

White Paper: Engineering Resilience in Transportation

Critical Considerations for Embedded Systems, Displays, and Connected Transport Infrastructure

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Table of Contents

- 1. Executive Summary**
The convergence of electrification, connectivity, and intelligent transport systems.
- 2. The Transportation Environment: Defining Mobility-Grade Reliability**
Outdoor deployment, continuous operation, and system interdependence.
- 3. High-Performance Displays & HMIs for Transport Systems**
Visibility, usability, and durability in public and roadside environments.
- 4. The Intelligent Core: Embedded Transport Architecture**
Real-time control, data processing, and system integration.
- 5. Connectivity & Analytics: The Smart Mobility Framework**
EV infrastructure, IoT, and predictive system management.
- 6. Signal Integrity and Interconnects in Transport Systems**
Ensuring reliability across distributed infrastructure.
- 7. Lifecycle Management: Infrastructure at Scale**
From pilot deployment to nationwide rollouts.
- 8. Compliance, Standards, and Safety in Transportation**
Meeting regulatory and operational requirements.
- 9. Conclusion: The Future of Intelligent Transport Systems**
Enabling connected, electrified, and resilient mobility networks.

1. Executive Summary

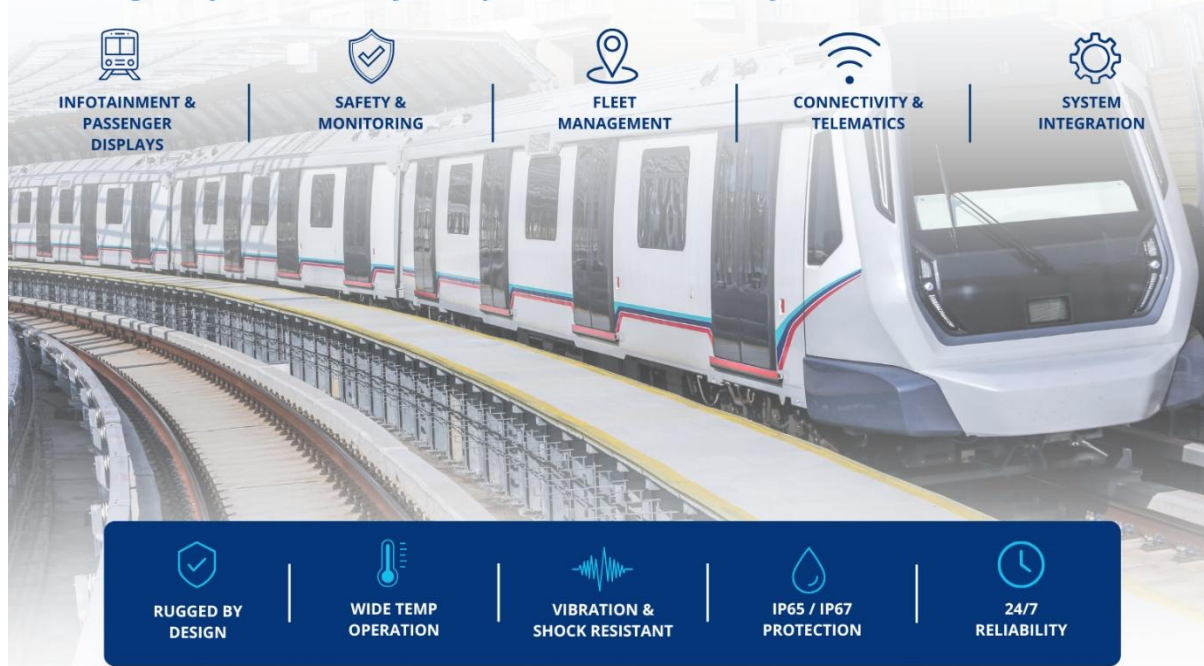
The transportation sector is undergoing a fundamental transformation, driven by electrification, digitalisation, and the demand for smarter, more sustainable mobility solutions. Electric vehicles (EVs), smart infrastructure, and connected systems are reshaping how people and goods move.

At the centre of this evolution lies a robust hardware ecosystem, comprising embedded computing platforms, high-performance displays, and reliable interconnect systems. These technologies enable everything from EV charging infrastructure and traffic management systems to real-time passenger information and fleet monitoring.

This paper explores the engineering considerations required to deliver reliable, scalable, and intelligent transport systems, with a focus on EV infrastructure and connected mobility.

Transportation System Architecture

Intelligent systems. Safer journeys. Connected mobility.



2. The Transportation Environment: Defining Mobility-Grade Reliability

Transport systems operate in highly dynamic and exposed environments, where reliability is essential for safety and usability.

Key challenges include:

- **Outdoor Exposure:** Systems must withstand temperature extremes, UV radiation, and weather conditions

- **Continuous Operations:** Infrastructure such as EV chargers and traffic systems must operate 24/7
- **High Public Interaction:** Systems must remain intuitive and responsive for diverse users
- **System Interdependence:** Transport systems are increasingly linked with energy infrastructure particularly through EV charging networks

The growing adoption of electric vehicles introduces additional complexity, including increased demand on power networks and the need for coordinated infrastructure planning.

Engineering for transportation requires designing systems that are both physically robust and digitally resilient.

Built for Transport Environments



WIDE TEMPERATURE
-40°C to + 70°C operation



VIBRATION & SHOCK
EN 61373 compliant



DUST & WATER PROTECTION
IP65 / IP 67 protection



EMI / EMC PROTECTION
Compliant



SALT FOG & CORROSION RESISTANT
EN 60068-2-11 compliant



24/7 RELIABILITY
Designed for continuous transport operation



3. High-Performance Displays & HMIs for Transport Systems

Displays play a critical role in transport environments, enabling user interaction, system monitoring, and real-time information delivery.

Visibility in Outdoor Conditions

Transport displays must remain readable in challenging environments:

- High-brightness displays for sunlight readability
- Optical bonding to reduce reflections and improve clarity
- Anti-glare and UV protection coatings

Clear visibility is essential for both safety and usability, particularly in EV charging stations and roadside systems.

User Interaction and Accessibility

Interfaces must cater to a wide range of users:

- Responsive PCAP touch interfaces
- Glove and wet-touch compatibility for outdoor use
- Intuitive UI design for quick, simple interaction

Durability and Protection

Transport systems require robust design:

- IP-rated enclosures for weather resistance
- Impact-resistant materials for public-facing installations
- Long operational lifespans for infrastructure deployment

4. The Intelligence Core: Embedded Transport Architecture

Embedded systems provide the processing capability behind transport infrastructure, enabling real-time control and data management.

Feature	Technical Specification
Processing Power	ARM or x86 platforms for data processing and control
Form Factors	Embedded modules, IoT gateways, industrial PCs, rugged edge servers, and rack-mounted transport workstations
Ruggedisation	Fanless designs for outdoor reliability
Longevity	10–15+ year lifecycle support

Key design priorities:

- **Real-Time Data Processing:** Supporting traffic systems, charging management, and monitoring
- **Scalability:** Enabling deployment across distributed transport networks
- **Integration:** Seamless communication with sensors, displays, and cloud platforms

- **Edge Intelligence:** Supporting local analytics, AI-driven monitoring, and operational decision making directly within transport infrastructure
- **Ruggedised Compute Platforms:** Systems designed to withstand vibration, temperature variation, and continuous operation within rail, roadside, and vehicle-mounted environments.

Modern transport infrastructure increasingly relies on high performance embedded servers operating both at the edge and directly onboard transport systems themselves. In many rail and public transport applications, rack-mounted industrial servers function as onboard workstations, managing passenger information systems, surveillance, operational control, diagnostics, and communication networks in real time.

Alongside onboard compute platforms, edge hardware deployed trackside, roadside, or within EV infrastructure enables low-latency processing closer to the source of data generation. This distributed architecture reduces dependency on centralised cloud infrastructure while improving responsiveness, resilience, and bandwidth efficiency across transport networks.

These edge-enabled systems are becoming increasingly important as transport networks adopt AI-driven analytics, predictive maintenance, autonomous operational support, and real-time monitoring applications. By processing data locally, transport operators can react more quickly to operational events, improve passenger experience, and enhance infrastructure reliability.

Embedded systems enable intelligent decision making across transport ecosystems.



5. Connectivity & Analytics: The Smart Mobility Framework

Modern transport systems are built on connectivity and data intelligence.

- **EV Charging Infrastructure:** Requires real-time monitoring, billing, and system management
- **IoT Integration:** Enables communication between vehicles, infrastructure, and central systems

- **Edge Computing:** Allows local decision making for faster response times
- **Predictive Maintenance:** Identifies faults before system failure

The adoption of distributed edge computing architectures is also reshaping smart mobility infrastructure. By developing intelligent compute platforms closer to transport assets, operators can support faster analytics, reduce network congestion, and improve operational continuity even in environments with limited connectivity.

This approach is particularly valuable in rail systems, EV charging networks, intelligent traffic management, and fleet operations, where rapid localised processing can support safer and more efficient decision making.

The rapid growth of EV adoption introduces challenges such as infrastructure demand, grid integration, and communication security.

Connected systems enable transport networks to operate more efficiently, safely, and sustainably.

6. Signal Integrity and Interconnects in Transport Systems

Reliable connectivity is essential for distributed transport infrastructure.

- **EMI Shielding:** Protecting systems from electrical interference
- **Rugged Cabling:** Supporting outdoor deployment and mechanical stress
- **Secure Data Transmission:** Ensuring accurate communication across networks

In EV charging infrastructure, robust cabling and interconnect systems are critical for safe and efficient power delivery.

7. Lifecycle Management: Infrastructure at Scale

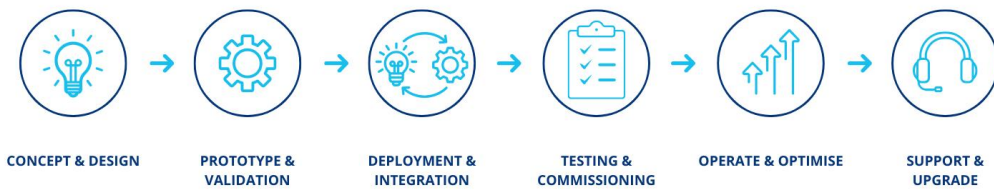
Transport systems are typically deployed at scale and must remain operational for extended periods.

1. **Concept & Design:** Engineering systems for scalability and integration
2. **Pilot Deployment:** Testing in real-world environments
3. **Scaling:** Rollout across cities, regions, or national networks
4. **Maintenance & Monitoring:** Remote diagnostics and updates
5. **Obsolescence Planning:** Ensuring long-term system availability

Infrastructure projects require long-term planning and support to remain effective over time.

Life-Cycle Support

From concept to long-term support.



- ✓ Design expertise & system engineering
- ✓ Environmental & compliance testing
- ✓ Regulatory compliance support
- ✓ Obsolescence management
- ✓ Long-term availability & repair support



8. Compliance, Standards, and Safety in Transportation


Transport systems must meet stringent regulatory and safety requirements:

- **CE / FCC Compliance:** Ensuring safe operation
- **Automotive and EV Standards:** Compliance with global charging and connectivity standards
- **Safety-Critical Design:** Systems must operate reliably in public environments
- **Data Security:** Protecting user and operational data


Regulatory compliance is essential to ensure safety, interoperability, and public trust.

Compliance & Quality


Engineered to meet global standards.




QUALITY
MANAGEMENT




EUROPEAN
CONFORMITY



CERTIFIED
COMPONENTS



COMPLIANT



EN 61000-6-2
EMC IMMUNITY

9. Conclusion: The Future of Intelligent Transport Systems

The future of transportation is connected, electrifies, and intelligent. As EV adoption accelerates and smart infrastructure expands, the demand for reliable, high-performance hardware systems will continue to grow.

By combining:

- High-visibility displays
- Robust embedded computing
- Secure connectivity and interconnect systems
- Distributed edge computing and onboard transport servers

Transport providers can deliver:

- Improved user experience
- Greater operational efficiency
- Scalable, future-ready infrastructure
- Real-time operational insight and predictive system management

Achieving this requires integrated engineering approaches that prioritise reliability, usability, long-term performance, and resilient distributed computing architectures capable of supporting the next generation of intelligent mobility systems.

Review Display Systems: A Volex Group Company

As part of the Volex Group, Review Display Systems delivers integrated technology solutions for transportation and e-mobility applications.

From EV charging infrastructure and smart transport systems to embedded computing and display solutions, RDS provides the hardware foundation for modern mobility systems. Through access to Volex's global manufacturing capabilities and interconnect expertise, customers benefit from a fully integrated solutions, spanning design, prototyping, and high-volume production.

This vertically integrated approach ensures that transport systems are engineered for reliability, scalability, and long-term success in an increasingly connected world.