

ICM+ Standard of Procedures



Moberg CNS monitors

23 April 2018

<http://icmplus.neurosurg.cam.ac.uk>

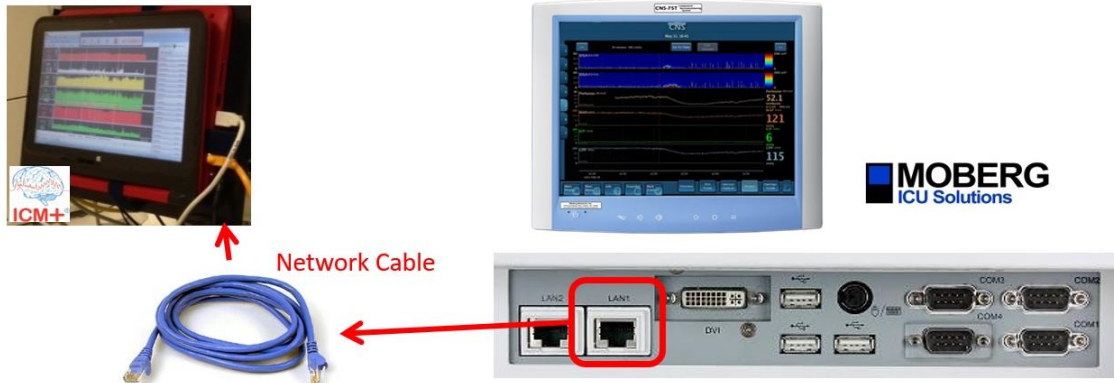
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Table of Contents

Prerequisites.....	3
Locking and unlocking ICM+	4
Starting a new data collection session	5
Manually configuring data collection	8
Annotating clinical events	13
Terminating the data collection session and uploading the data	14
Restoring a closed data collection session.....	16
Exporting data to a csv (Excel) format	17
Appendix 1: Configuring ICM+ system options.....	19
Appendix 2: ICM+ configuration folders and files	24
Appendix 3: Editing ICM+ Projects.....	25
Appendix 4: Registering ICM+	28
Appendix 5: Preconfigured users and passwords	31
Appendix 6: Configuring Moberg network	32
Appendix 7: Configuring the computer's network interface.....	35

Prerequisites

1. **A laptop (or a PC) with the latest ICM+ and its Moberg CNS Monitor module installed**
2. **Moberg CNS-Monitor.**



3. **Network connectivity** – ICM+ can be installed on a separate laptop computer or on the PC integrated into the new CNS monitor models. In either case the computer's and the monitor's network connection have to be configured so that they are both on the same network. Ethernet network cable needs to connect the ICM+ computer with the CNS Monitor either to LAN1 port, or via the existing network infrastructure (e.g. network hub or router) when that is already in place (the connection is then to the hub/router or a designated network port).

Please make sure both the laptop and the CNSMonitor network interfaces are correctly configured (ie both are on the same IP subnet). Details of CNSMonitor network configuration can be found in Appendix 6, while step by step instruction for setting up the network interface on the ICM+, Windows, laptop can be found in Appendix 7.

4. If there is a wireless network available both, the monitor and the laptop/PC can be hooked up to it, but the laptop should, if possible, be allocated a static IP address (or at least reserved one on the router, so it does not change on reboot). Alternatively the two can be connected with a network cable (the port marked in red in the figures below) and then both the monitor and the laptop need to be configured with a static IP addresses, for example 192.169.1.1 (for the monitor) and 192.168.1.2 (for the laptop). In N17 series the integrated computer network is shown on the right, marked blue
5. Optional file server, for archiving the data.

Locking and unlocking ICM+

ICM+ includes a simple system of user based permissions, which allows it to be used safely in a clinical environment, also by people with minimal training, ensuring that the vital data collection process is not inadvertently interrupted or disturbed.

If your ICM+ is correctly configured when the program is run it will automatically initialize with the default user 'Nurse'. There are three other users already configured in ICM+, the Administrator, the Manager and the Operator. The users have been configured with progressively decreasing operational rights.

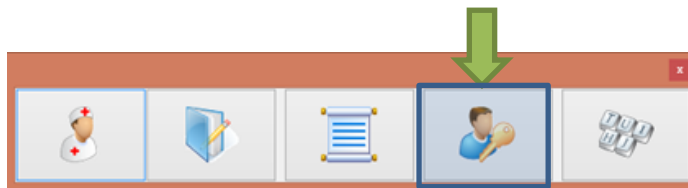
The **Nurse** is the user with the fewest rights in the software, effectively only being able to insert clinical events, browse the charts and starting new sessions, without any possibility to disrupt the data collection procedure. Please refer to the 'How to use the events form' for more details. After 3 minutes of inactivity, ICM+ automatically logs in as a Nurse.

The **Administrator** is the user that will have full access to the full features of the application.

The **Manager** will have the same privileges but will not be able to manage user accounts.

The **Operator** will only be capable of starting new Recording sessions with available profiles, browsing data, inserting clinical information and display configuration.


Login (change users) form is accessible via a button on the tool bar/main menu bar.




When the Login button is pressed, the User login form will appear.

User login form

Current user: **Administrator**
 Default user: **Nurse**


 Default 1


 Lock

Other user

Name 1 Administrator

Password

1	2	3
4	2	6
7	8	9
	0	Back

✔ OK
✘ Cancel

In this form you will find:

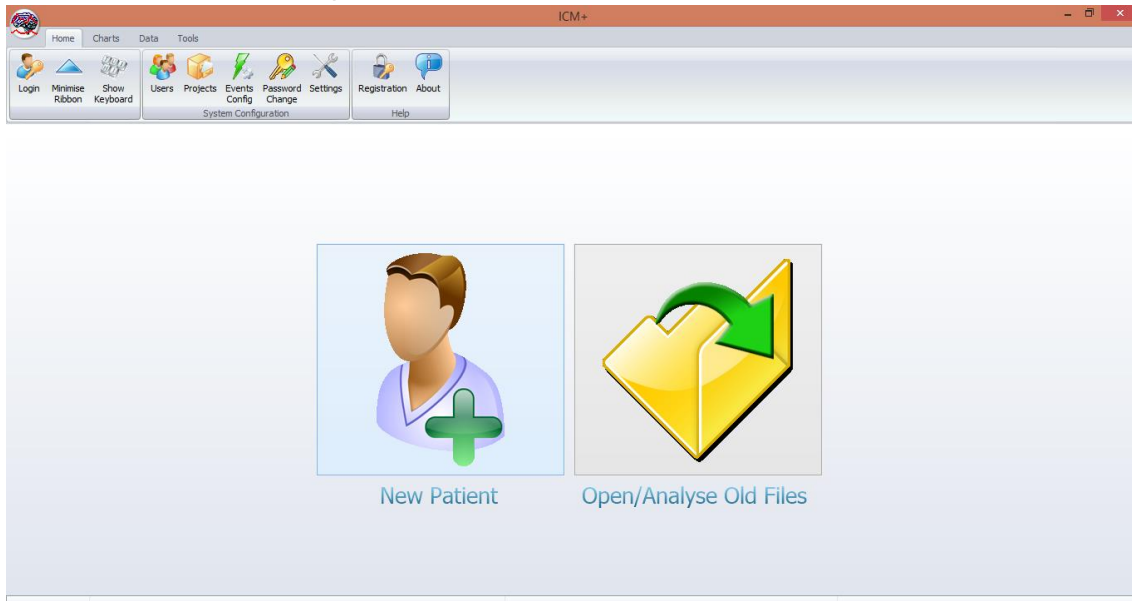
1. A button to the Default user and a button to lock the application so that nothing but the login button is accessible.

2. A key pad to insert the Password for a given use.

3. And a Drop-Down menu to select the user to Login as

Starting a new data collection session

To create a new data acquisition session hit New Patient button.



This will bring up the New Data Acquisition form:

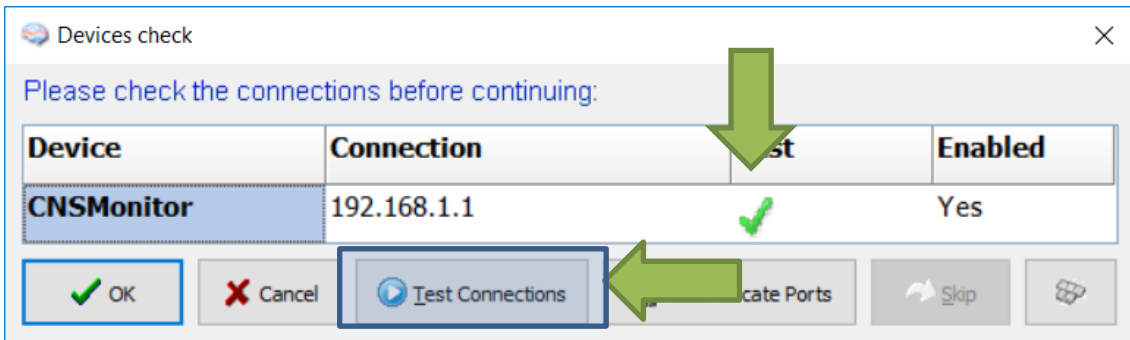
 The screenshot shows the 'New Data Acquisition Session Form' dialog box. It has a title bar with 'New Data Acquisition Session Form' and a close button. The form is divided into several sections:

- Project:** A dropdown menu set to 'Traumatic Brain Injury' and a 'New Project' button.
- Data File:** A text field containing the path 'C:\Users\lps100\Documents\ICM+Data\TBI_20180519141205_NEWTON.icmp' and a file selection icon.
- Patient's information:** A section with input fields for 'First Name', 'Middle Initial', 'Surname', 'Hospital ID', 'Room/Bed No', and 'Anonymised ID'. It also includes date and time pickers for 'Date Of Birth', 'Date Of Ictus', and 'Date Of Admission', and radio buttons for 'Gender' (Male/Female).
- Clinical background:** A large text area for notes.
- Demographics:** A 'Retrieve Demographics From ...' button and a dropdown menu set to 'CNSMonitor'.
- Data Acquisition/Analysis Configuration Profile:** A dropdown menu set to 'C:\Profile - Moberg TBI.icmc' and a file selection icon.
- Customise the profile:** A row of buttons: 'Clear All', 'Signals Sources', 'On Line Analysis', and 'Clear History'.
- Buttons:** 'OK', 'Cancel', and 'On Screen Keyboard' buttons at the bottom.

 Two green arrows point to the 'Project' dropdown and the 'Data Acquisition/Analysis Configuration Profile' dropdown.

Here the relevant project, if any configured, should be selected. More importantly the right data acquisition/analysis profile (configuration) file should be chosen, either from the history list box or loaded from the file system, that includes required modalities to acquire. These can then be modified if necessary using Signal Sources editor (describe below), and/or On Line Analysis editor.

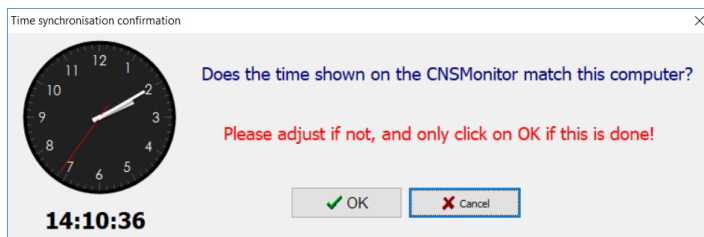
After the OK button is clicked, the Devices check dialogue is presented.



This dialogue is used to test the communication between the ICM+ and the monitor (the 'Test connections' button). If the test is successful the OK button can be pressed.

This form can also be used to modify the connection port (if it is a serial connection) or an IP address (in case of a network interface). For serial connections, the button 'Auto allocate ports' can be used to initiate the process of scanning and testing all the available ports for automatic port allocation.

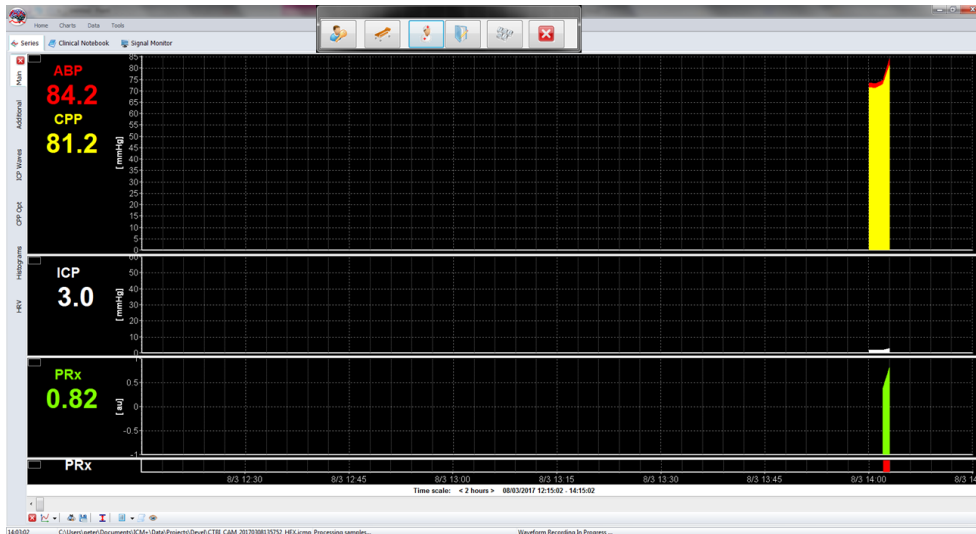
In the next step the user is asked to compare the clocks on the CNS monitor and the ICM+ computer, to ensure better time synchronisation.



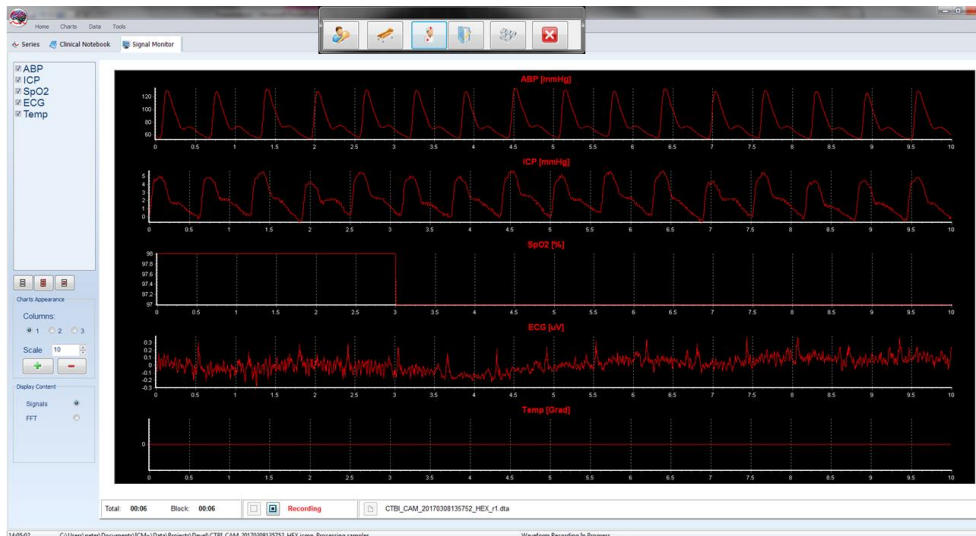
Just before the session starts, the user is prompted to insert some additional information about the patient, if configured, via the Project Specific data dialogue. This form is also accessible from the Patient Notebook tab but it is highly recommended that it is filled in, as much as possible and practical to do, at the start of the session.

After this dialogue, ICM+ main display is presented and the session begins recording automatically, if this behaviour is configured in the used project. Otherwise use Start button to start data acquisition (see below). The charts with configured calculated parameters will get updated with the rate specified in the configuration profile. In order

to see the raw data as it comes in from the monitor(s) click on the Signal Monitor tab, or the Monitor button in the tab is not available yet (see below).

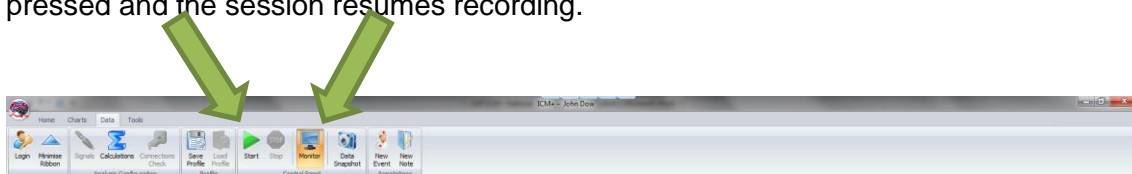


Data analysis, main, display (as configured in the loaded profile). The charts can be modified using Charts top menu tools.



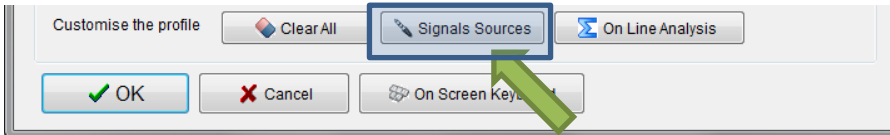
The raw signal monitor, showing all the data as it comes in. Please note that the raw data is stored in a separate file (or files if the one grows too large) with the name shown at the bottom of the monitor signals panel (file extension *.dta).

If ICM+ **shuts down during a recording session** the next time it is run, the previous session is automatically restored, but here the user must first verify that all the signals are being received correctly in the Monitor button. After this the Start button must be pressed and the session resumes recording.

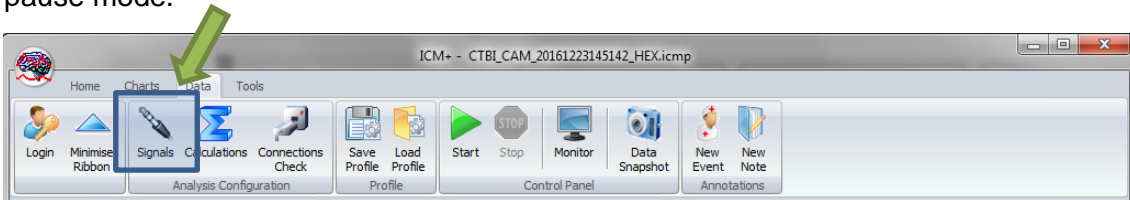


Manually configuring data collection

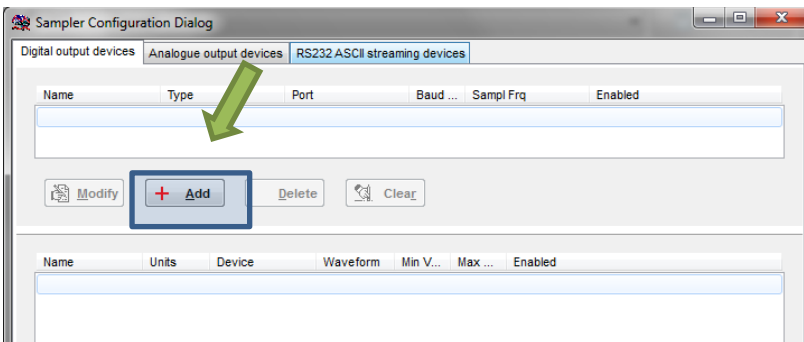
If there is no prepared profile available that includes desired data collection from the monitor or if there is a need to modify or add parameters downloaded from the monitor Signal Sources option needs to be used. This can be done in the New Data Acquisition Form:



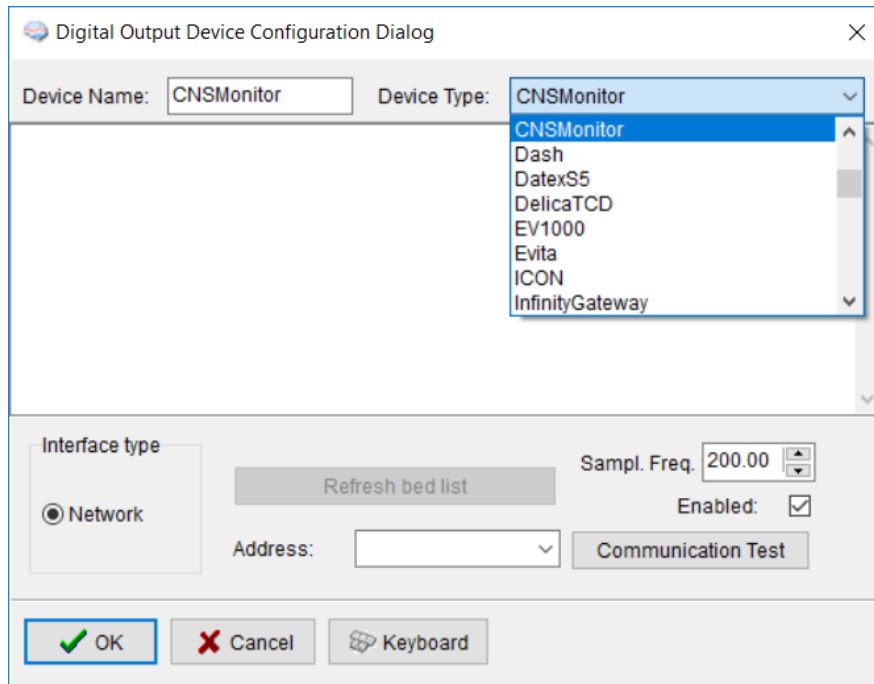
Or using Signals button in the main Menu (Data Section), with the data acquisition in pause mode.



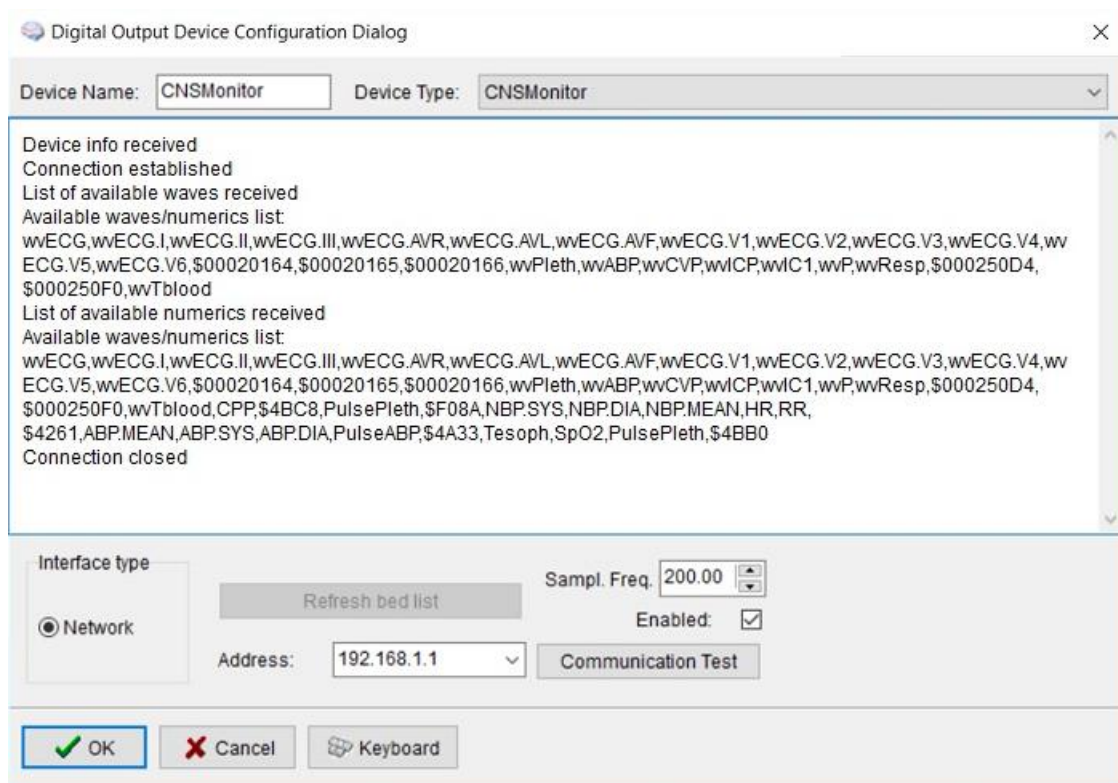
This brings up the Sampler Configuration form:



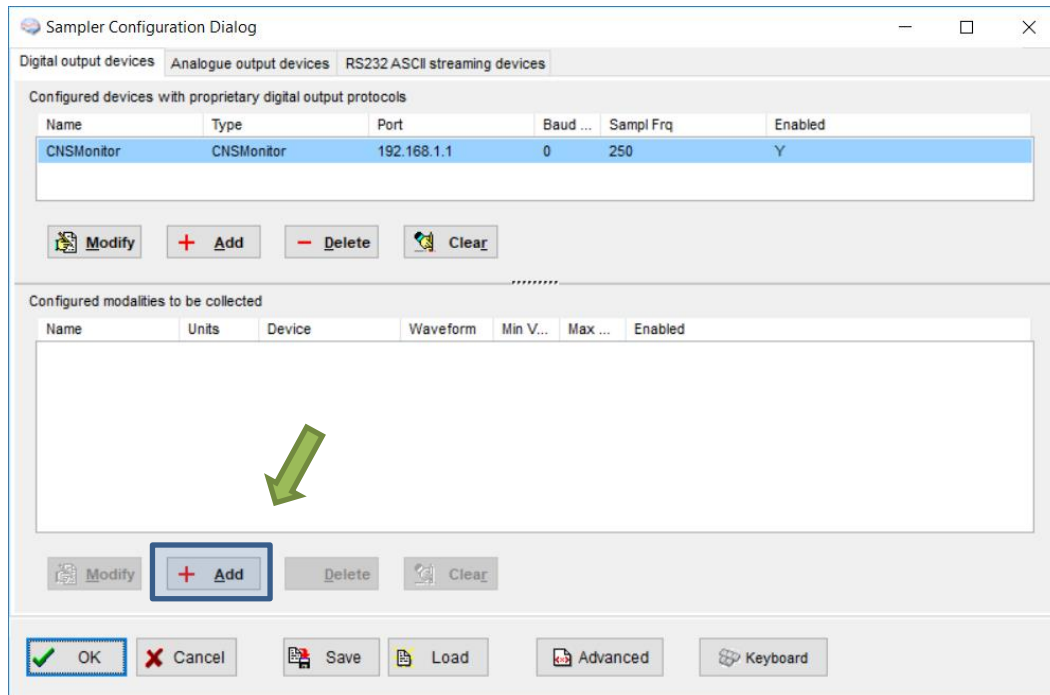
Clicking on Add button in the upper part (Digital Output devices tab) opens a Device Configuration dialog. Here, one can select the monitor module from the list of available (installed) interfaces, as well as specify the serial port (real or virtual, when using USB-RS232 adapter) and its baud rate to match the one configured/offered by the device.



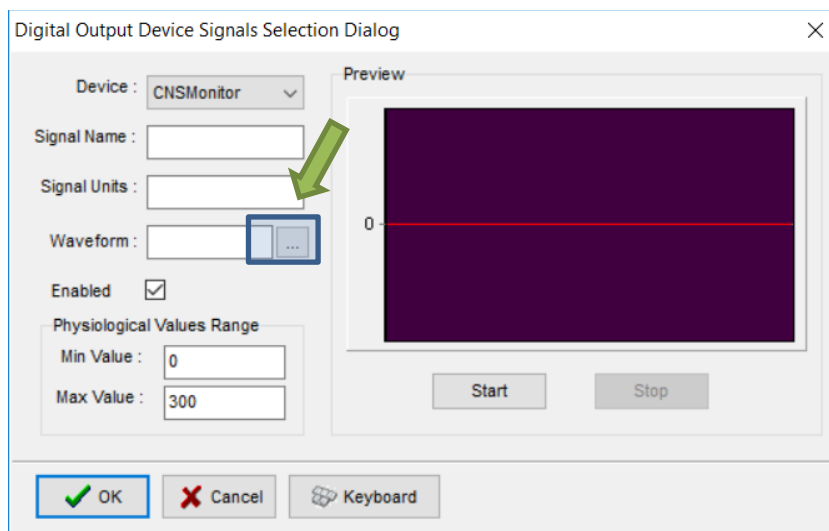
When the correct interface module is chosen (CNSMonitor), clicking on 'Communication Test' will try to establish communication with the monitor and the log of that communication is printed in the memo box, listing also all the parameters that are available to download from the monitor. Please note that it may take a few seconds to receive all the info from the monitor.



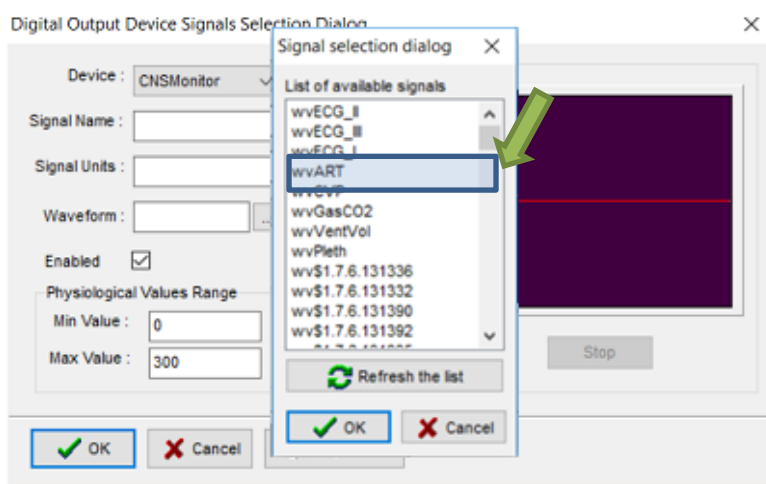
When the connectivity is confirmed the dialog can now be closed, which causes the device to be added to the data collection configuration. What remains to complete the configuration is adding to the configuration all the desired parameters to be downloaded. This can be achieved by using the Add button in the lower part of the Sampler Configuration dialog.



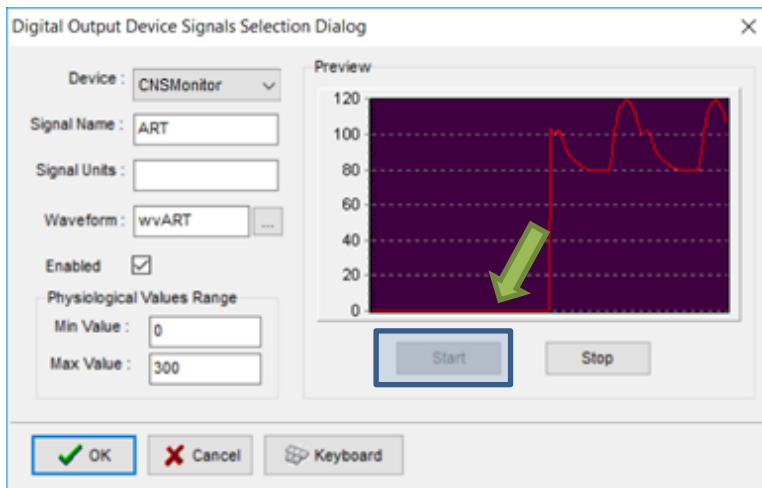
This opens a signal selection dialog:



Using the little '...' button one can select available signal, one at a time.

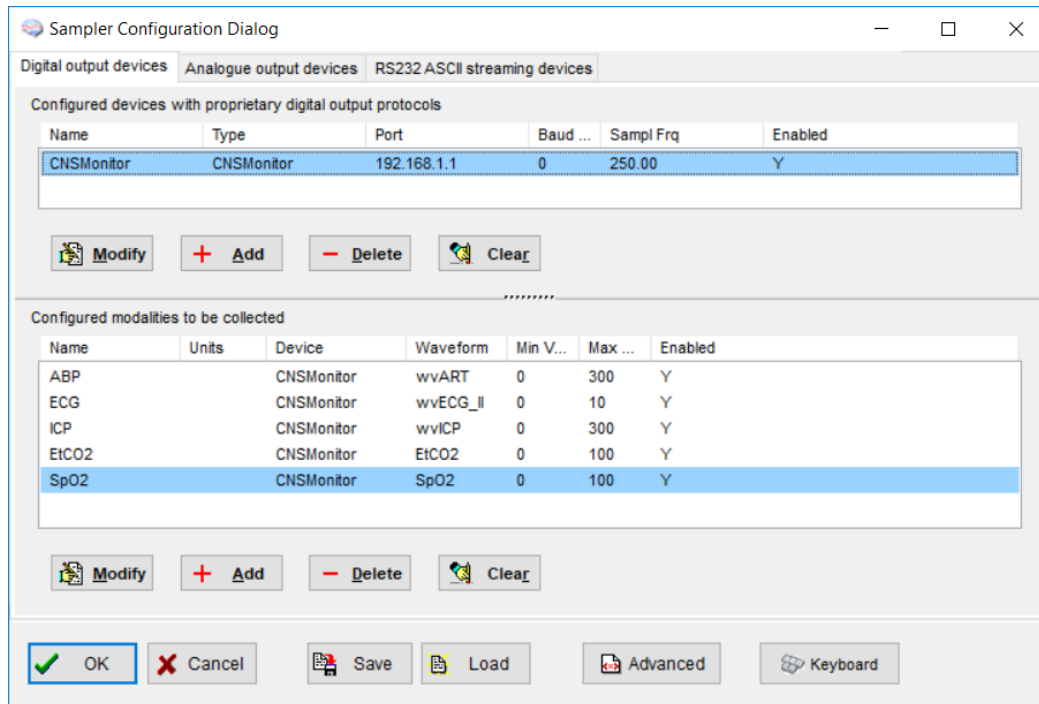


When a parameter is selected one can test if the data is coming in as expected by using the Start button.

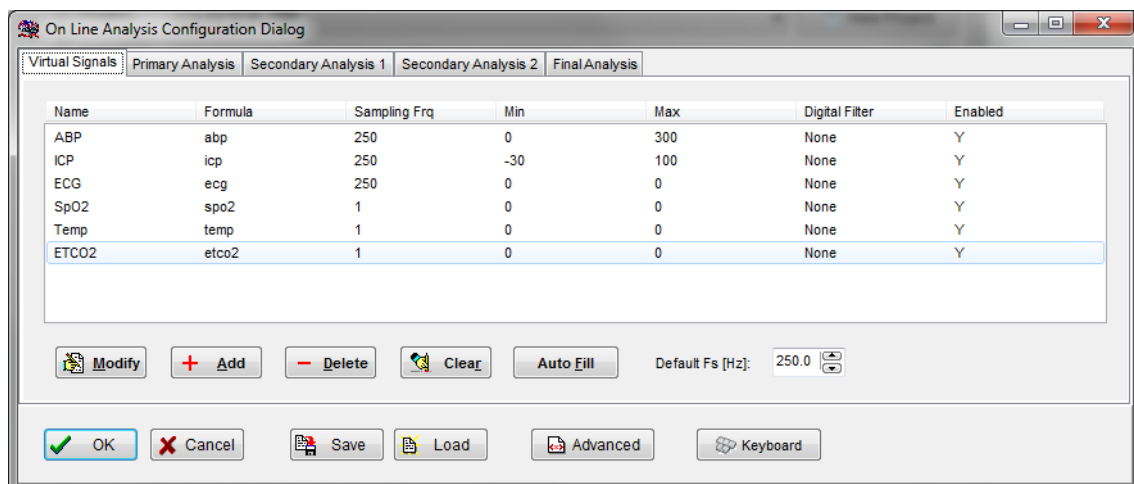


Please note that it will take up to few seconds for the data to start coming through.

This process can be repeated as many times as it is needed putting together the complete list of parameters to be collected, which complete the data acquisition configuration procedure.



Please note, that adding parameters/signals to the data collection will make ICM+ show and record the data through the Signal Monitor window but the trends charts will not automatically get configured to show them. This is because the trend charts only show results of calculations, not the raw data. So to display even just a mean trend of a newly added variable collected from the monitor ICM+ this needs to be configured first in the analysis section, as in picture below, and then the new trend added to the charts.



Annotating clinical events

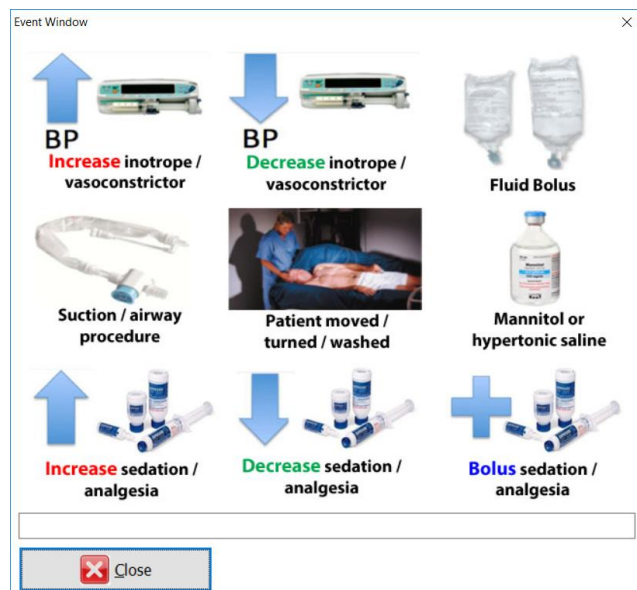
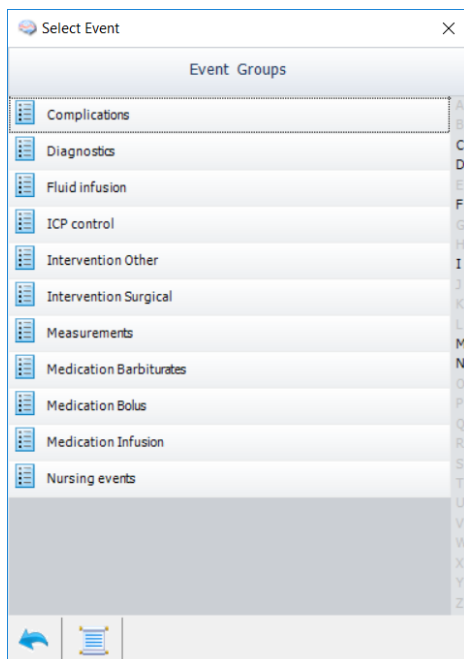
As soon as the acquisition of data starts the main menu tool bar will get minimised and in its place a small, 'data acquisition essentials', tool bar will open, as below.



There, from left to right the following functions are accessible:

1. Log-in/Log-off form – to change the user (ie privileges)
2. Event annotation form
3. Free textual annotations form
4. An on-screen keyboard
5. The last button closes this tool bar and unfolds the main men toolbars

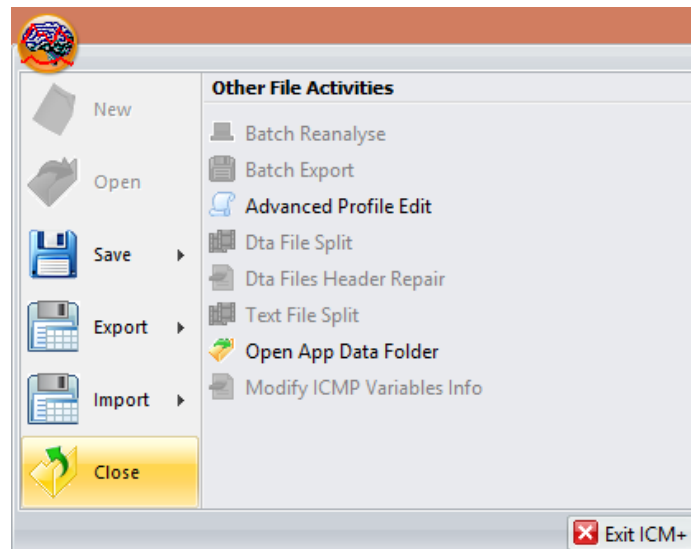
When Event button is clicked and there are events configured for the project that the data acquisition is running under an event selection form will be shown. This could be a universal event selection form (below left) , or a custom made one (blow right). Which form to use and which events to show is configured in the project configuration dialog.



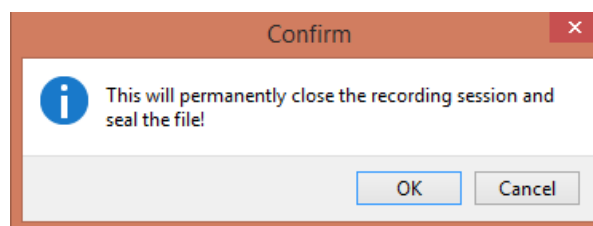
Terminating the data collection session and uploading the data

When the data acquisition process is finished the recording session can be closed using the Close button present in the Application Menu accessible via the Brain button in the left top corner. This will initialize a cascade of forms that will eventually lead to the sealing of the file and subsequent archiving the data to the file server, if required.

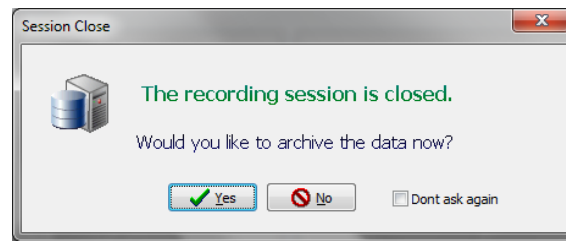
Closing a session is different from closing the program. To close the ICM+ application without closing the session you can press an 'x' button in the top right corner of the main window, or the 'Exit ICM+' button in the Application Menu. If ICM+ is closed (Exited) using this button or if the computer shuts down, the next time it is run, the recording session will be resumed with the same configurations it had at the moment of shutdown.



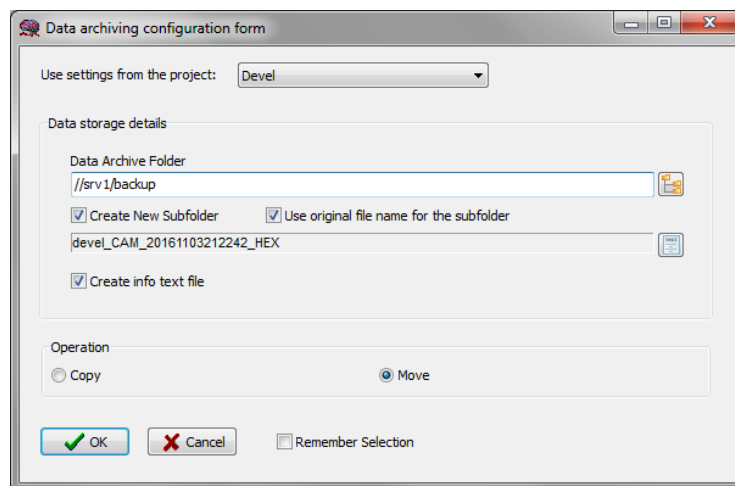
When this button is pressed a dialogue is presented prompting the user to confirm the closure of the recording session:



After confirming the end of the recording session another dialogue is presented prompting the user to archive the data:

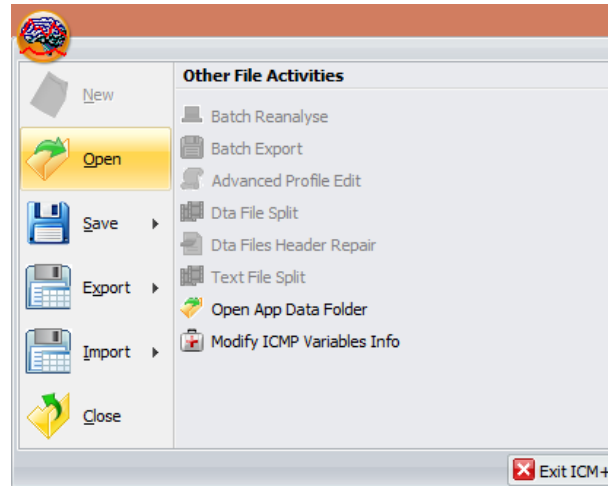


After confirming this dialogue the Data Archiving Form is presented, where the user can specify/confirm the location of the server and its share to use:

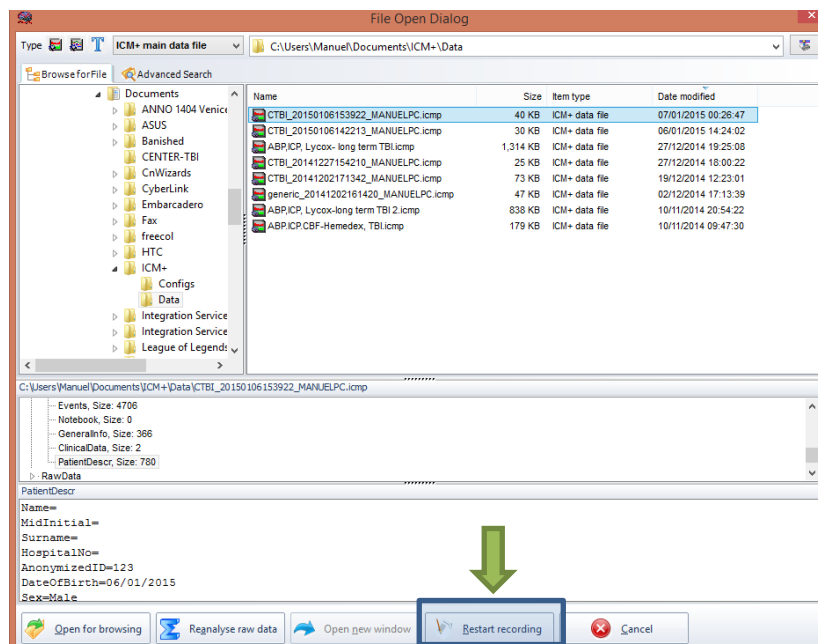


Restoring a closed data collection session

If a session was for some reason closed and a recording needs to be restored again the button open can be pressed.



The dialog that opens can be used to reopen the file in order to upload the data to our servers or to restore the recording session.

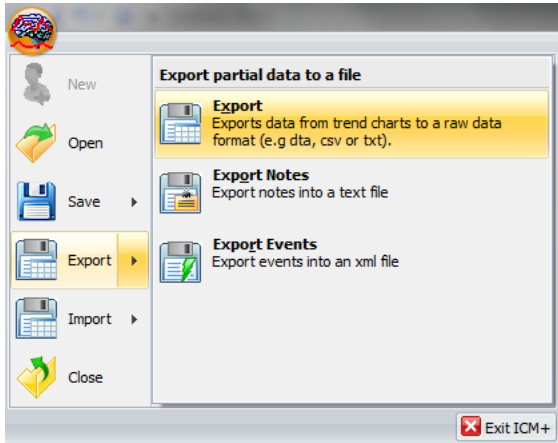


To reopen a file for inspection or to upload it is only necessary to double-click the desired file.

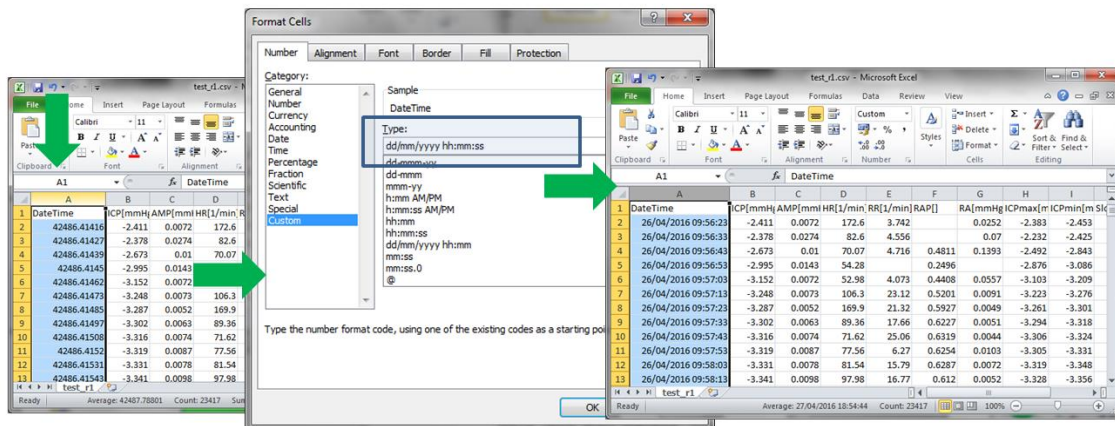
To restore the recording session, the highlighted button must be pressed and the recording resumes using the same profile as when it was closed.

Exporting data to a csv (Excel) format

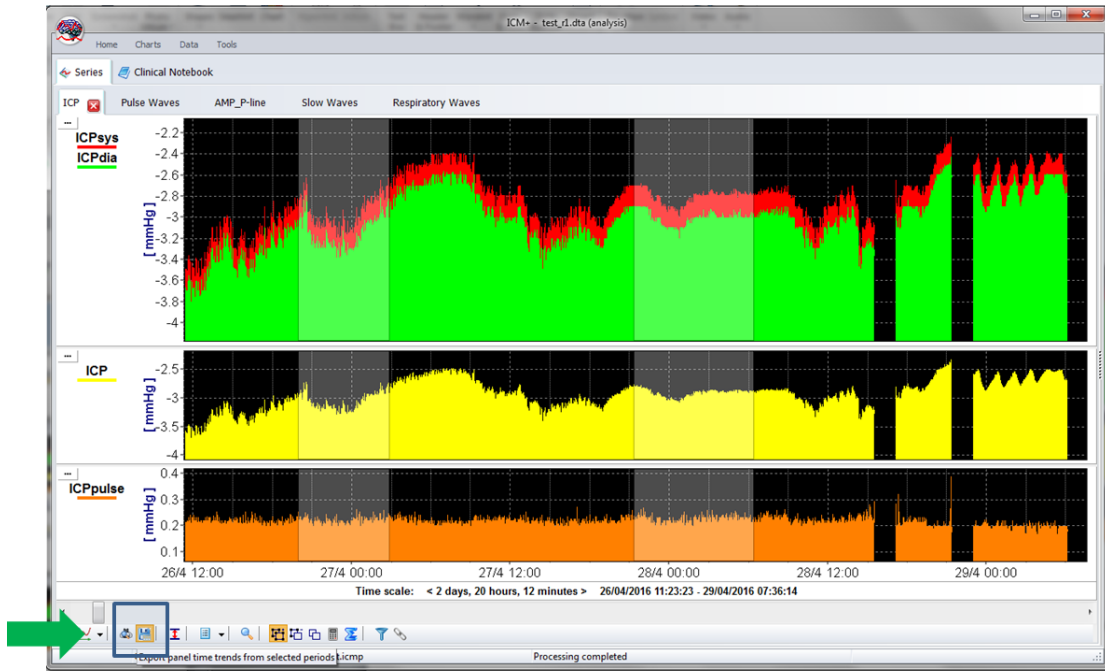
There are two ways the data can be exported from ICM+. One way is to select Export option in the main menu (the Brain icon).



This will export all the trend data from the memory, all the variables, in commas separated columns of values, with the first column containing the time stamps, in the internal Windows DateTime format. The DateTime format is essentially a number of days (and their fraction, which translate into time) since 31/12/1899. Imported into Excel it will initially showed up as those numbers, but if date or time (or combined) cell formatting is requested for that column the data and or time will be shown.



The second way of exporting data is to use the data export chart tool, located at the bottom of each charting vertical panel:



This will export data only from the variables plotted in the panel corresponding to the button toolbar, in this case it will be ICPsys, ICPdia, ICP and ICPpulse only, and only from selected time periods, if the selection tool is used, or the whole recording time, if not.

The screenshot shows a Microsoft Excel spreadsheet with the following data:

	A	B	C	D	E	F	G	H
1	DateTime	ICPsys[mmHg]	ICPdia[mmHg]	ICP[mmHg]	ICPpulse[mmHg]			
2	42668.57096	216.4	-3.937	0.744	220.4			
3	42668.57108	-2.629	-2.899	-2.743	0.2701			
4	42668.57119	-2.481	-2.647	-2.554	0.1663			
5	42668.57131	-2.406	-2.594	-2.511	0.1877			
6	42668.57142	-2.396	-2.594	-2.498	0.1984			
7	42668.57154	-2.396	-2.567	-2.484	0.1709			
8	42668.57166	-2.396	-2.539	-2.481	0.1434			
9	42668.57177	-2.396	-2.539	-2.476	0.1434			
10	42668.57189	-2.387	-2.539	-2.471	0.1526			
11	42668.572	-2.387	-2.521	-2.468	0.1343			
12	42668.57212	-2.341	-2.521	-2.462	0.1801			
13	42668.57223	-2.368	-2.53	-2.464	0.1617			
14	42668.57235	-2.359	-2.503	-2.459	0.1434			
15	42668.57247	-2.341	-2.521	-2.453	0.1801			
16	42668.57258	-2.313	-2.503	-2.431	0.1892			
17	42668.5727	-2.332	-2.512	-2.43	0.1801			
18	42668.57281	-2.313	-2.503	-2.426	0.1892			
19	42668.57293	-2.313	-2.503	-2.431	0.1892			
20	42668.57304	-2.332	-2.503	-2.433	0.1709			
21	42668.57316	-2.322	-2.503	-2.425	0.1801			

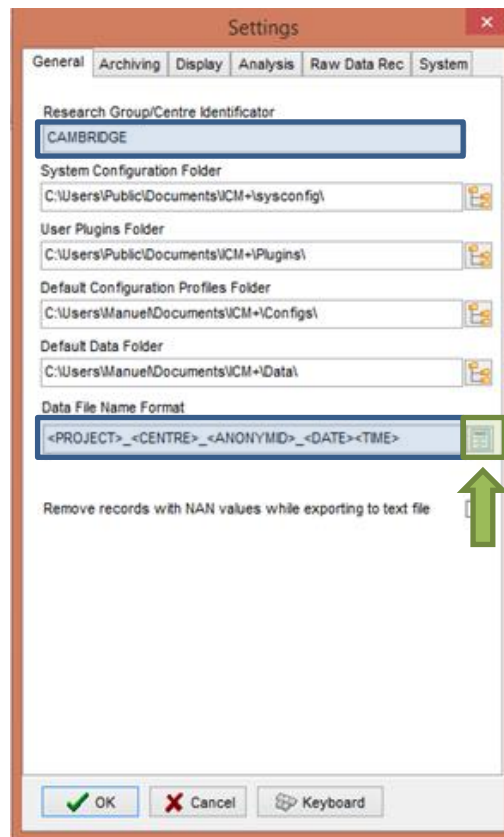
Appendix 1: Configuring ICM+ system options

Most of the programmable behaviours of the software can be adjusted via the Settings menu. This menu can be found by clicking the Home tab and the Settings button.



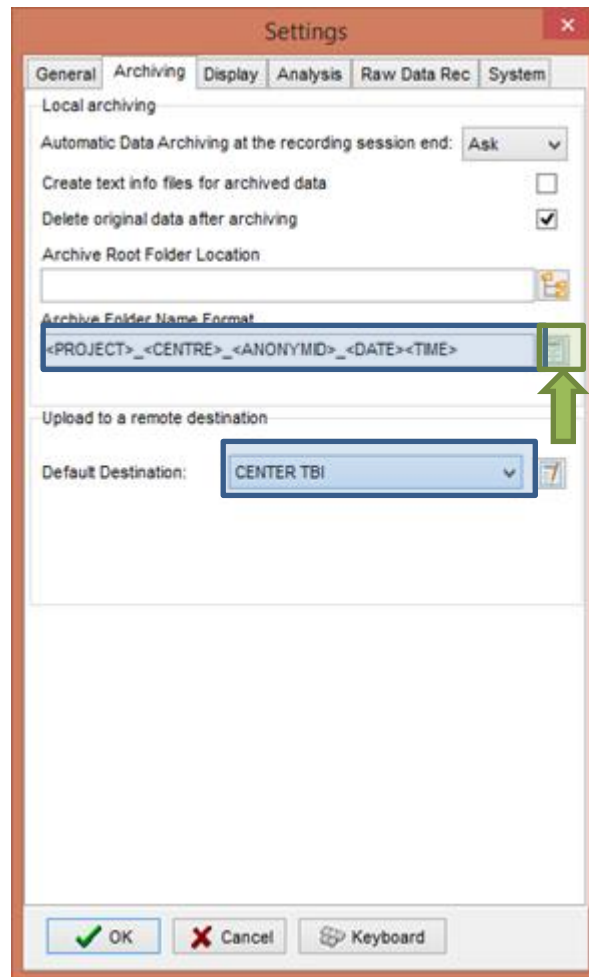
In the Settings menu you will need to configure several things:

- On the General tab:



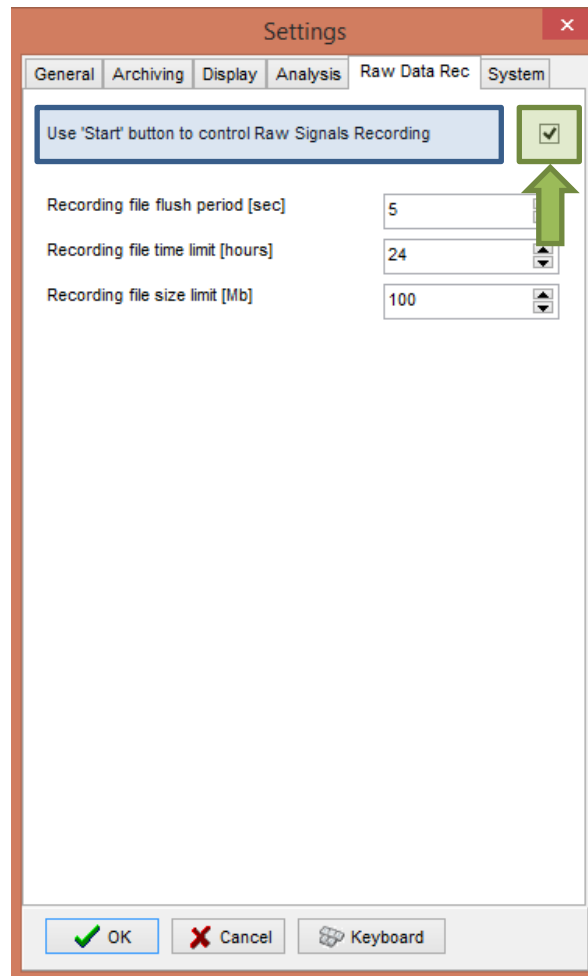
- The Research Group/Centre identification will be a unique name in the project that will identify the centre. This identifier is mainly used for multicentre collaborations, as it can be used to form part of the file name, and for SSH data transfers to the coordinating centre.
- The **Data File Name Format** will be used to configure the structure to be used on the construction of the name of each data file. As each file generated in the study must have a unique identifier we agreed in using a structure that uses the format highlighted in the picture. A description on how to build this File Name format is presented further down in this appendix.

- On the Archiving tab:



- The Archive Folder Name Format will follow the same structure as the Data File Name Format. This setting is used for organising local archival storage of the data files.
- The remote server Upload (accessible via the upload function) default Destination can be selected here but it is the matching setting in the Project configuration that will ultimately take precedence.

- On the Raw Data Rec tab:



- The Use 'Start' button to control Raw Signals Recording **must be checked if you are using ICM+ to record any data directly from bed side monitors**

However, when only CNS Monitor is used as the source of raw data duplication of recording of raw data by ICM+ may not be needed, as ICM+ can open data files directly from Moberg device, or from an archive. However, in this case, if any other time stamped information like Events are collected with ICM+, special care must be taken to make sure the clocks of ICM+ and CNS monitor agree (as explained above).

- On the System tab:

Settings

General Archiving Display Analysis Raw Data Rec System

Auto restore session in progress on startup Enable

Auto restart recording at program startup Enable

Inactivity time to software auto logout [min] 0

Auto unlock program as user : Nurse

Operating System Policy

Use this program instead of Windows shell Disable

Disable logoff/shutdown Disable

Disable Task Manager Disable

Disable locking the computer Disable

Disable Windows password change Disable

Windows Auto Login

State Disable Password

User Confirm

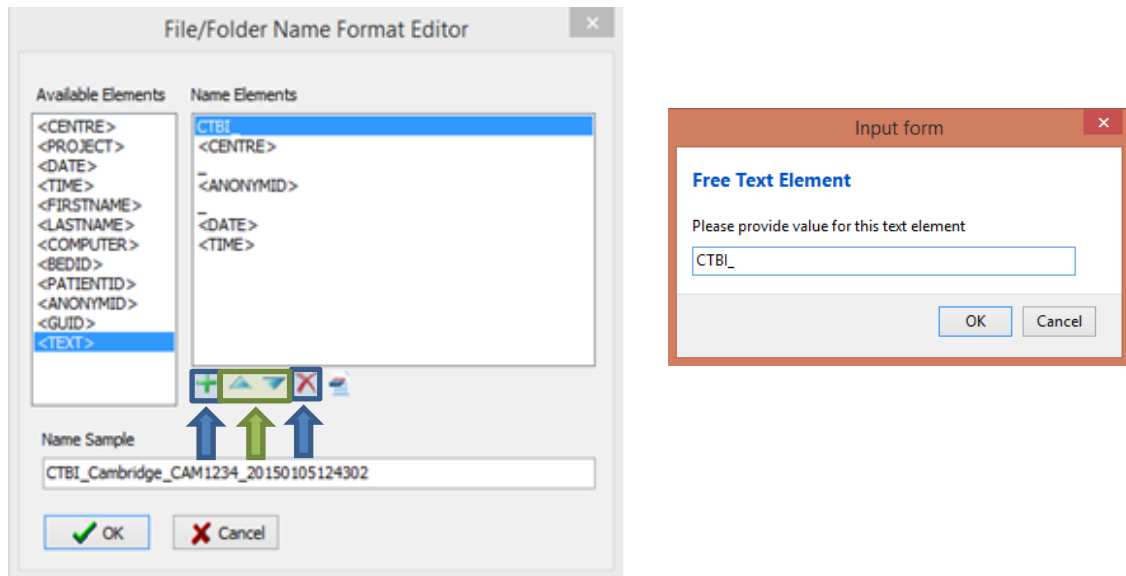
Patient description encryption

Passphrase

OK Cancel Keyboard

- Set the Auto unlock program as user to Nurse. Setting the inactivity time to a value greater than 0, eg 10 min, will cause the software to auto log-in as that default user following a selected period of time without interaction with the software (this will only happen of course if the program was unlocked as another user)

To build the **Data File Name Format** you will need to click the highlighted button and the following form will appear:



In this form it is possible to add/remove any name element present in the Available Elements menu.

The '_' and any additional static text can be inserted by using the element '<text>' and inserting the text to be added manually.

Appendix 2: ICM+ configuration folders and files

ICM+ uses two locations (configurable via the Settings form) to store all its configuration files:

Location 1: C:\Users\\Documents\ICM+.

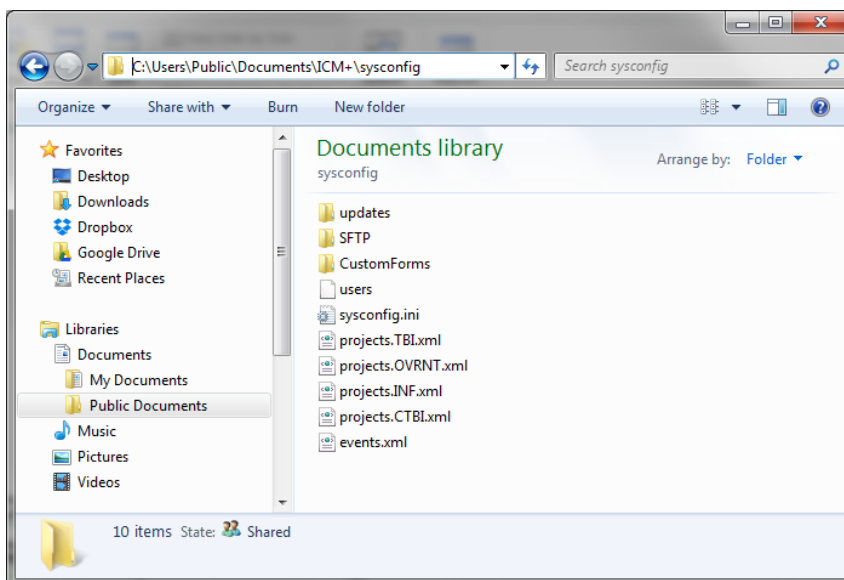
There are two subfolders here:

 ‘**Data**’ folder, where all the data recorded during the acquisition process is stored, and

 ‘**Configs**’ folder, used to store the data collection and analysis configuration ‘profile’ files, as in the figure below.

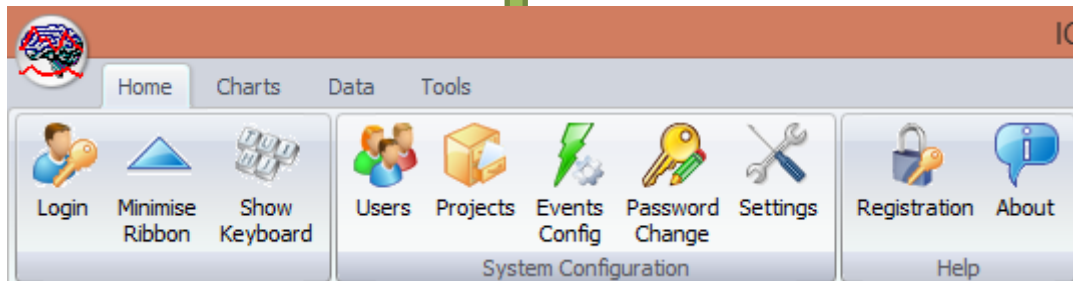
Location 2: C:\Users\Public\Documents\ICM+

Here all the environment configurations/settings are stored. This location contains a folder called **Plugins**, where 3rd party function libraries reside, a folder called **TxtFilters**, containing parsing definitions for different text format data files, and a folder called **sysconfig** containing all the settings of the software, except the data collection and analysis profiles which are store in the Location 1 (as above). Although these files could be edited directly using a text editor ICM+ has specific user interface forms to edit all aspects of the program functionality.

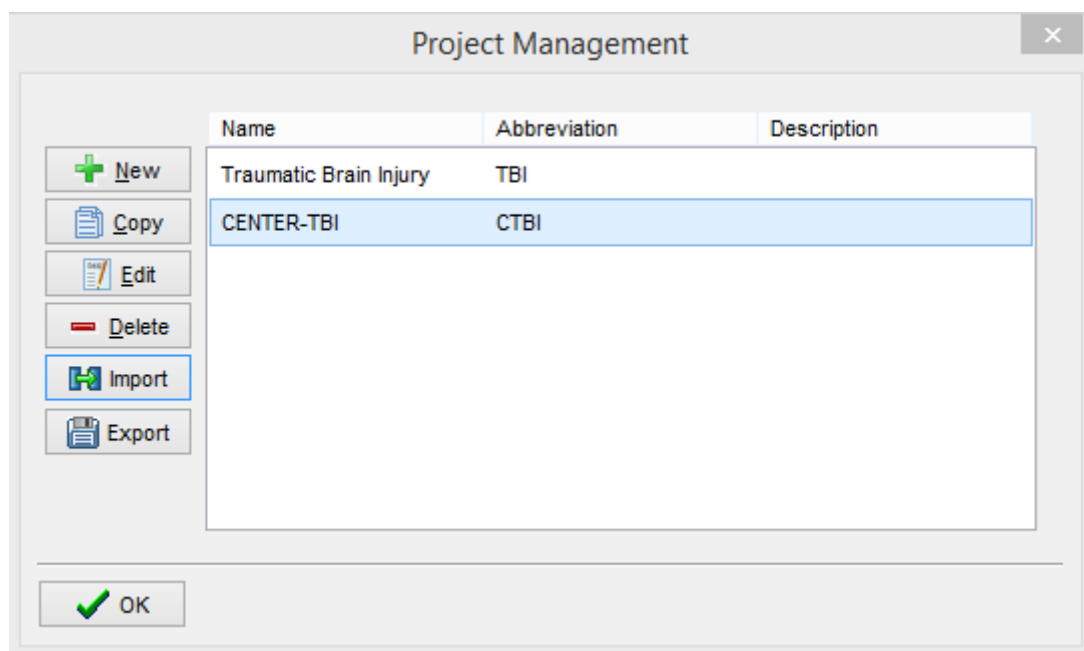


Appendix 3: Editing ICM+ Projects

Projects contain various configurations specific to a particular research project. These can be edited using **Projects** button in the main menu tool bar.



Clicking this button will open the Project Management dialogue, where you create, copy, edit, delete, export/import selected projects to/from a file.



Double clicking on a selected project or clicking on Edit will open a Project Editor where all the custom project settings can be modified.

The following screen shots describe the CENTER-TBI specific settings. These settings would have already been preconfigured for you if you have copied the provided project.ctb.xml file to the ICM+ sysconfig folder, or used the Project Manager to import the settings from that file. Please do not modify those for CENTER-TBI project.

Project Configuration

General | Data Fields | Events | Data Archiving

Project Definition

Name: CENTER-TBI Abbreviation: CTBI

Description:

Data Folder: C:\Users\peter\Documents\ICM+Data\Projects\CENTER-TBI

Data File Name Format: <PROJECT>_<CENTRE>_<ANONYMID>_<DATE><TIME>

OK Cancel Keyboard

1. The project **abbreviation** will be part of the file name

2. **'Data Folder'** is a local folder where the data collected as part of this project will be stored

3. **Data File Name Format** lists elements that will be used to create automatic file names for each new data acquisition sessions. Please note that elements listed here will have to be filled in (e.g Centre ID, or the anonymous Patient ID) at the New Data Acquisition form stage before continuing.

Project Configuration

General | Data Fields | Events | Data Archiving

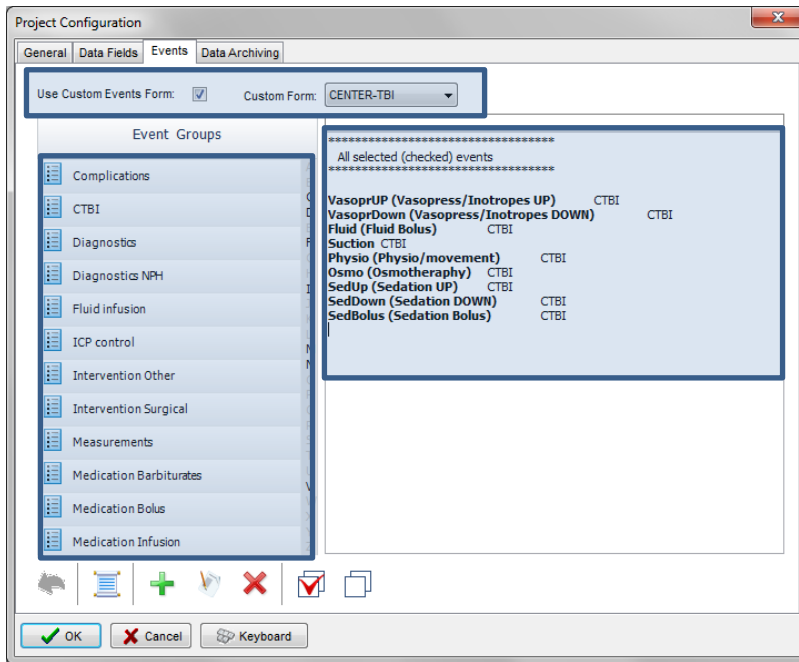
Data Fields Definitions

Name	Caption	Type	Description
GCS	GCS	Category	Glasgow Coma Score at admission
CT	CT Marshall score	Category	CT Marshall score at admission
TypeTBI	Type of TBI	Category	General type of brain trauma
Politrauma	Politrauma	Category	Other significant injury

Buttons: Add, Edit, Remove, Move Up, Move Dn

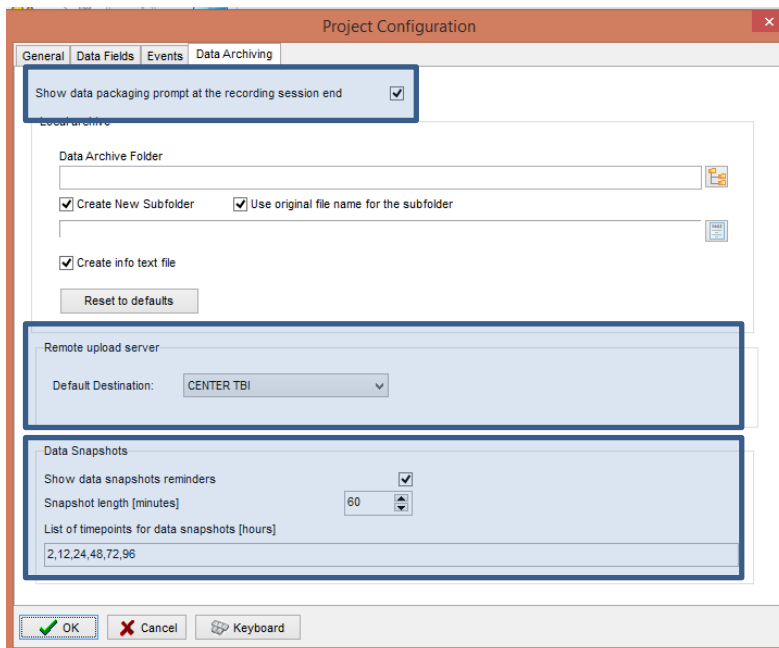
OK Cancel Keyboard

The data fields define placeholders for general clinical descriptors that characterise the patient at the time of admission to the critical care unit, that are useful to be kept together with the monitoring data.



This is where events that are already defined elsewhere (in the Events form), listed in the left panel (1), can be assigned to the particular project (listed in the right panel 2.).

Please note that CENTER-TBI uses a customised event form, selected using the 'Custom Forms' list box (3). It is possible however to add more events to the project but those will only be accessible from within the 'Event List' panel, toggled from the main menu tool bar panel, Charts section.



In this dialog one can set up data archiving options and for multicentre projects also select the coordinating centre central server, if such is configured.

1. If this is ticked you will be prompted to convert the dataset to HDF5 format for archiving, at the end of the recording session
2. the destination of the remote server for data uploads,
3. Only used for multicentre data collection project to prompt users to create and send data snapshots to the coordinating centre.

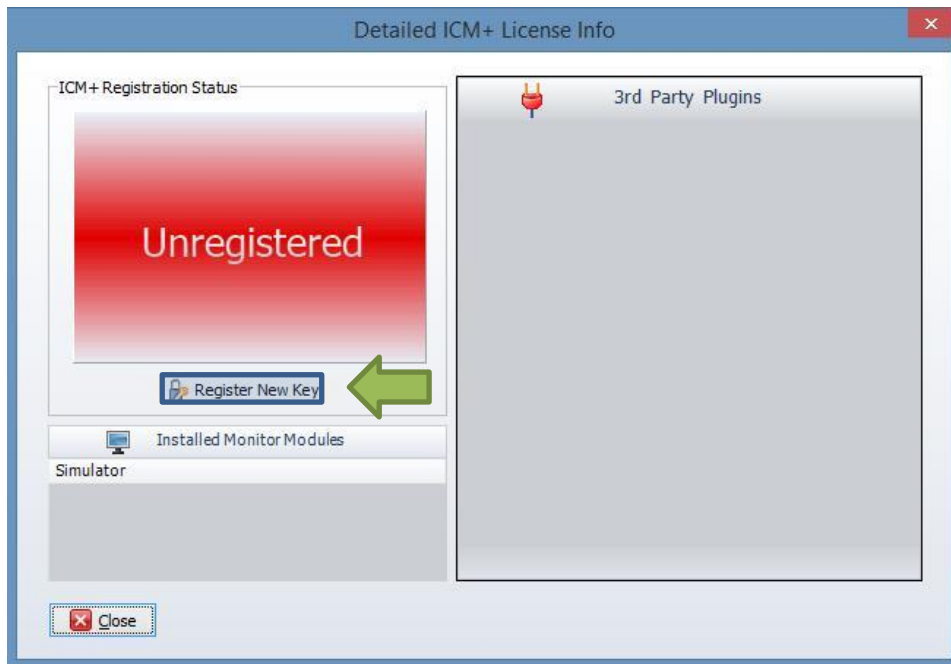
Appendix 4: Registering ICM+

When ICM+ is successfully installed for the first time in a computer it needs to be registered. This will probably already be done for you when you get the laptops, but if any major update needs to be done you will have to register it again.

To register ICM+ you need to press the Registration button on the Home tab.



This will bring up the Detailed ICM+ License Info window where you will need to press the Register New Key button.



This will display the ICM+ Registration Form and here you will have to press the Copy Details then paste them into an email to Dr Peter Smielewski (ps10011@cam.ac.uk) so that the key can be generated.

ICM+ REGISTRATION FORM

Please quote this code for any further assistance

InstallCode: 485ACBC6D289

Username: ICMadmin

Institution: Institution Name

Computer: CTBI-Copenh2

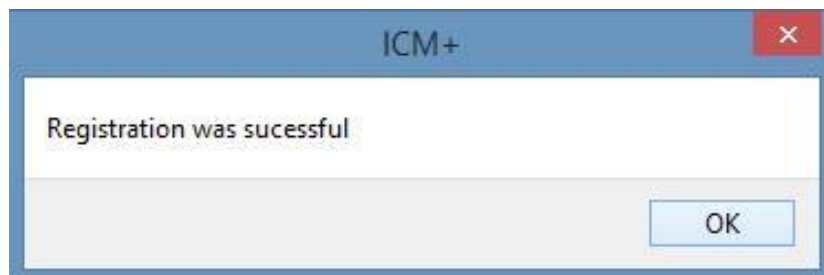
Copy Details **Email Details**

Register Now

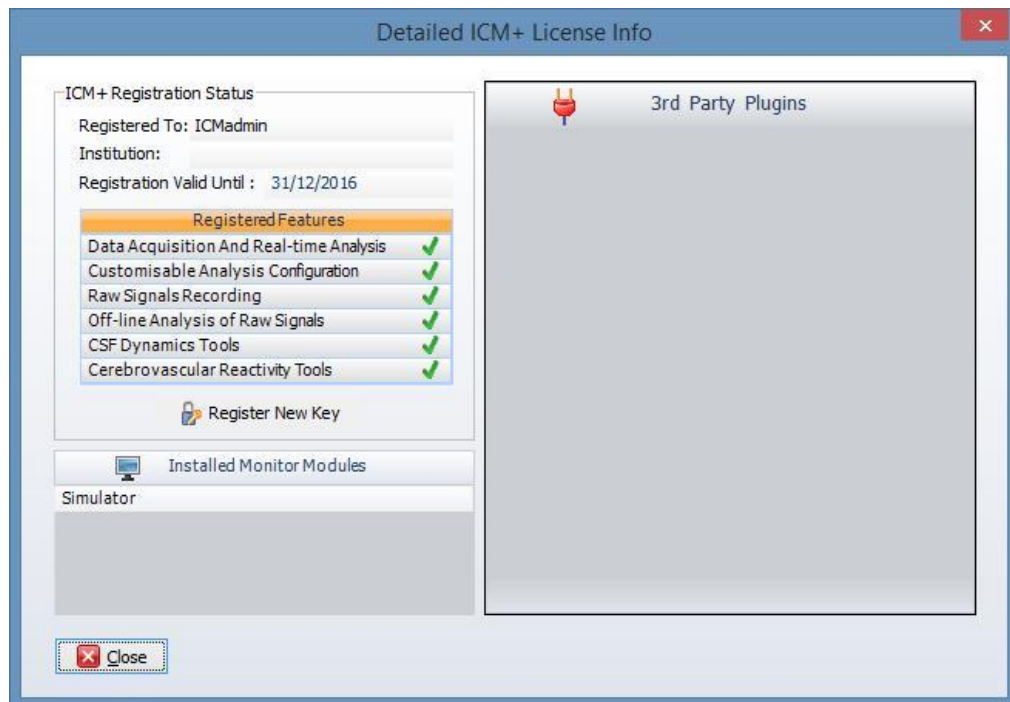
Please enter the registration key, then press the [Register] button

Register Now **Cancel** **Keyboard**

You will then have to paste the Key to the highlighted space and click Register now. If you are successful you will see the Registration successful dialogue.



And your Detailed ICM+ License Info window should look like this:



Please note that the keys expire after a year and need to be renewed. The software will show a warning message with less than 30 days to go.

Appendix 5: Preconfigured users and passwords

Administrator – 2718

Manager – 1618

Operator – 3142

Nurse – 1414

The users, their passwords, and their rights are fully configurable in the software, using Users form. The default users have been chosen to fulfil the following roles:

User	Role
Administrator	Complete access to all the software configuration options, the users and passwords
Manager	Access to all the configuration options, except the users and password. This will normally be the user to do the entire configuration needed for data collection.
Operator	Control of the data collection process using preconfigured profiles, and changes to the charts layout and properties.
Nurse	Access to clinical annotations tools only. This should be normally set up as the default user kept logged-in during the data collection process, in order to prevent any inadvertent disruption to data recording but at the same time allowing and encouraging quick access to the clinical annotations.
Guest	This 'user' has no rights, making it impossible to interact with the software in any way.

Appendix 6: Configuring Moberg network

The first time the Moberg device is connected to ICM+ the network between the devices must be configured as both the **CNSMonitor** and ICM+ must sit on the same network. To do this you only have to make sure that the IP addresses on both machines belong to the same subnet. To do this you must look into two things:

The **Ip address** ex. '192.168.100.200'

The **Subnet mask** ex. '255.255.255.0'

To configure the IP address and the subnet mask on the ICM+ laptop, refer to 'Appendix 5: Configuring the computer's network interface'. Further down in this chapter you can find how to do it in the CNSMonitor side.

You can define IP addresses and subnet masks yourself, but if you have an IT specialist he should be the one doing this part. The only constraint is that no other machine on the same network can share the same IP address with any other machine.

If you are doing this yourself you should first check if ICM+ and Moberg are the only machines on the network (this will happen when both devices are directly connected with a LAN cable) or if there are more machines sharing the network.

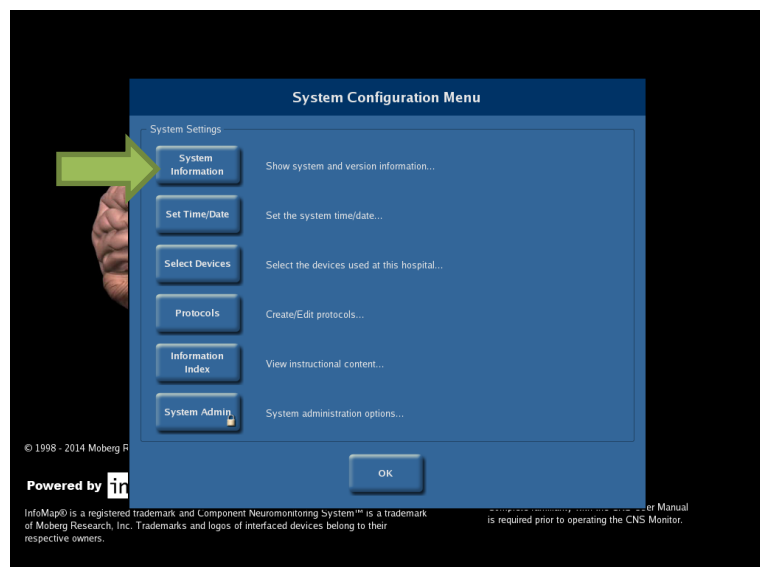
In the first case you will have total freedom and you can choose the IP addresses (one for the CNSMonitor and one for ICM+ laptop) that you want, as long as they are within the same subnet. In the second case you should try to find out the subnet mask and the IP of one of the machines already on the network.

As an example:

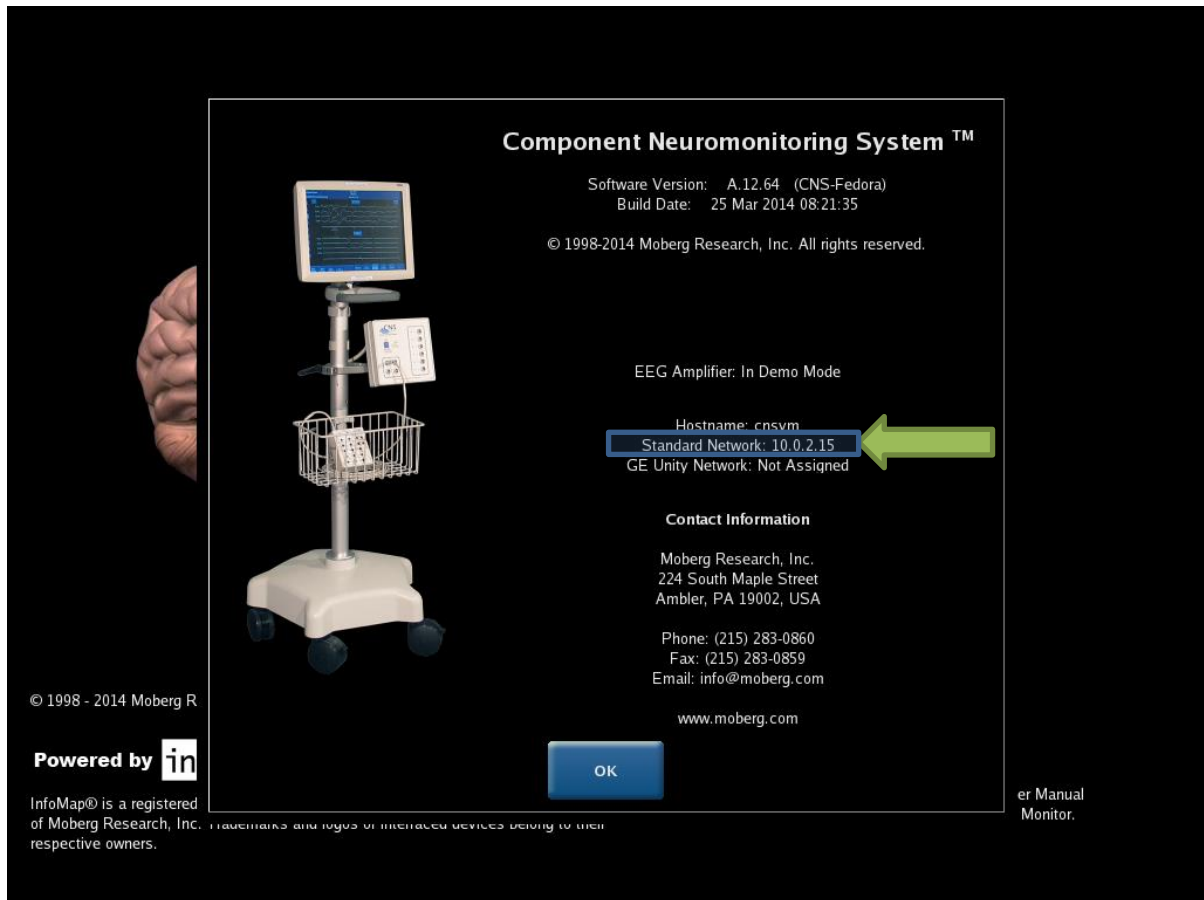
If the **subnet mask** is 255.255.255.0 and the **IP address** of another machine in the same subnet is lets say 192.168.100.200, the new IPs you chose for the ICM+ laptop and the CNSMonitor must start with 192.168.100.XXX. The last three digits must be different for every machine on the same network and must be between 0 and 255.

If the subnet mask is 255.255.0.0 the IP addresses must share the first 2 numbers (dot separated) and will be: 192.168.XXX.XXX.

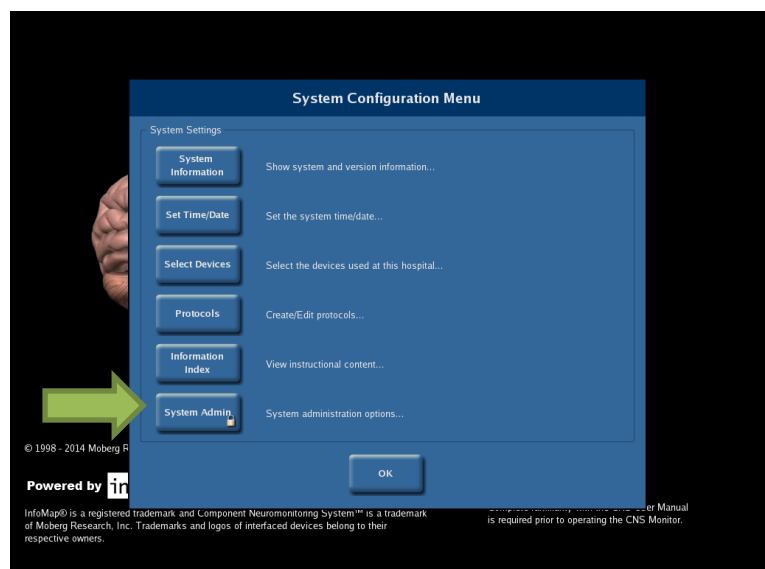
To check the IP address already configured in the CNSMonitor you need to click the **System Configuration Menu** and then click on the **System Information** button.



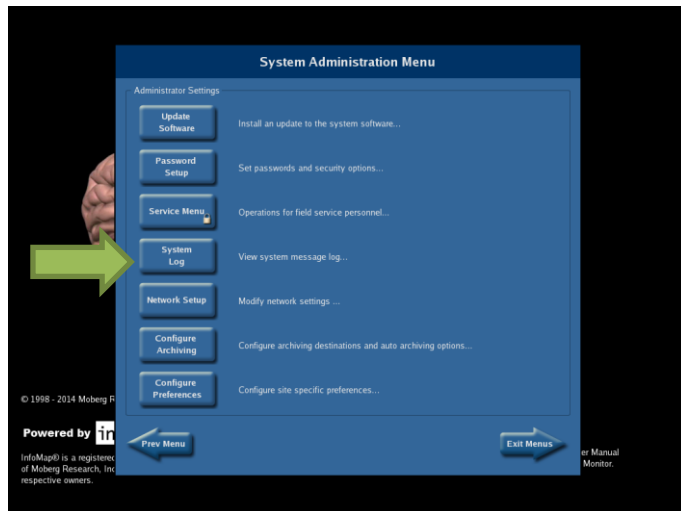
This will bring up a window that will contain the current IP address that the monitor is using.



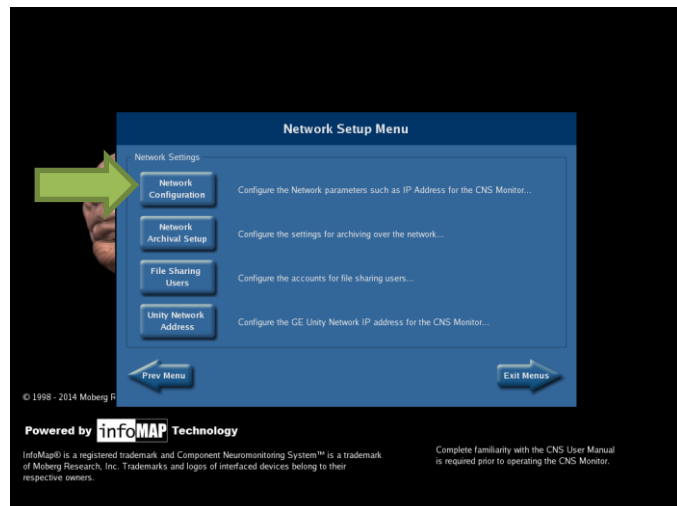
If you need to **configure** a different **IP address** on the CNSMonitor you first ne need to click on the **System Admin** button and insert the password that is asked. This password should be 'moberg'.



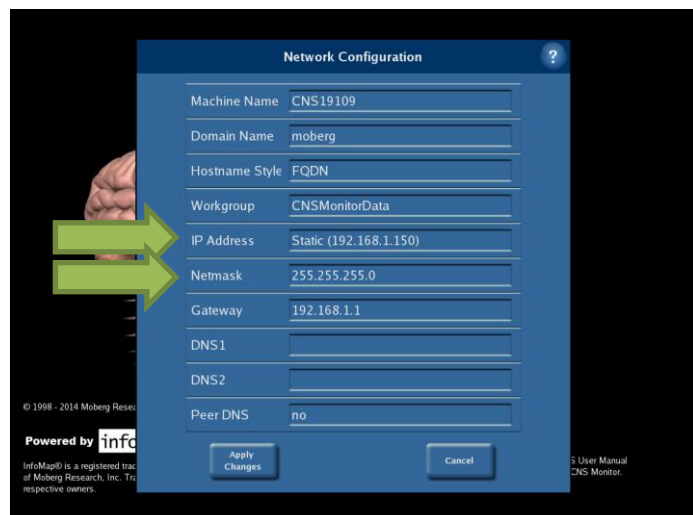
After this you will be presented with the **System Administrator Menu** and here you want to click on the **Network Setup** button.



In the Network Setup Menu you will want to click on the **Network Configuration** button.

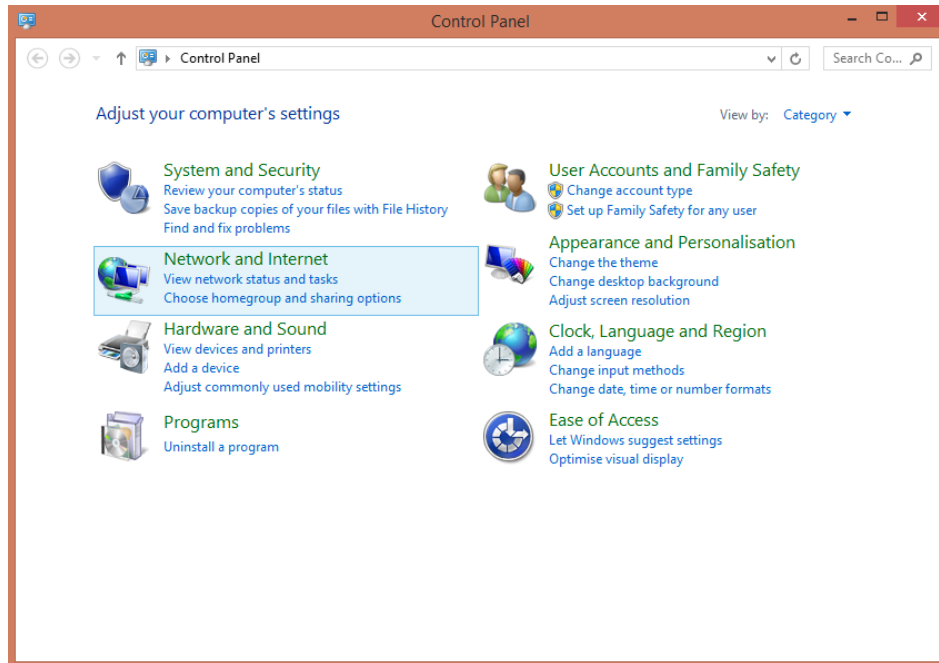


In this menu you will be able to change both the **IP address** and the **Subnet mask**.

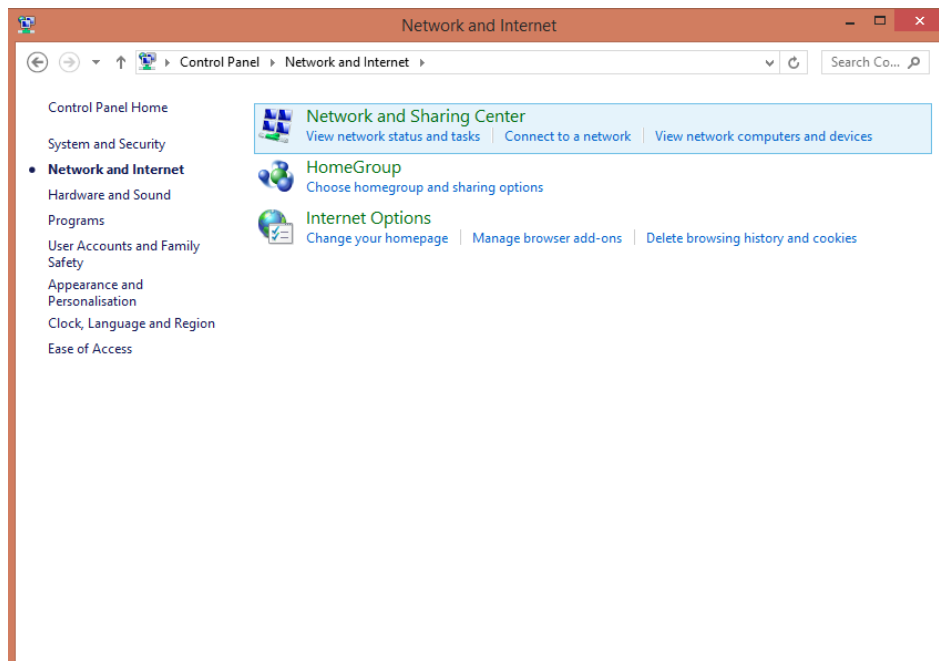


Appendix 7: Configuring the computer's network interface

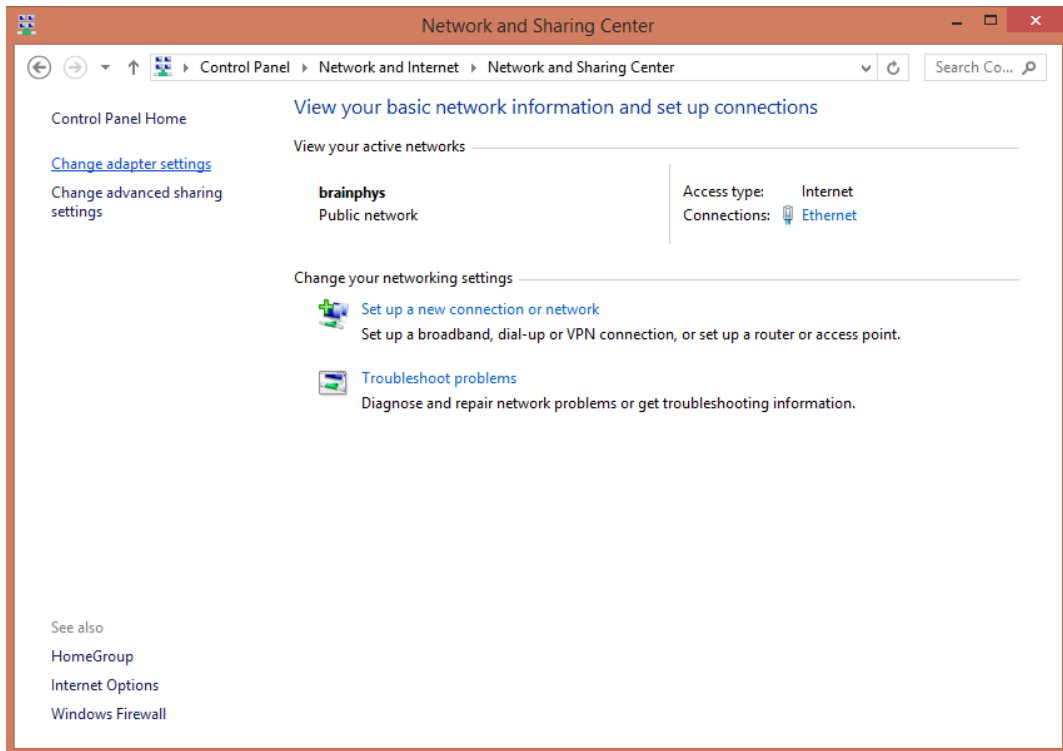
To configure the Network of your Computer you need to open the Control Panel and click on the **'Network and Internet'** button.



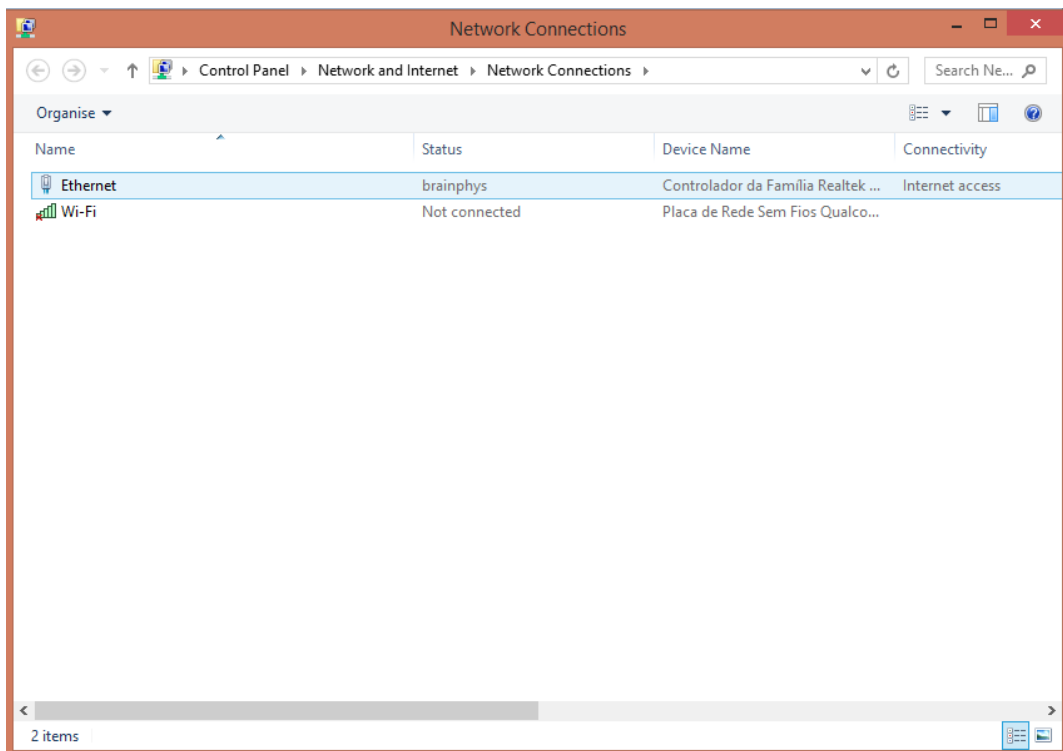
In the new window that will open click on the **'Network and Sharing Center'**



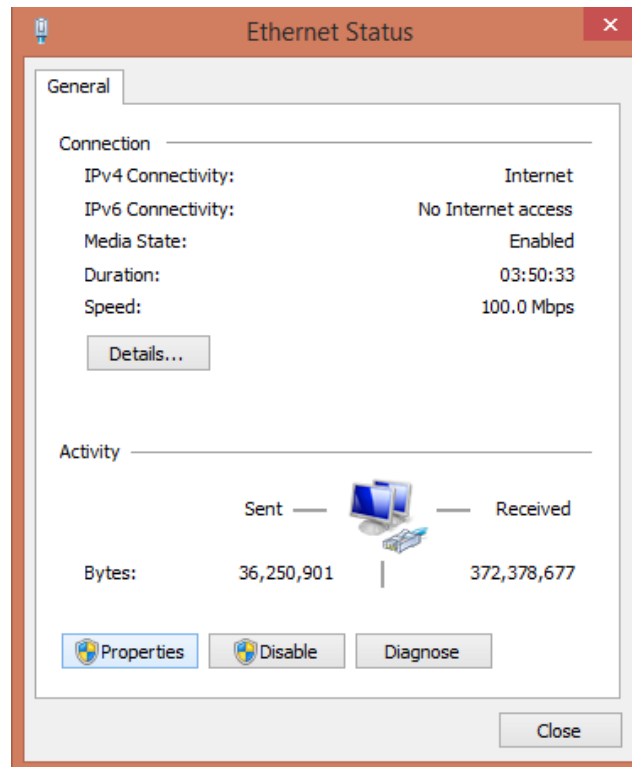
In the new window that will open click on the '**Change Adapter Settings**'



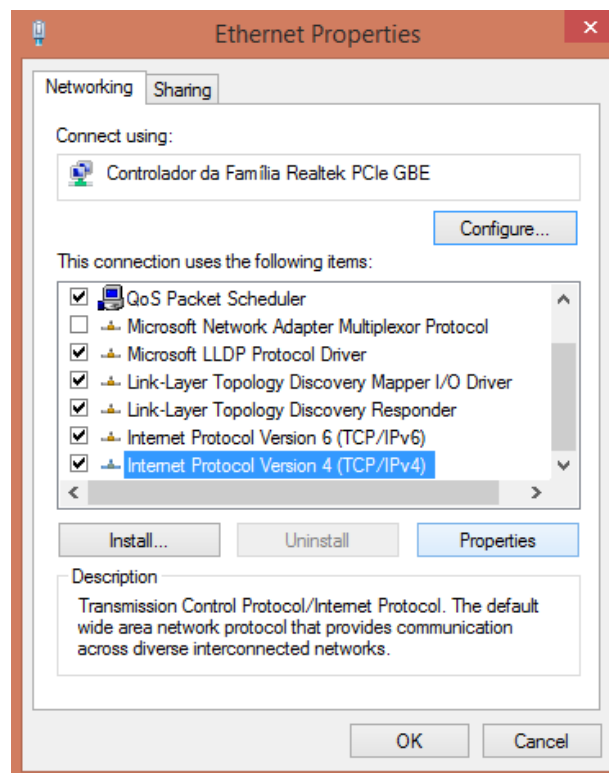
In the new window that will open click on the '**Ethernet**'



In the new window that will open click on the **'Properties'**



In the new window that will open click on the **'Internet Protocol Version 4 (TCP/IPv4)'** and on properties.



In the new window that will open insert the new IP address that your machine will be using. For CENTER-TBI, when CNSMonitors are used, this has to match the CNSMonitor network subnet settings.

