

Development of Performance Metrics and Test Methods for First Responder Location and Tracking Systems

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Categories and Subject Descriptors

D.3.3 [Programming Languages]: N/A

General Terms

Measurement, Documentation, Performance, Design, Reliability, Experimentation, Security, Standardization, Verification.

Keywords

First responder, firefighter, evaluation, test methods, location, tracking, test methods

1. EXTENDED ABSTRACT

The need for the development of performance requirements, metrics and test methods for evaluation of location and tracking systems is increasing as these systems begin to become commercially available for use by emergency responders. A working group was recently formed at the 5th Annual PPL Workshop¹ consisting of members of the various emergency responder communities, representatives of government agencies, and location and tracking system manufacturers with plans to collect and share information about their ongoing efforts that have bearing on this effort. The goal of the working group is to develop baseline *performance requirements* for reliable and interoperable indoor location systems for emergency responders and develop *test procedures* to validate vendor systems against those requirements. The final deliverable will be a proposed draft document in acceptable format to be presented to appropriate standards developing organization(s). The following text describes in broad terms the steps by which the draft document will be created.

1.1 Information Collection

Information about past and current activity in the development of performance evaluations of location/tracking systems for first responders will be collected for as many efforts as possible. This serves two main purposes: to learn from the successes and failures of others, and to foster a spirit of cooperation amongst interested parties. This work was begun last year as part of an internally funded NIST project within BFRL. Pertinent information collection items include:

- Thorough literature search on existing solution technologies and manufacturers which offer mature solutions.

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- Thorough literature search on existing standards documents and user requirements, including all emergency responder communities.
- Contact key people from government agencies that are involved in or might have an interest in development of performance standards for location and tracking systems (LTS) for first responders.
- Contact emergency responders and manufacturers that are interested in LTS evaluations and invite them to contribute to this effort.

1.2 User Community Input

A very important aspect of this work is to maintain a close relationship with the various LTS user groups so that their requirements and desires are met to the fullest extent possible. The three main user groups are fire fighters, police, and EMS personnel. Other user groups may include the National Guard, the Coast Guard, hazmat, and USAR (technical rescue). In addition to gaining an understanding of the users' needs, information about their operating environments is also essential to design test methods that will ensure the LTS under test will perform adequately in the field. For fire fighters, the LTS must be robust enough to function in a hot, smoke-filled building, regardless of the location technology being used. The input desired from user groups includes:

- Preferred performance requirements: location accuracy, communications reliability, equipment form factor, etc.;
- Description of operation scenarios: building materials, number of floors, number of users, etc.
- Preferred user interface: voice-activated, handheld device, visual display, etc.
- Technical barriers that challenge/prohibit the use of LTS: radio frequency interference, access to building maps, etc.
- Non-technical barriers that challenge/prohibit the use of LTS: lack of resources, political climate, receptiveness of users, etc.

1.3 Roles of Working Group

As this information is collected and questions are answered, the scope of the current project will take shape and reveal new roles for NIST and other stakeholders in the working group. A Steering Group at the PPL Workshop was appointed to provide

guidance and order to the efforts of the working group. Some important steps towards achieving the goal of the working group and facilitating the flow of activities are listed below:

- Each stakeholder will provide enough information about their respective activities to allow others to plan their work in a constructive way that may or may not involve collaborations.
- Proceed in the areas that are common among all applications while specific interest groups can work in parallel to develop test methods for the applications with which they are most concerned, with guidance from the Steering Team.
- Leverage as much as possible existing standards for performance requirements and test methods which apply generally to the ruggedness of fire equipment.
- Assign a task group the responsibility for correlating the pieces and assembling them into a cohesive document that can then be channeled to standards developing organizations (SDOs) when the latter are ready to start working on formal standards documents.

1.4 Related Activities at NIST

In the interest of sharing Information about past and current activity in the development of performance evaluations of location/tracking systems for first responders, relevant work at NIST includes:

- The Building and Fire Research Laboratory is compiling a prioritized list of fire scenarios that are important to the fire service with respect to LTS.
- The Building and Fire Research Laboratory is currently developing ground-truth measurement science with which to verify LTS location performance. Future work will incorporate testing of existing LTS in real-scale environments to validate the test methods. The feasibility of using small-scale test facilities for ground-truth measurements and rough-duty ruggedness testing will be explored.
- The Electrical and Electronic Engineering Laboratory is developing an understanding of the way RF signals are attenuated by building materials, reflected and redirected by building surfaces, and how interference from other wireless devices can impact RF signal quality. A measurement campaign will be conducted to characterize RF links in various structure types with respect to time-of-arrival, angle-of-arrival, received-signal-strength, etc.
- The Electrical and Electronic Engineering Laboratory will validate the use of a reduced-scale reverberation chamber in which “virtual” RF signals are generated as a method by which the performance of RF-based, and possibly other types of LTS, is measured.
- The Information Technology Laboratory will develop a computer simulator to extrapolate the tested small-scale performance of actual location/tracking systems to large-scale networks and in fire scenarios in order to validate their performance in realistic deployments.

- The Information Technology Laboratory has been involved in the development and evaluation of many different LTS technologies.
- The Manufacturing Engineering Laboratory is active in the development of standards and guidance documents for search and rescue robots, which involves LTS for certain performance tests included in the suite of requirements for some applications.

2. ACKNOWLEDGMENTS

While this project is just beginning, it would not have gained momentum without financial assistance from the Standards and Technology Directorate of DHS. Also, David Cyganski, Jim Duckworth, and John Orr of Worcester Polytechnic Institute helped considerably by including a session on standards development in their 5th annual Precision Indoor Personnel Location and Tracking for Emergency Responders Workshop. Lastly, our student intern, Adam Kopp’s enthusiasm is infectious and much appreciated.

3. REFERENCES

- [1] Fifth Annual Workshop, “Precision Indoor Personnel Location and Tracking for Emergency Responders Workshop”, <http://www.wpi.edu/academics/ece/ppl/>