Enterprise Core Systems Engineering Reference Manual: Automated Guided Vehicle (AGV) Wireless Roaming Router

PRODUCT IDENTIFICATION

The AGV Wireless Roaming Router represents a paradigm shift in industrial mobility infrastructure. Designed specifically for the unique demands of automated guided vehicles, this platform is a Layer 3 routing solution that ensures sub-50ms seamless handover between access points, maintaining uninterrupted telemetry, control, and teleoperation links. It is engineered to operate in the harshest industrial environments, featuring a wide operating temperature range (-40 ° C to +75 ° C), high vibration tolerance, and an IP67-rated chassis. This document details the full hardware specifications, radio architecture, and roaming algorithms that define the new benchmark for industrial wireless routing.



CORE INTERNAL TOPOLOGY

The internal architecture is a convergence of high-performance computing and deterministic radio switching. At its core is a quad-core ARM Cortex-A72 processor operating at 2.2 GHz, paired with a dedicated Real-Time Unit (RTU) for managing the PHY/MAC layers of the dual Wi-Fi 6E radio modules. The system integrates a hardware-accelerated encryption engine (AES-NI) to offload IPsec and MACsec processing, ensuring that secure tunnels do not compromise throughput. The Layer 2/Layer 3 forwarding engine leverages an FPGA-based programmable pipeline, allowing for custom packet filters and priority queuing necessary for industrial protocol traffic. The system memory architecture comprises 4 GB of DDR4 ECC RAM for routing tables and stateful firewall sessions, and 8 GB of eMMC flash for firmware and persistent configuration logs.

SWITCHING AND RADIO SUBSYSTEM CAPABILITIES

The routing engine is complemented by a multi-radio concurrent architecture. It features a primary 4x4:4 MIMO radio operating in the 5 GHz UNII-2c and UNII-3 bands, supporting up to 2400 Mbps of data rate for the backbone network. A secondary 2x2:2 MIMO radio provides dedicated scanning and security monitoring on the 2.4 GHz band, simultaneously performing spectrum analysis and rogue AP detection without interrupting data flow. The roaming router utilizes a patent-pending Fast-Transition (FT) algorithm that employs Opportunistic Key Caching (OKC) and 802.11r/k/v to reduce authentication times. When coupled with our centralized Wireless LAN Controller (WLC), the system achieves Zero-Transition Roaming, where the data plane is steered via a mobility tunnel, achieving packet loss rates of less than 0.01% during vehicle traversal of a facility.

OPERATIONAL ADVANTAGES AND SECURITY

Security is not an afterthought but an intrinsic design principle. The router features a hardware Trusted Platform Module (TPM) 2.0 for secure boot, ensuring only signed firmware loads. All management interfaces (SSH, HTTPS, SNMPv3) are standard. For data encryption, the platform supports

WPA3-Enterprise (GCMP-256) for wireless links and MACsec (IEEE 802.1AE) for wired backhaul, establishing a secure domain from the vehicle's controller to the network core. Operational advantages include a dual, hot-swappable power input (24/48 VDC, supporting standard industrial voltages with reverse polarity protection) and a built-in GNSS receiver (GPS/GLONASS) for precise vehicle positioning and time synchronization, crucial for synchronized multi-robot operations.

SPECIFICATION MATRIX

Parameter	**Specification**
Form Factor	Industrial DIN-Rail / Rack-Mount (1RU Adapter Kit Optional)
Processor	Quad-core ARM Cortex-A72 @ 2.2 GHz with RTU co-processor
Memory / Storage	4 GB DDR4 ECC / 8 GB eMMC Flash
Wi-Fi Standards	IEEE 802.11a/b/g/n/ac/ax (Wi-Fi 6E)
Max Data Rate	Up to 2400 Mbps (5 GHz, 4x4:4)
Wired Interfaces	1x 2.5G SFP, 2x 1G Copper (RJ45), 1x Console (RJ45)
Power Supply	Dual Hot-Swappable 24/48 VDC (Terminal Block)

Operating Temperature	-40°C to +75°C (No moving parts)
Roaming Technology	802.11r/k/v with OKC and PMK Caching (<30ms avg.)
Security	Hardware TPM 2.0, WPA3-Enterprise, MACsec (802.1AE), Secure Boot
Dimensions	51 x 150 x 150 mm (W x H x D)
MTBF	> 500,000 hours at 25°C

REGULATORY COMPLIANCE AND STANDARDS

The AGV Wireless Roaming Router adheres to all relevant international and regional standards for safety and emissions. Compliance includes FCC Part 15, ISED (Canada), CE (EU), and RCM (Australia/New Zealand). It meets the requirements of IEC 61000-6-2 (Industrial Immunity) and IEC 61000-6-4 (Industrial Emissions), ensuring it does not interfere with sensitive factory floor equipment. The device is also certified for UL 60950-1 / UL 62368-1 safety standards. It supports the DFS (Dynamic Frequency Selection) and TPC (Transmit Power Control) features required for operation in the 5.25-5.35 GHz and 5.47-5.725 GHz bands.

