Official Rules for the
First Responder Smart Tracking (FRST) Challenge
Version 1.6 (Updated 23 September 2023)

Challenge Host:

Funded by: National Institute of Standards and Technology

Partners:

February 2022–November 2023

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Cooperative Agreement Notice

The First Responder Smart Tracking (FRST) Challenge is administered by the Trustees of Indiana University (IU) through the Crisis Technologies Innovation Lab (CTIL). Support for this research comes from award 70NANB21H022 of the Public Safety Innovation Accelerator Program (PSIAP) of the National Institute of Standards and Technology (NIST) Public Safety Communications Research (PSCR) Division.

The PSIAP utilizes grants and cooperative agreements to stimulate critical R&D for public safety communications technology and provide access to cutting-edge technologies and applications that will enable responders to better carry out their mission to protect lives and property. For more information, visit pscr.gov

Revision Notice

15 August 2022– Page 26. Section **C. Prototype Remote Testing Results** was changed to eliminate JSON file types and to reference a required data format.

> Deleted Sentence: Data files should be submitted either as a csv or json files.
>
> New Sentences: Data files should be submitted as csv files. A required data format will be posted on the competition website.

25 August 2022–Page 28.

> Deleted Sentences: 15 minutes duration/ five 20-meter position range sensing in X-Y with at least 15-meter range in both X and Y in at least three trials, all of which have at least one 5-meter-wide barrier in place. The goal is +/- 2-meter accuracy. An accuracy description such as circular error radius or coordinate error should be noted in section B above. (20%)
>
> New Sentences: Completion of four or more trials to demonstrate system's capabilities, including the Z-axis requirement listed below. These trials must display at least a 15-meter position sensing range on both the X and Y axis and three (or more) of these must have at least one 5-meter-wide barrier in place. Video and resulting data of these trials may be submitted to fulfill Sections C and E above - data from roughly 15 minutes of these trials should be submitted to meet Requirement C. The goal is +/- 2-meter accuracy. An accuracy description such as circular error radius or coordinate error should be noted in section B above. (20%)
>
> - A strongly suggested (but not required) testing "script" is available to download on FRSTChallenge.com/rules

15 February 2023–Tables 2, 3 and 4.

> Prize amounts have been updated to include travel awards for the 5x5: The Public Safety Innovation Summit. Dates for the conference have been added for the event.
>
> Dates for the Phase 4 winner announcement and Phase 5 kickoff webinar changed.

15 February 2023–Page 31.

New Section: Entire new section under How to Enter added to summarize submission requirements and related dates for each component.

15 February 2023–Page 33-33.

Requirement Moved and Edited: Requirement *C. Prototype Live Testing Results* deleted and replaced with Requirement *I: Prototype Live Testing Results Review*.

Requirement Added: Requirement *H. Optional: Training Video for First Responder Role-Players* added.

15 February 2023–Page 35.

Modified Requirement: The following criterion was adjusted from 10 to 15 meters.

New Sentences: Positioning in the Z-axis is to be judged independent of the X-Y plane, although position in Z will be measured concurrently with the X-Y position. A change of elevation (e.g., traveling up and down stairs or elevator) of up to **15 meters** will be tested. The goal for full scoring is 2-meter accuracy relative to pre-determined waypoints.

15 February 2023–Page 35.

Deleted Sentences: Live communication (i.e. <10-second refresh rate and <1-second data acquisition rate) with "Command Center" hub, wired or wirelessly. The transmission should be dynamic and contain data that provides a means to visualize, tabularize, or describe location data in a live environment.

New Sentences: Teams are required to transmit to their own receiving device wirelessly in real-time (<10-second refresh rate and <1-second data acquisition rate). Teams may not use MUTC-provided wireless networks to transmit this data. The transmission should be dynamic and contain data that provides a means to visualize, tabularize, or describe location data in a live environment.

New Sentences: Immediately following the trial, teams will be required to provide data from the trial to FRST admins in the required data format. Any data post-processing following the trial is not permitted. This data will be collected as a batch via USB or cloud data transfer.

17 February 2023–Tables 2 and 3

Updated to correct typographical errors in prize amounts.

14 March 2023–p.31

The Documentation items to be submitted on March 20 were updated to include item D as previously announced.

23 September 2023–p.38

Section C. Prototype Live Testing Results was removed from competition requirements and replaced with a new requirement Prototype Documentation for Public Dissemination.

23 September 2023–p.39-40

Section I, Optional: Training Video for First Responder Role-Players was added.

23 September 2023–p.40-41

Criterion 1 was edited to add a new technical outcome for live field testing and to correct

math errors in subscores.

23 September 2023–p.41-42

Criterion 2 was edited to update transmission and data requirements.

23 September 2023–p.42-43

Changes to BIC scores made to correct typographical errors.

Introduction

Overview

The Indiana University Crisis Technologies Innovation Lab (CTIL) invites members of the public to join the First Responder Smart Tracking Challenge (FRST Challenge or FRST). Funded by the Public Safety Communications Research Division (PSCR) of the National Institute of Standards and Technology (NIST) through award 70NANB21H022 of the Public Safety Innovation Accelerator Program (PSIAP), the competition will award up to $5,460,000 to winning contestants.

First responders face life-threatening situations daily to provide safety and security to the populations they represent. Risk is a reality of emergency response and reducing that risk should be a societal priority. Technologies that could provide better situational awareness to first responders have developed rapidly over the last decade, with many wireless devices and sensors emerging within the global context of the Internet of Things (IoT). However, an area significantly lacking for first responder situational awareness is accurate responder location within various types of building structures above ground and underground such as tunnels and basements.

These problems and the potential to solve them are the motivation for the prize funding from NIST. The members of our multi-institutional team, led by the Crisis Technologies Innovation Lab (CTIL) at Indiana University (IU), and key partners with expertise in prize competitions, indoor tracking technologies, entrepreneurship, and first response are implementing the FRST Challenge. In this competition, competitors will develop and be tested on the performance of sensors and systems for localization and tracking of first responders operating indoors in a variety of building environments (without the benefit of pre-deployed dedicated tracking infrastructure) and other challenges that we believe will lead to best-of-breed solutions to this problem. With support from our partner in entrepreneurship and business development, we will assist teams in developing technologies that can be commercially deployed for use by first responder communities at the local, state, and federal levels and internationally.

Locating first responders within building structures is a complex problem, and solutions will have a transformative effect on first responder effectiveness and safety. Therefore, this competition intends to blend a breadth and depth of experience and capabilities that will maximize chances of success for the participants and their technologies and lead to the introduction of products to the market. Solutions can be an integration of current off-the-shelf and new custom technologies developed by the team.

Competition Goal

Contestant goals will be to produce marketable prototypes that demonstrate indoor localization and tracking of first responders within 1-meter accuracy in a variety of buildings and structures without any pre-deployed infrastructure. Marketable prototypes are robust for first responder use cases, are scalable across diverse organizations and communities, and are affordable for first responder organizations.

Over the five phases of the main competition, competitor teams will submit increasingly refined prototypes. They will fully address the essential criteria listed in Table 1 in their final prototypes and planning documents by the end of the competition. More details will be provided as the competition moves into each phase about the importance of each in competition judging.

Table 1. Competition Criteria and General Metrics

Criteria	Metrics
Location Tracking Accuracy	Prototypes must accurately detect and locate first responders as they move through different structures with a goal of <1-meter on the X-, Y- and Z-axes.
Ease of Deployment	The practicality and efficiency of deploying the devices and infrastructure needed to use a team's solution.
Robustness/Ruggedization	Prototypes must operate effectively in multiple scenarios, adverse conditions, and environments. This score is also based on the solution's durability, flexibility, and expected maintenance needs. In addition, various technical criteria will be evaluated within the entire prototype across critical technical systems, including power, sensors, communication with other responders and incident command, cybersecurity, and data management.
User Experience	Proposed solutions should be straightforward for personnel to use in various situations in the field. Usability will be assessed across the entire solution and will be an essential metric in live field testing.
Cost Feasibility	Life cycle costs of the prototype systems will provide an understanding of the feasibility for first responder organizations of various sizes and types to adopt the technology.
Business Development Plan	A team's proposed business development, commercialization, licensing, and related goals should demonstrate an understanding of the realities of the first responder markets and present a viable approach to bringing the solution to market.
Extensibility & Interoperability	The prototypes will utilize various types of data, standards, and infrastructure, some of which the Challenge may require or recommend. While the core system must operate without pre-deployed infrastructure, if specific tools, data, and services are provided, the solution should be able to use it. This might include items such as electronic maps, cellular and Wi-Fi networks, and GPS signals. Where the challenge requires certain technologies, this will generally be to promote interoperability or facilitate the judging process.

As teams evolve their prototypes throughout the Challenge, they will need to make strategic tradeoffs among the criteria in Table 1. For example, a more cost-effective solution may be less accurate or less extensible. In addition, there are likely multiple approaches that are equally feasible for different sectors of the first responder market. However, a more generalizable solution that works across many first responder use cases is desirable.

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Technology Agnostic

Teams should use whatever technologies they deem beneficial to challenge goals. The competition is technology agnostic except where specific instructions are provided to conform to a particular standard, to integrate a specific functionality, or where legal restrictions limit the technologies that can be used. For example, teams will be testing at a United States military training facility and subject to certain restrictions. Where a competitor's approach provides potential conflicts, the competitor should consider changing their product design, or they may need to adapt their prototype for the live field testing. For instance, drone flights may be restricted to specific types of drones and capabilities. Where a competitor anticipates a problem, they should consult with the IU CTIL team to find an acceptable solution.

Community Approach

The FRST Challenge is developing a community around the issue of indoor tracking of first responders, with the competition being the community's primary focus. However, individuals, teams, first responders, industry partners, experts, and other interested parties are encouraged to join the community, even if they are not competitors for prizes. Programming will be offered that is broadly applicable to various stakeholders. In addition, the community will be provided tools on the FRST Portal to enhance their ability to communicate, collaborate, share, and help each other.

The FRST Challenge competition is a five-phase program in which competitors move from early concept papers to complete prototypes. The first three phases are focused on the growth of the competitor teams and building a community. Prizes will be awarded at the end of Phases 1 and 2, but no team is eliminated. Walk-on competitors are encouraged in the first three phases, as described below. Teams will be eliminated from the competition at the end of Phases 3 and 4 as the competition narrows down to the finalists.

Throughout all five phases of the competition, the FRST Community will remain active, enabling people to stay engaged in the community even if not an active competitor.

Summary of Prizes

Prizes are divided into the five phases of the competition (Table 2), with increasing funds available at each stage. The prize structure is designed with three key goals in mind (Table 3). The first goal is to provide teams with adequate funds from Phase 1 to purchase the hardware, software, and services a team might need to begin early prototyping of their solutions. Given that teams will be competing for an invitation to the live fields event months after the competition launches, they need funds early in the process. The second goal is to provide substantial prize awards for multiple teams rather than one or two teams. Given the failure rate of technology ventures, the odds of long-term success are potentially increased if multiple teams are incentivized with significant cash awards. Except as limited within the rules, competitors may shift their focus throughout the challenge. For instance, a team may submit a prototype for Phase 3 that is significantly different than what they proposed in their initial concept paper.

The prizes for the competition are structured to support several essential elements that NIST and IU have identified as important for success.

- Each phase includes prize funds for a public safety partner. Teams will partner with these representatives to ensure they are developing technology solutions that work for

these communities.

- Travel prizes are included so that teams can attend the 2022 PSCR Stakeholder Meeting, where they will be provided with training sessions, mentoring, and meetings with stakeholders. Additional funds are provided for travel to the two live events.

- Entrepreneurial Support and Seed Business awards are designed to train and actively assist the teams in developing the business components of their projects.

Summary of Competition

The competition plan is focused on the concept of helping teams building marketable prototypes. The challenge has five competition phases, with the last two being in-person live field-testing events (see Table 4 for Important Dates). As the competitors move through the phases of the competition, their technologies must mature and meet more stringent review criteria. The first three phases are designed as remote events to provide a cost-effective way to engage diverse teams and account for potential issues with travel due to the pandemic. The last two phases are live field-testing events that will test the product prototypes in authentic scenarios with hands-on use by first responders. The field tests are designed to help the competitors develop a robust prototype that is operational in complex and diverse environments. The following is an overview of each phase (details in narrative later in this document):

Phase 1: Concept White Papers

Teams will submit concept papers (see below) describing their proposed technology solution, team qualifications, and public safety partnership.

Phase 2: Early Prototype Demonstration

Teams will provide an interim report of progress in building out and testing their initial systems. Judges will determine if teams have made adequate progress in developing a solution that will meet target benchmarks.

Phase 3: Refined Prototype Demonstration

Teams will provide a complete system design, benchmark performance data, including sensor data, and a video demonstration of the system working with the possibility of a remote interview. Up to 10 teams will be invited to Phase 4.

Phase 4: Live Field Testing at the Muscatatuck Urban Training Center (MUTC)

First responders will use participant technologies in a series of authentic simulated tasks at the MUTC facilities, with each task lasting up to two hours. Up to 6 teams will be invited to Phase 5.

Phase 5: Advanced Live Field Testing at the Muscatatuck Urban Training Center (MUTC)

First responders will use participant technologies in a series of complex simulated tasks at the MUTC facilities with each task lasting up to four hours. Final cash prizes will be awarded after this phase.

Field Testing + Support at Live Event Venue

For the Live Field Testing events of Phases 4 and 5, MUTC will provide a wide variety of building options with an excellent range of competition environments, including environmental levels of difficulty for tracking, communications, RF signaling, and other real-world constraints. The permitted use of radio spectrum and flight space above and within MUTC makes it ideal for

this competition. In addition, the MUTC staff is experienced with the logistics of competitions, and the facility has extensive support for hosting a large, multi-day event, including staging areas, security, and network infrastructure.

The two 5-day events are anticipated to include the following activities:

Day 1 Team Preparations

Teams and challenge staff will use facilities for planning and setup, a site tour, and competition prep.

Day 2 & 3 Testing of Prototypes

Teams will compete in various testing scenarios using appropriate MUTC above-ground and below-ground spaces to support the simulation. First responders will serve as role-players in the scenarios following standard operational procedures. These responders will have access to authentic equipment used in training exercises and provide feedback to teams based on their experience using their prototypes. This feedback will also be presented to the judging panel.

Multiple teams and simulation runs will be necessary to efficiently use the space and time available for data collection. Each scenario will be scripted, with actors and effects as needed, so that each iteration of a simulated scenario is consistently similar to the last. Actors and effects personnel will be sourced locally. As MUTC regularly deploys actors, effects, and even animals housed on-site for simulated training events (e.g., outdoor markets, disasters, etc.), we will be able to source appropriate talent. A variety of building types will be used in testing. The spaces will represent a rich mix of building construction, pathing to room spaces, background EMF, and RF-denied environments.

Day 4 & 5 Individual Team Refinement and Demonstration of Prototypes

Given the unique nature of MUTC, teams will be provided access to the facilities to test further, refine, and demonstrate their technologies. This will include mentoring sessions with public safety and technical experts and meetings with and demonstrations for potential industry, government, and private partners/investors.

Table 2. Challenge Phases & Award Summary

Phase	Phase Description	Number of Contestants Eligible to Compete/Awards
Phase 1		
Concept Paper	Contestants will submit a concept paper for their proposed solution, team biographies, and documentation of a public safety partner.	Open to all eligible Contestants
		Total prize purse up to $165,000
Phase 2		
Early Prototype Demonstration	Contestants will provide an interim system design & benchmark data report of progress in building and testing their initial systems. Judges will determine if teams have made adequate progress in developing a solution that will meet target benchmarks.	Open to all eligible Contestants; Walk-on entries allowed
		Total prize purse up to $870,000
Phase 3		
Refined Prototype Demonstration	Contestants will provide a complete system design & benchmark data report of progress in building and testing their initial systems. Teams will meet via video conferencing with judges to demonstrate the prototype. Teams will submit an initial business plan.	Open to all eligible Contestants; Walk-on entries allowed
		Total prize purse up to $449,000
Phase 4		
Live Field Testing	Teams will submit their complete prototypes for live field testing for all judging criteria.	Up to 10 teams invited from Phase 3
		Total prize purse up to $948,000
Best in Class (BIC) Awards	Contestants will submit their prototypes for testing and evaluation. Teams can win cash prizes for BIC Level 1, Level 2, or Level 3.	Up to 4 teams
		Total prize purse up to $1,000,000
Seed Business Development	Teams will submit a business plan for bringing their product to market.	Up to 6 teams
		Total prize purse up to $180,000
Phase 5		

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Advanced Live Field Testing	Teams will submit their ruggedized prototypes for advanced live field testing for all judging criteria.	Up to 6 teams invited from Phase 4
		Total prize purse up to $1,893,000
Best in Class (BIC) Award	This is a continuation of the BIC Award from Phase 4 for allocating any remaining BIC prize funds. See Phase 4 above and details in narrative below.	See Phase 4
		See Phase 4
Public Safety People's Choice	All prototypes in Phase 5 will be considered for the award. A panel of public safety judges will rank prototypes.	Up to 1 team
		Total prize purse up to $10,000

Table 3. Challenge Award Details

Phase	Award Description	Number of Awards[1]	Award $ Value
Phase 1			
Concept Paper	Team Cash Prize	30	5,500
Phase 2			
Early Prototype Demonstration	Team Cash Prize	30	22,000
	Public Safety Partner Cash Prize[2]	30	2,000
	Travel Funds for PSCR 2022 Conference[3]	30	5,000
Phase 3			
Refined Prototype Demonstration	Team Cash Prize	10	29,000
	Public Safety Partner Cash Prize[2]	10	2,000
	Travel Funds for Phase 4 Testing[3]	10	5,500
	Business & Technical Assistance[4]	10	7,400
	Judges Special Recognition Awards	2	5,000
Phase 4			
Live Field Testing	1st Place Team Cash Prize	1	230,000
	2nd Place Team Cash Prize	1	190,000
	3rd Place Team Cash Prize	1	150,000
	4th Place Team Cash Prize	1	67,000
	5th Place Team Cash Prize	1	67,000
	6th Place Team Cash Prize	1	67,000
	All six finalist awards include:		
	Public Safety Partner Cash Prize[2]	6	2,000
	Travel Funds for Phase 5 Testing[3]	6	5,500
	Travel Funds for 2023 5x5: The Public Safety Innovation Summit[3]	6	5,500
	Business & Technical Assistance[4]	6	16,500

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Best in Class (BIC) Awards	Up to four teams are eligible for additional awards based on meeting benchmarks (capped at $1 million)[5]		
	BIC Target Level 1 Cash Prize	4	250,000
	BIC Target Level 2 Cash Prize		100,000
	BIC Target Level 3 Cash Prize		50,000
Seed Business Development	Team Cash Prize	6	30,000
Phase 5			
Advanced Live Field Testing	Excellent Rating Team Cash Prize	2	500,000
	Good Rating Team Cash Prize	2	300,000
	Fair Rating Team Cash Prize	2	100,000
	All six finalist awards include:		
	Public Safety Partner Cash Prize[2]	6	2,000
	Travel Funds for PSCR 2023 Conference	6	5,500
	Business & Technical Assistance[4]	6	18,000
Best in Class (BIC) Awards	Unallocated BIC funds from Phase 4 awarded to high-achieving teams. A team that has already won a lower-level award may win a higher-level prize minus the funds already received. For instance, if they won Level 3 in Phase 4 and now quality for Level 1, they would receive $200,000).[5]		
	BIC Target Level 1 Cash Prize	4	250,000
	BIC Target Level 2 Cash Prize		100,000
	BIC Target Level 3 Cash Prize		50,000
Public Safety People's Choice	Team Cash Prize	1	10,000

[1] Number of awards listed is the maximum number. The prize administrator and judges may choose to award fewer awards, lesser amounts for submissions deemed partially compliant, or no awards at their discretion. This table only describes prize awards; Contestants may be invited to participate in challenge stages that are not eligible to receive prize awards.

[2] Teams are responsible for distributing prize funds to their public safety partner.

[3] Teams that do not travel to the designated events will not be eligible for the travel prize: Phase 2 award is for the 2022 PSCR Stakeholder Conference; Phases 3 is for the live field-testing event and Phase 4 is for the 5x5 Summit and live field testing event. Teams that attend the 5x5 Summit must attend for a minimum of two days and participate in the demonstration area of the event to be eligible for the travel prize.

[4] Business & Technical Assistance is in the form of training, consulting services, marketing and promotion, and other support provided for the teams.

[5] The BIC prizes are intended to reward teams for significant achievements towards meeting or exceeding challenge goals and are structured so only the four best performing teams are awarded. The judges may determine that no team has meet the minimum threshold for any of the BIC levels during Phase 4 and no awards will be made during Phase 4 judging. If four teams

do not reach BIC Level 1 by the end of Phase 5, IU CTIL and the Judges may decide to award up to six smaller awards.

Table 4. Important Dates*

Date*	Event
February 28, 2022	FRST Challenge is open for Phase 1 Concept Paper Submissions
March 3, 2022	Phase 1 Kickoff Webinar
March 21, 2022	FRST Challenge Phase 1 closes on this date at 11:59 PM (EDT) for Concept Paper submissions**
April 1, 2022	Phase 1 Winners announced; begin Phase 2
April 6, 2022	Phase 2 Kickoff Webinar
May 16, 2022	FRST Challenge Phase 2 closes on this date at 11:59 PM (EDT) for Early Prototype Demonstration submissions**
May 27, 2022	Phase 2 Winners announced; begin Phase 3
May 30, 2022	Phase 3 Kickoff Webinar
June 7-9, 2022	PSCR 2022 Annual Stakeholder Meeting for Phase 3 participants
October 3, 2022	FRST Challenge Phase 3 closes on this date at 11:59 PM (EDT) for Refined Prototype Demonstration submissions
October 25, 2022	Phase 3 Winners announced; begin Phase 4
November 8, 2022	Phase 4 Kickoff Webinar
March 27-31, 2023	FRST Challenge Phase 4 closes with Live Field Testing
May 1, 2023	Phase 4 Winners announced; begin Phase 5
May 3, 2023	Phase 5 Kickoff Webinar
June 28-30, 2023	5x5: The Public Safety Innovation Summit for Phase 5 participants
October 23-27, 2023	FRST Challenge Phase 5 closes with Advanced Live Field Testing
November 3, 2023	Phase 5 Winners announced

*IU CTIL reserves the right to revise the dates at any time.

** In Phases 1 and 2, Indiana University will make up to 30 awards for highly qualified teams. If the judges and Indiana University determine that 30 submissions have not met their minimal thresholds for quality, the competition may accept and review late submissions until all 30 awards have been made. Communication of this late submission opportunity will be published on the FRSTchallenge.com website if it becomes available.

Official Contact Information

Questions about this Challenge should be directed to info@FRSTchallenge.com.

Information about the Challenge will be posted at https://www.FRSTchallenge.com/

Competitors, industry partners, First Responders and other interested parties should join and participate in the First Responder Smart Tracking (FRST) Challenge Community Portal ("FRST Portal") by creating an account at https://www.FRSTchallenge.com/portal. Competitors will use the Portal, or other method published by the competition, to submit their official submission in each phase.

Iterative Release of Rules

The FRST Challenge is conceived as an evolving competition that is responsive to the community that develops and the emerging prototypes of the competitors while focusing on the core goals of the competition as described previously. Edits to the rules for each phase may be made and released as the competition moves forward. If changes are made, the revised rules for the next phase will be released concurrently with the release of the results of the previous phase. We do not anticipate making changes once a phase is underway except in extenuating circumstances. General information about each phase is provided in this document to provide a broad framework for competitors to plan their overall roadmap.

Phase 1 – Concept Paper

Indiana University Crisis Technologies Innovation Lab invites all eligible contestants to submit concept papers. The judging panel will evaluate their proposed approach to ensure they demonstrate a clear understanding of the problem and the objective to successfully develop a marketable prototype that demonstrates indoor localization and tracking of first responders with a goal of 1-meter accuracy in a variety of buildings and structures without any pre-deployed infrastructure. Submissions should address the entire product design and not just the location tracking component, though that is the core focus of the competition. In addition to individuals and organizations already working in the location tracking field, the competition seeks to attract new technical experts who do not have a complete solution design by the Phase 1 submission date. If the competitor knows key weaknesses in their approach, they should describe their initial approach and how they will address those weaknesses over the course of the competition. The competition is not focused on the visualization of the location data, rather on how you will track location and communicate that information to relevant systems used by other responders and incident command. Therefore, your project description should focus on these aspects of your prototype.

In addition to describing their technical approach, submissions should also provide biographical sketches of the team. Judges will be evaluating the teams for their skillsets to address the development of complete prototypes and eventually develop commercialization plans. Teams do not necessarily need to be fully formed at the time of concept paper submission. Teams should address their perceived weaknesses and how they will address those weaknesses, such as by recruiting additional team members or hiring contractors. The judges are looking for teams with a high probability of success even if the entire team is not in place at the time of submission.

Lastly, a crucial part of developing a successful solution will be engaging with first responders. Each team should recruit a first responder partner who agrees to work with them throughout the competition. Phases 2-5 include allocation of prize funds for first responder partners. If your team does not have a first responder partner, they must sign a statement that they will recruit one in the early stages of Phase 2.

Eligibility: Any contestant as defined in *General Submission Requirements for All Phases (Rights & Warranties): Eligibility Requirements* can participate.

Prizes: See Table 3

How to Enter

Review these Official Rules and submit a concept paper through the FRST Portal. The concept paper (Sections A-F) must be a single PDF file with a **maximum of 15 pages and a <u>file size of less than 25MB</u>**. See *General Submission Requirements for All Phases: Submission Requirements* for document size specifications.

- Register for the FRST Challenge by completing the online registration form on the FRST Portal, https://www.FRSTchallenge.com/portal
- Review the IU Crisis Technologies Innovation Lab provided resources on the "Resources" tab on the FRST Challenge website https://www.FRSTchallenge.com/
- Submit entries by the date provided in the Important Dates section of this document.

Submission Requirements

Each of the following sections should start on a new page, with the header being the section title (e.g., "B. Project Description").

A. Cover Page and Abstract

Page limit: 1-page maximum

The cover page must include:

- Contestant's Name or Team Name (Team, Organization or Entity Name with a complete list of individual team members)
- Contestant's Location (City, State/Region, and Country). If Team, Organization or Entity, must include the principal place of business
- Team Logo
- Official Representative and their preferred contact information (including email, phone, and physical mailing address)
- A brief description (500 words maximum) of the unique aspects of the contestant's approach and the potential impact that the proposed approach could have in achieving the goals of the FRST Challenge. Do not include proprietary or sensitive information in this summary.

B. Project Description

Page limit: 7 pages maximum

The scoring criteria should be your primary objective; therefore, create your concept paper to

address the criteria. It is assumed many competitors will not be able to fully address all of the following issues in the concept paper. Where you do not yet have an answer, state that and describe your process to address these issues as the competition moves through future phases. Address the following points:

- Project Descriptions should focus on two overarching themes:
    - Solutions need to address indoor 3D location tracking use cases for <u>first responders</u> and demonstrate an understanding of and applicability to their needs.
    - The final prototype system should be capable of meeting the competition 1 meter in 3D space (X, Y, and Z-axis goal). If your current system can't achieve this level of accuracy, describe how you will work towards this goal.
- Each item in *Table 1. Criteria and Metrics* should be addressed. Where the team is unsure of what they will do, they should address their methodology for addressing those criteria in their eventual prototype.
- The following technical capabilities will be assessed throughout the competition with competitors expected to evolve their solution toward effectively addressing them:
    - While in use, the location accuracy of the system should remain at acceptable levels throughout an incident.
        - Systems might be more accurate when a user is standing still than when they are walking, running, crawling, etc.
        - The system might be more accurate when initially deployed, but accuracy may deteriorate over time due to accumulated error.
    - The system should be capable of real-time reporting.
    - The system should operate at a minimally viable level of functionality without pre-deployed infrastructure
    - The system should provide reasonable power requirements for first responder use cases.
    - Using a typical scenario, describe the process of setting up and operating your proposed solution.
        - Describe the key steps first responders have to take to begin using the technology.
        - Describe the experience of using the technology. If different roles or professions use or interact with different components of your solution, describe what is different and why. For instance, will you track location differently for a police SWAT team than a firefighting team?
    - The system should be ruggedized for diverse first responder use cases. While ruggedness will not be tested in earlier phases, the competitors should address how their technology will be ruggedized.
    - The size and form factor of the final prototype needs to be appropriate for diverse first responder use cases. While this will not be tested in the earlier phases, the competitors should address how their target design will be suitable for first responders.

- The ultimate product must be cost-effective for first responder organizations to purchase and maintain. As the competition progresses, teams will develop estimates of costs and may even create tiered solutions for various types of organizations or use cases.

- Explain how the solution addresses the technology gaps such as those described in these Official Rules and other sources.

- Explain how the solution addresses the unique needs of first responders and incident command when operating in different building types and various environmental conditions.

- Where relevant, describe how you will support interoperability

- While the competition focuses on the base mode of operation working without pre-deployed infrastructure, describe how the system would use it for enhancements or redundancies if there is infrastructure (hardware, software, data).

- Explain the design of the solution and justification for significant design choices.

- Describe the competitive advantage offered by the contestant's approach or solution.

Section B should contain only text and tables; do not include graphics and images in this section. Place all figures in Section C.

C. Information Sheet or Technical Schematics

Page limit: 1-2 pages maximum

Concept sketches, technical schematics, and other visual materials supporting the team's Project Description can be included in this section.

D. Information about Key Team Members

Page limit: 2 pages maximum

Include information on the key team members and why they are well-suited to accomplish the project, with supporting information on their qualifications, skills, and capabilities (i.e., previous projects, experience) related to the FRST Challenge goals. If a team is not fully formed or lacks needed skills, information on the types of people they will add as team members or how they will secure the required skills through other methods should be provided.

E. Information about First Responder Partner

Page limit: 1-2 pages maximum

For your public safety agency or entity, provide the point of contact, a description of the collaboration, what they are committed to doing, and an acknowledgment of prizes reserved for the collaborating public safety agency. While a complete plan is not expected, include enough details to demonstrate that the team and partner have a general understanding of the commitment needed (e.g., how often will you meet and what tasks will they help with). This information should be signed by the project's point of contact at the collaborating public safety entity.

Should the participant not submit their concept paper with a named collaborating agency, the participant must discuss its willingness to collaborate with a public safety agency, how they anticipate they would work with that partner and include an acknowledgment of prizes reserved for the collaborating public safety agency. The Challenge team will try to assist teams without a

partner to identify an appropriate partner, but the ultimate responsibility resides with the team.

F. Public Abstract

Page limit: 500-1,000 words

The competitor must provide an abstract that will be published on the FRST Portal as part of the community for everyone to view. The abstract can include any of the above information or be reworded as the team desires. There may be ways you want to describe your solution to the judges that differ from the way you want to portray this to the larger community. Do not include proprietary or sensitive information in this summary. This public abstract will not be judged for quality but will be part of the pass/fail criteria of complying with submission requirements.

Review

The IU Crisis Technologies Innovation Lab will review each contestant's entry in the Concept Paper phase. A submission that fails to meet the compliance criteria will be disqualified and ineligible to compete in this phase. Submissions that pass the initial compliance review will be evaluated and scored by a panel of judges. IU makes an independent assessment of each concept paper based on the scoring criteria outlined below. During the review, each subject matter expert and Judging panel member will review the entire concept papers assigned to them. The review is not done in sections with different reviewers responsible for different assigned sections. Therefore, it is not necessary to repeat information in every part of the concept paper.

Do not include sensitive materials in the concept paper, for example, personally identifiable information like social security numbers, business-sensitive information, tax identification numbers, etc.

Subject Matter Expert (SME): An expert in their respective field, either from IU or an entity collaborating with IU. Subject matter experts will conduct independent reviews of the submissions received during the FRST Challenge. The subject matter experts are not judges and, as such, will provide recommendations based on the evaluation criteria to the judging panel.

Judging Panel: The Director of NIST will select members from the public safety industry, first responders, location-based services, and academia to evaluate the submissions for the FRST Challenge. The judging panel will take subject matter expert recommendations into consideration when evaluating contestants' submissions. The judging panel will make the final determination of awards for the FRST Challenge.

Evaluation Criteria and Judging

Judges will evaluate the Concept Papers using the following criteria:

Criterion 0: Compliance Check (pass/fail)

This criterion will be evaluated on the following factor:

- Completeness according to the 'How to Enter' section
  If a submission passes Criterion 0, it will be evaluated on the following criteria.

Criterion 1: Strategic Alignment & Technical Outcome (70%)

This criterion involves consideration of the following factors:

- Strategic Alignment – The extent to which the proposed approach meets the objectives listed in the FRST Challenge goals; the likelihood the contestant's solution, if successfully implemented, will result in a marketable product for first responders.

    - Proposed Technology & Justification – Contestant's strategy for solving the problem statement, making technological improvements, and justification for those improvements aligns with the FRST Challenge goals.

    - Method for 3D Location Tracking–Contestant demonstrates an understanding of indoor location tracking technologies, their approach's capabilities and limitations, and propose a viable path forward to mature their technology.

    - Proposed Solution Meets First Responder Needs–Contestant's solution and approach demonstrate an understanding of first responder needs and the environments in which the solution will be deployed.

- Technical Outcome – Extent to which the proposed approach will result in significant improvement in commercially available technology and potentially result in a technical outcome that enables considerable progress toward the FRST Challenge goals.

- Accuracy of the technological solution – demonstrates a viable path to at minimum 1-meter accuracy tracking prototype.

Criterion 2: Feasibility & Team (30%)

This criterion involves consideration of the following factors:

- Team – The extent to which the contestant's capability can address all aspects of the proposed project with a high chance of success, including, but not limited to, qualifications, relevant expertise, and time commitment of the contestant. Reviewers will assess: (a) the relevance of the qualifications and experience of the key staff, leadership, and technical experts, (b) the extent to which the contestants' prior experience and the quality of the results in similar projects related to the purpose, scope or tasks of this challenge.

- Approach – Contestant's plan to manage the limited schedule, resources, project risks, and other challenges and produce high-quality project outcomes to meet the FRST Challenge goals.

- First Responder Partner – Contestant's plan to engage with a first responder partner with a meaningful level of involvement.

Scoring for Concept Papers

The concept papers will be evaluated based on the criteria above. Each concept paper will be reviewed by subject matter experts and evaluated by a panel of judges. Each submission will be scored as follows: criterion 1 will be recorded on a scale of 0 to 70 points, and criterion 2 will be recorded on a scale of 0 to 30 points. Contestants will not be provided oral or written feedback based on the evaluation of their submissions.

Phase 2 – Early Prototype Demonstration

All eligible contestants are invited to submit an early prototype demonstration. The submission will be an expanded version of the concept paper with expected details on the prototype design, documentation of the initial development efforts and outcomes, and a product roadmap.

Eligibility: Any contestant as defined in *General Submission Requirements for All Phases (Rights & Warranties): Eligibility Requirements* can participate. Walk-on competitors new to the competition and those who entered Phase 1, whether they won a prize or not, are eligible to submit.

Prizes: See Table 3

How to Enter

Review these Official Rules and submit the required documentation and videos through the FRST Portal. See Submission Requirements in *General Submission Requirements for All Phases* for document size specifications and video submission formats.

Submission Requirements

A. Cover Page and Abstract

Page limit: 1-page maximum

The cover page must include:

- Contestant's Name or Team Name (Team, Organization or Entity Name with a complete list of individual team members)
- Contestant's Location (City, State/Region, and Country). If Team, Organization or Entity, must include the principal place of business
- Team Logo
- Official Representative and their preferred contact information (including email, phone, and physical mailing address); if different from a previous submission, indicate a change in the official representative
- A brief description (500 words maximum) of the unique aspects of the contestant's approach, the potential impact that the proposed approach could have in achieving the goals of the FRST Challenge, and a general overview of the prototype developed. Do not include proprietary or sensitive information in this summary.

B. Prototype Documentation & Demonstration

Page limit: 12 pages maximum

The competitor teams will provide documentation of their prototype design, including information on all hardware, software, algorithms, and data formats developed as of the submission. Competitors should refer to the Phase 1 description for the relevant items that will be addressed in this documentation. The team should describe preliminary results of testing their prototypes, the process(es) utilized for testing and propose methodologies for addressing any issues discovered. In addition to initial functionality development for this phase, a roadmap should be

provided that describes how the team will mature their prototype, including technical improvements, over the remaining phases of the competition.

C. Information about Key Team Members

Page limit: 2 pages maximum

Include information on the key team members and why they are well-suited to accomplish the project, with supporting information on their qualifications, skills, and capabilities (i.e., previous projects, experience) related to the FRST Challenge goals. If a team is not fully formed or lacks needed skills, information on the types of people they will add as team members or how they will secure the required skills through other methods should be provided. This may be updated information submitted in Phase 1.

D. Video Presentation for Judges

Length: Maximum of 5 minutes

Competitors should upload a video presentation for the judges describing the prototype, including any visual elements, prototype images, diagrams, and other information that will enable the judges to understand the competitor's approach and unique aspects of the technology.

E. Video Presentation for FRST Community

Length: 1 - 3 minutes

To facilitate community building and partnering, competitors should upload a video presentation for the FRST Community describing their prototype, including any visual elements, prototype images, diagrams, and other information that will enable the community to understand the competitor's approach and unique aspects of the technology. This video should demonstrate a competitor's familiarity with and understanding of public safety operations, problems statements, and a realistic roadmap that leads to an effective and feasible solution. Competitors should use their judgment in determining how much of their technology and approach they wish to share. Note that this will be judged for compliance only, and it is encouraged to submit well before the end of Phase 2 if possible.

F. Public Abstract

Page limit: 500-1,000 words

The competitor must provide an *updated* abstract that will be published on the FRST Portal as part of the community for everyone to view. Competitors are not required to change their abstract if previously submitted; however, if not changed, the abstract still needs to be included in this submission. The abstract can include any information from Phase 1 and new content from this phase, as the team desires. When preparing the abstract, keep in mind there may be ways you want to describe your solution to the judges that differ from the way you want to portray this to the larger community. Do not include proprietary or sensitive information in this summary. This public abstract will not be judged for quality but will be part of the pass/fail criteria of complying with submission requirements.

Review

The IU Crisis Technologies Innovation Lab will review each contestant's entry in the Early Prototype Demonstration phase (Phase 2). A submission that fails to meet the compliance

criteria (Phase 2 Criterion 0) will be disqualified and ineligible to compete in this phase. Submissions that pass the initial compliance review will be evaluated and scored by a panel of subject matter experts and judges. IU makes an independent assessment of each concept paper based on the scoring criteria outlined below. During the review, each subject matter expert and judging panel member will review entire submissions including the paper, any supporting materials, and video demonstrations to which they are assigned. The review is not done in sections with different reviewers responsible for different assigned sections. Therefore, it is not necessary to repeat information in every part of the submission.

Do not include sensitive materials in the concept paper, for example, personally identifiable information like social security numbers, business-sensitive information, tax identification numbers, etc.

Evaluation Criteria and Judging

Judges will evaluate the Early Prototype Demonstration submissions using the following criteria:

Criterion 0: Compliance Check (pass/fail)

This criterion will be evaluated on the following factor:

- Completeness of the submission according to the 'How to Enter' section

    If a submission passes Criterion 0, it will be evaluated on the following criteria.

Criterion 1: Strategic Alignment & Technical Outcome (60%)

This criterion involves consideration of the following factors:

- Strategic Alignment – The extent to which the proposed approach meets the objectives listed in the FRST Challenge goals; the likelihood the contestant's solution, if successfully implemented, will result in a marketable product for first responders.

    - Proposed Technology & Justification – Contestant's strategy for solving the problem statement, making technological improvements, and justification for those improvements aligns with the FRST Challenge goals.

    - Method for 3D Location Tracking–Contestant demonstrates an understanding of indoor location tracking technologies, their approach's capabilities and limitations, and proposes a viable path forward to mature their technology.

    - Proposed Solution Meets First Responder Needs–Contestant's solution and approach demonstrate an understanding of first responder needs and the environments in which the solution will be deployed.

    - Process for Deployment–A short example describing how the proposed solution would integrate into public safety operations when managing a common type of call for service where responders are operating inside a residential dwelling, multi-story structure, or below grade location. The description should include a high-level overview of how the solution would be deployed upon arrival and utilized during the initial stages of incident management to track and view responder locations.

- Technical Outcome – Extent to which the proposed approach will result in significant improvement in commercially available technology and potentially result in a technical outcome that enables considerable progress toward the FRST Challenge goals.

- Progress made toward the Technical Outcome – Extent to which the competitor has made design and construction progress toward the Technical Outcome.

    - Are designs in place for a prototype system?

    - Are prototype demonstrations repeatable?

    - Is the prototype framework supported by First Responder input?

Criterion 2: Product Roadmap (20%)

The product roadmap describes, with milestones, a plan to develop a proof of concept (PoC) (as described in Phase 1 requirements), define and prototype a tangible representation of the PoC, an iterative process for testing the prototype, and a list of questions and considerations to explore prior to any potential Phase 3 iterations and system development.

- Extent to which the roadmap realistically describes milestones to achieve technical goals of the FRST Challenge.

- Clear description of current unmet dependencies

    - Extent to which plans are in place to produce a working, lab-based prototype by Phase 3.

    - Extent to which the prototype device is performing and a demonstrated awareness of how performance can be improved prior to submitting an entry for the Phase 3 competition.

    - Extent to which data types and formats, network and system communication, and regulatory compliances are addressed in the current state.

    - Extent to which the aforementioned topics can be adaptable should a standard for interoperability be required for subsequent phases.

- Extent of clarity of pathway towards commercialization

Criterion 3: Early Prototype Demonstration (20%)

The Early Prototype Demonstrations will be evaluated based on the criteria above. Each submission will be reviewed by subject matter experts and evaluated by a panel of judges. Each submission will be scored as follows:

- Extent to which the system has achieved the following traits for determining and delivering location information in real-time:

    - During a period of 5 minutes duration, a position in the X-Y plane should be tracked for at least 20 meters of movement. An accuracy description such as circular error radius or coordinate error should be noted. A method and reference should be provided to support the +/- coordinate error statements.

    - Positioning in Z. Positioning in the Z-axis is to be described by method and core technology type(s). A demonstration of the data produced, and an accuracy statement is required independent of the X-Y plane. A demonstration consisting of at least two positional changes in elevation (e.g., traveling up and down stairways) is required. A method and reference should be provided to support the +/- coordinate error statements.

Live communication with a "Command Center" hub, wired or wirelessly. The transmission should be dynamic and contain data that provides a means to visualize, tabularize, or describe

location data. Off-line or post-deployment processing must be described and accompanied by a detailed plan that outlines how the solution can be operated in a live production environment.

- ● Position sensing should be demonstrated with a barrier in place. This barrier can be represented by walls, furniture, trees, etc. *A submitted presentation of prototype systems should not require an open-air or obstruction-free data transmission as a dependency for performance.*

Contestants will not be provided oral or written feedback based on the evaluation of their submissions

Phase 3 – Refined Prototype Demonstration

All eligible contestants are invited to submit a refined prototype demonstration. The submission will be an expanded version of the early prototype demonstration submitted in Phase 2 with a complete prototype designed, documented, and implemented. While the final form factor of the prototype may not have been achieved, the expectation is the judges will be provided evidence that all the core technologies are in place and functioning at an appropriate level. In addition, the product roadmap should be updated and provide evidence the team is advancing towards a final prototype at the end of Phase 5 that meets competition goals. Up to 10 teams will be invited at the end of this phase to attend the Phase 4 live field testing, so teams should demonstrate their ability to execute their plans. In addition to their technical prototype, teams will need to provide initial business development plans. The plans should provide evidence of a reasonable path to bringing the innovation to market. In addition to the regular award, the judges may award up to two special recognition awards for exceptional accomplishments or unique contributions of a competitor.

Eligibility: Any contestant as defined in *General Submission Requirements for All Phases (Rights & Warranties): Eligibility Requirements* can participate. Walk-on competitors new to the competition and those who entered Phase 1 or Phase 2, whether they won a prize or not, are eligible to submit.

Prizes: See Table 3

How to Enter

Review these Official Rules and submit the required documentation and videos through the FRST Portal. See Submission Requirements in *General Submission Requirements for All Phases* for document size specifications and video submission formats.

Submission Requirements

A. Cover Page and Abstract

Page limit: 1-page maximum

The cover page must include:

- ● Contestant's Name or Team Name (Team, Organization or Entity Name with a complete list of individual team members)
- ● Contestant's Location (City, State/Region, and Country). If Team, Organization or Entity, must include the principal place of business
- ● Team Logo

- Official Representative and their preferred contact information (including email, phone, and physical mailing address); if different from a previous submission, indicate a change in the official representative
- A brief description (500 words maximum) of the unique aspects of the contestant's approach, the potential impact that the proposed approach could have in achieving the goals of the FRST Challenge, and a general overview of the prototype developed. Do not include proprietary or sensitive information in this summary.

B. Prototype Documentation & Demonstration

Page limit: 20 pages maximum

The competitor teams will provide documentation of their prototype design, including information on all hardware, software, algorithms, and data formats developed as of the submission. Competitors should refer to the Phase 1 and Phase 2 descriptions for the relevant items that will be addressed in this documentation. The team should describe updated results of testing of their prototypes and methodologies for addressing any issues discovered. A product roadmap should be provided that describes how the team will mature their prototype over the remaining phases of the competition.

C. Prototype Remote Testing Results

Page limit: 5 pages text, 5MB data maximum

Competitors will be required to perform tests using their prototype comparing the prototype positions sensing to an established standard set of positions. Text should describe testing technique, standards methods, data format, and a graphical representation of test data which includes relative errors. Data files should be submitted as csv files. A required data format will be posted on the competition website.

D. Information about Key Team Members

Page limit: 2 pages maximum

Include information on the key team members and why they are well-suited to accomplish the project, with supporting information on their qualifications, skills, and capabilities (i.e., previous projects, experience) related to the FRST Challenge goals. If a team is not fully formed or lacks needed skills, information on the types of people they will add as team members or how they will secure the required skills through other methods should be provided. This may be updated information submitted in Phases 1 and 2.

E. Video Presentation for Judges

Length: Maximum of 10 minutes

Competitors should upload a video presentation for the judges describing the prototype, including any visual elements, prototype images, diagrams, and other information that will enable the judges to understand the competitor's approach and unique aspects of the technology. This video will include a demonstration of the prototype system being used in a live test.

F. Video Presentation for FRST Community

Length: 1 - 3 minutes

Competitors should upload a video presentation for the FRST Community describing their prototype, including any visual elements, prototype images, diagrams, and other information that will enable the community to understand the competitor's approach and unique aspects of the technology. Competitors should use their judgment in determining how much of their technology and approach they wish to share. This will be judged for compliance only.

G. Public Abstract

Page limit: 500-1,000 words

The competitor must provide an *updated* abstract that will be published on the FRST Portal as part of the community for everyone to view. Competitors are not required to change their abstract if previously submitted; however, if not changed, the abstract still needs to be included in this submission. The abstract can include any information from prior phases and new content from this phase, as the team desires. When preparing the abstract, keep in mind there may be ways you want to describe your solution to the judges that differ from the way you want to portray this to the larger community. Do not include proprietary or sensitive information in this summary. This public abstract will not be judged for quality but will be part of the pass/fail criteria of complying with submission requirements.

Review

The IU Crisis Technologies Innovation Lab will review each contestant's entry in the Refined Prototype Demonstration phase. A submission that fails to meet the compliance criteria will be disqualified and ineligible to compete in this phase. Submissions that pass the initial compliance review will be evaluated and scored by a panel of judges. IU makes an independent assessment of each submission based on the scoring criteria outlined below. During the review, each subject matter expert and Judging panel member will review entire submissions to which they are assigned. The review is not done in sections with different reviewers responsible for different assigned sections. Therefore, it is not necessary to repeat information in every part of the submission.

Do not include sensitive materials in the submission, for example, personally identifiable information like social security numbers, business-sensitive information, tax identification numbers, etc.

Evaluation Criteria and Judging

Judges will evaluate the Refined Prototype Demonstration using the following criteria:

Criterion 0: Compliance Check (pass/fail)

This criterion will be evaluated on the following factor:

- Completeness according to the 'How to Enter' section

  If a submission passes Criterion 0, it will be evaluated on the following criteria.

Criterion 1: Strategic Alignment & Technical Outcome (80%)

This criterion involves consideration of the following factors:

- Strategic Alignment (30%)–The extent to which the proposed approach meets the objectives listed in the FRST Challenge goals; the likelihood the contestant's solution, if successfully implemented, will result in a marketable product for first responders.

- Proposed Technology & Justification–Contestant's strategy for solving the problem statement, making technological improvements, and justification for those improvements aligns with the FRST Challenge goals.

- Method for 3D Location Tracking–Contestant demonstrates an understanding of indoor location tracking technologies, their approach's capabilities and limitations, and propose a viable path forward to mature their technology.

- Proposed Solution Meets First Responder Needs–Contestant's solution and approach demonstrate an understanding of first responder needs and the environments in which the solution will be deployed.

- Process for Deployment–A short example describing how the proposed solution would integrate into public safety operations when managing a common type of call for service where responders are operating inside a residential dwelling, multi-story structure, or below-grade location. The description should include a high-level overview of how the solution would be deployed upon arrival and utilized during the initial stages of incident management to track and view responder locations.

- Technical Outcome (10%)–Extent to which the proposed approach will result in significant improvement in commercially available technology and potentially result in a technical outcome that enables considerable progress toward the FRST Challenge goals.

- Progress made toward the Technical Outcome (40%)–Extent to which the competitor has made design and construction progress toward the Technical Outcome and Challenge metrics. The Prototype Demonstrations will be evaluated based on the submissions in parts B and C above. Extent to which the system has achieved the following traits:

  - Completion of four or more trials to demonstrate system's capabilities, including the Z-axis requirement listed below. These trials must display at least a 15-meter position sensing range on both the X and Y axis and three (or more) of these must have at least one 5-meter-wide barrier in place. Video and resulting data of these trials may be submitted to fulfill Sections C and E above - data from roughly 15 minutes of these trials should be submitted to meet Requirement C. The goal is +/- 2-meter accuracy. An accuracy description such as circular error radius or coordinate error should be noted in section B above. (20%)

    - A strongly suggested (but not required) testing "script" is available to download on FRSTChallenge.com/rules

  - Positioning in Z. Positioning in the Z-axis is to be described by method and core technology type(s). A demonstration of the data and accuracy is required independent of the X-Y plane. A change of elevation (e.g., traveling up and down stairs or elevator) of 5 meters is required. Accuracy within 2 meters is ideal. (10%)

  - Live communication (i.e., <10 second refresh rate and <1 second data acquisition rate) with "Command Center" hub, wired or wirelessly. The transmission should be dynamic and contain data that provides a means to visualize, tabularize, or describe location data. Off-line or post-deployment processing must be described in section B above and be accompanied by a

detailed plan that outlines how the solution can be operated in a live production environment. (5%)

- Position sensing with a barrier in place to approximate infrastructure-free sensing. This can be represented by walls, furniture, trees, etc. Submitted video and presentation of prototype systems should not require open-air or obstruction less data transmission as dependencies. (5%, pass/fail)

Criterion 2: Product Roadmap and Progress (20%)

As an update of Phase 2, the product roadmap describes, with milestones, a plan to improve prototype performance, and a list of questions and considerations to explore prior to Phase 4 development.

- Extent to which the roadmap realistically describes milestones to achieve technical goals of the FRST Challenge.
- Clear description of current unmet dependencies.
  - Extent to which plans are in place to produce a working, field-based prototype by phase 4.
  - Extent to which the prototype device is performing and a demonstrated awareness of how performance can be improved prior to Phase 4 prior to submitting an entry for the Phase 4 competition(s).
  - Extent to which data, interoperability, network or system communication, and regulatory compliances are addressed in the current state.
  - Extent to which the aforementioned topics can be adaptable should a standard or format be required or modified for subsequent phases.

Scoring for Refined Prototype Demonstration

The Refined Prototype Demonstration will be evaluated based on the criteria above. Each submission will be reviewed by subject matter experts and evaluated by a panel of judges. Each submission will be scored as follows: Criterion 1 will be recorded on a scale of 0 to 80 points, and criterion 2 will be recorded on a scale of 0 to 20 points. Contestants will not be provided oral or written feedback based on the evaluation of their submissions.

Phase 4 – Live Field Testing

All eligible contestants are invited to submit a complete prototype and participate in live field testing. First responders will use participant technologies in a series of authentic simulated tasks at the MUTC facilities (e.g., house fire; active shooter incident; search and rescue mission). Competitor prototypes should be in near-final form so that judges may effectively evaluate the usability of the design.

In addition to technical development, the teams will submit an improved business plan. During the Phase 4 period, teams will be invited to participate in a series of training and mentoring programs that will assist them in determining their strategy for commercialization. The team may pursue various strategies such as forming or expanding a business, licensing their technology, or selling their technology to an established company.

There are three main prize categories for the Phase 4 Live Field Testing.

1. Testing to determine a ranking of the competitors from first place to sixth place team.
2. Best in Class awards for teams that meet minimum goals set for each level.
3. Seed Business Development awards for initial business plans and to further commercialization efforts.

Eligibility: Only contestants as defined in *General Submission Requirements for All Phases (Rights & Warranties): Eligibility Requirements* and invited at the end of Phase 3 may submit to the main competition. Invited teams who do not participate in the live competition will be disqualified from consideration for awards.

Prizes: See Table 3

How to Enter

Review these Official Rules and submit the required documentation and videos through the FRST Portal. See Submission Requirements in *General Submission Requirements for All Phases* for document and datafile size specifications and video submission formats.

Teams' submissions for Phase 4 are in three parts:

Part 1: Items to be submitted before the Phase 4 Live Field Testing event (Due March 20)
- Documentation (Items A, B, C, D, G)
- Video Presentation for Judges (Item E)
- Video Presentation for FRST Community (Item F)
- Optional: Training Video for First Responder Role-Players (Item H)

Part 2: Items collected at Phase 4 Live Field Testing Event (March 27 – 31)
- Data collected via trials

Part 3: Items to submit after the Phase 4 Live Field Testing event (Due April 12) (Item I)
- Prototype Live Testing Results Review

Submission Requirements

A. Cover Page and Abstract

Page limit: 1-page maximum

The cover page must include:

- Contestant's Name or Team Name (Team, Organization or Entity Name with a complete list of individual team members)
- Contestant's Location (City, State/Region, and Country). If Team, Organization or Entity, must include the principal place of business
- Team Logo
- Official Representative and their preferred contact information (including email, phone, and physical mailing address); if different from a previous submission, indicate a change in the official representative
- A brief description (500 words maximum) of the unique aspects of the contestant's approach, the potential impact that the proposed approach could have in achieving

the goals of the FRST Challenge, and a general overview of the improvements made since the previous phase on the prototype. Do not include proprietary or sensitive information in this summary.

B. Prototype Documentation & Demonstration

Page limit: 20 pages maximum

The competitor teams will provide documentation of their prototype design, including information on all hardware, software, algorithms, and data formats developed as of the submission. Competitors should refer to the Phase 1 to 3 descriptions for the relevant items that will be addressed in this documentation. The team should describe updated results of testing of their prototypes and methodologies for addressing any issues discovered. A product roadmap should be provided that describes how the team will mature their prototype over the final phase of the competition.

C. Information about Key Team Members

Page limit: 2 pages maximum

Include information on the key team members and why they are well-suited to accomplish the project, with supporting information on their qualifications, skills, and capabilities (i.e., previous projects, experience) related to the FRST Challenge goals. If a team is not fully formed or lacks needed skills, information on the types of people they will add as team members or how they will secure the required skills through other methods should be provided. This may be updated information submitted in Phase 3.

D. Initial Business Plan

Page limit: 10 pages maximum including tables and figures

Competitors will be required to submit an initial business plan that will describe the business environment for their solution as well as plans for how their product will fit into the market. Forecasts for the required financial resources to successfully market the product, along with tentatively identified sources of funding will also need to be included. Letters of support, documentation of strategic partnerships, sales and distribution agreements, and other supporting documentation may be provided and will not count toward the maximum page count.

E. Video Presentation for Judges

Length: Maximum of 10 minutes

Competitors should upload a video presentation for the judges describing the prototype, including any visual elements, prototype images, diagrams, and other information that will enable the judges to understand the competitor's approach and unique aspects of the technology. This video will include a demonstration of the prototype system being used in a simulated field setting.

F. Video Presentation for FRST Community

Length: Maximum of 10 minutes

Competitors should upload a video presentation for the FRST Community describing their prototype, including any visual elements, prototype images, diagrams, and other information that will enable the community to understand the competitor's approach and unique aspects of

the technology. Competitors should use their judgment in determining how much of their technology and approach they wish to share. This will be judged for compliance only.

G. Public Abstract

Page limit: 500-1,000 words

The competitor must provide an *updated* abstract that will be published on the FRST Portal as part of the community for everyone to view. Competitors are not required to change their abstract if previously submitted; however, if not changed, the abstract still needs to be included in this submission. The abstract can include any information from prior phases and new content from this phase, as the team desires. When preparing the abstract, keep in mind there may be ways you want to describe your solution to the judges that differ from the way you want to portray this to the larger community. Do not include proprietary or sensitive information in this summary. This public abstract will not be judged for quality but will be part of the pass/fail criteria of complying with submission requirements.

H. Optional: Training Video for First Responder Role-Players

- Teams may provide a brief (3-minute or less) video that instructs First Responder users on how to use your technology while conducting testing in authentic scenarios. Videos longer than 3 minutes will not be provided to the role-players. This video will be provided to the role-players prior to the trials
- Prior to each field test, teams will also have 10 minutes to interact with role-player(s) and will be permitted to install the technology on Role-Player equipment and provide additional instructions for use.
- Teams may not accompany role-players through testing scenarios.

I. Prototype Live Testing Results Review

Due April 12, 2023

Page limit: 5 pages text & graphics

Following the Phase 4 Live Field Testing Event, teams will be provided with:

- Information about the FRST Ground Truth system at this test
- An analysis of their technology's performance compared to this ground truth system
- Additional information about the testing environment and routes
- A copy of the data that was submitted to FRST Admins on-site
- In response, teams are required to submit a document that contains an analysis of their technology's performance that addresses:
  - Causes of variance in accuracy across and throughout trials - building construction type, environmental factors, movement type, etc.
  - Explain how they will overcome these inconsistencies moving forward to Phase 5 and the market
  - Any additional observations regarding prototype performance.

Review

The IU Crisis Technologies Innovation Lab will review each contestant's entry in the Live Field Test phase. A submission that fails to meet the compliance criteria will be disqualified and ineligible to compete in this phase. Submissions that pass the initial compliance review will be evaluated and scored by a panel of judges. IU makes an independent assessment of each submission based on the scoring criteria outlined below. During the review, each subject matter expert and Judging panel member will review entire submissions to which they are assigned. The review is not done in sections with different reviewers responsible for different assigned sections. Therefore, it is not necessary to repeat information in every part of the submission.

Do not include sensitive materials in the submission, for example, personally identifiable information like social security numbers, business-sensitive information, tax identification numbers, etc.

Evaluation Criteria and Judging

Judges will evaluate the full prototype and test results using the following criteria:

Criterion 0: Compliance Check (pass/fail)

This criterion will be evaluated on the following factor:

- Completeness according to the 'How to Enter' section

If a submission passes Criterion 0, it will be evaluated on the following criteria.

Criterion 1: Strategic Alignment with Technical Outcome (30%)

This criterion involves consideration of the following factors:

- Strategic Alignment (20%)–The extent to which the proposed approach meets the objectives listed in the FRST Challenge goals; the likelihood the contestant's solution, if successfully implemented, will result in a marketable product for first responders.

    - Proposed Technology & Justification–Contestant's strategy for solving the problem statement, making technological improvements, and justification for those improvements aligns with the FRST Challenge goals.

    - Method for 3D Location Tracking–Contestant demonstrates an understanding of indoor location tracking technologies, their approach's capabilities and limitations, and propose a viable path forward to mature their technology.

    - Proposed Solution Meets First Responder Needs–Contestant's solution and approach demonstrate an understanding of first responder needs and the environments in which the solution will be deployed.

    - Process for Deployment- Contestant's solution and approach should secondarily be described in a manner that First Responders could provision, integrate, and utilize during a hypothetical deployment. For example, a 911 call is placed describing an event at a residential, two-story home.

- Technical Outcome (10%)–Extent to which the proposed approach will result in significant improvement in commercially available technology and potentially result in a technical outcome that enables considerable progress toward the FRST Challenge goals.

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Criterion 2: Technical Outcomes from Live Challenge (60%)

This criterion will consider the performance of each prototype over Challenge testing courses consisting of both indoor courses and obscured outdoor courses, including some subterranean locations such as basements or tunnels:

- Extent to which the system has performed the following tasks:

    - Monitored X-Y position along each course over a timescale of up to 20 minutes and through several rooms with various barrier materials over length scales of up to 100 meters. The goal for full scoring is 1.5-meter accuracy relative to pre-determined waypoints along the course. (33%)

    - Positioning in Z. Positioning in the Z-axis is to be judged independent of the X-Y plane, although position in Z will be measured concurrently with the X-Y position. A change of elevation (e.g., traveling up and down stairs or elevator) of up to 15 meters will be tested. The goal for full scoring is 2-meter accuracy relative to pre-determined waypoints. (27%)

    - Teams are required to transmit to their own receiving device wirelessly in real-time (<10-second refresh rate and <1-second data acquisition rate). Teams may not use MUTC-provided wireless networks to transmit this data. The transmission should be dynamic and contain data that provides a means to visualize, tabularize, or describe location data in a live environment.
    - Immediately following the trial, teams will be required to provide data from the trial to FRST admins in the required data format. Any data post-processing following the trial is not permitted. This data will be collected as a batch via USB or cloud data transfer.
    - For scoring of these criteria, the results of all test runs will be considered in aggregate.

Criterion 3: Initial Business Plans (10%)

Separate from the technically focused Product Roadmap, the initial business plan will address at least the following issues:

- Cost of development of initial production-ready product.
    - Include costs to create business and development teams
    - Include additional costs to develop an initial marketable product
- Identification of potential sources of investment to surpass the costs associated with productization.
- Potential market size
    - Including dependencies on the final product specifications
- Potential initial product cost to produce, cost to purchase, and ongoing customer costs.
- Value added for the customer through product use.
- A modified technical product roadmap should be included.

Scoring for Live Field Testing

Main Competition. The entire prototype demonstration and test results will be evaluated based on the criteria above. Each submission will be reviewed by subject matter experts and evaluated by a panel of judges. Each submission will be scored as follows: Criterion 1 will be recorded on

a scale of 0 to 30 points, criterion 2 will be recorded on a scale of 0 to 60 points and criterion 3 will be recorded on a scale of 0 to 10 points. Contestants will not be provided oral or written feedback based on the evaluation of their submissions.

Best in Class Award. The BIC awards provide an opportunity for teams to receive additional prize funds for meeting overall competition goals. BIC scoring is based on Phase 5 judging criteria. All Phase 4 submissions will be judged using Phase 5 criteria to determine if any teams have meet BIC award thresholds. See BIC scoring criteria under Phase 5 for requirements. The judges may determine that no team has meet the minimum threshold for any of the BIC levels during Phase 4 and no awards will be made during Phase 4 judging.

Phase 5 – Advanced Live Field Testing

All eligible contestants are invited to submit a complete prototype and participate in advanced live field testing. First responders will use participant technologies in a series of advanced authentic simulated tasks at the MUTC facilities (e.g., house fire; active shooter incident; search and rescue mission). Competitor prototypes should be in final form so that judges may effectively evaluate the design's usability, ruggedization, and overall market readiness. At this stage, prototypes should be deployable in a full spectrum of first responder use cases and be hardened to withstand rigorous physical and cyber testing. (

> Note that previous versions of the rules indicated cybersecurity testing in Phase 5 but this has been removed. Competitors are encouraged to address cybersecurity and other items described in Table 1 and other places in their documentation even if not explicitly tested in the live field test.

Teams should have utilized seed business development funds to develop a complete business plan with go-to-market strategy, financial model, and other key elements. The winning teams should be at the stage where there is a clear path from their prototype to a product on the market following the competition.

There are three prize categories for the Phase 5 Advanced Live Field Testing.

1. Testing to determine a rating of the submissions as either Excellent, Good, or Fair
2. Best in Class awards for teams that meet minimum goals for each level (using any unallocated funds from Phase 4)
3. Public Safety People's Choice is determined by public safety judges and experts

Eligibility: Only contestants as defined in *General Submission Requirements for All Phases (Rights & Warranties): Eligibility Requirements* and invited at the end of Phase 4 may submit to the main competition. Invited teams who do not participate in the live competition will be disqualified from consideration for awards.

Prizes: See Table 3

How to Enter

Review these Official Rules and submit the required documentation and videos through the FRST Portal. The format of submission will be described upon full release of the rules. See Submission Requirements in *General Submission Requirements for All Phases* for document size specifications and video submission formats.

Submission Requirements

A. Cover Page and Abstract

Page limit: 1-page maximum

The cover page must include:

- Contestant's Name or Team Name (Team, Organization or Entity Name with a complete list of individual team members)
- Contestant's Location (City, State/Region, and Country). If Team, Organization or Entity, must include the principal place of business
- Team Logo
- Official Representative and their preferred contact information (including email, phone, and physical mailing address); if different from a previous submission, indicate a change in the official representative
- A brief description (500 words maximum) of the unique aspects of the contestant's approach, the potential impact that the proposed approach could have in achieving the goals of the FRST Challenge, and a general overview of the improvements made since the previous phase on the prototype. Do not include proprietary or sensitive information in this summary.

B. Prototype Documentation & Demonstration

Page limit: 20 pages maximum

The competitor teams will provide documentation of their prototype design, including information on all hardware, software, algorithms, and data formats developed as of the submission. Competitors should refer to the Phase 1 to 4 descriptions for the relevant items that will be addressed in this documentation. The team should describe updated results of testing of their prototypes and methodologies for addressing any issues discovered. A product roadmap should be provided that describes how the team will mature their prototype after Phase 5 and bring it to market.

C. Prototype Documentation for Public Dissemination

Page limit: Web form

Competitors will be required to submit documentation of their prototype in a standardized format that can be used by the competition for publications, reports, presentations, marketing and other uses. This documentation will include images of the final prototype, measurements such as size and weight, schematics, and other information. A preliminary version of the information may be due shortly before the live field testing, with revisions, as needed, due after the event.

D. Information about Key Team Members

Page limit: 2 pages maximum

Include information on the key team members and why they are well-suited to accomplish the project, with supporting information on their qualifications, skills, and capabilities (i.e., previous projects, experience) related to the FRST Challenge goals. If a team is not fully formed or lacks needed skills, information on the types of people they will add as team members or how they

will secure the required skills through other methods should be provided. This may be updated information submitted in Phase 3.

E. Final Business Plan

Page limit: 10 pages maximum including tables and figures

Competitors will submit a full business plan containing information that will enable the judges to evaluate the team's strategy for commercialization. The competition will provide resources, training, and mentoring to help teams develop this plan. Competitors will be required to submit information that will describe the business environment for their solution as well as plans for how their product will fit into the market. Forecasts for the required financial resources to successfully market the product, along with identified sources of funding will also need to be included. Letters of support, documentation of strategic partnerships, sales and distribution agreements and other supporting documentation may be provided and will not count towards the maximum page count.

F. Video Presentation for Judges

Length: Maximum of 10 minutes

Competitors should upload a video presentation for the judges describing the prototype, including any visual elements, prototype images, diagrams, and other information that will enable the judges to understand the competitor's approach and unique aspects of the technology. This video will include a demonstration of the prototype system being used in a simulated field setting and shall be uploaded by the first day of field testing.

G. Video Presentation for FRST Community

Length: Maximum of 10 minutes

Competitors should upload a video presentation for the FRST Community describing their prototype, including any visual elements, prototype images, diagrams, and other information that will enable the community to understand the competitor's approach and unique aspects of the technology. Competitors should use their judgment in determining how much of their technology and approach they wish to share. This will be judged for compliance only.

H. Public Abstract

Page limit: 500-1,000 words

The competitor must provide an *updated* abstract that will be published on the FRST Portal as part of the community for everyone to view. Competitors are not required to change their abstract if previously submitted; however, if not changed, the abstract still needs to be included in this submission. The abstract can include any information from prior phases and new content from this phase, as the team desires. When preparing the abstract, keep in mind there may be ways you want to describe your solution to the judges that differ from the way you want to portray this to the larger community. Do not include proprietary or sensitive information in this summary. This public abstract will not be judged for quality but will be part of the pass/fail criteria of complying with submission requirements.

I. Optional: Training Video for First Responder Role-Players

- Teams may provide a brief (3-minute or less) video that instructs First Responder users on how to use your technology while conducting testing in authentic scenarios. Videos

longer than 3 minutes will not be provided to the role-players. This video will be provided to the role-players prior to the trials.
- Prior to each field test, teams will also have a setup period to interact with role-player(s) and will be permitted to install the technology on Role-Player equipment and provide additional instructions for use.
- Teams may not accompany role-players through testing scenarios.
- This video may be submitted on or before October 23, 2023.

Review

The IU Crisis Technologies Innovation Lab will review each contestant's entry in the Live Field Test phase. A submission that fails to meet the compliance criteria will be disqualified and ineligible to compete in this phase. Submissions that pass the initial compliance review will be evaluated and scored by a panel of judges. IU makes an independent assessment of each submission based on the scoring criteria outlined below. During the review, each subject matter expert and Judging panel member will review entire submissions to which they are assigned. The review is not done in sections with different reviewers responsible for different assigned sections. Therefore, it is not necessary to repeat information in every part of the submission.

Do not include sensitive materials in the submission, for example, personally identifiable information like social security numbers, business-sensitive information, tax identification numbers, etc.

Evaluation Criteria and Judging

Judges will evaluate the final prototype and test results using the following criteria:

Criterion 0: Compliance Check (pass/fail)

This criterion will be evaluated on the following factor:

- Completeness according to the 'How to Enter' section

If a submission passes Criterion 0, it will be evaluated on the following criteria.

Criterion 1: Strategic Alignment with Technical Outcome (25%)

This criterion involves consideration of the following factors:

- Strategic Alignment: Overall (10%)–The extent to which the proposed approach meets the objectives listed in the FRST Challenge goals; the likelihood the contestant's solution, if successfully implemented, will result in a marketable product for first responders. (Note this score is primarily derived from written documentation including product roadmap.)
    - Proposed Technology & Justification–Contestant's strategy for solving the problem statement, making technological improvements, and justification for those improvements aligns with the FRST Challenge goals.
    - Method for 3D Location Tracking–Contestant demonstrates an understanding of indoor location tracking technologies, their approach's capabilities and limitations, and propose a viable path forward to mature their technology.
    - Proposed Solution Meets First Responder Needs–Contestant's solution and

approach demonstrate an understanding of first responder needs and the environments in which the solution will be deployed.

- Process for Deployment- Contestant's solution and approach should secondarily be described in a manner that First Responders could provision, integrate, and utilize during a hypothetical deployment. For example, a 911 call is placed describing an event at a residential, two-story home.

- Teams should identify key differences between their expected product and the prototype deployed in the live field testing.

- Technical Outcome (5%)–Extent to which the proposed approach will result in significant improvement in commercially available technology and potentially result in a technical outcome that enables considerable progress toward the FRST Challenge goals. (Note this score is primarily derived from written documentation including product roadmap.)

- Technical Outcome: Usability, Robustness, and Ruggedization from Live Challenge (10%)

  - Ease of Deployment–The practicality and efficiency of deploying the devices and infrastructure needed to use a team's solution.

  - User Experience–Proposed solutions should be straightforward for personnel to use in various situations in the field. Usability will be assessed across the entire solution and will be an essential metric in live field testing.

  - Robustness/Ruggedization–Prototypes must operate effectively in multiple scenarios, adverse conditions, and environments. This score is also based on the solution's durability, flexibility, and expected maintenance needs. In addition, various technical criteria will be evaluated within the entire prototype across critical technical systems, including power, sensors, communication with other responders and incident command, and data management.

    - Due to the financial implications of potentially damaging prototype(s) during ruggedization testing, teams may opt out of ruggedization testing at the cost of the 5% of points allotted to this category.

Criterion 2: Technical Outcomes from Live Challenge (60%)

This criterion will consider the performance of each prototype over Challenge testing courses consisting of both indoor courses and obscured outdoor courses, including some subterranean locations such as basements or tunnels:

- Extent to which the system has performed the following tasks:

  - Monitored X-Y position along each course over a timescale of up to 20 minutes and through several rooms with various barrier materials over length scales of up to 1000 meters. The goal for full scoring is 1.0-meter accuracy relative to pre-determined waypoints along the course. (30%)

  - Positioning in Z. Positioning in the Z-axis is to be judged independent of the X-Y plane, although position in Z will be measured concurrently with the X-Y position. A change of elevation (e.g., traveling up and down stairs or elevator) of up to 20 meters will be tested. The goal for full scoring is 1.0-meter accuracy relative to pre-determined waypoints. (24%)

  - Teams are required to transmit to their own receiving device wirelessly in real

time (<10-second refresh rate and <1-second data acquisition rate). Teams may not use MUTC-provided wireless networks to transmit this data. The transmission should be dynamic and contain data that provides a means to visualize, tabularize, or describe location data in a live environment. This data must be transmitted to FRST servers during the trial in accordance with the Phase 5 Data Format and Protocol Requirements document. (6%)

- Teams should record a local copy of this data to provide as a backup in the case of transmission failure to FRST servers.

- For scoring of these criteria, the results of all test runs will be considered in aggregate.

Criterion 3: Final Business Plans (15%)

Separate from the technically focused Product Roadmap, the full business plan will address at least the following issues:

- Cost of development of the initial production-ready product.
  - Include costs to create business and development teams
  - Include additional costs to develop an initial marketable product
- Identification of potential sources of investment to surpass the costs associated with productization.
- Potential market size
  - Including dependencies on the final product specifications
- Potential initial product cost to produce, cost to purchase, and ongoing customer costs.
- Value-added for the customer through product use.
- A modified technical product roadmap should be included.
- Demonstrated market support of the product, development of marketing and sales partnerships, and other validations of business maturation.

Scoring for Advanced Live Field Testing

Main Competition. The final prototype demonstration and test results will be evaluated based on the criteria above. Each submission will be reviewed by subject matter experts and evaluated by a panel of judges. Each submission will be scored as follows: Criterion 1 will be recorded on a scale of 0 to 25 points, criterion 2 will be recorded on a scale of 0 to 60 points and criterion 3 will be recorded on a scale of 0 to 15 points. Contestants will not be provided oral or written feedback based on the evaluation of their submissions.

Best in Class Award. The judges will evaluate all submissions for achievement of the BIC Awards. Up to four teams will be selected based on the achievement of thresholds. Best in Class Awards will be selected based on performance and judge review set forth in the rules for Phase 5 criteria. The competitors are automatically reviewed for this award as part of their submission. The judges may determine that no team has met the minimum threshold for any of the BIC levels during Phase 5, and no awards will be made during Phase 5 judging. See footnote 5 in Table 3.

BIC Level 1: Criterion 1 score of 25. Criterion 2 score of 60. Criterion 3 score of 15 or higher.

BIC Level 2: Criterion 1 score of 23.25 or higher. Criterion 2 score of 55.8 or higher. Criterion 3 score of 13 or higher.

BIC Level 3: Criterion 1 score of 17 or higher. Criterion 2 score of 54 or higher. Criterion 3 score of 11.75 or higher.

Public Safety People's Choice Award. The judges will use the input of first responder subject matter experts and role-players to select one winner of the people's choice award. They will provide a rank order of the Phase 5 competitor prototypes based on their individual perceptions of usability, scalability, affordability, and applicability to the first responder market.

General Submission Requirements for All Phases (Rights & Warranties)

The challenge is administered by the Trustees of Indiana University (IU; Indiana University) through a cooperative agreement with the National Institute of Standards and Technology (NIST). Rules and guidelines are derived from both federal and university requirements. IU is managing the competition through the IU Crisis Technologies Innovation Lab (IU CTIL).

Eligibility Requirements

A contestant (whether an individual, private entity, or team ("Contestant" herein)) must have registered to participate and complied with all of the requirements under Section 105 of the America COMPETES Reauthorization Act of 2010 (Pub. L. No. 111-358), as amended by Section 401 of the American Innovation and Competitiveness Act of 2016 (Pub. L. No. 114-329) and codified in 15 U.S.C. §3719 (hereinafter "America COMPETES Act" or "15 U.S.C. §3719") as contained herein.

A Contestant who registers or submits an entry (whether an individual, private entity, or team or anyone acting on behalf of a private entity or team) to participate in this Challenge represents that they have read, understood, and agree to all terms and conditions of the Official Rules.

To be eligible to win a cash prize, a Contestant must register as an individual, private entity, or team as defined below:

- Individual: a person age 18 or older at time of entry and a U.S. citizen or permanent resident of the United States or its territories.

- Private Entity: a company, institution, or other organization that is incorporated in and maintains a primary place of business in the United States or its territories.

- Team: a group of individuals or a group of private entities, with at least one member of the team meeting the definition for either Individual or Private Entity.

Contestants not eligible for cash prizes: a contestant that enters the challenge without the ability to claim a cash prize based on the eligibility requirements above. Contestants not eligible for cash prizes must be age 18 years or older at time of entry and cannot be individuals on the denied persons list nor from entities or countries sanctioned by the United States Government.

Submission Requirements

In order for submissions to be eligible for review, recognition and award, contestants must meet the following requirements:

- Deadline - The submission must be available for evaluation by the end date noted in the "Important Dates" section of these rules.

- Each submission must be original, the work of the contestant, and must not infringe, misappropriate, or otherwise violate any intellectual property rights, privacy rights, or any other rights of any person or entity.

- It is an express condition of submission and eligibility that each contestant warrants and represents that the contestant's submission is solely owned by the contestant, that the submission is wholly original with the contestant, and that no other party has any ownership rights or ownership interest in the submission. The contestant must disclose if they are subject to any obligation to assign intellectual property rights to parties other than the contestant, if the contestant is licensing or, through any other legal instrument, utilizing intellectual property of another party.

- Each contestant further represents and warrants to NIST and IU that the submission and any use thereof by NIST and IU shall not: (i) be defamatory or libelous in any manner toward any person, (ii) constitute or result in any misappropriation or other violation of any person's publicity rights or right of privacy, or (iii) infringe, misappropriate, or otherwise violate any intellectual property rights, privacy rights or any other rights of any person or entity.

- Each submission must be in English.

- Submissions of any required videos for evaluation must be in .mp4 format.

- Eligible formats for the evaluation of Phases 2-5 are applications (software), hardware, and text files (e.g., .docx, .pdf).

- All materials submitted should conform to specific guidelines provided for each phase. Except where otherwise noted, all document submissions must use one-inch margins on 8.5 by 11-inch paper (215.9 by 279.4 mm) ("US Letter") with a minimum font size of 11-points and single-line spacing. Diagrams and images may use fonts no smaller than 9-points.

Submissions containing any matter which, in the sole discretion of IU or NIST, is indecent, obscene, defamatory, libelous, in bad taste, which demonstrates a lack of respect for public morals or conduct, which promotes discrimination in any form, which shows unlawful acts being performed, which is slanderous or libelous, or which adversely affects the reputation of IU or NIST, will not be accepted, and will not be evaluated or considered for an award. IU shall have the right to remove any content from the challenge websites and community portal in its sole discretion at any time and for any reason, including, but not limited to, any online comment or posting related to the Challenge.

If IU, in its sole discretion, finds any submission to be unacceptable, then such submission shall be deemed disqualified.

General Eligibility Requirements

For all Contestants, general eligibility requirements include:

- Contestants may not be a Federal entity or Federal employee acting within the scope of their employment.

- Contestants may not be a NIST employee.

- Non-NIST Federal employees acting in their personal capacities should consult with their respective agency ethics officials to determine whether their participation in this Challenge is permissible. A contestant shall not be deemed ineligible because the individual or entity used Federal facilities or consulted with Federal employees during

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this challenge if the Federal employees and facilities are made available to all contestants on an equitable basis.

- Contestants from Indiana University and its contractors are allowed to participate in the competition except as follows individuals who are directly employed by the IU CTIL as an employee, or is a contractor or associate, or private entity providing services to the IU CTIL for the FRST Challenge acting within the scope of their contract, employment, or funding or acquisition agreement with the IU CTIL which would involve the use of IU funding to support a contestant's participation in the challenge.

- Contestants may not be individuals or private entities which provide program support services to the IU Crisis Technologies Lab, including strategic planning, project/program management, communications, reporting, program evaluation, or other similar services to the IU Crisis Technologies Innovation Lab.

- Any individuals (including an individual's parent, spouse, or child) or private entities involved with the design, production, execution, distribution or evaluation of the Challenge are not eligible to enter as an individual or member of a team.

- Employees of any official co-sponsoring entities are not eligible to enter, if those employees are directly or indirectly involved in supporting the challenge.

- A Contestant (whether participating as an individual, private entity, or member of a team) must not have been convicted of a felony criminal violation under any Federal law within the preceding 24 months and must not have any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

- Contestants must not be suspended, debarred, or otherwise excluded from doing business with the Federal Government.

Special Eligibility Requirements

- Individuals currently receiving NIST funding through a grant or cooperative agreement are eligible to compete but may not utilize the NIST funding for competing in this challenge.

- Previous and current PSCR prize challenge contestants are eligible to enter.

Official Representative

At the time of entry, all contestants must designate one individual to serve as their Official Representative and one individual to serve as an alternate to assume the role and requirements of the Official Representative if, and only if, the first individual has resigned from their role as Official Representative or has failed to respond to IU CTIL communications for 30 consecutive days. The Official Representative will be the only individual with authority to officially interact and communicate with IU CTIL regarding the contestant-created materials, completion of tasks as part of the challenge, signing official documentation related to the challenge, providing information to process prize payments, and any other administrative requests related to the challenge.

The eligibility of a contestant is determined by the Contestant's registration status (individual, private entity or team) as defined above – the Official Representative does not determine the Contestant's eligibility.

- For Individual Contestants, by default, the Official Representative must be the individual.
- For Private Entity Contestants, the Official Representative can be any individual designated by the Private Entity.
- For a Team Contestant
  - If the Team is comprised of Individuals, the Official Representative must be a team member who individually meets the eligibility requirements of an Individual Contestant.
  - If the Team is comprised of Private Entities, the Official Representative can be any individual designated by the Private Entity leading the team.
  - If the Team is comprised of a mix of Individuals and Private Entities, the Official Representative, designated by the team, can be any qualified individual meeting the requirements of an Individual or member of a Private Entity.

The Official Representative will be authorized to interact with IU CTIL and be responsible for meeting all entry, evaluation, and administrative requirements of the challenge.
If a contestant decides to withdraw their submission from consideration, the Official Representative must notify IU CTIL in writing of their decision.

If a contestant (whether an individual, private entity, or team) is selected as a prize winner, the Official Representative must register the team in the Indiana University BUY.IU system and provide appropriate payment information within ten (10) calendar days of notification of award. The named account must belong to an individual or private entity as defined above in the eligibility requirements for Individual or Private Entity. The Trustees of Indiana University will award a single dollar amount to the account named in this system by the Official Representative.

On behalf of the team, as defined above, the Official Representative shall be solely responsible for allocating any prize amount among the members of the team. IU CTIL will not arbitrate, intervene, advise on, or resolve any matters between team members.

Judging Panel

A qualified panel of experts selected by the Director of NIST will judge the submissions. The panel consists of experts from within NIST and outside of NIST; they will evaluate the submissions according to the criteria identified above to select winners. Judges will not have personal or financial interests in, or be an employee, officer, director, or agent of any entity that is a registered contestant in the challenge; or have a familial or financial relationship with an individual who is a registered contestant. The judging panel's decisions for the contest will be announced in accordance with the dates noted in these rules. IU will not make evaluation results from the judging panel available to contestants or the public.

Conflicts of Interest Review

Judges will not (A) have personal or financial interests in, or be an employee, officer, director, or agent of any entity that is a registered contestant in a challenge; or (B) have a familial or financial relationship with an individual who is a registered contestant.

Tie-Breaking

In the event of a tie between contestants, the judges will review the evaluations of the contestant submissions to assess if there is a means based on the evaluation data to

differentiate the submissions in order to break the tie. If the submissions cannot be differentiated to break the tie based on the evaluation data, the contestants shall split equally the combined prize amounts of the tie (for example, a tie for 1st place, where the 1st place prize is $30,000 and the 2nd place prize is $20,000 will result in the two contestants each being awarded $25,000 (equaling ($30,000 + $20,000)/2). If this tie-breaking provision is applied, the tied contestants will share the highest-placed prize, and the next lower place prize will be "skipped" (for example, 1st, 1st, 3rd, etc.). This tie-breaking provision will be applied to all ties involving two or more contestants. In resolving all ties, the total cumulative value of prizes awarded will not change.

Notification and Verification of Potential Winners:

ALL POTENTIAL CHALLENGE WINNERS WILL BE SUBJECT TO VERIFICATION OF IDENTITY, QUALIFICATIONS AND ROLE IN THE CREATION OF THE SUBMISSION BY THE TRUSTEES OF INDIANA UNIVERSITY.

Contestants must comply with all terms and conditions of the Official Rules. Winning a prize is contingent upon fulfilling all requirements contained herein. The potential winners will be notified by email, telephone, or mail after the date of winning results. Each potential winner of a monetary or non-monetary award will be required to register the team in the Indiana University BUY.IU system and provide appropriate payment information to the Trustees of Indiana University within ten (10) calendar days of the date the notice is sent, and a Contestant Eligibility Verification form in order to claim the prize.

In the sole discretion of the Trustees of Indiana University, a potential winner will be deemed ineligible to win if: (i) the person/entity cannot be contacted; (ii) the person/entity fails to complete their registration in the Indiana University BUY.IU system and a Contestant Eligibility Verification form within the required time period; (iii) the prize or prize notification is returned as undeliverable; or (iv) the submission or person/entity is disqualified for any other reason. In the event that a potential or announced winner is found to be ineligible or is disqualified for any reason, the Trustees of Indiana University, in their sole discretion, may award the prize to another contestant.

Winners Not Eligible for Cash Prizes:

Winners who are found to be ineligible for cash prizes may still be publicly recognized. In the event that the prize award normally allotted to the place or rank of an ineligible winner occurs, the cash prize will be awarded to the next eligible winner in the series or ranking. Throughout the challenge, winners who are ineligible for cash prizes will continue to have opportunities to have their work viewed and appreciated by stakeholders from industry, government, and academic communities.

No Endorsement

You agree that nothing in these Rules grants you a right or license to use any names or logos of NIST or the Department of Commerce, or the Trustees of Indiana University or any other intellectual property or proprietary rights of NIST or the Department of Commerce or the Trustees of Indiana University or their employees or contractors.

Submission Rights

Any applicable intellectual property rights to a submission will remain with the contestant. The

contestant is not granting any rights in any patents, pending patent applications, or copyrights related to the technology described in the entry. However, the contestant is granting the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University certain limited rights as set forth herein.

- The contestant grants to the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University and any parties acting on its behalf the right to review the submission, to describe the submission in any materials created in connection with this challenge, and to screen and evaluate the submission, and to have the judges, Challenge administrators, and the designees of any of them, review the submission. The Department of Commerce, National Institute of Standards and Technology, the Trustees of Indiana University, and any Challenge Co-Sponsors, will also have the right to publicize contestant's name and, as applicable, the names of contestant's team members and/or organization which participated in the submission following the conclusion of each phase of the challenge.

- You grant to NIST and the IU and any parties acting on their behalf, the right to include your name and your company or institution name and logo (if your entry is from a company or institution) as a Contestant on the Challenge Website and in materials from NIST or IU, and any parties acting on their behalf, announcing Winners, Finalists or Contestants in the Challenge. Other than these uses or as otherwise set forth herein, you are not granting NIST or IU any rights to your trademarks.

- The contestant grants the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University, and any parties acting on their behalf, a royalty-free, non-exclusive, irrevocable, worldwide license to display publicly and use for promotional purposes the contestant's entry ("demonstration license"). This demonstration license includes posting or linking to the contestant's entry on the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University's websites, including the challenge website and inclusion of the contestant's submission in any other media, worldwide.

- Any data generated in the evaluation of contestant submissions is the property of the Trustees of Indiana University. The contestants, reviewers, and judges involved in the evaluation acknowledge and agree IU will own this evaluation data, and that the evaluation data created can be used in future research and development activities. To the extent that IU is able to, IU will anonymize for research purposes, whether it is used internally or published, any such data and will not include any contestant's, reviewer's, or judge's personally identifiable information. The contestant acknowledges and agrees that the data generated through evaluation of submissions may be used by IU for future research related to the challenge.

Warranties

Each contestant represents and warrants that the contestant is the sole author and copyright owner of the submission; that the submission is an original work of the contestant; and that the contestant has acquired sufficient rights to use and to authorize others, including the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University, to use the submission, as specified throughout the Official Rules, that the submission does not infringe upon any copyright or upon any other third party rights of which the contestant is aware; and that the submission is free of malware.

The contestant represents and warrants that all information submitted is true and complete to

the best of the contestant's knowledge, that the contestant has the right and authority to submit the entry on the contestant's own behalf or on behalf of the persons and entities that the contestant specifies within the entry, and that the entry (both the information and materials submitted in the entry and the underlying technology/method/idea/treatment protocol/solution described in the entry):

- is the contestant's own original work, or is submitted by permission with full and proper credit given within the entry;

- does not contain proprietary or confidential information or trade secrets (the contestant's or anyone else's);

- does not knowingly violate or infringe upon the patent rights, industrial design rights, copyrights, trademarks, rights in technical data, rights of privacy, publicity or other intellectual property or other rights of any person or entity;

- does not contain malicious code, such as viruses, malware, timebombs, cancelbots, worms, Trojan horses or other potentially harmful programs or other material or information;

- does not and will not violate any applicable law, statute, ordinance, rule or regulation, including, without limitation, United States export laws and regulations, including but not limited to, the International Traffic in Arms Regulations and the Department of Commerce Export Regulations; and

- does not trigger any reporting or royalty or other obligation to any third party.

No Confidential Information

Each contestant agrees and warrants that no part of its submission includes any trade secret information, ideas or products, including but not limited to information, ideas or products within the scope of the Trade Secrets Act, 18 U.S.C. § 1905. All submissions to this prize challenge are deemed non-proprietary. Since NIST and IU will not accept or hold any submitted materials "in confidence" it is agreed that, with respect to the contestant's entry, no confidential or fiduciary relationship or obligation of secrecy is established between NIST, IU and the contestant, the contestant's team, or the company or institution the contestant represents when submitting an entry, or any other person or entity associated with any part of the contestant's entry.

Additional Terms and Conditions

This document outlines the Official Rules for the FRST Challenge. Nothing within this document or in any documents supporting the FRST Challenge shall be construed as obligating the Department of Commerce, NIST or any other Federal agency or instrumentality or the Trustees of Indiana University to any expenditure of appropriated funds, or any obligation or expenditure of funds in excess of or in advance of available appropriations.

Challenge Subject to Applicable Law

All challenge phases are subject to all applicable federal and state laws and regulations. Participation constitutes each contestant's full and unconditional agreement to these Official Rules and administrative decisions, which are final and binding in all matters related to the challenge. Eligibility for a prize award is contingent upon fulfilling all requirements set forth herein. This notice is not an obligation of funds; the final award of prizes is contingent upon the

availability of appropriations.

Participation is subject to all U.S. federal, state and local laws and regulations. Contestants are responsible for checking applicable laws and regulations in their jurisdiction(s) before participating in the prize challenge to ensure that their participation is legal. The Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University shall not, by virtue of conducting this prize challenge, be responsible for compliance by contestants in the prize challenge with Federal Law including licensing, export control, and nonproliferation laws, and related regulations. Individuals entering on behalf of or representing a company, institution or other legal entity are responsible for confirming that their entry does not violate any policies of that company, institution or legal entity.

Resolution of Disputes

The Trustees of Indiana University are solely responsible for administrative decisions, which are final and binding in all matters related to the challenge.

In the event of a dispute as to any registration, the authorized account holder of the email address used to register will be deemed to be the contestant. The "authorized account holder" is the natural person or legal entity assigned an email address by an Internet access provider, online service provider or other organization responsible for assigning email addresses for the domain associated with the submitted address. Contestants and potential winners may be required to show proof of being the authorized account holder.

Publicity

The winners of these prizes (collectively, "Winners") will be featured on the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University websites, newsletters, social media, and other outreach materials.

Except where prohibited, participation in the challenge constitutes each winner's consent to the Department of Commerce, National Institute of Standards and Technology's and the Trustees of Indiana University's, their agents', and any challenge co-sponsors' use of each winner's name, likeness, photograph, voice, opinions, and/or hometown and state information for promotional purposes through any form of media, worldwide, without further permission, payment or consideration.

Payments

The prize challenge winners will be paid prizes directly from the Trustees of Indiana University. Prior to payment, winners will be required to verify eligibility. The verification process with the agency includes providing the full legal name, tax identification number or social security number, routing number and banking account to which the prize money can be deposited directly.

All cash prizes to contestants by the Trustees of Indiana University are subject to tax liabilities, and no withholding will be assessed by the Trustees of Indiana University on behalf of the contestant claiming a cash prize.

Liability and Insurance

Any and all information provided by or obtained from the Federal Government or the Trustees of Indiana University is without any warranty or representation whatsoever, including but not

limited to its suitability for any particular purpose. Upon registration, all contestants agree to assume and, thereby, have assumed any and all risks of injury or loss in connection with or in any way arising from participation in this challenge, development of any application or the use of any application by the contestants or any third-party. Upon registration, except in the case of willful misconduct, all contestants agree to and, thereby, do waive and release any and all claims or causes of action against the Federal Government and Trustees of Indiana University and their officers, employees and agents for any and all injury, death, damage, or loss of property, revenue, or profits of any nature whatsoever (whether existing or thereafter arising, whether direct, indirect, or consequential and whether foreseeable or not), arising from their participation in the challenge, whether the claim or cause of action arises under contract, tort, or loss through negligence or otherwise. Upon registration, all contestants agree to and, thereby, shall indemnify and hold harmless the Federal Government and Trustees of Indiana University and their officers, employees and agents for any and all injury, death, and damage of any nature and against third party claims for damages arising from or related to Challenge activities.

Contestants participating in Phases 4 and 5 live field testing are required to demonstrate general liability insurance coverage, in a form acceptable to the Trustees of Indiana University, in the amount of:

    i. $300,000.00 for injury to any person in any single occurrence and

    ii. $1,000,000.00 for injury to all persons involved in such occurrence

    iii. $25,000.00 for property damage per occurrence

The policy shall name the Military Department of Indiana, the Adjutant General's Office, the Indiana State Armory Board, the State of Indiana, the Indiana National Guard, the Trustees of Indiana University, the Federal Government, their representatives, agents, and officers as additional insured parties. The policy shall provide for no less than ten (10) days advance notice of cancellation of the policy, with said notice provided directly to the IU CTIL and the Muscatatuck Urban Training Center (MUTC) Future Operations Service Center (FOSC). A copy of such policy detailing the coverage laid out above shall be submitted at least 45 days prior to Phase 4 and Phase 5 live field tests. In addition, each contestant will be required to complete the Phase 4 and Phase 5 Muscatatuck Urban Training Center waiver document.

Records Retention and FOIA

All materials submitted to the Trustees of Indiana University as part of a submission become official records and cannot be returned. Any confidential commercial information contained in a submission should be designated at the time of submission. Submitters will be notified of any Federal Freedom of Information Act (in accordance with 29 C.F.R. § 70.26) or Indiana Access to Public Records Act (in accordance with Indiana Code 5-14-3) requests.

508 Compliance

Contestants should keep in mind that the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University considers universal access to information a priority for all individuals, including individuals with disabilities. The organizations are strongly committed to meeting their compliance obligations under Section 508 of the Rehabilitation Act of 1973, as amended, to ensure the accessibility of its programs and activities to individuals with disabilities. This obligation includes acquiring accessible electronic and information technology. When evaluating submissions for this challenge, the extent to which a submission complies with the requirements for accessible technology required by Section 508

will be considered.

General Conditions

All challenge and prize competitions shall be performed in accordance with the America COMPETES Act.

The Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University reserves the right to cancel, suspend, and/or modify the challenge, or any part of it, if any fraud, technical failures, or any other factor beyond the Department of Commerce, National Institute of Standards and Technology's or the Trustees of Indiana University's reasonable control impairs the integrity or proper functioning of the challenge, as determined by the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University in their sole discretion. The Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University are not responsible for, nor are they required to count, incomplete, late, misdirected, damaged, unlawful, or illicit votes, including those secured through payment or achieved through automated means.

IU reserves the right in its sole discretion to extend or modify the dates of the challenge, and to change the terms set forth herein governing any phases taking place after the effective date of any such change. You agree to the terms set forth herein and to all decisions of NIST or IU and/or all of their respective agents, which are final and binding in all respects.

ALL DECISIONS BY the Department of Commerce, National Institute of Standards and Technology and the Trustees of Indiana University ARE FINAL AND BINDING IN ALL MATTERS RELATED TO THE CHALLENGE.