Signal K - The Internet of Things Afloat & Next Generation Interfacing
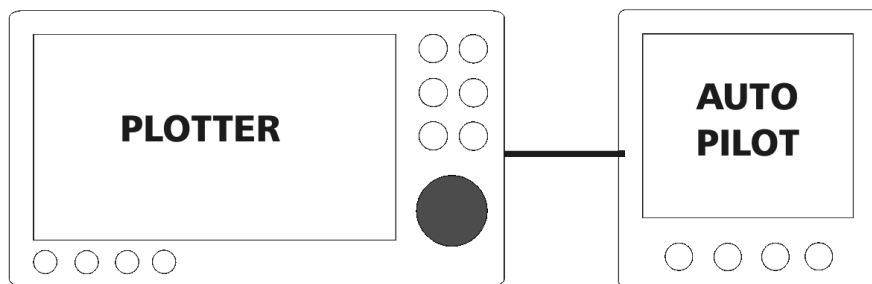
White Paper

Background

Many boaters will be familiar with the NMEA data standard for interfacing on board electronics and allowing devices like instruments, GPS, chart plotters and autopilots to communicate and share information. The first variation of NMEA 0180 was developed nearly 40 years ago allowing devices to communicate using a simple two wire interface. Other versions then followed leading to NMEA 0183 which became ubiquitous. Over the past 10 years, the newer NMEA 2000 standard has become widely used by all major manufacturers' of marine electronics. Many, like Navico and Raymarine "customise" this standard using their own physical connector format (Simnet and SeaTalk NG respectively) but the core data used for interconnection is based on and compatible with the NMEA 2000 data standard.
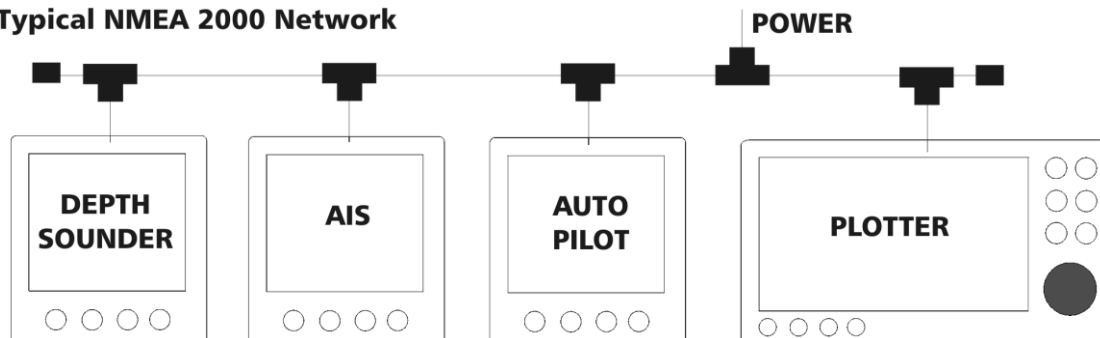
Why Another Standard?

There are both technical and legal issues with the current interfacing standards that have created demand for a new data format. NMEA 0183 (based on RS422) is limited to 4800 baud and 34,800bps in high speed mode, with just one transmitting device (Talker) connected to multiple receiving devices (Listeners). At these slow speeds there is a very limited bandwidth for information and combining multiple devices is difficult or requires the use of multiplexers.

Traditional NMEA 0183 Network

NMEA 2000 works at a higher bit-rate (250kbps) using CanBus protocols and allows multiple devices to transmit and receive on one shared bus. Devices are prioritised, but with a limit of 50 physical devices on a bus and compared to today's world (where we are familiar with 100/1000MB networks on all our consumer devices) it has limitations. It is, however, very fault tolerant and reliable, which for your key navigation and engine data is an extremely important consideration. With a large number of existing installations and all the current (2015) major marine electronic products supporting this standard, it has inertia and will remain the core data network on most boats.

Typical NMEA 2000 Network

The NMEA data standard also has some legal issues in that developers of both hardware and software applications must pay for documentation and certification of products. This helps with reliability and inter-operability but can act as a barrier to small start-ups or individual developers who are driving fast paced innovation.

Signal K

It's clear that NMEA interfacing has an important role to play and is here to stay, especially with the long term investment made by many customers in NMEA 0183 and NMEA 2000 based systems. But, in today's internet connected world, these older standards just cannot provide applications with the functionality that we see in the consumer electronics world. It was this need for a new modern way of communicating that caused a group of open source developers and boating enthusiasts to develop a new platform called Signal K. The name comes from the original signal K (kilo) flag which indicates "I want to communicate"!

Signal K aims to be the next generation solution for marine data exchange. It is intended to be used not only for communication between instruments and sensors on board a single vessel but also to allow for sharing of data between multiple boats, aids to navigation, ports, marinas etc. It is designed to be easily implemented by web and mobile applications and to connect boats and ships to the Internet of Things.

> NMEA recognizes the Signal K Open Source project as it serves the need and creates a method that allows both large and small mobile app developers to get involved with NMEA networking. NMEA will recognize this through the means of a NMEA 2000 certified gateway as it does for all other protocols. Signal K developers will need to use a NMEA 2000 certified and fire-walled gateway for the physical interface -- either standalone or built within a display. This protects the NMEA Intellectual Property and the investments of years of development by many manufacturers worldwide. This method allows the NMEA Intellectual Property to be locked by the gateway as stated in the NMEA 2000 License Agreement. Only this style gateway can perform the translation from NMEA 2000 to Signal K. The gateway requirements are defined in NMEA 2000 Appendix H "3RD Party Gateway Requirements." This potential new gateway is treated by NMEA no differently than any other certified gateway on the market, such as a NMEA 2000 to J1939 as an example. If NMEA members wish to get involved in Signal K, more information is available at http://signalk.org/

By taking data from the "closed" industry standard networks found on most boats and converting it to an "open" HTML5 based internet ready data format, a whole new world of social and connected boating will now be possible. Interestingly, the NMEA organisation has embraced Signal K as per the statement here

Mobile and web developers will be able to create a new generation of apps and cloud based solutions that will provide boat owners with the same experience on the water, as they get on land, making boating more exciting, safer and accessible.

Both NMEA standards and the other proprietary protocols in the industry were developed when the instruments on the average boat were much simpler and much less capable. Today's world is a lot more connected and there are huge benefits of tablet, PC and smartphone integration for data displays, applications, sharing and control.
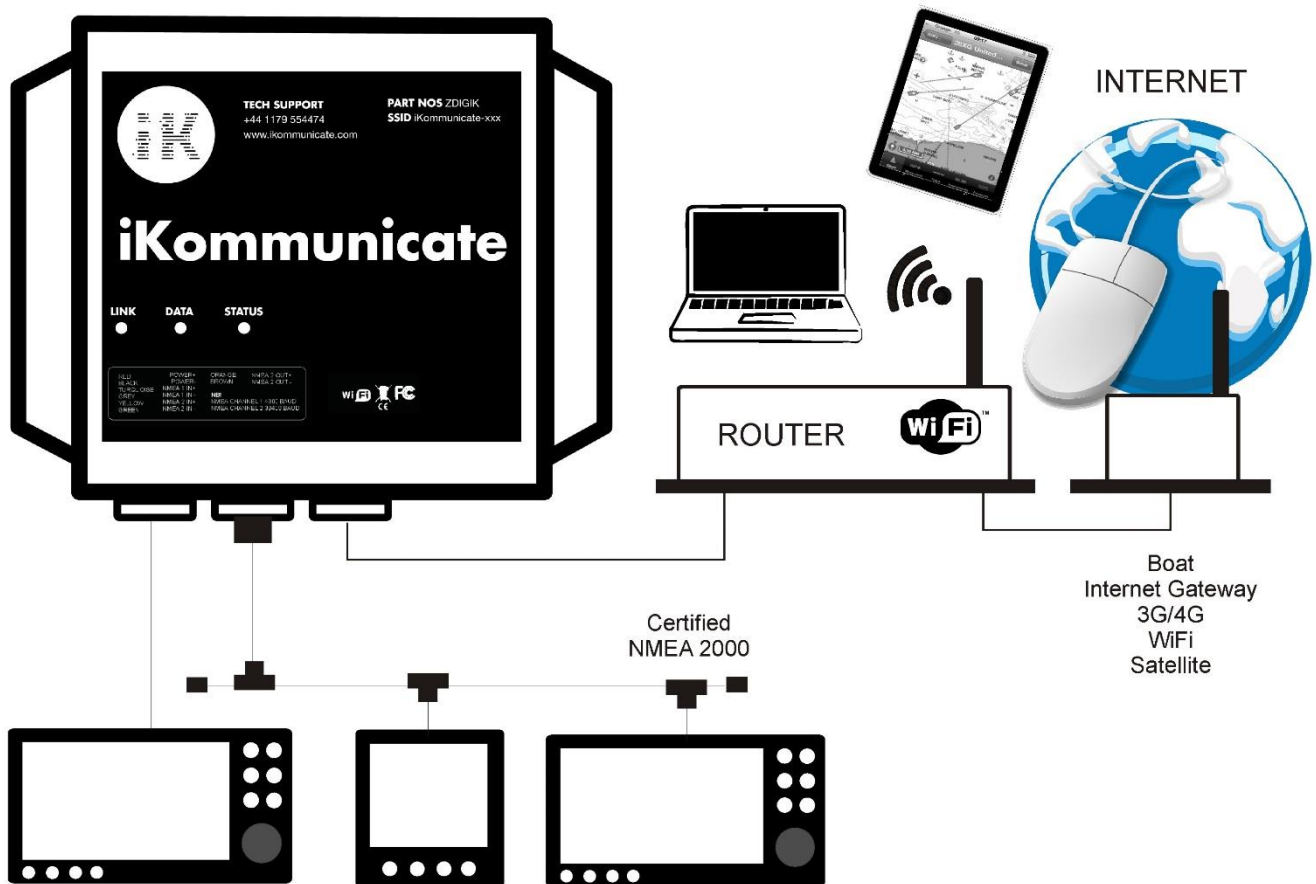
Signal K – The technicalities

Signal K is well documented on the developer's website at www.signalk.org. Essentially, data is transmitted as a JSON string. JSON is native to the internet, and to browsers, so transmission is supported on any medium that can access the internet. That includes mobile data, WiFi, Ethernet, USB, Bluetooth, and pretty much anything coming. It makes developing apps easy. Signal K is also transmitted as plain text so decoding and debugging is simple. The screen shot to the right shows a typical block of data. You'll note that it includes the identity of the vessel which means data can be shared between boats if required. Most importantly, Signal K is not limited to simple numeric information like speed or position. Photos, charts, notice to mariners, data from AtoNs etc could all be easily embedded!

```
{
  "self": "123456789",
  "vessels": {
    "123456789": {
      "name": "motu",
      "mmsi": 123456789,
      "navigation": {
        "headingTrue": {
          "value": 23,
          "source": "self",
          "timestamp": "2014-03-24T00:15:41Z"
        },
        "headingMagnetic": {
          "value": 43,
          "source": "self",
          "timestamp": "2014-03-24T00:15:41Z"
        }
      }
    }
  }
}
```

Signal K - Implementation

Implementation of any new data standard is a classic "chicken and egg" situation. App developers will hesitate if they don't see a ready market and consumers will not see value in a Signal K interface if there are no beneficial apps. It's clear too that new products will take some time to include this additional interface.

For Signal K to start making headway, existing instruments will need to become Signal K ready. After all, you don't want to change all your existing electronics to enable the connected boat. At Digital Yacht, we firmly believe that a low cost, certified NMEA 0183 and NMEA 2000 to Signal K Gateway will be the catalyst to start implementing this new interface standard. Making it easy for developers to access existing boat data, without burdening them with certification or documentation costs will encourage natural organic growth.

The previous drawing shows how a gateway could integrate with an existing system, even using an on board router for access to the internet although it should be noted that internet access isn't a prerequisite for Signal K applications
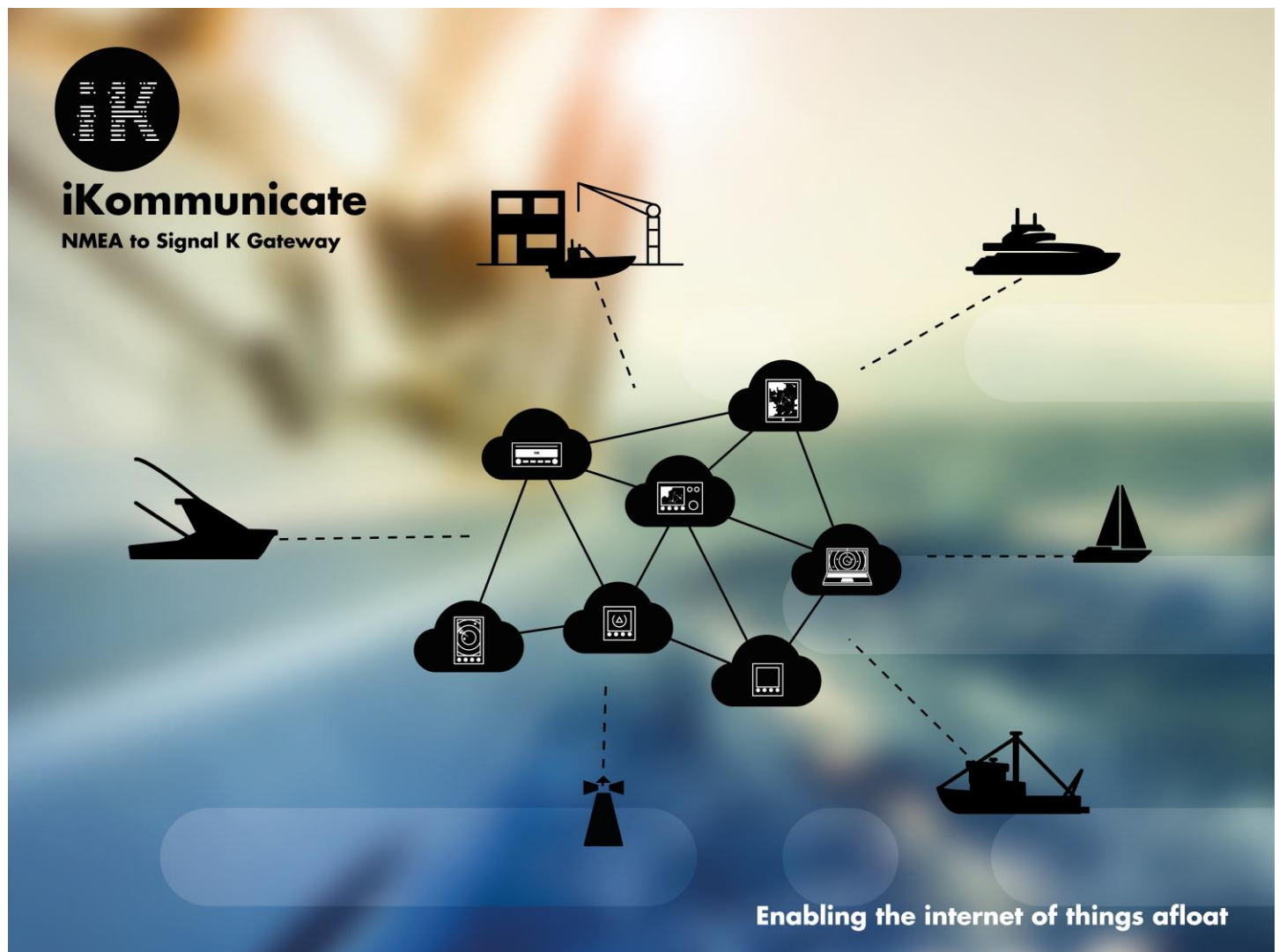
iKommunicate Gateway

Digital Yacht plans to embrace the new interfacing standard and have created a product group under the iKommunicate brand to accelerate development. Our initial development will create a low cost NMEA0183/2000 to Signal K server called iKommunicate which will help developers and consumers quickly integrate their existing electronics. We hope to have this available early 2016

Signal K will not just have applications on yachts but also on ships, marine navaids and ports. It is enabling the internet of things afloat

iKommunicate
NMEA to Signal K Gateway

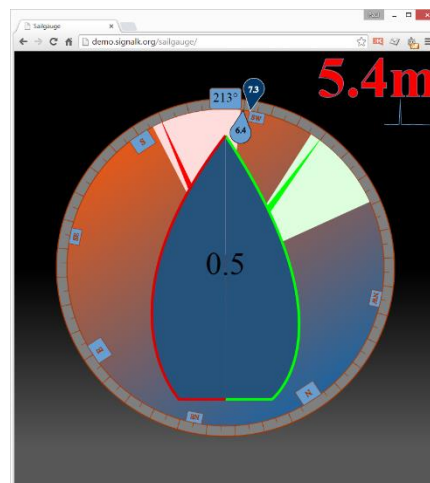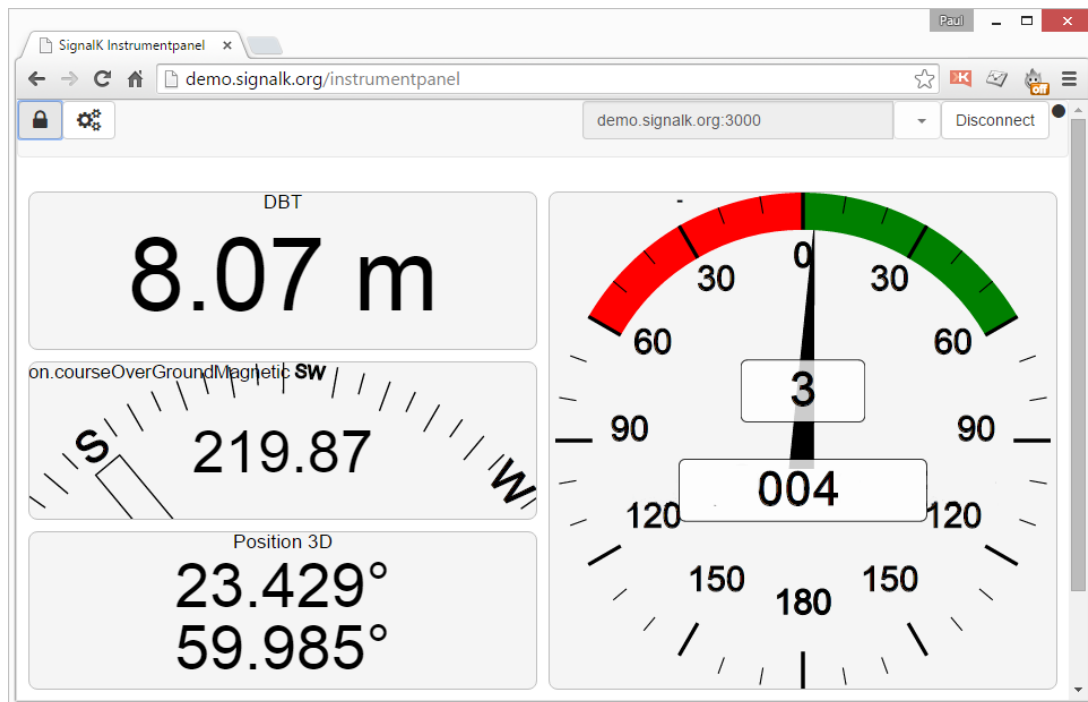Enabling the internet of things afloat

Signal K Typical Applications

In its simplest form, data can be converted from an existing system and then displayed on mobile devices like smart phones or tablets, whose high resolution, graphic touch screens allow a more flexible view of data. Digital information can easily be converted to dynamic analogue displays, logs of data brought to life in graphs, overlaid on charts or even used to create a detailed interactive log book.

Application 1 – Simple Instrument Monitoring

These screen shot show apps already developed for Signal K, displaying simple boat data within a browser. Of course, existing systems can also use tablets to display data but these tend to be proprietary to individual manufacturers. The benefit of Signal K is the ease and flexibility of working with an "open" data format that provides the raw data in a simple human readable, web ready format.

Application 2 – Twitter Integration For Tracking & Logging

Where real benefit can be derived is with the processing power of the tablet and also its internet connectivity. Take the application below of Twitter integration. The tablet is used to "tweet" your boat's information so your boating friends and family can follow your progress as a simple tweet. Twitter APIs are easy to implement on a wide variety of devices and well documented . Equally, a marina could have an auto feed of berth status, wind speed and direction or lock gate status all thanks to the Signal K interface.

Application

App can be used for navigation with additional functionality offered thanks to internet connectivity through the mobile device. For instance "TWEET" boat status or track my buddies

Internet

iKommunicate server provides real time feed of boat data to the iPad app via the router

Key issue is easy JSON string of data which allows fast, cheap and simple app development

@yachtsignalk
David Smith

Yacht Signalk Call Sign MMNZ7 currently at 51:27.30N 2:35.56W 8.2KTS, HEADING 320. WIND SPEED 18KTS, ETA destination 42 MINUTES #raftupparty
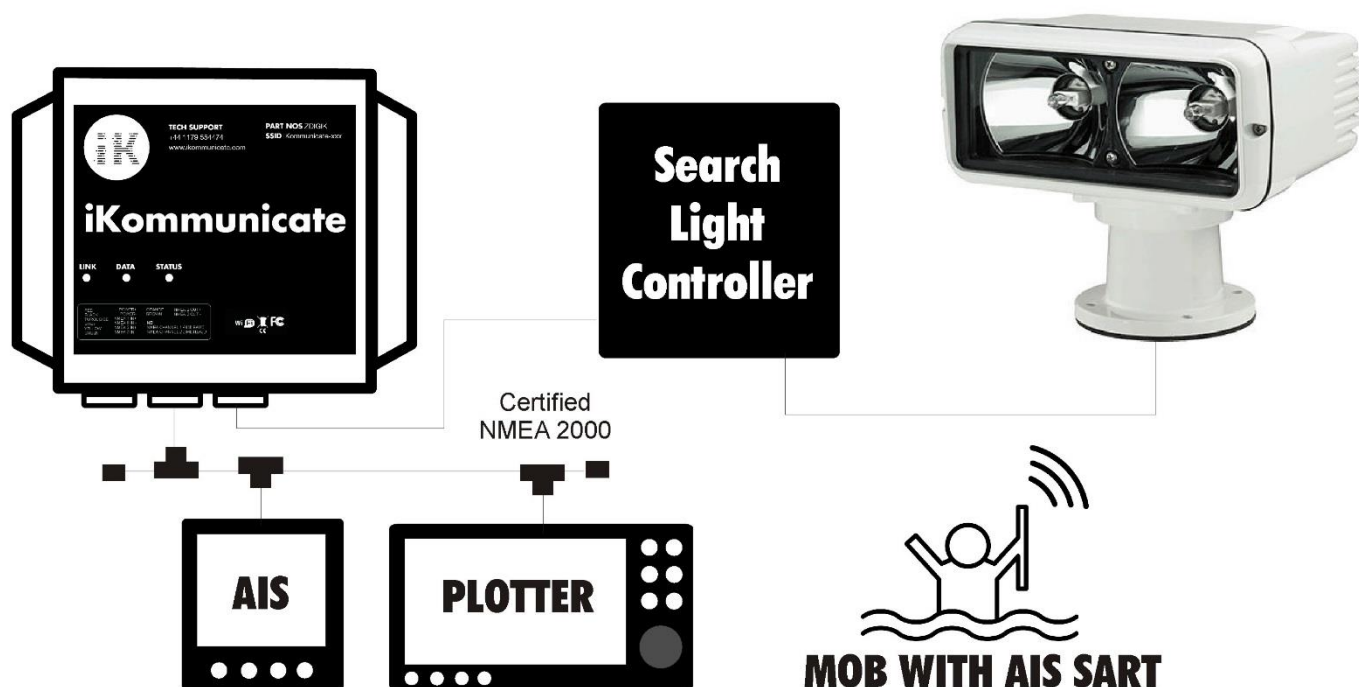
3 minutes ago via web

Simple tweet sent – could be a private direct message or tweet to the world of location or feed to cloud based server

Application 3 – Integration of 3rd Party Products

AIS SARTs are a great life saving device allowing a plotter to show the position of a Man-Over-Board casualty. But if it happened at night, that final location and recovery of the MOB would be greatly aided by a search light providing visual guidance too. Signal K interfacing makes it easy and affordable to add this functionality to what were in the past closed systems.
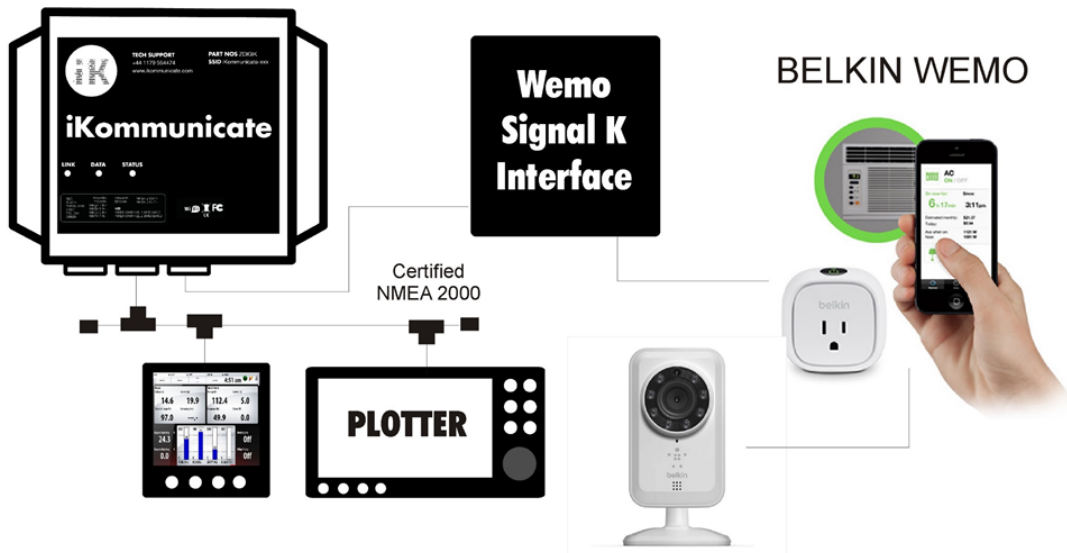
Application 4 – Consumer Product Integration

There are many consumer products that could be utilised on board boats to enhance comfort and improve systems. Belkin have produced a low cost digital switching system called WEMO for AC appliances in the home allowing control through smart devices and across the internet. Volume production for consumer electronics make these systems very affordable and they can have applications afloat. Signal K makes integration of these systems simple and also intelligent using simple "if this happened, then do this" commands.

Application

Wemo is a low cost system manufactured by consumer giant Belkin to allow a smart phone to control AC appliances, dim lights and provide video security. It's also easy to develop for and Signal K would be an ideal way to integrate traditional marine electronic displays into the system for control and data viewing
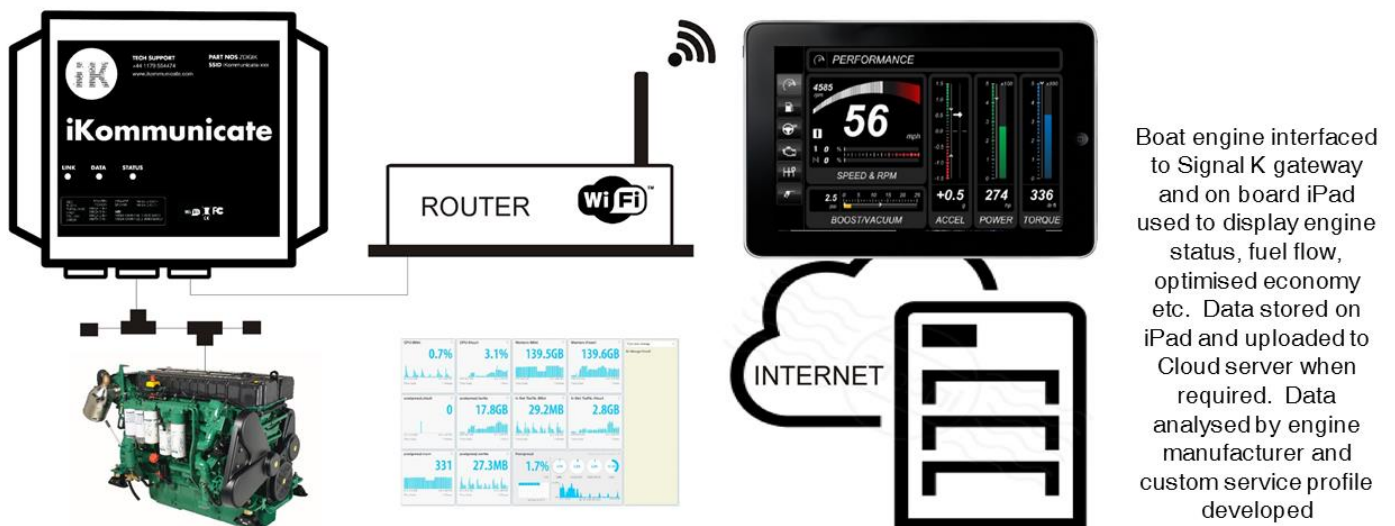
Equally, marine electronic equipment manufacturers can add control screens so you can use your plotter to control digital switching – in the same way we see audio control being added to displays today. Signal K is the gateway to better and lower cost integration and applications.

Application 5 – Engine Monitoring & Cloud Analysis

Modern engines are now fitted with electronic interfaces – many have NMEA 2000 or the similar SAE J1939 data standard which can easily be converted as it is also based on CanBus. This application shows an on board tablet being used to show engine data and also to calculate optimum economy based on speed and fuel flow. Data is stored in raw format on the device and uploaded to a cloud server when required. Data is analysed by the dealer or manufacturer and a custom service profile developed for your boat

Application

Boat engine interfaced to Signal K gateway and on board iPad used to display engine status, fuel flow, optimised economy etc. Data stored on iPad and uploaded to Cloud server when required. Data analysed by engine manufacturer and custom service profile developed

Summary

The common and key element between all of these applications is that Signal K makes them possible by opening up these "niche" marine data standards and making them compatible with the internet, in a format/language that web developers understand and can use, even if they have never set foot on a boat.

No longer do marine applications have to be custom, turnkey solutions written by a limited number of marine specialist software programmers, now anyone can see an interesting application or service and develop solutions using the latest HTML5 web development tools and servers.