

Battelle Transportation

# DRIVING INNOVATION FOR TRANSPORTATION SYSTEMS & TECHNOLOGIES

**BATTELLE**



How do you make the movement of goods and people safer, more reliable and more efficient?

At Battelle, we're hard at work solving the transportation challenges that matter most. From positive train control to connected vehicle solutions, our work has been driving innovation for highway, transit, rail, aviation and maritime transit for nearly 50 years.

## TOMORROW'S TRANSPORTATION SYSTEMS START HERE

We bring together unmatched scientific, technical and engineering experience across a wide range of disciplines to find new approaches for transportation challenges. That's why we've been trusted to lead the development and deployment of numerous large-scale transportation research projects for the U.S. Department of Transportation, the Department of Homeland Security and a variety of state and local agencies and commercial organizations.

Our strategy lies in the application of rigorous system engineering principles supported by deep expertise, state-of-the-art software applications and an approach that incorporates human factors and policy implications along with technology. We're turning great ideas into real world solutions, from ideation to commercialization or deployment.

# HOW WE HELP:

INTEGRATED  
TRANSPORTATION  
SOLUTIONS

TRANSPORTATION  
OPERATIONS

RESEARCH &  
DEVELOPMENT

SYSTEM DESIGN &  
ENGINEERING

SAFETY ANALYSIS  
& ASSESSMENTS

PROTOTYPE  
DEVELOPMENT &  
DEMONSTRATION

TESTING  
& EVALUATION

KNOWLEDGE &  
TECHNOLOGY  
TRANSFER

HUMAN FACTORS  
RESEARCH

DATA  
ANALYTICS

CYBERSECURITY  
SOLUTIONS

TRANSPORTATION  
POLICY &  
PLANNING



An aerial photograph of a city intersection. Several vehicles are visible: a white delivery truck on the left, a red SUV in the center, a large red and white bus in the upper right, and a dark blue SUV in the middle left. Numerous yellow concentric circles are drawn around each vehicle, representing their communication range or sensor field. These circles overlap significantly, illustrating the interconnected nature of the vehicles. A blue rectangular banner is superimposed across the middle of the image, containing the text 'CONNECTED VEHICLES' in white capital letters. The intersection features a crosswalk with white stripes and a red brick-paved area. A traffic light pole is visible on the right side.

# CONNECTED VEHICLES

# Battelle is improving the safety, mobility and environmental impact of surface transportation through innovative systems and applications for personal-to-vehicle, vehicle-to-vehicle, personal-to-infrastructure and vehicle-to-infrastructure connectivity.

Our systems are already enabling:

- Reduced crash rates, injuries and deaths
- Traffic, weather and emergency warnings
- Route planning for optimal driving and fuel efficiency
- Traffic pattern and transportation system planning
- Reduced environmental impact

## Comprehensive, Field-Ready Solutions

We offer solutions for connected vehicle system integration, with comprehensive in-vehicle, infrastructure, data capture and data processing systems to reduce ramp-up time and project complexity.

- In-vehicle hardware system takes only 10 minutes to install
- Rapidly deployable DSRC infrastructure
- Comprehensive suite of deployment-ready applications
- Scalable cloud-based data collection and processing

## Scaling Large Data

Our expert data analysts translate data into actionable information. We leverage sophisticated analytical and computational methods to help you identify meaningful and relevant patterns, determine which programs and policies are most effective, and make informed and timely decisions. Our integrated services include statistical and semantic methods of analysis, modeling and simulation, and high-performance computing capabilities for effective data acquisition, analysis and integration.

## Our Work

- **Transit Safety Retrofit Package (TRP):** The successful demonstration of buses retrofitted with a suite of vehicle-to-vehicle safety applications and Battelle-developed transit-specific safety applications as part of the Safety Pilot Model Deployment in Ann Arbor, Michigan.

- **Integrated Dynamic Transit Operations (IDTO):**

Implemented and deployed a Connect and Ride system in Central Ohio, and then Central Florida, which demonstrated the integration of multiple transportation modes and service offerings to support local commutes – including traditional transit offerings, as well as rideshare and dynamic demand response providers.

- **Intelligent Network Flow Optimization (INFLO):**

A Battelle-led prototype project implemented mobile devices supporting DSRC and cellular connections to enable communication of speed harmonization and queue warning information between vehicles and traffic management centers. Demonstrated in controlled environments in Columbus, Ohio, and Seattle, Washington.

- **R.E.S.C.U.M.E.:** Program named for response, emergency staging, communications, uniform management and evacuation piloted in Columbus, Ohio, and Sykesville, Maryland, utilized a dynamic mobility application bundle to demonstrate support for first responders by making incident scene information readily available.

- **Signal Phase and Timing and the Integrated V2I**

**Prototype:** Projects focused on designing and testing the enabling technologies necessary to communicate signal phase and timing information from traffic signal controllers to vehicles in a connected vehicle environment.

- **NYC Connected Vehicle Pilot Deployment Project:**

In 2016, Battelle was a sub-consultant supporting the NYC Connected Vehicle Pilot Deployment Project. Battelle led the safety management and human use approval plan development, and had a major support role in developing the pilots concept of operations, system requirements, application deployment and comprehensive deployment plans.



A young child with curly brown hair is sitting inside a train, looking out the window. The child is wearing a grey hoodie and holding a small yellow and black toy train engine in their hands. The train is moving, as evidenced by the blurred tracks and buildings outside the window. A blue banner with white text is overlaid on the image.

# RAIL & TRANSIT SAFETY

We're helping freight/passenger railroads and metropolitan transit systems reduce the risk of train-to-train collisions, vehicle collisions, derailments, rail/highway crossing accidents and rear-end collisions through a comprehensive suite of safety assessment services.

Our services are built upon a foundation of 40 years of involvement in the rail and transit industry and backed by a large staff of technical experts in the fields of engineering, statistics, economics, human factors and material science. We bring thorough knowledge of globally developed safety-critical train control signaling products and systems and the safety design methodologies upon which they are based. In fact, we've been directly involved in the creation of many of these standards (e.g., IEEE 1483).

We can provide objective, independent assessment to help you reduce your risks, protect your freight and passengers and comply with new government regulations.

### Communication Based Train Control

To enhance safety and improve operational efficiencies, many transit agencies are employing moving block technology. This next-generation train control or Communication Based Train Control (CBTC) is being deployed on the world's largest transit systems and Battelle is there ensuring the safety and interoperability of these systems supplied by multiple vendors.

### Positive Train Control

To comply with RSIA, every Class I railroad has to submit a plan for Positive Train Control (PTC) implementation to the Federal Railroad Administration (FRA). Battelle has been involved with the earliest demonstration projects and technologies, which have been the genesis of PTC as well as the current generation of technology. Battelle has assisted the majority of Class I railroads, Class II railroads and Shortlines comply with these federal standards.

## Our Work

### Independent Safety Assessment

- Independent review team for safety processes and products, in partnership with rail/transit authorities or other government agencies.

### Safety Program Management & Training

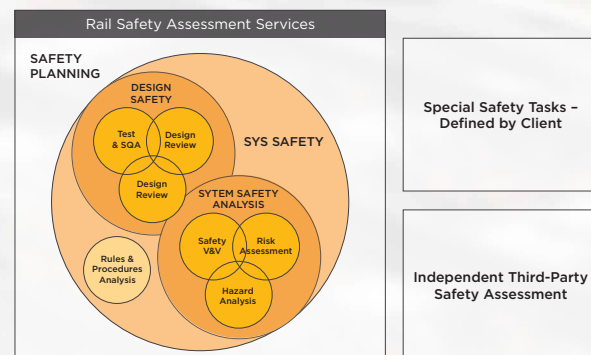
- Development of safety programs for existing systems and in advance of new system deployment.
- High-impact training programs tailored to your teams.

### Quantified and Qualified Assessment of System Safety – Hazard and Risk

- Hazard and probabilistic risk assessments, fault tree analyses (FTAs), failure modes and effects analyses (FMEAs), etc. at the product or system level.
- Accident impact analysis (including consequential damages) using the Battelle Risk Assessment and Comparative Evaluation (BRACE™) toolset.
- Standards compliance, verification and validation (V&V).

### Application and Technology

- Design recommendations, review of technologies being applied, evaluation of application environment and auditing of adherence to industry standards from a safety perspective.







# SURFACE TRANSPORTATION SECURITY



Security for public venues is problematic. You need to provide open access to your patrons while providing a strong deterrent to those intent on doing harm. You also need a system that is aesthetically pleasing while being visible.

Our security solutions are designed help you achieve these diverse goals.

We offer a comprehensive set of security solutions that provides the ultimate in perimeter security, designed to meet your security and budgetary needs. Our solutions are:

- Scalable
- Cost Effective
- Minimum to Maximum Security
- Integration Solution Set
- Interoperable
- Single Site to Enterprise Solutions

### Access Control

Effective access control solutions keep unauthorized individuals and delinquent tenants out, enabling your customers to flow in and out of protected areas with ease and a sense of security.

### Video & Analytics

We offer high-quality, high-resolution security cameras, NVRs, monitors and camera control devices that provide you with crisp, clear images, making monitoring easy.

### Intrusion Detection (Volumetric Sensors)

We offer volumetric sensors; passive infrared sensors, ground vibration and video analytics provide a comprehensive solution set. Receive either absolute or conditional alarms based upon your specific requirements.

### Bollards

Fixed-post security bollards provide solid, uncompromising protection against vehicle incursion. Embedded bollards come in carbon steel, stainless steel and aluminum materials.

### Physical Barriers

Whether you want chain link, welded wire, expanded metal or an ornamental system, we can provide anti-climb, anti-cut features without compromising the aesthetics of the site.

### Turnstiles

Available in stainless steel, galvanized and color powder coat finishes for many years of reliable service. Card reader mounting plates are also available.

### Virtual Presence

Get instant notifications based on the rules you select (motion, no-motion, object removal, object left behind, directional motion, trip lines or combination) so you can deploy resources as needed.

### Fence Sensors (Planar Sensors)

Choose from planar sensors; active infrared sensors, fence sensors and video analytics provide a comprehensive solution set. Receive either absolute or conditional alarms based upon your specific requirements.



NEED A ROADMAP  
TO THE FUTURE?



No matter what you're trying to achieve, Battelle can help. We provide expert consultation, research, design, engineering, deployment and testing and operations support at every stage of your project, from initial planning to roll out and implementation.



## Specialized Services

### Cybersecurity

We have extensive automotive cybersecurity experience spanning penetration testing of embedded systems, wireless networking and communication vulnerability assessments, cellular network infrastructure, secure use and operation of cloud computing resources, mobile device security, analytics and testing and including Battelle's innovative NEM™ technology for detection and mitigation of anomalies. Our expert team is ready for any challenge.

### Human Factors Research

All of our services are informed by a deep understanding of how human factors influence the safety and usability of transportation systems. We can help you assess the safety of existing systems from a human factors perspective and design products and systems that reduce the risk of "cognitive overload" in operators and maintainers.

Our cross-disciplinary Human Centric Design (HCD) teams combine experimental psychology, human factors, cognitive science, industrial engineering, software development, physiology and statistics to address issues related to human performance and safety at both system and individual levels.

### Transportation Policy and Planning

Our transportation policy team brings together cross-disciplinary expertise to provide objective, informed analysis of potential policy issues and solutions. We apply modeling and simulation exercises, statistical analysis and fundamental research to bring new insights to the challenges facing the industry today. Our methods allow us to provide a broad perspective that facilitates innovative thinking and solutions that meet the needs of all stakeholders.

# What can we solve for you today?

[solutions@battelle.org](mailto:solutions@battelle.org) | [www.battelle.org/transportation](http://www.battelle.org/transportation)

## Who is Battelle?

We are the world's largest independent research and development organization, operating at the forefront of scientific discovery. We apply cutting-edge research and engineering methods to some of today's most complex transportation challenges.

- **Infrastructure Experience:** We have been driving innovation in transportation for nearly 50 years, with deep expertise in surface transportation, freight rail, mass transit, maritime, aviation, pipelines and commercial and military vehicles of all types.
- **Interdisciplinary Expertise:** We bring together leading experts in system engineering, cybersecurity, electronics, computer science, advanced analytics and other related disciplines for a multidisciplinary approach to difficult systems challenges.
- **Deep Insight:** Our technology solutions are grounded in a solid understanding of the public policy, economic and human factors implications of different approaches to transportation system design. We offer more than just technology expertise—we can help you find the best answer for the problems you are facing today.

### About Battelle

Every day, the people of Battelle apply science and technology to solving what matters most. At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Headquartered in Columbus, Ohio since its founding in 1929, Battelle serves the national security, health and life sciences, and energy and environmental industries. For more information, visit [www.battelle.org](http://www.battelle.org).

800.201.2011 | [solutions@battelle.org](mailto:solutions@battelle.org) | [www.battelle.org](http://www.battelle.org)

**BATTELLE**  
It can be done

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ID 554 01/17