

**Notice of Request for Collaborators:
Developing Measurement Tools to Predict
Emergent Behavior in Complex Information Systems**

In recent years, awareness has increased that the interaction of millions of components in large-scale distributed systems, such as cloud systems and computing grids, can lead to dynamic global behaviors that are extremely difficult to predict. Such behaviors include phase transitions and oscillations that can drive systems from normal operating ranges to degenerate regimes and collapse. While system operators possess some control methods for mitigating such degenerate behaviors in distributed systems, they lack the ability to predict them. This gap in our knowledge must be addressed, because the economic costs of these events are considerable and can be expected to grow in the future. Therefore, NIST is considering an applied research project to develop measurement methods to predict such behaviors. The project proposes to *create algorithms for combining mathematical, statistical and computational techniques developed in the natural and physical sciences for use in predicting the onset of phase transitions to degenerate behavior in large information systems. We then intend to evaluate these algorithms (as well as algorithms developed elsewhere) as a measurement basis for detecting and predicting the onset of phase transitions.* The proposed work is based on an extensive body of knowledge produced in an ongoing, multi-year project for developing methods to measure complex behavior in large, distributed information systems. Both the details of the proposal and the results from previous work can be found at http://www.nist.gov/itl/antd/emergent_behavior.cfm. The envisioned project plan calls for NIST to initially use in-house simulations to develop the detection algorithms and prototype measurement basis. In a second stage, we hope to test the developed products, as well related tools developed externally, either in real-world test beds or using real-world data. We are currently seeking collaborators from industry and/or other government entities to work with us both to develop the detection algorithms and to test the measurement products under real-world circumstances. In this way, we hope to further the development of measurement methods for managing real-world complex information systems, as well as to defray costs among collaborators. Interested parties should contact Chris Dabrowski (cdabrowski@nist.gov) by 5 PM on March 9, 2012.