

## ***Enhancing Rail Cargo Freight Security with Sensor-based e-Seals and Monitoring Devices:***

AVANTE ZONER-Seal uses optical fiber for sealing all of the access openings of the tanker container or wagon. Any tampering of the seal triggers instant alerts to both the train engineer, the central monitoring center and other stakeholders involved. It communicates the status with the onboard RELAYER-CONTROLLER located in the locomotive via RF and communicates to the HQ via GPRS with failover to the satellite for security/redundancy and cost-effectiveness.

Systems include:

- Integrated covert End-of-Train Device (ETD) for real-time wagon decoupling alert.
- End-of-Train-Device-ETD-for-Real-Time-Decoupling-and-Exception-Reporting

AVANTE End-of-Train Device is based on RFID-based sensors that communicate with the RELAYER-CONTROLLER for its status and proximity to the locomotive in real-time. Decoupling is immediately detected and alerts are sounded and displayed locally to the train engineer and to the HQ. It is installed covertly for additional security.

- RFID-based End-of-Train Device (ETD) for continuous monitoring and real-time alert to both the train engineer and the monitoring center whenever decoupling occurs.

Our RELAYER-CONTROLLER not only serves as communication hub for the train, it also provide visual and sound alerts to the train engineers for any exception. A full display of operation parameters and visual-IR-Doppler images are also available when this specialized patent-pending technological capability is installed.

- Integrated and customized digital fuel sensors to supplement legacy visual and manual fuel gauges provide real-time fuel usage statistics and couples to the trip management to provide real-time alerts in case of fuel shortage or excessive fuel depletion.

Our Digital Fuel Sensor Module is installed to provide supplementary visibility to both legacy locomotives and recent models. Real-time fuel level and usage are documented continuously and provide real-time alerts for potential shortage for the scheduled trip.

- Sensor-based AVANTE Track Integrity Monitoring Device for geo-tagging any defective segments of the rail track all while train normal operations.

We engineered a specialized Track Integrity Monitor that directly interfaces with the RELAYER-CONTROLLER for detailed and complete geo-tagged track condition data based on train/track shock. Repair tickets can be generated automatically before major accidents take place.