U.S. Department of Transportation
Intelligent Transportation Systems
Joint Program Office

Highlighted ITS Benefits

- Variable Speed Limits
- Adaptive Signal Control
- Ramp Metering
- Transit Signal Priority
- Smart Work Zones
- Bus Rapid Transit
- Truck Platooning
- Electric Vehicle Stations
- Electric Bus Fleets
- Integrated Corridor Management

Since its formation in 1994, the US Department of Transportation (USDOT) Intelligent Transportation Systems (ITS) Joint Program Office (JPO) has worked to spur the intermodal development of ITS to enhance the movement of people and goods.

This document provides an overview of featured benefits of select ITS technologies. Benefits measure the effects of ITS on transportation operations according to the USDOT's six goals: safety, mobility, efficiency, productivity, energy and environmental impacts, and customer satisfaction. Benefits featured here are sourced from the ITS-JPO's ITS Deployment Evaluation Benefits, Costs, and Lessons Learned Databases.

Featured technologies include traffic and signal management, smart work zone safety, electric vehicle infrastructure and more. Many of these ITS solutions have crosscutting benefits that can improve transportation efficiency, mobility, safety and reduce environmental impacts. Adoption of these technologies can help lead to a transportation system that is safer, smarter, and more connected.

These benefits were selected to highlight relevant and applicable outcomes of the various technologies featured within. Scroll through this document to discover and learn more about some of the ITS technologies that the ITS JPO tracks and the benefits they provide.

Variable Speed Limits

13 to 60 percent reduction in extreme speeding through work zones.

Source: Transportation Research Board (2018)

7:1 to 14:1 safety impact benefit-to-cost ratios.

Source: Texas A&M Transportation Institute (2015)

Over 50 percent reduction in collisions in low visibility conditions.

Source: Virginia DOT (2018)

Variable speed limits (VSL) are signs that can dynamically display different speed limits depending on different factors like traffic, time of day, or weather conditions. They are primarily used for three purposes: reducing congestion, reducing speeds during inclement weather, and managing speeds during traffic events. (FHWA-OPS)

VSL Use Cases

With VSL, agencies can address a variety of conditions such as traffic volume, operating speeds, weather information, sight distance, and roadway surface conditions when posting speed limits. They can improve safety by decreasing risks associated with traffic moving at speeds higher than appropriate for challenging driving conditions. (FHWA-OPS)

VSL Outcomes

VSL can dynamically manage speeds during planned (rush hour congestion) and unplanned (incidents) circumstances. They can help eliminate or delay bottlenecks and mitigate the possibility of rear-end, sideswipe, and other collisions generally associated with slowed traffic on high-speed roadways. (FHWA-OPS)

Source: USDOT

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Adaptive Signal Control

For weekdays, ASCT in Phoenix, AZ saved **$9,500 to $25,900 in operations costs** and **20 to 51 percent savings in travel time.**

Source: NOCoE (2020)

ASCT at Maine's busiest intersection was estimated to **reduce intersection delays by 20 percent.**

Source: NOCoE (2019)

Adaptive signal control technologies (ASCT) help manage throughput and improve average travel time, control delay, emissions, and fuel consumption. ASCT is particularly effective on arterials with variable traffic demand.

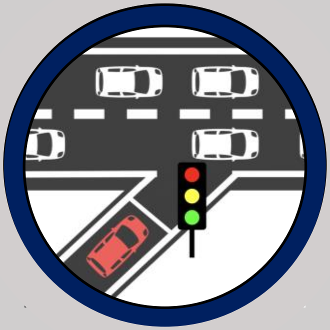
Types of ASCT

Adaptive Control Software Lite (ACSLite) is just one example of ASCT which was developed through a public-private partnership with the FHWA. With this type of technology, traffic sensors collect and evaluate data to implement signal timing updates every few minutes. Traditional signal retiming technology may update every 3-5 years via manually collected traffic data (FHWA, EDC-1), so the adaptive system can be a massive improvement, as shown in the benefits highlighted on the left.

ASCT Facts (FHWA, EDC-1)

- In the United States, ASCT are used on less than 1% of all signalized intersections.
- Barriers can include cost, complexity, uncertainty about benefits, and overhead associated with traffic detection and communications between traffic signal system components.
- Some systems provide an entire system solution evaluated on a second-by-second basis; other systems evaluate and optimize each individual signal on a cyclic basis.

Ramp Metering



On a freeway in Minnesota, **vehicle delays were reduced** by an average of **48 percent.**

Source: MnDOT (2015)

In Florida, a system using ramp metering **reduced odds of crashes by 6 percent.**

Source: Transportation Research Board (2017)

Ramp meters are traffic signals installed on freeway on-ramps that regulate the frequency at which vehicles enter the flow of traffic. They reduce overall congestion by managing the amount of traffic entering the freeway and by breaking up platoons that make it difficult to merge onto the freeway. (FHWA-OPS)

Ramp Metering Goals

Ramp metering implementation is flexible, so implementation strategies should be aligned to regional transportation objectives. Objectives might include decreasing freeway crashes or increasing average speeds. (FHWA-OPS)

Ramp Metering Facts

(FHWA-OPS)

- By smoothing out flow of traffic, ramp metering also has environmental benefits in the form of fuel savings.
- Some agencies have installed bypass lanes for high-occupancy vehicles to skip the queue.

Source: USDOT

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Transit Signal Priority

A TSP system in Utah **reduced late arrivals by 40 percent**

Sources: USDOT-FHWA (2018)

A TSP project in San Antonio **reduced travel times by 15 to 20 percent.**

Source: Metro Magazine (2013)

Active Transit Signal Priority (TSP) tools use communication technologies to prioritize transit vehicles at traffic signals by modifying signal timing or phasing. TSP can be deployed in different configurations; for instance, TSP might be applied to all transit vehicles or to only those behind schedule. (NACTO)

TSP Implementation Considerations (NACTO)

- TSP can be especially effective on corridor streets with long signal cycles.
- Intersections that favor the cross street to transit routes can provide outsized benefits.
- Active TSP requires coordination between agencies responsible for traffic signals and transit vehicle operation. Operational coordination may be accomplished by long-term agreements, which also can extend to purchase, installation, and maintenance of technology units.

Source: iStock

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Work Zone ITS

In Texas, **queue warning systems reduced crashes by 44 percent.**

Source: Transportation Research Board (2016)

Truck-mounted radar speed signs in work zones **reduced traffic speeds between 1 and 15 percent.**

Source: Oregon DOT (2016)

With **drone remote sensing**, bridge inspections can be done in **25 percent of the time** at **5 percent of the cost.**

Source: AASHTO (2016)

Freeway construction work zones, although necessary for maintaining the transportation system, give rise to many safety and efficiency issues. From the motorist perspective, bottlenecks formed by work zones decrease efficiency and increase delays. From the worker perspective, work zones pose a risk to safety and can even result in fatalities. In 2019, an estimated 38,900 injuries and 115,000 crashes occurred due to work zones. (Workzonesafety.org)

Work zone ITS systems encompass a range of technologies that aim to inform motorists of work zones and alternate routes, reduce freeway congestion, and enhance safety of workers and motorists. (FHWA-OPS)

Work Zone ITS Technology Examples

- Queue warning systems (QWS) are installed ahead of work zones to provide warning to approaching drivers of stopped or slowed traffic conditions due to the work zone. (MnDOT)
- Automated Speed Enforcement (ASE) systems that capture license plate numbers for vehicles exceeding the speed limit to enhance enforcement of work zone speed limits. (FHWA-OPS)
- Drone remote sensing accomplishes advanced surveying using airborne sensors to collect environmental and structural data. Workers can use aerial drones to survey work zones more quickly and safely than in the past. (AASHTO)

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Bus Rapid Transit

BRT implementations are shown to **increase bus speeds** in major urban areas by **20 to 23 percent.**

Source: USDOT-FTA (2012)

BRT implementations in two corridors in LA increased **peak period ridership by 41 to 52 percent.**

Source: USDOT-FHWA & FTA (2015)

Bus Rapid Transit (BRT) refers to type of high-capacity mass transit system that utilizes a mix of infrastructure improvements, policies, and technologies to greatly improve the performance of buses. BRT transit systems can achieve performance on par with light rail transit in many cases. (USDOT)

ITS play plays a key role in BRT systems. ITS can facilitate off-board or mobile fare collection, improve signal phase and timing for buses, and offer travelers information about bus arrival times.

Elements of BRT Systems (USDOT)

- Dedicated bus lanes that help buses avoid traffic, decreasing travel times and avoiding congestion.
- Improved fare collection that reduces or eliminates the delays in service caused by passengers taking time to pay bus fares.
- Transit signal priority, advanced communication systems, and real-time traveler info for more convenient trips.
- Higher quality vehicles that are larger more comfortable, and provide all-door boarding
- Enhanced bus stations that are aesthetically-designed and provide passenger amenities like next vehicle arrival info.
- Easy boarding that is accessible and minimizes delay for wheelchairs, disabled passengers, strollers, and carts.

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Truck Platooning

Truck platooning can result in up to **6 to 7 percent fuel savings on the second truck and 9 to 11 percent savings on the third truck**, with no loss in fuel efficiency for first truck.

Source: Caltrans (2018)

Truck platooning uses technology, including Vehicle-to-Vehicle (V2V) wireless communication, to have trucks follow each other safely and more closely than in typical driving in order to reduce air resistance and create fuel savings. The first vehicle in the truck platoon acts as the leader, with following vehicles adapting based on the leader's patterns. For instance, any initiation of braking by the lead truck can be instantaneously copied by following trucks. (ITS-JPO)

USDOT is researching truck platooning to ensure that it is mature enough for widespread adoption. There have been a number of pilot deployments with promising results. (ITS-JPO)

Path to Widespread Deployment (EAMA)

- Further development of technology and standards.
- Upgraded infrastructure to support platooning.
- A supportive regulatory framework.
- More experience with platooning in real-time traffic situations.
- Cooperation between relevant stakeholders.
- Public buy-in.

Source: USDOT

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EV Charging Stations

Public infrastructure that enables fast charging can **save a driver $1,500 to $6,500** over the average lifetime of vehicle ownership.

Source: Transportation Research Part D (2020)

Intelligent vehicle charging infrastructure has potential for as much as **$420 annual savings per electric vehicle**.

Source: USDOE (2013)

Both consumer motorists and transit fleet drivers of plug-in electric vehicles (EVs) require access to charging stations. Although users typically have charging installations at home or at fleet facilities, charging stations elsewhere such as public spaces and workplaces can help bolster adoption of EVs.

Charging Station Types

Charging station equipment is ranked by how quickly batteries are charged. There are three main types (ranked from slowest to quickest charge): Level 1, Level 2, and DC Fast Charging. (US DOE)

The EV Charging Market

Consumers consistently cite lack of access to efficient charging stations as a barrier to purchasing an EV. In the United States, total charging energy demand could rise by 1,300 percent from 2020 to 2030. (McKinsey)

Within the US, the industry could require over 20 million chargers and $10 billion in investment by 2030 to meet demand. Although most chargers will be in homes or in workplaces, approximately 30 percent of capital costs will come from publicly available charging stations. (McKinsey)

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Electric Bus Fleets

A transit agency's estimated life-cycle **costs** for battery electric buses can be up to **23 percent lower than diesel**.

Source: Transportation Research Part D (2017)

Fleet electrification could save **$72 billion in healthcare costs**, research on avoided emissions and health impact shows.

Source: American Lung Association (2020)

Battery-electric buses piloted in Seattle **reduced maintenance costs per mile by 44.1 percent** compared to diesel.

Source: National Renewable Energy Lab (2018)

Battery electric buses offer zero-emissions, quiet operation, and reduced ongoing operational costs compared to their combustion engine counterparts. Because of these factors, transit agencies are adopting electric bus fleets to replace traditional combustion engine buses.

Electric Bus Adoption

In the United States as of 2017, electric buses only accounted for 0.5 percent of total public transit buses. At that same time, 9 percent of agencies reported that they were using electric buses as part of their fleets. (Sustainable-Bus)

However, electric bus adoption is moving fast and only expected to accelerate. Cities like New York, Los Angeles, Seattle, and Houston have set aggressive zero-emission bus fleet goals that will push the technology forward, with other municipalities following suit. The FTA's Low- or No-Emission Vehicle Program provides competitive grants for bus and bus facility projects that support low and zero-emission vehicles. (FTA)

Lithium-ion batteries are most commonly used in electric buses. These batteries have fallen in cost by over 80 percent since 2010 and are expected to drop another 50 percent by 2025. This trend points to accelerated agency adoption in the near future. (EESI)

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Integrated Corridor Management

Analysis, modeling, and simulation showed that in San Diego, ICM **can save commuters more than 1,400 person hours per day** during peak commute periods.

Source: USDOT (2016)

Transportation corridors often contain underutilized capacity due to parallel roadways, single-occupant vehicles, and transit services that could be better leveraged to improve person throughput and reduce congestion. However, facilities and services along a corridor are often independently operated which limits their full utilization. (ITS-JPO)

Integrated Corridor Management (ICM) seeks to realize major improvements in the movement of people and goods with institutional collaboration and aggressive, proactive integration of existing infrastructure along major corridors. (ITS-JPO)

Bringing it together: ICM Elements (SANDAG)

ICM can include many elements in working towards the goal of an integrated traffic management system, including:

- ITS solutions for freeway, transit, and arterials to measure and manage corridor performance.
- Ramp metering that includes holistic analysis of freeway throughput and integration with traffic signals.
- Robust data collection for transit, highways, and arterials for enhanced traveler info systems and incident response.
- Advanced integrated Decision Support Systems (DSS) capable of near real-time traffic forecasting and making recommendations to minimize corridor congestion.
- Proactive agreements between agencies for multimodal operational strategies that improve overall corridor performance instead of narrower goals.

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Thank you for exploring these highlighted ITS benefits. To find more benefits and ITS technologies, visit the ITS-JPO's ITS Deployment Evaluation Benefits, Costs, and Lessons Learned Databases.

If you have any comments, concerns, feedback, or questions please contact Marcia Pincus, ITS Deployment Evaluation Program Manager.

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Source: iStock