

T2: Telemetry

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QUICK START

MoTeC

T2 Telemetry Quick Start Guide

About this Guide

The aim of this guide is to provide basic instructions to get T2 Telemetry working end-to-end. The possible variations, and the flexibility built into the system, are not covered.

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System Requirements

T2 Telemetry (T2) requires the following hardware and software.

Hardware

- ADL3 or C185 Data Logger with the T2 function upgrade enabled.
- Radio or GSM modem with RS232 connection to the PC. Hardware used for the existing MoTeC Telemetry system is also supported.

Software

- ADL3 or C185 Dash Manager version 5.5 and later
- i2 Pro Analysis version 1.1 and later
- T2 server, version 1.1 and later

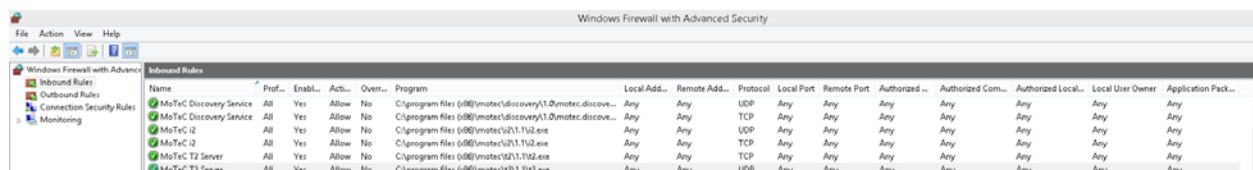
Computer

- Operating system: Microsoft Windows Vista or above.
- Note:** Windows XP and earlier versions are not supported
- Screen resolution: 1366 x 768 or greater
 - Browser: Internet Explorer 9 (minimum), 10 or above recommended

Other Requirements

- Administrator privileges are required for installation
- Any active firewalls may need to be updated to allow the following for both T2 and i2:
 - Inbound and Outbound Multicast DNS traffic (IPv6) on UDP port 5353
 - Inbound HTTP traffic (IPv6) on TCP port 8888
 - Outbound Multicast UDP (IPv6) traffic from T2.exe
- MoTeC i2 1.1 or higher is required for data analysis.

Firewall Settings



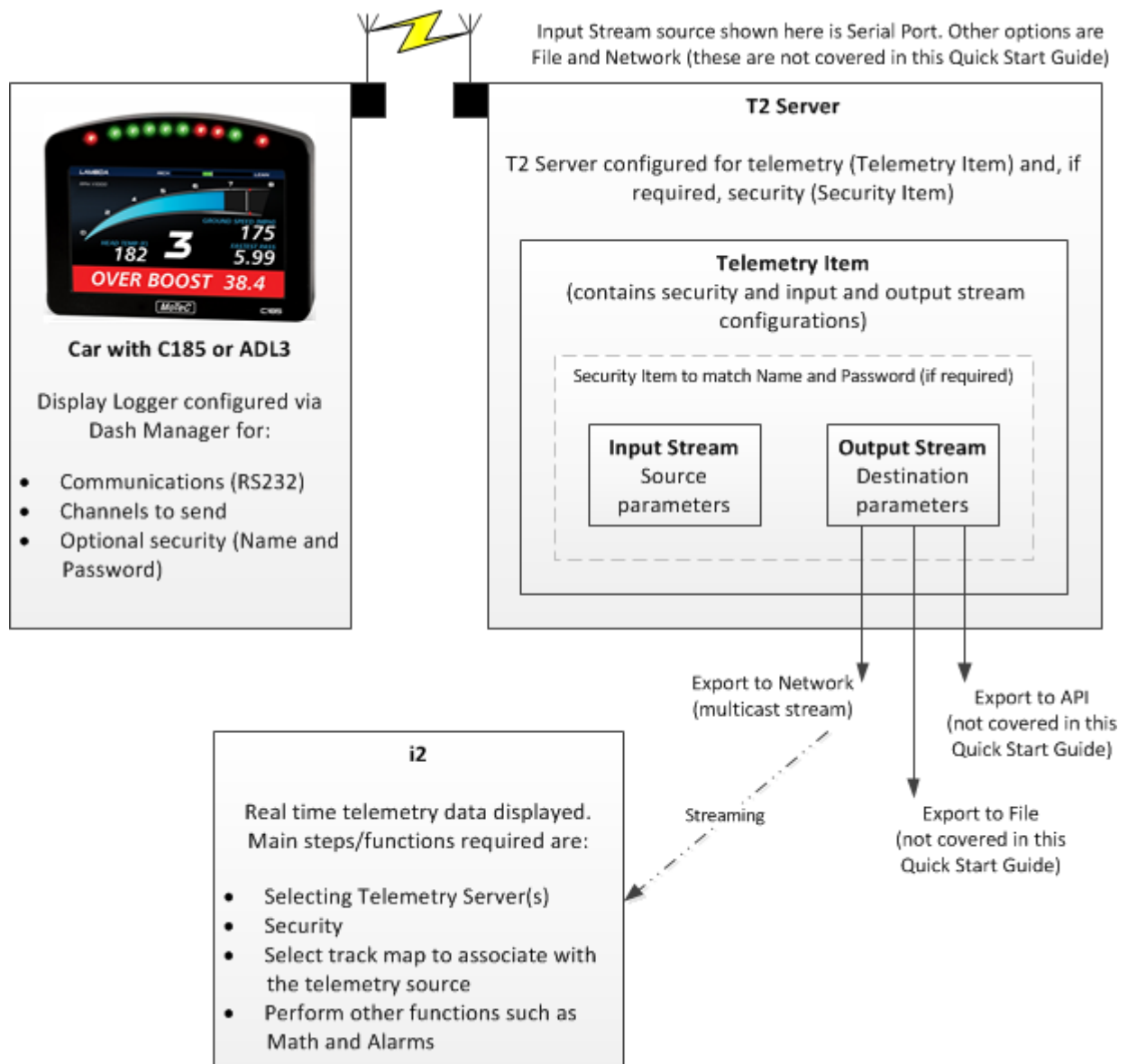
The screenshot shows the Windows Firewall with Advanced Security console. The 'Inbound Rules' list on the right contains the following rules:

Name	Prof...	Enabl...	Acti...	Over...	Program	Local Add...	Remote Add...	Protocol	Local Port	Remote Port	Authorized ...	Authorized Com...	Authorized Local...	Local User Owner	Application Pack...
MoTeC Discovery Service	All	Yes	Allow	No	C:\program files (x86)\motec\discovery\1.0\motec.discover...	Any	Any	UDP	Any	Any	Any	Any	Any	Any	Any
MoTeC i2	All	Yes	Allow	No	C:\program files (x86)\motec\i2\1.1\i2.exe	Any	Any	TCP	Any	Any	Any	Any	Any	Any	Any
MoTeC T2 Server	All	Yes	Allow	No	C:\program files (x86)\motec\i2\1.1\i2.exe	Any	Any	TCP	Any	Any	Any	Any	Any	Any	Any
MoTeC T2 Server	All	Yes	Allow	No	C:\program files (x86)\motec\i2\1.1\i2.exe	Any	Any	UDP	Any	Any	Any	Any	Any	Any	Any

Overview of T2 Telemetry

This is a simplified overview of T2 Telemetry requirements and function.

Figure 1. T2 Telemetry Overview



Dash Manager Setup

Communications Setup

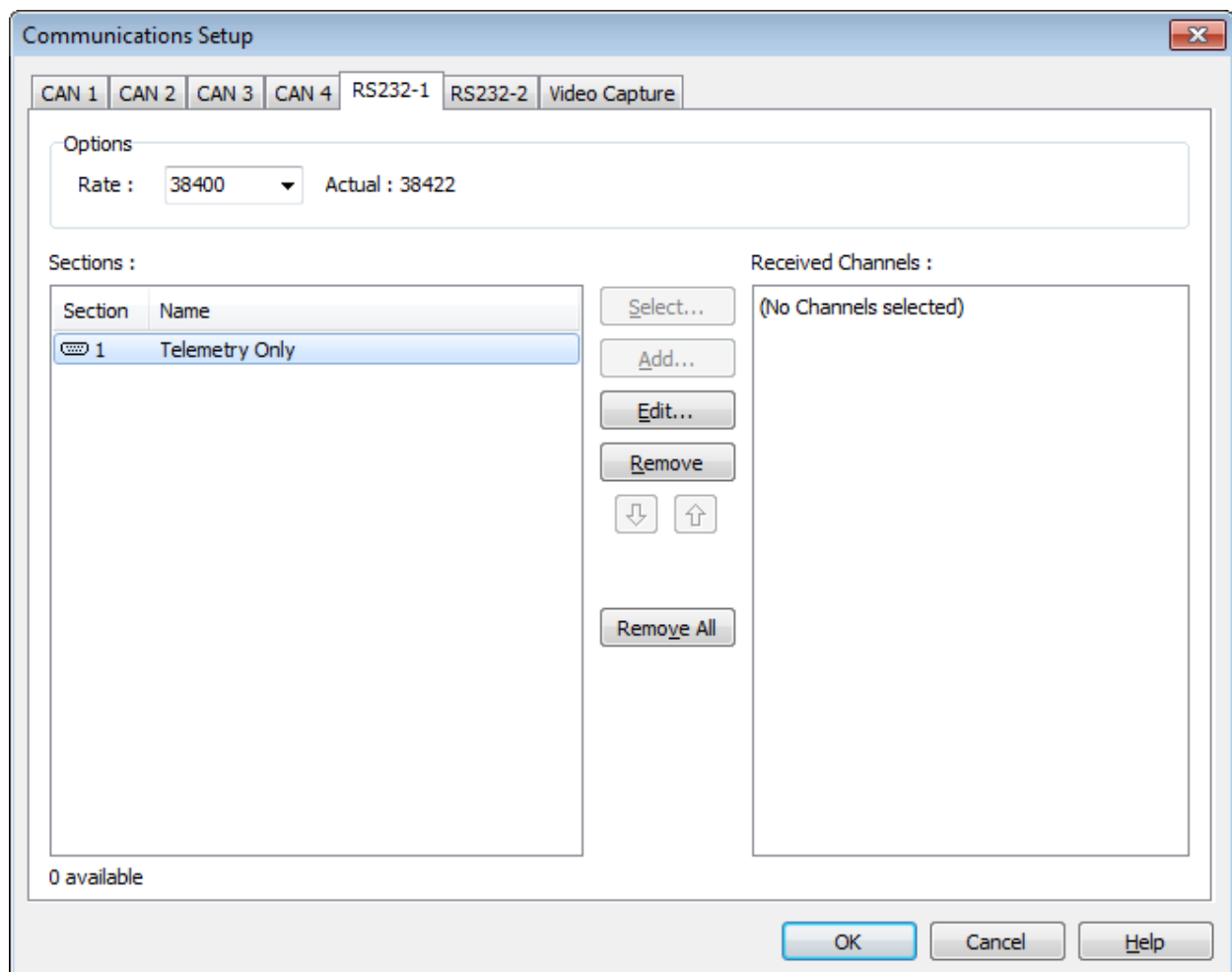
Note: The T2 function upgrade must be enabled for the Data Logger to send telemetry data.

Current RS232 communication templates Telemetry Only or GPS & Telemetry can be used with T2.

To setup communications:

1. Go to the **Connections > Communications** menu.
2. In the Communicators Setup window, select an **RS232** tab.
3. Set the applicable baud rate for the selected RS232 port.
4. Select **OK**.

Figure 2. Example Communications Setup



Channel Setup

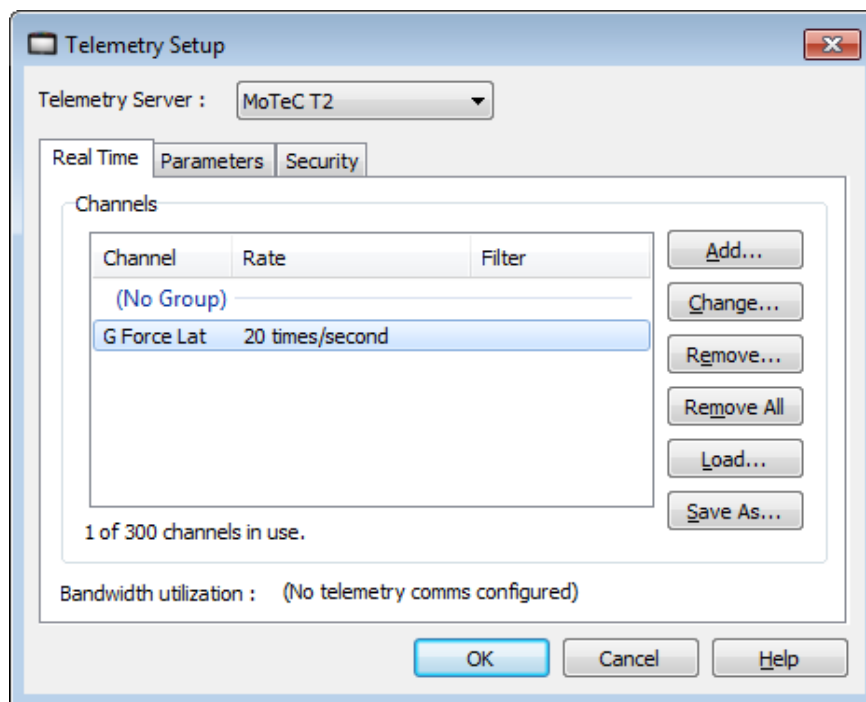
Select the channels to be included in the telemetry stream. To do so:

1. Select the **Functions > Telemetry** menu.
2. In the **Telemetry Server** field, select **MoTeC T2**.

Real Time tab

1. In the **Real Time** tab, select **Add** and select channels to include in the telemetry stream.

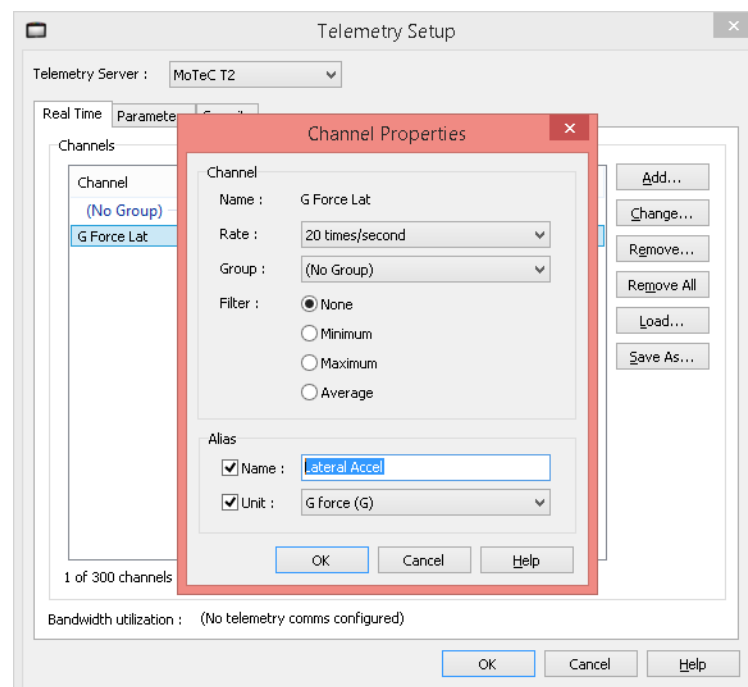
Figure 3. Example channel selection the Real Time tab



Tab buttons	Function
Add	Add channel(s) to the T2 stream. Channels are added with default rate.
Change	Change T2 channel properties: Rate, Group and Filter.
Remove	Remove the selected channel(s) from the list.
Remove All	Remove all channels from the list.
Save As	Save the T2 setup to a file.
Load	Load the T2 setup from a previously saved setup file.
Bandwidth Utilization	Percentage of the RS232 bandwidth occupied by the selected channels.

2. If the properties of any of the channel need to be altered:
 - a. Select the channel.
 - b. Select the **Change** button.

Figure 4. Example Channel Properties



Channel property	Function
Rate	The rate at which a sample of the channel is included in the telemetry stream.
Group	Arrange channels in groups. This allows group filtering when setting up the T2 server.
Filter	If the Rate is slower than the channel's sampling rate, filters can be applied so that the telemetry sample will have the minimum, maximum or average value over the previous sampling interval.
Alias	A channel can be sent over telemetry with the option to have it display a different name and unit. Figure 4 shows G Force Lat being sent with the alias of Lateral Accel.

Parameters tab

Use the **Parameters** tab to add any modem initialisation parameters.

Security tab

Used to enable encryption of the telemetry stream and/or set a new Salt.

Encrypted telemetry data needs to be decrypted in the T2 server and/or in i2 Pro Analysis. Two encryption and decrypt/authentication methods are provided, password-based and key-based.

Figure 5. Example Security Screen

Channel property	Function
Name	This is the username that is associated with either the password or key authentication.
Salt	<p>About Salt</p> <p>Security must be enabled to create a Salt.</p> <p>A Salt is a set of encrypted bytes that are part of the telemetry metadata. It is used to match a telemetry data stream with a given configuration downstream (a T2 server, i2 etc.).</p> <p>If security is enabled, and this is a completely new configuration, or the configuration has never had a Salt, then a Salt is automatically generated; this is the only time a Salt is automatically generated.</p> <p>An existing Salt can only be replaced manually; otherwise, the original Salt remains. A new Salt is generated by selecting the Generate New Salt button.</p> <p>If a new Salt is generated, the metadata file (which will contain the new Salt) must be provided downstream; otherwise, the stream will not be usable by a T2 server or i2.</p> <p>Note: If a Salt does not exist, correct matching between the data stream and the configuration must be manually managed by the user/team.</p>

Channel property	Function
Password based authentication	Specify the password with which to encrypt and decrypt the telemetry stream. The password must be provided to downstream users of the telemetry data.
Key-based authentication	<p>A public key is required to encrypt the data; this can be created using the Create button or imported using the Import button.</p> <p>If imported, the matching private key needs to be available downstream to those who need to decrypt and access the data.</p> <p>If the Create button is used both a private and public key is produced. The private key should then be made available downstream as required to decrypt the data.</p>

T2 Server Setup

Create Telemetry Configuration

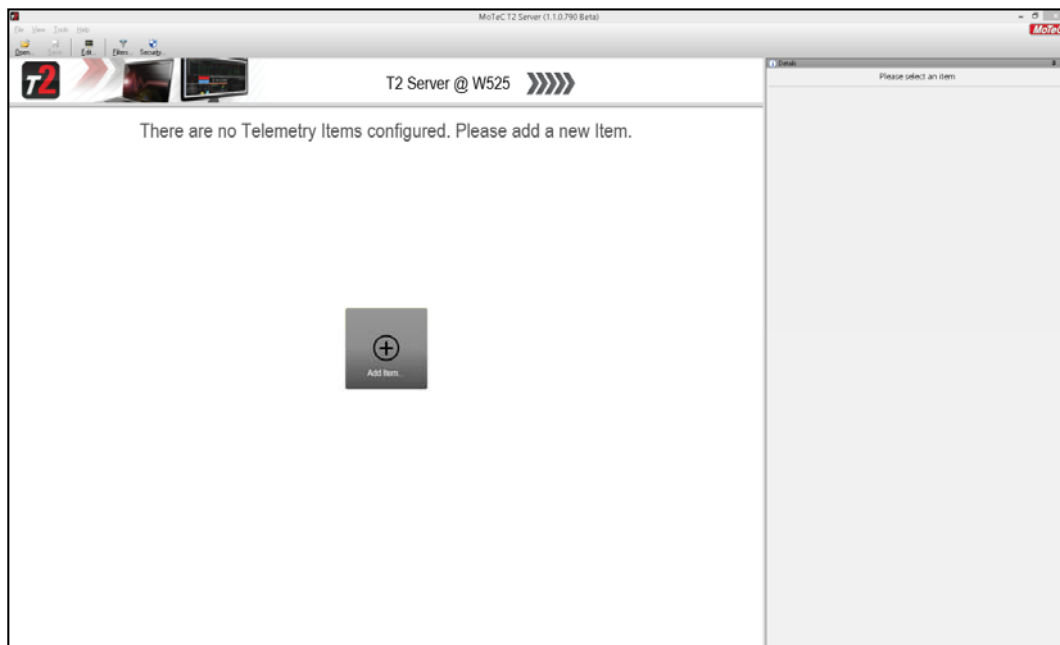
In T2 Server, a telemetry configuration contains one or more Telemetry Items, and optionally Security information. A Telemetry Item configures Input and Output Stream parameters.

The Input stream identifies the origin of the telemetry data. The output stream(s) identify the destination of the telemetry data. A Telemetry Item contains one input stream and one or more output streams.

To create a new Telemetry configuration:

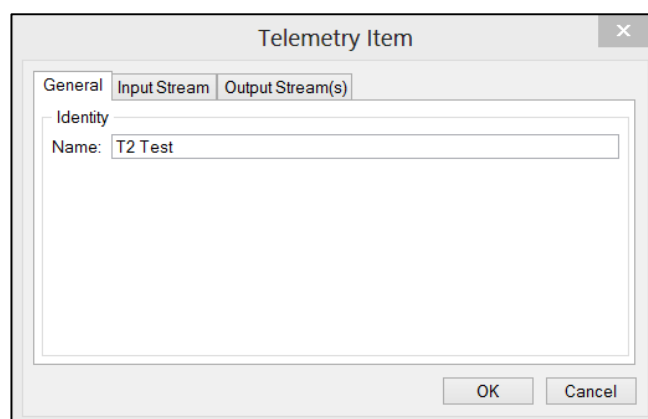
1. Select the **File > New** menu option.

Figure 6. Telemetry Configuration

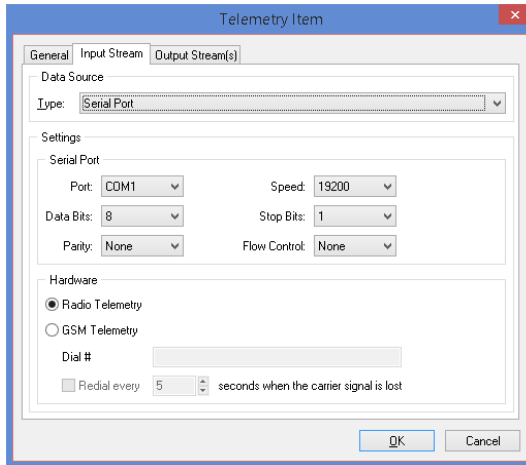
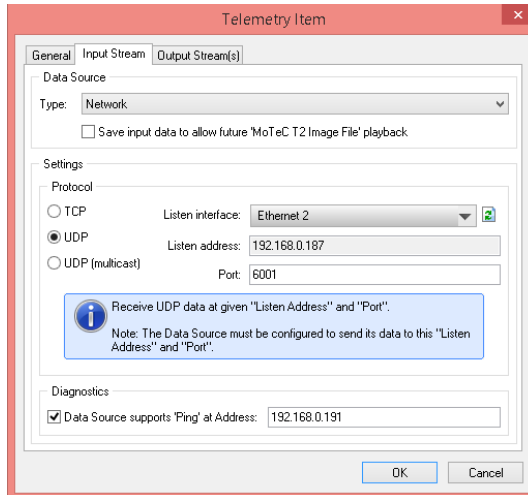


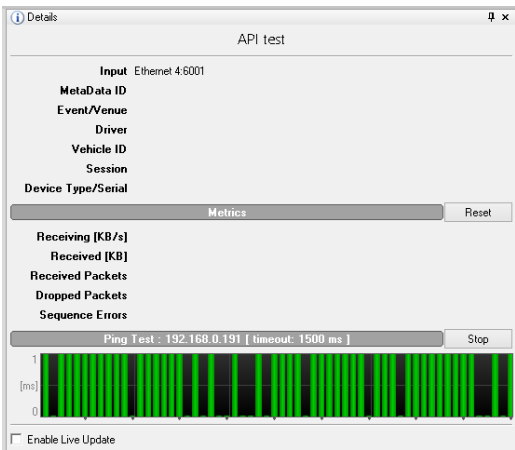
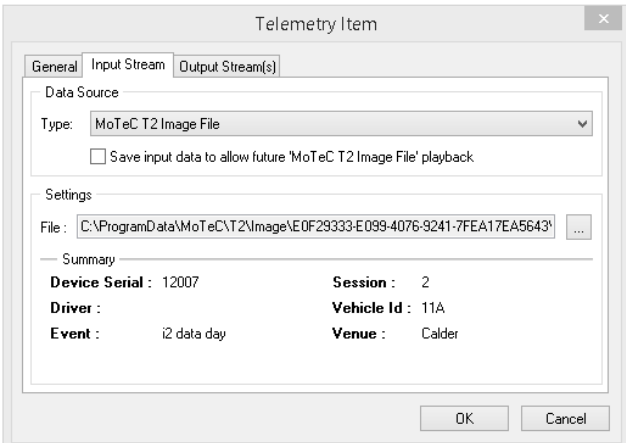
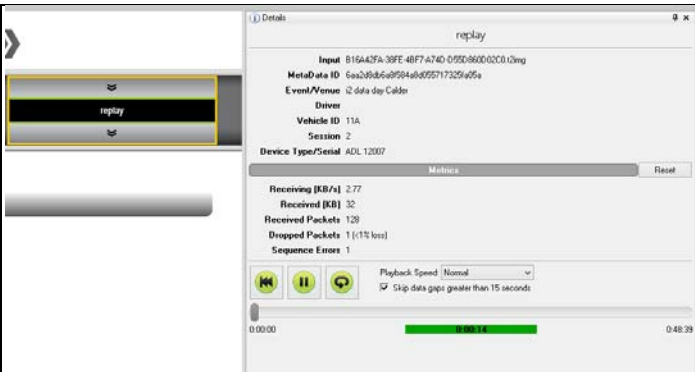
2. Select the **Add Item...** button to setup a new Telemetry item. The Telemetry Item properties dialogue displays.

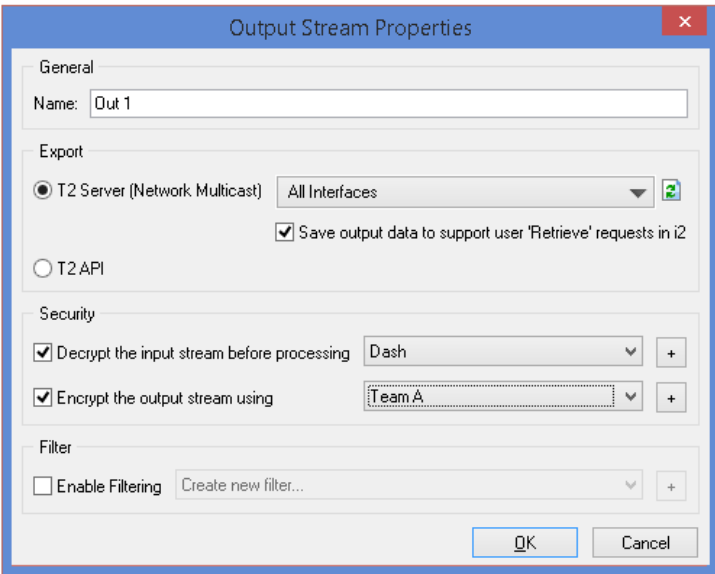
Figure 7. Telemetry Item screen



3. Complete the following details in each tab and screen as follows.

Tab or Screen	Tab or Screen Item	Setup
General tab	Name field	Enter an identity, for example: Car 1.
Input Stream tab specifies the input stream type.	Data Source field	Select how T2 server is to receive its input, this can be from a serial port, network connection or replay of a saved image file or logged data.
	Settings: Serial Port selection	<p>The telemetry input stream comes from a radio or GSM modem. The Serial Port Settings should be set according to the COM port that receives the telemetry stream and according to the RS232 parameters in the modem.</p> <p>Figure 8a. Example Serial Port Input Source</p> 
	Settings: Network selection	<p>If the telemetry input stream comes from a network device, (RS232 to UDP or the car radio itself), these devices need to be configured to push their data to an IP address and a port number.</p> <p>Example shown in figure 8b has the incoming data on IP 192.168.0.187 and a port number of 6001, The radio device sending the data has a fixed IP address of 192.168.0.191.</p> <p>Entering this IP in the Diagnostics section will aid diagnosis of a connection by allowing the main details tab of T2 to show a ping response from the device (see figure 8c).</p> <p>Figure 8b. Example Network Input Source</p> 

		<div>Figure 8c. Example Network Input Source with Ping test</div> <div></div>
	Settings : Save the telemetry image	<p>On the Input tab, under the Data source type is a tick box Save Input data for Playback (see Figure 8b). When this box is ticked T2 will record the incoming telemetry data stream so that the user can replay it at a later time. T2 telemetry images can be found in C:\ProgramData\MoTeC\T2\Image.</p>
	Settings: Image Play back selection	<p>Selecting the Data Source Type as MoTeC T2 Image file, will allow the user to replay a recorded telemetry session.</p> <div>Figure 8d</div> <div></div> <p>When a telemetry image is setup and that car or input is selected, the controls for playing/stopping are displayed on the main T2 display., Figure 8e shows an input named replay that is setup and selected, displaying the controls on the right hand side.</p> <div>Figure 8e</div> <div></div>

<p>Output Stream tab allows creation of a number of output streams. The telemetry data can be transmitted (streamed) over different network connections, saved to an image file or accessed via the T2 Server API.</p>	<p>Add button</p>	<p>Adds a new output stream. The Output Stream Properties dialogue displays, and is used to configure the stream.</p> <p>Figure 9. Output Stream Properties</p> 
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Output Stream Properties screen	Name field	Enter a name for the output stream.
	Export: T2 Server (Network Multicast)	The data is streamed over the network. A specific network card (interface) can be selected. Default is sending the data to All Interfaces . If the Save output data... checkbox is checked, the output data is also saved to a backup file while T2 Server is running. When the T2 Server application is closed, the backup file is deleted. The Save output option allows downstream clients to request data. For example, i2 allows data to be retrieved and loaded as a Log File.
	Export: T2 API	Allows T2 Telemetry stream to be used with the T2 Server API (not covered in this guide).
	Security: Decrypt... checkbox	If telemetry stream was encrypted in the Data Logger, it can be decrypted in T2 Server and sent to the output as non-encrypted. Decryption is done using Security Items. If Auto is selected from the drop down menu, T2 will search through all configured security items looking for a match. The user can select from this menu a security item to use that only decrypts the incoming stream for that input (if it matches what is selected).
	Security: Encrypt... checkbox	The output stream can be encrypted using a Security Item. To create a new Security Item, select the [+] button. See Security.

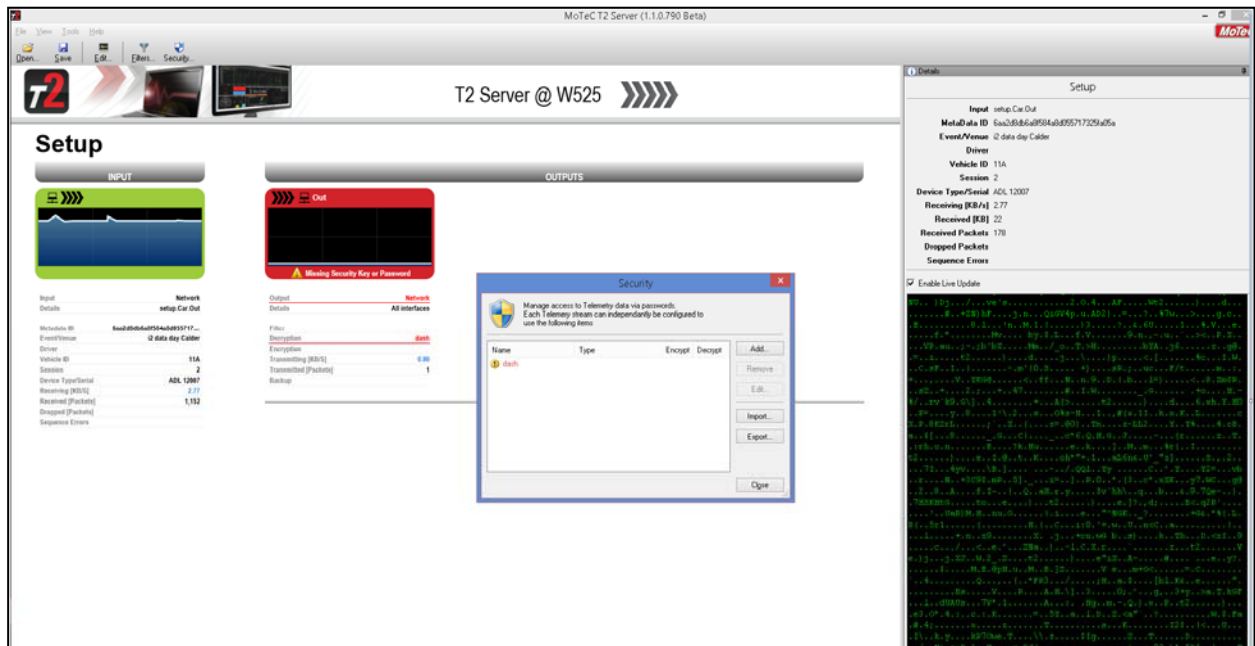
Security

The **Security** toolbar button allows creation of a number of Security Items.

A Security Item is a Name and Password or Key pair that can be applied to an input or an output stream.

Note: If security has been applied to the input stream (that is, the telemetry stream is encrypted in the Data Logger), the T2 Server Security screen will show the names of the security items applied to the input streams. The Password has to be provided for the input stream to be decrypted.

Figure 10. Example Security Screen



T2 Server - Confirming Telemetry Configuration Setup

If T2 Server and Telemetry Item(s) are configured correctly, the Telemetry Item will be green and the packet counters will show packets coming in and going out. The graph will give an indication of data coming in and going out via the outputs. If there is a fault, the Input or Output boxes will go red and an error message will display to highlight where the possible fault may lie. See figure 10 above where the security password has not been entered, preventing the output going green).

To view Telemetry Item details, use the **Details** screen. Select **Enable Live Update** checkbox to allow viewing the raw RS232 input stream; however, we recommend it only be used for diagnostics purposes, and otherwise left disabled.

Figure 11. Example Active Telemetry Stream

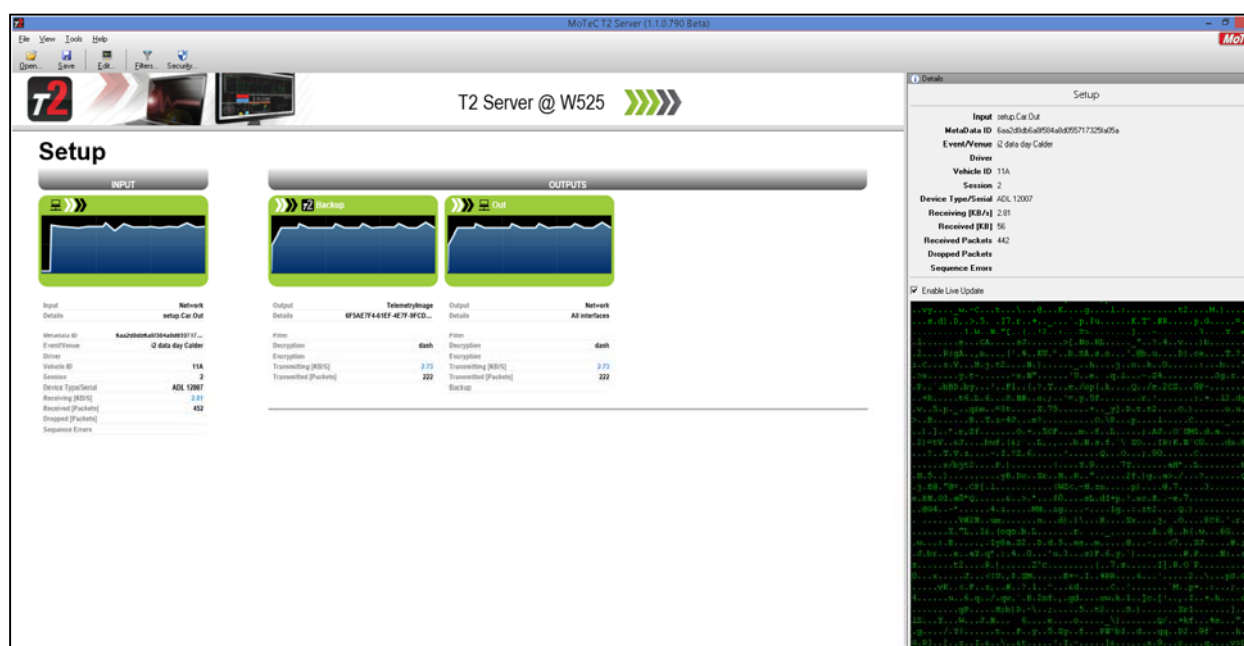
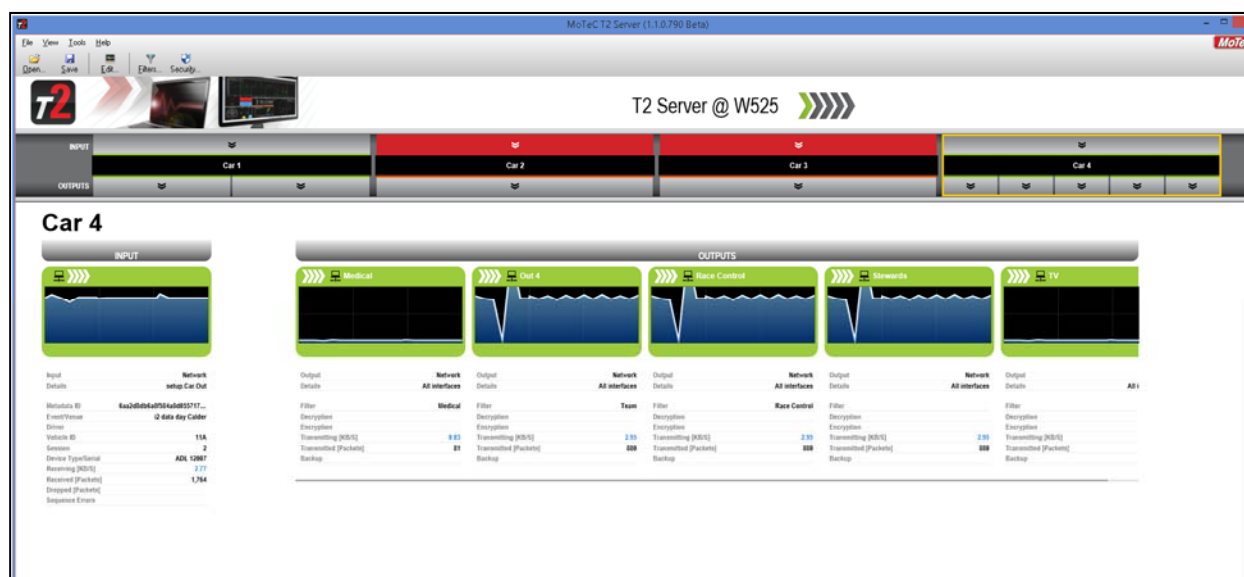


Figure 12. Example Active Telemetry Stream

The example below shows 4 cars configured in the same T2 Server. The example shows cars 1 and 4 connected. Car 4 is setup to go to multiple sources with active filters (to limit what the source has available to view in i2 Pro).

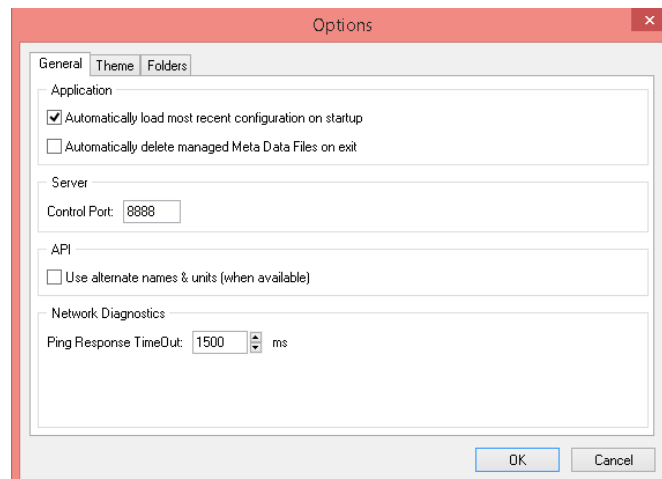


Using Alias Names in T2 Server for API output

If a channel has been sent over telemetry with an Alias configured as outlined on page 6, and you want to use this name in the T2 API output, select **Tools > Options** from the T2 menu,

On the **Options** Tab (figure 13a) select the option **Use alternative names & units**

Figure 13a. T2 Server Options box

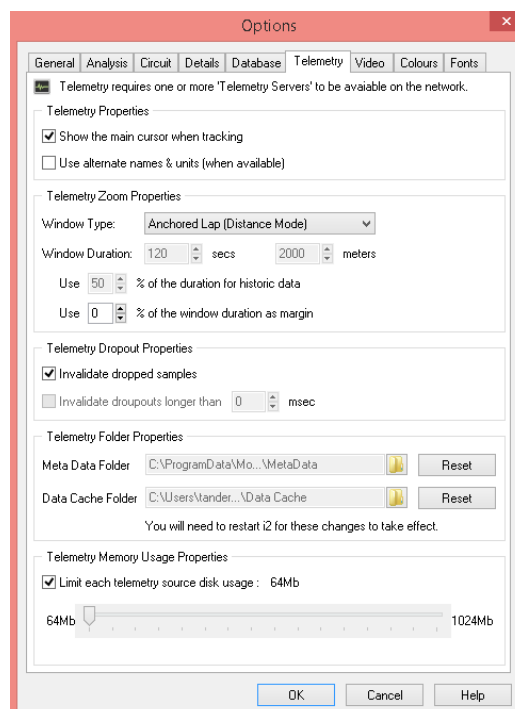


Using Alias Names in i2 Pro

If a channel has been sent over telemetry with an Alias configured as outlined on page 6, and you want to use this name in i2 as the name of the channel, select **Tools > Options** from the i2 menu,

In the Options box (figure 13b), click on the **Telemetry** Tab and select the option **Use alternative names & units**

Figure 13b. i2 Pro Options box



If **Use alternative names and units** is not selected in either T2 or i2Pro, the standard channel name is used.

i2 Pro Analysis

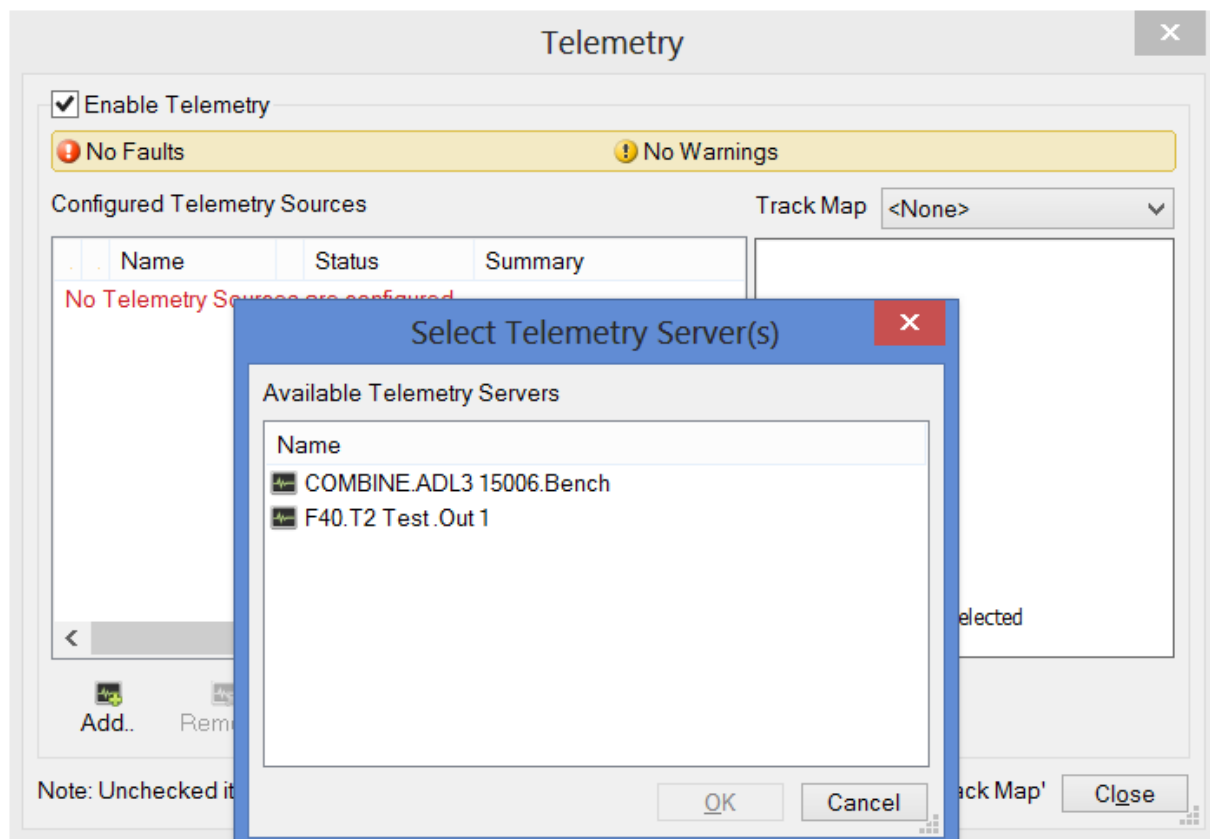
i2 T2 Telemetry Setup

The streamed telemetry data can be viewed live in i2 as follows.

1. Select **File > Telemetry** menu item to display the Telemetry screen.
2. Check the **Enable Telemetry** checkbox.
3. Ensure T2 Server is configured and running.
4. Select the **Add** button.

All the T2 Server and Telemetry Items available on the network are listed in the Select Telemetry Server(s) screen.

Figure 14. Telemetry Setup



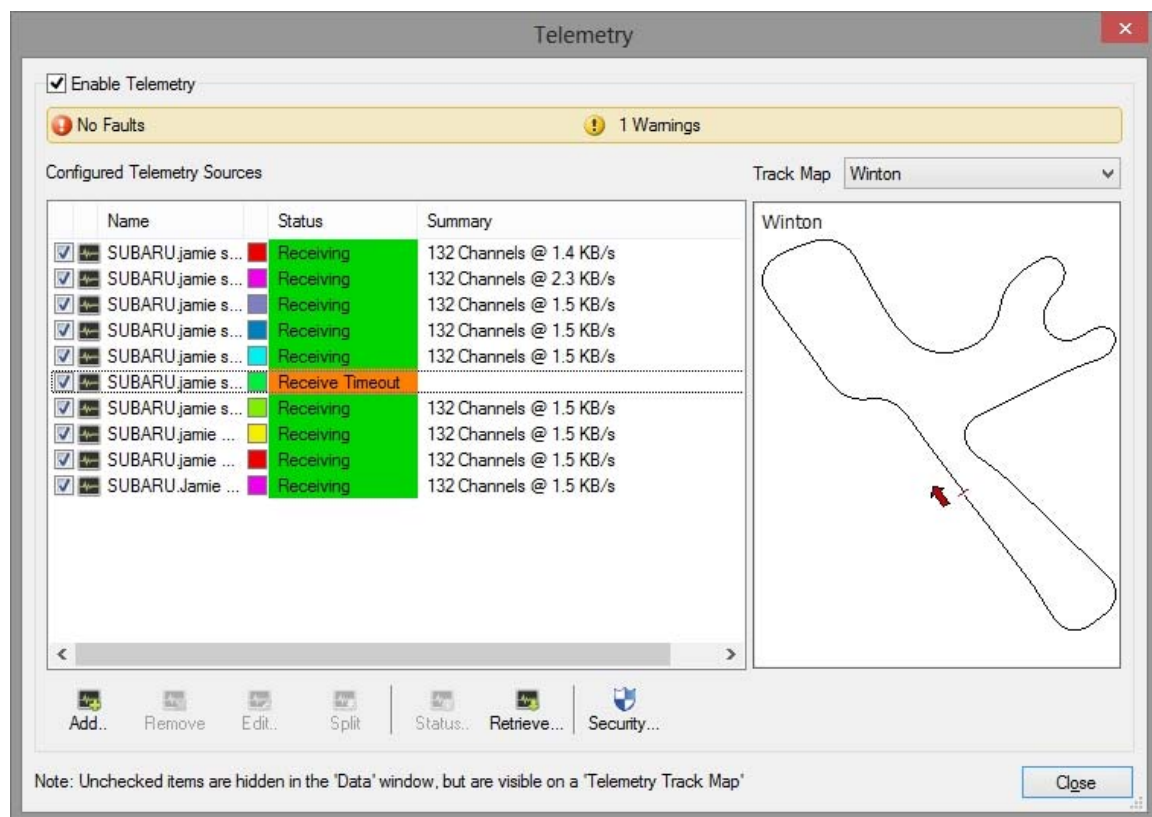
5. Select the required Telemetry Server and associated Telemetry Item from the list.

In the example above two T2 Servers and Telemetry Items are listed. For the first, the breakup of the name is as follows:

COMBINE	ADL3 15006	Bench
T2Server	Telemetry Item name	Output Stream name

The selected T2 source name will appear in the **Configured Telemetry Sources** list.

Figure 15. Example Configured Telemetry Sources List with Receive Timeout



If the T2 Source Status remains as **Connecting** or **Timed Out** make sure that your antivirus and firewall configuration settings are correct. See [System Requirements](#).

Note: Telemetry Source Status of **Receive Pending** indicates that the telemetry stream is encrypted.

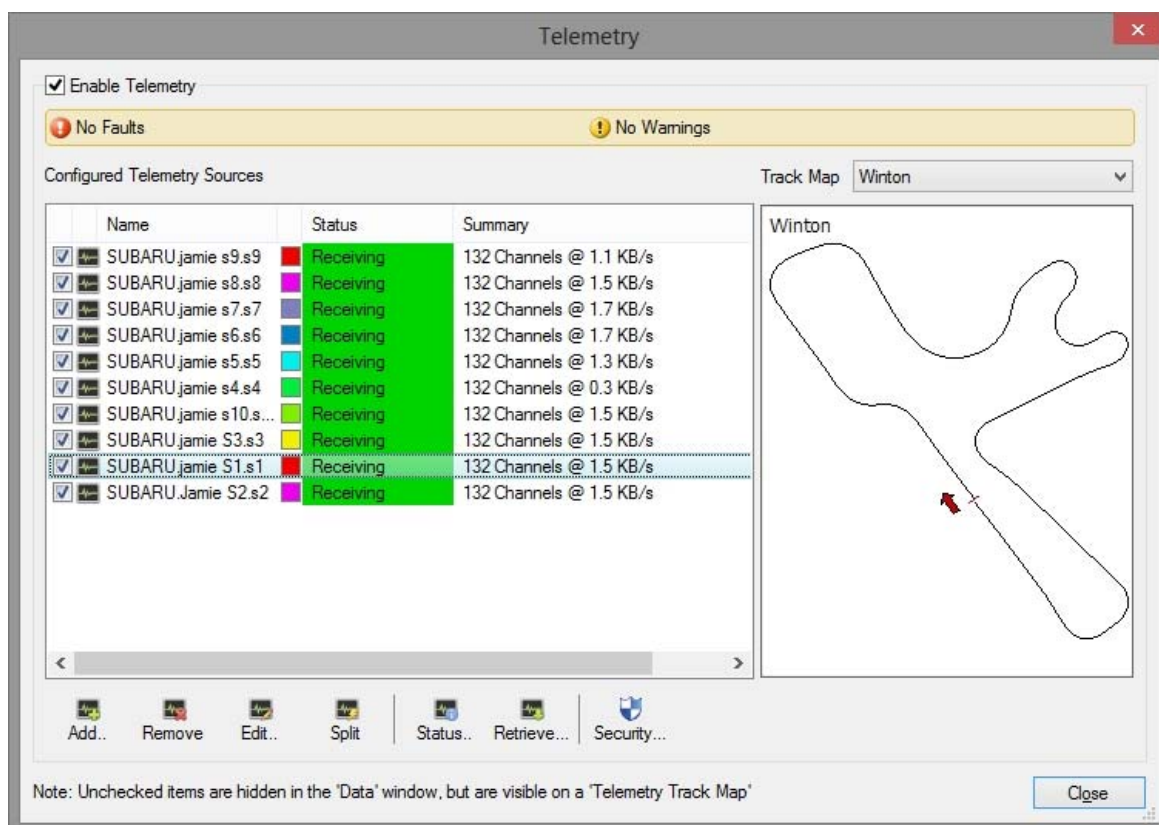
- To decrypt the telemetry stream, select the **Security** button.
- Select the relevant Security Item, select the **Edit** button and enter the password. This same screen is used to create Security Items, for example if the Item required does not exist in the list. See [Security](#).

Figure 16. Security Example



When i2 Pro Analysis receives a valid telemetry stream, the **Telemetry Source Status** indicator changes to **Running**.

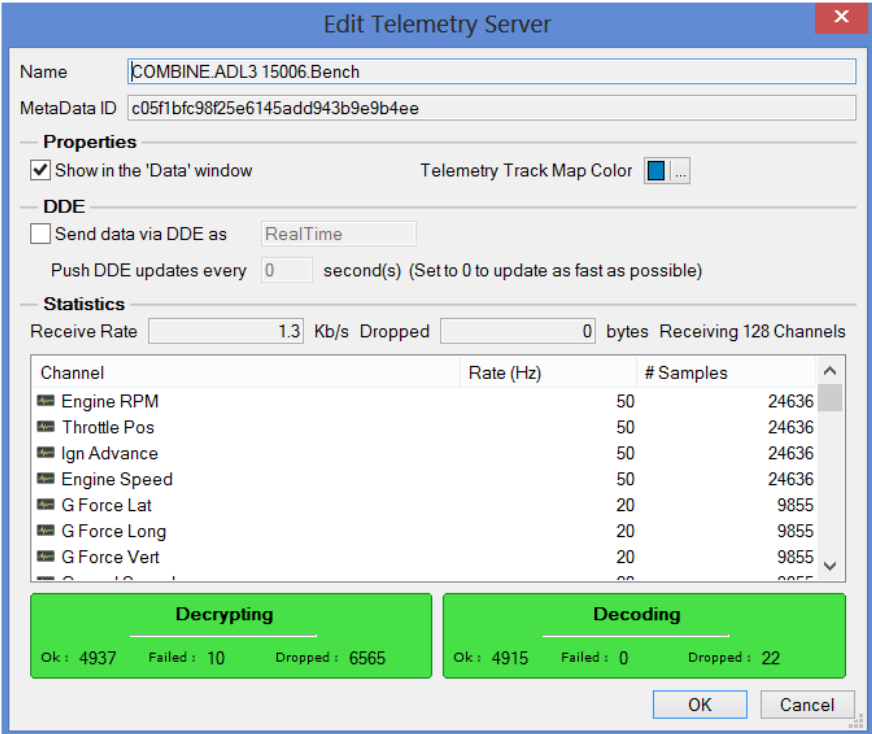
Figure 17. Example of a Telemetry Steam with a Running Status

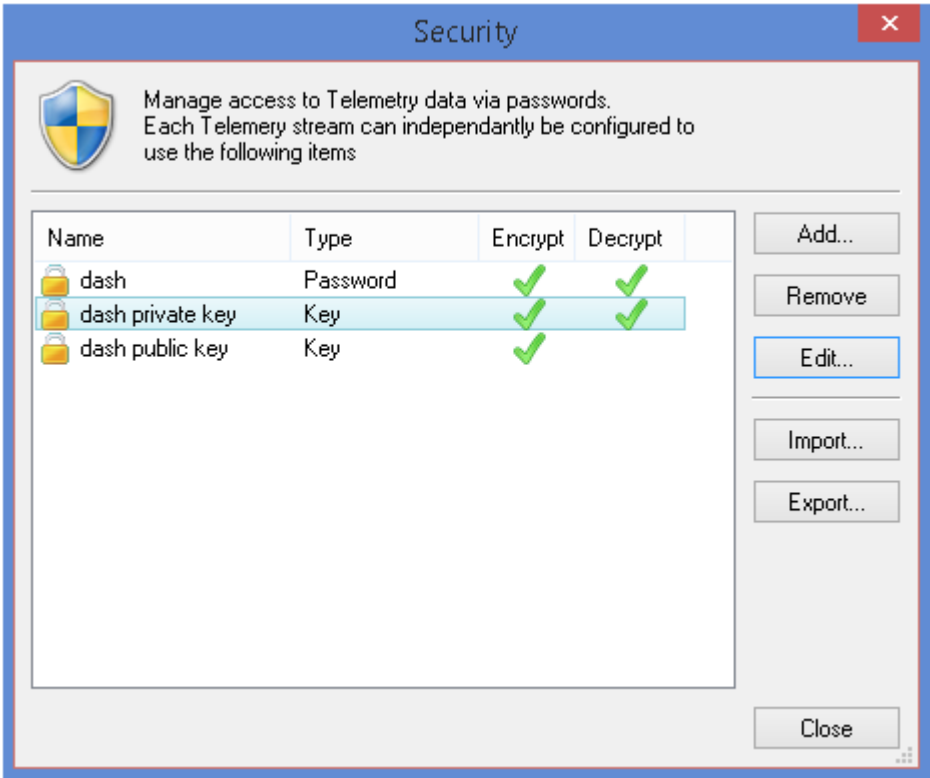


8. Use the **Track Map** drop-down list to select a track map associated with the telemetry source.

Track maps (*.mt2 files) must be located in the **Track Maps** folder of the i2 Pro Analysis workspace.

The **Remove**, **Edit**, and **Security** buttons on the Telemetry screen perform the following function.

Button	Function
Remove	Removes the selected Telemetry Source from the list.
Edit	<div>Opens the Edit Telemetry Server screen.<div><p>Figure 18. Example Edit Telemetry Server Screen</p></div></div> <p>The following function apply to these items on the Edit Telemetry Server screen:</p> <ul style="list-style-type: none">• Show in the 'Data' window checkbox De-selecting disables the Telemetry Source.• Telemetry Track Map Colour selector Sets the Telemetry Track Map Position colour.• DDE checkbox Selecting enables sending telemetry data over DDE.

Button	Function																
Security	<p>Allows a Security Item to be added, removed, imported from or exported to a file.</p> <p>A public key can only encrypt an output stream, A private key can both encrypt and decrypt. If the main server is setup to encrypt with a public key, then the private key (for decryption) will be required for the second T2 server or I2 setup.</p> <p>Figure 19. Example Security Screen</p>  <p>The screenshot shows a 'Security' dialog box with a blue title bar and a red close button. Inside, there's a shield icon and text: 'Manage access to Telemetry data via passwords. Each Telemetry stream can independantly be configured to use the following items'. Below this is a table with columns: Name, Type, Encrypt, and Decrypt. The table contains three rows: 'dash' (Password), 'dash private key' (Key), and 'dash public key' (Key). The 'dash private key' row is highlighted. To the right of the table are buttons: 'Add...', 'Remove', 'Edit...' (highlighted), 'Import...', 'Export...', and 'Close' at the bottom right.</p> <table><tr><th>Name</th><th>Type</th><th>Encrypt</th><th>Decrypt</th></tr><tr><td> dash</td><td>Password</td><td>✓</td><td>✓</td></tr><tr><td> dash private key</td><td>Key</td><td>✓</td><td>✓</td></tr><tr><td> dash public key</td><td>Key</td><td>✓</td><td></td></tr></table>	Name	Type	Encrypt	Decrypt	dash	Password	✓	✓	dash private key	Key	✓	✓	dash public key	Key	✓	
Name	Type	Encrypt	Decrypt														
dash	Password	✓	✓														
dash private key	Key	✓	✓														
dash public key	Key	✓															

i2 Telemetry Functions

Add menu

Allows addition of the following items:

Add > Telemetry > Track Position

Add > Telemetry > GPS Track

Add > Telemetry > Web View

If the computer has an internet connection, the **Web View** element allows the display of web page content.

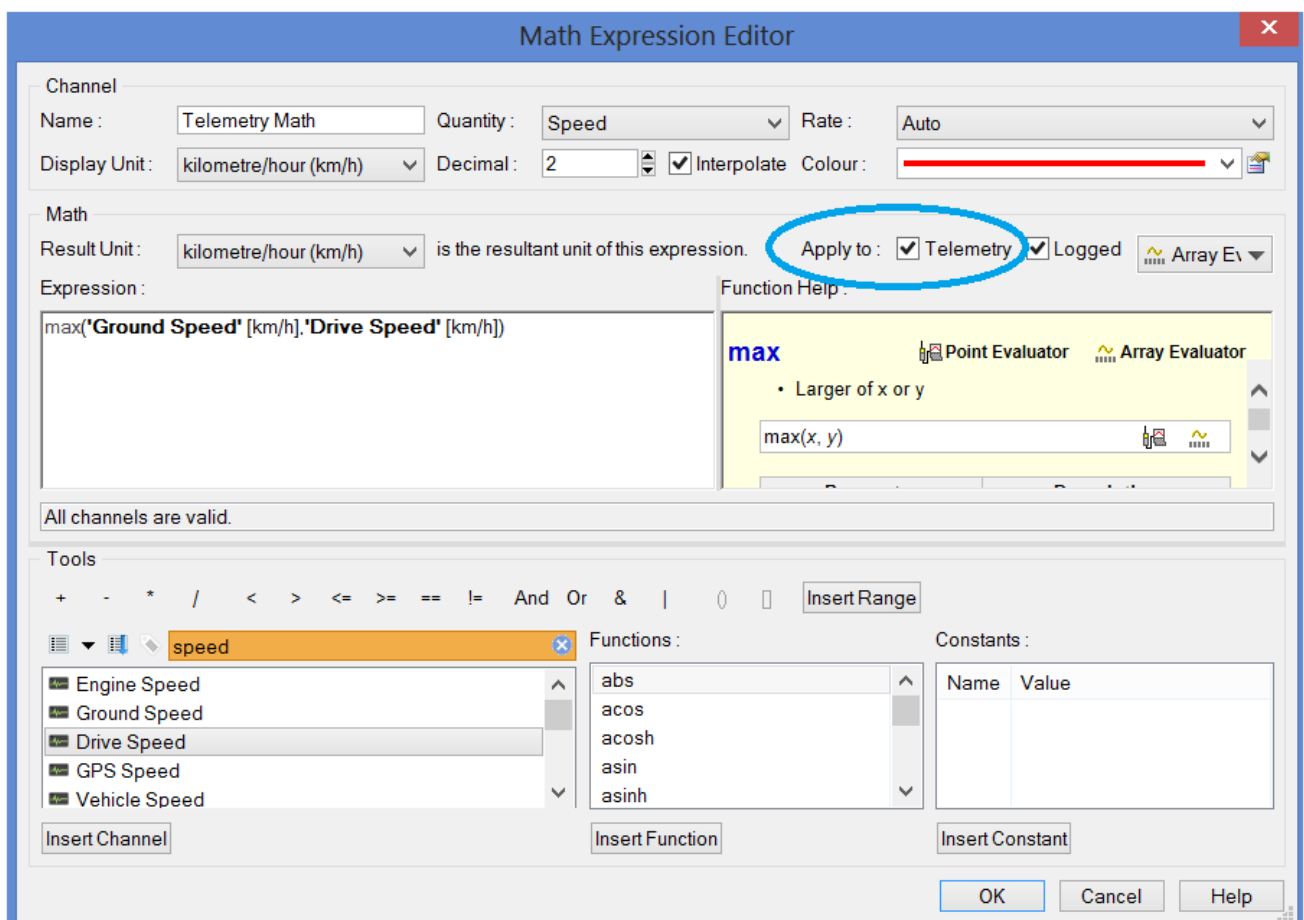
Options menu

Tools > Options – telemetry options can be set in the **Telemetry** tab.

Math Channels

In telemetry mode, Math Channels can calculate their values live. To do this, in the Math Expressions Editor, select the **Apply to: Telemetry** checkbox.

Figure 20. Example Maths Expression Editor



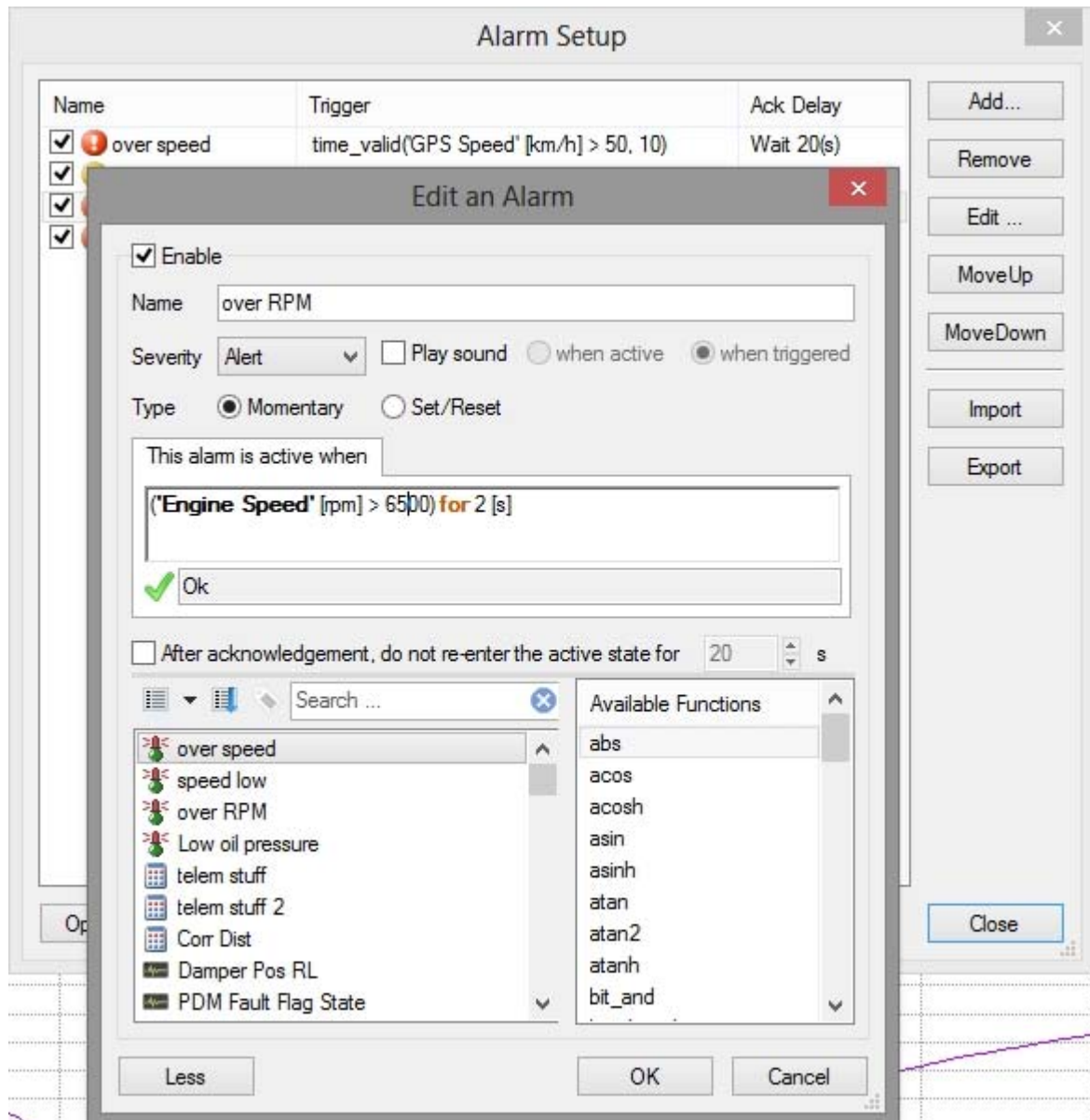
Alarms

Create alarms using the **Tools > Alarms** menu.

In the example below, the following alarm is created.

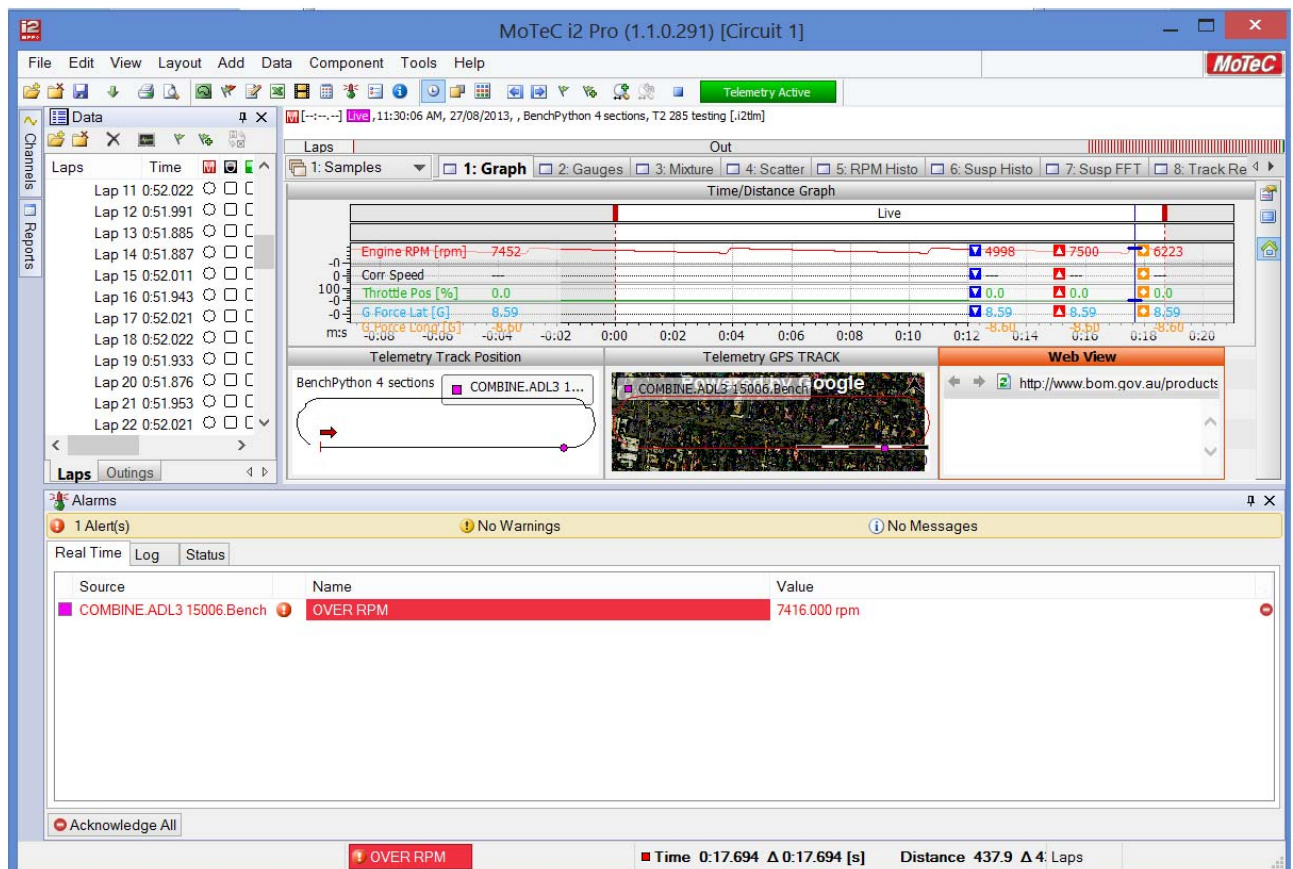
Timed alarms: ('Engine RPM' > 6500) for 2[s]

Figure 21. Example of Alarm Creation



When an alarm is active, the alarm name will flash at the bottom of i2 Pro Analysis screen. Click on the indicator or press **[F3]** to open the Alarms popup window; from where they can be viewed and acknowledged.

Figure 22. Example Alarm



Supplementary Information

Metadata File

When a Data Logger configuration file that includes T2 Telemetry setup is sent to the Data Logger, a Metadata file is created. This file is essential for T2 to operate.

Note: When Dash Manager and T2 Server are running on the same PC, and using the default location for the Metadata file, no intervention is required and access to the file is automatic.

MetaData Location

Dash Manager

By default, the Metadata file is saved in the **C:\ProgramData\MoTeC\T2\MetaData** folder of the Dash Manager PC.

To specify a different location: in Dash Manager **Tools > Options** menu **Telemetry** tab, specify the required location.

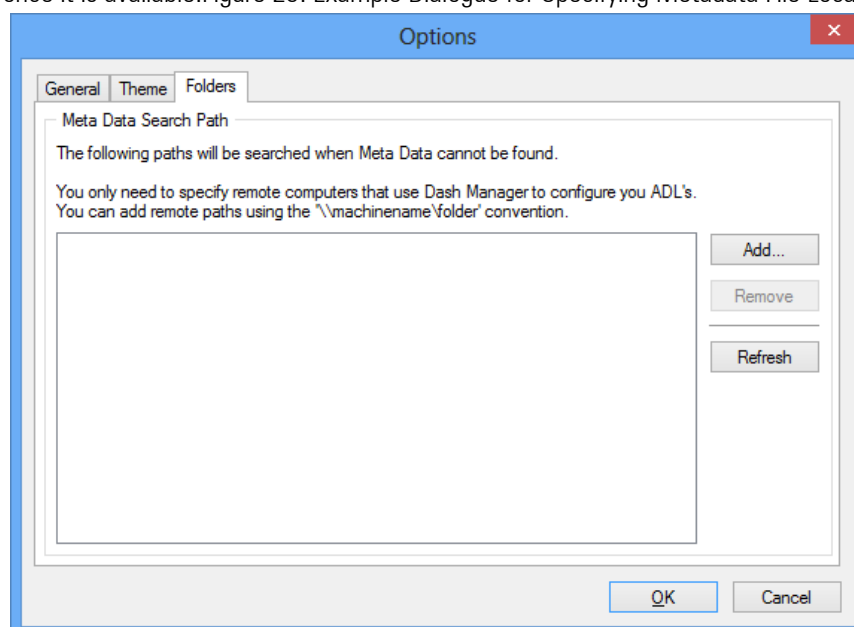
T2 Server

To receive and transmit telemetry data, the T2 server requires the Metadata file to be located in the **C:\ProgramData\MoTeC\T2\MetaData** folder on the PC that runs T2 Server.

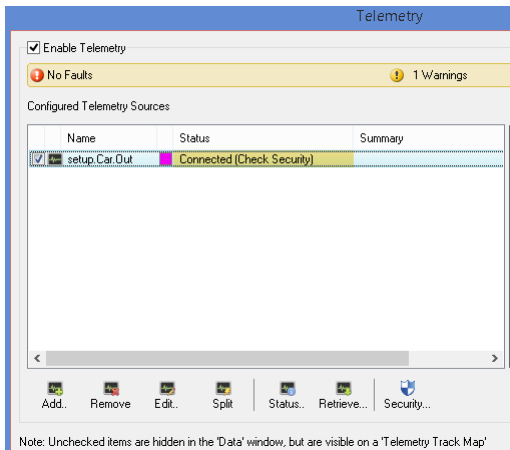
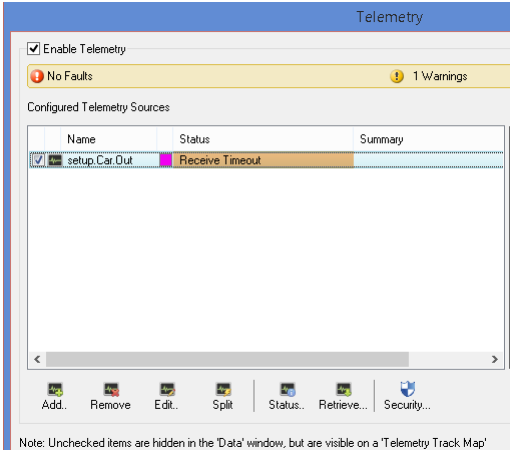
T2 Server can be set up to automatically pull and copy the file to this location as follows:

1. In T2 Server, go to the **Tools > Options** menu **Folders** tab and specify the remote location for T2 Server to search.
2. Select the **Add** button to specify other locations.

As each Metadata file has a unique identifier, T2 server monitors all specified locations and pulls the Metadata file once it is available. Figure 23. Example Dialogue for Specifying Metadata File Locations



Frequently Asked Questions

Question	Remedy
The input Stream is green and I have data coming in, but the Output stream is Red?	<p>On the configured output, check the network output is selected and available. The Network Adaptor will only be available for selection when it has an active link.</p> <p>If running security, click on Security and check the password is correct.</p>
T2 asks for a password when I open the application?	<p>If the saved configuration has any security setup, it will ask for a master password upon closing for the first time and opening, This password encrypts the configuration so that the Security tab cannot be accessed by anyone without the master password. This eliminates the user setting the passwords or loading keys each time the configuration is loaded.</p>
T2 Server has green input/outputs, but I can't connect i2 on another machine located on the same network?	<p>If the PC is connected to the network via a router, check that the router is configured to allow multicasting to be passed through.</p>
i2 can see a Telemetry Source from the T2 Server but the data won't scroll in?	<p>Once a telemetry source is added, check what is being shown in the status column. See examples below.</p>  <p>In this example it won't connect due to the stream being encrypted. If this occurs, click on the security tab at the bottom to rectify.</p>  <p>In this example, check the T2 server still has a valid input, check antivirus and firewall settings are correct.</p>

Question	Remedy						
	<div><div><div><div>Telemetry</div><div><div><input checked="" type="checkbox"/> Enable Telemetry</div><div><div>No Faults</div><div>1 Warnings</div></div></div><div>Configured Telemetry Sources</div><table><tr><th>Name</th><th>Status</th><th>Summary</th></tr><tr><td><input checked="" type="checkbox"/> THINKPAD4.Car...</td><td>Connecting</td><td></td></tr></table><div><div><</div><div>></div></div><div><div>Add..</div><div>Remove</div><div>Edit..</div><div>Split</div><div>Status..</div><div>Retrieve...</div><div>Security...</div></div><div>Note: Unchecked items are hidden in the 'Data' window, but are visible on a 'Telemetry Track Map'</div></div></div></div> <div>If i2 status stays at connecting, check antivirus and firewall settings.</div>	Name	Status	Summary	<input checked="" type="checkbox"/> THINKPAD4.Car...	Connecting	
Name	Status	Summary					
<input checked="" type="checkbox"/> THINKPAD4.Car...	Connecting						