WHITE PAPER

MARINE ELECTRONICS

How to make use of Mobile Apps Onboard.

CONTENTS

INTRODUCTION

The software industry is a weird place to work. Nothing is real; as in solid.

It used to be that you built a factory to build a car and competitors not only had to come up with the knowledge and learning you had made, but they also had to invest huge amounts of money to create the factories and designs just to start to compete.

But today in the software industry, our "car" is a universal computer, or an iPhone or Android device or a normal computer and the software changes it into a navigation device, or weather station or AIS monitor… as if you could plug a new CD into your car and change the colour or number of wheels, or the type of engine.

As a result, new players enter the market all the time. The barriers to entry are low and the competition breeds a fierce environment where change is quick. Simply, if you are not doing it significantly better than the last guy, you're dead in the water tomorrow.

Mix this into the marine software market and you have a potent brew that should quite rightfully terrify incumbent marine electronics companies. BUT IT SHOULD REALLY EXCITE YOU.

This is the main reason why getting into the software driven marine application market is something that you should strive to understand, come to grips with and make sure you are in a position to take advantage of.

Software is of no use without data. If I cannot access your boat speed or depth or position reliably then the value of what a software application can do is greatly diminished.

This data flows around your boat on an NMEA network. Either a 0183 or 2000 version.

If you can make this data available to applications on a TCP/IP based network (Wi-Fi, 4G mobile or physical networks such as your work or office TCP/IP based networks) then you are suddenly in business.

The next great leap forward in navigation or some other marine software application will suddenly be available to you, probably via the easy download of an app.

Because of the competition and rate of change in this world, it will probably be cheaper, faster, better, and next week will have more features.

The purpose of this White Paper is to demonstrate that this isn't hard to do, and it is something you should consider investing in.

Here are a few reasons to consider why you need NMEA data on your TCP/IP based phone or tablet.

- To add a separate chart plotter to your boat so you have redundancy in navigation will cost you upwards of £4000, or you could build your own for less than £400 if you have a network to hook into. You can also subscribe to an android or iPhone app such as iSailor, iNavX, or even Navionics for a fraction of the cost and get cheaper faster updating maps to boot. Without building anything.
- You can add more flexibility in your boat electronics suppliers
- Accurate and reliable anchor alarms, wind alarms, forecast alarms, depth alarms etc.
- Debugging of your NMEA network for the cost of a download.
- Integrate Grib file downloads into your navigation software.
- Add devices to track and graphs such things as water temp, barometric pressure, average wind speed (histogram).
- Be ready for the next step advance in marine software developments.

WHAT'S AVAILABLE NOW? IS IT WORTH IT?

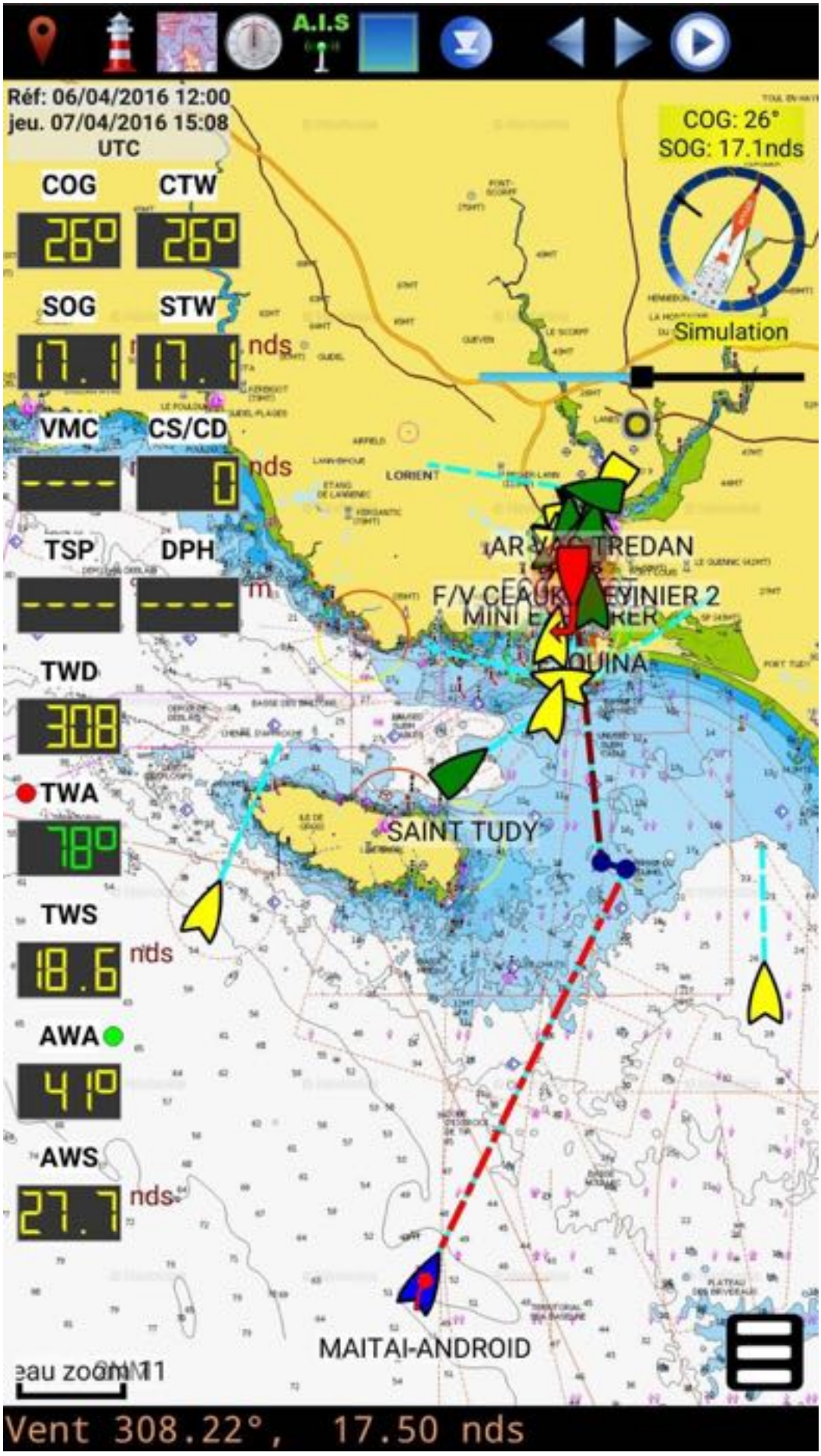
NMEARemoteby Zapfware:

Zapfware develop NMEARemote.

There is a free version and a paid version. The paid version retails for about $14.

It allows you to track, monitor and display just about every type of NMEA data that is available. It can calculate polar charts, set alarms on wind, depth, just about anything. It can work as an anchor alarm, monitor fuel/waste/water tanks, battery levels etc. if they are available on NMEA.s

I PERSONALLY USE THIS AND HAVE FOUND IT QUITE AMAZING FOR THE PRICE OF BREAKFAST. I USE IT TO ALARM FOR WIND INCREASES DURING THE NIGHT OR UNEXPECTED DEPTH CHANGES AND MANY MORE THINGS WHEN I AM AWAKE.


A.I.S
Réf: 06/04/2016 12:00
jeu. 07/04/2016 15:08
UTC
COG: 26°
SOG: 17.1nds
COG
CTW
26°
26°
SOG
STW
17.1
17.1
nds
Simulation
VMC
CS/CD
nds
0
LORIENT
TSP
DPH
m
AR VAG TREDAN
F/V CEAUX
MINI
QUINA
TWD
308
TWA
78°
SAINT TUDY
TWS
18.6
nds
AWA
41°
AWS
27.7
nds
MAITAI-ANDROID
eau zoom
Vent 308.22°, 17.50 nds

qtVLM is a fully featured navigation software that aims to replace your MFD on a tablet, computer, Raspberry Pi, Apple, Windows you name it.

Free on some platforms and a reasonable price on mobiles and tablets it provides everything other than radar integration, which I am sure will be coming in a future release. It is being refined and updated very quickly and I am usually at least two versions behind as I update as I feel I need to. When was the last update or a new feature added for your Chart Plotter????

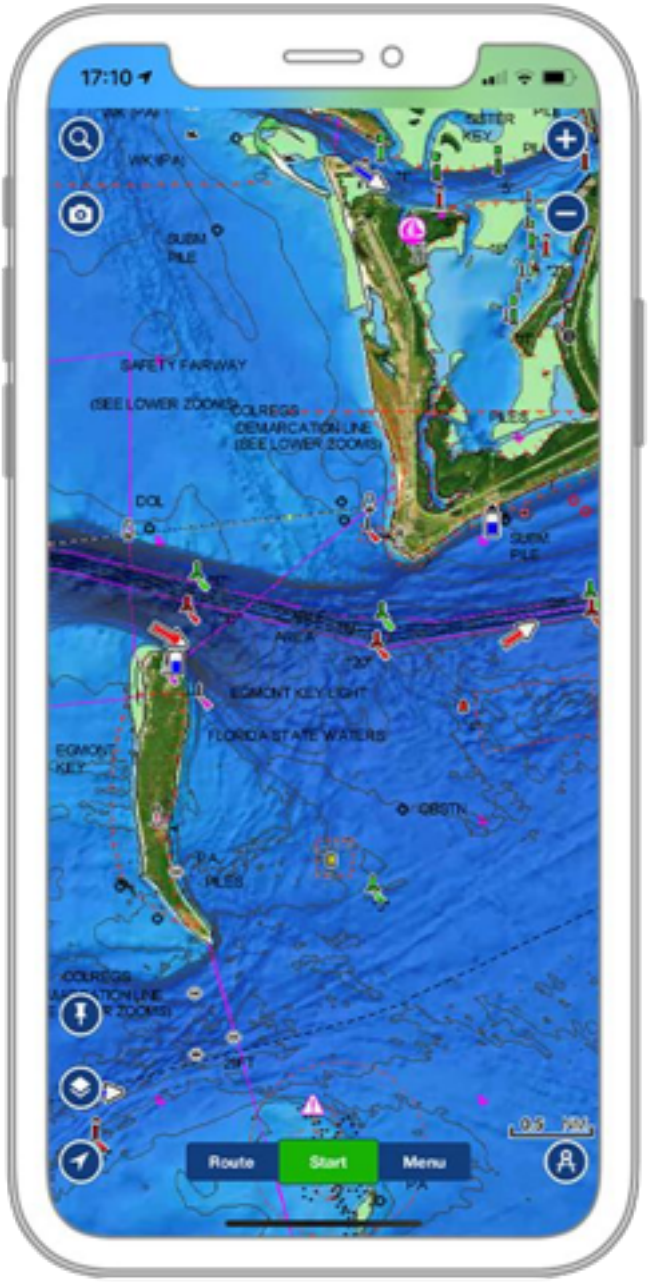
The AIS tracking, interface and useability is far preferred by my partner, especially for night passages and this software runs on my own personal Raspberry Pi home-made MFD in the saloon.

Very valuably it integrates directly into the NMEA data stream and has such 'nice to sees' as TWS histograms, GPS track and such like. We often use these features to check we are not dragging and to check the wind trend. It can be very comforting to my Admiral when she sees the TWS trending down in a graph, showing the storm is slowly passing.

There are too many features here to discuss in full, so I strongly recommend you take a look at the website link. INSERT LINK?

P.S. I also use OpenCPN but as this is a more reliable development and also has a much faster development cycle, I find it far more stable and useable than OpenCPN.

The only feature I really would like to see, which is why I still use OpenCPN as well, is radar integration.



Navionic boat app is a fully featured MFD that provides most (not all) functionality you would expect from an MFD.

I personally use Navionics maps on my main MFD so sometimes will use this app. It is solid and considerably cheaper to provide maps for than my MFD, although the maps are both just as good and more dynamic using crowd sourced data to enrich things like soundings.

Wärtsilä iSailor is a fully featured MFD replacement software available for phones, tablets and the iWatch.

I personally use iSailor for my route planning and as a backup to the MFD should I need a separate view.

iSailor comes with (you pay for) Wartsila maps which are commercial grade. Wartsila are a major player in commercial mapping and applications for tankers et al and have proven extremely reliable, even more so than my main MFD charts. To give you an idea of cost the charts for the Caribbean Sea, Cuba, Cayman islands, Jamaica and Hispaniola are roughly $25. They are very regularly updated and highly detailed.

The features and speed with which I can plot a course on the iPad, export them to both the MFD and our RPi (Saloon MFD built using Raspberry Pi) which then means I can compare the course on three different charts and even satellite imagery if I choose.

Logbook App connects to your NMEA data and then routinely tracks and logs position, speed, wind, depth, tanks etc. etc.

We use this as our main logbook for the boat. We have it set to automatically log every 30mins when underway. We also add manual log entries, complete with pictures, narration etc. Even with manual entries we automatically get all the data that is available from the NMEA logged.

Then at the end of each leg we print out a hard copy of the log and keep this in a binder. We also share the log with some interested readers with a simple email attachment.

The app is extremely cheap for what it offers, and we bought it in a bundle that has given us even more value.

App Icon	App Name	External NMEA	Charts	AIS	Instruments	Weather + Tides	Racing	Price
	Aqua Map	✓	Official Vector	✓	✗	✓	✗	FREE (IAP)
	Boat Beacon	✓	Apple Maps	✓	✗	✗	✗	£
	Boat Instruments	✓	✗	✓	✓	✗	✗	£
	Boating	Depth+GPS+ AIS Data Only	Navionics	✓	✓	✓	✗	£££
	C-MAP	✗	C-Map	✗	✗	✓	✗	FREE (IAP)
	Charts & Tides	✓	USA + Canada S57 Vector	✗	✗	Tides Only	✗	FREE (IAP)
	iAIS	✓	Navionics	✓	✓	✗	✗	FREE (IAP)
	Imray	✓	Imray	✓	✓	✓	✗	FREE (IAP)
	iNavX	✓	Navionics + Official Raster	✓	✓	✓	✗	FREE (IAP)
	iRegatta 2	✓	Navionics + Transas	✓	✓	✓	✓	FREE (IAP)
	iSailer	✓	Transas	✓	✓	✓	✗	FREE (IAP)
	NavLink HD	✓	Official Vector	✓	✓	✓	✗	FREE (IAP)
	NKE Pro	✓	✗	✗	✓	✗	✓	FREE (IAP)
	NMEAremote	✓	✗	✗	✓	✗	✗	££
	NV Charts	GPS+AIS Data Only	NV Digital	✓	✓	✗	✗	FREE (IAP)
	qtVLM	✓	Official Vector + Raster	✓	✓	✓	✓	FREE (IAP)
	Sail Racer	NMEA + Signal K	Raster	✗	✓	✗	✓	FREE (IAP)
	SailTimer	Wind Data Only	Navionics + Official Raster	✗	✓	✗	✓	££
	SeaIQ	✓	Multiple Vector + Raster	✓	✓	✓	✗	FREE (IAP)
	SeaNav	✓	Official Vector	✓	✗	✓	✗	FREE (IAP)
	SeaPilot	GPS+AIS Data Only	Official Vector	✓	✗	Weather Only	✗	FREE (IAP)
	TZ iBoat	✓	Navionics + C-Map + Raster	✓	✓	✓	✗	FREE (IAP)
	Mid Wi-Fi	✓	OpenStreet Map	✓	✓	✗	✓	££
	Weather4D	✓	Geogarage	✓	✓	✓	✓	£££
	WilhelmSK	Signal K	Navionics	✓	✓	✗	✗	££

DigitalYacht have a great PDF review of some of the better apps available. It's worth a look and read.

These are just the apps I use personally. As you can see, they are worth it, and I can testify that these apps have proved reliable and in some cases invaluable.

GETTING NMEA ONTO A TCP/IP WIFI NETWORK

The NMEA bridge

To join the two networks together, i.e., get NMEA data onto the TCP/IP network and instructions back onto the NMEA we need a device called an NMEA bridge.

There are lots available, but the important thing is that you get one that has the right connections to your NMEA network (See the white paper on NMEA networks) and of course to your TCP/IP network.

You can get these with Wi-Fi built in so you can get your NMEA straight onto a Wi-Fi network where it can be consumed by your phone or tablet, but this does not give you a lot of control over how you setup that network. You may end up with a Wi-Fi for NMEA and another for your boat so you can't see both Netflix and NMEA data at the same time.

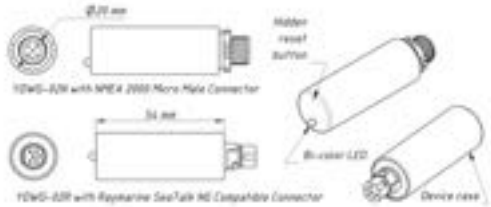
If you plan well, you can get a Wi-Fi enabled NMEA gateway that also has the ability to connect to a normal TCP/IP network later on. The choice is one of complexity and what you want to do eventually with your network vs simplicity and fast easy results.

See: Whitepaper - Marine Electronics - How to build your own Boat network and WIFI for more information on how to plan for the future with your setup.

What's Available for NMEA Bridges

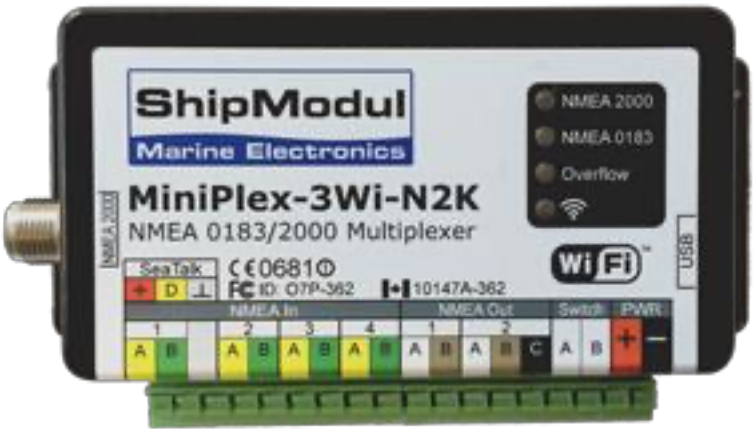
Including WIFI

Yacht Devices make a small and completely capable bridge in either wired or Wi-Fi format.



They retail for around the $200 and come with a Web interface for configuration and setup.
See: How NMEA over TCP/IP works

They also have models that are aimed at 0183 networks as well.



ShipModul have several gateways, both Wi-Fi and wired, 0183 and 2000.

Digital Yacht also have several gateways. They range from simple 0183 to Wi-Fi through to a universal unit that can pretty much connect any boat network to Wi-Fi.

NOTE: Digital Yacht also have a number of SeaTalk interfaces for older boats that are using SeaTalk.

Actisense Also have several options for bridging NMEA onto Wi-Fi.

Including WI-FI and Wired Network.

Digital Yachts iKommunicate – Universal NMEA Gateway is the only gateway I know of that has both Wi-Fi and wired network connections.

There may be others, but mostly they tend to offer built in Wi-Fi or hardwired ethernet.

MY Own Installation

I went for a simple Yacht Devices unit that took the NMEA data and put this onto the physical TCP/IP network. I would then make this available via my own Wi-Fi and make sure it was all on the single network that I could control as I liked.

It's just as valid to use an NMEA gateway with Wi-Fi built in. My reasons for going the way I went were: (See: Whitepaper - Marine Electronics - How to build your own Boat network and WIFI)

- Speed of operation – I wanted to build an MFD and have that connected directly to a hardwire network. It would need access to the NMEA
- Resiliency: Wi-Fi transmitters create heat as part of their operation and as such often suffer from shorter lives, heat kills electronics.
- Wi-Fi built into smaller devices, like gateways, can have shorter lives as a result of the above.
- by connecting the NMEA to the hardwired TCP/IP network I created a more resilient gateway and then have multiple possible Wi-Fi transmitters available as well as these being larger more heat tolerant devices.
    - My. 4G router can do Wi-Fi
    - My DHCP server can do Wi-Fi
    - I have a spare Wi-Fi router on board as well.
    - Plus the mesh system I use consists of 3 separate Wi-Fi transmitters that can all do each other's jobs.
- I have also considered a second NMEA gateway which would allow me complete redundancy; this would be much harder to accomplish with a WIFI built in gateway. But not impossible.
    - **NOTE**: I have not implemented this yet because of cost.
- Built in Wi-Fi requires other services to be built in, such as DHCP, DNS etc. Separating these out allows me more redundancy and flexibility in my network as I add more features and components. Such as:
    - Opensource MFD
    - 4G router for mobile connectivity
    - Satellite connection
    - External AIS transmitter with independent GPS receiver
    - Weather station, Barometer etc.
    - Network Attached Storage (NAS)

Plugging in an NMEA Gateway device

The NMEA gateway connects to a NMEA backbone, in my case behind the Nav station and then plugged into the TCP/IP router behind the nav station.

If you are using a gateway with built in Wi-Fi plugging it into the NMEA network is all you need to do, apart from the configuration of it.

Now because of the variations of NMEA connectors, identifying the correct connector you need for your gateway can be a challenge. See: Whitepaper - NMEA Networks simplified for an understanding on how to identify your particular connector.

You'll need to either order your Gateway with the correct connector or perhaps an adaptor to join it to your NMEA network.

- *For instance, on my boat the network is all NMEA 2000 B&G but the backbone uses SIMNET connector blocks. The gateway I purchased (Yacht Devices YDEN-02) does not come with an option for SIMNET so I purchased the Micro-c connector version and an adaptor cable from Micro-c to SIMNET.*

Shown here is an NMEA backbone with the YachtDevices NMEA gateway plugged in, via a Micro-c to SIMNET adaptor cable.. The cables from the back of the Gateway (out of picture) then runs off to the router and connects with a simple RJ45 plug at each end (its an industry standard network cable for called Cat5 or Cat6).

HOW NMEA OVER TCP/IP WORKS

NMEA is a simple data stream. Little packets of information are broadcast over the network continually by devices and systems so that it's available for consumption by any other device on the NMEA network.

These packets of information are called sentences and each sentence describes something of value like depth, location in GPS coordinates, speed etc.

When you move this onto a TCP/IP network it is presented to applications on the TCP/IP network as a service that is streaming this data. That service has an address, like any other device and a thing called a port.

In the network world a service is some software that provides “Services”. A webserver is a web service running on a computer.

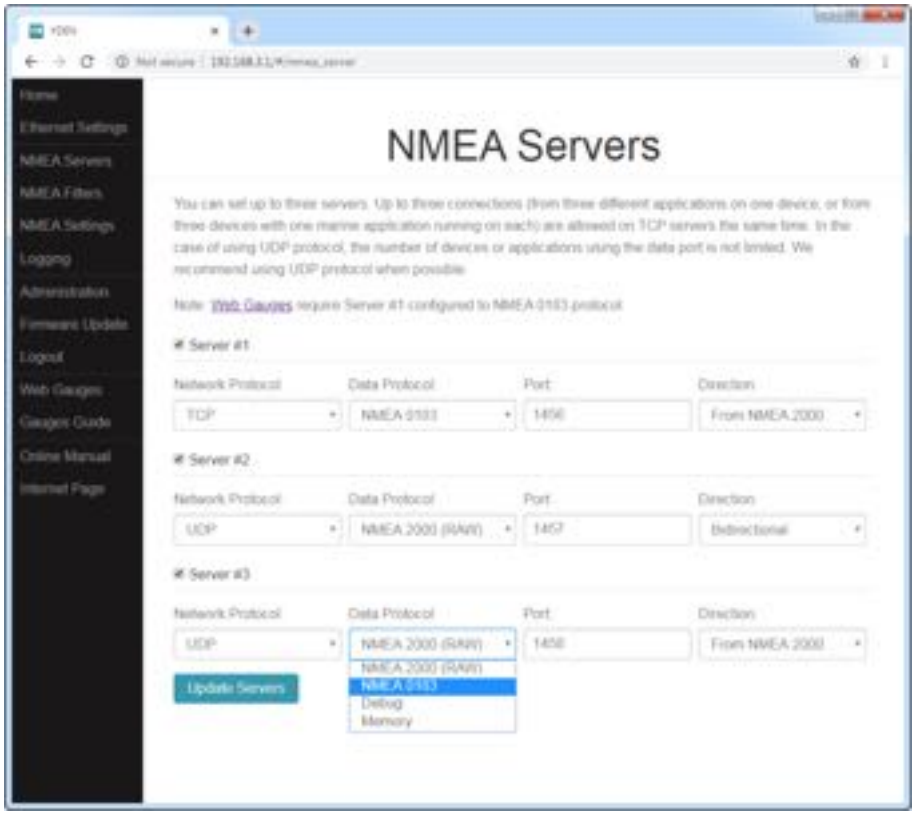
To give you an idea of how this works a website is a service that presents HTML data over port 80 (or 443 if you are using SSL).

If you are browsing www.sailingwaiata.com over HTTPS you would be connecting to 139.59.161.151 on port 443 and what you would be getting back is HTML code for the website to be interpreted by a browser and displayed.

The combination of the IP address (the machine address, like a phone number, 139.59.161.151) and the port (the service address on that machine, 443) allow you to access data over what’s called a protocol (a way of talking that both devices understand), so for instance, HTML for web pages. The difference between port 80 and 443 is that 443 routes the data stream through a secure encryption software and port 80 does not.

To get the NMEA data on your TCP/IP network, first you need to setup these servers using an interface on the NMEA Gateway. The interface is usually a web interface (over port 80/443) that presents you with a screen to configure things like IP address, port etc to use for the NMEA streaming.

This is what mine looks like:



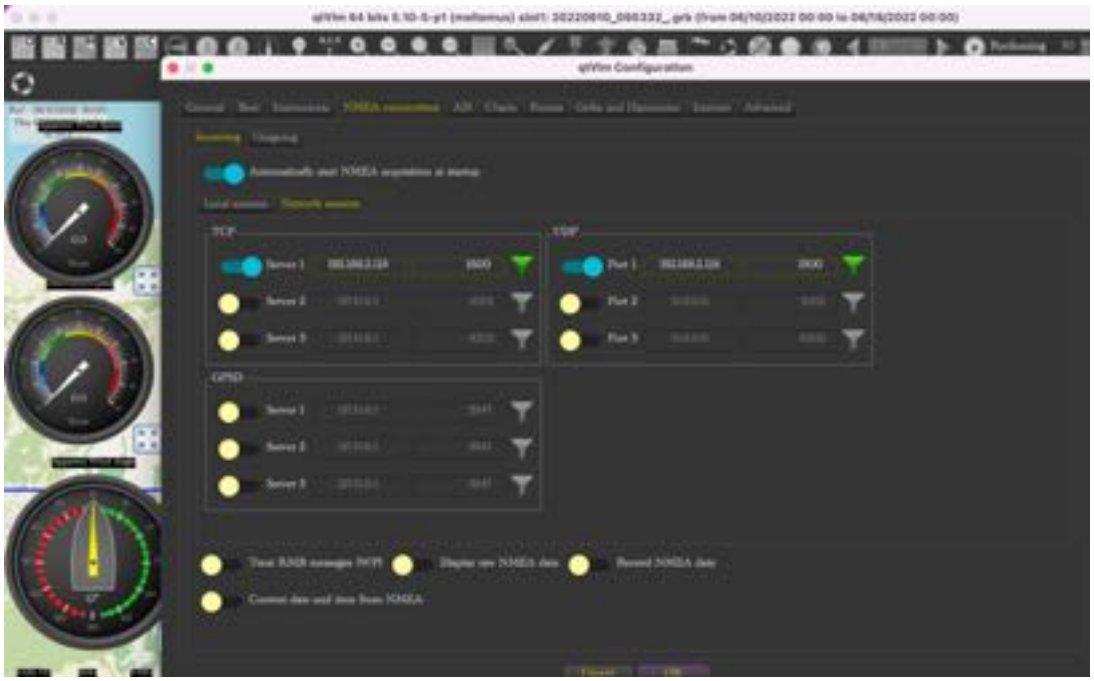
SETTING UP YOUR APPLICATIONS TO USE THE NMEA DATA

Once setup you then need to tell any application you might be using where to go to get the NMEA data.

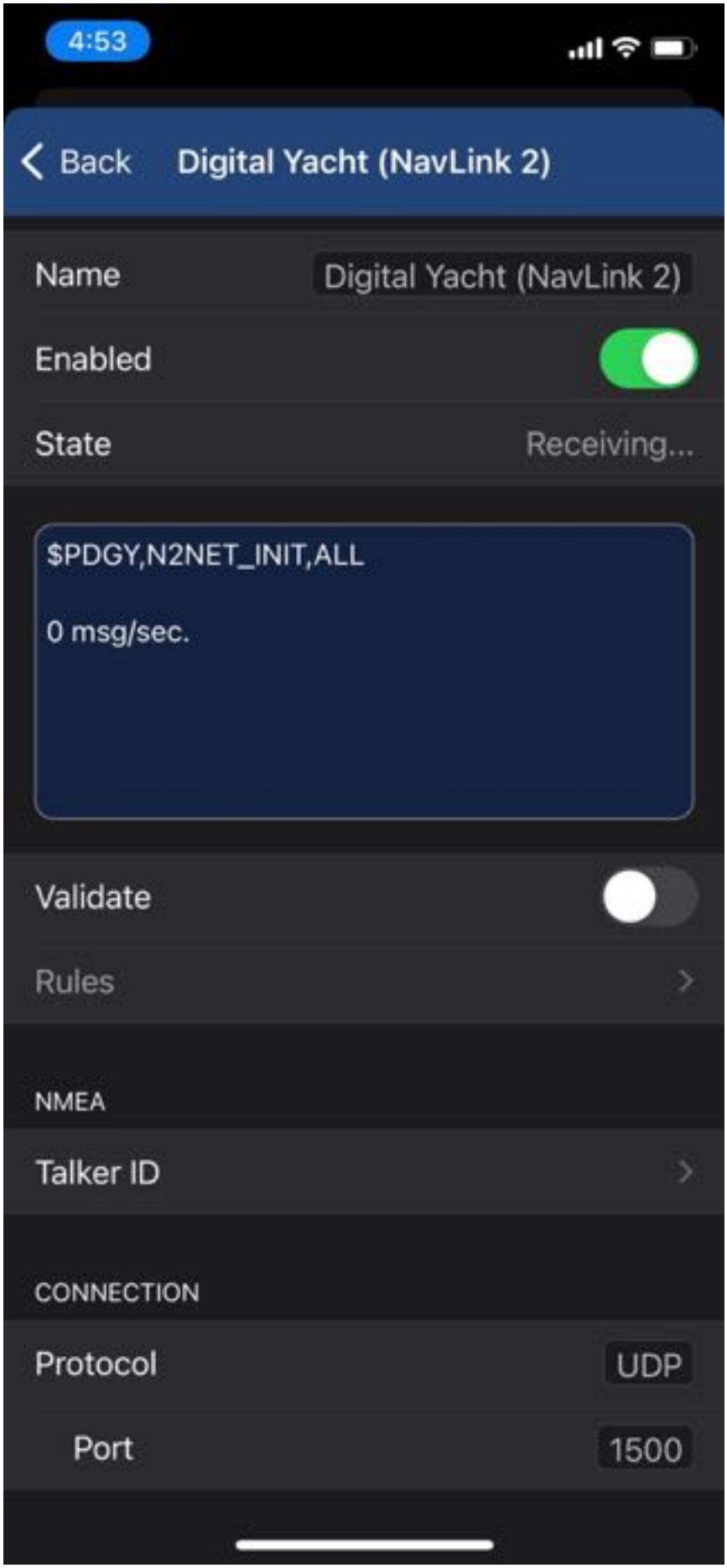
This will vary for each application and each applications documentation will tell you how to set it up.

For instance, on my Chart plotter (RPi) I use qtVLM for plotting and AIS et al. In its configuration page I go to NMEA Servers and set the same details as I have setup on the gateway.

This is what that looks like



On NMEARemote on my iPhone I set it up like this


4:53
Back
Digital Yacht (NavLink 2)
Name
Digital Yacht (NavLink 2)
Enabled
State
Receiving...
$PDGY,N2NET_INIT,ALL
0 msg/sec.
Validate
Rules
NMEA
Talker ID
CONNECTION
Protocol
UDP
Port
1500

CONFIGURING THE IP ADDRESS IS QUITE IMPORTANT

I also make sure that the IP address I assign to my gateway is a static address in my DHCP server so that it doesn't change between restarts, or I would have to keep updating every device that wants to listen to that data.

With my setup, a wired network with separate DHCP servers etc. this is relatively easy for me. Depending on your own setup this may not be so easy or be very simple.

If you are using a Gateway with Wi-Fi built in this WILL BE SIMPLE because the device will control its own IP address and it will be static. This will be covered in the documentation about how to set it up that comes with it.

IF YOU ARE USING A GATEWAY WITH BUILT IN WIFI, YOU CAN JUMP OVER THE REST OF THIS SECTION.

If, however you are using a wired (instead of Wi-Fi) gateway you need to make a few choices about where you DHCP will be, and then how you allocate an IP address to your gateway that won't change all the time for you.

On my network I have a separate DHCP server, and I just allocate a static IP there for my gateway, but you'll find (same in my case) that the gateway probably has as simple DHCP server built in and you might want to disable or use it.

The best approach on how you do this is open to debate and you should probably read through See: Whitepaper - Marine Electronics - How to build your own Boat network and WIFI if you want to take this route.

Again, built in Wi-Fi on your gateway is simpler to setup but more limited in some ways. I'm happy to help with advice if this gets a bit confusing, just send me a message or call me. You'll find my details on the website under the IT Sailor section.

What you need to know about protocols

When you setup your NMEA Server on the Gateway (or servers) you'll be asked for IP address, protocol, and ports to enter.

- The IP is the address you assign (or is assigned) to the gateway device (it allows addressing the actual device, sort of like my home address).
- The port can be anything, but I suggest that you stick to around the 1400-1500 numbers as other numbers are defined as different things and although it will work if you put it on 80 for instance, your management website might not work anymore. You get the idea. This addresses the service on that device, sort of like address mail to me or my wife at my home address, we would be different ports.
- The protocol needs to be TCP or UDP (in most cases) and this you need to understand a little about. (I have setup both and use both on my network, because TCP is limited to 3 connections, but UDP is not. They both work very reliably and without issues).

So what's the difference between TCP and UDP?
TCP/IP is a protocol set. A protocol is a set of rules that allow two parties, or devices to communicate using those rules to understand what is being said.

You could say that English, French and German are different language protocols and that inside them there are subprotocols such as formal, informal etc.

TCP is a protocol for communication that runs over IP. This subject can get complicated but to keep it very simple you can think of TCP as the one-to-one communications language over IP which allows you to address the messages. i.e., I can address you using your phone number (IP) and we talk German (TCP) to understand each other.

UDP is the other Protocol you need to be aware of when setting up a network and most importantly setting up things like NMEA. Unlike TCP which is a personal connection, and you need to establish a connection first, UDP is more like a broadcast, and you just need to understand how to "tune in" to the broadcast.

The big difference is that to configure NMEA (for instance) using TCP you need to have the IP address of the specific device that is supplying the data **AS WELL AS** the port number for that service.

But with UDP you only need the network/Subnet that the data comes from and the port, you don't need to know the actual IP address of the device.

Also, a BIG difference that might catch you out if you get more complicated with your network design, UDP is **NOT BROADCAST OUTSIDE THE SUBNET** but TCP can travel across the entire internet if need be.

The other big difference is that the device being addressed needs to maintain that connection for TCP so there is a limit as to how many it can cope with, think personal phone call, whereas UDP is a broadcast and everyone on the subnet can listen if they want.

My own NMEA gateway device can only support 3 TCP connections at a time to the server, whereas UDP is unlimited.

UDP also does a datagram checksum, so you know if it's been corrupted during transmission or you have only received part of it, but no negotiation mechanism (because it's a one-way communication) so unlike TCP where the receiving device and sending device can ask for resends and confirmation etc. if you get an error with UDP, tough. You'll need to wait for the next transmission. This is less of a problem than you might think.

KEY FINDINGS

- Getting NMEA data onto your boats network can open an amazing number of options for a boatie.
- Software options and charts can be cheaper, faster developing and more flexible.
- You need an NMEA Gateway to bridge NMEA data onto a Wi-Fi network
- NMEA Gateways can come with Wi-Fi built in meaning that one purchase can have you able to leverage mobile/tablet apps via Wi-Fi
- NMEA Gateways with built in Wi-Fi are not the most flexible solution BUT are simple and easy fixes to get NMEA data onto mobile devices.

CONCLUSION

The days where competition in marine software have a high barrier to entry and proprietary are coming to an end.

Just like the PC market before it, software driven solutions based on standards-based hardware and universal computing devices are the future and will result in rapid expansion of the number of developers and suppliers in the marine IT market.

This is pushing a need for highspeed networks and Wi-Fi on boats.

Although the author would argue, adding a highspeed wired network to your boat with Wi-Fi as an addition to this would make better long-term sense from a feature, future and resiliency point of view, nearly 90% of the currently available benefits can be obtained with a simple Wi-Fi NMEA Gateway device for circa $2-300.

This investment can be repaid in the first year of operation if not the first few months just on charting costs alone and opens up a huge benefit of features that are not currently available to boaties otherwise.

Whether the approach of fuller solution or a simple Wi-Fi NMEA gateway is taken, connecting your boat CANBUS (NMEA) to a highspeed Wi-Fi able network is very easy to justify and highly recommended.

NOTE: This article was designed to help a decision process and arm you with much of the information you might need. This is in no way sponsored or money making for us, examples of what I have chosen are simply here because I WILL get asked this otherwise.

Further, I understand that this can be daunting for the non-IT sailor and as such freely offer my help and invite you to contact me if you need further help or advice. I don't see my time in doing this as anything more than paying back/forward what has already been offered to me for free during my learning curve as a sailor.

CONTACT DETAILS:

Feel free to contact me on GREG@ABBISS.CO.NZ or WhatsApp +447495739753

Good luck with your future boat network.