

# ***Investigating Potential Reliability and Robustness of Standards-Based Grid Computing Systems***

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**Presented at GGF15 in Boston, USA**  
**October 6, 2005**

# Motivation

**Vision:** Future global information infrastructure will rely on emerging standards for Web Services and Open Grid Services Architecture

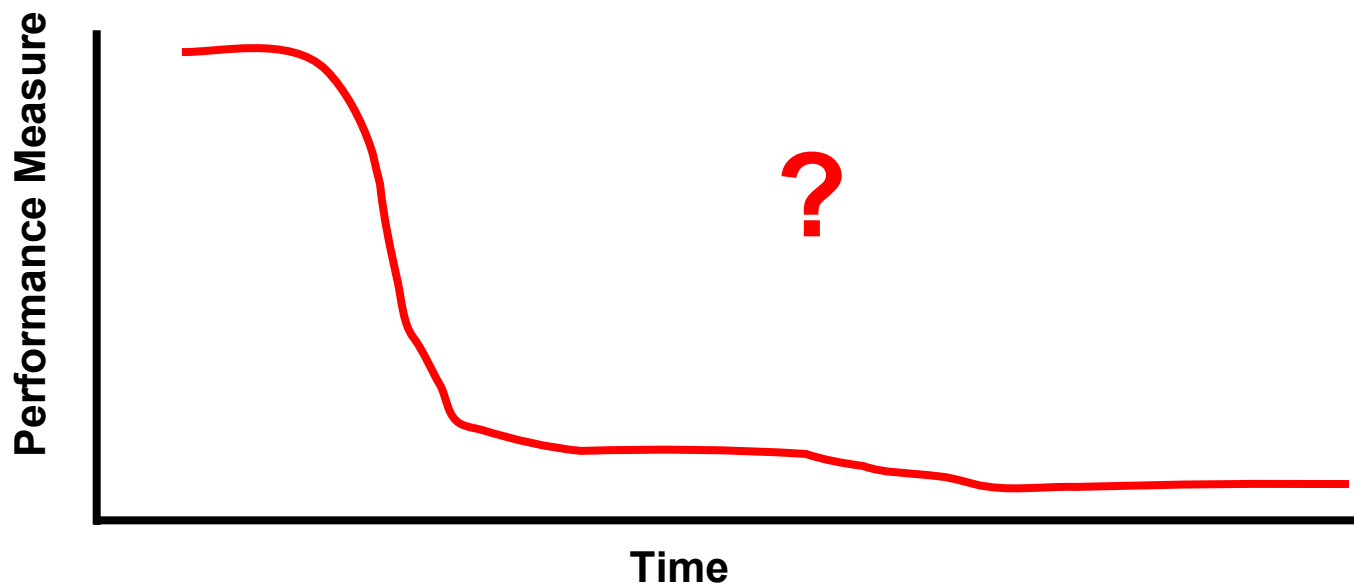
**Question #1:** – Will future distributed systems designed in conformance to Web Services and Grid standards achieve levels of robustness, scalability, and performance required for critical enterprise applications?

**Question #2:** – As industrial grid systems grow in size, can unplanned interactions among distributed components lead to emergence of undesirable patterns of incoherent and chaotic behavior?

**Question #3:** – Can we identify areas in GGF specifications that might lead to in implementation of operational Grids that are unreliable or that experience unexpected failures?

## Possibility of emergent behaviors

- **Possible Concerns:** System designs may lead to interactions under failure conditions that result in emergent behaviors and unexpected performance degradations. The scaling of grid systems may, in and of itself, result in emergent behavior that adversely affects system behavior.



# Definitions of Terms

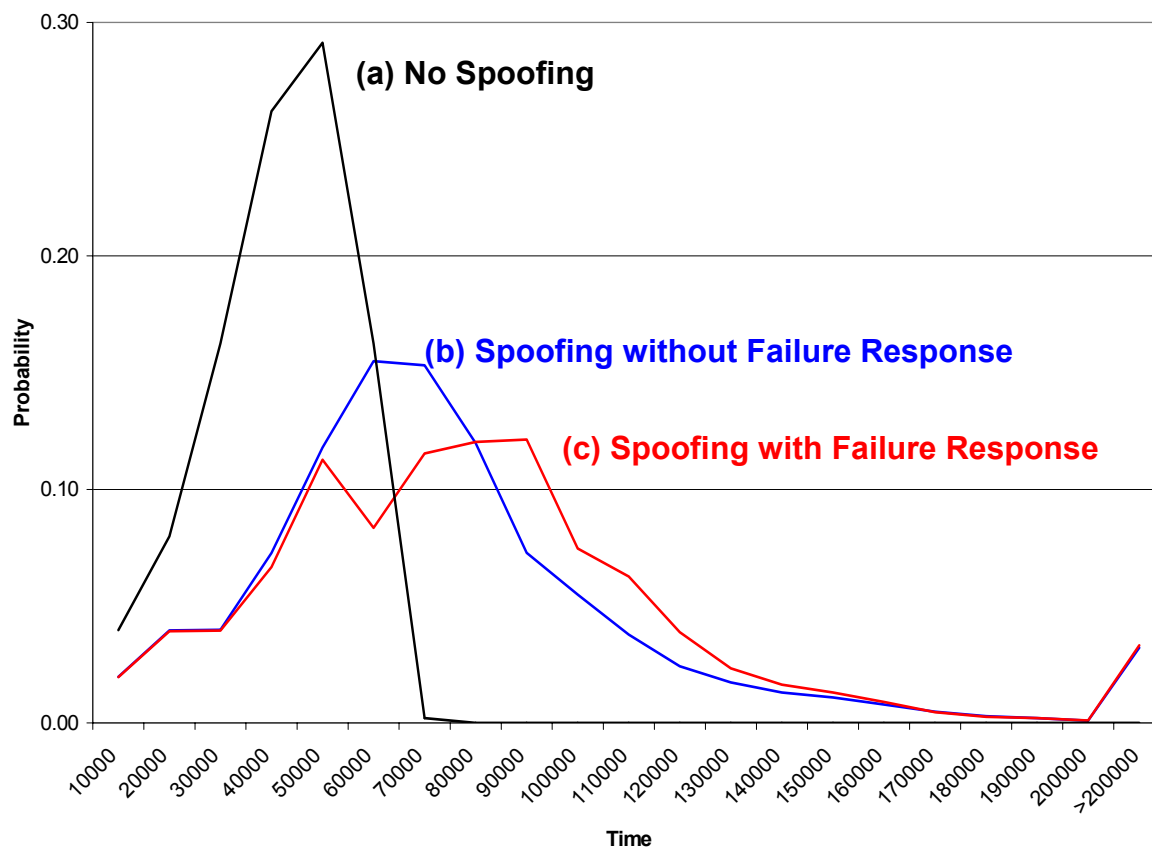
## Reliability (system)

- “An attribute of any system that consistently produces the same results, preferably meeting or exceeding its specifications. *Free On-line Dictionary of Computing*”, <http://foldoc.doc.ic.ac.uk/foldoc>
- “In engineering in general, reliability is the capacity of a component or a system of such components to perform as designed”, *Wikipedia*, <http://en.wikipedia.org/wiki>

## Robustness

- “... an ability to recover gracefully from the whole range of exceptional inputs and situations in a given environment”, *Free On-line Dictionary of Computing*
- “In terms of computer software, refers to the resilience of the system when under stress - for example, when running a large number of processes, or when starved of memory or storage space, or when confronted with an application that has bugs or is behaving in an illegal fashion....”], *Wikipedia*

## Example: Performance Degradation Caused by Spoofing Activity in Simulated Grid



**Comparative Probability Density Functions (PDFs) for Application Completion Times given:**  
**(a) No Spoofing, (b) Spoofing without Failure Response, and (c) Spoofing with Failure Response.**

## Next Steps?

What actions should GGF take to assess potential of robustness and reliability of grid systems developed with GGF specifications?

- Form RG to serve as focus of research that addresses questions of grid reliability and robustness? **[This group forms recommendations]**
- Initial meeting of this BOF (GGF12 Brussels) resulted in draft RG charter. Can we restart this effort?

## Research Group for Reliability and Robustness?

- **Motivation:** *(from previous slides)* As grid systems are increasingly commercialized and grow in size, they are likely to be subjected to volatile and uncertain conditions that endanger or severely degrade their effectiveness in everyday use.
- **Question to be addressed:** How can we determine that the web-service and grid standards currently being developed will enable large-scale grids to detect and overcome failures to provide a level of reliability and robustness needed for industrial and scientific purposes?
- **RG Focus/Purpose:**
  - Identify issues related to reliability and robustness in grid computing systems designed in conformance to Web Services and Grid standards
  - Make recommendations, and explore methods, for improving reliability and robustness of standards-based grid systems developed for critical enterprise applications and production systems.

## Research Group Scope

- Identify reliability concerns in industrial and scientific grid systems developed on the basis of Web Services and Grid Standard Specifications.
  - especially, those that can be directly (or indirectly) related to behaviors required or implied by Web Services and Grid Standard specifications
- Develop recommendations/guidelines for
  - Specifications that enhance reliability of deployed systems
  - Standards-based grid systems that exhibit high reliability
- Identify (or foster research that identifies) test methods and metrics for evaluating grid systems reliability, including the ability to detect, and respond to various kinds of failures, such as failures of individual components, links, as well as entire subnetworks. .
- Explore (or foster research that explores) algorithms or protocols for improving grid reliability and robustness.
- Examine how mechanism for ensuring reliability (reliable grid ftp, monitoring service, replication service, checkpointing, etc.) interact with grid specifications/standards. Exploring relationship between mechanisms and standards
- Define minimum performance levels/thresholds for grid system reliability



## Research Group Goals

- To organize forums that allow researchers, application developers, and others to present results of their work on grid reliability and related work and to exchange information. The RG may provide information, through web-pages, mailing lists, white papers, best practices documents, and other publications, on critical reliability issues as they relate to:
  - GGF standard specifications and those of related bodies
  - Defined or deployed grid services and software
  - Real-world Grid system applications
- To promote and facilitate:
  - Collaborations between researchers in grid systems reliability
  - Access to testbeds and simulation models that investigate reliability issues
- Represent the general experiences and findings on grid systems reliability of application developers using Grid technologies

## Possible Products/Deliverables

- Documents: requirements, best practices, and case studies, reports identifying specifications with reliability concerns
  - best practices document: year 1 study on impacts of reliability issues on GGF work (reliability requirements for standards, identification of impacts within GGF standards (which standards are impacted, what changes might be made), empirical studies on reliability in grid systems (including statistical studies), & case studies
- Workshops that collect requirements and case studies; serve as focus to bring community together.

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