Installing and using the D3 USB interface

Mark Johnson, University of St. Andrews
Tom Hurst, Woods Hole Oceanographic Institution
9 October, 2009

All DTAG-3 style devices (collectively called D3 devices) use USB to communicate with a host computer. The USB interface is used to program and configure the device, and to offload data. The interface is compatible with USB 2.0 and works under the XP operating system. For other operating systems please contact us. Note that, although the devices use USB 2.0, they only operate at USB full-speed, not high speed. This means that data offload occurs at between 0.5 and 1 MB per second or 1.8-3.6 GB per hour. Multiple D3 devices can be attached to a single computer although the offload rate per unit will reduce accordingly (this is a current software shortcoming and will be addressed in later revisions). Please report any problems that occur while following the instructions below to majohnson@whoi.edu.

1. Installation

The USB driver and host software is in *d3usb.zip*. Copy this file to a local directory on your computer and extract the contents by double-clicking on the file icon. A directory called '*d3usb*' will be created. A sub-directory in this directory called '*install*' contains the drivers that Windows needs to talk to a USB device. If you are using the full D3 distribution, the *install* directory is in the *host/d3usb* directory.

Plug the USB cable into your D3 device without connecting the other end to the computer. When the cable is attached to the device, plug the other end into a USB port on the computer. Depending on the device, a red, green or blue LED may light up. Not all devices show a USB confirmation LED so, if an LED does not light, this may not be a fault. If any D3 device has ever been installed on this computer, your device will be ready to use immediately - no additional driver installation should be necessary. You can check this by double-clicking on the *d3host.exe* icon in the *d3usb* directory. If the program says '*rebooting...*' and shortly after displays a control menu, you are in business; go to Section 2.

If this is the first time that a D3 device has been attached to this computer, or you are attaching to a different USB hub, the '*Found New Hardware*' wizard will open automatically on your computer. Select '*No, not this time*' and '*Next*' in the window. In the following window, select: '*Install from a list or specific location*' and then '*Next*'.

In the following window, select: '*Search for the best driver in these locations*', de-select '*Search removable media*' and select '*Include this location in the search*'. Using the '*Browse*' button find the *d3usb* directory that was created when you expanded the *d3usb.zip* file and browse to the *install* directory. This might be, for example, at *C:/d3/d3usb/install*.

A message will appear saying that '*The software you are installing for this hardware has not passed the windows logo test*'. Select '*Continue anyway*'. The '*Completing the Found New Hardware Wizard*' window will appear. Select '*Finish*'. You have now successfully installed the first of two drivers (this is called the *D3-BOOT* driver).

To install the second driver, you need to run *d3host.exe* in the *d3usb* directory. Double-click on *d3host.exe* . A black console window will open with the message '*rebooting...*' at the cursor. If the window goes on to show a menu, you are done (the second driver may have been installed previously). Otherwise, a second '*Found New Hardware*' window will open and the console window may report *'Device not found, try again?'*. This is normal; continue with the instructions in the next paragraph. If the console window does not say '*rebooting...*' but fails after the '*Searching for device...*' message saying: '*Device not found, try again?*', you need to reset the D3 device. This often happens in older Windows installations and is not a problem, just a small inconvenience. To reset the device, unplug the USB cable from the device and attach the on/off cable (the one with the switch). When this is attached, move the switch to the 'OFF' position for a second or two and then return it to the center position being careful to not pass to the 'ON' position (if you do so by mistake, just go back to 'OFF' and then center the switch). Meanwhile on your PC, the '*Found New Hardware*' window will probably have closed itself with a message that an error occurred during installation. This is not a problem. Close any hardware installation wizard windows and close the d3host program by clicking on the '*x*' icon in the top right of the window . Re-attach the USB cable to the device and plug the cable into the computer. Double-click on d*3host.exe* and the program should advance to the '*rebooting...*' message. A second '*Found New Hardware*' window will open.

In the hardware installation wizard window, select '*No, not at this time*' and '*Next*'. In the next window, select '*Install from a list or specific location*' and then '*Next*'. In the following window, select: '*Search for the best driver in these locations*', de-select '*Search removable media*' and select '*Include this location in the search*'. The same *d3usb/install* directory as before should show up automatically. If not, use the *browse* button to locate it. The message will appear saying that '*The software you are installing for this hardware has not passed the windows logo test*'. Again, select '*Continue anyway*'. The '*Completing the Found New Hardware Wizard*' window will appear. Select '*Finish*'. The second level driver (the '*D3-HOST*' driver) is now installed and the interface is ready to use.

In the *d3host* console window, type '*y*' to search again for the D3 device (or launch *d3host.exe* again if you closed it in the previous steps). The program should locate the device and display a menu of options. If not, you need to reset the D3 device again. Close the *d3host.exe* program by clicking on the '*x*' icon in the top right of the window. Then follow the directions two paragraphs above for reseting the D3 device.

For ease of use, create a default directory for the data that will be offloaded in the future from your device. You could create, for example, a '*data*' directory under *C:/d3*. Avoid the '*Documents & Settings*' or '*Desktop*' directories in Microsoft Windows as these have long path-names that are easily mis-typed. In the *d3host.exe* window, select option 5: '*Set*

data directory'. You will be asked for the pathname of your data directory. Enter this (copy and paste will not work - just type the full path name at the cursor). From now on, all data offloaded from a D3 device will be stored in that directory. You can always change this later as required.

Make short-cuts to the two executables *d3host.exe* and *d3read.exe* in the *d3usb* directory and move them to your desktop or to a work directory. You will be using these to talk to your devices and to expand data, respectively.

In case you want to check, D3 devices will appear in your computer's device manager as '*D3-TEST*' under '*LibUSB-Win32 Devices*'. This will only appear when a device is plugged into the computer. To access the device manager window, right click on '*My Computer*' and then select '*Properties*', '*Hardware*' and '*Device Manager*' in the following windows.

2. Using the USB interface

Once the drivers are installed in your computer, you can program and offload data from a D3 device using the *d3host.exe* program. To talk to a device, do the following, in the order shown:
1. connect the USB cable to the device
2. connect the other end of the cable to a USB port on your computer
3. run the *d3host.exe* program by double-clicking on the icon

If all is well, a window will open with some text ending with '*rebooting...*'. Shortly afterwards, this will be followed by a menu of options. If this does not happen, go to Section 4.

Above the menu you will see two lines starting '*Connected to...*' and '*Battery...*'. These tell you important information about the device you are connected to. The first line will tell you what type of device has been recognized by the software. An 8-digit unique identifier code is also given. This is the identifier for the device and it helps us keep track of the configuration and any problems with each piece of hardware. If you do have problems, make a note of this number and include it in an email describing the problem. Note that the digits are hexadecimal and so run from 0-9 and a-f. An example ID is 040ab7ef.

The line starting '*Battery..*' tells you what the current battery voltage is. A fully charged battery will reach 4.2 V. A battery with 3.8 V or more has useable charge and a battery with less than 3.7 V needs to be charged before a recording can be done. The battery is charging while the device is connected to your computer - *d3host.ex*e does not need to be running for battery charging but charging will be fastest if you run *d3host.exe* when you first connect the device.

The menu of options allow you to see a directory of recordings on the device, offload data, clear memory, check the status of the battery, download a new program or change the configuration of the device. To select an option, just type the number next to it - it is not necessary to press the '*enter*' key after the number.

The directory command displays a list of the recordings stored on the device. Note that the directory command can respond slowly because it scans the entire memory on the device looking for recordings. Each recording is given a number and the start and end time/date are reported along with the file size in MB. The total free space available in the device for new recordings is also reported. The start and end times/dates are given in UTC time (see below). Note that the end time is approximate - especially at low sampling rates, it may understate the actual end time by a number of seconds.

Both the offload and erase commands refer to recordings by the numbers listed in the directory. When you select command 2 or 3, the directory list is re-shown and you can enter the number(s) of the files you want to offload or erase, or '*a*' for all files. Multiple file numbers can be selected, e.g., entering: '*5-7,9,12-15*' would offload or erase files 5,6,7,9,12,13,14,15. Enter an '*x*' to return to the main menu without offloading or erasing any files. Be careful when erasing - once erased, files cannot be recovered. Note that the D3 device can only use the memory space after the last file for new recordings. That means that if you erase some files but keep one of the last ones in the list, that file will limit how much memory is available for new recordings. The amount of free memory shown at the end of the directory listing is the actual amount available for recording. Also note that, if you erase files, a new directory list will be generated. The files are always numbered in the order they are found in the memory so the numbers will change after files are erased. This should not cause any problems but is worth keeping in mind.

To offload files, select command 2, enter the numbers of the files to be offloaded and then enter the name you want the files to be given on your computer. The name can be any (reasonable) length and can include letters, numbers and some punctuation characters (e.g., _ &). The filename actually given to each recording will be the name you entered followed by three numbers matching the number of the recording in the directory list. For example if you offload recordings 3-5 with the file base name of '*sthstation_23oct09*', three files will be generated in your default data directory called:

sthstation_23oct09003.dtg
sthstation_23oct09004.dtg
sthstation_23oct09005.dtg

A time count-down will be displayed as each file is downloaded. The offload speed is currently an unimpressive 2-4 GB per hour so a full device may take a long time to offload.

When you have finished with the *d3host* interface, type *q* to quit. The time clock on the device will be synchronized to your computer's time and you will be asked if you want the device to run immediately or not. To '*Run immediately*' means that the device will start its built-in program as soon as it is disconnected from the computer, e.g., it will start recording. If you want to start the device later, type '*n*'. You can always start it later using the on/off cable even if you don't have a computer handy.

Note that the device is synchronized to UTC (Universal Time Coordinate) time. It uses your computer's time zone setting to correct the time displayed in your computer to UTC. It is therefore important to check that your computer's time and date are configured correctly. Websites are available to get the correct local time, timezone and daylight saving correction.

The battery in the device is recharged while it is connected to the USB port. The maximum charge rate is limited to 500mA by the USB specification which means that charging will be relatively slow for a large capacity D3 device as compared to using an external power supply. For devices with small batteries (e.g., DTAG-3), the USB charge rate is optimal and full charge will take about 3 hours. After you quit *d3host*, the device will keep charging while it is still connected to the USB port. If you need to run d3host again, just double-click on the icon - you don't need to disconnect the USB cable. Whenever you wish to remove the device, simply pull the USB plug. You do not need to ask the computer's permission before doing so.

3. Collecting and offloading real data.

Once the D3 device is erased and recharged, it can be started for recording at any time, assuming that a recording executable file has been downloaded to the device. If you selected '*Run immediately*' when quitting *d3host*, it will start recording in a few seconds after USB is disconnected. If you did not select '*Run immediately*', you can start recording when you are ready by connecting the on/off cable to the device and moving the switch to the 'on' position for a second or two. Disconnect the cable and return the switch to the center position. The device does not consume battery power while it is idle (i.e., when not recording) but lithium batteries self discharge at about 10% per month, especially in warm temperatures, so it always best to re-charge the battery (e.g., by connecting to a USB port) before use. Lithium batteries do not have a memory effect so it is not necessary to discharge the battery before recharging.

Indications that the device is recording are available on some devices. On DTAG-3, the VHF beacon will be transmitting about once per second.

Checklist for deploying a D3 device:
1. all the recordings in the device have been offloaded and the memory is erased.
2. the battery is recharged - it should read close to 4.2 V
3. the computer time/date clock and time zone is set correctly
4. you exited *d3host* using the *q* (quit) command so that the clocks were synchronized.
5. when you are ready, use the on/off cable to start the device. Check that it shows the correct indication (LEDs or VHF according to the device type).

When you recover a D3 device after a deployment, it is a good idea to stop it recording straightaway even if you are not going to offload it until later. This avoids recording incriminating conversations on the boat and keeps the offload time and file size to a minimum. To stop the device, connect the on/off cable and move the switch to the 'off' position for a second or two. Disconnect the cable and re-center the switch. Alternatively,

you can stop the recording by plugging the device into a USB port on a computer. It is not necessary to run d3host, just plugging the device will stop the recording.

When you are ready to offload the data, plug the USB cable and run *d3host*. Note that if you plugged in the USB cable to stop the device recording, you have to unplug it and plug it in again to wake up the device for USB offloading. Once in *d3host*, use option 1 to request a directory and check the times/dates of each file listed to identify the files which were made during the deployment. Remember the times/dates are in UTC, not local time. More than one file may be created during a single deployment because the file size is automatically constrained to less than 700 MB. When a file gets close to this limit, it is closed and a new one is started. This means that the offloaded files will each fit on a CD if needed for archiving. Consecutive files made during a single deployment will have end times 1-3 seconds before the start time of the following file. This does not mean that there is a 1-3 second gap in the recording - there shouldn't be any gap. The end time displayed in the directory is just an approximation and is always a few seconds less than the actual file end time.

Offload the files for your deployment as described above using a meaningful file name base. Each 700 MB file will take about 20 minutes to offload and the files will be automatically given a number at the end of the name matching the number in the directory. You should end up with a set of consecutively numbered files in the default data directory. Make sure that you have enough room on your hard drive for the files or use an external hard drive. If you need to stop the offload at any time, simply type any key and the program will terminate shortly afterwards. Data from the file that is being currently offloaded will be lost but you will be able to resume offloading that file and the remaining files when you want to. Use the same filename base so that the new files join the previously offloaded files as a sequence of like-named files.

When offload is complete, there should be a set of files with names like '*xxxx001.dtg*' where the three-digit number matches the directory number and *xxxx* is your file name base. The files will be in the default data directory you selected using command 5 in the *d3host* menu. Check that the size of the data files roughly match the sizes listed in the directory. Do not erase the files on the device yet - you don't yet know if the files you offloaded are good..

The offloaded files are in the *.dtg* file format. This is an archive-quality binary format that includes all metadata, timing information, and error detection codes. To expand the data into standard format files, use *d3read.exe*. Launch this program by double-clicking on the icon. By default, *d3read* uses the same data directory as *d3host* but it asks if you want to change this directory when it runs. If your data is in the default directory, enter '*n*'. Now enter the first few letters of the filename of the file(s) you want to open. You do not need the whole name - just the first letter or two maybe enough. A list of all files in the data directory with names that match these letters will be shown. You can select which files you want to open from this list by entering numbers or '*a*' for all. You can select a single file or a sequence of files using the same way of listing numbers as in *d3host*, e.g., entering '*5-8,12,14*' will read the 6 files in the list with numbers 5,6,7,8,12,

and 14. These numbers are the numbers next to each file name in the displayed list, they are not the same as the numbers embedded in the file name when you offloaded the data. Unfortunately, *d3read* is not especially fast, particularly if your computer does not have a lot of free disk space. Be patient! If you have *d3host* open while running *d3read*, that may slow things down even more.

Each file opened by *d3read* will generate at least two output files. These will have the same filename as the *.dtg* file that they were made from but they will have different extensions. One file will have a *.wav* extension. This is the audio recording in the standard WAV format which can be read and played in any WAV player or in Matlab. The *.wav* file may be a lot larger than the *.dtg* file because D3 devices use a loss-less compression algorithm to efficiently store audio data. Typically the *.wav* file will be 3-4 times larger than the *.dtg* file. The second file that will be generated will have a *.xml* extension. This is the metadata for the recording and is in a text readable 'markup' format. If you double-click on this file, it will probably open in your default internet browser and will show a number of lines of markup containing information about the device id, time of the recording and the configuration of the device.

The default recording behaviour of D3 devices is to perform a self-calibration when they start recording and periodically throughout the recording. Self-calibration takes 10-15s and will be evident in the audio recording as periods with lower noise level than usual and possibly with a sequence of tones. The times at which self-calibration occured will be listed in the *.xml* file.

4. Dealing with problems

Most problems that arise when trying to interface with a D3 device fall into the following categories:

1. The device is not in the right state to connect to the USB interface. If the device is running software that does not detect the USB connection or the software has malfunctioned, it may not connect to the computer correctly. To overcome this, connect the on/off cable instead of the USB cable, move the switch to the 'off' position for a second or two and then return it to the center position. Re-connect the USB cable always making sure to connect the cable to the device before you connect it to the computer. The device should now wake up and connect to the computer correctly. Note that if the device was recording and you connect the USB cable, it will stop recording and enter a sleep state. To communicate with it, you need to unplug the cable from the computer and re-plug it. This wakes up the device and communications can start.

2. The cable is not well connected. Make sure that the cable is well seated in the connector on the device and in the USB connector on the computer. If this doesn't fix things, try a different USB port on the computer or swap the cable.

3. The driver is not properly installed on the host computer. Check that the device is recognized in the device manager as described in Section 1 above. If not, you may need

to re-install the device drivers. Follow the steps for uninstalling the drivers first (see the document '*UninstallingD3.pdf*' and then repeat the steps in Section 1.

4. The current-limit has been exceed on the computer's USB port and it has been disabled. D3 devices incorporate circuitry which limits the current drawn from a USB port to below the specified limit of 500 mA. Nonetheless, some computers (especially some laptops) can be very sensitive to the current drawn by a USB device. If you are normally able to connect a D3 device to a computer and it suddenly fails to connect, it may be because the protection circuit in the computer has mis-detected an over-current and disabled the port. Try plugging to a different USB port or re-enabling the port in the device manager window on your computer. To do this, right click on '*My Computer*' and then select '*Properties*', '*Hardware*' and '*Device Manager*' in the following windows. Look for the heading *Universal Serial Bus Controllers* and check each *USB Root Hub* listed. If one is disabled, enable it. If all else fails, re-boot the computer with the USB cable disconnected and try again. This resets the over-current protection on the USB ports.

5. The computer's operating system is not compatible with the software. The drivers have only been tested under 32-bit Windows operating systems (XP, Vista and Windows 7) and so it may be necessary to find a computer with one of these operating systems. The computer does not need to be especially powerful to interface with a D3 device and cheap refurbished laptops are fine. These are great for fieldwork with D3s.

Occasionally, you may be given (or even generate yourself) new firmware for a device that you are using. This may correct a bug or change the way it records data. The firmware will be in a small file with a *.bin* suffix and will have a size between 5k and 80 k bytes. To download new firmware, copy the file to the *d3usb* directory and then start the *d3host* interface as described above. Select option 7 and then enter the filename of the firmware including the '*.bin*' suffix. The code will be automatically loaded in the device and will be run the next time that the device wakes up unconnected to the USB. Use menu option 8 to find out what code is currently installed in a D3 device.