TRACE

inTegration & haRmonizAtion of logistiCs opErations

White Paper

Integrating Europe's Logistics: How the TRACE Platform Enables Sustainable Multi-Modal Delivery

A practical guide to collaborative transportation coordination

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Executive Summary

European logistics networks operate as fragmented systems. A parcel moving across borders typically passes through multiple independent companies, each managing their own vehicles, routes, and data separately. This fragmentation creates real problems: delayed deliveries, wasted fuel from inefficient routing, underutilized vehicle capacity, and missed opportunities for companies to work together. For cities implementing stricter emissions regulations and zero-emission zones, the challenge intensifies. Logistics companies struggle to coordinate which vehicles can access restricted areas, leading to failed deliveries and operational disruptions.

TRACE solves this problem by creating a unified coordination platform. Rather than replacing existing systems, TRACE connects the networks of different logistics companies and allows them to share information securely while optimizing operations together. The platform coordinates shipments across multiple transportation modes: traditional trucks, cargo bikes, and unmanned aerial vehicles. It selects the most efficient option for each delivery stage based on real-time conditions.

The platform works through four key capabilities. First, it collects live information from vehicles, sensors, and external sources, providing a unified view of the entire logistics network. Second, it uses intelligent algorithms to optimize delivery routes by considering traffic patterns, weather, and vehicle capabilities. Third, it allows companies to share operational data without exposing proprietary information or creating isolated data stores. Fourth, it records all transactions using blockchain technology, creating transparent and permanent records that build trust among participating organizations.

TRACE has been tested across pilot sites in Greece, Slovenia, and Italy. Results show reduced delivery times, lower carbon emissions through better vehicle selection and route planning, and improved reliability through automatic detection of problems and rerouting. The platform directly supports European Green Deal objectives by helping cities meet emission reduction targets while maintaining effective logistics operations. It also simplifies compliance with urban logistics regulations, particularly zero-emission zones that require real-time vehicle eligibility checks.

This white paper explains how TRACE works, why it matters for European logistics, and how organizations can use it to build more efficient, sustainable, and collaborative transportation networks. The platform has been validated through real-world operations and is ready for deployment across European markets.

The Problem: Fragmented Logistics Systems

Why Current Logistics Networks Don't Work Well Together

Picture a package traveling from a warehouse in Germany to a customer in Italy. The journey involves multiple handoffs. A German logistics company picks up the parcel and transports it to a regional hub. There, it transfers to a different company specializing in cross-border transport. At the Italian border, a third company takes over for final delivery. Each company operates independently. They use different systems, different vehicle fleets, and different routing methods. Nobody has a complete picture of where the package is or how long it will take to arrive. This fragmentation is the norm in European logistics. Companies compete fiercely, so they guard their data and operational details. They invest in proprietary systems that don't communicate with competitors. Routes are planned in isolation. Vehicles from one company cannot easily coordinate with vehicles from another. The result is inefficiency at every level.

The Costs of Fragmentation

The inefficiencies are substantial. Delivery times stretch unnecessarily because route planning happens company by company rather than network-wide. Vehicles travel half-empty because companies cannot easily share capacity. A truck heading from Vienna to Prague might pass empty cargo bikes heading the same direction, but there is no mechanism to coordinate the shipment to the most suitable vehicle. Fuel consumption rises as a result. Routes are not optimized for the entire network, only for individual companies. In urban areas, the problem worsens. Cities are introducing strict regulations to reduce pollution and congestion. Many now restrict access to certain vehicles or certain times of day. Some have designated zero-emission zones where only electric vehicles or cargo bikes can deliver. Logistics companies must track which vehicles can access which areas. With fragmented systems, this becomes a coordination nightmare. A company planning a delivery might not know in real time whether their available vehicles meet the area's requirements. This leads to failed deliveries, frustrated customers, and wasted trips. Environmental costs are equally serious. Suboptimal routing means more kilometers driven, more fuel burned, and higher emissions. Underutilized vehicles mean more individual trips are needed to deliver the same volume of goods. A fragmented system cannot easily consolidate shipments or select the lowest-emission vehicle for a job. European cities and countries have committed to significant emissions reductions. Logistics fragmentation actively works against these commitments.

The Business Case for Change

Companies recognize these problems. Yet changing the status quo is difficult. Building integrated systems requires trust, technical investment, and willingness to share information. Most logistics companies lack incentives to invest alone. The benefits only materialize when multiple companies participate. This creates a chicken-and-egg situation: no single company can solve the problem by itself. Yet the case for solving it is compelling. Faster deliveries improve customer satisfaction and competitiveness. Lower fuel costs improve margins. Better vehicle utilization increases revenue per asset. Compliance with urban regulations becomes automatic rather than manual and error-prone. Environmental performance becomes a competitive advantage rather than a regulatory burden. What has been missing is a practical tool that enables this coordination without requiring companies to abandon their independence or share sensitive competitive data. TRACE provides that tool.

What Is TRACE?

A Platform for Logistics Collaboration

TRACE is a digital platform that enables logistics companies to work together without giving up their independence. Think of it as a coordination layer sitting between different company networks. Each company keeps its own systems, its own data, and its own operations. But TRACE allows them to share relevant information securely and to coordinate shipments across their combined fleets. The name reflects its purpose: ***Integration and Harmonization of Logistics Operations***. It integrates disconnected systems. It harmonizes data so that different companies can understand each other's information. The result is a unified network where shipments can flow smoothly across multiple companies and multiple transportation modes.

How It Differs from Traditional Systems

Traditional logistics management systems focus on a single company's operations. They optimize that company's routes and vehicles. They track that company's shipments. But they cannot see across company boundaries. A traditional system might tell you that your truck is 80 percent full heading to Milan, but it has no way to coordinate with another company's cargo bike that is heading the same direction with spare capacity. TRACE operates at the network level. It sees shipments from multiple companies simultaneously. It understands the capabilities of vehicles from different operators. It can suggest that a shipment move

by cargo bike instead of truck because that is more efficient for the urban environment. It can recommend consolidating several small shipments into one vehicle to save fuel and emissions. These optimizations happen across company boundaries, which is impossible in traditional siloed systems.

The Technology Behind the Scenes

TRACE connects to each participating logistics company's existing systems through secure data connections. It does not replace those systems. Instead, it reads relevant information from them: available vehicles, current shipments, vehicle locations, capacity, emissions standards, and delivery constraints. This information flows into a central platform. Within the platform, intelligent algorithms analyze the network state. They consider factors like traffic patterns, weather conditions, vehicle capabilities, and delivery time windows. They calculate the optimal routes and vehicle assignments. The results flow back out to the companies involved, appearing in their own dashboards and systems in a format they already understand. The platform uses encryption and security protocols to ensure that sensitive data remains protected. One company cannot see another company's pricing or customer information. Each company sees only the information necessary to execute its role in the coordinated delivery. Trust is built through transparency about operations and outcomes, not through exposure of competitive secrets.

Supporting Multiple Transportation Modes

A key capability of TRACE is its ability to coordinate across different vehicle types. Traditional delivery relies almost exclusively on trucks. TRACE expands the toolkit to include cargo bikes for short urban distances, unmanned aerial vehicles for specific scenarios, and traditional vehicles for longer routes. The platform selects the right tool for each leg of the journey. A typical delivery might involve three stages. The first mile moves a shipment from a warehouse to a regional hub, typically using a truck. The middle mile transports it across longer distances, potentially consolidating it with other shipments. The last mile completes the delivery to the customer, often in an urban area where cargo bikes or small vehicles are more efficient and less disruptive than trucks. TRACE optimizes each stage separately but coordinates them as one operation. It might determine that a shipment should travel by truck for the first and middle miles, then transfer to a cargo bike for the final urban delivery. This decision happens automatically based on the shipment's characteristics, the destination, traffic conditions, and vehicle availability.

The Core Promise

TRACE's fundamental promise is this: it makes coordination easy and secure. It removes technical barriers to companies working together. It makes better decisions possible by analyzing the entire network rather

than isolated company operations. It does all of this while preserving each company's autonomy and protecting their competitive information. For cities and customers, TRACE delivers tangible benefits: faster delivery, lower emissions, improved compliance with urban regulations, and better service reliability. For logistics companies, it delivers competitive advantage through efficiency and the ability to meet customer demands for sustainable delivery options.

How TRACE Works: Four Pillars

Pillar 1: Real-Time Data Coordination

TRACE continuously collects live information from the logistics network. GPS signals show where vehicles are located. Sensors on vehicles report temperature, fuel levels, and equipment status. Messages from logistics company systems indicate which shipments are ready for pickup, where they need to go, and when. Traffic systems provide current road conditions. Weather services report conditions that affect vehicle operations. All this information flows into TRACE in real time. The platform organizes it into a single unified view of the entire network. When a dispatcher needs to know which vehicles can deliver a shipment within a time window, TRACE instantly provides accurate information. When a vehicle breaks down, TRACE detects it and alerts relevant operators. This real-time awareness enables decisions that would be impossible in fragmented systems.

Pillar 2: Smart Routing and Scheduling

TRACE uses intelligent algorithms to determine the best way to execute shipments. These algorithms consider multiple factors simultaneously: the shipment's weight and size, the distance to be traveled, current traffic conditions, weather forecasts, vehicle capabilities, and delivery time requirements. They calculate optimal routes that minimize time, distance, and fuel consumption. The algorithms also consider environmental factors. They check which vehicles meet the emissions standards required in the destination area. They prefer lower-emission vehicles when options exist. They consolidate multiple shipments when doing so saves fuel and reduces total trips. These decisions happen automatically without manual intervention. The result is routing that works better than any single company could achieve alone, because it sees the entire network and makes decisions across company boundaries.

Pillar 3: Secure Data Sharing

Multiple companies contribute data to TRACE and rely on it to coordinate. They need confidence that their sensitive information remains protected. TRACE uses encryption and access controls to ensure each company sees only what it needs to see. A logistics company using TRACE to coordinate with competitors does not expose its customer list, pricing structure, or proprietary operational details. It shares only operational information necessary for coordination: vehicle availability, capacity, location, and capabilities. The platform acts as a trusted intermediary, allowing collaboration without exposing competitive secrets. This approach makes participation possible. Companies can benefit from network-wide coordination without fear of losing their competitive advantage or leaking sensitive data.

Pillar 4: Transparent Transaction Records

Every coordinated delivery creates a record in TRACE's blockchain system. Blockchain is a technology that creates permanent, unchangeable records that multiple parties can verify. When a shipment is handed from one company to another, that transfer is recorded. When a vehicle is assigned to a delivery, that assignment is recorded. These records cannot be altered after the fact. This transparency builds trust. All participating companies can verify what happened and when. Disputes about responsibility are resolved by checking the unchangeable record. Customers can track their shipments with confidence that the information is accurate and complete. Regulators can audit operations to verify compliance with rules.

Key Capabilities Delivering Business Value

Reduced Delivery Times and Costs

TRACE optimizes routes across the entire network rather than company by company. This eliminates unnecessary detours and consolidates shipments efficiently. Deliveries reach customers faster. Companies complete more deliveries per vehicle per day, reducing cost per shipment. The platform also reduces failed deliveries. Traditional systems sometimes send the wrong vehicle to a location, only to discover upon arrival that the vehicle cannot access the area due to size restrictions or emissions regulations. TRACE checks these constraints before assigning vehicles, eliminating wasted trips.

Lower Carbon Emissions

TRACE selects the lowest-emission vehicle suitable for each task. For short urban distances, it assigns cargo bikes instead of trucks when possible. For longer routes, it consolidates shipments to reduce total trips. It routes vehicles to avoid congestion, reducing idle time and fuel consumption. The platform also enables compliance with zero-emission zones. It automatically filters which vehicles can operate in restricted areas and routes other shipments through alternative modes or times. This allows cities to maintain strict environmental standards while ensuring logistics continues to function.

Improved Service Reliability

TRACE continuously monitors vehicle operations through sensors and GPS. When it detects a problem, it immediately alerts operators and automatically recalculates routes. A breakdown no longer cascades through the network causing multiple delayed deliveries. Instead, affected shipments are reassigned to alternate vehicles within minutes. Weather poses another threat to reliability. TRACE receives weather forecasts and evaluates which vehicles can safely operate in predicted conditions. It adjusts vehicle assignments and routes before problems occur rather than reacting after delays happen.

Compliance with Urban Regulations

Cities increasingly restrict which vehicles can operate when and where. Zero-emission zones limit access to electric vehicles and bicycles. Time windows restrict truck deliveries to off-peak hours. TRACE manages these constraints automatically. The platform maintains current information about all urban restrictions. Before assigning a vehicle to a delivery, it verifies that the vehicle meets the destination's requirements. If a standard truck cannot enter a zero-emission zone, TRACE automatically routes the shipment through a cargo bike instead or flags it for alternative timing. Compliance becomes automatic rather than manual and error-prone.

Competitive Advantage Through Sustainability

Customers increasingly demand sustainable delivery options. Companies that can offer lower-emission deliveries gain competitive advantage. TRACE makes this possible by enabling efficient multi-modal coordination that traditional systems cannot achieve. A company using TRACE can offer customers delivery by cargo bike or electric vehicle as a standard option rather than as a premium service. The platform makes these options economically viable by optimizing the entire network. This becomes a selling point, not a cost burden.

Alignment with European Priorities

Supporting the European Green Deal

Europe has committed to becoming climate-neutral by 2050. Logistics accounts for a significant portion of urban emissions. Trucks idling in congestion, half-empty vehicles making redundant trips, and inefficient routing all contribute to pollution that undermines climate goals. TRACE directly supports Green Deal objectives by making sustainable logistics economically viable. The platform reduces emissions through optimized routing, vehicle consolidation, and intelligent mode selection. Cities can deploy cargo bikes and electric vehicles without sacrificing service quality or speed. Companies can meet customer demand for sustainable delivery without losing competitiveness on cost. The platform enables cities to implement strict emission regulations with confidence that logistics will continue to function reliably. Zero-emission zones become manageable because TRACE automatically routes shipments through compliant vehicles or consolidates them efficiently. This accelerates Europe's transition toward climate-neutral urban transport.

Enabling Digital Transformation

European policy emphasizes digital transformation of the economy. Fragmented logistics networks represent an outdated operating model. TRACE modernizes logistics by creating digital coordination infrastructure that connects companies and systems. The platform demonstrates how digital technology can improve efficiency and sustainability simultaneously. It shows that European companies can compete globally through smarter operations, not just lower costs. This aligns with European objectives to build digital leadership and competitive advantage through innovation.

Building Trust and Interoperability

European regulation increasingly requires systems to interoperate and share data responsibly. TRACE demonstrates practical interoperability. Multiple independent companies contribute data to a shared platform while maintaining security and competitive protection. This model aligns with European digital policy objectives around data sharing and digital sovereignty. The blockchain component builds additional confidence. Transparent, verifiable records reduce fraud risk and build trust among companies that may not have worked together before. This supports European objectives around trusted digital infrastructure.

Supporting Urban Mobility Goals

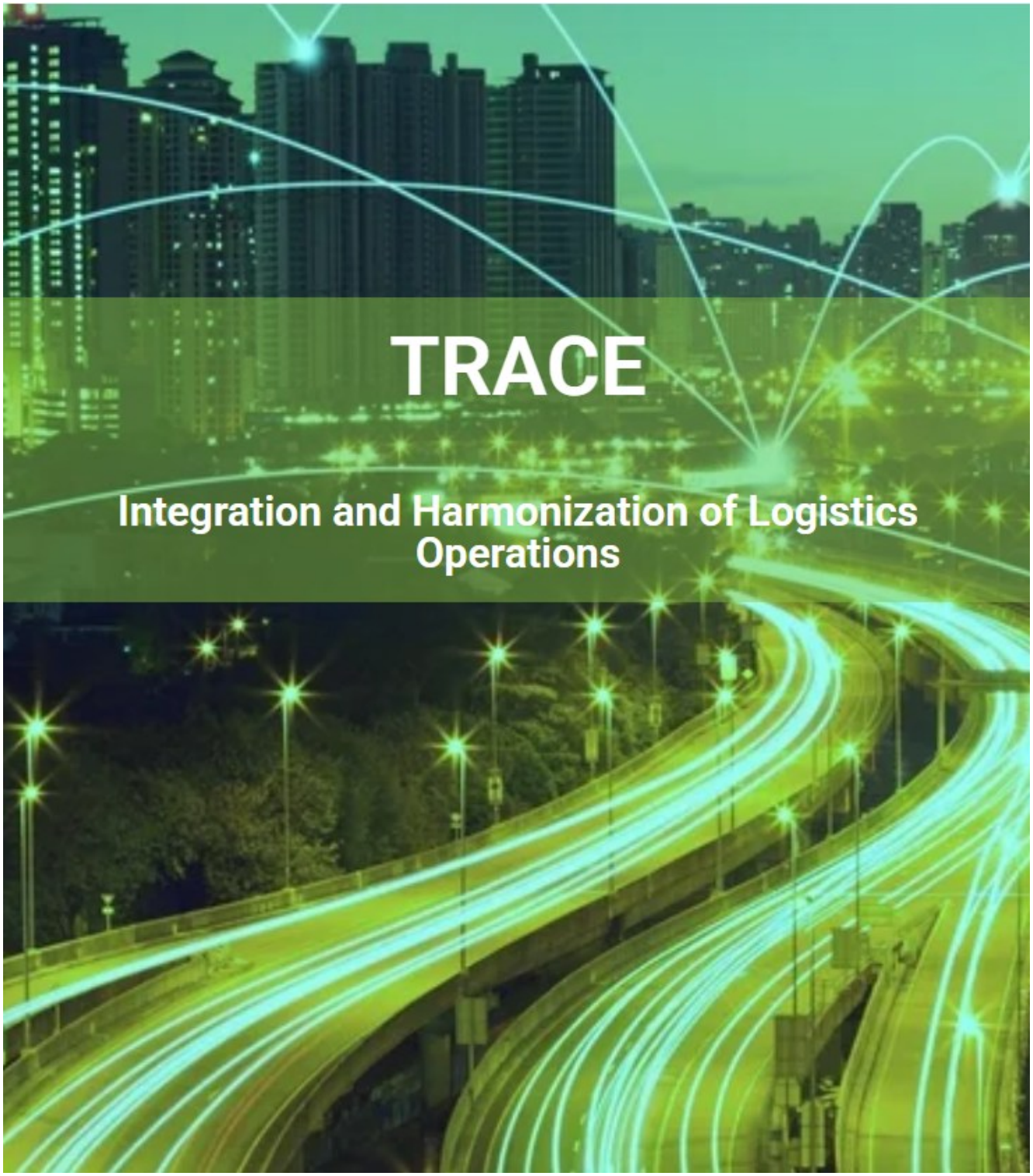
European cities face mounting pressure to reduce congestion and pollution. Traditional logistics cannot solve this problem alone. TRACE enables cities to implement ambitious urban mobility strategies by ensuring that stricter regulations do not paralyze commerce. The platform supports last-mile delivery innovation. Cargo bikes, electric vehicles, and micro-hubs become viable options when coordinated through TRACE. Cities can deploy these solutions knowing that logistics companies can use them efficiently across their entire operations. This accelerates adoption of cleaner urban delivery models.

Creating Economic Opportunity

TRACE creates competitive advantage for European logistics companies. By coordinating across company boundaries, the platform achieves efficiency gains that companies operating alone cannot match. This improves European logistics competitiveness globally while supporting domestic employment and investment. The platform also enables smaller logistics companies and innovative transport providers to participate in complex logistics networks. Cargo bike operators and specialized services can integrate with large logistics networks through TRACE rather than competing only on price. This fosters a diverse, resilient logistics ecosystem.

Looking Forward

TRACE has been validated through real-world operations across multiple European cities. The platform is ready for broader deployment across European logistics networks. Future expansion will extend coordination to additional cities, additional logistics providers, and additional transportation modes. As more companies participate, network effects amplify benefits for all participants. TRACE demonstrates a practical path toward integrated, efficient, and sustainable European logistics. This foundation supports European Green Deal objectives, digital transformation goals, and urban mobility strategies for decades to come.



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