EXECUTIVE SUMMARY

Modern information-technology and telecommunications (IT/telecom) facilities create challenges for the design of fire protection systems and for the development of codeguidance for those systems. The high flow rates needed to provide adequate cooling impact the performance of detection and suppression systems (upwards of 100 ACH or more). This impact has not generally been quantified for those higher flow rates by experiment, and current modeling tools, while having the ability, have not been validated for the specific application of detection performance in high air flow rate conditions. To reach the end point of having modeling tools for design engineers and code guidance for fire detection system installation requires a multi-step process, including:

- Identifying the modeling requirements for evaluating the performance of detection and suppression in high air flow rate environments for IT/telecom facilities
- Identifying potential computer models
- Indentifying gaps in knowledge for either model capability or model validation
- Developing a program of research to address the gaps
- Executing the research program to address critical gaps in knowledge or validation data
- Validating models for use in high air flow rate environments for IT/telecom facilities
- Using the validated models to develop code guidance and to design systems

To begin addressing this, the Fire Protection Research Foundation has funded a project to address the first four items above for detection performance. This report documents the result of that project.

Seventeen model requirements were identified for evaluating the performance of detection in high airflow rate environments in IT/telecom facilities. These requirements include both software capabilities (geometry, heat transfer, fire physics, etc.) and software quality (validation, user support, etc.). Twenty-six models (one network model, two zone models, and twenty-three CFD models) were evaluated against these criteria. Eight models were identified as being candidates for use in predicting detection performance in IT/telecom facilities with high flow rates: ANSYS-CFX, ANSYS Fluent, FDS, FLOTHERM, FLOVENT, KAMELEON, PHOENICS, STAR-CCM+.

Following a review of available models, a gap analysis was performed. This analysis considered the ability to specify the necessary inputs for the models (geometry, material, heat loads, fire sources, etc.), the ability of the models to predict performance of detection (smoke transport, prediction of detector performance), and the ability to validate the usage of the models. The gap analysis identified four gaps:

1. Specification of the fire and smoke inputs: There is very limited data for representative sources in IT/telecom facilities that have been characterized in a way that it is usable as an input to a model.

2. Smoke Transport: There is a need to assess the importance of being able to predict smoke deposition and spatial particle size distributions (e.g. the adequacy of treating smoke as a gas verse particles) on the ability of models to adequately predict detection performance.

3. Smoke detector performance: There is no data to reliably predict detection performance at high flow rates. The ability to correlate conditions predicted by a model (e.g., smoke concentration) at the location of a smoke detector/ASD sampling port to an alarm condition within the detector is a significant gap.

4. The existence of large scale integral test data is limited. There is no work that completely validates the full process of imputing representative fire sources into a model and predicting a detection response for a high air flow environment.

To address the four gaps, a test plan was developed. The test plan consists of three phases of testing to be conducted in a future project:

1. Characterizing typical fire sources in IT/telecom facilities to develop smoke and fire source inputs for modeling.

2. Characterizing the performance of detectors against the selected fire sources at high air flow rates to develop detector response correlations.

3. Execution of large scale tests using the selected fire sources and characterized detection to generate validation data that is then used to validate a candidate model (or models).

The end of the test program will be one or more models suitable for use in predicting the performance of detection in high air flow IT/telecom facilities. The model(s) would then be available for use by engineers designing detection systems and by code committees to develop guidance and code requirements for detector selection and installation.