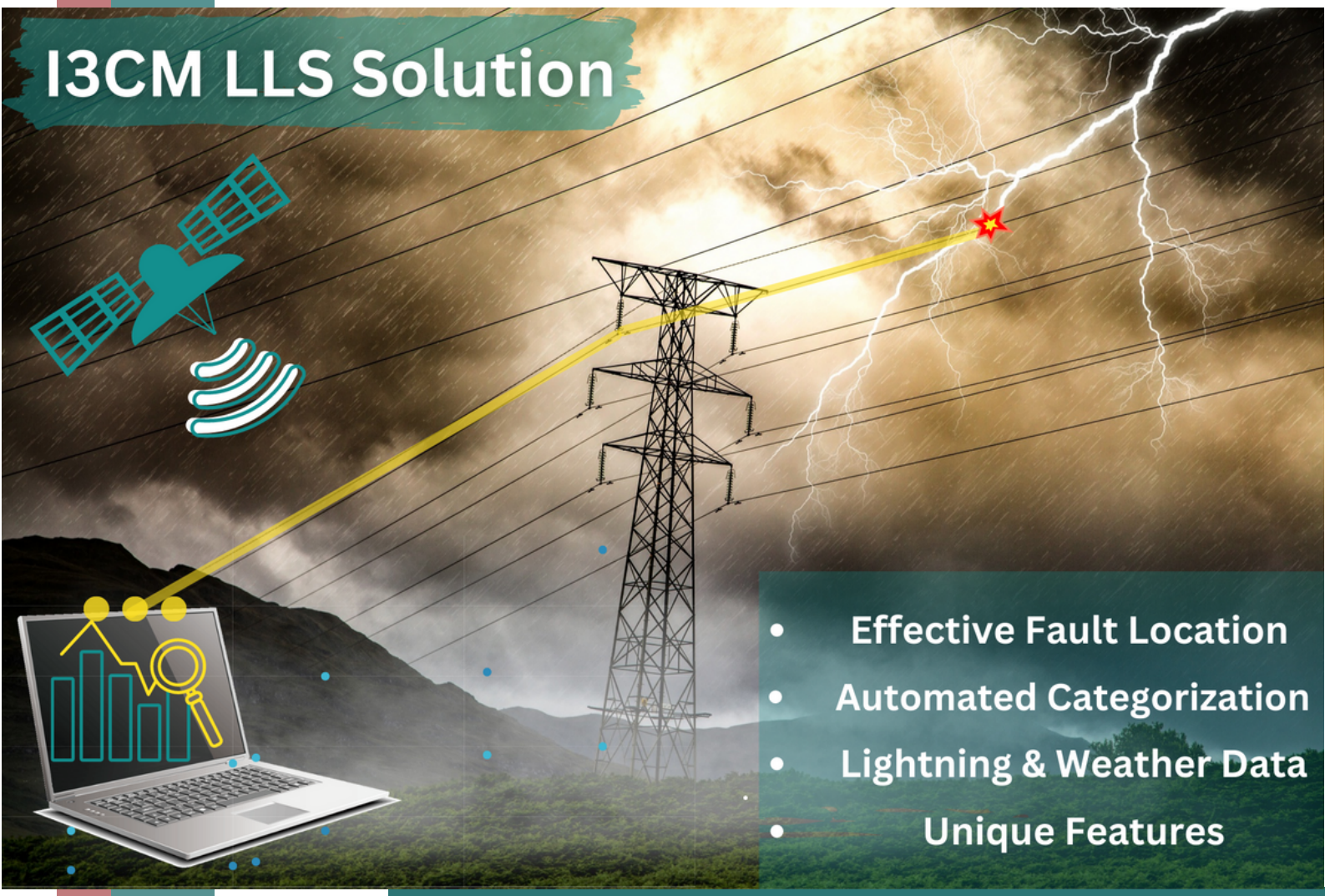
METARRESTERS
BEYOND THE STANDARDS

Partner of Sadovic Consultant



I3CM 5G FL
FAULT LOCATOR & MORE

Version 1.2 - September 2023

I3CM LLS SOLUTION

REAL-TIME ONLINE MONITORING AND EFFECTIVE FAULT LOCATION/CATEGORIZATION ON OVERHEAD LINES

- **Double Ended Traveling Wave (TW)**
- **Lightning Location System (LLS)**
- **Synchronization GNSS timestamp**
- **Weather data analysis**
- **4G/5G wireless communication**
- **Online-based software application with dedicated functions**

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I3CM 5G FL Device - Technical Features

Power Supply **Power Consumption**	80 VDC to 300 VDC (Interface Terminal Block) < 40 Watts
Measurement Inputs **Line modules**	6 input channels (Interface Terminal Block) Up to 6 current inputs suitable for a double circuit line Or 3 current inputs and 3 voltage inputs for a single circuit line
Processing **Performance** **Data Acquistion card**	Analog to Digital Converters (ADCs) :Digitizer Vertical Resolution of 16 bits Sample Rate: 5 Million Samples / channel / second
Storage	Solid-state drive (SSD) - 1 TB Capacity
Clock	Embedded GNSS module synchronization Multiple constellation / Supported signals: GPS, Galileo, GLONASS, BeiDou, and QZSS Timing Accuracy : 5 ns (1-sigma, clear sky) Sensitivity = -167 dBm (Tracking and navigation with good external LNA) Frequency: 1575.42 MHz
GNSS Indoor **Antenna**	Included - Lead Length 3 meters Mounting: Magnetic base suitable for cabinet top
Mobile Antenna	Included - Lead Length 3 meters Mounting: Magnetic base suitable for cabinet top
Communication	Ethernet port 10/100/1000 Mbits/s - RJ45 for local connection 3G/4G/5G mobile network communication (for safety backup & configuration)
Case / Enclosure	Weight: 2 kg (without antennas, cables, current transformers) (W) 190 mm x (D) 230 mm x (H) 60 mm [7.48'' x 9.06'' x 2.36''] Additional mounting brackets included
Environmental **conditions**	Operational Temperature : 10 °C to 40 °C [50°F to 104°F] Storage Temperature : -20 °C to 70 °C [-4°F to 158°F] Relative Humidity : 10% to 90%, non-condensing
Additional **Accessories**	Clamp-on type Current Monitoring Transformers & BNC adapters Voltage Monitoring Leads Connectors & BNC adapters (if applicable)

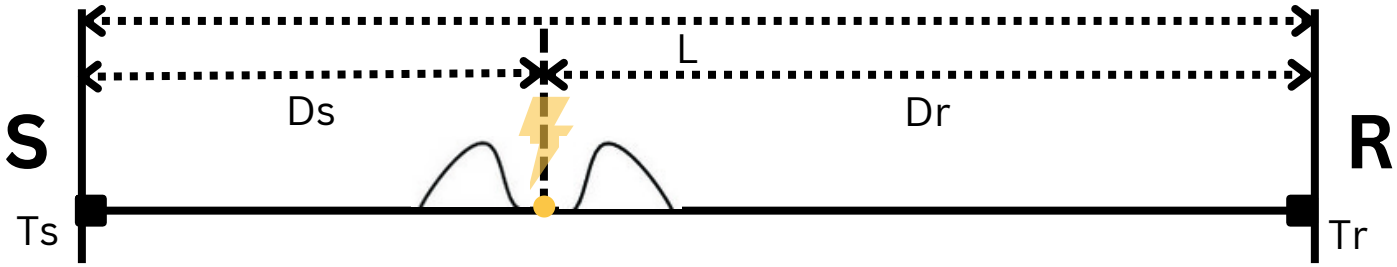
TYPE D (DOUBLE ENDED) METHOD

High Acquisition Sample Rate of 5M/s

Fault Locator based on Double Ended Traveling Wave principle
Two devices at both ends of the line to be monitored are required.

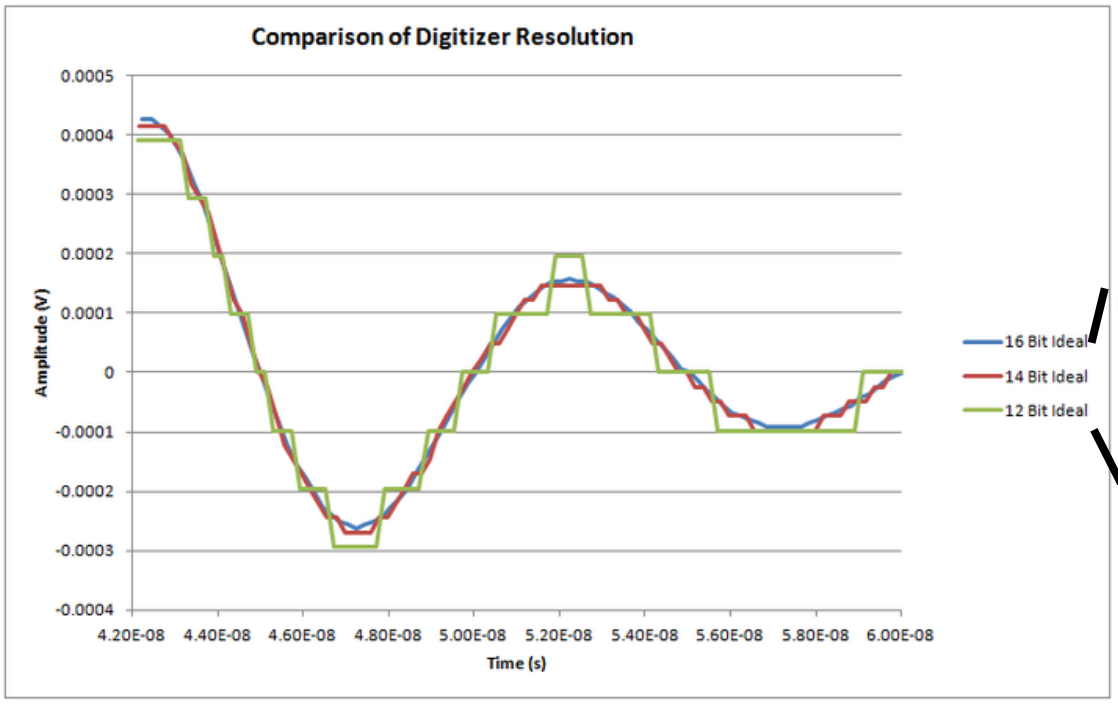
$$Ds\ (Distance\ to\ S) = [\ (Ts - Tr) \times V + L\ ] / 2$$

- V is the velocity of the travelling wave along the line close to the speed of light (~97%)
- Ts and Tr are the arrival times of the fault traveling waves at both ends of the line
- 5 Million samples/channel/second allow a wave sampling of 0.2µs which provide an theoretical accuracy of 60 meters for a speed of light of 300 m / µs



ANALOG TO DIGITAL CONVERTERS (ADCS)

Digitizer Vertical Resolution of 16 bits

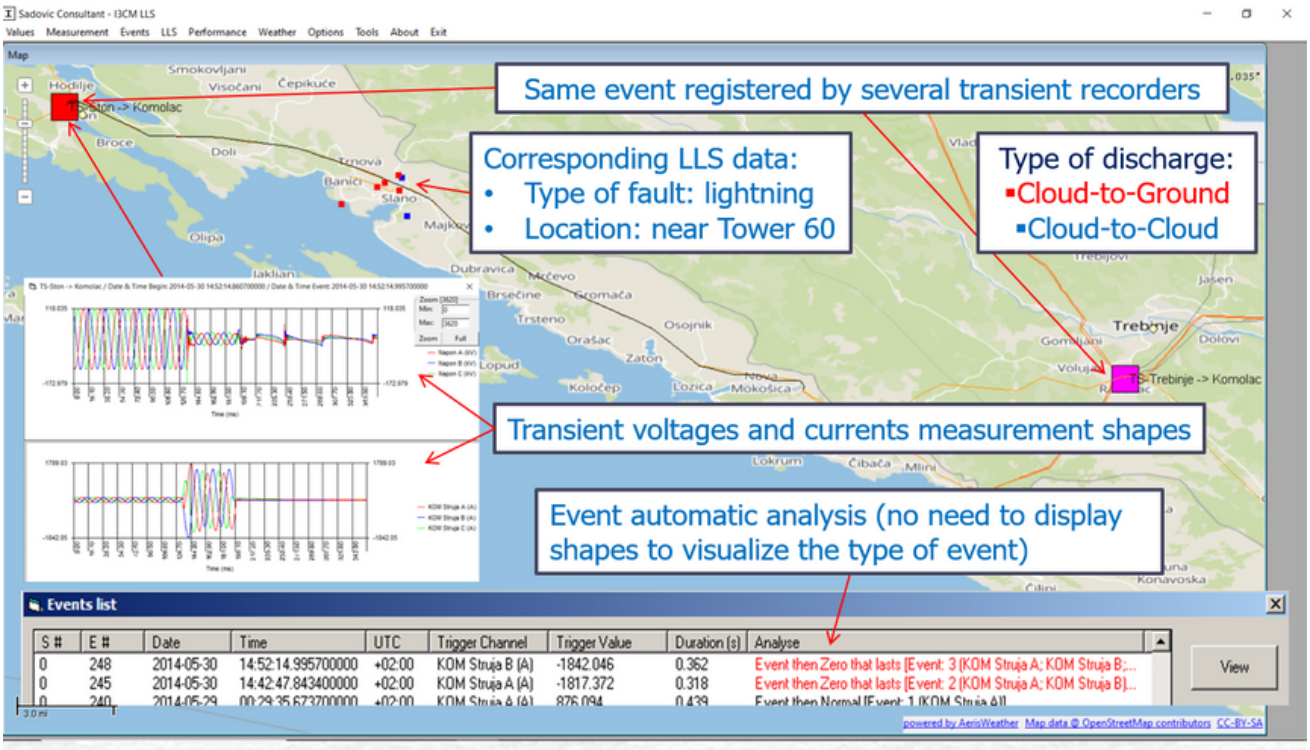


I3CM 5G FL
DYNAMIC RANGE 65536:1

Other devices
DYNAMIC RANGE 4096:1

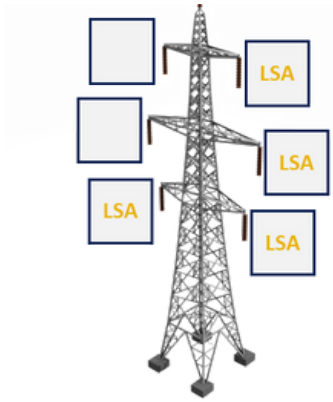
OPEN SOURCE MAP VISUALIZATION

Events notifications & Automatic analysis from Lightning Location Systems and Weather data providers

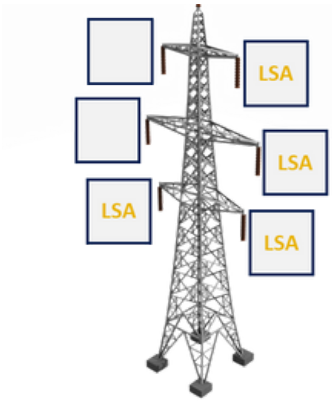


DIGITAL TWIN OF YOUR LINE

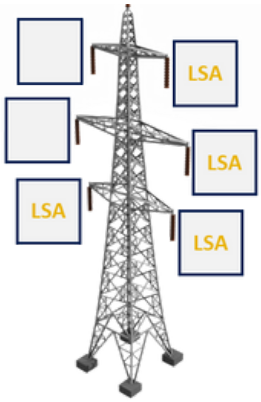
Your line can be customized to provide specific features such as Line Surge Arresters failure detection. Other parameters can be used for extensive system studies.



T-29: Tower N°29
T: Tension Tower
Tower footing resistance: 26.5 Ohm
Insulation U50% - CFO: 550 kV
Altitude: 299 meters
Configurable for LSA presence



T-30: Tower N°30
T: Suspension Tower
Tower footing resistance: 32.5 Ohm
Insulation U50% - CFO: 550 kV
Altitude: 305 meters
Configurable for LSA presence



T-31: Tower N°31
T: Suspension Tower
Tower footing resistance: 21.2 Ohm
Insulation U50% - CFO: 550 kV
Altitude: 285 meters
Configurable for LSA presence

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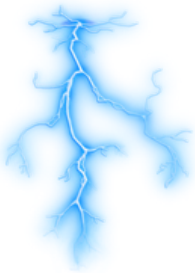
GENERAL PRINCIPLE OF I3CM LLS SOLUTION

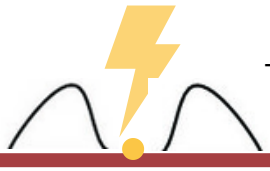


Lightning related events
Cloud to Ground
Stroke amplitude
Localization

GNSS Synchronization

Weather related events
Wind speed/Gusts
Rain, Snow, Hail
Temperature

I3CM 5G Fault Locator 1



Traveling Wave Principle

OVERHEAD LINE

I3CM 5G Fault Locator 2

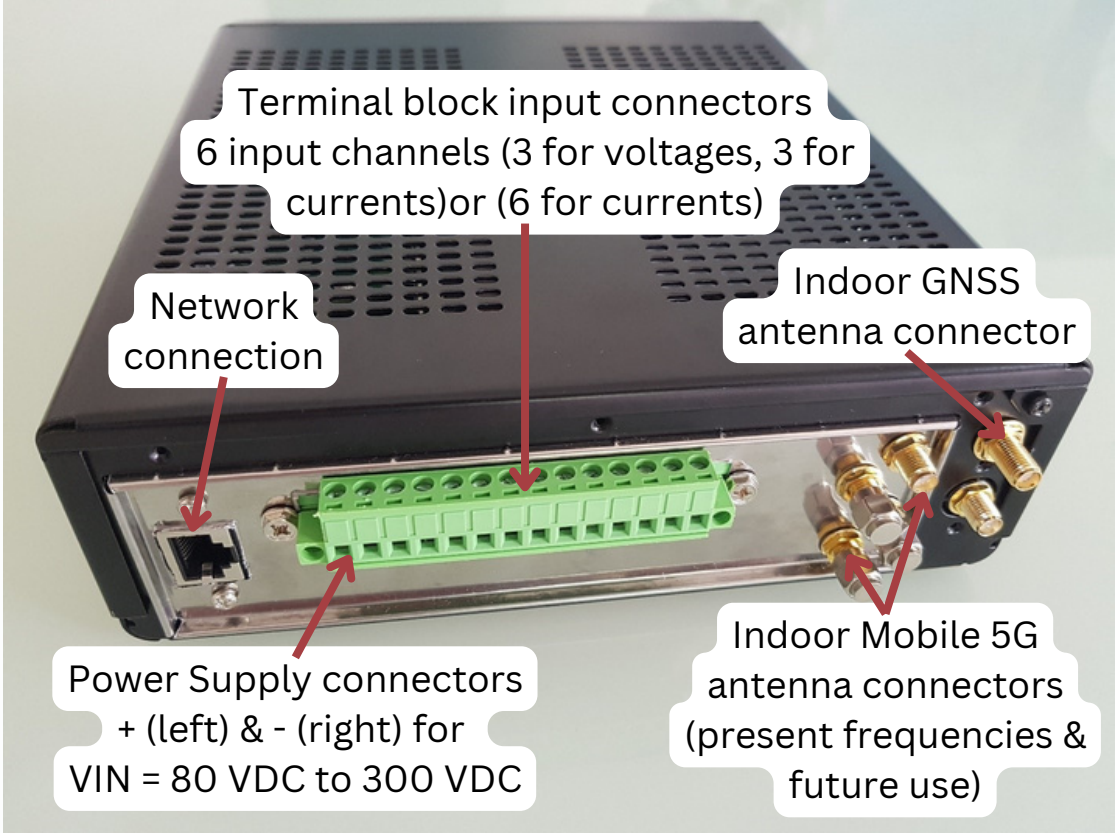
Communication
Ethernet & 4G/5G Network

Lightning Location System (LLS) Data
Weather Data

I3CM Server

I3CM LLS Software
Local Client or
Remote client

CONNECTIVITY & INTEGRATION (1)



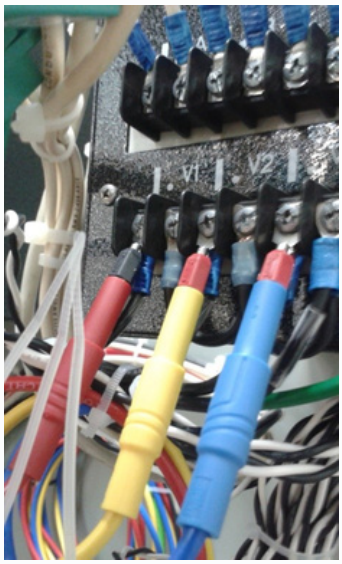
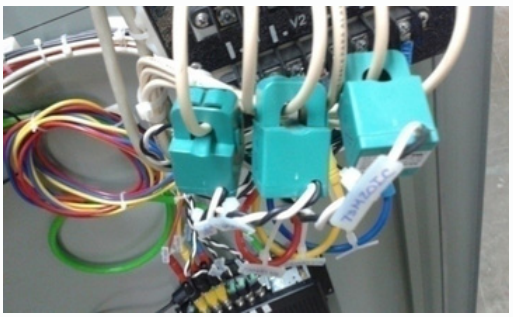


Illustration of Voltage lead connectors installed on the secondary side



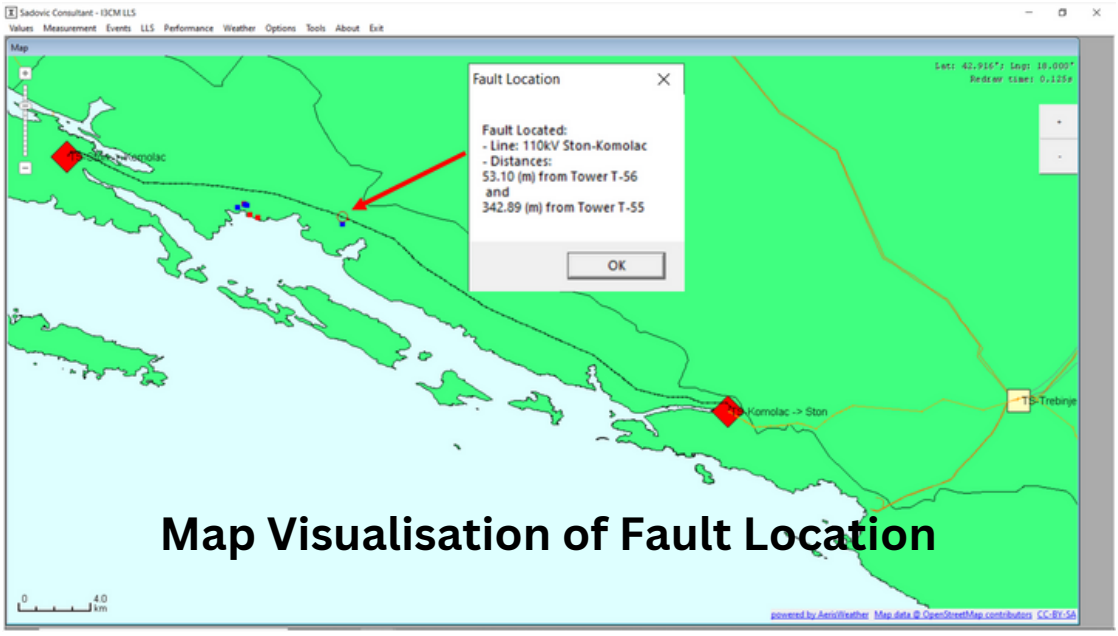
Clamp on type current transformers installed on the secondary side

The I3CM 5G FL can be fixed with the provided fixation brackets. Illustration of this type of fixation.

CONNECTIVITY & INTEGRATION (2)

The I3CM 5G FL is a versatile device designed for seamless integration into the secondary equipment cabinet. It can monitor either a single circuit—capturing data from three-phase voltages and currents—or two circuits, each with their own set of three-phase currents.

For optimal fault location, a pair of I3CM 5G FL Fault Locators should be installed at both ends of the line being monitored. This enables double-ended traveling wave fault location, boasting an impressive theoretical accuracy of up to 60 meters.



Map Visualisation of Fault Location

Connectivity is a breeze. The I3CM 5G FL Fault Locators communicate with the I3CM servers either over your existing network or via a mobile Internet connection.

For maintenance purposes, including potential upgrades, the devices and servers should be accessible online. To ensure the highest level of security and avoid any interference with your utility network, it is recommended to house all I3CM equipment within a dedicated Virtual Private Network (VPN). This ensures complete isolation from the utility network, with appropriate firewall settings for added protection.

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I3CM LLS IS A COMFORTABLE REAL-TIME ONLINE MONITORING TOOL TO FACILITATE THE DETECTION, THE CATEGORIZATION AND THE LOCATION OF LINE FAULTS.

We take a lot of hard work off your hands with automatic analysis
We help utilities and grid operators to categorize faults and provide real-time notifications. It supports decisions and helps for making prioritization.

A quality of information that is difficult to access today
Outages/System Faults can be detected and localized with high accuracy (~60 meters) and their cause can be analyzed. Lightning outages detection is guaranteed. Weather data providers are queried if LLS data do not match.

Significant costs savings compared to conventional fault detection systems
Suspicious faults can be localized precisely and crews can be sent to the exact location for line inspection.

Unique features for LSA failure detection and more
Crews can go to the exact location to inspect the suspicious Line Surge Arresters. Digital twin of the line in I3CM LLS can be customized to provide specific features such as LSA failure detection.

Real-world data simulations as valuable output to make decisions
Lightning data can be collected and used for accurate system studies as customized stroke distribution and Ground Flash Density. Data can be exported into specialized lightning simulation software (like Sigma SLP) for the computation process. "Hot zones" can be identified for effective lightning outage mitigation.

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METARRESTERS

Your partner for lightning performance and surge arrester technology

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I3CM LLS is developed, manufactured and supported by Sadovic Consultant SARL

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