SECRETARIAT

APPLYING FIELD REMOTE INFRASTRUCTURE MONITORING ON COE GENERATORS

Secretariat Issue Paper # 13

1. ISSUE PAPER THEME: Major Equipment

2. SUMMARY / BACKGROUND / PREVIOUS HISTORY

Field Remote Infrastructure Monitoring (FRIM) is a technology that enables real-time remote monitoring and management of critical infrastructure, such as water, wastewater, energy, fuel…etc., by collecting and analyzing performance data. It enhances efficiency, reliability, and decision-making through predictive insights and instant alerts for maintenance and operational optimization.

The Department of Operational Support (DOS) hosted a COE-FRIM Workshop in Valencia, Spain, from 20 - 22 November 2024, as a key outcome of the 7th Partnership for Technology in Peacekeeping Symposium. The event demonstrated the collective commitment of the United Nations and Member States to enhancing the sustainability and efficiency of peacekeeping operations. The workshop was successful with fruitful participation from 13 Member States, UN field missions, and UN Headquarters representatives. Discussions focused on advancing the UN Smart Camp initiative by leveraging the transformative potential of Internet of Things (IoT) technologies, including the FRIM system, to automate reporting processes of COE.

While the FRIM is applicable to various critical infrastructures, this issue paper focuses on its application to Contingent-Owned Equipment (COE) generators, as a starting point and as recommended by the Valencia workshop. This will enable real-time monitoring of key parameters such as power output, engine temperature, fuel efficiency, and oil pressure of generators, providing immediate alerts for anomalies to ensure timely repair. By analyzing historical data, FRIM supports predictive maintenance of generators, reducing downtime and preventing costly repairs. It optimizes fuel usage and load management, improving operational efficiency and extending generator lifetime, while also delivering cost savings through reduced maintenance expenses and minimized emergency repairs. Additionally, FRIM offers valuable data analytics for informed decision-making, simplifies reporting, and promotes environmental sustainability by lowering fuel consumption, reducing emissions, and detecting leaks.

3. DETAILED PROPOSAL

This issue paper aims to provide a comprehensive project proposal, which is based on a UN successfully implemented System (Unite FRIM ecosystem) already implemented for United Nations-Owned Equipment (UNOE) equipment, supported through a global system contract, which currently covers over 8,000 devices and 40,000 data points (readings).

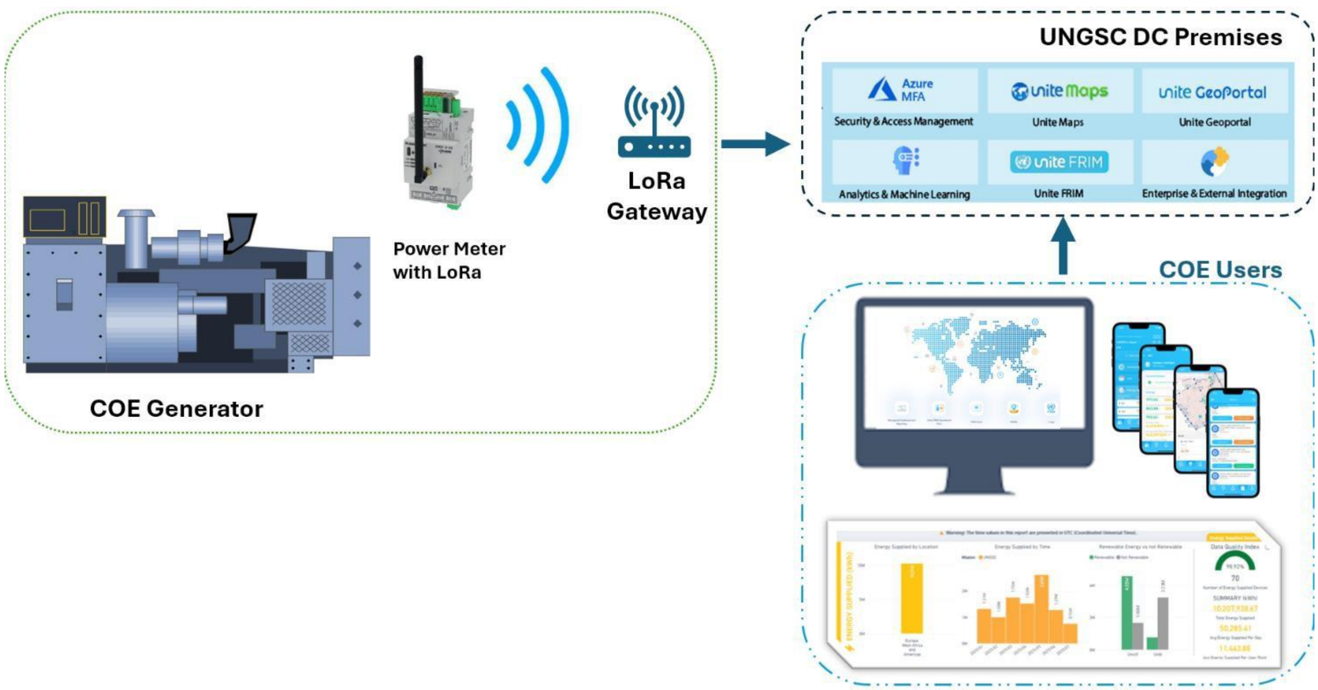
The United Nations Field Mission’s infrastructure portfolio includes a significant number of power generation assets across both UNOE and COE categories. COE generators account for approximately 50 per cent of all UN power generation equipment deployed in the field (COE + UNOE combined) and are provided by more than 25 contributing countries, operating at numerous mission locations worldwide. The first phase of the proposed project will focus on COE generator monitoring, serving as the foundation for a broader core infrastructure monitoring framework that can be scaled to other COE asset categories in the future.

3.1 TECHNICAL SOLUTION

Using a standardized configuration and approach offers several important benefits: installations become faster and easier, integration with other systems is smoother, troubleshooting and maintenance are simpler, the design takes up less physical and technical space, and the monitoring approach is consistent and well-defined.
The proposed solution follows a standard design applied in the same way to all generators. This ensures consistency, easier installation, training and simpler maintenance.

- Smart energy meter Components
  - Each generator will have a three-phase power meter connected to a wireless communication module using Long Range (LoRa) technology.
  - It will also include four current smart energy meters, each with a two-meter cable, to measure the electrical flow.
  - The installation will include all necessary electrical wiring and related components to operate the equipment.

In addition, each site will require a LoRa Gateway, which acts as the hub for the wireless network that allows the generators to send their data. One gateway can cover several kilometers and connect to many generators at the same time. In many locations, these gateways are already in place, making it straightforward to bring additional generators online.



3.2 BENEFITS

3.2.1 **Operational:**

- Increase Service Availability
- Prolong equipment life span (preventive maintenance)
- Optimize equipment working point by correct sizing (predictive analysis)

3.2.2 **Resources:**

- Increased efficiency-reduce, and optimize consumption
- Rationalize supply chain planning, and source planning
- Increase analytical capability

3.2.3 **Environmental**
- Reduce environmental footprint.
- Data-driven Environment monitoring and management.
- Raise cultural and environment awareness – positive legacy.

3.2.4 **Safety & Security**
- Improved staff well-being.
- Reduce exposure to risks
- Enhanced security and situational awareness.

3.2.5 **Strategic Alignment**
- Strategy for Digital Transformation
- DOS Environmental Strategy
- Sustainable Development Goals
- Significant reduction in utility costs through early detection of inefficiencies.
- Enhanced sustainability reporting aligned with UN environmental strategies.
- Increased equipment lifespan via predictive maintenance analytics.

3.3 IMPLEMENTATION REQUIREMENTS

Implementing FRIM solution requires a comprehensive approach that brings together technology, infrastructure, people, and well-defined processes.

3.3.1 Hardware Components

- **Smart Energy meter devices:**
  - Each generator will be fitted with a monitoring device (Smart Energy Meter) that collects and sends data on power generation. Where needed, additional Smart Meters can be installed to track important operational details such as fuel levels and generator status.
  - All required hardware can be sourced through the UN's global system contract, ensuring compatibility and reliability.

3.3.2 Software Components

FRIM platform collects, stores, and processes data in a centralized system hosted at the UNGSC, supporting the proposed power monitoring solution for COE equipment.

Reporting and dashboards:
- Site Dashboard: Each camp, contingent, or site has a secure, role-based webpage for managing generator data.
- Higher-Level Dashboards: Role-based overviews at mission or multi-mission levels show data across multiple locations or contributing contingents.

Reports are tailored to user needs:
- Operational Dashboards: For engineers and technicians, with real-time data and alerts to support maintenance and troubleshooting.
- Management Dashboards: For managers, with historical data and trends for planning and reporting.

3.3.3 Integration Capabilities

FRIM platform can connect with other UN systems such as the Electronic Fuel Management System (eFMS) and Enterprise Resource Planning (ERP) tools.

When required, and if a TPCC has an existing infrastructure-monitoring system, integration is possible but will require prior approval by the United Nations and be handled on a case-by-case basis in line with UN/OICT protocols and TPCC data-exchange policies, with no additional cost to the United Nations.

3.3.4 Communication Infrastructure

While FRIM supports multiple network technologies, the proposed solution is based on LoRaWAN (Long Range Wide Area Network) to ensure extensive coverage. This approach significantly reduces the time and cost associated with cabling, minimizes interference with other wireless systems such as Wi-Fi, and enhances both communication security and data protection.

3.3.5 Data Hosting, Management and Security

FRIM is hosted at the United Nations Global Service Centre (UNGSC) Tier III Data Center (Tier III indicates that the facility has redundant systems, allowing it to remain operational during maintenance or equipment failures), which ensures secure, reliable, and compliant data management.

- **Secure and Scalable Storage**
  The infrastructure can handle large volumes of generator data while ensuring integrity, confidentiality, and capacity for future growth.
- **Data Analytics**
  Integrated analytics tools enable detailed analysis of generator performance, operational efficiency, and cost-saving opportunities, supporting data-driven decision-making.
- **Hosting and Infrastructure**
  - Redundant power and cooling systems
  - 24/7 monitoring and technical support
  - Compliance with international standards for data center operations
  - Strong physical and digital security controls
- **High Availability and Disaster Recovery**
  The system is designed for continuous operation with minimal downtime. In the event of a failure, disaster recovery measures restore services quickly to maintain operations.
- **UN Data Security, Sovereignty, and Compliance**
  - All data is stored within UN-managed infrastructure, ensuring adherence to UN governance and sovereignty requirements.
  - Advanced cybersecurity protection, encryption, access controls, secure network protocols, and continuous monitoring, keep sensitive data safe.
  - All information remains under UN jurisdiction and control.

3.3.6 Human Resources

As part of the implementation requirements, the following roles are essential:

- **Electricians / Installation Technicians**: Qualified electricians responsible for installing and maintaining hardware components in the field.
- **UN FRIM IoT Support Team**: Specialists responsible for maintaining the FRIM platform, supporting remote installations, applying software updates, and assisting COE generator personnel in creating operational dashboards.
- **COE Generator Operators**: Staff overseeing generator operations, interpreting performance data, and making operational decisions to ensure optimal performance.

3.4 POTENTIAL CHALLENGES

The implementation of such an advanced system requires not only dedicated experts and adequate resources but also a clear understanding of user requirements. These requirements must be accurately translated into technical specifications that can be measured and monitored using tools like FRIM.

Meeting this need may involve securing both skilled human resources and sufficient funding to implement the project. In the long term, this investment will provide significant benefits to the organization by reducing operational and management costs (fuel and manpower), improving environmental controls, and enhancing oversight of legacy infrastructure and assets. Therefore, the following are conditions for the project’s success:

3.4.1 Budget

- Funding Sources: Identify and secure funding for both the initial capital investment and ongoing operating costs, including the purchase and installation of hardware.
- Operational Costs: It is very important to plan for recurring expenses such as software subscriptions, communications fees, maintenance costs, capacity building and personnel salaries.

3.4.2 Installation

Missions with relevant experience will be responsible for installing the equipment and providing direct support to COE personnel. They will also be responsible for data collection and ensuring data quality.

If additional training is required, the mission may request the UNGSC to provide capacity-building support and should include the associated costs in its budget planning.

When internal resources are not available at the location:

- Determine whether installation and maintenance will be handled by other UN resources or contractors.
- If managed internally, ensure that personnel have the necessary expertise and capacity for installation, configuration, and ongoing maintenance.
- If outsourcing, select reputable vendors with proven experience in installing smart energy meter solutions, and ensure contracts clearly define service levels, maintenance schedules, and support procedures.

3.4.3 Training

- Adequate training must be provided for the installation team, whether internal personnel or external contractors, to ensure they are fully familiar with the system's requirements, components, and operational procedures.
- Training should also cover data collection standards, troubleshooting, and basic maintenance to ensure consistent and reliable operation.
- UNGSC can provide capacity-building, training, and hands-on sessions when required. If travel is necessary, the mission should cover the associated costs.
- Online and eLearning materials are available to UN personnel and can also be provided to uniformed personnel on demand (Technology Training Portal)

3.4.4 Timeline

- A reasonable installation timeline should be developed to minimize disruption to ongoing operations.
- The plan should include clear milestones and progress-tracking points to ensure the project stays on schedule and meets its objectives.
- It is important to measure key power performance metrics (KPIs) before implementation to establish a baseline for assessing improvements.
- UN Missions should coordinate directly with TPCCs and will receive support from the UNGSC FRIM Team in this process.

3.5 CONCLUSION

- Implementing FRIM is a significant undertaking that represents a major upgrade to generator management systems for both UNOE and COE assets. The solution offers substantial opportunities to improve operations, increase efficiency, and strengthen monitoring capabilities.

- For COE generators, it is essential to clearly define the roles and responsibilities of all parties involved, along with funding and management arrangements, before deployment. Given the complexity of the process, thorough planning and precise execution are critical to success.

- By meeting these foundational requirements, COE can better manage their generators, optimize performance, monitor fuel consumption, and ensure effective oversight of operational efficiency.

4. FINANCIAL IMPLICATIONS

For the purpose of this budget estimation exercise, the total number of generators currently owned by the COE across all missions is 2,548. The estimates are based on a two-year implementation and incorporate the pricing of smart energy meters as defined in existing system contracts.

The costs considered for this proposal are:

a. Hardware cost
b. Subscription costs
c. Management and maintenance costs
d. Summary and estimation cost for upcoming years

a. Hardware cost

The cost of the smart energy meter components depends on the type of current transformer selected; using solid transformers requires disconnecting the generator's power lines, increasing installation effort, while flexible transformers simplify installation but come at a higher cost. For this issue paper, it is assumed that 50 per cent of COE generators will use solid current transformers and the remaining 50 per cent will use flexible ones.

Also, we anticipate including 2 per cent of additional hardware to be used as spare parts. For this issue paper, we estimated an average cost of around **$750** per generator.

In addition to the smart energy meter components, the project also requires communication hardware at the network layer to ensure smart energy meter connectivity. The solution relies on LoRa technology, which necessitates the deployment of a LoRa Gateway at each location to enable reliable communication. The average communication hardware cost per generator has been estimated at approximately **$100** for this exercise.

As a summary, below are the calculations:

Year	Cumulative Generator Installed	Annual Communication Hardware Cost ($)	Annual Energy meter Hardware Cost ($)
One	**1274**	**$ 127,400**	**$955,500**
Two	**2548**	**$ 127,400**	**$955,500**
		$ 254,800	**$1,911,000**

The annual financial implications for hardware are $ 1,082,900 for a total of $ 2,165,800.

b. Subscription costs

This cost estimation is based on two key components: the unit cost of each TAG (data point – one measured parameter that is being monitored) and the number of TAGs required per generator, as determined by the configuration of the energy meter.

- The TAG cost has been sourced from the current Service for Geospatial, Information and Telecommunications Technologies (SGITT) rate card, and is set at **$2.39** per month.

ID	Description	Cost
SC-MON-004.03*	*FRIM (Field Remote Infrastructure Monitoring) - Monitoring Service*	*$1.65*
SC-MON-	*FRIM (Field Remote Infrastructure Monitoring) - Remote*	*$0.15*

004.05	*Monitoring by NCC*	
SC-MON-008	FIMMS (Facilities and Infrastructure Management and Monitoring Solution) Web	*$0.53*
SC-MON-014	FIMMS Mobile Module	*$0.06*

This cost will be reviewed annually as part of the cost recovery process, ensuring alignment with actual service usage and operational expenses.
* SC-MON = Service Catalogue – Monitoring services in the United Nations Global Service Center (UNGSC), Service for Geospatial, Information and Telecommunications Technologies (SGITT) Service Rate Card

- The number of TAGs required for standard power meter are **13 TAGs**, as defined by the specifications of the source power meter. Below is the list of standard TAGs associated with the power meter configuration.
  - Current (L1, L2, L3)
  - Energy
  - Power (L1, L2, L3, Total)
  - Voltage (L1, L2, L3)
  - Power Factor
  - Status

As a summary, the total estimated cost per generator ($ 2.39/TAG x 13 TAGs) is $ 31.07.
Depending on the number of parameters monitored and using the entire FRIM capabilities, we estimate that **an average of $32.00 per Generator monthly** is sufficient to cover the subscription fees.

Year	Cumulative Generator Installed	Annual Service Fee ($)
One	**1274**	**$ 489,216**
Two	**2548**	**$ 978,432**
		$ 1,467,648

The average annual financial implications for running costs are $ 733,824 for a total of $ 1,467,648.

c. Management and maintenance cost

Ensuring the system is fully functioning requires constant monitoring and FRIM management tasks. Each TCC/PCC will have access to its generators and full online visibility 24 hours a day.

The Engineering and Field Technology Sections will be responsible for the installation and maintenance of smart energy meters.

However, effective management of the FRIM platform requires additional dedicated personnel to support backend operations and assist field teams with installation, troubleshooting, maintenance, research, training, documentation, user onboarding, and other technical and coordination activities.

Below is an estimate of the staffing required to ensure the successful operation, support, and sustainability of the FRIM system.

Category	Number of Staff	Estimated Cost	Total Cost/Year ($)
NOP - IOT	**1**	**$ 130,000**	**$ 130,000**
G6 - IOT	**3**	**$ 90,000**	**$ 270,000**
			$ 400,000

d. Summary and estimation cost for upcoming years

Overall cost to equip 2548 COE Generators

Year	Cumulative Generators Installed	Annual Communication Hardware Cost ($)	Annual Smart energy meter Hardware Cost ($)	Freight Cost ($) (7% Hardware cost)	Service Fee ($)	Management Staffing	Total Cost ($)
1	1274	$ 127,400	$955,500	$85,000	$ 489,216	$ 400,000	$2,057,116
2	2548	$ 127,400	$955,500	$85,500	$ 978,432	$ 400,000	$22,546,832
						Total Cost for the first two years	**$4,603,948**

The average annual financial implications of this project are $ 2,301,974.
The total financial implications of this project are $ 4,603,948.

From Year 3 onwards, the annual recurring cost is estimated at **$1,318,432**. Presented as follows:

Item	Associated cost
Annual Device Maintenance	$30,000
Service Fee	$978,432
Management Staffing	$310,000
Total Annual Cost	$1,318,432

5. PROPOSED 2026 COE MANUAL TEXT

Revise Chapter 3, Section VI, C. Operational readiness inspections, para 15 (b), pp. 26-27 of the COE Manual, add the text in bold and delete the text with a strikethrough.

(b) Major equipment will be inspected to ensure that it is operational to the extent agreed to in the memorandum of understanding. The United Nations considers that unsafe vehicles endanger the life of personnel and jeopardize the effectiveness of a mission and should not be considered operationally serviceable. The Chief Transportation Officer will review vehicle safety and make recommendations to the Director/Chief of Mission Support and Force Commander/Police Commissioner on this issue. In addition, ~~as from 1 July 2024,~~ the applicable equipment must have a functional odometer, hour meter or kWh-meter, as appropriate, to be considered fully operationally functional and reimbursable. **In addition to those meters, generators shall be equipped with United Nations provided functioning smart energy meter as per the standards described under paragraph 12, chapter 3, annex A of this manual.**

Add a new para 12 in the COE Manual, Chapter 3, annex A, Electrical equipment, page 31, after the current para 11, add the text in bold and revise the subsequent para numbering accordingly.

12. To support integration with the United Nations Field Remote Infrastructure Monitoring platform, all major equipment generators shall be equipped with a three-phase smart energy meter – IoT-enabled (LoRa)[12] – and associated components including clamp-on current transformers, and standard cabling. The United Nations will install and maintain such meters.

Footnote
[12] LoRa - Long Range Wide Area Network is a low-power, long-range wireless communication protocol designed for Internet of Things (IoT) applications, enabling devices to communicate over distances of several kilometers.