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An interview with CAE S.p.A. Chairman, Guido Bernardi

We are glad to share CAE's perspective on recent developments in the real-time monitoring market for civil protection, with a particular focus on innovations in the hydrometric and meteorological fields. It concerns investments aimed at reliability, interoperability and technologies opened to mitigate the risk.

Nowadays the Civil Protection code defines the operation of the National Alert System and recognizes the importance of real-time monitoring for effective hydrogeological risk mitigation. However, the path towards this awareness has been long and arduous, and, in some respects, it is not yet fully complete. What role did CAE play in the evolution of hydro-metric, rainfall and meteorological monitoring in Italy?

Automatic monitoring networks were crucial in order to improve real-time flood forecasting. Until the late 1970s, monitoring had always been manual and data collection was costly and complicated, making it difficult to realize in the timelines required for early warnings.



From 1980, with a very clear entrepreneurial vision, CAE committed itself to ensure that monitoring system users, usually public administrations with civil protection responsibilities, received reliable, automatic data in real-time, directly in their offices. Our first clients were the “Genio Civile for the Reno River” and CNR-IRPI of Perugia. These were followed by various offices of the national hydrographic service and many others.

The technology was not like these days. Everything had to be developed or customized ‘in-house.’ There were no cellular communications or internet, and we worked only on adapting commercial radios and the first microcontrollers.

Product innovations were vital in this journey. However, I would like to point out a major innovation in service: remote maintenance of equipment, with 24/7 intervention possibilities and the following guarantee of real-time data collection.

It was this innovative approach, and so the promise to always receive data, especially during emergencies, that made CAE one of the main players in the creation of the regional Decentralized Functional Centres network in the early 2000s.

Looking at the present day, what are the main advantages that innovation offers in the field of real-time monitoring?

Today, **power consumption** remains low, ensuring **independence from the electrical grid**, but, in addition, **multiple transmission media** can now operate simultaneously between measurement stations and control centres. This means higher **reliability** in data collection, with measurement update frequencies that are more suitable for monitoring intense and, in a sense, sudden and localized phenomena.

Furthermore, dataloggers are now equipped with powerful **microprocessors**, programmable to manage local alarm algorithms or scenario changes. In this way, where necessary, a monitoring station can evolve into a truly proactive territorial safeguard.

The wide use of **wireless devices** between sen-

sors and dataloggers, or even between different dataloggers, extends the effectiveness of these solutions to many different risk scenarios and applications: from landslides and hydraulic works to flooded underpasses and urban flash floods.

The availability of **standard data sharing tools** and **software** that, from the central centre, allow users to access data via any application and even on the move, completes the picture.

How does CAE address the topic of technological openness and overcoming lock-in in monitoring networks?

CAE Magazine dedicated an entire special article to **overcoming technological lock-in**.

When we decided to embrace the wave of technological **openness** back in 2014, we only partially understood the potential of this choice. We initially aimed to address the need to overcome lock-in, we achieved much more.

The development path CAE has followed until now, consolidating the second generation of technologies based on **standards, interoperability, and programmability**, has accelerated the creation of new functionalities. It has also simplified the integration of third-party sensors and components, allowing us to offer increasingly effective and performing solutions.

The modernization of monitoring networks in Italy is taking place progressively, also because the **backward compatibility** of all components allows even the oldest systems to be upgraded in successive steps.

The complete overcoming of lock-in occurs where latest-generation systems are operational, such as the one recently implemented in Calabria. In these cases, it is possible to use components from other manufacturers, such as dataloggers, to maintain and expand networks originally built by CAE.

From technologies to corporate skills: what is CAE’s capacity for maintaining monitoring networks based on other companies’ technologies?

One of the most significant **investments** CAE has made in recent years concerns the ability of our technicians and the company to perform maintenance on monitoring networks built by other providers.

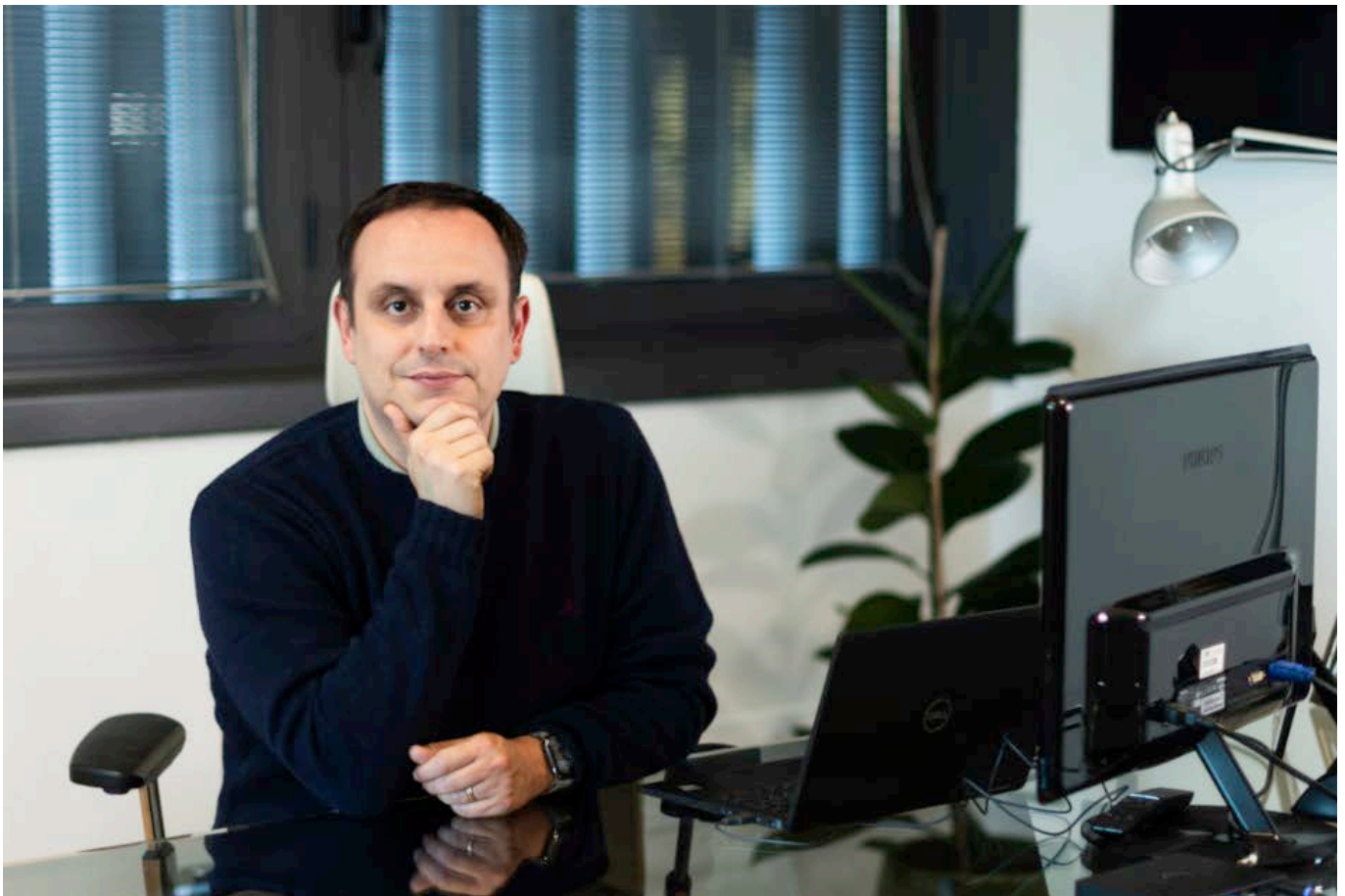
Today, we successfully manage the regional monitoring networks of Veneto and Puglia, which were previously upgraded and managed by other market operators. Among the many examples we could cite, we also maintain the **ISPRA tide gauge monitoring network** and the system in the **Lombardy Region**, where we have successfully learned to manage third-party dataloggers for monitoring numerous landslides.

We decided to invest in this direction after stepping back, a few years ago, from a maintenance tender for a major regional network. That network had been upgraded by a competitor just a few years earlier, with the goal of making it free from technological lock-in.

Only one operator participated in that public tender, the one that had performed the upgrade, while CAE, as we say in sports, was watching from the sidelines. We decided not to take any reckless risks and declined to participate, protecting our reputation but, more importantly, the safety of that Region's citizens and the work of the client managing the network.

To continue with the sports metaphor, in the following years we trained hard to ensure we could compete with other public tenders involving the maintenance of equipment not of our own manufacture.

We utilized all the information clients provided about their systems, which were unfamiliar to us, and reconstructed the rest. We tested again and again until we successfully managed to use software, dataloggers, and sensors from other manufacturers. Only at that point did we step onto the field to play our game.



Yours is a very specialized sector, and you are the market leader. How does this “social role” of the company reflect in its daily management?

We are well aware that the effectiveness of our clients' decisions, the proper mitigation of risks, and, consequently, the safety of citizens can depend on our work.

First of all, this awareness drives us to lead technological development with **investments that have positive impacts on the entire sector**. A prime example is our **promotion of IP standards for communication** between control centres and monitoring stations.

In addition, we **always stand by our clients**, pro-

viding them with professional assistance not only through the standard project implementation phases, from reporting to managing permits and construction sites, but also, during the most critical moments, such as emergencies.

We believe that the key to success for a company like ours is the **ability** to face great challenges with a sense of responsibility. The ability to adapt to any context to meet client needs is **not the result of improvisation**; it is the result of foresight, planning, continuous training, hard work, and, above all, **investments**. ■

Edited by the CAE Magazine Editorial Staff

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The advantage of IP protocols for real-time monitoring networks

The use of IP technologies for collecting measurements from real-time monitoring networks and managing equipment distributed across the territory offers many functional advantages:

- native integrability into existing telecommunications networks;
- high levels of “cyber security” thanks to TLS/DTLS encryption standards;
- standardization with respect to other markets converging on IP networks;
- possibility of using innovative application protocols, both existing and future;
- openness through the use of universally recognized protocols.

For all these reasons, regarding real-time moni-

ring networks in the hydrometric and meteorological fields for civil protection purposes, **IP technology is now the established standard in Italy.**

Furthermore, speaking specifically of UHF radio data transmission, this choice, when implemented using **the RÆVO radios** proposed by CAE, allows for low **power consumption, high transmission speeds**, so reduced acquisition times, and all the **reliability of multipath routes.**

Owning a telecommunications infrastructure based on **RÆVO IP radios**, designed to carry UDP protocols, allows the user to choose among various standards to implement communication with the “nodes” (that in this specific case are the dataloggers) of the monitoring network.



Among these standards, CAE has predominantly proposed implementations based on the **CoAP** protocol, which is particularly suited for creating fast, reliable, and secure networks, as well as for implementing **high-value-added services** for the monitoring network users. From a technical perspective, it is a **lightweight protocol** that minimizes *overhead*, capable of offering innovative REST interfaces over a UDP transport.

Why the choice of UDP? Because narrow-band radio networks are not suitable for efficiently carrying TCP-based protocols due to the higher volume of traffic generated, especially given the recent trend of using *half-duplex* networks on a single frequency. By fully leveraging the synergy between the “**Data-life Platform**” and the **CoAP protocol**, CAE’s latest generation of monitoring systems features advanced **automatic message recognition**. This intelligence allows central stations to interpret and adapt communication streams in real-time, **tailoring data exchange to the specific configuration and status of each individual datalogger** within

the network.

The decision by a majority of **Functional Centers (Regional Civil Protection Centers)** to modernize their networks using these standards is rooted in three core pillars:

- **High-Performance Transmission:** Utilizing UDP over IP ensures low-latency data delivery, critical for early warning and civil protection.
- **Robust Security:** The adoption of IP-based protocols allows for the seamless integration of modern encryption and authentication standards, safeguarding sensitive environmental data.
- **Maximum Interoperability:** By adhering to universal IP and CoAP standards, CAE ensures that monitoring infrastructures remain flexible, scalable, and compatible with broader national and international datasets.

This transition to IP-based technology, pioneered by CAE’s RÆVO and Datalife ecosystems, represents the current state-of-the-art for resilient, real-time environmental monitoring. ■

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Network maintainability and integrability: replacing or adding components in modern networks



For a monitoring network spread across multiple measurement sites to be maintainable by various operators, achieving a **complete overcoming of technological lock-in**, it is essential that its main components can be integrated or replaced by third-party operators, other than those who originally built the network. The primary components of a remote monitoring network are sensors, dataloggers, and transmission modules.

The datalogger is the heart of the automatic remote monitoring station. It is the electronic control unit that acquires data from the sensors, verifies its quality, performs any necessary processing,

and then stores and transmits the information. For civil protection purposes, it is fundamental that these devices have low power consumption, allowing them to be used in monitoring sites where energy is provided by independent power systems, such as batteries and solar panels.

It is therefore extremely useful for any operator tasked with maintaining a monitoring network to be able to replace or integrate new sensors on existing automatic measurement stations. **The dataloggers of Compact line** support multiple **standard interfaces** that allow commercial sensors to be changed or added with relative ease. This



process is further facilitated by the configurability and programmability of the control units themselves, which aids in the potential integration of proprietary protocols from other manufacturers.

Always with the aim of ensuring the overcoming of *lock-in*, it is crucial that the datalogger itself is a replaceable component, allowing for third-party products to be used in the event of failure.

The **investment** CAE has made to combine high-end performance with technological openness involves **the implementation of standard interfaces between the company's sensors and the datalogger, as well as the use of CoAP protocol for communication between the datalogger and the control centre.**

In the most modern networks, whether built or fully upgraded by CAE, an operator needing to replace an existing Compact line datalogger with a

compatible spare would only need to ensure that it communicates via CoAP and features interfaces to connect to the **RÆVO radio**, either via serial connection, implementing a **PPP protocol**, or via **Ethernet**. Once this is established, it is sufficient to correctly assign the IP address to the new datalogger, following the company's documentation, and the replacement can be completed, communicating via standard CoAP with the central system. The methods used by the datalogger and the control centre are described in the user documentation and are based on standard formats: CoAP with REST APIs, JSON, etc.

To demonstrate this concept even more clearly, we present a short video showing this exact scenario: the installation of a **Campbell datalogger**, model CR1000X in this case, within a network managed by the **DATALIFE PLATFORM** software,

identical to those currently installed in our clients' most modern control centres.

It is important to emphasize that the **programming of the standard CoAP protocol communications on board this datalogger, one of the most widely used in the world, was carried out without**

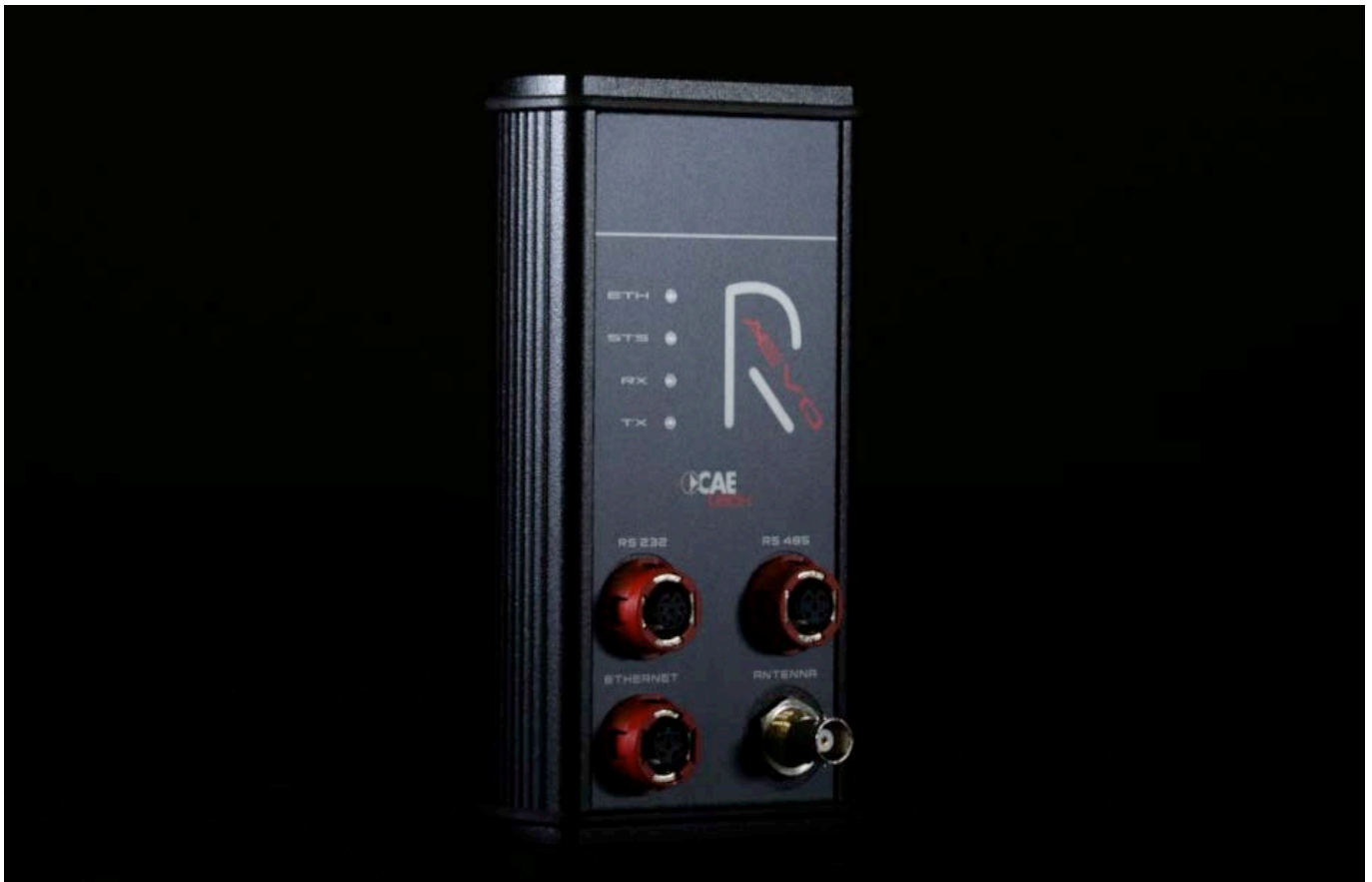
relying on any of CAE's proprietary or confidential information.

Similarly, any other modern datalogger that offers user-programmability can be implemented with the required standard protocols and used as a replacement for the Compact unit. ■



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Higher performance, overcoming lock-in, and maintenance activities: a deep dive into the RÆVO radio



RÆVO is the latest radio developed by CAE specifically for updates to hydro-meteorological monitoring networks, in order to **increase interoperability, standardization and transmission speed**, while maintaining the traditional **reliability** that radio networks have always guaranteed.

The radio modem is suited to the creation of Point-to-Point and Point-to-Multipoint connections, even with very complex networks that require very low power consumption: its use in environmental monitoring and warning systems implies the need to guarantee **operation in extreme conditions** and give up the power supply from mains. Conse-

quently, RÆVO is developed to ensure functionality even when powered by a solar panel and buffer battery.

With regard to **interoperability with commercial dataloggers** and implementation into mixed technology systems, RÆVO allows interfacing with external devices via 3 ports: RS485, RS232 and Ethernet. Being a **CAEtech product**, RÆVO is able to interact with devices and applications of different nature, as it is able to support modern standard **IP** protocols.

Therefore, thanks to CAE's investments, the RÆVO radio combines a transmission speed of **14,400**

bps with the possibility of using **standard IP protocols**, while ensuring **low energy consumption**.

With these devices, besides achieving high transmission speeds, it is possible to implement radio network characterized by so-called “**multiple paths**”.

As known, UHF radios generally are fully compatible only with radios of the same brand, and, among them, with some models. This happens because the “on-air protocol” implemented by specific radio manufacturer is usually “proprietary” and not made known.

In order to mitigate the potential lock-in that could be associated with this technological characteristic, RAEVO provides on-board modulations from the Finnish manufacturer, SATEL OY. This allows the radio to be used in a compatible way with other devices from the same manufacturer for certain applications.

To ensure commercial transparency and accessibility, especially in the Italian market where single-distributor models can often create bottlenecks, CAE has established a network of selected distributors committed to making the RAEVO radio available to all operators.

Among these partners is **Sartelco Sistemi Srl**, a company chosen for its extensive experience and historical presence in the sector. Under a formal commercial agreement with CAE, Sartelco and other specialists ensure the RAEVO radio remains freely available on the market.

Ivan Sartini of Sartelco Sistemi Srl confirms this commitment to availability: *“To the best of my knowledge, to date, Sartelco Sistemi has always offered the RAEVO radio to any operator who has requested it in Italy. We have accepted all orders received following our offers, within the timelines provided by the factory.”* ■

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Maintenance of the real-time monitoring network kicks off in the Calabria Region



We are proud to announce that CAE has been entrusted with the four-year maintenance of the Calabria Region's hydro-meteo-pluviometric monitoring network. Operated by **ARPA Calabria**, this strategic infrastructure is vital for Civil Protection activities and regional safety. The appointment confirms CAE's excellence and reliability in ensuring safety, innovation and environmental protection.

In the recent network upgrade, the most advanced technologies on the market were employed: the **CompactPlus** and **RAEVO** radios. These components ensure the network is not only **open and interoperable** but also capable of delivering **top-tier performance**.

High-level performance is not just about high-quality sensors, measuring water levels, rainfall, and air temperature, but is most evident in the speed and reliability of data collection.

The radio network itself, which works with a cellular module backup always available to guarantee redundancy and security, offers two benefits: it allows all network data to be updated every 10 minutes and, in case of a malfunction on one or more radio networks, it enabled real-time **alternative paths**.

Regarding the radio network architecture, which manages multiple paths, CAE has introduced, for the first time, an innovative, high-value added service, which is currently patent pending. This technology not only allows for switching radio paths in case of failure but also enables the selection of the best new radio path among all the available ones at that specific moment.

The regional network consists of **255 measuring stations**, connected to typical hydro-meteorological sensors, and in addition sensors for soil para-



meters measurement. The stations are equipped with UHF transceivers and are monitored by two control centers, Catanzaro and Cosenza, each provided with a backup (for a total of 4 centers) via 43 radio repeaters.

Over the next 48 months, the maintenance service will be structured into three distinct types of ordinary activities:

- **Preventive maintenance:** Periodic inspections, calibrations, and supervision to keep stations, repeaters, and control centers at peak efficiency;
- **Corrective maintenance:** Rapid-response inter-





ventions to resolve any system anomalies or hardware malfunctions;

- **Remote maintenance:** Constant remote monitoring of operational status. This allows our team to intervene proactively, often before the Administration even identifies an issue, to minimize downtime. This service also includes the management of the “AllertaCal-Aegis-Datalife” platform.

To enable urgent interventions at the remote station installation sites, transmission equipment and control center system, CAE – as the contract winner – has established a **local spare parts wa-**

rehouse prior to the start of services, as required by the technical specifications. This ensures full compliance with corrective maintenance response times during emergencies.

Proud of the results achieved in the previous contract – where CAE successfully combined **innovation, openness, standards and efficiency** in the upkeep service offering – the company will provide comprehensive support. CAE will offer all the assistance and services necessary to enable the Client to fully leverage the extraordinary potential of the system, constantly flanking him in daily operations. ■

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