Welcome to the NMEA Gateway session
San Diego
Wednesday Sept 25 8:00am
Thursday Sept 26 1:30pm
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Managing Director, Active Research Ltd.

Actisense intelligent sensors and interfaces

The NMEA Specialists
Actisense is a brand name of Active Research Limited

Active Research Limited was established in 1997.

Based on the south coast of the UK in Poole, England.

To promote the ground-breaking designs of Active Research Limited, the Actisense brand name was registered in 2001.

Active member of the NMEA 2000 and OneNet standards specification meetings.

Purpose :-

“Actisense aim to be the installer's product of choice by making navigation safer with the most reliable boat system interface designs.”
What we do

The Actisense brand stands for excellence and the highest levels of service in the NMEA interconnection and sensor interface product areas.

Actisense has developed a wide range of products:

- NMEA 0183 interfaces
- NMEA 2000 interfaces
- Depth sounders
- Gateways
- Cables and connectors
NMEA 2000 is an ‘open’ network system based on “CAN” bus (Controller Area Network)

- CAN is used in the automotive industry
- CAN is a robust, error resistant protocol with automatic re-transmissions
- CAN has embedded Messaging Priority
- A faulty CAN device should disconnect itself from the network
- CAN enables the exchange of data between multiple devices simultaneously
NMEA 2000 added the following specifics:

- Marine manufacturers collaborated to create an ‘open’ network environment
- Data rate of 250 Kbit/s (50x NMEA 0183)
- Standard connectors were specified
- Isolation in the interfaces was added to prevent ground loops
- No need for multiplexers as used in NMEA 0183 – the bus itself is the multiplexer
A network gateway is an internetworking device capable of joining together two networks that use different base protocols.

A network gateway can be implemented completely in software, completely in hardware, or as a combination of both.

Because a network gateway, by definition, appears at the edge of a network, related capabilities like firewalls tend to be integrated with it. For example, on home networks, a broadband router typically serves as the network gateway although ordinary computers can also be configured to perform equivalent functions.
Description
Just like the general gateways described on the previous slide, an NMEA 2000 gateway operates on the edge of the NMEA 2000 network.

Certification requirements
As the NMEA 2000 network has specific timing requirements in the Network management layer, it is a requirement that NMEA gateways are provided as certified hardware devices on the bus.

Using non standard hardware
The requirement for dedicated hardware precludes the use of devices such as Personal Computers using a standard CAN interface to be used directly on the bus as gateways, as the tight timing requirements could not be met.
The Gateway operates at the “edge” of the network

An NMEA 2000 network will have many edges, where the core network interacts with the outside world in different ways.

Typical edges of an NMEA 2000 network are where NMEA 2000 connects to:

- Legacy NMEA networks, e.g. NMEA 0183
- Analogue sensors – e.g. engines, trim tabs, fuel levels
- Personal computing devices – directly via USB or via TCP/IP over Ethernet or Wi-Fi
NMEA 2000 Network Overview

NTA-1
- Drive analogue devices from NMEA 2000 data
- Show digital readings on analogue gauges

QNB-1
- Reduces installation costs
- Ideal for areas of high instrument density
- Fuse protected power entry

NGT-1-USB
- Allows you to see the data on the NMEA 2000 network
- Compatible with industry leading chart plotters

NGW-1-ISO
- Converts NMEA 0183 to NMEA 2000 & vice-versa
- Allows NMEA 0183 devices to be used with NMEA 2000 network

ATN-1
- Converts analogue signals to NMEA 2000
- New and existing devices can work together

EMU-1
- Converts engine analogue signals to NMEA 2000
- Share engine data on the network
NMEA 2000 to NMEA 0183 Gateways
In NMEA 2000:

Data is shared across all devices

All devices connected to the bus have instant access to all the data on the bus

No multiplexers or buffer amplifiers are required

All devices have electrically isolated interface circuitry

A binary encoded message structure is used, using “PGNs”, which are identifiers for data packets sent over the bus

Baud rate is 250,000 bits/s
In NMEA 0183:

NMEA 0183 is an ASCII “Text” based standard

**NMEA 0183 data is transmitted from Talkers**

Only one *Talker* is allowed on an NMEA 0183 data connection

*Talkers* generally use non electrically isolated interfaces

To **combine** data from multiple *talkers* together, a **multiplexer** must be used

Baud rates of 4,800 and 38,400 bits/s are allowed

**NMEA 0183 data is received by Listeners**

An NMEA 0183 data bus can have multiple *Listeners*

*Listeners* (NMEA 0183 ver.2 onwards) must be electrically isolated
Why use an NMEA 0183 to NMEA 2000 gateway?

For over 25 years, NMEA 0183 has been the standard method for marine electronic devices to share information with each other. There are a huge range of devices installed on boats that will continue to function effectively for many years.

An NMEA 0183 to NMEA 2000 gateway protects that investment, while allowing the adoption of the NMEA 2000 bus as the primary data backbone during a major refit.

NMEA 0183 gateways avoid the “all or nothing” headache of upgrading to an NMEA 2000 networked system.
An NMEA 0183 Gateway should convert NMEA 0183 sentences to NMEA 2000 messages and vice-versa.

However, as stated before, NMEA 0183 sentences are ASCII text based, while NMEA 2000 uses a binary protocol.

This implies that a complex protocol conversion from NMEA 0183 data to NMEA 2000 data is essential.

This is not a trivial task, and there are a few pitfalls that can cause problems in the translation process.
An NMEA 0183 gateway will try to convert all the NMEA 0183 sentences it receives into NMEA 2000 PGNs.

This means that the ideal use case for an NMEA 0183 gateway is to connect a single NMEA 0183 talker to the NMEA 2000 bus.

However, it may be likely or desirable to connect the NMEA 0183 gateway via a multiplexer to multiple talker devices.

It is essential that only one type of each device is connected to the gateway.

i.e. if a gateway receives two GPS GLL sentences from two GPS receivers, the GPS position on the NMEA 2000 bus could continually switch between the two sources as the gateway converts the data.
An NMEA 0183 gateway will come preconfigured with a range of sensible NMEA 2000 to NMEA 0183 conversions.

A NMEA 0183 gateway will try to convert all the NMEA 2000 PGN data it receives into NMEA 0183 sentences.

Because of the baud rate differences, this can lead to complete overload of the bandwidth on the NMEA 0183 side, meaning that the rate of sentences will slow down if it is trying to send all the data available.
The baud rate of the NMEA 0183 side of the gateway can be set to 38400 baud.

This increases the available bandwidth, and is particularly important where AIS data is present or required on the NMEA 0183 output.
Some data cannot be translated between NMEA 0183 and NMEA 2000

This is because there may be no appropriate NMEA 0183 sentence for a particular PGN (or vice-versa)
On Actisense gateways, and potentially on other gateway makes, the received PGN list should be configurable.

This allows the user to turn off default received PGNs that are in its “out of the box” configuration.

By turning off PGNs, less NMEA 0183 conversions will take place and the bandwidth required on the NMEA 0183 side reduced.

The Actisense software “NMEA reader” can be used to do this job.
NMEA 2000 to PC Gateways
Gateways which act as a link to personal computing devices fall into the PC Gateway class.

These allow NMEA 2000 devices to connect the NMEA 2000 data to other computing devices, allowing much expanded computing capability and extended functions such as wide area network / internet connectivity.

They can also act as a dongle to allow a PC full access to the NMEA 2000 bus.
NGT-1: NMEA 2000 PC Interface Gateway

Connects your PC to an NMEA 2000 network

An NMEA 2000 CAN-Bus gateway for Windows, MAC or Linux that runs the NMEA 2000 stack

Transfers NMEA 2000 messages to and from the NMEA 2000 bus

Firewall enforces the NMEA 2000 rules

Works with many brands of PC navigation software

Makes NMEA 2000 diagnostics easy

Available in ISO and USB versions

DLL and source code software stacks available

Works with the free NMEA Reader software to help diagnose an entire NMEA 2000 network
The NGT-1 is acting in the same way as a cable modem would between a PC and the internet.

Other similar dongle devices are made by Maretron (USB100) and other manufacturers.

These devices require a programming library (dll) and allow computer software to interact with the NMEA 2000 bus in a direct way.

This means that a compatible software product such as Maxsea, Fugawi Marine, coastal explorer etc. can all read PGN data from the bus and also write back data such as autopilot commands through the gateway.
Other gateways in the NMEA 2000 to PC class also convert data on the NMEA 2000 bus and connect it to other devices.

NMEA 2000 to TCP/IP gateways
(Future application includes the forthcoming NMEA OneNet Gateways)
e.g. Maretron IPG-100, Chetco Seasmart E-NET

NMEA 2000 to Wi-Fi
This is a specialisation of the above. Wi-Fi adds the ability to talk to devices such as smart phones, tablets and PDAs that do not have a wired connection.
e.g. Digital Yacht iNAV Hub, Chetco Seasmart Wi-Fi
Analogue to NMEA 2000 Gateways
EMU-1: Engine Monitoring Unit

Share analogue engine information on the NMEA 2000 bus

Converts engine and other types of analogue signals into NMEA 2000 PGN messages

6 Gauge/Sender inputs, 4 Alarm inputs, 2 Tach inputs and 2 flexible auxiliary inputs (for future expansion)

Configurable to suit the engine it is working with

Configuration Tool allows setting of Gauge/Sender type, engine speed / Tach ratio, Alarm trigger voltage and the PGN field association

Supports a range of PGNs such as Transmission (Gearbox) Parameters, Battery Status, Alternator Potential and Fluid Level
Analogue gateways require some level of configuration

The conversion from analogue to NMEA 2000 needs to be specified

This means knowledge of the basic voltage, current or other quantity must be known versus the intended data output

For example, a pressure gauge provides a voltage where a particular voltage “means” a particular pressure. This can be presented as a conversion curve

In the case of the EMU, these curves are stored in the configuration tool and uploaded to the EMU via the NMEA 2000 bus
Using an analogue to NMEA 2000 converter – under the hood

**Analogue Fuel level voltage**

**Database conversion lookup curve**

<table>
<thead>
<tr>
<th>PGN</th>
<th>Instance</th>
<th>Fluid Type</th>
<th>Fluid Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>127505</td>
<td>0 (0..15)</td>
<td>0 = Fuel</td>
<td>50.0 (%)</td>
</tr>
</tbody>
</table>

PGN sent to NMEA 2000 bus
ATN-1: Analogue to NMEA 2000 converter
Converts analogue signals (voltage, current, frequency) into digital and then output that value in a user defined NMEA 2000 message (PGN)
Each input will be isolated from each other and the NMEA 2000 network
Full input configuration available to the installer
Connects directly to existing analogue gauges to share the reading on the NMEA 2000 network

NTA-1: NMEA 2000 to Analogue converter
Can convert a user defined NMEA 2000 message (PGN) in to an analogue signal (voltage, current, frequency)
Allows old gauges to show NMEA 2000 data values
Enables NMEA 2000 engines to work with old gauges

NOG-1: NMEA 2000 to OneNet gateway
OneNet is the new Internet Protocol designed by the NMEA for transmission and routing of NMEA PGNs over wired Ethernet networks.
And finally...any questions?

Checkout our comprehensive website for more details.

In particular we are producing some how-to guides for marine interfacing to enhance our website – please let me know if you have any suggestions or areas of “maximum pain” that often cause you the biggest issues.