innovation for a safer world.

CAE MAGAZINE
n.43 · *July 2026*

INDEX

Piedmont: maintenance of the regional meteorological and hydrometric monitoring network

The real-time hydrometeorological monitoring network of the Piedmont Region was installed in the late 1980s by CAE. It is a historic network, among the most extensive in Italy in terms of size, and for the next 5 years, CAE will continue to handle its maintenance service. It is a strategic infrastructure supporting forecasting, monitoring, and alerting functions of the **Regional Functional Centre at Arpa Piedmont in Turin**.

CAE has deep knowledge of the network architecture and its technological evolution, thanks to over thirty years of experience in the Piedmont area, enabling it to offer a specialized service designed to:

- ensure operational continuity, maximum availability, and high-quality real-time data;
- monitor and prevent hydrogeological, hydraulic, and meteorological risk phenomena;
- support Civil Protection alerting functions.

Maintenance activities are divided into the following categories:

- **Preventive maintenance**, aimed at preserving the full efficiency of the system as a whole and of its individual components, while ensuring adequate data quality.
- **Corrective maintenance**, aimed at restoring system functionality following malfunctions or failures.

- **Integrative maintenance**, covering all timely interventions required following significant events that may compromise any network component. This includes **remote maintenance services, 24/7 customized support, and maintenance of the transmission medium**

All activities will be systematically reported through the Maintenance Portal.

As part of the maintenance service, an innovative **Dynamic Adaptive Routing (RAD)** system will be introduced, aimed at automatically optimizing UHF radio paths between peripheral stations and the control center. RAD enhances the reliability and resilience of the regional transmission system through continuous analysis of signal parameters and diagnostic information from nodes, **selecting the most efficient connections in real time**. Operating transparently with the existing radio infrastructure, the system ensures operational continuity even in the presence of attenuation or failures, **evolving the network from a static structure into a dynamic one** capable of auto-

matically adapting to environmental and operational conditions.

The Piedmont network represents a complex system consisting of **372 measurement stations** distributed across the territory, equipped with UHF transceivers as the primary transmission system, with GPRS and satellite modules as backup. The stations are categorized as follows: 102 hydrometric, 177 pluviometric, 80 meteorological, and 13 nivometric, in addition to 45 repeaters and a main acquisition center with backup in Turin. Thanks to the **SIM Project (Sistema Integrato di Monitoraggio e Previsione, in English, Integrated Monitoring and Forecasting System) by the Italian Ministry for the Environment and Energy Security, funded through NRRP resources**, the network will be further upgraded and expanded in the Alessandria area.

The service organization considers the **morphological characteristics of the Piedmont territory**, which includes **hard-to-reach sites, 69 of which are accessible only by helicopter and only during certain periods of the year, areas subject to extreme weather conditions, and over 50 high-altitude locations**. ■

BACK TO INDEX

Radio IP and Machine Learning: CAE develops Dynamic Adaptive Routing (RAD)

The radio transmission medium, often complemented for redundancy by cellular or satellite data transmission technologies, continues to be the most widely used solution to ensure the **security and reliability** of telemetry networks in Italy for civil protection purposes. This is because radio technology makes it possible to establish a dedicated data transmission channel, owned by the public administration, which combines low power consumption, bidirectional communication, and a adequate speed and capacity for data collection.

CAE has for several years been offering the RAEVO radio, capable of natively carrying IP protocols such as the **CoAP standard**. This radio, which operates with very low power consumption compared to other IP devices currently on the market, can be easily interfaced with **existing broadband backbones**: a virtuous example of **technological interoperability** at the service of the Public Administration.

Today, as extreme rainfall events become increasingly short, intense, and localized, an important requirement for users of real-time monitoring networks for civil protection purposes is **faster telecommunications**, so that an Italian Region with a widespread distribution of measurement stations across its territory **can receive updated data via radio every few minutes**.

RAEVO is the first transmission system with a high

level of standardization in this sector, characterized by IP protocol support, reduced energy consumption, and **speeds of up to 14,400 baud**.

Another key element, for those managing hydrometric and meteorological monitoring networks for civil protection purposes, is the **reliability of the network itself**. The radio, owned by the administration, is chosen to precisely ensure the **reception of real-time measurements even during emergencies**, when public cellular networks may struggle. Recent events have demonstrated the importance of this choice, which is why CAE has always invested in the development of tailored solutions to improve the safety and reliability of radio networks.

CAE can design and implement UHF radio networks in which message routing from the field to the control center, and therefore real-time data collection, occurs through "multiple paths". This feature of the systems, highly appreciated by Civil Protection operators, is now further enhanced thanks to CAE's latest research achievement: Dynamic Adaptive Routing (RAD).

This functionality, now offered as a service, is enabled by software that leverages procedures typical of **Machine Learning techniques to route data packets through the radio network along the path that, each time, proves to be the most efficient and secure**. Routes are therefore calculated in real time based on network diagnostic parameters such as RSSI, operating percentages, etc. **This solution is unique** in a radio product of this category, and CAE is currently filing a **patent** for it.

The advanced RAD functionality, which further enhances the advantages already offered by "multi-path" architectures, can be applied both to co-frequency networks and to networks with high-low frequency pair channels, making it a possible upgrade for all users already using standard RAEVO radios in their monitoring networks.

Although it is an effective and modern solution, **RAD does not require hardware upgrades to the devices** and therefore always allows a return to the commercial solution, using a traditional configuration of devices and routing, ensuring **full maintainability** of the network even by **third parties**.

BACK TO INDEX

A hydrometric monitoring system for the flood expansion basin of the Muson stream

Within the framework of the expansion basin designed **to mitigate flood events of the Muson stream and its tributary Lastego, the Veneto Region**, through the Civil Engineering Department of Treviso, **planned the implementation of a hydrometric monitoring system**, developed by CAE and aimed at real-time water level measurement **to support flood management activities and the control of hydraulic dynamics.**

The basin is designed to be activated during rapid flood events, as occurred in October 2023, when it prevented downstream flooding by reducing the peak of the flood event. Monitoring water levels facilitates decisions regarding the **management of hydraulic infrastructure and the operation of sluice gates.**

Specifically, **four hydrometric stations have been installed** at key points within the expansion basin, namely:

- the Muson intake/diversion structure;
- the Lastego intake/diversion structure;
- the intermediate spillway;
- the return structure into the Muson stream.

The stations are equipped with **Compact dataloggers and hydrometers**, using either radar or piezometric technology depending on the installation site characteristics. In all cases, the instruments are built

with robust and reliable materials, designed to withstand the test of time and endure sudden and extreme climatic variations typical of alpine environments. The monitored sites are also equipped with **staff gauges for low-flow and high-flow levels**. These are complemented by dedicated webcams, allowing users to visually verify conditions even in the absence of transmitted data, supporting decisions on opening or closing sluice gates.

Special attention has also been given to energy aspects: all stations are **autonomous thanks to solar panels with backup batteries** capable of ensuring operation for several days even in the absence of external power supply.

The project was delivered as a "**turnkey solution**", including not only the instrumentation and **software** but also all activities required for full operation: installation, commissioning, and technical documentation.

Thanks to the compatibility of the instrumentation,

the stations **can be integrated into the regional hydro-nivo-agro-meteorological monitoring network of ARPAV**.

To support monitoring, several activities were carried out at each station, **including topographic and bathymetric surveys**, **establishment of planimetric-altimetric benchmarks, determination of geographic coordinates and elevations above sea level,** referenced to the National Dynamic Network, as well as **the survey of cross-sections of riverbeds and existing structures such as bridges and hydraulic works**. CAE also calibrated the hydrometric zero level of staff gauges and hydrometers, where present, using high-precision topographic instruments.

The contribution of these four hydrometric stations to the **alert system** is significant, enhancing the availability of real-time data to support downstream flood forecasting. **In particular, they will be essential for safeguarding and managing hydraulic risk in the municipalities of Castelfranco Veneto and Castello di Godego.** ■

BACK TO INDEX

Campania: CAE wins the second phase of the tender for weather, water, and rainfall monitoring of the Civil Protection trusted network

In 2022, CAE was awarded the First Phase of the tender issued by the Campania Region for the technological upgrade and adaptation of the stations, data transmission infrastructures, and core equipment of the regional Civil Protection's real-time weather, hydrological, and rainfall monitoring network. By winning the Second Phase, CAE will have the opportunity to complete the technological modernization process of the network started in 2022.

The system consists of a total of over **250 pieces of equipment, including automatic monitoring stations, radio repeaters, and central control devices.** All SP200/300 measuring stations distributed across the territory have already been updated with the most modern **Compact Plus dataloggers** from the CAEtech line, as part of Phase 1. With this new contract, CAE will instead be committed to replacing the SPM20 acquisition units, **completing the technological modernization process of the network started in 2022**. A total of **142** stations will undergo interventions, and it will not be necessary to introduce additional modules thanks to the **compatibility** of CAE

products with the existing system.
The Compact Plus dataloggers, equipped with GPRS/UMTS/LTE cellular transmission components, will be configured to communicate with the Control Center according to the same operational logic and communication protocols already adopted for the stations upgraded in the first batch.
In addition, CAE will replace **178 rainfall sensors** with new **PG10 rain gauges** installed both in the already upgraded stations and in those that will soon undergo modernization interventions. Initially, 199 rain gauges were planned, but considering the flood events that hit the province of Salerno, 21 were supplied as part of the urgent civil protection interventions funded by the Delegated Commissioner ex O.O.P.C.M. (Ordinances of the Head of the Department of Civil Protection).
The **new rain gauges** will allow a significant improvement in both the quality and quantity of the acquired information, including **diagnostic data** made available to the Administration.
The stations' solar power systems will be upgraded with **new high-performance photovoltaic panels**, capable of ensuring greater efficiency and operational reliability.
The central system will store and process the data received from the new stations in the same way as the existing ones without requiring modifications. Furthermore, as requested by the specifications, a platform will be provided for the visualization of real-time weather and climate information acquired by the stations belonging to the monitoring network: **AEGIS**.
The offer includes design, installation, and real-time monitoring activities, as well as remote maintenance services and 24/7 continuous assistance. Special attention has also been dedicated to training, with the proposal of "on-the-job

training" sessions to support the Campania Civil Protection in data control and management, alongside traditional classroom training.

Strengthened by its consolidated experience in the sector and a constant focus on technological innovation, CAE is committed to delivering all services according to the highest professional standards, on a "turnkey" basis.

CAE ensures the creation of a fully integrated and coherent system, preserving the full operational continuity required for a system with civil protection purposes. ■

BACK TO INDEX

CAE awarded the maintenance of the Emilia-Romagna regional network

CAE has been awarded the contract for the **maintenance** of the **real-time regional hydrometeorological monitoring network of the Emilia-Romagna Region (RIRER)** for civil protection purposes, managed by the Regional Agency for Prevention, Environment and Energy of Emilia-Romagna (**ARPAE**). The regional network is extensive and consists of:

- 352 automatic real-time hydrometeorological stations;
- 2 tide gauge monitoring stations;
- 3 GNSS monitoring stations;

- 42 UHF-band repeaters specialized in radio signal transmission;
- 1 main (redundant) control center located at the ARPAE headquarters in Bologna;
- 1 secondary (redundant) control center located at the ARPAE headquarters in Parma;
- 10 secondary centers;
- 26 data visualization and processing workstations.

Maintenance activities will be carried out according to three different service modes:

- **Preventive**: aimed at keeping the entire system and its individual components in perfect working condition;
- **Corrective**: required to promptly restore system functionality and its components in case of faults or failures;
- **Integrative**: including remote maintenance services, telephone support, and 24/7 on-call availability to ensure optimal network performance.

CAE has in-depth knowledge of the network, thanks to years of continuous presence in the area, and will leverage its know-how within the new contract to ensure a **high-quality service**, essential for safeguarding the Emilia-Romagna territory and its population. To achieve this, it will also rely on tools **based on Artificial Intelligence and Machine Learning** for various purposes, including, for example, the ability to route data packets through the radio network along the path that, at any given moment, proves to be the most efficient and secure, thanks to the **Dynamic Adaptive Routing (RAD) service**.

The ultimate goal remains to ensure **reliability, robustness, and continuity of operation** of the entire monitoring system. ■

CAE MAGAZINE

Managing Editor: Guido Bernardi
Editor-in-Chief: Enrico Paolini
Editorial Staff: Mirco Bartolini, Daiana Elena Cical, Alessio De Faveri, Armando Di Martino, Virginia Samorini
Editorial Assistant: Virginia Samorini

For reference: https://www.cae.it/eng/magazine-hm-30.html?mId=209