



ETN symposium: Manufacturer discussion panel

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This document was drafted from meeting notes gathered by the reporters above and does not reflect in any way their opinion. The panelists below act as manufacturer representatives. Sonotronics could not attend the discussion panel but was given the opportunity to provide written answers to the questions afterwards.

The below questions were registered by the ETN user community via an online survey sent in October 2024, organizers of the panel structured the questions within the 3 key themes: (1) Advances on technology, (2) sustainability and (3) Compatibility.

Several questions were not asked/answered within the live panel session. Manufacturers had the opportunity to respond to these questions after the panel via email, their answers are included in each section under –Unanswered questions–.

Additional information for further reading and for providing some context to the questions, is available as footnotes where relevant.

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Panelist introduction

At the beginning of the panel session, panelists were allowed a couple of minutes to introduce themselves.

1. Asgeir Bjarnason, Research Engineer at Star-Oddi.
Introduction: Star-Oddi currently does not produce acoustic tags but has produced archival and physio-loggers for 30 years, such as heart rate and activity sensors. They have currently been working on developments to transmit heart rate data using Open Protocol.
2. David Gambin, Project Manager at Lotek.
Introduction: David is the product manager for acoustic and radio tags. Lotek produces radio, acoustic, archival and satellite tags for mammals, birds and fish.
3. Cathrine Schulze, Sales and Support Team at Thelma Biotel.
Introduction: Thelma Biotel has a wide array of inhouse personnel both on the production, development and operational side, with some key people from the largest technological university in Norway. Their products have a quite long battery life, amazing performance and are highly adaptable to scientific needs, which results in high flexibility. Thelma Biotel has currently the smallest multi sensor tag on the market. Thelma aims to offer user-friendly solutions. Thelma was a driving force being the Open Protocol production ever since compatibility issues have been arising. They will introduce a new tag platform soon, that will allow for shorter size tags with a good battery lifetime.
4. Mark Jollymore, President at Innovasea
Introduction: Innovasea has over 50 years of experience, and has a big focus on acoustic telemetry. Innovasea is based in Nova Scotia, where mostly all of their acoustic tag production takes place.

Session 1 - Advances in technology

As we look to the future, what advancements are around the corner? This topic includes future products, sensors, device attachment techniques, helpful software, memory, processing and data recovery tools.

Q1. Additional sensors have the potential to vastly improve our understanding of the potential drivers of animal movement, while reducing the number of attached devices that can yield the necessary data streams. What type of sensors are currently being considered, and developed?

Star-Oddi

Related to acoustic telemetry tags, Star-Oddi is currently working on transmitting heart rate data to Open Protocol receivers; for data loggers, they are doing lots of work relevant to fish, mainly extracting tailbeat frequency and are doing experiments on blood pressure measurements. They have been working on pop-up tags and have been able to deploy some prototypes this summer.

Lotek

Lotek has been manufacturing sensor tags since its inception (including pressure, temperature and acceleration) in both acoustic and radio tags. Historically, they've made electromyography (EMG) but the demand for this has decreased. New sensors for their next generation of acoustic telemetry tags, based on demand, are being considered and include salinity, conductivity and chlorophyll. Lotek is open to input from the community regarding sensor development.

Thelma Biotel

Thelma is currently developing an acoustic tag with an integrated magnetometer which allows to look at the effect of magnetic fields on fish, they are currently in the testing phase and should be commercially available soon.

Thelma is also looking to develop a compass tag.

Innovasea

A balance between failures and successes. Sensor tags are generally very hard to develop (as in getting a sensor to be as small as the size of a fish tag). For example, Innovasea worked with MIT to try to develop a cortisol sensor to look at fish stress; the tag failed but they still hope they can make something work.

They have predation tags (that sense changes in pH), to give researchers the certainty that it is the tagged fish, and not a predator, that they are tracking. They are working towards the miniaturization of this tag.

Tag size depends heavily on the number of sensors being deployed, whereby more sensors equate to a bigger size.

NexTrak will have the capability for every tag to have sensor(s).

Sonotronics

Sensors used in fitness trackers are being evaluated for fisheries.

Q2. Will combination tags be sold in the future? E.g. combined PSAT and acoustic tags, PSAT and PIT etc.

Star-Oddi

No comment

Lotek

Lotek has produced a combined acoustic and radio tag for about 20 years.

Lotek is looking to add acoustic tags into satellite tags but again, needs people to ask for this development in order for them to pursue it.

Thelma Biotel

No comment

Innovasea

The challenge with this is miniaturization.

Sonotronics

Depends on demand.

Q3. What type of technology will be available for cabled receivers in the future?

Star-Oddi

No comment.

Lotek

Cabled units allow you to get data more or less in real time. The pro is that it has an infinite battery life (if, for example a solar panel is used or if plugged in). This technology works best in freshwater environments such a river with heavy flow that can drag autonomous receivers. The con is that it is pricier.

They had cable technologies in the past, they currently offer autonomous units, especially for fixed deployments in freshwater set ups. The option of bringing them back is possible.

Thelma Biotel

Thelma has live transceivers (allows for 2-way communication) that you can plug into a deck box, you can check with the grid. Adjustment of cable length is possible.

Innovasea

Innovasea has various cable receiver versions. They are predominantly used in 2 cases:

- 1) Realtime systems transmitting to cell/satellite network to track sharks (close to shore).
- 2) Integrated into gliders, to download data of other receivers, in this case they can also be deployed in the open ocean, so there are definitely also applications in the marine environment.

Sonotronics

Sonotronics continues to support OP compatible cabled receivers.

Q4. There is a need for multi-sensor platforms e.g. acoustic receivers, environmental sensors, passive acoustics etc. Such an integrated unit would allow for single deployments on single locations. This would help reduce the footprint of independent moorings and alleviate licensing concerns. Are there any multi-sensor platforms being developed?

Star-Oddi

They can be used in combination with receivers. A multi-sensor device is a fantastic idea; however recalibration and servicing requirements differ between different sensors, and there is a constraint to how much can be added into a unit. Maybe it's better to have separate devices in these cases.

Lotek

All Lotek receivers (all manufacturer receivers) offer built-in sensors for temperature, pressure and tilt.

If we think of passive acoustic monitoring (PAMs) and acoustic telemetry, for mammals, you need to listen and store a very wide frequency spectrum. There is an engineering constraint; to listen to high quality and at specifically targeted frequencies. So, in the end you still need 2 components.

Thelma Biotel

No comment.

Innovasea

Innovasea has an active system of environmental monitoring that is normally deployed in close proximity to a receiver. They are water bottle-sized, and measure oxygen, temperature, etc.

Sonotronics

No comment.

Q5. What factors influence positioning accuracy?

Star-Oddi

No comment.

Lotek

The position of the mooring is very difficult to determine, or also if the receivers are moving because they're on a float. It's best when moorings are fixed and a differential gps is used (cell phone can at best get to 3m accuracy). Using codes and modulation you get more refined time stamps, like with digital coding structure which could improve positioning.

Thelma Biotel

No comment.

Innovasea

No comment.

Sonotronics

Receiver position and "rigid" mounting. Water velocity and temperature. Clock drift.

Q6. I work with raw detection data to perform my own telemetry positioning. By far the largest source of error in my models is clock drift. Even over a few days, this can be several seconds. Correcting for this is very challenging, especially if receiver positions are unreliable/inaccurate. Q6A. Why are clocks susceptible to drift? Q6B. What can be done to improve arrays that use independent (non-cabled) receivers?

Star-Oddi

No comment.

Lotek

Receivers have a temperature-compensation oscillator that can be more or less accurate and will impact clock drift over time. In the future, the challenge will be to manufacture better clocks. In this sense, cable receivers have an advantage as well.

"Beacon" or synchronisation tags can be used to correct receiver clocks.

Lotek encourages users to get in touch if refining clocks on receivers is considered a major issue.

Thelma Biotel

No comment.

Innovasea

The trade off with better clocks is size and battery consumption.

Sonotronics

This is a matter of precision: 1ppm->1 sec/11.5 days. To maintain 1mS accuracy (1.5 meters) for 1 month requires clock stability of about 1.5ppb (parts per billion). So called “atomic clocks” are now available that are small enough to fit inside a submersible would increase the price of a receiver by at least 4x.

Session 1 – Unanswered questions

Q. With the addition of new sensors, tags are becoming bigger. Will 69 kHz tags be available with battery life of >1 year in the future?

Star-Oddi

No comment.

Lotek

Lotek currently offers 69kHz tags that can achieve greater than 1 year of battery life. Battery life depends upon tag size, the programmed transmit interval, and any additional scheduling that is implemented.

Looking to the future, 69kHz tags utilizing BPSK modulation will provide approximately 10+ times the life of the current 69kHz tags which are utilizing PPM modulation. This improved efficiency will provide greater flexibility in the amount of data that may be collected over a defined period, the length of deployment, or the tag sizes offered, depending on project needs.

Thelma Biotel

Thelma Biotel produces tags today (transmitting in the 63-77 kHz frequency band) in many different sizes, lasting over 1 year. Our largest tags designed for aquatic animals can live for more than 10 years.

- Early 2025, Thelma Biotel will be finalizing implementation of a new tag platform to streamline the production process of tags, bringing the power draw even further down for longer battery life, as well as opening up for shorter tags - regardless of added sensors.
- A lower power draw with the new production platform for tags allows the tags to last even longer than previous generation. This also makes it easier to store tags on shelf for some time and ready for use at a later date with minimal battery loss.

Innovasea

Innovasea presently produces 69kHz tags that can last for up to 10 years. We are continuing to work on ways to extend battery life for all our tags.

Sonotronics

There are many 69kHz tags available with >4 year battery life

Q. How do your technologies use digital signals? How is digital signal processing progressing across the different manufacturers?

Lotek

The Lotek ORCA receiver utilizes a digital signal processor to demodulate both PPM and BPSK signals. It is safe to assume that all manufacturers are utilizing modern digital signal processing techniques across their receiver models. Other manufacturers may or may not yet have products capable of demodulating BPSK signals but it is relatively safe to assume everyone is developing solutions to do so if they do not already offer them.

Thelma Biotel

- At Thelma Biotel we have long experience in digital signal processing, having based our receivers on this technology for over a decade. This provides a strong foundation for understanding complex signal processing challenges and continuously improving performance. This extensive experience helps in fine-tuning algorithms, ensuring optimal results across different conditions, and developing solutions to specific signal processing problems that may arise in real-world applications.
- Enhanced CRCs to minimize false detections: Cyclic Redundancy Checks (CRCs) are employed to verify the integrity of the received data. Enhanced CRC implementations improve error detection, reducing the likelihood of false detections or incorrect data being processed. This is particularly important in ensuring that the system reliably identifies valid signals while rejecting erroneous or corrupted ones.
- Multi-frequency: Digital signal processing (DSP) opens up for handling signals across a range of frequencies (63-77 kHz) simultaneously (up to three). Furthermore, this allows you to tag a higher number of fish or other aquatic animals where individuals tend to accumulate.
- Signal collision reduction: Signal collisions, where multiple signals interfere with each other, can be detrimental to the accuracy and clarity of the received data. Digital signal processing techniques reduce the likelihood of these collisions by employing strategies like frequency division, and advanced error correction. This ensures more reliable data transmission even in complex environments.
- Mitigating background noise: One of the primary roles of DSP is to remove or reduce unwanted background noise that can distort the signal. Using techniques such as noise filtering, adaptive algorithms, and noise cancellation, DSP enhances the quality of the received signal, making it more accurate and easier to interpret. This is especially crucial in environments where signals are weak or heavily contaminated by external noise.
- SNR/Signal-to-noise ratio: The signal-to-noise ratio (SNR) is a key metric that measures the strength of the desired signal relative to the background noise. DSP techniques are used to maximize SNR, ensuring that the useful information in the signal is clear and distinguishable from noise. This is achieved through advanced filtering, signal

amplification, and noise suppression algorithms, which improve the overall clarity and reliability of signal reception.

- Receiver noise logging: By logging noise data from the receiver, it becomes possible to monitor and evaluate the noise environment over time. This can be especially useful when assessing large datasets, as it helps identify patterns, trends, or specific conditions under which noise levels fluctuate. This information is invaluable for refining signal processing techniques, adapting to varying conditions, and improving the overall system performance.
- Adaptive processing to optimize performance: Adaptive digital signal processing allows the system to dynamically adjust its settings based on real-time signal conditions. Adjusting gain levels and choosing the most suitable algorithms depending on factors like signal strength, interference levels, or noise. Adaptive processing ensures that the system performs optimally regardless of the changing conditions it may encounter during operation.

Innovasea

Innovasea has been using digital signal processing for many years with the 180kHz and 307kHz HR product lines, and we have introduced digital signal processing in NexTrak. The architecture of Innovasea's receiver products uses a combination of analog and digital techniques to convert acoustic signals from transmitters to ID and sensor data (if applicable). This is the case for most receivers in the market. Analog techniques offer benefits like low power consumption that make batteries last longer but little flexibility, while digital techniques offer flexibility but have high power consumption that make batteries last shorter periods of time. Innovasea develops solutions based on the customer's needs and use cases, balancing the trade-offs of different technological options.

Sonotronics

All signals in both receivers and transmitters are ultimately converted to digital and then processed. DSP algorithms are used when deemed appropriate.

Q. Higher resolution, high accuracy animal positions have the potential to help answer a plethora of questions relating to the pressures that aquatic animals face. How close/far are we to tracking fish in real time?

Lotek

Actively tracking fish from a moving boat using a receiver that is connected to a viewing window provides as near real time data as is possible. This type of fish tracking has been available for decades. The Lotek AcouTrack2 receiver will be capable of real-time tracking Open Protocol code spaces.

Providing real time detections from a submersible stationary data logging receiver requires transfer of data from the receiver to an above surface modem which will relay data to the user. If the scientific user community requires this, it can be included on the development

path for the evolution of the interoperable global system. Timing of availability will depend upon the development of other projects and market size. It is simply a matter of costs and demand and not a limitation of technology.

Thelma Biotel

- Current equipment from Thelma Biotel is used for live tracking in collaboration with researchers/partners who perform part of the work. In the future, technology will likely become more accessible and more affordable to use.
- New BPSK protocols (in the making) will enable higher resolution tracking data compared to PPM codes.

Innovasea

Innovasea developed a real-time positioning system (VRAP) in the 1990s and early 2000s. While the product gained popularity among a relatively small group of users, the demand for this capability did not grow enough to justify continued support for the product. In the 2010s, Innovasea tested a prototype of a more modern solution. Today, Innovasea's 180kHz HR and 307 kHz systems provide high-resolution positioning, and we continue to explore ways to improve real-time tracking. Fathom Live supports real-time tracking; however, we currently do not offer a real-time positioning solution. If there is sufficient interest to justify the investment, Innovasea would be willing to develop a real-time positioning system.

Session 2 - Sustainability

As this technology is increasingly used as a tool for informing aquatic management and conservation, efforts must be made to minimize its impact on the environment and its inhabitants. This session includes questions relating to manufacturing, enhanced capacity and provisioning for the future.

Q1. What are your plans regarding the ‘greening’ of tags and receivers? Especially, are you proactive in this matter or do you work on customer requests or policy implementing regulations?

Star-Oddi

Star-Oddi has sustainability efforts in production to reduce unnecessary waste. There is also a drive from clients, who have asked for an environmental policy. For small companies it can be very hard to implement.

Lotek

The biggest action Lotek is doing is introducing a rechargeable battery pack for their receivers, limiting the waste of lithium batteries.

(Referencing an ETN symposium presentation that mentioned the US military having environmental units made of biodegradable materials) Lotek would be interested to know what it’s made of, because their belief is that receivers would still have harmful materials, like lead. David Gambin’s POV: sometimes to make a technology last longer, you have to choose the least sustainable option/material at the moment.

David Gambin POV’s: drive should come from the consumer demands; the expense cannot be justified, in this competitive landscape.

Thelma Biotel

Thelma tries to make equipment that lasts, and that can be updated with hardware upgrades, without the need for new equipment.

They would like to follow up on biodegradable plastics (have been talking about this internally).

Innovasea

The manufacturing of receivers is historically very wasteful. Innovasea is committed to reducing plastic waste by 50%.

The request for these changes comes from the marketplace but the urgency is driven by their board.

Sonotronics

Currently RoHS compliant, with “Annex III exemption 7(c)-I” due to PZT ceramics.

Q2. As a research community, we are putting a lot of plastics and materials in the water. Is there any R&D on reducing the amount?

Star-Oddi

No comment.

Lotek

No comment.

Thelma Biotel

No comment.

Innovasea

This is a valuable question.

Sonotronics

New materials are reviewed many times a year.

Q3. How much emphasis is placed on ensuring existing equipment can be upgraded to accommodate new systems or technology as it's introduced?

Star-Oddi

No comment.

Lotek

Lotek actively service receivers that have been around for 30 years. Lotek aims for a 15-year lifetime for acoustic telemetry but of course that depends on the environment.

Their new receiver ORCA is bringing back BPSK (3 frequencies 69, 180 and 416 kHz) that will support PPM technology for as long as it is required.

Thelma Biotel

Thelma offers receiver service. Their receiver lifetime is similar, 10 years approximately. Thelma offers a care package for free to update the battery compartment of TBR800-RELEASE receivers.

Innovasea

Innovasea guarantees at least 15 years of lifetime for their receivers. They also provide a rolling up cycle for all the previous hardware that is in the water.

Sonotronics

Most receivers now allow for field upgrade of firmware.

Q4. Is there any effort being made to develop rechargeable animal tags, or tags that are powered by the environment e.g. turbulence via mini propellers?

Star-Oddi

Star-Oddi has this development on their list.

There has been some major development regarding their capacity, but keeping the voltage over time is a challenge, it will never match a primary cell. Maybe they need to be charged every 3-4 months, and these charging periods will get shorter and shorter over time.

Lotek

Energy density halves with rechargeability. With receivers, it is not a problem to make them bigger to accommodate this, but with tags it is trickier.

For satellite tags Lotek offer rechargeable batteries. For tags with GPS, you have to get the tag back, so it does make sense to have it rechargeable. However, Lotek's experience is that an acoustic tag is unlikely to be seen again after an animal is tagged. So, it doesn't make as much sense as for satellite tags.

Thelma Biotel

No comment.

Innovasea

The trade-off with rechargeability is the battery density (not as good as a one-time use cell). They are currently working with a battery company and on the table, there is at least some degree of rechargeability.

Fish tracking technology follows what is commercially available, it is hard to get the interest of battery developers, because the scientific market is just too small.

Sonotronics

Energy harvesting is frequently reviewed.

Q5. Are rechargeable receiver batteries being considered? What are the pros and cons?

Star-Oddi

No comment.

Lotek

P&L developed an energy harvester (a tag with a little torpedo) that worked on the oscillation of the fishes' body (tuna), but it introduces a lot of dragging in the system. Physics works, but the feasibility does not.

But it is not 100% impossible.

Thelma Biotel

No comment.

Innovasea

There is the challenge that the behavior of the fish is impacted.

Sonotronics

Reliability and safety are major concerns here. Also, the energy density of rechargeables is still not adequate compared to primary battery systems.

Q6. Fully recoverable acoustic units are more than twice the price of using devices that leave sacrificial anchors. Are any manufacturers developing more affordable recovery systems?

Star-Oddi

No comment.

Lotek

Lotek will bring to the market a new recovery system that they will try to market as cheaply as possible.

Estimated starting price is 1000 EUR (without receiver), with additional cost of release and canister.

Thelma Biotel

Thelma has a new recovery system that is relatively affordable. They would love to get feedback for improvements, etc.

The market price is between 1000-1400 EUR.

Innovasea

At the same time, you can get into a complicated system (acoustic release); you need to make it highly reliable, which costs money.

Acoustic release on its own (without the receiver) is 1500 EUR. The total (mooring + receiver) is estimated to be between 3000-4000 EUR.

Sonotronics

There remains a price/reliability tradeoff: there is not much value in a cheaper release system that has a high failure rate.

Q7. (From the audience): when you do the math on your head of all the tags (most of them won't even be recovered) if feels like a biodegradable tag will be cost-effective, especially for one that will only last for 2 years?

Star-Oddi

No comment.

Lotek

The area of focus of plastic pollution in the ocean is not acoustic tags. We choose polymers based on the pressure it can withstand, etc.

We expect solutions from the alternative plastic industry, so that's something more in the future.

Thelma Biotel

No comment.

Innovasea

The capsule could be biodegradable, but then once it erodes all the stuff inside is nasty (it's a battery). Manufacturers are stuck with what the industry provides.

Session 2 - Sustainability: Unanswered questions

Q. What is the recommended biofouling for tags and receivers for long term studies?

Star-Oddi

No comment.

Lotek

We recommend users consult with colleagues regarding their experience and preferences for antifoul methods. All methods should be thoroughly tested to ensure equipment performance is not degraded and animal welfare standards are upheld.

Thelma Biotel

- Biofouling mitigation, receivers:
If biofouling significantly overgrows the transducer (on the top of the receiver), it has the potential to influence the system's performance. Techniques such as anti-fouling paint or manual wash/scrub can be helpful, but more scientific backing in the area is required to guarantee the efficacy of such preventative measures.

General receiver maintenance

Cleaning: Excessive biofouling can get caught in the seals when replacing batteries, potentially causing leaks. Keep receivers clean with a soft brush or a non-abrasive scrubber.

- Biofouling mitigation, tags:
Mitigating biofouling on tags could be relevant in some cases of external tagging or tagging of fixed structures. If biofouling significantly overgrows the transducer, it has the potential to influence the tags range. Techniques such as anti-fouling paint or manual wash/scrub can be helpful, but more scientific backing in the area is required to guarantee the efficacy of such preventative measures.

Innovasea

A significant body of knowledge regarding the effectiveness of various antibiofouling agents for a given deployment area and its impact on receiver performance/longevity has been built up by the research community over decades of practical use. This knowledge has given rise to different preferences among researchers for solutions. Innovasea does not have a recommended biofouling solution for long-term studies.

Sonotronics

Sacrificial membranes (think nylon hosiery) or non-copper based paints available from boating suppliers.

Session 3 - Compatibility

To promote a fair market, enable collaboration, maximize value for money and support cross-border science, compatibility is key. This topic will include questions relating to current and future programming and compatibility between manufacturer equipment and data architecture.

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- *Information about compatibility and the Open Protocol can be found on the ETN website: <https://www.europeantrackingnetwork.org/en/compatibility>.*
 - *To see which tag and receiver protocols are compatible with each other, visit <https://www.europeantrackingnetwork.org/en/compatibility-tag-protocols>.*
 - *ETN recommendations: <https://www.europeantrackingnetwork.org/en/recommendations>.*
 - *FAQ: <https://www.europeantrackingnetwork.org/en/FAQs>.*
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Q1. Is it possible to have transmitter/receiver/device metadata automatically flow into the ETN database upon purchase of the equipment? An alternative could be to provide customers with an Excel spreadsheet with the needed metadata in a format that can be directly uploaded to the ETN?

Star-Oddi

Star-Oddi works in different sectors.

This type of development is tricky. A license is needed to install and use Star-Oddi software. Having the possibility of Star-Oddi's software to communicate with networks is unlikely to be developed. As an alternative, it may be possible to have it as a package.

Lotek

Yes, it's possible. On the ORCA receiver, Lotek hopes just to have it as an integrated tool. For satellite products, Lotek has the option to directly upload data to Movebank.

Thelma Biotel

Thelma Biotel is currently working on this feature, to have it hopefully running by spring 2025. Currently, Thelma is developing a new tag platform that allows metadata of tags and receivers to be automatically uploaded to ETN.

Innovasea

Innovasea is planning to have a button in the Fathom software that says 'push to ETN/OTN/GLATOS'¹.

Sonotronics

No comment.

¹ Extra feedback requested to Innovasea to further explain. The answer given by Innovasea was "Fathom Central currently provides the ability for OTN members to push study metadata and detection data directly to the OTN Data Centre. Innovasea has offered to work with ETN to provide this same capability for ETN members. ETN advised they were prioritizing development of an automation for tracking Open Protocol tag ID assignment by manufacturers. Telemetry network export is a feature that can be expanded to any interested telemetry networks."

Reply by ETN: "we're investigating the best way forward to exchange metadata information from manufacturers to ETN. Several options are possible and we're assessing what would be best for the user community."

Q2. What is equipment encryption?

Star-Oddi

No comment.

Lotek

David Gambin's POV: Encryption is very relevant regarding security in IT or banking contexts. When you have a code for your bank account, for example, the encryption keys allow the codes to change periodically. This security measure, e.g. in the form of one-time passwords, makes your bank account secure over time. In acoustic telemetry, codes don't change over time.

Thelma Biotel

No comment.

Innovasea

Encryption exists on many different levels. One of them is between a tag and a receiver, i.e., encrypting the acoustic signal. Then, encryption basically means to scramble the bits, preventing another entity to decode the signal, similar to having a secret language.

Sonotronics

A method of obscuring data.

Q3. What are the pros and cons of encryption?

Star-Oddi

No comment.

Lotek

Cons: In acoustic telemetry, true encryption requires additional bits which come at the cost of energy (battery). While often stated that there is increased security when encrypting acoustic signals, it is trivial to build an 'acoustic trash machine' to get behind the acoustic encryption patterns, so it is too easy to think no one will get your signal just because you encrypt your tags. Additionally, there is a compatibility loss when encrypting.

Thelma Biotel

No comment.

Innovasea

Pros: Encryption provides a layer of protection from somebody copying the coding scheme in an unauthorized manner (technological protection measure). And it also in itself provides a layer of

security (e.g. one tag being interpreted as the wrong id), the ability to expand the key and really lock down the insecurity, giving, for example, more certainty on false detections.

Sonotronics

Encryption is useful for protection of sensitive data (eg. banking information), but it also hides useful information from those who could potentially benefit. Would you want a medical alert bracelet to have information encrypted? Possibly, but at the cost of being unusable when necessary. Who benefits from keeping data obscured and proprietary? Who benefits from having the data being readily available?

Q4. What is Open Protocol (OP) and how was it developed?

David Gambin's recollection of the history of OP

There was a call initiated by ETN for manufacturers to get together to make an interoperable system in 2017. At the ICFT in Norway, the infrastructure of OPi (code scheme for OP acoustic ID tags) and OPs (code scheme for OP acoustic sensor tags, e.g. depth), which was developed by Erik Høy (former CEO of Thelma Biotel), was shared with the rest of manufacturers so that they could comment on it. All manufacturers were present and had the opportunity to comment. Those protocols were refined: Number of sensor tags OPs had, number of id tags OPi had, and the error correction they had. Some codes in the OPs code scheme, for example, were too similar to one of Innovasea's protocols. Innovasea suggested changing to another protocol so there wouldn't be false detections. A Memorandum of Understanding² was signed so that all manufacturers³ would be on the same page. Now, VLIZ (a research institute, not a manufacturer) hosts all available OPi/OPs tag IDs and gives them out to the manufacturers upon request.

Star-Oddi

No comment.

Lotek

OP is a framework for interoperability in acoustic animal telemetry. Manufacturers and researchers formed a steering committee to bring OP forward together. OP is ensuring interoperability for acoustic tags, similar to cellphones (compatibility in phone connection in Canada vs Mallorca, Wi-Fi, Bluetooth, etc.).

Thelma Biotel

No comment.

² MoU, document [here](#)

³ Star-Oddi, Lotek, Thelma Biotel, Innovasea, and others see list of signees [here](#)

Innovasea

There is also a temporal component of compatibility - “do I know that my deployed technology will work in the long term (be compatible with updates, etc.)”. Compatibility also has an evolutionary trait to it.

Sonotronics

No comment.

Q4. What is the role of networks like ETN in enabling compatibility?

Star-Oddi

No comment.

Lotek

To Lotek it boils down to business; purchasing drives innovation and development. A driver can be regulations, for example, the USB-C requirements in the EU – the manufacturers had to adapt their products to have an USB-C port.

Another driver can be a consumer driven change, like boycotts.

Thelma Biotel

No comment.

Innovasea

Compatibility can be a counterbalancing puzzle piece. Given the ability of the group that is driving the standard – can they keep that technology forward? Trade-off on prioritization between performance and a rapid turnaround of development.

Compatibility is not necessarily a barrier to innovation, but it can be. It can hinder innovation because it is consensus-driven and thereby slows down development of new technologies. But it is a trade-off between prioritizing performance (in terms of compatibility of equipment) and rapid turnaround of development.

Comment by Kim Aarestrup (DTU)

Compatibility is about my equipment being detected on other people’s equipment. It does in no way inhibit innovation and development.

New developments must be part of OP and can quickly find their way into the code schemes. That is also why there are separate code schemes for id and for sensor tags (OPi and OPs, respectively).

Comment by Jan Reubens (VLIZ)

The community requesting developments is key. In the case of OP, it was also a community request for interoperability that got it started. Because there is a steering group for OP that the manufacturers are also part of, new technological developments will be noticed immediately.

Q4. How many IDs are available on Open Protocol (OP)? And how can we make sure duplicate IDs aren't sold? Is it more susceptible to generating more false IDs?

Star-Oddi

No comment.

Lotek

There are one million OPi ids, and 64000 OPs ids. Blocks of ids are assigned to manufacturers (e.g., id 1 to 10000). If a manufacturer runs out of ids, they get more ids allocated from VLIZ as per the MoU.

Personal opinion of David Gambin: He does not believe that there is an increased risk in duplication of ids because they get sent out in blocks.

Thelma Biotel

No restrictions from Thelma.

Innovasea

Innovasea is only offering OP to European customers, if they were to transition all their tag production into OP, especially in the sensor space, they would fill up the available codes very quickly. The whole community won't want to see tag id reuse become a common event in the community.

Lotek

If there is a demand from the community to have more sensor IDs, then we should discuss this and build this factor into the development of OPs2 (the future OP encoding scheme).

Innovasea

Time is the worry when Innovasea rolls out a new code map, as they must think about things years and years in advance. They must start with a date at which they need to have this capability in the field. This takes 5-7 years before it is all deployed.

Lotek

If the OPs code map is not large enough for the demand that Innovasea forecasts, then it would make sense to not sell OPs tags in North America, but then what about the receivers? Shouldn't they be able to listen to OP?

Innovasea

Then the message becomes confusing – it's very clear now that we don't sell outside of Europe.

Comment from Jan Reubens (VLIZ)

ETN wanted to have a 3rd party to do the ID control so that duplicate IDs would not happen (initial it was requested to OTN, but they refused. Thereafter it was asked to VLIZ, who took up this role). OP

is something initially from ETN, but it was then opened globally. From the perspective of ETN, OP is meant for global adoption, and it is definitely not limited to Europe.

Q5. Is Open Protocol available outside of Europe?

Star-Oddi

Yes.

Lotek

Yes.

Thelma Biotel

Yes.

Innovasea

No.

Sonotronics

It is, from Lotek, Thelma, and Sonotronics.

Q6. Is Open Protocol (OP) the “default” for tags/equipment or do I need to request it?¹⁴

Star-Oddi

No comment.

¹⁴ Fact check was needed here as there was confusion. All manufactureres were asked to clarify whether OP is the default option.

Lotek: “OP is enabled on all Lotek hydrophones. OP is available for all acoustic tags as well. Yes it is the ‘default’ for orders.”

Thelma Biotel: “As you know, the essence behind the Open Protocol initiative requested by the community and started by ETN, was to make one language open for all, to avoid closed local networks and enable worldwide collaboration benefiting the global research community in the long run. As there are still some proprietary systems in the acoustic telemetry world, we will always ask you, and you must specify, the protocol you need for your project. We aim to make OP more default with time, but for now the choice of protocol is handled from case to case. When ordering tags, you have the opportunity to order the protocol “of your choice” that we, the manufacturer, have available. As a standard, you have to choose one protocol for the tags you order. Thelma Biotel wants to make it easy to combine equipment from several different manufacturers, today that means ordering tags on Open Protocols (OPs/OPi), and in some cases R64K, to be compatible with the older more proprietary networks that have yet to open up for the more modern Open Protocols. When ordering receivers: Thelma Biotel receivers support all shared and Open Protocols as a standard, and you can change the listening mode settings in ComPort if you want to limit the protocols your

Lotek

You should specifically state that you want OP (when buying tags). All 69 kHz receivers by default listen to OP.

Thelma Biotel

No comment.

Innovasea

No comment.

Sonotronics

Request.

Q7. How much does it cost to “unlock” Open Protocol?

Star-Oddi

No additional cost.

Lotek

No additional cost.

unit listens to. The next generation of Open Protocols, based on BPSK (most protocols on the market today are PPM based), is also in our development plans for our receivers.”

Innovasea: " When purchasing Innovasea equipment, European researchers must request Open Protocol at the time of sale. By default, Innovasea tags transmit Innovasea proprietary code spaces and Innovasea receivers listen for the same. Tags and receivers are not OP-enabled by default.”

Sonotronics: “Sonotronics receivers (SUR,miniSURT,USR23) are shipped with firmware that allows detection and decoding of multiple protocols including OP. Specific selection of OP (or other protocols) is performed by the end user. In many cases, it is possible to choose several protocols to be enabled at the same time (for example OP, r64k, and s256) or to restrict decoding to only one protocol if the end user decides this better suit their needs. These choices may be changed at any time by the end user.

There is no “default” selection for transmitters. Based on the design of a particular study, Sonotronics will often suggest a method, including the type of protocol, that in our experience will best meet the needs of the particular study. OP is but one of the possibilities and may be selected when products are ordered and is available without additional charges to the end user. However once produced, tag protocols cannot be changed

Thelma Biotel

No additional cost.

Innovasea

It is possible to buy an OP only receiver, or a regularly encrypted receiver plus OP. Innovasea asks for a price of 300EUR to upgrade existing infrastructure as part of their cost-recovery. It was very expensive to make older receivers OP compatible.

Follow up question from moderator Danielle Orrell (UCC/MaREI)

How much did this innovation cost, and will this be made freely available when the company breakeven on this investment? This is a huge barrier for research groups with limited budgets

Innovasea response

Realistically speaking, Innovasea says that they won't ever breakeven. If Innovasea breaks even at some point, it would follow the logic to give the OP upgrade for receivers for free.

Sonotronics

For Innovasea only, other manufacturers do not charge for OP.

Session 3 - Compatibility: Unanswered questions

Q. What is the role of networks like ETN in supporting/enabling OP/compatibility?

Star-Oddi

No comment.

Lotek

Acoustic Telemetry Networks are critical to enabling equipment interoperability.

At the group and individual member level they gather and share equipment performance details regarding the capabilities of Open Protocols and tag and receiver brands which allow others to make informed, unbiased decisions in selecting equipment best suited to achieve their study objectives. These networks establish and maintain a strict scientific code of conduct to ensure data is

safe. They manage the ID codes for OPi and OPs and screen manufacturers who wish to license the use of Open Protocols to ensure they commit to the terms regarding their use defined in the Memorandum of Understanding.

As these networks represent the largest segment of the acoustic telemetry user community, they define the scientific questions that need to be addressed. Which, in turn drives the development of equipment by manufacturers.

It is the purchasing of interoperable equipment that drives competition between manufacturers, pushing them to produce reliable, competitively priced tags and receivers and to be innovative to attract users.

OPi and OPs are the result of the efforts of networks like ETN and other users who have advocated for compatibility between manufacture brands for decades.

Thelma Biotel

ETN and other tracking networks represent a wide range of researchers and serve as an important link between the scientific community and the manufacturers of acoustic telemetry equipment.

The tracking networks will normally present the challenges and wishes from the community regarding hardware and software development to the manufacturers. The manufacturers are dependent on feedback from the tracking networks to know where development is wanted and/or needed the most, and encourage healthy competition between manufacturers to drive innovation in this field.

ETN has taken on the responsibility to streamline the Open Protocol initiative and has an overview on the Open Protocol ID's used. They control which Open Protocol ID's and how many each manufacturer has available to program into the tags they produce. Furthermore, the ETN has created a platform for Open Protocol data to be shared in the community and collaborate with the manufacturers to run automatic upload of metadata to their database from the manufacturers when OP tags are ordered.

Innovasea

Networks can play a constructive role in supporting and enabling any technology by providing objective, balanced assessments of the benefits and trade-offs of available solutions so researchers can make informed decisions/choices on which solution works best for their research questions.

Sonotronics

No comment.

Q. How can we effectively use a combination of receiver brands into global networks when there are encrypted tags sold - that aren't detected on all manufacturers receivers?

Star-Oddi

No comment.

Lotek

The user community must commit to using Open Protocol code spaces and migrate to an interoperable receiver infrastructure. The user community must require interoperability in their purchasing decisions. This is the only way to facilitate cross-brand receiver interoperability.

Thelma Biotel

- OP was made to make this possible.
- Equipment with limited support for open protocols, will hinder a streamlined mixed grid of equipment.
-

Innovasea

The determination of best value is subjective and usually sensitive to the context. This statement reveals a biased view of value angled toward a specific manufacturer. It is worth noting that other manufactures also sell proprietary tags.

Sonotronics

No comment.

Q. Innovasea has previously argued that monopolies are “good” for innovation, but this can lead to price enforcement and reduced services. How does Innovasea justify working for a monopoly against the well-established principles of a competitive market?

Star-Oddi

No comment.

Lotek

Lotek agrees with the statement “monopolies are against the well-established principles of a competitive market”.

Thelma Biotel

Innovasea will have to comment.

Innovasea

Innovasea does not argue that monopolies are good for innovation, we have simply argued that ETN’s OP framework will limit innovation. Furthermore, there is no evidence of price enforcement and reduced services. Innovasea’s prices are set in the context of the free-market competition that exists in this space and our service level remains best-in-class.

The acoustic telemetry fish tracking market is competitive in nature with several entities offering solutions-- so the question of monopolies is misguided and moot. Fundamentally, customers can choose among manufacturers and products. Specific to the ETN context (Europe) and Innovasea’s products, customers can also choose between the capability provided by Innovasea’s OP-enabled products or performance-based products like NexTrak.

Sonotronics

No comment.

Q. Can you explain the technology behind Nextrak receivers, is it PPM or BPSK?

Star-Oddi

No comment.

Lotek

Lotek understands that the Nextrak receiver is capable of PPM decoding since it is stated in Innovasea’s product literature that it is backward compatible with legacy tags (i.e. R64k). Regarding bpsk capabilities; a contract to supply 69KHz bpsk receivers was recently awarded to Innovasea within the USA. Innovasea will need to clarify which receiver model has this bpsk functionality and if it will include Open Protocol.

Thelma Biotel

Innovasea will have to comment.

Innovasea

NexTrak presently implements PPM but that may change as our R&D efforts progress.

Sonotronics

No comment.

Q. The Innovasea R1 receivers can detect OP tags, but Innovasea refuses to decode them. Why should researchers agree to purchase receivers that limit our ability to work as a network?

Star-Oddi

No comment.

Lotek

Researchers should not agree to this.

Thelma Biotel

Innovasea will have to comment.

Innovasea

NexTrak has brought and will continue to bring new capabilities to the marketplace that enhance science. OP and the OP framework, as it exists today, limit the capabilities we can offer with NexTrak if incorporated. For researchers who choose OP over the capability that NexTrak brings, they can choose from Innovasea's or other manufacturers' OP-capable products. Choice is a key feature of a competitive market, and these choices empower the researcher. Innovasea enables, supports and respects that choice.

Sonotronics

No comment.

Q. Do any manufacturers envision subscription fees for decoding tags or accessing cloud services that might limit its accessibility?

Star-Oddi

No comment.

Lotek

Lotek does not take issue with companies charging for cloud services. Cloud service

charges will be fair in markets with healthy competition.

Having said that, Lotek does not charge fees for decoding tags, and we do not anticipate that this will change. Though Lotek does not offer cloud services for acoustic telemetry data, we do offer web services for satellite telemetry products.

Thelma Biotel

TBs vision does not include subscription fees for decoding tags. We deliver raw data, where the researcher has full control of their data set.

Innovasea

Cloud services present the possibility of many benefits to the research community (e.g. streamlined data management, collaboration, processing horsepower to extract more/new data, etc.). Researchers will determine whether any such initiatives bring value, are appropriate, and are economically practical.

Sonotronics

No comment.

Q. Through discussions in the last year, I have the feeling that Innovasea gave up on the free market. Specifically, that Innovasea explicitly said that OP does not fit their business plan while the European community is moving forwards with Open Protocols. Can you comment on Innovasea’s positionality on compatibility, and their approach to the European market?

Star-Oddi

No comment.

Lotek

Although Innovasea is a part of Open Protocol, Innovasea’s actions thus far appear to be non-supportive of global interoperability. While not explicitly stated in the OP Memorandum of Understanding and Licensing agreement, it is understood that purpose of OP was to unite acoustic telemetry networks and individual researchers at the global Scale.

Thelma Biotel

Innovasea will have to comment.

Innovasea

On the contrary, Innovasea very much believes in the free market. Innovasea listened when the European researchers represented within ETN said OP solutions were desired. As a result, Innovasea brought numerous OP specific and “dual-mode OP” products to the European market.

Innovasea is also providing OP solutions to the European market alongside other capabilities like NexTrak. European customers can choose between these products and also choose other manufacturers' products. Choice is a cornerstone of a free and competitive market. At a fundamental level, Innovasea believes that the fish research market will frequently value (that is to say 'choose') innovation over most other factors when given that choice. Fundamentally, new capabilities are needed to drive new science. As part of that, Innovasea believes that NexTrak can enable new capabilities which are not possible within the constraints of the OP framework. That is why we are investing in NexTrak.

Sonotronics

No comment.

Q. Do you see a future where compatibility is common ground with all manufacturers?

Star-Oddi

No comment.

Lotek

Yes, but not until researchers insist upon it.

Compatibility between manufacturers has been available for over a decade. It is up to the user market to use interoperable equipment and dictate equipment needs for the future. This will require communication and co-operation between manufacturers and the user community to ensure compatibility.

Thelma Biotel

Yes, that's the goal!

Innovasea

Given that Innovasea along with other manufacturers have already found common ground with OP compatible product lines, implicit in this question is the notion that manufacturers ONLY build compatible products. This narrows the possibilities for new, breakthrough capabilities to what is possible with the existing, consensus state of compatible technologies. Such a future is possible but has limitations in what it can accomplish.

Sonotronics

Yes.

Q. How important is science to your business, and what role can science play in driving innovation and infrastructure?

Star-Oddi

No comment.

Lotek

Science drives innovation and infrastructure by demanding equipment which delivers data necessary to address specific questions. Interoperability enhances the capabilities of networks and expands the horizons and depths of what is possible to study and explore.

Thelma Biotel

- Thelma Biotel is a science driven company, quickly following new and available technology to implement into our products for best possible data collection within research. We are always looking to improve our methods and products, contributing to driving innovation in this field.
- Thelma Biotel is owned by several researchers at the Norwegian University of Technology with great interest in the technology and its potential.
- We have exceptional expertise on development within acoustic telemetry, keeping close contact with researchers at the Norwegian University of Technology for updates in the field, as well as an interest to meet the new requests in the research community. One result of this specifically is the EMF tag which measures electromagnetic fields (prototypes in field in 2024).
-

Innovasea

Advancing science is the north star of Innovasea's fish tracking business and is an essential element to how Innovasea approaches innovation.

Sonotronics

Absolutely critical... product development follow the needs expressed by the scientific community.
