NEWSLINE

Unidata

Environmental Monitoring & Industrial Measurement No. 17, 2020

A lot of old Rubbish - Stormwater Monitoring

City of Joondalup

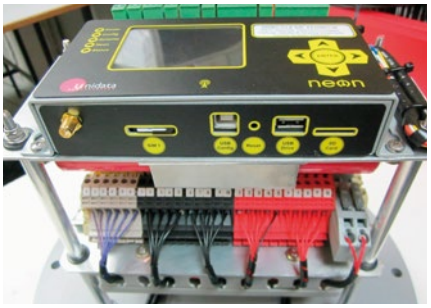
Unidata has worked with a large City Council, the City of Joondalup, on environmental management Internet of Things (IOT) projects to monitor and manage stormwater for some years.

This year we worked on a project to allow rubbish in the stormwater system to be trapped in strainer catchments in a large sump, rather than be washed further down the system. Unidata installed a Neon system, with various sensors and a high-resolution camera system, so the level of trapped rubbish could be monitored and then taken for recycling/ waste management when the sump filled up. The sensors reported the levels and flows, and the camera images were used to identify rubbish types. The camera selected was a very high-resolution system, and the camera image quality was sufficient to allow city engineers to identify in detail the kind of rubbish, as well as the volume of rubbish.

Remarkably, in one heavy rain event, the sump filled up in a few hours, which was unexpected. This event showed the city engineers that there was more rubbish in the system than had been expected. The rubbish is removed through a normal sump vacuum process.

This use of sensors and adding a camera to identify the actual rubbish type remotely and without a person accessing the sump system proved a useful way of managing the large sump. It allowed the stormwater system to be better managed for all the local residents. It also minimised the need for staff to enter the sump system, which was a good health and safety improvement. It reduced staff accident risk in this enclosed space.

This is a good example of adding image information to sensor information in an IOT application.



Unidata Neon System for University of Western Australia Water Quality Monitoring

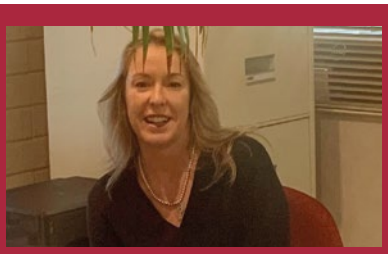
The Swan River is a large body of water, and the water quality is excellent; however, there are the occasional algal blooms in the upper reaches, especially in hot weather. Since the Swan River is the habitat for many fish species, birds, and the population of 19 to 25 Indo-Pacific bottlenose dolphins and their calves, the water quality, requires careful management.

Last year, the University of Western Australia conducted a water quality monitoring project in the Swan River in Perth. A purpose-built buoy system, designed and manufactured by Unidata staff, integrated water quality sensors, a solar power system and a Neon Remote Logger. This setup allowed for data to be telemetered to the Neon Server for data viewing, storage, analysis and alarm management.

For measurement stability, the EXO instruments had to be powered all the time. However, to overcome power limitation, due to the small size of the solar panels, the other sensors were powered up only one minute before the log time. Furthermore, the system integration was quite complex due to limited space, for the instruments and control equipment, within the buoy housing. The dedicated waterproof connectors were fitted to make the installation and maintenance of the sensors stress-free, especially when the buoy is anchored in the river.

The system has been proven and is now in operation, collecting valuable water quality data on the Neon Application Server system. This system will contribute to the proactive management of the quality of the water in the Swan River well into the future. Now it is very common to see schools of dolphins when boating on the Swan River. Attentive water quality monitoring and management will make sure dolphins continue to accompany sailing vessels during Yacht Club races!

UNIDATA **STAFF PROFILE -**



Rochelle Whitelaw

Rochelle joined Unidata last year to provide more assistance with shipping and production.

Rochelle comes to Unidata with broad commercial experience, as well as experience as a fire and safety technician at fire service companies. Rochelle's fire safety experience is very good for Unidata because Rochelle understands the need for process and quality management, and she is also able to assist with our general fire safety and the associated alarm systems and emergency exit equipment.

Rochelle attends to our shipping and also works in production on the NRL and Starflow product line. Rochelle has already made some good system improvements in shipping, and we look forward to her contributing to further improve our quality processes. Rochelle's experience with stock control and inventory management is also very useful as she prepares customer shipments.

Rochelle is married with teenage children, one of which is learning to drive, so Rochelle can clearly cope with high levels of stress. Rochelle lives very close to the Unidata factory, so travel to work is just a 5 minute commute. Rochelle is a very happy and friendly person, who brings smiles to her workmates faces on a regular basis. Rochelle is a "south of the river" person, so she supports the Fremantle Dockers AFL team. That's why she relates well to Elena and Ines because they are also Dockers supporters. All the sensible people at Unidata support the best AFL team, the West Coast Eagles.

Environmental Management Indonesian Palm Oil Plantation

Unidata has recently completed a water-level monitoring project at Palm Plantation in Indonesia.

The Peat fires (burning of partially decayed biomass) break out often in this region and are challenging to extinguish as Peat soils are the largest reserves of terrestrial organic carbon. Some may burn for months or years, causing soil degradation, damaging carbon emissions and increasing occurrence of floods. The proper environmental management and government regulation compliance require continuous local weather conditions, temperature and water-levels monitoring.

The water-level falling below the specified threshold increases the chance of peat fires incidence. On the other hand, if the levels are too high, the production capacity of the Palm Oil trees is negatively affected. For that reason, the water- level must be monitored and managed very carefully to ensure the environment remains safe.

As the banks of the irrigation channels are soft and filled with sediment, radar level measurement was chosen as the best-suited measurement method. The radar sensors are positioned from a stable part of the land, well back from the bank of the irrigation channel, directly looking down onto the water surface.

The plantation needed a weather and water level measurement and telemetry system with a large number of sensors to be deployed at several locations. Since there was no cell phone coverage in the region, satellite telemetry seemed like a logical choice. However, due to there being many monitoring points, a dedicated satellite link for each monitoring station would have been too expensive. After performing a site survey, a LoRa LPWAN network option appeared to be the most cost-effective solution.

The LoRa LPWAN network was designed in a way that only one Base Station is connecting to the central server via satellite. At the same time, all other stations communicated with the Base Station utilising LoRa technology.

This configuration made the cost of the satellite link reasonable.

The plantation company used its own developed Central Application Server / Dashboard to monitor, manage and ensure best practice environmental management as well as proper government regulation compliance.

The satellite backhauled LoRa is one of the possible solutions for multi-sensor remote monitoring systems, where there is no cell phone coverage. It is a good and effective solution.

Neon Enterprise Loggers and Over the Air (OTA) Management

The Unidata Neon Applications Software allows organisations to effectively manage a fleet of internet-connected telemetry data loggers in the field. What does that mean?

What is Over the Air Management (OTA) and what does that mean?

Stand Alone Telemetry Loggers in the Field are:

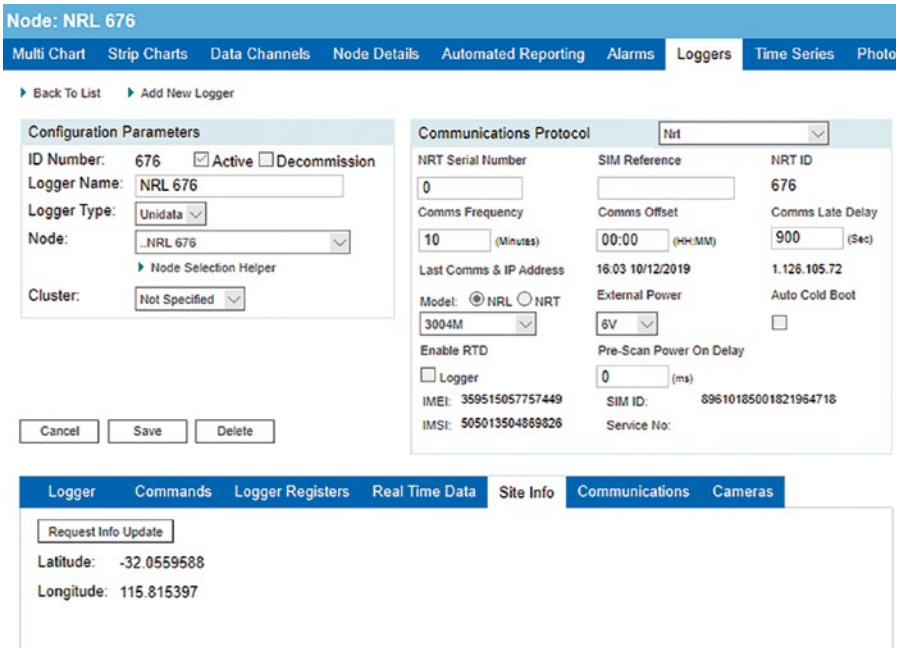
- Programmed individually in the workshop or in the field
- Setup individually on site by trained staff
- Maintained individually on site by trained staff
- Can't be audited remotely
- Transmit data on a set schedule
- Must be visited on site to do any program adjustments
- Must be visited on site to install new firmware.

Neon Enterprise Loggers in the field are:

- Programmed over the air from the Neon Application on a remote server
- Can be set up in the field by untrained staff, using Auto Configuration
- Are maintained over the air using remote diagnostic facilities
- Can be audit remotely, to ensure the correct operating program is installed in each unit
- Can be geo-located using various geo location tools available in Neon
- Can be reprogrammed over the air without the need for a site visit
- You can reprogram any Neon system, anywhere in the world, the site location is irrelevant.

If you have a fleet of 5 telemetered loggers, it is easy to remember and check that all are working with the correct program. If you have a fleet of 500 telemetered loggers, it becomes impossible to visit each site in the field to manage them.

As we adopt more internet connected devices, and embrace the Internet of Things (IOT) we will see so many devices being managed over the air (OTA), an industry term for being reprogrammed or software updated across the internet or other digital



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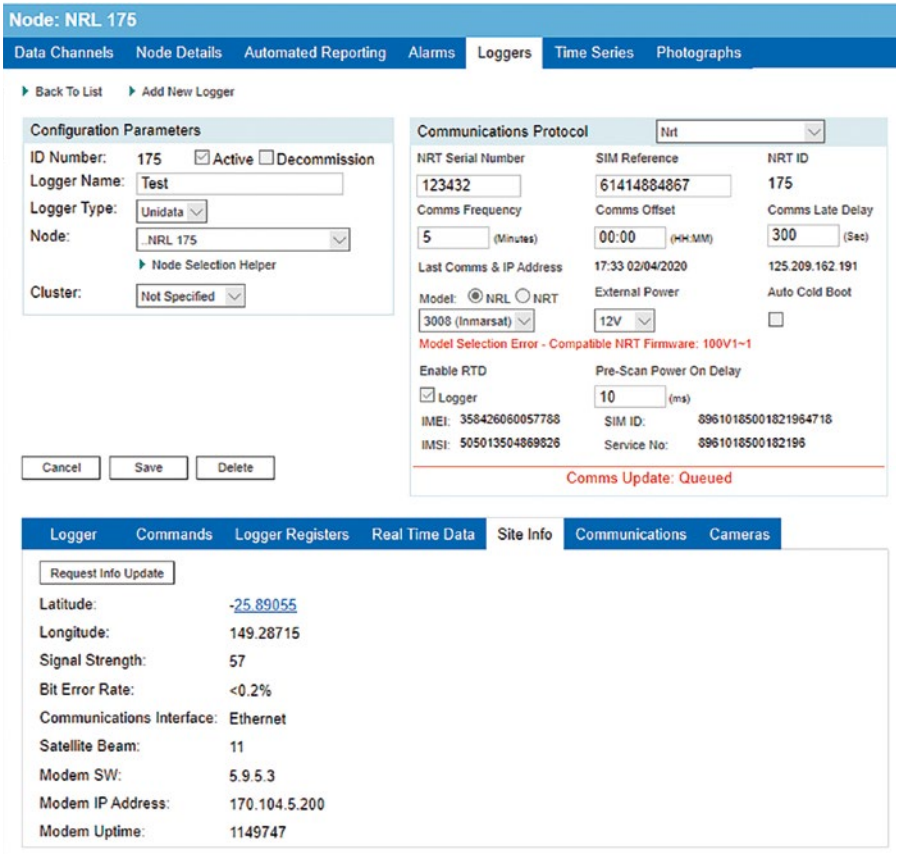


Site Info Inmarsat

transmission system such as the digital television DVB system.

Your smart TV is connected to the internet and receives regular software updates over the air.

Your smart phone is always being updated over the air.

If you have an internet connected fridge, that is also being updated over the air.

The modem inside your smart phone is being updated with new firmware over the air.

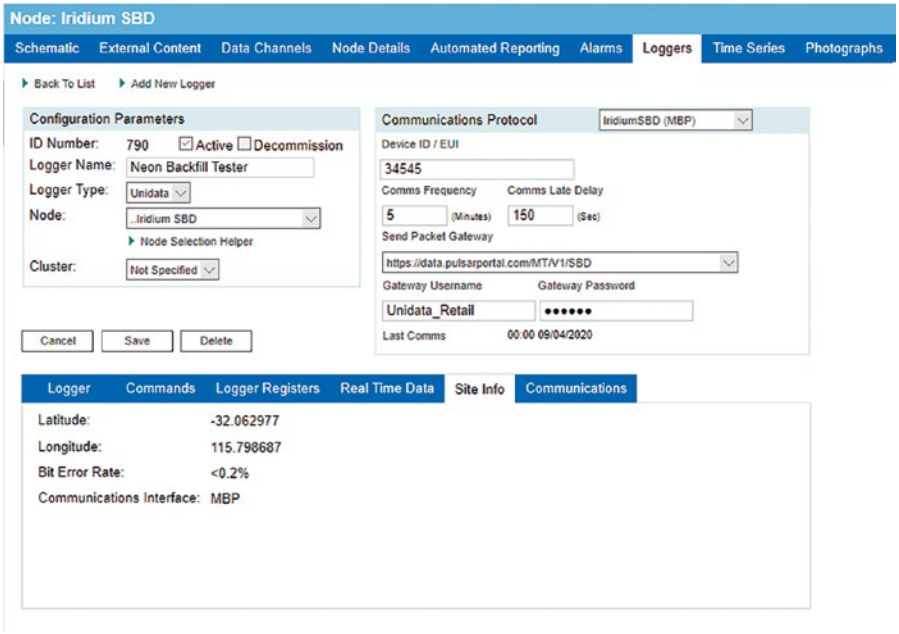
Making adjustments over the air (OTA) is fast and very cost effective. It is impractical to visit hundreds, perhaps thousands or millions of sites to do such updates.

Utilising over the air management (OTA) for telemetered data loggers in the fields is the same, it is a must have these days.

The latest release of the Neon Applications Software and the Neon Field Unit firmware includes more OTA management and monitoring of the communications networks. When released we will be able to interrogate and display the cell tower information including the latitude and longitude for Cell Phone Networks, and other operational parameters. We can interrogate satellite network modems in a similar way and show the latitude and longitude of other satellite information such as antenna beam selection, signal strength and bit error rate.

All of this extra information makes it easier and more cost effective to maintain a large group of Neon telemetered loggers remotely, from a central location, or any browser connected to the Neon Server on the internet. This minimises the high cost and the inconvenience of needing to visit sites to maintain the Neon telemetered loggers.

In some cases, a site visit will be required. Perhaps there has been a lightning strike, or some local physical damage. However, as we minimise the need for site visits we can better manage loggers in the field, and do so faster and more cost effectively.



Site Info Iridium

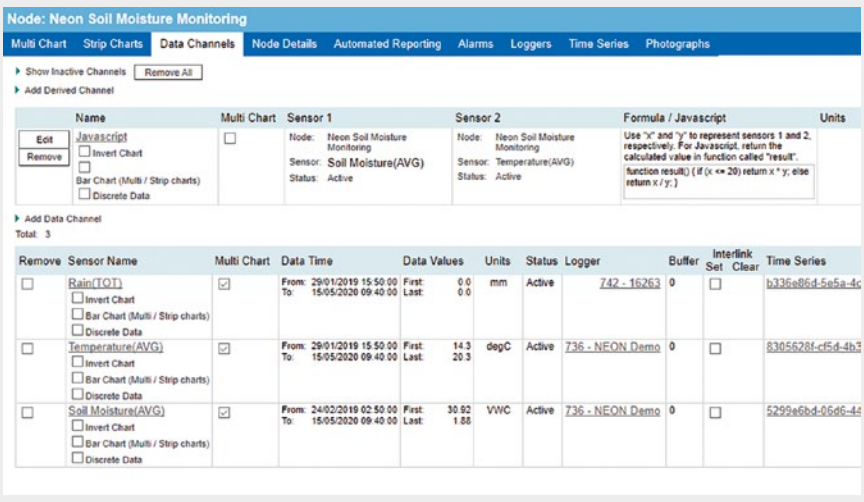
Neon Derived Channel Java Script Formula Programming

The latest version of the Neon Applications Software now has facilities to write a complex javascript to manipulate formulae for derived channels.

Previously we could only do simple mathematical functions; however, as the use of the derived channel function grew our customer asked for more mathematically complicated formulae.

With the new java scripting function, a user can perform very complex mathematical formulae and other data manipulation functions using the familiar Java scripting language.

Please see the screenshot showing a small part of a Java script within the derived channel.



Cottonwood Creek installation

Starflow QSD 6537 Flow Test in Cottonwood Creek, Dallas, Texas

A test Starflow QSD 6537 has been installed in an urban creek in Dallas as a long term test site. A Starlog V4 Flow Scheme has been installed to record the flow activity. Being in an urban environment, the creek is very "flashy", and the water flow increases very rapidly when rain events occur. One such event is shown in the graph and text below.

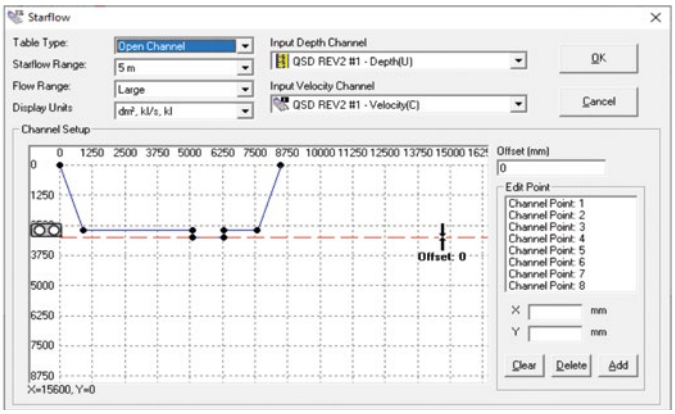
The creek cross-section has a flat bottom with sloping sides and a low flow channel towards one side (see profile below).

In 30 minutes, the depth went from 250 to 750 mm; the flow rate went from .05 to 4 kl/s (m^3/s). Over the period 12/4 @ 11:00 to 18:00 a total of 40,000 kl (m3) of water flowed down the creek (~ 1.5 million cubic feet of water). The depth topped out at about 1m. By contrast, a normal household uses about 300 to 400 kl each year, so there's a lot of water goes down your creek when it rains.

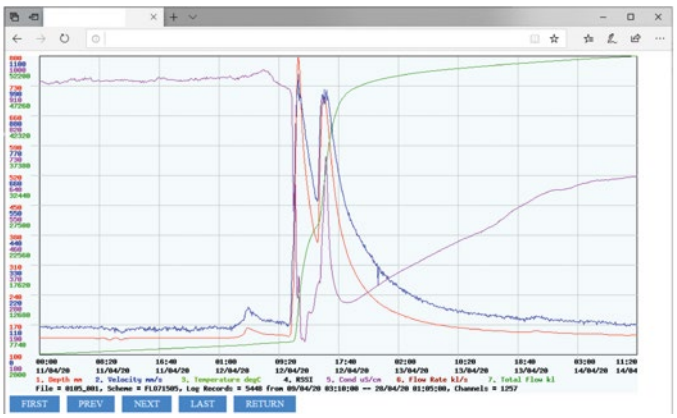
Note also the Conductivity response during this event. Starting above 1000 uS/cm (quite polluted urban run-off) it drops almost instantly to below 200 uS/cm (clean water) as the creek is flushed with rainwater. It then gradually increases as the flow drops and the proportion of urban run-off increases.

A perfect example of how the Starflow QSD 6537 can provide insight to drains and creeks that cannot justify the expense of permanent gauging stations.

The Starflow QSD 6537 was screwed onto a cement slab placed at the bottom of the low flow channel in the creek (see photo). It is solar-powered and reports back to the central server across the internet. The ultrasonic depth sensor within the Starflow QSD 6537 performs very well in turbulent and silt loaded conditions.



Creek Cross-Section entered into Starlog V4 Scheme



Performance during a flow event

Unidata working with Partner HydroTerra

Unidata and HydroTerra have completed several projects in the last few months, and new projects are coming up in the future for us to work together. HydroTerra specialises in the implementation of custom environmental monitoring solutions – they are Environmental Monitoring Specialists. HydroTerra provides environmental monitoring equipment, completes field data collection and provides landfill monitoring systems.

The combination of Unidata Neon Data loggers and the Neon Enterprise Telemetry platform with HydroTerra Environmental Monitoring expertise, industry-standard monitoring equipment and project experience has been right for both Unidata and HydroTerra.

In recent months we have worked together on some large projects like groundwater monitoring projects for the mining industry and cooperation with an agricultural research organisation to build remote environmental monitoring systems, just to mention a few. HydroTerra's headquarters are in Melbourne, and Unidata's in Perth. That is a lot of distance between us. The ability to prepare Neon data logging systems online with the Neon Enterprise System, work with Microsoft Teams for project coordination as well as our flexibility to work from home, have proven that the physical distance between the companies is not a barrier to successfully working together.

The Unidata Neon System interfaces to the HydroTerra DataStream Data Visualisation System using web services and FTP application. This system provides high-level analysis and visualisation of data collected in the field. Data collected and sent by Neon Field units to the Neon Applications Server is then transferred to the HydroTerra DataStream Data Visualisation System for further processing. All of this happens seamlessly through the system. The process is entirely hands-off.

Unidata Operations during COVID 19 Pandemic

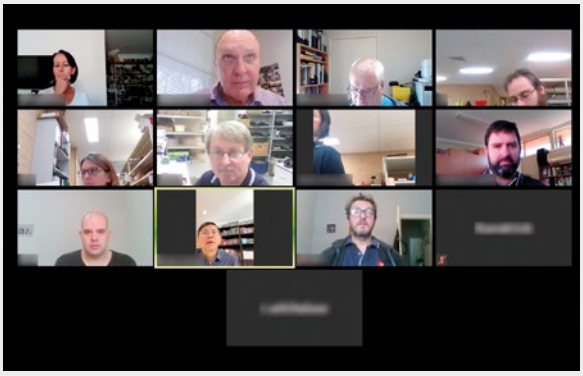
Unidata staff survived the worst days of this pandemic with a lot of social distancing, open-air meetings and home working. We also had alternative transport arrangements for people who regularly used public transport to get to and from work.

We held daily video staff meetings using Teams and Zoom. We maintained a connection with our customers in the same way. While a personal visit to customers is always best, we managed quite well using the video conferencing tools. We believe that our travel activities will be reduced, in the long term because we will meet on Teams and Zoom more often with customers and other stakeholders.

Some also worked effectively from home, and we see that trend continuing in the future.

To stay connected to customers, we will also hold webinars on technical subjects, and we can provide product training using webinars in the long term.

As Unidata is in the essential services industry group, we did not notice a significant decline in revenue, so we maintained our 10-year record of finishing up the financial year in profit, however we all worked much harder this year to maintain the complex manufacturing operations during the pandemic.

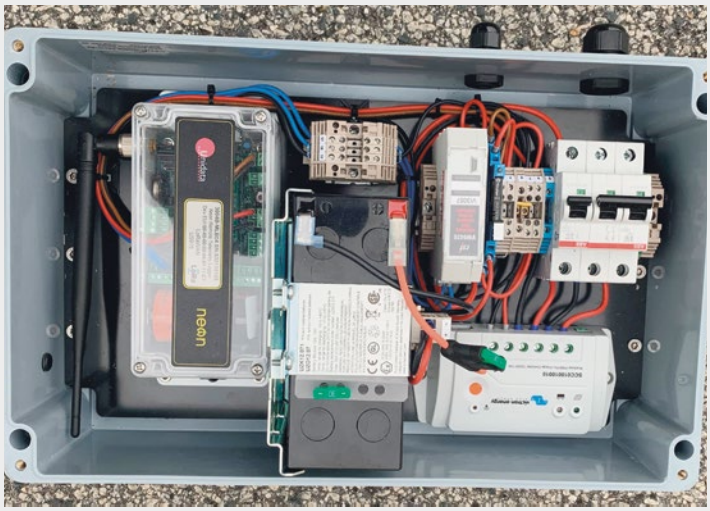


Unidata assists Inmarsat with IOT Kiosks

Our good partner Inmarsat is building some new systems for major projects. They have engaged Unidata to assist with some manufacturing for this region of the world.

Inmarsat has some new and innovating projects, needing what Inmarsat calls an IOT Kiosk. This equipment is a solar-powered system helping connect a large number of sensors and backhaul important sensor data to an application server via a very reliable BGAN system. The system has complex high-reliability subsystems which Inmarsat can control and monitor across the network, with a high level of Over the Air (OTA) management facilities. OTA is critical for remote and unmanned systems located in isolated places in the field. The system integrates a new robust power system utilising a supercapacitor, as opposed to the commonly used standard battery. These supercapacitors are an emerging innovation for high power applications; they have unlimited power cycles and are much more robust in harsh environments.

You will note the Unidata Neon LoRa Logger which is also an integral part of the sensor inputs subsystem.



3600 Neon LoRa WAN SDI 12 Extender - No need for wires

Unidata has released a special purpose variant of the Neon LoRa Logger, for the special purpose of easily extending an SDI 12 bus, when connecting SDI 12 instruments using a wire is not practical.

The 3600 Neon LoRa WAN SDI 12 Extender is an extender device which utilises the LoRa communication system as its method of providing an SDI 12 extender function between SDI 12 field sensors and a Neon Remote Logger. The 3600 Neon LoRa WAN SDI 12 Extender provides a bridge between two SDI 12 devices, emulating a standard wire connection between SDI 12 devices.

The 3600 Neon LoRa WAN SDI 12 Extender is a useful accessory product to be used in any measurement station, especially when the measuring instruments are located a few hundred metres away from the central Neon Remote Logger at the hub of the measurement station. Using this extender eliminates the need for long runs of wire, which may not be practical, especially in some river measurement stations.

Modbus Slave Support Released for the NRL

The Neon Remote Logger range now has Modbus Slave support, adding to the existing Modbus Master support.

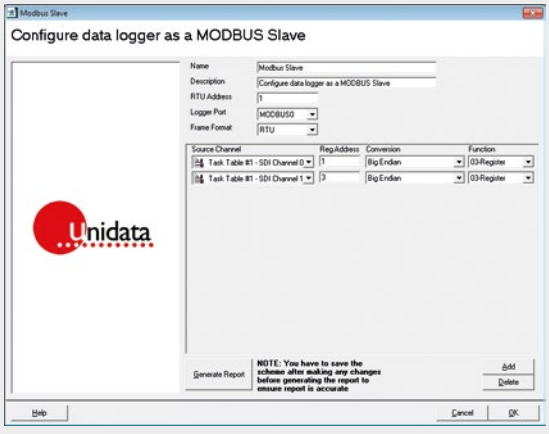
What does that mean?

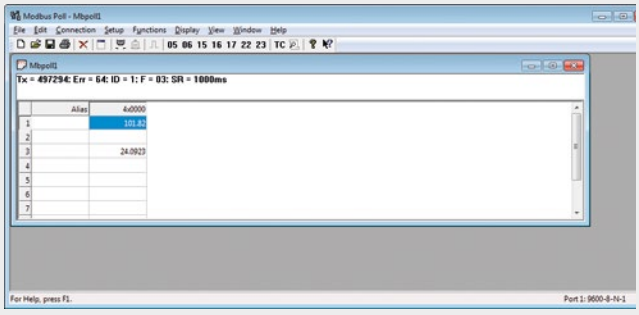
Modbus Master reads Modbus instruments and controllers and returns values from those Modbus connected instruments.

Modbus Slave presents data on a Modbus interface which can be read by other Modbus master systems, such as Programmable Logic Controllers (PLC's) and other industrial and agricultural systems which are only capable of polling. For example, most PLC systems are not compatible with SDI 12 sensors, so this new Modbus Slave facility allows SDI 12 Sensors to be polled by a Neon Remote Logger and then present that data on the Modbus slave interface, to be read by a Modbus Master system.

This feature was included in the NRL Firmware version 29.

The image below shows SDI 12 sensor data (pressure and temperature) being presented on a Modbus master register map for another end system to read.



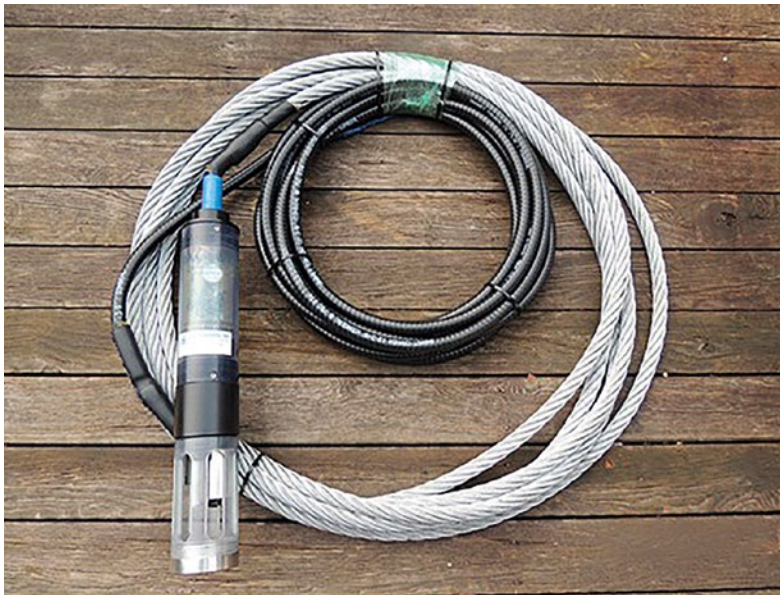


Geoscientific Armoured Cable Sensor Installation

Our Partner, Geo Scientific, in Vancouver Canada, quite often requires solutions suitable for very hostile environments. Rivers in Canada can be very rocky, and ice flows will cause sensor damage if the sensors and the cables are not adequately protected.

One good way to solve that problem is to use an armoured cable from the sensor to the data logger/ telemetry location, and then bury that cable. This is a very effective approach; however, the cost of such cable and the associated earthworks are high. Sometimes it is more economical to accept an occasional loss of a sensor being swept away in a flood. However, this approach does not address the serious issue of critical data losses in the event of a sensor damage event. It will always be a trade-off in terms of initial costs and the importance of an ongoing reliable data stream during a severe environment event.

This example is a good one to show how such important monitoring sites can be protected and critical data retained. This installation is very robust.



Neon Remote Loggers in Production

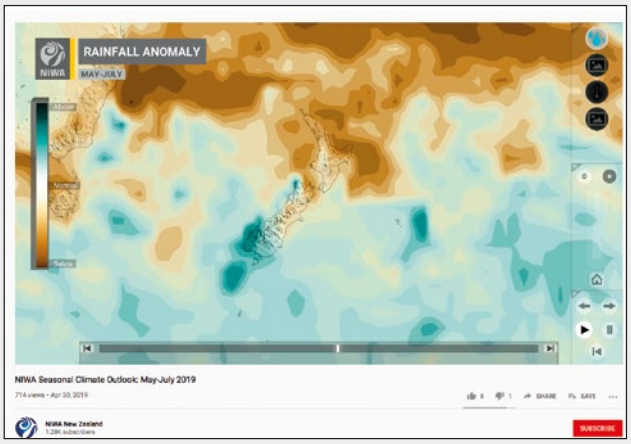
Earlier this year Unidata shipped its 1000th Neon Remote Logger. Production remains busy with building Neon Remote Loggers for customer orders and stock. We also continue production for the older Neon Remote Terminals, with more than 500 of them shipped as well this year. We see a small decline of sales of the Older Neon Remote Terminals, but we maintain the ability to continue manufacturing them as needed.

There are two main streams in manufacturing NRLs, the 3004, 3008 and 3016 Metal case option which can have the convenient LCD Display and buttons and the smaller polycarbonate 3004M and 3001M series.

Both models are popular; however, we note the continued strong interest in the Metal case NRL units with the option for a display and the exterior field termination connectors seems to be the preferred unit for many customers.

In contrast, the 3004M and 3001M series do not have display option and come with the internal terminal connectors. The sensors connections are accessible through a gland. Furthermore, the NRL M series includes a lithium battery(s). The NRL M series is higher IP rated than the metal enclosure models.

Unidata continues to add improvements to the NRL range, with Bluetooth connectivity to be released soon and integrated solar regulator functionality, for the 3004, 3008 and 3016 models in the very near future.



Royal Irrigation Department Visitors in New Zealand

Late last year NIWA hosted a visit by senior staff from the Royal Irrigation Department (RID). The visitors wanted to view the innovative weather and water monitoring systems, developed by NIWA, to gain ideas and directions for this important very large government department in Thailand. Unidata was part of the delegation because of our close association with RID. They have NRT and NRL units installed in the thousands. They have multiple Neon Server Installations and have been using the Unidata NRT/ NRL products and the Unidata 6541 Water Level instruments for almost 15 years.

The senior staff who visited from RID were Mr Theeraphol Tungsomboun, Ms Supinda Wattanakarn, Ms Siripen Sinpo and Mr Kitsada Nalam.

The Royal Irrigation Department is a large government agency which has a long history in the development of water resources in Thailand, starting from the early 1900's. The visit was a Government to Government collaborative meeting for the mutual benefit of both RID and NIWA, to enhance the fields of Hydrology and Flood Monitoring and Forecasting.

The visit included a visit NIWA's Forecast and Visualisation Centre (flood and weather forecasting) in Auckland, hosted by Chris Brandolino - Principal Scientist - Forecasting and Media. The visitors were impressed by the complex visualisation tools which NIWA uses to communicate complex weather data. The RID Staff then travelled to Christchurch for more

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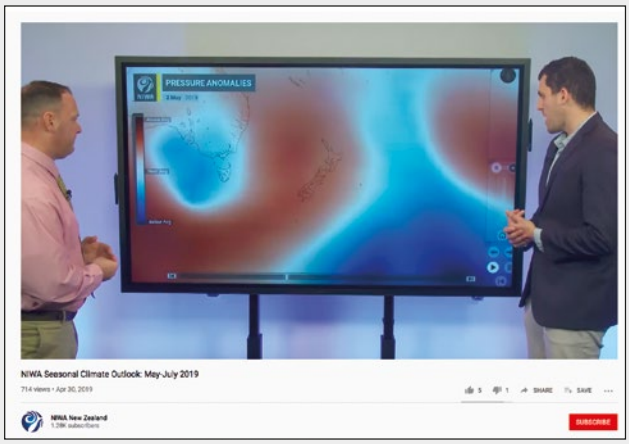

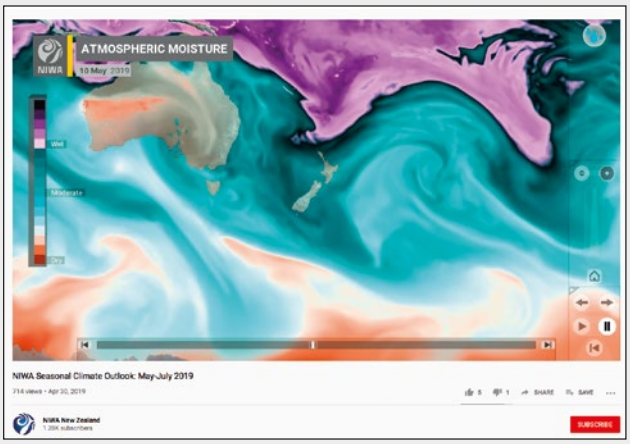

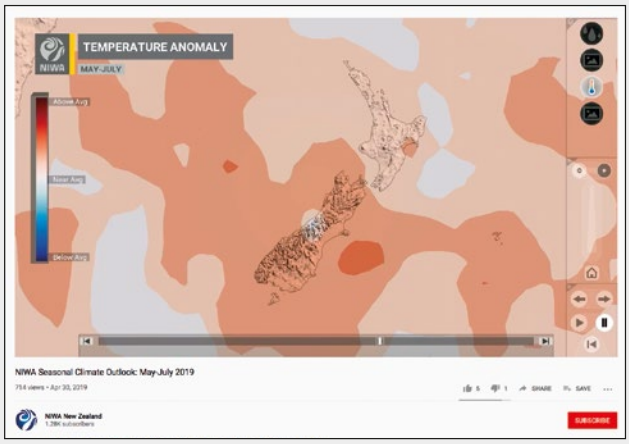

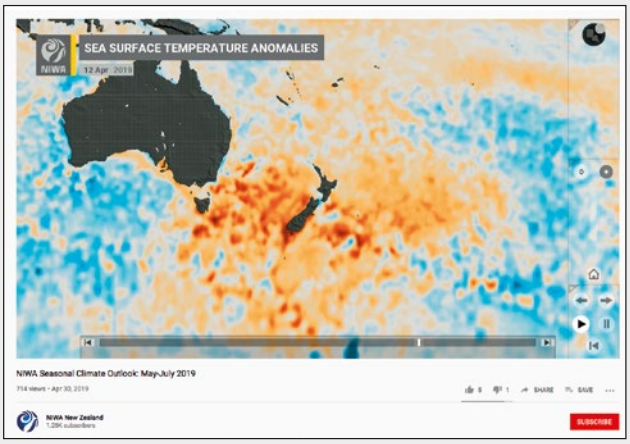

Above: Screen shots from youtube NIWA Seasonal Climate Outlook May-July 2019: https://www.youtube.com/watch?v=7aq19fJsZmE

Right: NIWA and senior staff from the Royal Irrigation Department.

- detailed meetings on specific areas of potential collaboration and further site visits.

The visualisation tools are impressive, check them out at:

https://www.youtube.com/watch?v=7aq19fJsZmE

Iridium Support for NRL and the new Message-Based Protocols

This year we released the Iridium support for the Neon Remote Logger range. Iridium supports short burst data (SBD), a message-based system, similar to text messages. The Iridium SBD service is robust and reliable, and it is an excellent example of message-based systems. Another message-based system is LoRa, and we expect that other emerging microsatellite systems will also use message-based protocols. The Inmarsat ISP Global beam service system uses a similar message-based system.

The NRL using a message-based service provides a lower class of service when compared to a full IP service. However, it has many advantages. It is less expensive generally, and if you use LoRa, then it is free. Choosing a message-based service is appropriate for many low data applications, such as groundwater monitoring - when a message per day is usually all that is needed. The airtime costs for a service with daily messages is low. As message-based services are much lower bandwidth, they are used with a much smaller, omnidirectional antennae which is very convenient.

Message-based services don't have sufficient bandwidth/capacity to deliver a full suite of OTA (Over the Air) management the way a full IP communications channel can. Unidata's initial implementation of the message based system allows for a limited sub set of neon commands to allow such things as rewind to a point and resend data. In the future, Unidata will be releasing firmware to support more features to provide more OTA functionality for message-based protocol systems. We expect that most of the features can be implemented, depending on the robustness of the message based service, except the substantial data requirements features such as firmware update over the air.

In summary, there will always be two classes of service, a message based service and full IP service. Unidata will build extra features for the message-based services over time. Our objective is to implement as much of the OTA features which are practical over these message services.

This message-based service is available on all models of Neon Remote Loggers; however, because it is a lower bandwidth option, it is more suited to the models with a smaller number of data channels such as the 3001 Neon Nano Logger and the 3004MI Polycarbonate case Neon Remote Logger.

3004MI Polycarbonate case Neon Remote Logger

3001 Neon Nano Logger

Satellite Link Margins / Link Budgets and why are they important

A link budget is an accounting of all of the power gains and losses that a communication signal experiences in a telecommunication system; from a transmitter, through a medium (free space, antenna, cable etc.) to the receiver. The result of this calculation is expressed in dBs. The higher the number, the more reliable the satellite link will be.

For Equatorial Satellite systems, there are higher power transmitters and larger antennae. However, the signals have to travel a long way, around 50,000 km to reach the receiving antenna. For Low earth orbit satellite systems, the transmit power is lower because the signals only have to travel about 1000 km to reach the receiving antenna.

The antenna size for satellite receivers is a significant consideration, the larger the antenna, the higher the gain which adds to the link margin. The smaller the antenna, the less gain is added to the link margin. If the antenna is directional, the gain is higher; if the antenna is omnidirectional the gain is lower. If the receiving antenna is fixed, a lower link margin is needed. If the antenna is moving, on a vehicle or vessel, the antenna movement changes the received signal level, and a higher link margin is required. If the data volume is high, then more link margin is needed. If the data volume is low, then the less link margin is required.

All of these factors need to be considered when choosing the best satellite service for a data logger. Major players in this industry, for example, Inmarsat and Iridium provide robust link margins, with an allowance above the minimum link margin to operate, however they are also more expensive.

Some new entrants into the satellite service market may have less robust link margins, and require larger, less convenient antennae to make these systems work reliably; however, these new entrants may also be offering less expensive services.

For equatorial satellite services, such as Inmarsat a larger antenna which must be pointed is usually needed, and a robust, reliable high-speed service results because they have robust link margins.

For a low earth orbit satellite services, such as Iridium and Globalstar, a smaller antenna which does not need pointing can be used, and they provide reliable low-speed data service. That service is often message - based, like a text message, but they do have robust link margins.

Some new entrants offer cheaper services. Sometimes these cheaper services come with less robust link margins. A skinny link margin may have a margin of 1dB or less, and such a margin has limited room for error. A robust link margin may have a 3dB Margin, which allows for general degradation of the antenna and cable components, some antenna misalignment and perhaps movement on a vehicle while still maintaining the satellite link. It is always a good idea to understand the link margin trade-offs, and make sure you choose systems with a link margin which has reasonable margin for error to ensure a reliable service for your particular application.

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