



GE VERNOVA

INDUSTRIAL COMMUNICATION SOLUTIONS FOR THE RAIL INDUSTRY

Whitepaper



Grid Solutions

GE VERNOVA'S RAIL COMMUNICATIONS

For more than 25 years, GE Vernova's Industrial Communications has provided a broad array of products to service the needs of critical infrastructure and industrial operations for multiple sectors, including industrial, energy and transportation companies around the world.

As the industry leader in deploying communication networks with exceptional reliability, GE Vernova's reputation for delivering high quality products is unsurpassed. With extensive domain expertise in industrially hardened networking applications for harsh environments, GE Vernova provides rail companies best-in-class solutions from the industry experts. From secure wireless, rugged Ethernet switches and hardened optical networks, to broadband power line solutions, GE Vernova's MDS™, Lentonics™ and e-terrapowercom devices utilize new technologies delivering complete networking solutions, withstanding the harshest environments. GE Vernova's industrial products allow customers to collect, manage and analyze data enabling insights resulting in maximized productivity, minimizing failures and downtime. This allows for the delivery of comprehensive end-to-end communication networks that scale to meet our customers' unique requirements.

GE Vernova's capabilities extend to purpose-built network management, providing IT departments with the tools specifically designed to proactively monitor and manage their communication assets. With an installed base exceeding 1.5 million devices worldwide, industries rely on GE Vernova's communication networks every day to attain operational targets and meet efficiency goals.

INDUSTRY CHALLENGES

Rail operations vary greatly around the world depending on the region, size and scale of the enterprise. Common to all rail applications, however, is the need for a reliable and robust communications infrastructure designed for operations in harsh environments. Whether it's critical freight or precious passengers being transported, providing the highest availability for control, logistics, and monitoring is a common thread.

Safety and continuous operation are the major objectives for rail companies to achieve commercial goals and fulfill responsibilities to the local and global community. These goals require solutions that reduce the risk of failure and minimize downtime. Improving efficiency and meeting production and safety targets drive the need for a secure and reliable communication infrastructure that supports reliable monitoring and control communications, even for hard-to-reach assets.





GE VERNOVA'S SOLUTIONS

GE Vernova's MDS and Lenronics products provide wide area coverage over miles upon miles of track worldwide for condition monitoring, signaling, and switch control as well as linking infrastructure control locations. This includes remote locomotive control, dispatch systems and traffic monitoring. GE Vernova's products are customized to meet the specifications and operational requirements of railroad applications such as Remote Control Locomotive (CAI-220 RCL) and Positive Train Control (PTC). GE Vernova also meets the "Buy American Act" standards, as its manufacturing plant is located in Rochester, New York. Through partnerships with system integrators, equipment manufacturers and railroads, GE Vernova has established itself as the go-to radio communications provider for rail, with core capabilities in the following areas:

IMPROVED SAFETY AND EFFICIENCY

For railroad applications, downtime is intolerable and efficiency is a must. Whether moving freight or people, railroads require ultimate reliability to prevent waste. GE Vernova's communication solutions offer messaging redundancy and error control for safety and reduced down time.

ENCRYPTION AND CYBER SECURITY

As demand and regulatory requirements in the transportation industry have grown to ensure protection of data, devices and network access, GE Vernova has developed advanced encryption and security on multiple levels. The MDS Orbit platform is built on an extensive enterprise-class cyber security framework.

INDUSTRIAL STRENGTH EQUIPMENT

GE Vernova's industrially hardened products are a perfect fit for the harsh environments in railroad deployments. GE Vernova's products' operational temperature includes ranges from -40°C to 70°C, and are designed and tested to applicable AAR, AREMA, and ETSI standards.

APPLICATION TAILORING

Railroads have very strict application requirements and generally will not tolerate changing their operation to support a consumer market radio product. GE Vernova's solutions include custom operational modes and messaging, as well as efficient spectrum use for the required communications.

MOBILE OPERATION

Railroads expect communications on the go. Whether it's at 5 mph/8 kph in a switching yard or 200 mph/320 kph on a high-speed train, there are serious considerations for the Modem and Media Access Control (MAC) vs. a fixed-site radio application. GE Vernova has field-proven solutions for each of these mobile challenges.

APPLICATIONS

GE Vernova's MDS wireless business has provided rail communications solutions for many years, both with standard off the shelf products and with customized products. Two applications for which MDS has developed special-purpose products are **Remote Control Locomotive (RCL)**, and **Positive Train Control (PTC)**. GE Vernova developed these solutions with deep integration, completely meeting the specific requirements of these applications.

REMOTE CONTROL LOCOMOTIVE

RCL is an application for freight rail switching yards. Each RCL system permits one or two operators with remote control packs to operate a locomotive from the ground. The operators use the locomotive to push and pull rail cars together to build trains for cross-country travel (refer to Figure 1).

GE Vernova's MDS RCL220 and RCL450 Communications Systems and MDS entraNET 900 families of spread spectrum radios facilitate remote control of switching locomotives in hump and flat yards. MDS offers 220 and 450 MHz licensed versions for use in reserved spectrum, as well as a 900 MHz unlicensed version for fast and easy deployment. GE Vernova's RCL products support peer-to-peer (direct mode) and Infrastructure mode operation.

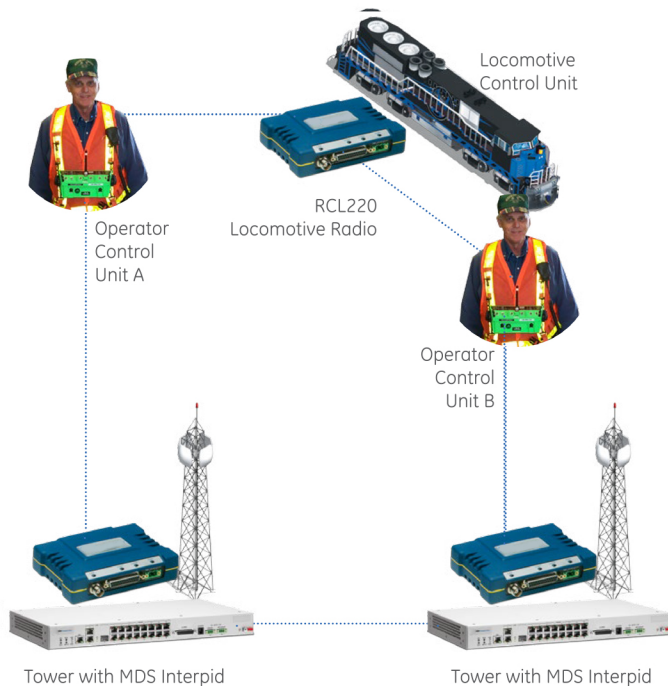


Figure 1: Freight Train/Rail Yard Application

MDS RCL220 COMMUNICATIONS SYSTEM

Used today by top Class One freight railroads in some of the largest yards in the world, the MDS RCL220 communications system includes Operator Control Unit (OCU), Locomotive Control Unit (LCU), repeater radios and access points. The OCU and LCU radios are incorporated into the RCL integrator's system while the repeaters can be provided turn-key to outfit each switching yard with the communications infrastructure needed to run RCL.

Also available, MDS RCL450 implements the same patented system on the 450 MHz band.

Key features include:

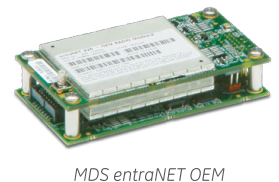
- Patented repeater community system for full yard coverage with cooperative repeaters
- Application-aware MAC layer and serial messaging protocol
- Patented robust over-the-air messaging scheme
- Session uniqueness with dynamic scrambling keys for protection against stale controllers
- GPS-disciplined time slotted operation for efficient use of channel
- Up to 30 locomotives supported in simultaneous operation over two licensed duplex channels
- Cyclic Redundancy Check (CRC) for end-to-end message integrity
- Rich test modes and network management and monitoring capabilities
- OCU firmware upgrade over the air to eliminate breaking the case seal
- Built with common unit types to facilitate easy spares program

MDS entraNET900 Spread Spectrum Radio

The MDS entraNET 900 spread spectrum radio family supports direct and infrastructure modes as well as over-the-air frame sizes ideally suited for RCL. The entraNET OEM packaging is designed to fit into an OCU form factor.

Key features include:

- Basic Serial Protocol (BSP) for addressing the LCU and OCUs individually
- Seamless handoff between cooperating bases triggered by signal strength and messaging thresholds
- Rich diagnostics and network management capabilities



POSITIVE TRAIN CONTROL

Positive Train Control is an application that enhances the safety of rail operations. PTC systems intelligently generate dynamic speed limits for trains to maximize efficiency but ensure safety (refer to Figure 2). PTC will slow or even stop a train automatically in the event that a work crew, other train, stuck gate or signal is ahead on the track. MDS has worked with several PTC vendors for years, perfecting a radio communications system ideally suited for PTC.

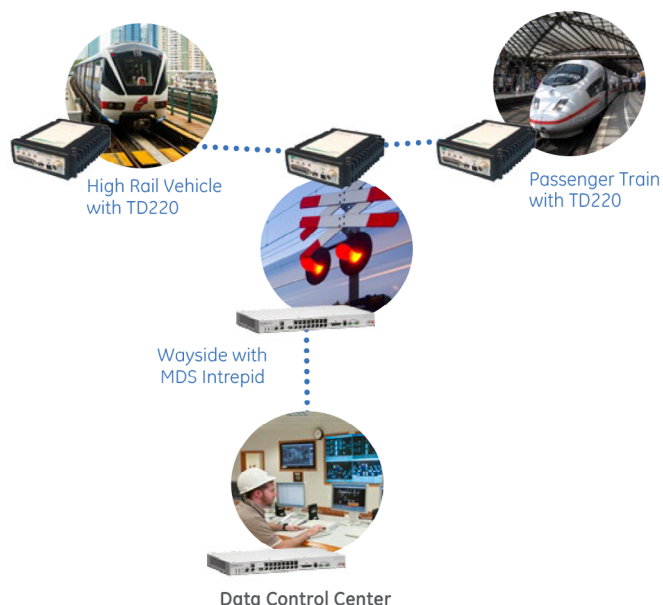


Figure 2: Positive Train Control

MDS TD TRAIN CONTROL RADIO FAMILY

The MDS TD radio family has several versions used in several different PTC implementations. There are versions on different frequency bands as well as implementing different protocols and MAC mechanisms.

Key features include:

- Small but highly rugged radio
- 25 Watts on 220, 256, or 450 MHz frequencies
- Patented error detection/correction scheme solving the mobile fading challenge vs. other radios intended for fixed operation only

- High-speed UDP/IP interface for data
- Over-the-air framing overcomes narrowband channel limitations
- IP stripped over the air
- GPS or PTPv2 disciplined TDMA MAC
- Local SNMP management
- Substantial RISC processor for future integration/expansion

MDS TD220 / TD450-PLUS

Used with GE Vernova Transportation's ITCS system, the TD220 and TD450-Plus are deployed in the US for transit operations and a large iron ore freight rail in Australia.

They both implement a full mobile MAC for base-to-base handoff and mobile slot allocation.



MDS TD220

MDS TD220X / TD220MAX

The TD220X and TD220MAX radios are used in the US for commuter rail PTC. They offer a unique MAC split to provide an application-specific communications manager access to the over-the-air TDMA frame.

The TD220MAX offers enhanced RF performance for densely deployed areas.

MDS TD256X

The TD256X is used in Brazil for IETMS PTC for mining and freight applications. The TD256X offers a unique MAC split to provide an application-specific Communications Manager access to the over-the-air TDMA frame.

ADDITIONAL APPLICATIONS

- High Throughput Data Mobility
- Wireless Backhaul
- Cellular Backhaul
- Fiber Backhaul
- Code Line and Pole Line Replacement
- Hydraulic Switch Automation
- Workforce and Yard Automation
- Signaling & Switching (CTC)
- Defect Detection
- ATCS
- Onboard/Ground Communications, Event Recorder

PRODUCT SOLUTIONS FOR RAIL APPLICATIONS

OTHER RAIL APPLICATIONS	HIGH THROUGHPUT DATA MOBILITY	WIRELESS BACKHAUL	FIBER BACKHAUL	CODE LINE AND POLE LINE REPLACEMENT	HYDRAULIC SWITCH AUTOMATION	WORKFORCE AND YARD AUTOMATION	SIGNALING & SWITCHING	DEFECT DETECTION	ATCS	ONBOARD/GROUND COMMUNICATIONS, EVENT RECORDER DOWNLOADS, TRIP PLANNING
WiYZ 900 MHz/2.4 GHz ISA 100 Mesh and Takeout					●		●	●		
MDS SD and SD Master 150/220/450/900 MHz licensed Narrowband for Ethernet/Serial				●			●		●	
MDS NETio 900 MHz/2.4 GHz Analog and Digital I/O					●		●	●		
MDS entraNET 900 MHz, 115 kbps for Ethernet/Serial					●		●	●		
MDS transNET 900 MHz, 115 kbps for Serial					●		●			
MDS Orbit Platform 900 MHz and 3G/4G Cellular for WiFi/Ethernet/Serial	●	●				●		●		●
MDS Mercury Series (1800/3650/5800 MHz up to 30 Mbps for WiFi/Ethernet/Serial)	●	●						●		●
MDS iNET 900 900 MHz up to 1 Mbps for Ethernet/Serial	●				●	●	●	●		●
MDS Intrepid Series (PTMP, HC Ultra)		●								
Lentronics JunglePAX or JungleMUX			●							

TECHNICAL SPECIFICATIONS AND ORDERING INFORMATION

RCL220/RCL450 FAMILIES

UNIT	ORDER STRING	KEY SPECIFICATIONS
RCL220 Access Point	eNETL2BFN10NN	216-222 MHz (US) 2 Watt TX 47 slot/second TDMA 9.6 kbps raw rate Basic Serial Protocol (BSP) Peer-to-Peer and Infrastructure support Cooperating Bases Rich Network Management Feature Set
RCL220 Packaged Radio Module	eNETL2QFN10NN	
RCL220 OCU Radio	eNETL2OFN10NN	
Power Amplifier Accessory	eNETL2TFN10NN	Up to 40 Watts adjustable power output 100% Duty Cycle RF Sense Switching

Consult the factory for ordering information for the RCL450 family

ENTRANET 900 FAMILY

UNIT	ORDER STRING	KEY SPECIFICATIONS
entraNET 900 Access Point	eNETN-MD9A1DFN101N	902-928 MHz (US, Australia, Brazil, etc.) 1 Watt TX 115 kbps 1 Ethernet Port 2 Serial Ports Basic Serial Protocol (BSP) Peer-to-Peer and infrastructure support Cooperating Bases Rich Network Management Feature Set
entraNET 900 Remote	eNETN-MD9R1DFN101N	
entraNET 900 OEM	eNETOEM9R3DF10NN	

POSITIVE TRAIN CONTROL

UNIT	ORDER STRING	KEY SPECIFICATIONS
TD220	TDMDH2NNNF	216-222 MHz (US) 256-261 MHz (Brazil) 25 Watts 8 slot/second TDMA 12.5 kHz channel 9.6 kbps raw rate Reed Solomon FEC FCC or Anatel (Brazil)
TD256X	TDMDHBNCNF	
TD220MAX	TDMDHMNXNF	
TD450-Plus	TDMDH5NNNF	450-520 MHz (Australia) 25 Watts 12 slot/second TDMA 25 kHz channel 16 kbps raw rate
Power Amplifier – 220 MHz	eNETL2TFN10NN	Up to 40 Watts adjustable power output 100% Duty Cycle RF Sense Switching
Power Amplifier – 256 MHz	eNETL2VBN10NN	

INDUSTRIAL COMMUNICATIONS SOLUTIONS

With over **2MM DEVICES INSTALLED** in applications around the world, our products allow customers to collect, manage and analyze data enabling insights that maximize productivity and minimize failures and downtime.



INDUSTRIAL WIRELESS SOLUTIONS

- Licensed, Unlicensed, Cellular, Wi-Fi
- Enclosures & Accessories
- Network Management Solutions



GLOBAL PROFESSIONAL SERVICES

- Radio System Design & Engineering Services
- RF Site Surveys & Path Studies, Spectrum Planning, Propagation Coverage Models
- FAT Testing, Commissioning, Network Audits



HARDENED OPTICAL NETWORKS

- Packaged Switched Solutions – MPLS-TP
- Optical Multiplexers – SONET / SDH
- Network Management Solutions



BROADBAND POWERLINE SOLUTIONS

- Broadband on Existing Power Cables
- Easy and Fast Installation
- Integrated Network Manager

For more information, visit
gevernova.com/grid-solutions

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