SUMMARY OF CONTESTS

The contest consists of 5 phases, ranging from concept design to a live competition with public safety at a firefighter training center. Each Haptic Development Team will be evaluated individually, and successful contestants will be invited to move on to the next phase. The scores from the final two phases, Evaluation Round 1: Haptic Interface Prototypes in Virtual Reality and Evaluation Round 2: Haptic Interface Prototypes at Firefighter Navigation Course, will be the basis for the final prize challenge awards. The 2 evaluation rounds will be equally weighted with each contributing 50% of the final score for each contestant.

The Haptic Providers will be evaluated based on the performance of the (up to 3) Haptic Development Teams they support. If 1 of their supported Haptic Development Teams advance to the next phase, the Haptic Provider will also advance. The final scoring for each Haptic Provider will be based on the average final scores from the Haptic Development Team(s) they supported.

The following is a summary of the various roles and definitions of the contestants and other Challenge participants:
Haptic Providers: manufacturers of haptic hardware consisting of individual devices or development kits. Haptic hardware consists of actuators, vibration motors, force feedback devices, temperature elements, electrical stimulation, or other tactile feedback devices. Haptic providers may also provide software and development support through software development kits (SDKs), application programming interfaces (APIs), or training solutions. A Haptic Provider will support up to 3 Haptic Development Teams, each creating up to 4 haptic interface prototypes, for a total of 12 haptic interface prototypes for this Challenge.

Haptic Development Teams: individuals or teams of programmers, hackers, and/or, thinkers that seek to create innovative solutions using haptic devices. Developers should have a strong background in embedded programming and wireless communications. They should also have general familiarity with the Unreal Engine and be able to integrate their haptic prototypes into the PSCR virtual environments. A Haptic Development Team will create 3 haptic interface prototypes for use in the virtual environments and 1 haptic interface prototype embedded into firefighter PPE for the search and rescue task.

Official Representative: designated point of contact for each contestant for PSCR. The Official Representative (individual or team lead, in the case of a group project) must be age 18 or older and a U.S. citizen or permanent resident of the United States or its territories. That designated individual will be responsible for meeting all entry and evaluation requirements. NIST will award the prizes in a single dollar amount to the Official Representative. The Official Representative is solely responsible for allocating any prize amount among its member contestants as they deem appropriate.

Subject Matter Expert: an expert in their respective field, either from NIST or from a collaborating entity. Subject matter experts will conduct independent reviews of the submissions received from the 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, Dr. Walter Copan, will select members from public safety industry, first responders, and PSCR to test and evaluate the submissions for the Challenge. The Judging panel will take subject matter expert recommendations into consideration with evaluating contestants' submissions. The Judging panel will make the final determination of awards for the Challenge.

Participant: the participant is a subject matter expert or Judging panel member that is testing and evaluating the contestant's solutions at various phases of the Challenge.

The following is only a summary of each contest. For more information, please review the full details of each contest terms and conditions as provided throughout this document.

Phase 1: Concept Paper Contest

For Haptic Providers
The Concept Paper Contest invites all eligible contestants to submit a concept paper outlining their haptic interface products (types of actuators, sensors, software/platform, etc.) that will be available to the Haptic Development Teams, their proposed level

of support, services and approach for the up to 3 Haptic Development Teams, with whom they can team for this challenge. Haptic Providers' concept papers will be reviewed by a panel of subject matter experts; the Judging panel will evaluate and select up to 3 Haptic Providers to be invited to the Challenge Kickoff and Teaming Webinar. Contestants selected by the Judging panel will be eligible to move forward to the Teaming Contest.

For Haptic Development Teams
The Concept Paper Contest invites all eligible contestants to submit a concept paper outlining their proposed team's solution, approach, capabilities, knowledge and skills for this challenge. Haptic Development Teams' concept papers will be reviewed by a panel of subject matter experts; the Judging panel will evaluate and select up to 9 Haptic Development Teams to be invited to the Challenge Kickoff and Teaming Webinar. Contestants selected by the Judging panel will be eligible to move forward to the Teaming Contest.

Phase 2: Teaming Contest

The Teaming Contest will be open to the winners of the Concept Paper Contest, up to 3 Haptic Providers and up to 9 Haptic Development Teams. During the Challenge Kick-off and Teaming Webinar, each of the Haptic Providers will present their haptic interface products, proposed level of support, services and approach to the Haptic Development Teams. The Haptic Development Teams will present their concept, team composition, and background. The contestants will then have two weeks to sign teaming agreements between the Haptic Development Teams and Haptic Providers; agreements will be reviewed for completeness by the judge panel. A Haptic Provider that does not successfully team with at least one Haptic Development Team will not be eligible to advance in the competition.

Alternatively, a Haptic Development Team may decide not to team with a Haptic Provider. They will not be eligible for the $15,000 of combined support awarded through the Haptic Provider during Phase 2 and Phase 4 of the challenge. Haptic Development Team(s) deciding to go solo must submit a letter documenting how they will proceed without Haptic Provider support. Successful contestants selected by the judge panel will be eligible to move forward to the next contest, Demonstration of Haptic Interface Prototypes in Virtual Reality. Additionally, up to 3 Haptic Providers will advance in the competition and will receive prize awards of $7,500 per matched Haptic Development Team; up to 9 Haptic Development Teams will advance in the competition and each will receive $2,500 for prototype development.

The teaming agreements will be reviewed for completeness by the Judging panel. Successful contestants will be eligible to move forward to the next contest, Demonstration of Haptic Interface Prototypes in Virtual Reality.

Phase 3: Demonstration of Haptic Interface Prototypes in Virtual Reality

PSCR will provide the invited contestants with 3 fully functional Unreal Engine virtual environments with their corresponding scenario details (i.e., law enforcement, EMS, and fire service). Each of the environments requires a desired performance task of which the haptic interface prototypes will be tested and evaluated to determine their impact on the task. Contestants will submit a video of their prototype(s) highlighting the functionality and a write-up with instructions on use of the prototype for pass/fail evaluation. The subject matter experts and Judging panel will evaluate the prototypes and invite contestants with passing entries to demonstrate their prototypes at the 2019 Stakeholder Meeting. A minimum of 2 prototypes are required for submission and demonstration at the meeting, however, contestants will be receiving feedback from first responders in attendance and would benefit from showcasing as many solutions as possible.

Haptic Providers
If at least 1 of the Haptic Development Teams supported by a Haptic Provider is invited to demonstrate, the Haptic Provider will also be invited to attend the 2019 Stakeholder Meeting. At the 2019 Stakeholder Meeting, Haptic Providers will have the opportunity to demonstrate their products. Also, they will provide support to their matched Haptic Development Teams during the demonstration of their prototypes. No official prize challenge judges will evaluate the prototypes. Invited Haptic Providers will receive travel funding to attend the 2019 Stakeholder Meeting, up to $5,000 for two team members. All contestants invited to

demonstrate at the 2019 Stakeholder Meeting will also be deemed eligible to move forward to the next contest, Evaluation Round 1: Haptic Interface Prototypes in Virtual Reality.

Haptic Development Teams
Each Haptic Development Team's haptic interface prototype(s) must meet UI/UX and functional elements based on the desired objectives in the 3 scenarios, for example, situational awareness for law enforcement, navigation for fire, and vital monitoring for EMS. Based on the compliance testing and functional evaluation, up to 9 Haptic Development Teams will be invited to demonstrate at the 2019 Stakeholder Meeting.

At the 2019 Stakeholder Meeting, invited the Haptic Development Teams will have their prototypes available for demonstration and feedback from the attending public safety community; there will be no official judging during the stakeholder meeting. Invited Haptic Development Teams will receive travel funding to attend the 2019 Stakeholder Meeting, up to $5,000 for two team members. All contestants invited to demonstrate and that attend the 2019 Stakeholder Meeting will also be deemed eligible to move forward to the next contest, Evaluation Round 1: Haptic Interface Prototypes in Virtual Reality.

Phase 4: Evaluation Round 1: Haptic Interface Prototypes in Virtual Reality

Haptic Providers
The contestants are encouraged to incorporate feedback from the 2019 Stakeholder Meeting and collaborate with any external public safety mentors and advisors for their haptic interface prototypes. The contestants will submit their haptic interface prototypes paired with the 3 virtual environments for evaluation by the Judging panel. Up to 3 Haptic Providers will be invited to the Evaluation Round 2: Haptic Interface Prototypes at a Firefighter Navigation Course contest. If at least 1 of the Haptic Development Teams supported by a Haptic Provider was invited to move forward to Phase 5, the Haptic Provider will also be invited to attend the final contest. Additionally, up to 3 Haptic Providers will be eligible for a prize award of $7,500 per Haptic Development Team supported that advances to Phase 5.

Haptic Development Teams
The contestants are encouraged to incorporate feedback from the 2019 Stakeholder Meeting and collaborate with any external public safety mentors and advisors for their haptic interface prototypes paired with the 3 VR environments. Contestants will submit their prototype(s) for evaluation by the judge panel. Up to 9 Haptic Development Teams will be invited to the Evaluation Round 2: Haptic Interface Prototypes at a Firefighter Navigation Course contest. Invited teams will receive firefighter PPE to embed their haptic interface prototype for the final contest of the challenge.

Invited Haptic Development Teams will receive travel reimbursement to attend the firefighter navigation course and live competition, up to $4,000 for two team members. Up to 9 Haptic Development Teams will receive $2,500 in cash prizes and firefighter PPE if selected to advance to Phase 5. PSCR will also rank and award the top 3 Haptic Development Teams based on Evaluation Round 1 who will eligible to receive additional cash prizes – 1st $7,500, 2nd $5,000, 3rd $2,500.

Phase 5: Evaluation Round 2: Haptic Interface Prototypes at Firefighter Navigation Course

For Haptic Providers
Contestants' embedded prototypes will compete in a search and rescue task at a firefighter navigation course. The haptic interface prototypes embedded in PPE will be tested and reviewed by subject matter experts, and then will be evaluated by the Judging panel. Each Haptic Provider will receive points based on the performance of the up to 3 Haptic Development Teams they support. Up to 3 Haptic Providers will compete for final prize awards, 1st Place: $20,000; 2nd Place: $10,000 and 3rd Place: $5,000 and an optional prize the judge panel can elect to award for the Most Commercially Promising: business technical assistance valued up to $3,500.

For Haptic Development Teams

Contestants' embedded prototypes will compete in a search and rescue task at a firefighter navigation course. The haptic interface prototypes embedded in PPE will be tested and evaluated by the subject matter experts and the Judging panel. Each invited Haptic Development team will compete for up to six (6) final prize awards, 1st Place: $25,000; 2nd Place: $20,000; 3rd Place: $15,000; 4th Place: $10,000; 5th Place: $7,500 and an optional award, the Most Commercially Promising: business technical assistance services valued up to $3,500.

Summary of Important Dates (all in 2019)

Phase	Start Date	Due Date	2. Judge and Notification Date	Demo/Competition
Phase 1 – Concept Paper	March 18	April 22	May 3	N/A
Phase 2 - Teaming	May 7	May 17	May 23	N/A
Phase 3 - Demonstration of Haptic Interface Prototypes in Virtual Reality	May 24	June 26	July 3	July 9-11
Phase 4 - Evaluation Round 1: Haptic Interface Prototypes in Virtual Reality	July 9	August 23	September 10	N/A
Phase 5- Evaluation Round 2: Haptic Interface Prototypes at Firefighter Navigation Course	September 10	November 5*	November 15	November 5-7*