

SMART TRANSPORTATION APPLICATIONS IN THE INTERNET OF THINGS

TECHNOLOGY OVERVIEW

INTELLIGENT SYSTEMS FOR THE TRANSPORTATION INDUSTRY

The Internet of Things (IoT) is fundamentally transforming the transportation industry. Next-generation intelligent transportation systems will optimize the movement of people and goods, improving economics, public safety, and the environment.

Smart transportation systems will automate our roadways, railways, and airways, transform passenger experiences, and reshape the way cargo and merchandise are tracked and delivered, creating substantial business opportunities for system integrators, independent software vendors (ISVs), service providers, and other solution providers.

Intelligent transportation system opportunities abound across a wide range of industries and market segments. Examples include:

- Fleet telematics and management solutions.
- Transport logistics applications.
- Guidance and control systems.
- Inventory and supply chain management solutions.
- Passenger entertainment and commerce applications.
- Smart vehicle applications.
- Reservation, toll, and ticketing systems.
- Peer-to-peer services like car sharing.
- Security and surveillance systems.

Whether you are designing an end-to-end intelligent transportation solution or developing individual components of a smart transportation system, Red Hat can help you eliminate solution cost and complexity, simplify development and integration efforts, and accelerate time-to-market. We offer a complete set of open and standards-based middleware solutions, virtualization technologies, storage products, cloud computing components, and open operating platforms for implementing a highly scalable, reliable, and secure intelligent transportation system.



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SMART APPLICATIONS FOR FLEET TELEMATICS

- Automated vehicle routing and scheduling
- Driver compliance, safety, and performance reporting
- Fleet maintenance and fuel conservation

Capabilities

- Track, schedule, and route vehicles in real time
- Proactively manage fleet maintenance and fuel economy
- Monitor driver behavior and performance (distance traveled, speed, location)

Benefits

- Accelerate delivery and dispatch rates
- Improve customer satisfaction
- Reduce fuel consumption and vehicle maintenance costs
- Ensure compliance with government and industry regulations
- Improve fleet productivity, uptime, and safety

FLEET TELEMATICS

Fleet telematics solutions help businesses, transportation carriers, and governments improve economics, safety, and compliance by intelligently monitoring and controlling their vehicles. Smart applications gather and analyze data from on-board instrumentation and GPS sensors to track vehicle status and location, optimize routing, and monitor driver and equipment performance and productivity.

FLEET TELEMATICS IN ACTION: AN ITALIAN TRAM SYSTEM OPERATOR

An important community asset, the tram system linking two cities in Italy needed to operate economically while sufficiently meeting the needs of commuters during peak travel times. The project goal was to identify the travel peaks and troughs and:

- Optimize the use of the fleet.
- Dynamically route trams based on real time conditions.
- Ensure trams are available when needed and not sent out empty unnecessarily.

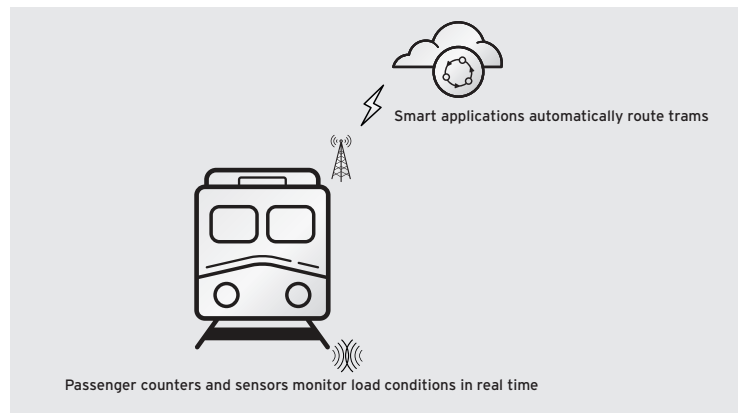


Figure 1. Fleet telematics use case

THE SOLUTION

Passenger counters were installed at each door and stereoscopic camera sensors were deployed to monitor door status. Wireless communications systems were mounted on the trams.

Red Hat® JBoss® A-MQ was used as the message broker to efficiently orchestrate data delivery from the mobile devices installed on the tram to a cloud-based tram routing system. Future plans may include using Red Hat JBoss BRMS to implement business rules to intelligently adjust fleet schedules based on historical trends.

KEYS TO SUCCESS

The system relied on a bandwidth-constrained wireless network. The designers sought to efficiently gather and analyze real-time and historical data, while avoiding expensive infrastructure upgrades. These keys to success applied to this project, and could apply to any fleet telematics project:

- Optimize utilization of wireless network
- Choose bandwidth-efficient protocols
- Limit upstream data communications
- Use on-board business logic to minimize network traffic

SMART APPLICATIONS FOR TRANSPORT LOGISTICS

- Transport and delivery logistics
- Location and condition monitoring
- Theft prevention and detection

Capabilities

- Track condition and location of cargo and goods in real time
- Automate scheduling, placement, and delivery
- Proactively manage vehicle capacity and routing

Benefits

- Optimize the transport and delivery of inventory and goods
- Reduce product spoilage, damage, delay, and theft
- Improve customer satisfaction and profitability
- Eliminate human intervention, manual processes, and inefficiencies
- Reduce fuel costs and vehicle maintenance expenses

TRANSPORT LOGISTICS

Intelligent transport logistics solutions help long-haul cargo operators and last-mile delivery providers efficiently manage the transportation and distribution of freight and merchandise. Smart applications gather and analyze data from on-board sensors to track containers and packages, and to monitor environmental conditions, ensuring goods arrive on time, at the right place, intact.

TRANSPORT LOGISTICS IN ACTION: SPECIALTY FREIGHT SHIPPING SERVICE

A leading courier delivery services company offers specialty shipping services for sensitive freight. Specially trained drivers and specially equipped vehicles ensure the reliable delivery of temperature-sensitive cargo, hazardous materials, or extremely valuable objects. The project goal was to implement a highly scalable system to monitor and track the delivery of sensitive freight from origin to destination.

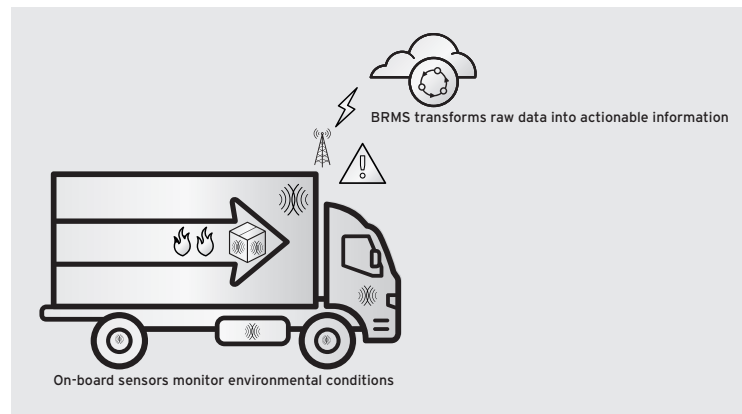


Figure 2. Transportation logistics use case

THE SOLUTION

Special delivery vehicles were equipped with environmental sensors to monitor temperature, humidity, light, and vibration in real time. Sensor data is transmitted wirelessly to a cloud-based application that continuously analyzes alarms and events and takes corrective actions.

Red Hat JBoss BRMS is the cornerstone of the solution. The comprehensive business rules management platform transforms raw sensor data into meaningful and actionable information that helps the shipping company ensure safe transport.

KEYS TO SUCCESS

The transport logistics system analyzes high volumes of diverse data collected from a variety of different sensors over time. The system designers sought an easy-to-use business rules management engine that supported the complex algorithms required to reliably monitor sensitive cargo. These keys to success applied to this project, and could apply to any transport logistics project:

- Execute advanced business rules
- Enable complex event processing
- Analyze massive volumes of endpoint data
- Correlate data from diverse sources over sliding time windows

SMART TOLL COLLECTION SYSTEMS

- Execute financial transactions in real time
- Generate billing records
- Provide customer-facing user interface

Capabilities

- Automate toll metering and revenue collection
- Introduce demand-based or time-of-day-based pricing
- Monitor vehicle counts and traffic flows

Benefits

- Enable immediate revenue collection
- Reduce traffic congestion, accidents, idle fuel consumption, and environmental impact
- Avoid cash handling expenses and security risks
- Reduce labor costs and operating expenses

SMART TOLL COLLECTION SYSTEMS

Intelligent toll collection systems help governments accelerate revenue collection and eliminate traffic congestion. In-vehicle transponders and roadside beacons automatically track vehicle movements and securely relay toll data to upstream financial transaction and billing systems, enabling accurate and instantaneous remuneration.

SMART TOLL COLLECTION IN ACTION: EUROPEAN ROADWAY SYSTEM

A European transportation ministry sought to automate toll metering and collection for commercial vehicles travelling across a 14,000 km multinational highway network. The project goals included:

- Implement a free-flow system that avoids stoppages and traffic delays.
- Calculate fees based on vehicle class and weight.
- Interface directly with banking systems to enable immediate revenue collection.

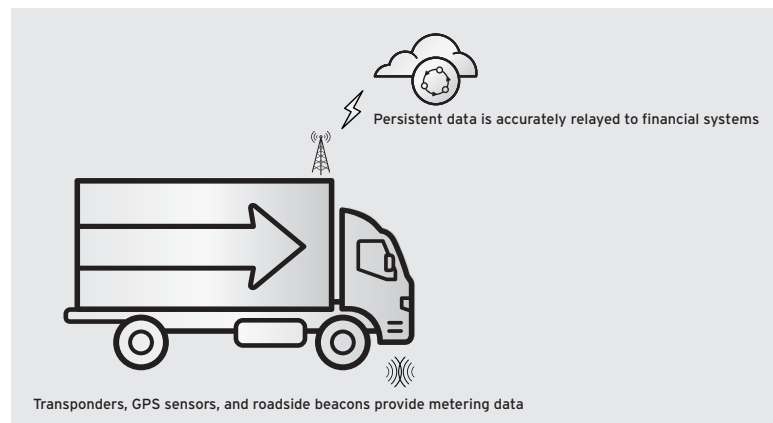


Figure 3. Smart toll collection use case

THE SOLUTION

Truck transponders, GPS sensors, and roadside beacons were used to provide precise vehicle class and location data. Roadside sensors collect, aggregate, and transmit data upstream to financial transaction systems. Tolls are automatically collected from financial institutions and immediately delivered to the government's treasury department.

The system integrator for the project used Red Hat intelligent systems solutions, including Red Hat JBoss Fuse and Red Hat Enterprise Linux® to create a highly reliable and extensible multinational toll collection system.

KEYS TO SUCCESS

The overall toll collection system tied together a complex web of applications and subsystems. The designers sought to efficiently integrate the various system components while ensuring end-to-end accuracy and completeness for all financial transactions. These keys to success applied to this project, and could apply to any toll collection project:

- Ensure highly reliable data collection and transmission
- Maintain full data persistence across entire transaction chain
- Guarantee data accuracy and integrity
- Safeguard privacy for confidential information

SMART TRAIN CONTROL SYSTEMS

- Track and guide trains in real time
- Take automatic braking action
- Manage system routing and costs

Capabilities

- Schedule and dynamically re-route trains
- Prevent collisions, over-speed derailments, improper movements, and work zone incursions
- Monitor conductor behavior and performance

Benefits

- Improve safety, on-time arrivals, passenger satisfaction, and profitability
- Reduce fuel consumption and maintenance costs
- Improve system productivity and uptime
- Ensure compliance with government and industry regulations
- Mitigate risks

SMART TRAIN CONTROL SYSTEMS

Intelligent train control and collision avoidance systems help rail operators ensure safety, control speed, predict failures, and reduce costs. Rail-side sensors monitor and record train speed and load characteristics. Smart applications securely relay guidance instructions to conductors to optimize scheduling and fuel economy. On-board control systems take automatic braking action to avoid collisions and derailments.

SMART TRAIN CONTROL SYSTEMS IN ACTION: U.S. RAIL NETWORK

The North American Positive Train Control (PTC) program is a set of smart technologies to help prevent train-to-train collisions, over-speed derailments, improper movements, and work zone incursions. PTC is the most complex and extensive technological initiative the rail industry has ever undertaken. When fully implemented, PTC will include over 60,000 devices installed on nearly 70,000 miles of track and 25,000 locomotives. The project goal was to implement an advanced wireless communications system that seamlessly integrates diverse technologies in a highly scalable and reliable manner.

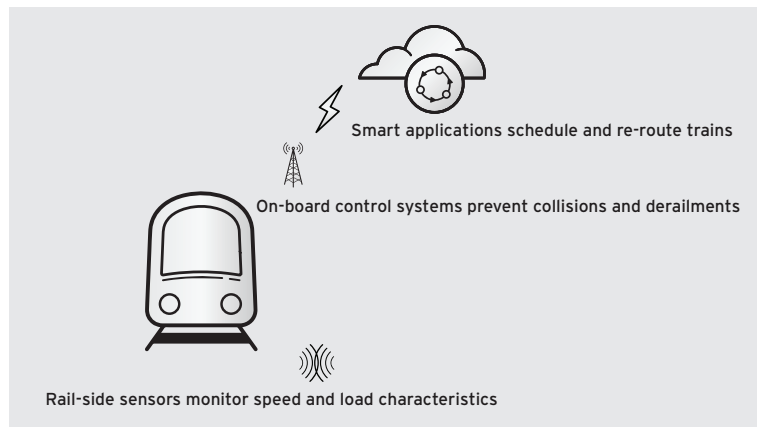


Figure 4. Smart train control use case

THE SOLUTION

The PTC communications system provider used Red Hat intelligent systems solutions, including Red Hat JBoss messaging solutions and Red Hat Enterprise Linux to construct an extensible and resilient wireless communications framework. Red Hat JBoss messaging technologies are built on an open, wire-level messaging protocol that streamlines interoperability among complex networked systems and mobile endpoints. Red Hat's tiered smart transportation architecture lays the foundation for a highly scalable communications infrastructure that meets strict reliability and security requirements.

KEYS TO SUCCESS

The PTC program brings the concept of carrier-class five 9's availability to the rail industry's wireless communication infrastructure. Overall system downtime cannot exceed 5.26 minutes per year. These keys to success applied to this project, and could apply to any smart transportation control system project:

- Ensure continuous system-level availability
- Provide full redundancy for all system components
- Route around node failures and network outages
- Enable horizontal scalability

TAP INTO THE MASSIVE IoT MARKET OPPORTUNITY

IDC projects the total worldwide Internet of Things market to reach \$1.7 trillion in 2020.¹ Tap into this massive market opportunity with intelligent systems for the transportation industry. A wide range of end-customers are looking to the Internet of Things to contain transportation costs, increase fleet productivity, and improve customer satisfaction. Table 1 summarizes common smart transportation applications and end-customer benefits.

APPLICATION	BENEFITS FOR END-CUSTOMERS
Fleet telematics and management solutions	
Intelligently monitor vehicle location, movement, status, and behavior	Optimize routes, fuel economy, and driver productivity
Transport logistics applications	
Monitor and track cargo conditions (temperature, motion, light, etc.) and movements	Avoid product spoilage, damage, delays, and theft; optimize routing and logistics
Reservation, toll, and ticketing systems	
Enable automated payment and ticketing	Avoid delays and inconvenience; introduce demand-based fees
Guidance and control systems	
Intelligently monitor and govern transportation networks and vehicles	Avoid collisions and derailments, improve public safety, and optimize traffic flows
Inventory and supply chain management solutions	
Intelligently manage the movement of goods and materials	Optimize inventories, order processing, shipping, and receiving
Passenger entertainment and commerce	
Offer interactive retail and entertainment services to captive passengers	Generate new revenue streams and improve customer loyalty and passenger experiences
Smart vehicle applications	
Intelligently route vehicles and adapt transportation infrastructure (traffic signals, signage, lanes)	Optimize traffic flows and fuel economy; avoid collisions; improve public safety and mobility
Peer-to-peer services	
Introduce smart services like car sharing or parking space finders	Create new business opportunities and revenue streams
Security and surveillance systems	
Intelligently monitor and analyze activities at transportation hubs and networks	Protect against safety hazards, terrorist threats, and other security concerns

Table 1. Smart transportation system applications and benefits

¹ IDC Worldwide Internet of Things Forecast 2015-2020, May 2015

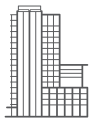
NEXT STEPS

The next wave of intelligent transportation systems must gather, analyze, and act upon massive volumes of data in a highly efficient and reliable manner. Red Hat can help you address stringent IoT performance demands, quickly and cost-effectively, with our smart transportation systems architecture and solution components.

Our tiered intelligent systems architecture provides a high degree of component modularity and autonomy, satisfying demanding smart transportation scalability, availability, and security requirements. And our standards-based solution portfolio lets you avoid vendor lock-in, contain costs, and accelerate time-to-market.

To learn more about Red Hat's smart transportation systems architecture and building blocks, download our *Transportation in the Internet of Things* technology overview at <https://www.redhat.com/en/resources/transportation-internet-things>

For additional information on the IoT, visit our Internet of Things insights page <https://www.redhat.com/iot>



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