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INTERSECTION SAFETY CHALLENGE

FROM CONCEPTUALIZATION TO INITIAL TESTING

U.S. Department of Transportation

JULY 27, 2023



WEBINAR PROTOCOL

- Please mute your audio (phone or laptop audio) during the entire webinar.
- You are welcome to ask questions via the Question and Answer (Q&A) Chat Pod during the Q&A Section.
- The webinar recording and the presentation material will be posted on the Intelligent Transportation Systems (ITS) Joint Program Office (JPO) Intersection Safety Challenge website: <https://its.dot.gov/isc/>.





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PURPOSE OF TODAY'S WEBINAR

- Provide an overview of the Intersection Safety Challenge Program, including the Prize Competition stages.
- Share DOT's vision of leveraging the Prize Competition to support potential intersection safety system prototypes and field tests.
- Preview Stage 1B: System Assessment and Virtual Testing.
- Provide answers to Frequently Asked Questions (FAQs).





AGENDA

- Welcome and Introduction
 - **Egan Smith**, Acting Director, Intelligent Transportation Systems (ITS) Joint Program Office (JPO)
- Intersection Safety Challenge Program Overview
 - **Kate Hartman**, Chief of Research & Evaluation, ITS JPO
- Conceptualization to Testing
 - **Chris Atkinson**, Deputy Director of Technology, Advanced Research Projects Agency – Infrastructure (ARPA-I), U.S. Department of Transportation (DOT)
- Frequently Asked Questions (FAQs)
 - **Alissa Dolan**, Attorney Advisor, Office of Chief Counsel Legislation, Regulations, and General Law Division, Federal Highway Administration (FHWA)
- Q&A
 - **Govind Vadakpat**, Program Manager, Smart Infrastructure, ITS JPO



INTRODUCTION

Egan Smith, Acting Director, ITS JPO

INTERSECTION SAFETY IS A GROWING ISSUE, ESPECIALLY FOR VULNERABLE ROAD USERS



Intersection Crashes

Each year, roughly one-quarter of traffic fatalities and about one-half of all traffic injuries in the United States are attributed to crashes at intersections.¹

¹ <https://highways.dot.gov/safety/intersection-safety/about>



Rising Vulnerable Road User Deaths

Vulnerable road user fatalities are on the rise, with pedestrian fatalities up 13% and pedalcyclist fatalities up 2% in 2021 compared to 2020.²

² <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813435>



THE INTERSECTION SAFETY CHALLENGE PROGRAM



- The program aligns with the [National Roadway Safety Strategy \(NRSS\)](#) and supplements current and existing U.S. DOT safety and equity efforts (e.g., FHWA Complete Streets, Proven Safety Countermeasures).
- A technology-based approach is one of many potentially cost-effective approaches for improving safety at intersections.
- The innovations sought in the Challenge operating in a real-time context are intended to augment (but not substitute for) a comprehensive suite of intersection safety considerations.



INTERSECTION SAFETY CHALLENGE PROGRAM OVERVIEW

Kate Hartman, Chief of Research & Evaluation, ITS JPO



INTERSECTION SAFETY CHALLENGE PROGRAM

- **VISION:** Transform intersection safety through the innovative application of emerging technologies including machine vision, sensor fusion, and real-time decision-making to identify and mitigate unsafe conditions involving vehicles and vulnerable road users.

- **PROGRAM STRUCTURE:**

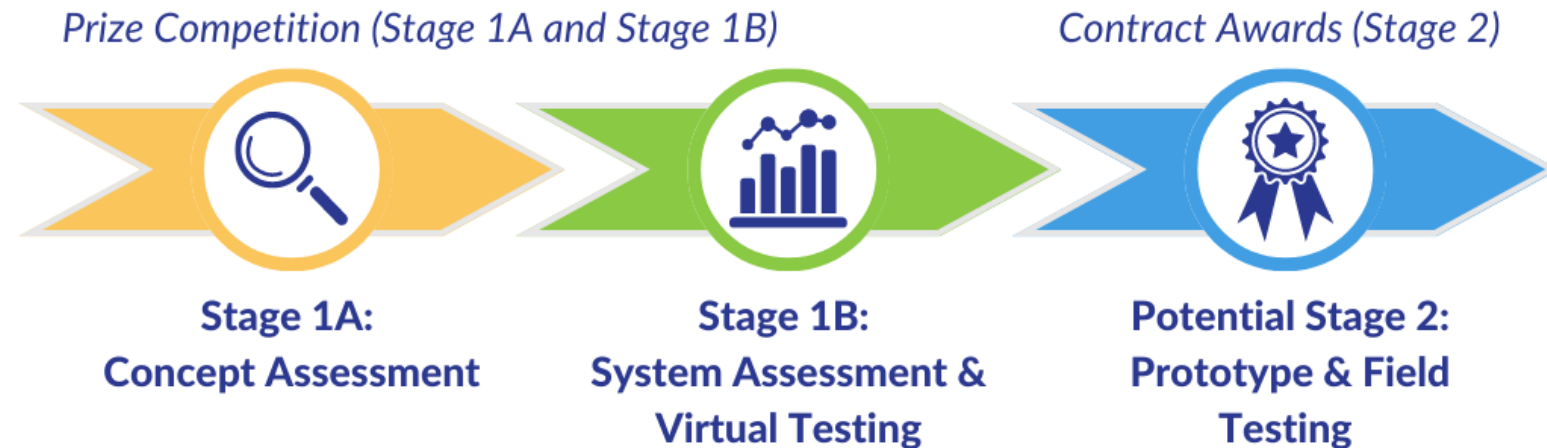


Image Source: U.S. DOT

- **PRIZE COMPETITION:** Encourage teams of innovators and end-users to develop and virtually test their intersection safety systems to compete for prizes.



PRIZE COMPETITION OVERVIEW

- **Stage 1A: Concept Assessment**
 - Develop an ISS Concept Paper.
 - Up to ten prizes may be awarded (up to \$100,000 each).
 - The total value of all Stage 1A prizes will be a maximum of \$1,000,000.
 - Winners may advance to Stage 1B.
- **Stage 1B: System Assessment and Virtual Testing**
 - Develop, train, and improve algorithms for the detection, localization, and classification of vulnerable road users and vehicles using DOT-supplied sensor data collected at a controlled test intersection.
 - The total value of all Stage 1B prizes will be a maximum of \$5,000,000.
 - *Additional details to come following Stage 1A awards.*




STAGE 1A: CONCEPT ASSESSMENT IS ACCEPTING CONCEPT PAPER SUBMISSIONS



<https://www.challenge.gov/?challenge=us-dot-intersection-safety-challenge>

An official website of the United States government [Here's how you know](#)


CHALLENGE.GOV Find a Challenge Resources Events Contact



U.S. DOT Intersection Safety Challenge

Transforming intersection safety through emerging technologies for all road users

Transforming intersection safety through the development of innovative intersection safety systems that identify, predict, and mitigate unsafe conditions involving vehicles and vulnerable road users.



INTERSECTION SAFETY CHALLENGE

Submission period: Open until 09/25/23 05:00 PM EDT

Challenge types: Technology demonstration and hardware; Analytics, visualizations, algorithms; Ideas

Total cash prizes: \$6,000,000



POTENTIAL STAGE 2: PROTOTYPE, FIELD TEST AND DEMONSTRATION (After Stage 1 Prize Competition)



- Potential Broad Agency Announcement (BAA) Solicitation – To develop, test, and demonstrate one or more prototype intersection safety systems (ISS) in a real-world environment.
 - **Prototype Test**
 - Prototype systems assessed at a controlled environment (e.g., U.S. DOT facility).
 - Limited, closed-course testing based on simple use cases at intersections.
 - **Field Test and Demonstration**
 - Develop, test, and demonstrate Minimum Viable Product (MVP) capability.
 - Conduct more complex field testing at site-identified test bed(s).
 - Prepare MVP for real-world demo leading to commercialization and deployment.



CHECK OUT THESE RESOURCES TO LEARN MORE



- **Intersection Safety Challenge Website**

- <https://its.dot.gov/isc/>

- **Enhancing the Safety of Vulnerable Road Users at Intersections:**

- **Request for Information (RFI)** (released September 16, 2022): [Link on the Federal Register](#).
- **RFI Summary Report** (February 2023): [FHWA-JPO-23-986](#).
- **Webinar** (March 17, 2023): [presentation material](#) and [recording](#).

- **Intersection Safety Challenge Prize Competition**

- **Webinar** (May 22, 2023): [presentation material](#) and [recording](#).



CONCEPTUALIZATION TO TESTING

Chris Atkinson, Deputy Director of Technology, ARPA-I,
U.S. DOT

PROPOSED SOLUTION: LEVERAGE EMERGING TECHNOLOGIES TO IMPROVE INTERSECTION SAFETY AT SCALE IN A NEW WAY.



Data Fusion Utilizing Existing and Emerging Sensors

Emerging, low-cost sensors can be deployed at intersections for **improved sensing of vulnerable road users**. Data from these sensors can be fused and used in new ways by AI.



Artificial Intelligence /Machine Learning

AI/ML can fuse data from multiple machine vision sensing modalities rapidly to **improve situational awareness** and **anticipate potential conflicts**.



Low-Cost, High-Value Opportunity for Integration at Scale

These existing technologies have not been deployed together at intersections broadly, offering an opportunity ripe for **innovative collaboration**.





INTERSECTION SAFETY SYSTEM (ISS) CONCEPT

- Emerging, low-cost sensors (e.g., cameras, radar, LiDAR, infrared) deployed at intersections to improve sensing.
- Multi-sensor data fusion/analytics to improve situational awareness and anticipate safety threats.
- System issues warnings or modifies control settings to improve safety.



Concept Illustration: Intersection Safety System

Safety systems informed by data fused from multiple sensors may anticipate unsafe conditions, e.g., a vehicle turning right in potential conflict with pedestrian pushing a stroller.

Image Source: U.S. DOT.





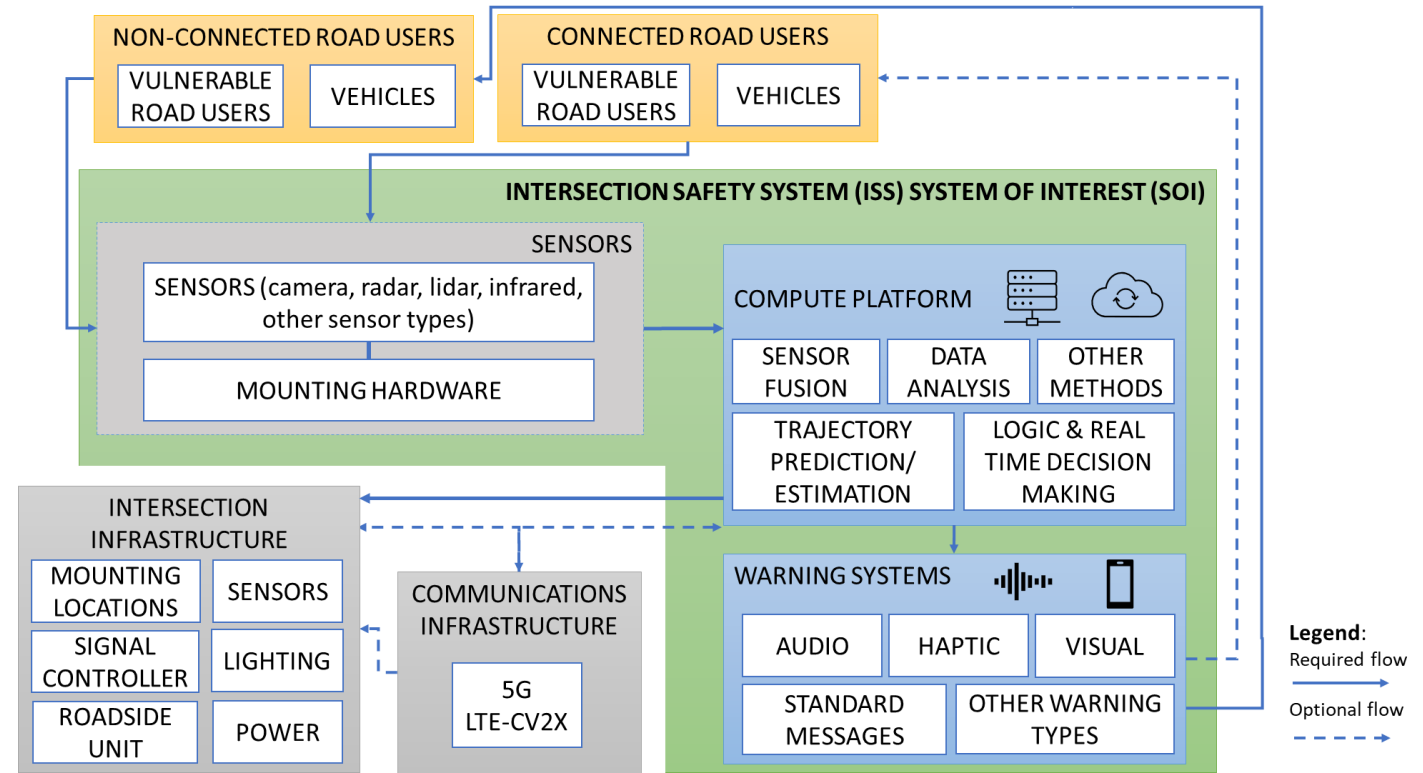
THE ISS SCOPE

■ ISS Costs

- As an overarching goal, the Challenge seeks ISS solutions that utilize core componentry costing in the order of \$10,000 (or less) per intersection at scale within 10 years following the end of the competition.

■ ISS Deployment Scope

- The Challenge seeks one or more interoperable ISS solutions that can collectively address a large proportion of our nation's intersections and make a significant improvement in overall road safety.



* CV2X: Cellular Vehicle-to-Everything

Image Source: U.S. DOT.





HOW DOES IT WORK?

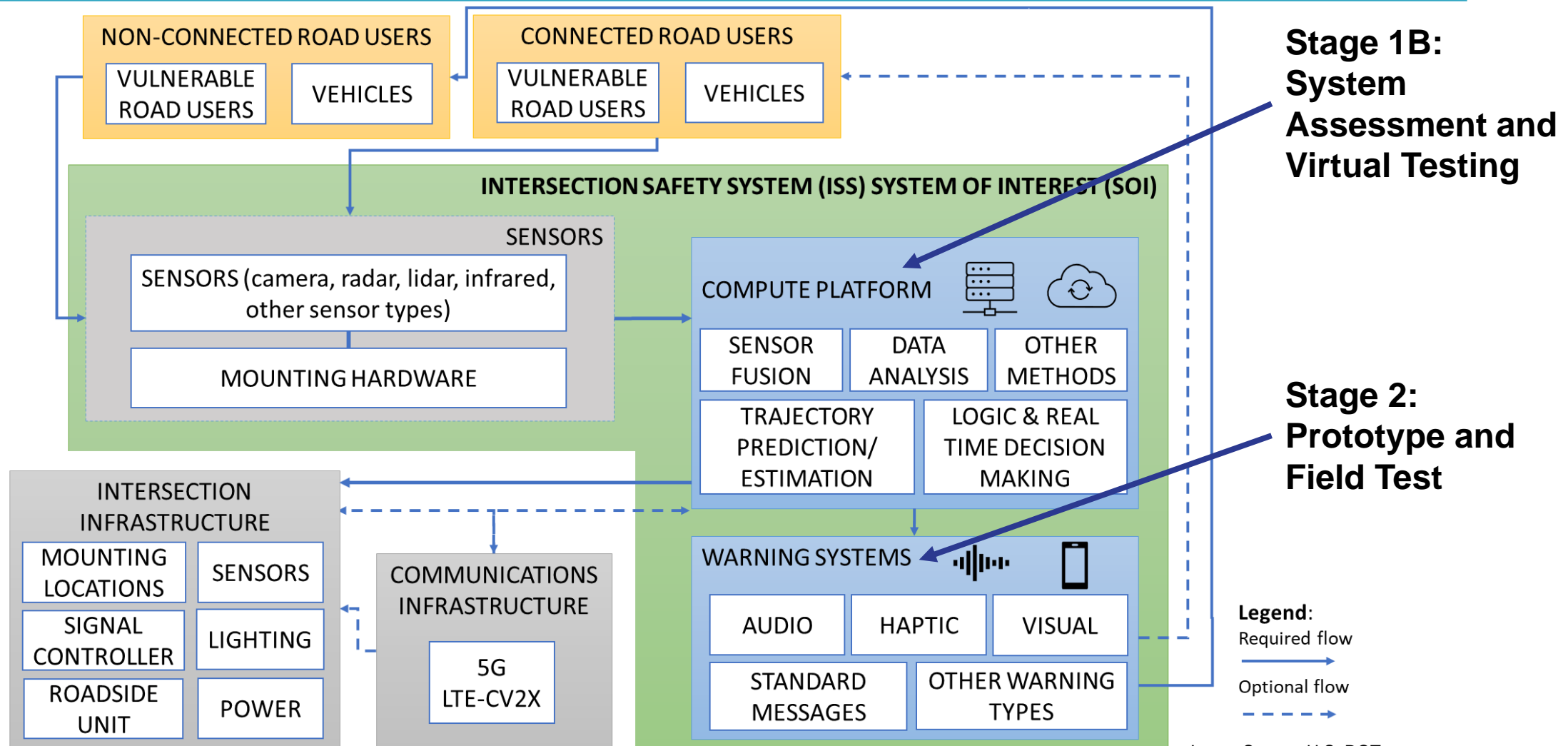


Image Source: U.S. DOT.



STAGE 1B: SYSTEM ASSESSMENT AND VIRTUAL TESTING - SCOPE



- **Sensor Fusion:**

- Integrates and analyzes sensor data in real-time on a computing platform that hosts the required software elements and machine learning algorithms.

- **Data Analysis:**

- Ingests and analyzes sensor data to differentiate, classify, and localize individual vehicles and vulnerable road users in real-time.

- **Trajectory Prediction and Estimation:**

- Predicts the real-time movements and future trajectories of individual vehicles and vulnerable road users within and in the immediate vicinity of the intersection (e.g., on adjacent sidewalks) and transit right of way.

Note: Stage 1B participants will use U.S. DOT-supplied sensor data collected at a controlled test intersection.



STAGE 1B: SYSTEM ASSESSMENT AND VIRTUAL TESTING – ELIGIBILITY & PRIZES



■ Who Can Participate:

- At a minimum, winners from Stage 1A will be eligible to participate in Stage 1B of the Challenge.
- Depending on the results achieved during Stage 1A, DOT may choose to broaden Stage 1B eligibility.

■ Stage 1B Prizes:

- Multiple prizes may be awarded in Stage 1B, with a maximum of one prize awarded per participant or team.
- Each Stage 1B prize will have a maximum value of up to **\$1,000,000**.
- The total value of all Stage 1B prizes will be a maximum of **\$5,000,000**.



STAGE 1B: SYSTEM ASSESSMENT AND VIRTUAL TESTING - COMPETITION PROCESS



■ **Sensor Data**

- Government will collect sensor data for Stage 1B participants (e.g., CCTV camera, LiDAR, thermal camera).
- Participants will be provided with both training data and test data.

■ **Team Performance Results**

- Participants are expected to predict future potential conflicts.
- Results submitted by participants will be updated regularly.

■ **Evaluation and Validation**

- Participants to submit both code and results for evaluation and validation.



POTENTIAL STAGE 2: PROTOTYPE AND FIELD TEST - SCOPE



- **Sensor Fusion + Data Analysis + Trajectory Estimation and Prediction** from Stage 1B
- **Logic and Real-time Decision Making:**
 - Issue coordinated messages to adapt or modify intersection control configurations in real-time in advance of potentially unsafe conditions and/or generate warnings regarding potential imminent collisions.
- **Warning Systems:**
 - Issue warnings to drivers and vulnerable road users with no wireless connectivity.
 - Warnings may also be issued to wirelessly connected vehicles and vulnerable road users as well.
 - Ensure that drivers and vulnerable road users can be alerted in an effective and timely way to prevent or mitigate unsafe conditions.



TO PREPARE FOR PROTOTYPE DEVELOPMENT AND TESTING



■ ISS Technologies

- Consider a range of relevant technologies, assess the potential for re-purposing both existing and emerging technologies to create an ISS concept aligned with the ultimate goal of at-scale deployment within, at most, 10 years.
- Using commercially available sensors and associated mass-produced componentry may result in lower system costs when deployed at scale.

■ Safety & Security

- Avoid degrading the underlying existing safety of any intersection at which it is deployed.
- Support further safety and operations analysis at the central traffic management system.
- Data storage needs to handle anonymization, privacy, and cybersecurity threats.

■ Team Formation

- Encourage formation of nontraditional teams with expertise in emerging tech and transportation.
- Consider a range of additional factors related to ISS suitability.





INTERSECTION SAFETY CHALLENGE

Don't miss out on your chance to transform intersection safety! The Intersection Safety Challenge begins with an innovative \$6 million prize competition open to individuals and teams from the academic, research, and business communities, as well as state and local agencies.

The deadline to enter the Challenge is September 25, 2023.



U.S. Department of Transportation



For more information, please visit: <https://its.dot.gov/isc/>

FREQUENTLY ASKED QUESTIONS (FAQS)

**Alissa Dolan, Attorney Advisor, Office of Chief Counsel
Legislation, Regulations, and General Law Division, FHWA**



OVERVIEW

- **The FAQs Page:**

- [The FAQ page on Challenge.gov](#) will be continually updated as additional questions are received. Please continue to monitor this page throughout the competition period.
- Additional questions can be sent to safeintersections@dot.gov or through the [“Contact” tab](#).

- **Note:**

- "Sections" refer to the “U.S. DOT Intersection Safety Challenge: Stage 1A (Concept Paper) Prize Competition Description for Participants” document, which is available in the [“Resources” tab](#).
- Participants are strongly encouraged to consult that document and the FAQs before submitting a Concept Paper.





FAQS – ELIGIBILITY (1 OF 2)

Who is eligible to participate in the Intersection Safety Challenge?

- **All** participants that are named in a submission (individuals, students, private sector entities, public agencies or organizations, and teams made up of a combination of these) – must meet the Challenge eligibility requirements in Section VI to be eligible to receive a prize.

Can an entity submit more than one Concept Paper? Can an entity be a member of multiple teams, with those teams submitting separate Concept Papers?

- No restriction on the number of Concept Papers that an entity (an individual participant or organization) may submit alone.
- An entity can be a member of as many teams as it chooses.
- Each team must identify a **single Team Lead** (an individual or organization).
- Prizes are paid directly to (1) the individual participant, if a Concept Paper is submitted by one entity, or (2) the Team lead, if a Concept Paper is submitted on behalf of a team. An individual or Team Lead is only eligible to be paid **one prize total**.





FAQS – ELIGIBILITY (2 OF 2)

Are non-U.S. entities eligible to receive a prize?

- To receive a prize, all named individuals and organizations submitting the Concept paper must meet the criteria described in Section VI:
 - A private **entity must be incorporated in and maintain a primary place of business in the United States or U.S. territory**; and
 - An individual **must be a citizen or permanent resident of the United States or U.S. territory**.





FAQS – TECHNICAL

What should be included in the Concept Paper? Can existing work/publications on an intersection safety system be included?

- There is **no required format for this submission**. Carefully consider how your submission addresses the Stage 1A judging criteria (Section VII).
- **Strict 15-page limit**. Submissions over the 15-page limit will not be accepted and will be ineligible for prizes.
- “Participant Team Organization and Qualifications” is one of four judging criteria for Stage 1A (see Section VII). The U.S. DOT expects prior work that demonstrates relevant team experience and qualifications to be a significant element of any submission. **Publications may be cited as evidence** of team experience and qualifications.





FAQS – PRIZES

Are participants expected to fund their own work on Stage 1A?

- Yes. Stage 1A is a prize competition and, therefore, **participants do not receive funding to develop Intersection Safety Challenge Concept Papers**. Eligible entities will be awarded prizes in accordance with Sections V Prizes, VI Rules, and VII Judging.

How will entities receive payment of a prize?

- Prizes will **be paid to the individual or Team Lead directly by DOT through electronic funds transfer**.
- For Concept Papers submitted by a team, following payment to the Team Lead, U.S. DOT will not be involved in determining how prize money is divided amongst the team members.





FAQS – STAGE 1B

Will Stage 1B be open to anyone or only the winners of Stage 1A? Can an entity that wins in Stage 1A partner with new individuals or organizations in Stage 1B?

- At a minimum, Stage 1A winners will be eligible to participate in Stage 1B. A Stage 1A winner is identified based on the single individual or entity that **received** the prize payment. The **Stage 1A prize payment recipient must remain the Team Lead in Stage 1B**, but other members of the team may change as determined necessary by the team itself.
- Depending on the results achieved during Stage 1A, DOT may choose to broaden Stage 1B eligibility.

What will the training dataset look like for Stage 1B? Can entities supplement with their own data?

- In Stage 1B, participants will test their proposed system using **real world sensor data collected on a closed course** to assess the solution’s potential to enhance intersection safety.” **This sensor data will be supplied by U.S. DOT.**
- Stay tuned for more details on Stage 1B.



Q&A

**Govind Vadakpat, Program Manager,
Smart Infrastructure, ITS JPO**



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STAY CONNECTED

- Go to the **Intersection Safety Challenge** website for more information:
 - <https://its.dot.gov/isc/>
- Go to the **Challenge.gov** website to apply for the Intersection Safety Challenge:
 - <https://www.challenge.gov/?challenge=us-dot-intersection-safety-challenge>
- For more information about the **ITS Joint Program Office (JPO)**, visit:
 - <https://www.its.dot.gov/>
- Sign up for the ITS JPO email list and/or follow the ITS JPO social media for upcoming events:
 - <https://www.its.dot.gov/contacts/maillinglist.htm>

