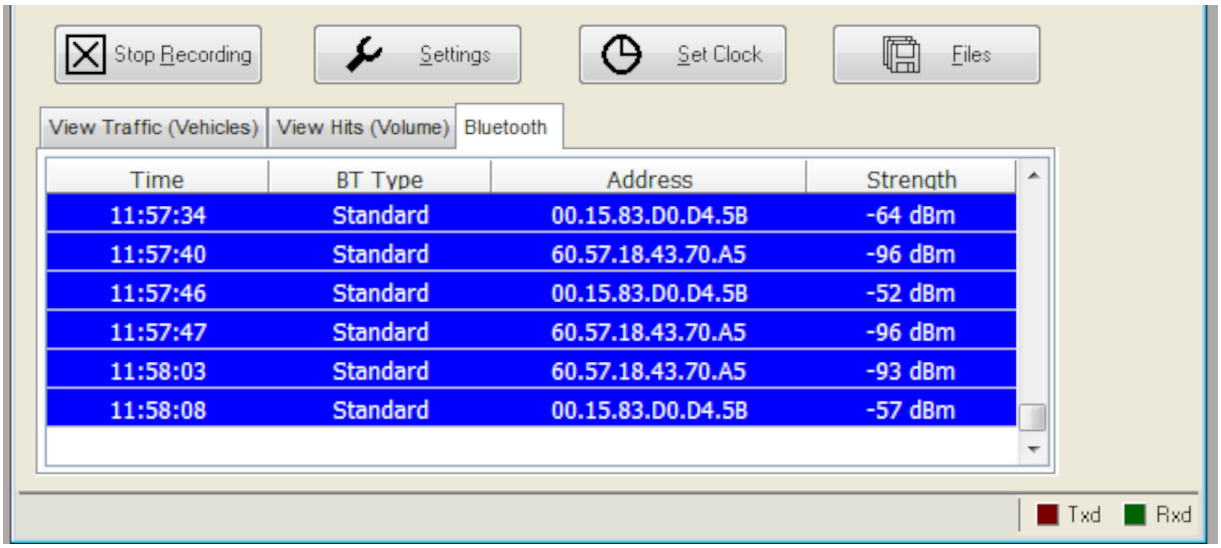
Notice the new check box (“Enable scanning and storing BT Addresses (high power draw)”) that appears when you enable this option as detailed in #3 (above). Check this box to enable Bluetooth data collection when the system starts collecting data, then click Next.

5. After clicking the Next button, the testing box will appear which by default will show either Volume or Vehicles. A new tab labeled “Bluetooth” will also be present. Click this new tab to show a screen similar to the following:



This shows about a dozen collected Bluetooth addresses along with the time it was detected, the type (“BT” for Standard, “LP” for Bluetooth LE Public, and “LR” for Bluetooth LE Random), and the strength of the signal. It is recommended you monitor for 5-10 minutes to insure you are picking up the addresses you want and not inadvertently picking up other undesired addresses. When ready, click the “Finish” button.

6. When Bluetooth data collection is active, the monitoring screen at the bottom of the main display is also updated with a new “Bluetooth” tab. It will generally appear something like this:



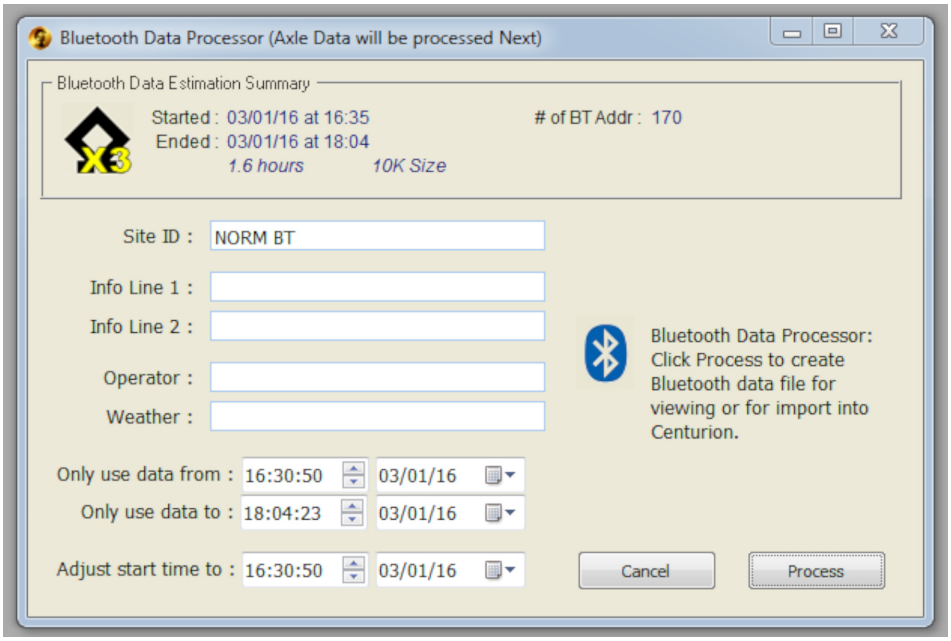
If also collecting Volume or Vehicle data, you can at will switch between any of the display types as desired.

7. Once data collection is complete, and if you no longer need to gather Bluetooth addresses at this site, it is highly recommended you **Stop Recording** before using the **Files** function to download the data. This is recommended due to the high power draw of collecting Bluetooth data.

   Download the data file and then either directly **Import** the data file into Centurion or use the **Files->Process Omega/RR3/OX3 Timestamp Data** to bring the Bluetooth data into the main Centurion database.

Processing Bluetooth Data from the Omega X3:

1. Make sure you are using Centurion V1.42 Build #0002 (or later) before trying to process Bluetooth data with Centurion.
2. **Import** the downloaded file into the Centurion database (or select **Process Omega/RR3/OX3 Timestamp Data** from the **File** menu). When this process is started (regardless of the manner), if Bluetooth data is detected in the file, then the following will immediately appear:

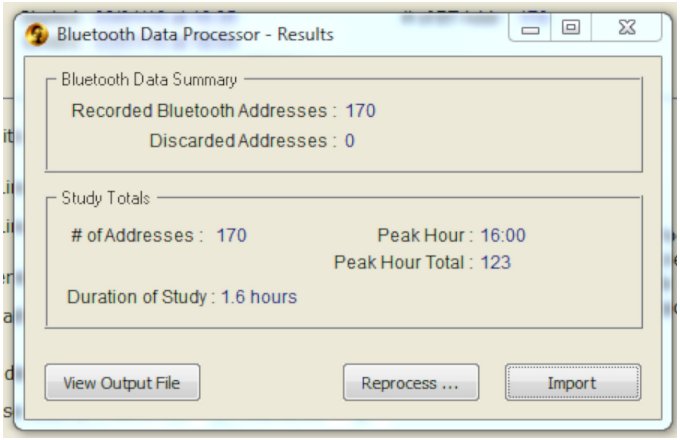


is This processing of data from the Omega X3 is done using what referred to as the TSProcess function of Centurion.

This processing screen shows some initial information about the Bluetooth data file you are processing (including number of BT Addresses recorded, the Site ID, data time/date range, and other info) and allows you to modify these values as desired prior to processing. Click **Process** when all values are set.

NOTE: Bluetooth data is always processed first and by itself prior to processing any simultaneously collected road tube axle data. The caption at the top of the window will say either "Bluetooth Data Processor" if *only* Bluetooth data was found in the file, or "Bluetooth Data Processor (Axle Data will be processed Next)" if it is first processing the Bluetooth data and when this is finished it will go back and process the road tube axle data. The Centurion database supports sites which have simultaneous collection of Bluetooth data and Vehicle/Volume data, but each type is processed and imported separately.

3. After clicking Process, the data is quickly analyzed and prepped for import into Centurion. A window similar to the following will appear:



From here, click **View Output File** to see the text file representation of the processed Bluetooth data.

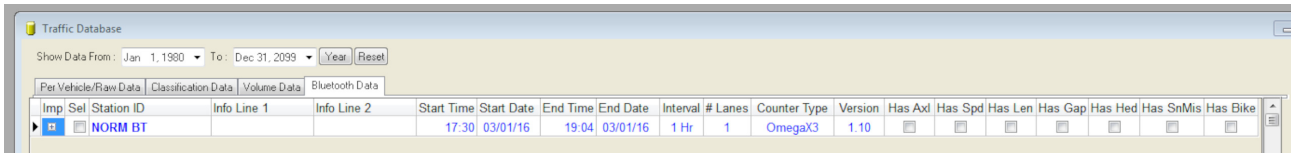
Click **Import** to schedule the Bluetooth data for import into Centurion. Note that this happens AFTER the processing of Vehicle / Volume data (if any is present).

Click **Reprocess** to reanalyze the Bluetooth data using different parameters.

Once the data has been imported into Centurion, it can be viewed, edited, and exported back out into multiple other formats. In addition, future versions of Centurion will include more Bluetooth analysis tools.

Bluetooth data and the Centurion Database:

1. Make sure you are using Centurion V1.42 Build #0002 (or later) before trying to work with Bluetooth data inside the Centurion database.
2. After processing the data using TSProcess (see previous section), it will normally be imported into the database where it can be viewed. Once the first Bluetooth data has been imported, a new tab will appear labeled “Bluetooth” (next to the “PerVehicle/Raw Data / Classification Data / Volume Data” tabs) which allows access to all the sites with Bluetooth datasets. For example:

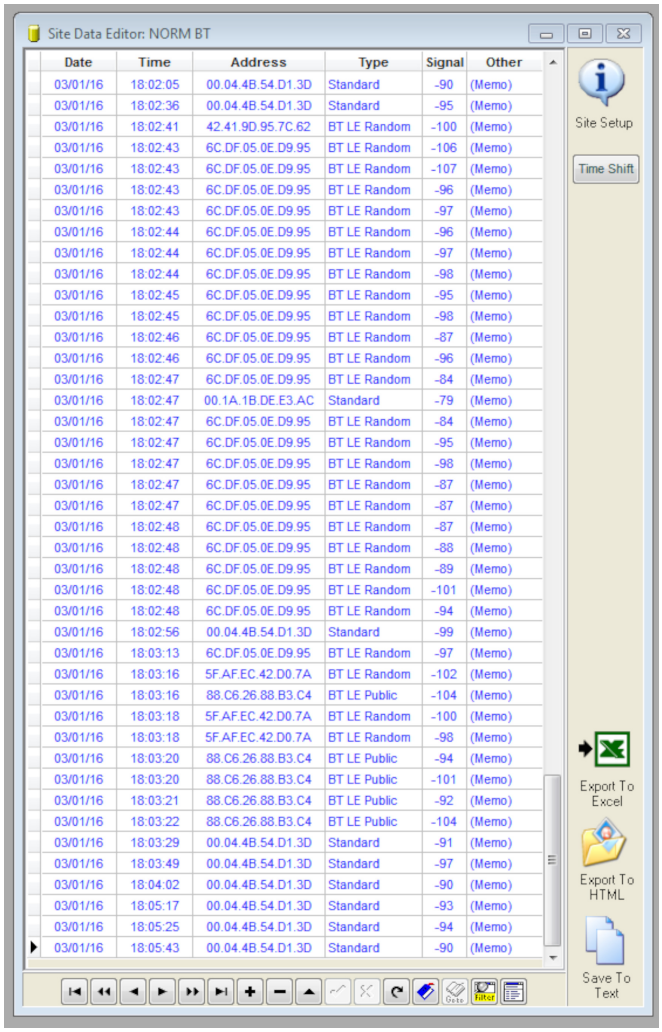


The above shows the new Bluetooth tab and a single imported dataset named “NORM BT”. Note that no “Has Axl”, “Has Spd”, etc values will be checked (unless you also imported some Vehicle data which created those datasets).

On the right of the Database Viewer, the following functions are available:

- **Export Data** – To output Bluetooth data to one of several output formats.
- **Edit Data** – To display and edit the Bluetooth dataset, including multiple copy/paste options into a variety of data formats (Excel, HTML, Text).
- **Edit Site Setup** – Same function as is available with the other database types.

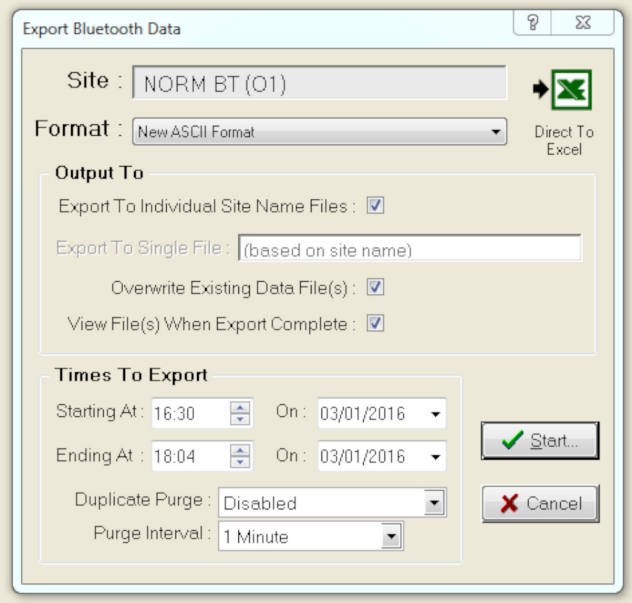
4. Select a site in the database and either double click it or select the **Edit Data** function. A window similar to the following will appear:



The editor works similar to any spreadsheet style editor. Data can be deleted, inserted, and modified as desired.

To use the “Export to Excel”, “Export to HTML”, or “Save to Text”, simply highlight one or more (up to the entire dataset) and then click the button for the format you want. This is a simple copy/paste type function (use the main Database Viewer **Export Data** function for more advanced exporting).

5. Select the **Export Data** function from the main Database Viewer to display the Bluetooth database exporter. The following window will appear:



The **Export Data** function for Bluetooth data has fewer output formats than the Vehicle/Volume. It currently supports the following output formats:

- New ASCII Format
- Binary Format
- Direct to Excel
- CSV ASCII Diamond

Most of the settings in this window are the familiar options, with the exception of two new options at the bottom of the window labeled **Duplicate Purge** and **Purge Interval**.

Duplicate Purge – This option controls how duplicate Bluetooth addresses found in the dataset should be handled. Can be set to "Disabled" (which leaves all duplicates in the output), "Purge All Duplicates" (which removes all duplicates and only outputs the first one found), and "Purge on Interval" (which removes any duplicates when found within the specified Purge Interval time period).

Purge Interval – How long before a duplicate address will be re-allowed in the dataset. For example, if it is set to "1 hour", then you must have at least a one hour break between getting a particular address before it will be included in the exported data.

6. The first two and the last export format (New ASCII, Binary, and CSV) are the standard Diamond export formats. Direct to Excel saves the data in a standard Excel spreadsheet with the Data page looking similar to:

D28

	A	B	C	D	E	F
1	**Data For Station: NORM BT (O1)**					
2						
3		Date	Time	Type	Address	Signal
4		03/01/16	17:02:48	LE Random	6C.DF.05.0E.D9.95	-88
5		03/01/16	17:02:48	LE Random	6C.DF.05.0E.D9.95	-89
6		03/01/16	17:02:48	LE Random	6C.DF.05.0E.D9.95	-101
7		03/01/16	17:02:48	LE Random	6C.DF.05.0E.D9.95	-94
8		03/01/16	17:02:56	Standard	00.04.4B.54.D1.3D	-99
9		03/01/16	17:03:13	LE Random	6C.DF.05.0E.D9.95	-97
10		03/01/16	17:03:16	LE Random	5F.AF.EC.42.D0.7A	-102
11		03/01/16	17:03:16	LE Public	88.C6.26.88.B3.C4	-104
12		03/01/16	17:03:18	LE Random	5F.AF.EC.42.D0.7A	-100
13		03/01/16	17:03:18	LE Random	5F.AF.EC.42.D0.7A	-98
14		03/01/16	17:03:20	LE Public	88.C6.26.88.B3.C4	-94
15		03/01/16	17:03:20	LE Public	88.C6.26.88.B3.C4	-101
16		03/01/16	17:03:21	LE Public	88.C6.26.88.B3.C4	-92
17		03/01/16	17:03:22	LE Public	88.C6.26.88.B3.C4	-104
18		03/01/16	17:03:29	Standard	00.04.4B.54.D1.3D	-91
19		03/01/16	17:03:49	Standard	00.04.4B.54.D1.3D	-97
20		03/01/16	17:04:02	Standard	00.04.4B.54.D1.3D	-90
21		03/01/16	17:05:17	Standard	00.04.4B.54.D1.3D	-93
22		03/01/16	17:05:25	Standard	00.04.4B.54.D1.3D	-94
23		03/01/16	17:05:43	Standard	00.04.4B.54.D1.3D	-90