

RTI CUSTOMER SNAPSHOT

OpenROV

SOLVING COMPLEX CONNECTIVITY IN UNDERWATER DRONES



“Ease of use, reliability and the technology’s proven success were among the many critical factors in selecting RTI to provide the connectivity platform for our underwater drones. The Connex DDS framework enables us to rapidly enhance interoperability between the technical aspects of our products, improving the way we utilize multiple vehicles at once and the way we expand the capabilities of each individual vehicle.”

Charles Cross
Software Engineer, OpenROV

COMPANY OVERVIEW

OpenROV is a leading developer of powerful drones for marine intelligence and exploration. Their mission is, “to empower everyone to explore the world’s oceans and waters.” In 2012 the company launched the world’s first affordable underwater robot kit, called OpenROV (open-source remotely operated vehicle). Since then, they have been working to evolve this robot into a device that was easy to use, ready to deploy out of the box, and able to perform in extreme underwater conditions. OpenROV is now preparing to launch their newest drone, Trident. Trident is the company’s first high-performing, commercially-available underwater drone with a re-designed software and hardware architecture equipped for complex environments.

OpenROV launched their out-of-the-box, advanced underwater drone built on RTI’s connectivity software to unlock access to the ocean for consumers, marine exploration, industry researchers and more. Trident has already shown promise as an alternative or problem assessment tool in areas traditionally served by larger more developed ROV technologies, such as ship maintenance, oil & gas

HIGHLIGHTS

- OpenROV is a leading developer of powerful drones for marine intelligence and exploration.
- OpenROV successfully completed their initial implementation of Connex DDS in just two days.
- RTI Connex DDS met the complex connectivity requirements of operating a drone with multiple live video streams while underwater in one of the world’s harshest and most unpredictable environments.

and offshore inspection/survey. The Trident’s compact size, low cost and ease of use has also proved to be beneficial to industries that aren’t usually served by ROVs including aquaculture, eco-tourism, and search and rescue.

CHALLENGE

Designing the technology architecture for the Trident was no easy feat. The ocean habitat is one of the most unpredictable and harsh environments on earth. This created many communications and sensing challenges for the OpenROV team, including the fact that electromagnetic waves do not transmit well through water. On top of that, the requirements of the underwater robot include video and telemetry recording, Wi-Fi connectivity, user control from standard consumer mobile devices, stabilized motion, as well as customized waterproofing and material selection to ensure that the vehicle is able to operate at 100m depths, and in various natural and chemical environments. The device must also be intuitive and easy to operate by someone without specific technical training.



Figure 1. Photo of a shipwreck taken from the OpenROV Trident

To achieve underwater video and recording, each OpenROV Trident is equipped with a built-in camera that produces multiple video streams. These streams are transmitted through the tether and then bridged to an operator's device via Wi-Fi. The vehicle's software is tasked with maintaining the balance between delivering low-latency, high-quality video, and working with the bandwidth and reliability constraints that the physical network imposes on the system. Additionally, due to the high-cost nature of underwater and maritime operations, reliability and robustness of both the physical vehicle and its software are of paramount importance. Even with traditional ROV equipment, which can cost hundreds of thousands to millions of dollars, the cost of the sensing equipment typically pales in comparison to the operational and personnel costs. In this context, Trident was designed to be cost-effective, fast and effective to deploy and use, and highly reliable when collecting valuable mission data. These requirements resulted in the need for an advanced connectivity solution.

SOLUTION

The OpenROV team first heard of RTI and the Data Distribution Service™ (DDS) standard when a software engineer joined the company from NASA, where he had managed a successful implementation with RTI Connex® DDS. He was responsible for facilitating research in autonomous aerial vehicles and implementing a solid connectivity platform where all of NASA's complex systems were interoperable, reliable and secure. RTI Connex DDS was the only solution able to address these issues and work seamlessly across NASA's systems. Additionally, RTI was selected for its superior documentation and customer support. The engineer recognized similar connectivity challenges at OpenROV and immediately recommended implementing RTI Connex DDS due to its proven success.

BENEFITS

OpenROV successfully completed their initial implementation of Connex DDS in just two days. They immediately realized the value of the framework, and given the distributed nature

of Connex DDS and its ability to enable automatic discovery between the various data streams and services in the vehicle, the engineering team was able to shift focus to their application data and business logic, and stop worrying about networking connectivity and performance. This opened up the ability for their developers to quickly analyze and iterate on the system's core software components, such as the vehicle's control system and video pipeline, and additionally create a wide variety of tools and monitors to aid in the company's production processes.

RTI's connectivity software enables OpenROV to ensure that all videos and telemetry captured by the Trident are simultaneously streamed live to the operator's device and recorded locally onboard the vehicle, as well. This means that the user always has a redundant source of mission data, in the event that the vehicle is lost or damaged while a mission is underway. Additionally, the flexibility of the pub-sub architecture allows the video delivery software to optimize the livestream's bandwidth for multiple operators, while delivering



Figure 2. A photo of the Trident captured during an underwater dive

the most consistent, low-latency experience possible to the direct pilot. In industries like oil & gas, where it can cost millions of dollars a day to have a crew deployed to a site to perform a job, or where expensive assets may be at risk, loss of mission data and unreliable operation of the vehicle is not an option. In this context, OpenROV aims to distinguish Trident from other drones in its class with enhanced reliability, flexibility and robustness.

The OpenROV team also leverages RTI's debugging and monitoring tools to identify any failing sensors or potential connectivity issues as the vehicles move through the production line. Tools like Admin Console and Recording Console are routinely used by production engineers to take snapshots of system state when issues arise and collect other valuable data and statistics. This data can then be forwarded on to the engineering team for analysis, troubleshooting, and optimization.

As an additional feature, because OpenROV customers have access to RTI Connector which supports the rapid development of DDS applications using scripting languages, such as Python, technically savvy users can quickly write their own plugins or tools for working with the vehicle. This makes the platform easier to experiment with in the context of adding new software features, such as autonomous control, data processing, artificial intelligence, and also new hardware components, such as additional sensors and manipulators. As an example, OpenROV has internally used this plugin approach to quickly integrate and test a new inertial measurement unit alongside the existing one without having to modify the vehicle or its core software. They are also working on an experimental Python plugin, built on top of Connector, which allows you to connect the vehicle with popular live streaming services and allow viewers to interact with and direct the vehicle in a limited capacity through a chat interface.

This ability to rapidly test new ideas and integrate with existing technologies and libraries is core to OpenROV's future plans for the vehicle as a platform for innovation in underwater applications.

With RTI's leading connectivity software, OpenROV was able to provide a high-performance underwater drone for consumers, researchers and professionals. In the future, the company plans to continue to advance this technology and expand into larger, industrial markets building off of the Connex DDS framework. Together, OpenROV and RTI are enabling the development and widespread expansion of technologically-advanced underwater drones via enhanced and reliable connectivity solutions. RTI will continue to support OpenROV as the company deploys new devices for the intelligent Industrial IoT systems of the future.

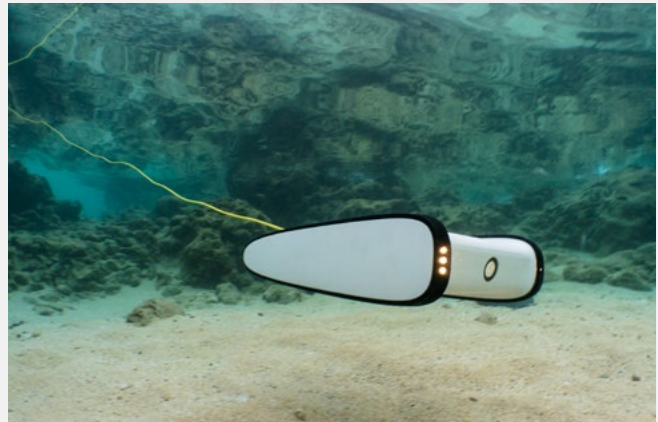


Figure 3. The Trident's tether is used to transmit the live video streams from the built-in camera to the user's mobile device.

ABOUT RTI

Real-Time Innovations (RTI) is the largest software framework provider for smart machines and real-world systems. The company's RTI Connex[®] product enables intelligent architecture by sharing information in real time, making large applications work together as one.

With over 1,500 deployments, RTI software runs the largest power plants in North America, connects perception to control in vehicles, coordinates combat management on US Navy ships, drives a new generation of medical robotics, controls hyperloop and flying cars, and provides 24/7 medical intelligence for hospital patients and emergency victims.

RTI is the best in the world at connecting intelligent, distributed systems. These systems improve medical care, make our roads safer, improve energy use, and protect our freedom.

RTI is the leading vendor of products compliant with the Object Management Group[®] (OMG) Data Distribution Service[™] (DDS) standard. RTI is privately held and headquartered in Sunnyvale, California with regional headquarters in Spain and Singapore.

Download a free 30-day trial of the latest, fully-functional Connex DDS software today: <https://www.rti.com/downloads>.

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