JavaScript Plugin Technical Guide

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1. Introduction

This document is a technical guide for the JavaScript plugin for OpenCPN. It is intended for those maintaining the plugin and building it from source.

This plugin started life with a cloning of the DR_pi as described here. However, v0.5 adopted the new standard build methods and were set up for me by Mike Rossiter.

Versions through to 0.4 were primarily developed on MacOS using Xcode and a stand-alone test harness that allowed me to run the plugin without OpenCPN.

Changes since v0.4 are highlighted in yellow.

2. The JavaScript Engine

The JavaScript engine used is Duktape, which is optimised for being built into an application such as this. It implements ECMAScript E5/E5.1 with partial support for later developments. The web site provides full details of the Duktape API - the interface between the engine and the host application. This is not to be confused with the OpenCPN API through which the plugin interacts with OpenCPN.

A more detailed explanation is provided in How the plugin works

3. Compiling and building

Having taken a clone of the plugin, locate the appropriate script within the ci folder.

Follow the instructions and you will end up with a tarball ready for importing into OpenCPN.

The code contains various experimental features not ready for release. These are not compiled and in some cases their inclusion or omission is set up in the buildConfig.h header file.

4. Duktape extensions

The JavaScript embedded engine has little access to its environment and performs no input or output. I have, therefore built in various extensions as functions.

The basic technique is that when setting up the Duktape context, an initialisation function is called, which loads into the global object the details of the C++ functions to be called when JavaScript executes the function.

The code to provide non-OpenCPN-specific extensions (such as the print function) are included in `JSExtensions.cpp`.

5. Duktape OpenCPN APIs

The extensions that provide the OCPN APIs work similarly and are to be found in the file `OPCNapis.cpp`. The file `opcpn_duk.h` contains the definitions of the classes and methods used to implement many of the APIs.

It takes some understanding of how to work with the Duktape context stack, especially when constructing objects such as that returned by, e.g. the `OCPNgetNavigation` function.

6. The script window

The console has been created with wxFormBuilder as usual.

The script and output windows are of type wxStyledTextCtrl. This requires the Scintilla package now included in all OpenCPN builds from v5.5

The following macros need to be defined:

```
#define TIXML_USE_STL
#define SCI_LEXER
```

The script window uses 'lexing' of the script to aid understanding. Various words are coloured, as described in the user guide. This is set up in the function JSlexit( ) included in the file JSlexit.cpp. I had help learning how to use multiple keyword lists through this post.

The JavaScript plugin now has a decent scripting window.

7. The require function

Duktape provides a framework in which to implement a JavaScript `require` function. In that framework, the included script is automatically compiled in a separate context and then exported to the user's context.

Despite two weeks of experimenting and testing, I found no way of exporting an object method. It was not recognised as callable. Eventually, I abandoned this approach and implemented a require function from scratch in which I compile the script as a function within the user's context.

8. How the plugin works

This section provides a description of how the plugin works in relation to the JavaScript engine. It does not cover standard OpenCPN plugin matters.

Major changes in version 0.4

Version on 0.4 introduced the ability to have any number consoles, each with their own instance of the JavaScript engine. This required a very major re-write of the code and much tidying up was undertaken in this process.

All code that relates to a console is now a method of the Console class. Data used to control the execution of the JavaScript were previously in a single structure of class JS_control. These have now been included in the Console class so a separate instance exists for each console. The few variables which apply in all instances have been moved into the JavaScript class.

General description

It is often necessary to find the JavaScript_pi instance. Its constructor places a pointer to itself in a global variable

```
JavaScript_pi* pJavaScript_pi;
```

Each console is implemented as an instance of the Console class. The consoles are chained in a linked list with the first one found at

```
Console* pConsole = pJavaScript_pi->mpFirstConsole;
```

And the next in the chain at pConsole->mpNextConsole.

Each instance of the engine uses a heap. For us, the most important aspect of the heap is the context which contains the Duktape stack - not to be confused with the C++ stack. All our actions are stack-based and care is needed to pop off the correct number of items at the right moment.

All communication with the JavaScript engine is by calls to the Duktape API, which all start with duk_ and reference the relevant context declared as

```
duk_context *ctx;
```

When the user clicks on the Run button, the plugin calls the run(wxString script) method, which, in summary, does does the following:

1. Initialises the attributes that will be used during the run of Duktape
2. Creates a Duktape heap and records a pointer to the context
3. Initialises the JS_control structure, which is where the plugin stores information about the state of operations
4. Starts a timer in case of loops etc
5. Invokes the Duktape engine to compile and run the script. During execution of the script, API calls to plugin functions may be called. These may set up timers or other call-backs. These are noted in the Console.
6. On completion of the main script it cancels the timer and a check is made for errors, which are reported.
7. A check is also made using the `isWaiting()` method to determine whether a callback is outstanding. If not, the `clearAndDestroyCtx()` method is used to clean up and release the Duktape heap.
8. When the JavaScript plugin receives an action from OpenCPN, it searches the consoles to see whether it satisfies an outstanding call-back. If so, it will
    a. Load the global object (the previously compiled script) onto the stack
    b. check that it contains the required function
    c. Call JS_exec, which
        i. Starts the timer
        ii. Calls the function using duk_pcall
        iii. Cancels the timer
        iv. Checks for an error return
    d. If there are no outstanding call-backs or action, we clean up, which includes restoring the Run/Stop button to Run

When the Duktape engine calls an API or returns an error, the Duktape context is available but it does not indicate which console this is for. The function

```
Console *findConsole(duk_context *ctx)
```

is used to search each console for a matching context and return it.

Callbacks

Scripts can arrange for functions to be invoked via callbacks, such as when an OpenCPN event happens, a dialogue is completed or on a timer.

Such callbacks could trigger other callbacks and this could lead to a very deep call stack or even a loop. To avoid this, call-back functions are executed using the wxWidgets all after feature, whereby thy are queued and called after the present thread has completed.

exitScript()

When a Duktape process completely successfully, it returns DUK_EXEC_SUCCESS. If this is not true, an error has been encountered. To get out of the script when exitScript( ) has been called, we have to throw an error but we don't want an error message. To avoid this, we look for a flag `mStopScriptCalled` and, if set, return STOPPED. Only after this do we check for a real Duktape error.

Time ticks

A wxTimer is run at one second intervals and used to check for timer events due.

Timing out

The code for this. Is to be found in the file `duktape_timeout.cpp`. The duktape engine is set up to call the C++ function `JSduk_timeout_check` at regular intervals. If the allowed time has been exceeded, this function returns 1 else 0. It has to do this repeatedly while the stack unwinds. It clears down only on the first timed-out call, using a flag `pConsole->m_backingOut` to manage this.

When the Duktape engine calls `JSduk_timeout_check`, there is no context nor indication which script instance it is for. We make the assumption that only one instance will be running at a time and have planted a pointer to the console in the global `Console* pConsoleBeingTimed`. This is a safe assumption as I have no evidence that OpenCPN multithreads calls to plugins and a given console's actions are single threaded. If the plugin was compiled with DUK_DUMP defined, the JavaScript extension `JS_mainThread()` allows a script to check whether it is running in the main thread. I have never seen it otherwise.

Closing consoles

Closing a console window turns out to be tricky. It is a bit like cutting off the branch of a tree you are sitting on. The solution adopted is to unhook the console from the chain of consoles and then add it to a bin of closed consoles. Then on the regular timer tick, a check is made to delete consoles in the bin. A check is also made during plugin deinit to delete any consoles in the bin.

Keeping the right console on top

The consoles are instantiated as wxDialogs but not modal. This is necessary to ensure they stay on top of the main canvas frame. An initial problem was that the dialogues overlapped each other in order of creation. When a console is activated, the wxSTAY_ON_TOP bit is turned off for the deactivating console and turned on for the newly active console. From v0.5 the wxSTAY_ON_TOP bit is then turned off again. This provides the expected behaviour.

Programmatically starting scripts

When a script is chained or a script in another console is to be run, simple calls to this process could lead to a build up of call nesting and running for long periods without yielding. To avoid this, the CallAfter( ) method is used, which schedules the call later. The call needs to be to a method and the console methods `doRunCommand` and `doExecuteFunction` handle these, invoking the underlying method to do the work.

Inter-script communication

Scripts can communicate using OpenCPN messaging. However, the recipient must be listening when a message is sent. This plugin has another method of inter-script communication, described here.

When a script runs, it is passed a *brief*, which it stores in its console structure. When a script is initially run through the console Run command, it is given a null brief. A brief contains the following:

bool	.fresh	If true, this brief has not yet been seen by a script. A brief can be read multiple times by the first script it is passed to but the same brief may not be used by any successor script it might chain to. Just before the script runs, this is set to false. During wrapUp( ), run at the end of every script, if .fresh is still false, we know that no new brief was set during this script and .hasBrief is set to false, making the script unavailable to any successor script.
bool	.hasBrief	If true, the Brief contains a string, being the actual brief for the script.
wxString	.theBrief	The brief itself. If not a string, it should be represented as its JSON string.
bool	.callback	If true, a different briefing script is to be called back when this script or chain of scripts ends.
wxString	.briefingConsoleName	If .callback is true, this is the name of a different console that is to be called-back.
wxString	.function	The function to be invoked during the callback.

When a script terminates, the wrapup( ) method examines the brief and, if it finds .callback true, will attempt to invoke the specified function running the specified console. It does this by calling its onExecute( ) method, passing to it a ConsoleCallbackResult structure, which is as follows:

Completions	.resultType	The type of the result. This might be one of ERROR, DONE or STOPPED,
wxString	.result	The result from the script, except that if .resultType is ERROR then the error message.
wxString	.function	The function to be invoked during the callback.

If a scriptChain( ) statement is executed, this preempts any callback and the brief is passed to the successor script - perhaps with the brief itself updated by the call. The callback details are thus inherited by the chained-to script. Thus when a console sets up a callback from another console, the callback is made from the last script of any chain of scripts that run in it.

When a console callback is to be made, the calling back console has to check that the console to be called still exists and that it is busy - hopefully awaiting the callback. If the specified function is no longer available, the call-back console will throw an error.

MessageBox

The `messageBox()` feature added in v2.0 presented a number of challenges, given that it uses a modal window to display the message. The advantage of the modal display is that it simplifies scripts that proceed through steps.

Complication arise when one script closes another console that has a modal messageBox displayed. I have not found a satisfactory way of dismissing a modal window from outside. See this discussion. If this situation rises, the console is given a special status of SHUTTING and moved into the bin but not deleted. When a button is eventually activated with this flag set, an error is thrown to unwind and clear down the script and the binned console can be deleted. This has the effect of leaving the message window apparently orphaned but dismissing it has no untoward effect.

Changes for v0.5

V0.5 uses the API 117 and makes extensive use of the extended API calls for waypoints and routes. It also implements additional APIs implemented in OpenCPN v5.5 to facilitate various JavaScript tasks.

OpenCPN v5.5 for MacOS moved up to wxWidgets v315 and so the plugin does likewise. There are a number of issues with v315 around closing windows. In addition to closing a window, it seems necessary to use sequences such as:

```
pWindow->Destroy( );
delete pWindow;
pWindow = nullptr;
```

OpenCPN v5.5 for MacOS includes the Scintilla library that was missing in v5.2. This means the Scintilla source no longer needs to be complied into the plugin.

9. Configuring settings for console parking

Consoles have a minimum size and the plugin can minimise a console and park it in the canvas frame's top bar. This requires constants which are platform dependent. This section describes how to configure these constants for a particular platform.

The constants are defined in the `consolePositioning.h` header file, are compiled conditionally depending on platform and are as follows

CONSOLE_MIN_HEIGHT	Minimum height of a console window
CONSOLE_STUB	Space to be left for things other than console name
CONSOLE_CHAR_WIDTH	Width to allow for name characters
PARK_FRAME_HEIGHT	Height of canvas window top frame
PARK_CILL	Space between bottom of minimised console and bottom of canvas top bar
PARK_FIRST_X	Indent of first parked console from left-hand edge of canvas window
PARK_SEP	Horizontal separation of parked consoles

Set these for a different platform as follows:

1. Clone a likely set of values as a starting point.
2. Check that the minimum height of a console window is narrow enough to show just the console name and the required other items, such as the dismiss button. The border separating the bottom of the top bar from the window proper should just not be visible. Tweak CONSOLE_MIN_HEIGHT to the correct value.
3. Create a console with a very short name, i.e. '1' and one with the most spacious name, i.e. 'OOOOOOOOOO'. The minimum width of each should just sufficient to contain the two names. This is configured by CONSOLE_STUB, which is the hypothetical width if there were no name and CONSOLE_CHAR_WIDTH, which is the horizontal width added for each character. Tweak these until satisfactory. Do not forget to check that the console is minimised when doing so.
4. Set PARK_CILL to zero and park a console. You can do this by running this simple script:
   ```
   consolePark(); scriptResult("");
   ```
   The console should park itself in the bar at the top of the canvas window just resting on the bottom of the canvas window bar. Tweak PARK_FRAME_HEIGHT until this is so. There should be no other console parked because parking takes note of any already-parked console.
5. Now increase PARK_CILL so that a console parks just above the bottom the bar and so appears to be in the bar.
6. Adjust PARK_FIRST_X if necessary, which is the horizontal position used if no other consoles are already parked.
7. Park a second console, it will be separated from the first by PARK_SEP. Adjust PARK_SEP if required.

8. Run the test script `44_parking.js` to exercise fully.
9. Report back on the settings for your platform so they can be included in the definitive source.

10. Error handling

How an error is handled depends on where it occurs.

Error in the plugin code when no JavaScript is running

This is the simplest situation and the error can be displayed in the output window using

```
pConsole->message(int style, wxString message)
```

The style is one of

```
enum {
     STYLE_BLACK,
     STYLE_RED,
     STYLE_BLUE,
     STYLE_ORANGE,
     STYLE_GREEN
     };
```

A newline is appended to the message by the function.

Error in the main script

`run(wxString script)` checks for an error return and displays the accompanying message which has been left on the stack, using `message` as above.

Error detected in C++ extension or OpenCPN API code.

The C++ code should push an error object onto the Duktape stack and then throw a Duktape error with `duk_throw()`. Do not use the C++ `throw()` - that will kill OpenCPN!

On call-back, the plugin detects error before invoking function

The plugin can display a message using `message` as above. It then returns.

Function invoked during call-back throws an error

A called-back function is executed with the executeFunction( ) method. If an error is thrown during execution of the function, it returns ERROR (-1) indicating the plugin should clean up.

This is also the route taken if C++ code invoked by the called-back function throws an error.

11. Testing

There is a set of test scripts in the folder Test_scripts. Within this folder is a script `00_main.js` which is a test manager through which you can run the tests individually or all of them as a sequence.

To use this, set the current directory to be this folder using the plugin tools, load `00_main.js` and run it.

The test manager requires that many aspects of the plugin are working sufficiently, especially timers, dialogues and console calls. If it is not working sufficiently well, you will need to run the relevant script directly from its file.

The test manager running all the tests is a thorough check on the functioning of the plugin.

12. Trouble-shooting and debugging

Preferences panel diagnostics tab

There are presently two diagnostic functions available.

Dump

This opens a new window and dumps selected diagnostic information

1. Environment and version information
2. For each console, selected attributes, including the addresses used to chain the consoles together.
3. If a console has a Duktape context, the Duktape stack is dumped. In this can be seen global JavaScript variables, names of functions and the stack stacking.

Clean and dump string

During development we encountered several problems with difficult character codes. The Duktape engine only accepts 16 bit characters as defined in the ECMA standard. wxWidgets as used by OpenCPN, on the other hand, uses an extended character set. Further, if scripts have been prepared or edited in word processors, they may include many esoteric characters such as "smart quotes". These all throw Duktape. To deal with this, a script is cleaned using the function

```
wxString JScleanString(wxString given)
```

which translates know unacceptable charrs into the most likely acceptable to Duktape. But we have had problems, especially with the Windows environment.

If you encounter a problematic character, this tab lets you examine the character coding before and after cleaning and should help identify any character not being translated satisfactorily.

Obtaining dumps from with code

It is also possible to obtain dumps at an individual console level if the plugin has been compiled with

```
#define DUK_DUMP true
```

From within C++ code

The console method dukDump( ) returns the current Duktape stack dumped into a string.

The console method consoleDump( ) returns a string being a dump of the console, including the Duktape stack.

You can display these as you will, perhaps using TRACE such as

TRACE(3, pConsole->dukDump( ));

From within JavaScript

The Duktape stack can be returned as a string using duktapeDump( ) and consoleDump( ). Example:

print("Near end of script ", duktapeDump( ));

Throwing an error with C++ code

There is a JavaScript function `JS_throw_test(int1, int2)` which returns the sum of the two arguments except that if the two arguments are equal, it throws an error within the C++ code. This can be used to check correct functioning of this process.

Re-entrancy and checking for the wx_widgets main thread

To avoid re-entrance issues, it is assumed the plugin is always running on the main wx_widgets thread. There is a JavaScript function JS_mainThread() which returns true if this is the case.

I have never seen anything other than main thread but, if in doubt, this function could be used to check.

However, it seems that if the main script sets up a call-back, such as by OCPNonMessageName( ), that may be called before the main script has completed. A flag mRunningMain is set until the main script has completed.

Similarly, a flag mTimerActionBusy is used to guard against timer actions piling up on each other.

A flag `mJSrunning` is set true while the time is running. This is checked before a callback function is executed to avoid re-entering the JavaScript object code.

Descriptions of the above JavaScript functions are omitted from the user guide. The script window lexer colours them orange to warn users off.

Tracing

There are many trace statements in the code of the form
`TRACE(int level, wxString message);`

These have been extremely useful to observe what is going on.

`Level` is the level of tracing with 1 for key points that should always be traced and a higher number such as 5 for detailed tracing within loops etc.

The header file `trace.h` sets this up with the macro `TRACE_LEVEL` set to the required level. All trace statements whose level does not exceed `TRACE_LEVEL` will output their message. Set `TRACE_LEVEL` to 1 for key points only and to a higher number for detailed tracing of iterating loops etc.

If you want to trace just a point or two, use a level of 1 so this will avoid the other numerous `TRACE` statements.

When `TRACE_LEVEL` is set to zero, there is no tracing and the tracing is omitted entirely from the compiled code. **This should be the case for releases**.

When `TRACE_TO_WINDOW` is false, tracing output is sent to the OpenCPN log file, so avoid over filling it. When running in the test harness, output is sent to `stdout`. However, neither of these are desirable when long tracing is occurring. When `TRACE_TO_WINDOW` is true, a separate window will be opened to receive the trace. Be aware that this window is lost if OpenCPN quits or crashes.

Debugging using Xcode

On MacOS it is possible to debug the plugin using Xcode. These instructions assume you have set up Xcode and have been verified for Xcode v13.1.

You need to build the plugin with the debugging tables. In the ci/circleci-build-macos.sh script, you will find

```
10    cd build-osx
20    #     alternaive types of build are
30    #  -DCMAKE_BUILD_TYPE=RelWithDebInfo \
40    #  -DCMAKE_BUILD_TYPE=Release \
50    cmake \
60      -DCMAKE_BUILD_TYPE=Release \
70      -DwxWidgets_CONFIG_EXECUTABLE=/tmp/wx315_opencpn50_macos1010/bin/
80    wx-config \
```

In line 60 above, replace `Release` with `RelWithDebInfo or Debug`

Don't for get to change this back later.

Now build the plugin and install into OpenCPN as usual.

Launch Xcode and create a workspace or, if you already have an Xcode workspace, invoke it.

Within Xcode select the project navigator, extreme top left, by clicking on the folder icon. Then use the command `File > Add files` to add the src folder of source files. Click on the loaded folder and you will see the list of source and header files. Set breakpoints where you need.

There are two ways of proceeding here.

Attach to a running OpenCPN process

Have OpenCPN running and within Xcode choose `Debug > Attach to process` and choose your running OpenCPN.

Sometimes it is not possible to attach - no list of running processes appears. In this case, use the following...

Launch OpenCPN from within Xcode

Quit OpenCPN if running

Choose `Debug > Debug Executable...` and choose the OpenCPN application.

Close the window that opens.

Click on the run triangle and Xcode will launch OpenCPN.

Getting to your breakpoint

Within OpenCPN take whatever action is needed to reach your breakpoint. When the breakpoint is reached, you will find yourself back in Xcode where you can examine variables and set through the code.

I am set up so that Xcode is locked to one desktop and OpenCPN to another. When moving between the two, the appropriate desktop slides into view.

Appendices

A Road map for future development

I am interested in working with others to develop ideas for this plugin. I set up a Slack workspace to liaise with Mike. If you would like to join in, please contact me by private message.

I anticipate developments will include:

- Addition of further APIs as need identified
- ~~Documentation and a user guide~~ ✓
- ~~Making the scripting window more programmer friendly. At present it knows nothing of tabs, indents and braces. For other than the simplest script, I presently use a JavaScript-aware editor (BBEdit in my case) and paste the scripts into the script window.~~ ✓
- ~~Better resilience. At present there is no protection against a script loop. `while(1);` hangs OpenCPN!~~ ✓
- ~~Implementing the JavaScript `require()` function, which is like a C++ `#include` to allow loading of pre-defined functions, objects, and methods.~~ ✓
- ~~Running without the console window visible~~ ✓
- ~~Tidier and more consistent error reporting, even when the console is hidden~~ ✓
- ~~'Canned' scripts that start automatically~~ ✓
- ~~At present, if you want to do separate tasks, you would need to combine them into a single script. I have ideas about running multiple independent scripts.~~ ✓
- I do not use SignalK but note its potential. I am interested in input from SignalK users to keep developments SignalK friendly.
- Other suggestions?

B Stand-alone test harness

The early development of this plugin was done using a stand-alone harness that replaced OpenCPN. This allowed the plugin to be run without OpenCPN for exploration and detailed debugging.

This test harness was last used for v0.4. To use with later versions would require significant reworking. The instructions for building the test harness are included below should anyone want to follow this route.

This approach would require significant reworking because:

- V0.5 uses the extended API calls available in API 117. The test harness used API 116 calls. New stubs would need to be created in the test harness.
- The v0.4 plugin for MacOS was built using Xcode. The instructions for building into the test harness include copying settings from the building of the plugin installer.

Instructions for building the Xcode test harness for the plugin v0.4

Building with the `Test-harness` target compiles the plugin together with the `Test_harness.cpp` main program, which allows the plugin to be run from Xcode without OpenCPN. Most of the development work was done this way and only after all was working in the test harness was it built as a plugin and installed into OpenCPN.

Running the test harness from Xcode provides full debugging tools including break points, step-by-step execution and examination of variables.

To make this possible, `Test_harness.cpp` includes dummy stubs for what is missing in the absence of OpenCPN. In a few cases it contains code to return sample data as if from OpenCPN so that subsequent processing can be developed within the debugging environment. An example is `GetActiveRoutepointGPX()`.

I found no way to dummy out the building of icons and so that code is not compiled if the macro IN_HARNESS is defined, as it is when building the test harness.

Building the test harness in Xcode (verified for Xcode v11.6 & wxWidgets 3.2)

To establish the test harness in Xcode

1. Select File-> New > Target…
2. Select target type of *Command line tool* and click on `Next`
3. Enter *Test-harness* as the product name and `Finish`. This creates a target of Test-harness and a yellow group called `Test-harness`, which will contain a dummy main.cpp
4. Control-click on this group to add files and choose *Test-harness.cpp*, which is located in the Test_harness folder. Delete and remove to the trash the provided dummy main.cpp
5. Select target Test-harness
6. For the next steps it is best to open a second window (File>New>Window), so you can have both the settings for building the plugin and the test harness side-by-side.
7. In Build settings, select the `All` tab to disclose what is needed
8. Copy the following settings from the JavaScript-pi target Build Settings and paste them into the equivalent setting in the Test_harness settings. To copy all the settings, click on them once so they are selected and copyable without opening them as a list - otherwise you would have to move them one at a time.
    1. Within *Search Paths*, the *Header search paths*
    2. Add to the search paths the folder *JavaScript_pi/buildosx/wx_includes* which contains wxWidgets headers. You can add an empty line using + and then in Finder drag the folder into this space.
    3. Copy across within *Apple Clang - Preprocessing,* the *Preprocessor Macros*
    4. To the Preprocessor macros add an extra line to define: IN_HARNESS
9. In Build phase settings
    A. add Compile sources using the + button to add the following files from the group *Source Files*:
        1. JavaScript_pi.cpp
        2. JavaScriptgui.cpp
        3. JavaScriptgui_impl.cpp
        4. JSExtensions.cpp
        5. OPCNapis.cpp
        6. optional.cpp
        7. duktape.cpp

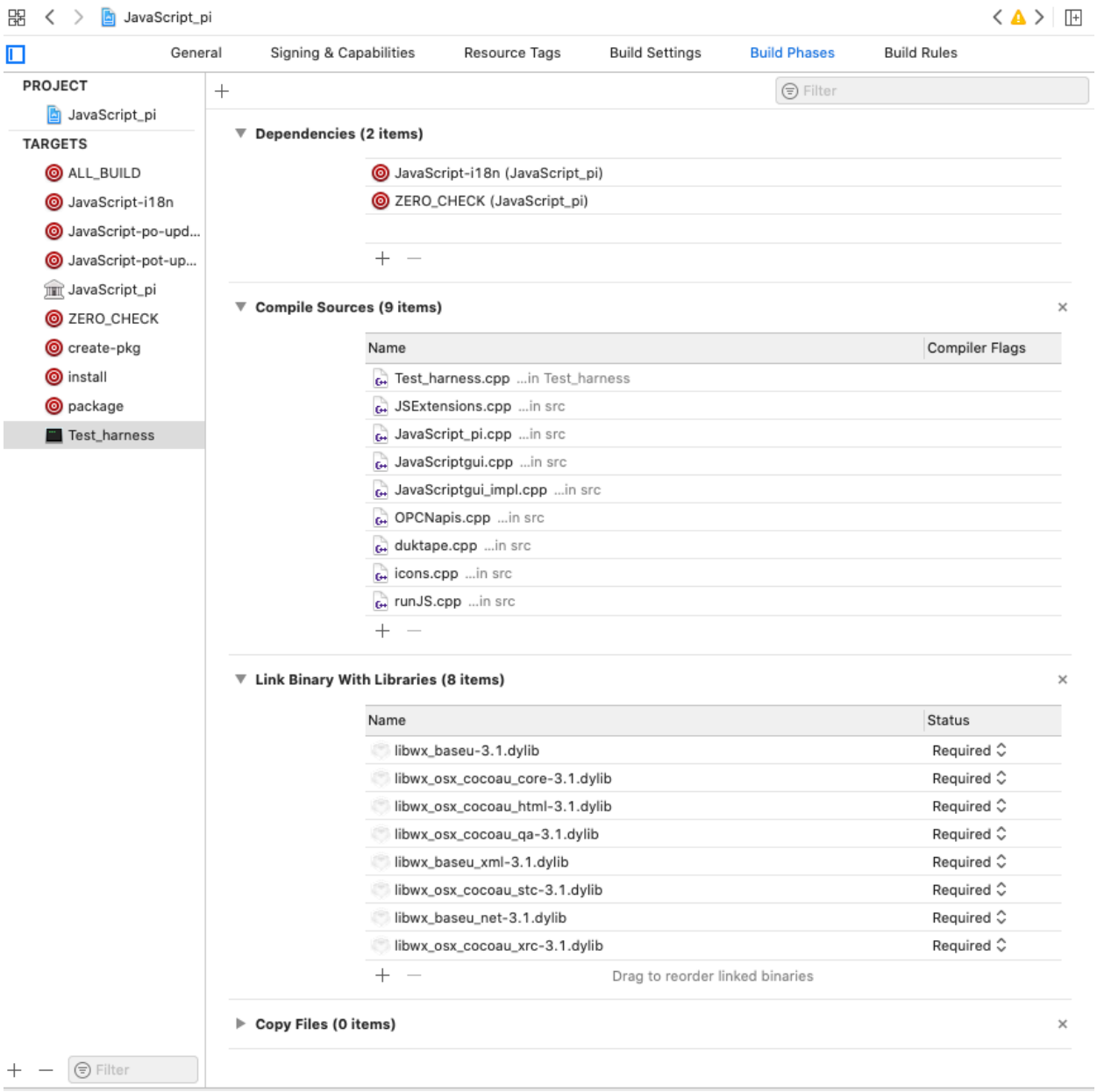
8. icons.cpp
9. JSlexer.cpp
10. JSdialog.cpp
11. functions.cpp
12. toolsDialogGui.cpp
13. toolsDialogImp.cpp
14. and from the *Test_harness group*, Test_harness.cpp

B. Add Dependencies selecting
   1. JavaScript-i18n
   2. ZERO_CHECK

10. To build the test harness, you will need to link it to the required wxWidgets libraries normally provided through OpenCPN. They are available in JavaScript_pi/buildosx
    1. In the *Build Phase* tab, disclose the *Link Binaries With Libraries* list and drag all the libraries from *buildosx/wx_libs* (8 files as of now) into this list.
    2. In *Build Settings* within *Search Paths*, open *Library search paths*
    3. Drag the icon for J*avaScript_pi/buildosx/wx_libs* into the field. It may insert the full file path or something like *$(PROJECT_DIR)/for_MacOS/wx_libs*

NB When the plugin is built as a dylib, we have to include in the compile list all 145 source files for scintilla as we cannot link its library into the installer. For the test harness, we can link them from the stc library, so it is only necessary to compile the plugin code files plus the test harness itself.

It should now look something like this:



You can now build the test harness and the console window should open. While running the test harness, the full riches of Xcode are available to insert break points and inspect variables, etc.

When the `require` function is given a simple module name, it looks for the scripts library build into the plugin. When running the test harness, it attempt to load the module from the library in the OpenCPN application. So it is necessary that the plugin has been installed in the application first and that it is located within the applications folder.

Duktape test

There is a folder JavaScript_pi/Duktape which contains a command-line utility for testing Duktape stnd-alone. You could build a separate Xcode target `Duktape test` for it. I have not used this after an initial check, preferring to do testing in the test harness as described above.

Document history

Version	Date	
0.1	19 Jul 2020	Initial version to accompany the plugin v0.1
0.2	20 Aug 2020	Update to accompany plugin release v0.2
0.3	14 Nov 2020	Update to accompany plugin release v0.3
0.4	7 Feb 2021	Update to accompany plugin release v0.4
0.5	26 Nov 2021	Update to accompany plugin release v0.5
1.0	26 Jan 2022	Re-issue to accompany plugin release v1.0
1.1	1 Mar 2022	Minor corrections and clarifications to accompany release v1.1
2.0	12 Nov 2022	Re-issue to accompany plugin release v2.0