

The Development of Dependable and Survivable Grids

Andrew Grimshaw, Marty Humphrey, John C. Knight, Anh Nguyen-Tuong, Jonathan Rowanhill, Glenn Wasson, and Jim Basney*

Department of Computer Science, University of Virginia, Charlottesville, VA
*NCSA/University of Illinois, Urbana-Champaign, IL



Problem Statement

- To date: Grids used to aggregate resources for scientific applications
- **Problem:** only tolerant users can use “The Grid”
- **Survivability:** alternate services (different, less dependable, degraded) if primary services are not available due to attack or failure
 - Each alternative can deal with a different class of faults
 - Note: cannot re-engineer from scratch
- **Goal: Grids as *critical infrastructure***



USATODAY.com - Hacker teams breach powerful research networks - Mic

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Posted 4/14/2004 7:33 PM

Hacker teams breach powerful research networks

By Anick Desjanun, Associated Press

NEW YORK — Hackers have broken into some of the world's most powerful computer clusters in recent weeks in an apparently coordinated cyberattack targeting research and academic institutions.

Although officials sought Wednesday to downplay the seriousness of the threats, some security experts warned that such a break-in could potentially be a serious attack on the Internet.

Stanford University, the National Center for Advanced Research, the San Diego Supercomputer Center, the University of Illinois' National Center for Supercomputing Applications were among the hit.

In a statement, the atmospheric center said several supercomputers were compromised, and part of its networks have been taken offline indefinitely.

Also affected was TeraGrid, a government-funded project to link together several supercomputers, including at San Diego and NCSA, so scientists can

The Chronicle: Daily news: 04/15/2004 -- 03 - Microsoft Internet Explorer

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THE CHRONICLE OF HIGHER EDUCATION

Today's News

Thursday, April 15, 2004

Hacker Attacks Prompt Academic Supercomputers to Block Outside Access Temporarily

By VINCENT KIERNAN

Supercomputer centers at universities and elsewhere around the country were

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Hackers Strike Advanced Computing Networks

By Brian Krebs
washingtonpost.com Staff Writer
Tuesday, April 13, 2004; 5:40 PM

Hackers infiltrated powerful supercomputers at colleges, universities and research institutions in recent weeks, disrupting one of the nation's largest online research networks for several days and raising concerns among computer security experts that the compromised machines could be used to attack specific Web sites or parts of the Internet.

As many as 20 institutions were targeted, according to two sources who work at facilities affected by the attacks. Both asked that their names be withheld because they are aiding the ongoing investigation and fear that

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Challenges

- How do you implement a single service to meet a particular dependability/survivability requirement?
- How do you implement service + alternative services to meet a particular requirement?
- How do you dynamically compose services to meet overall dependability/survivability requirements?
- How do you monitor the Grid infrastructure for dependability/survivability?
- *How do you do all of this across admin domains?*

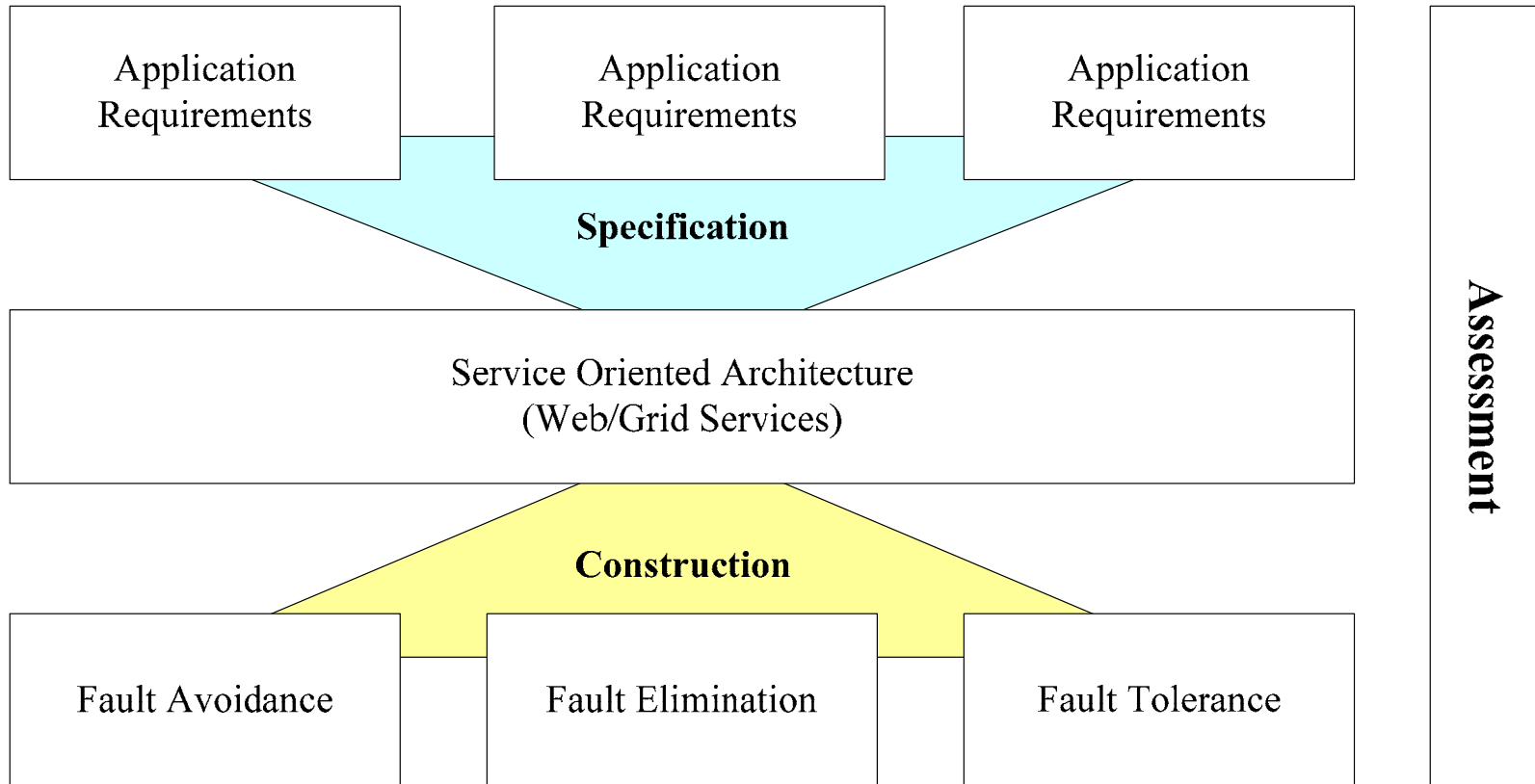


Approach

- **Support/Influence OGSA (and Web services)**
- **Leverage experience**
 - UVa: Legion, OGSI.NET / WSRF.NET
 - UVa: Willow
 - NCSA: TeraGrid/NCSA operations, MyProxy



Dependable Applications in Service-Oriented Architectures (SOAs)



Dependability Exchange and Specification Language (DESL)

- **Dependability characteristics**
 - “in mode 1, I will only service high-priority users”
- **Dependability requirements**
 - “my application is extremely critical to homeland security, so all services must respond with probability 95%”
- **Semi-automated processing (XML documents)**

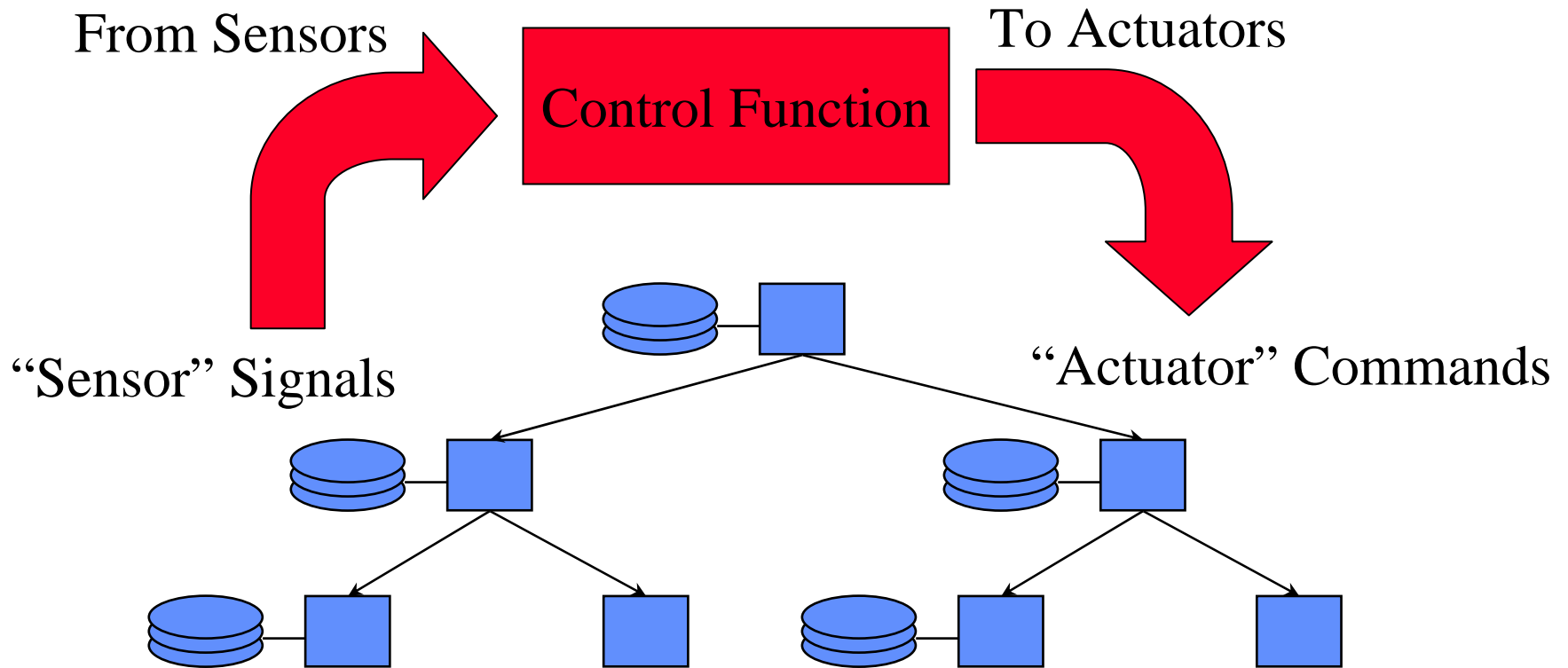


Sample DESL for MyProxy

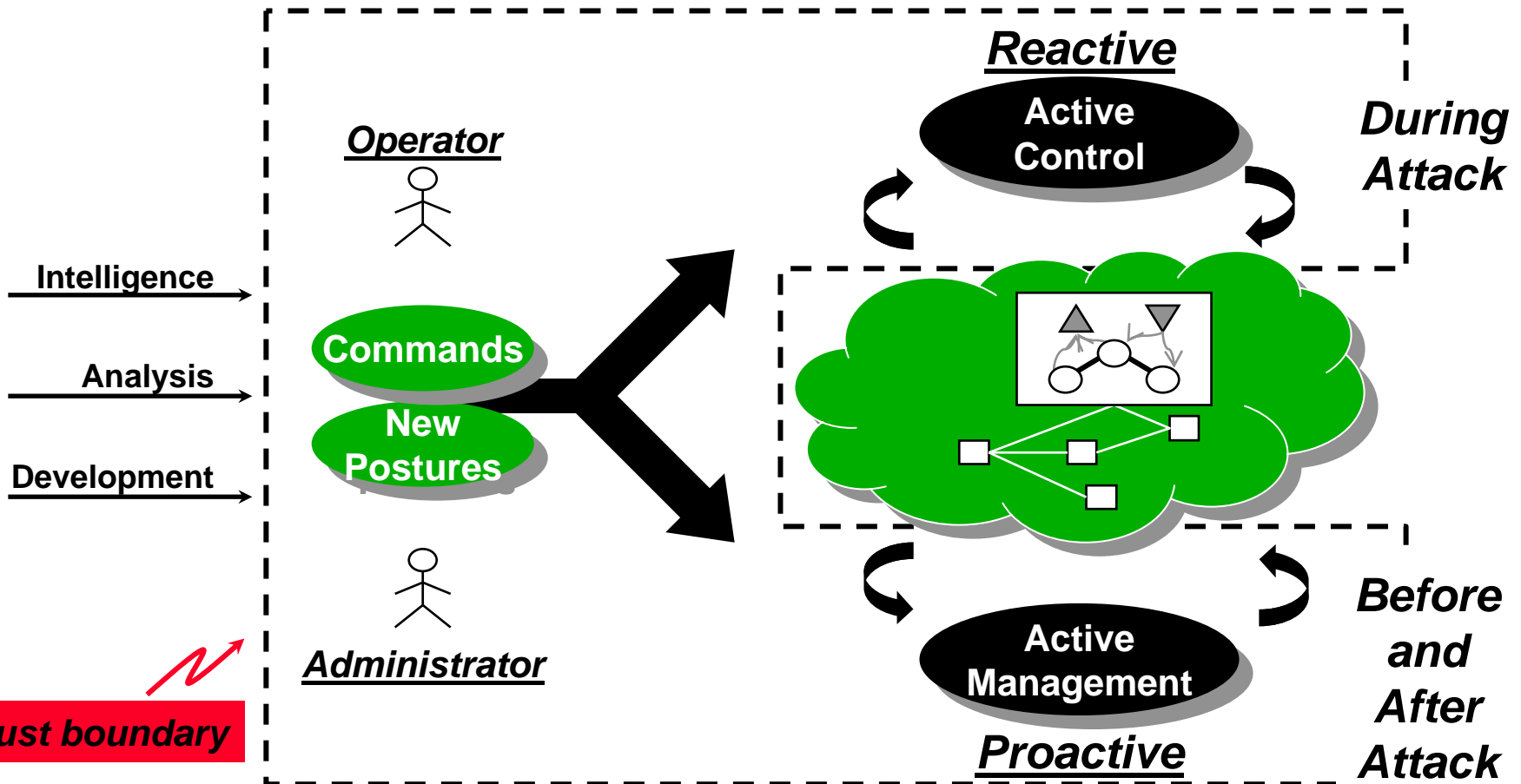
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<DESL xmlns:desl="http://gcg.cs.virginia.edu/DESL/02-21-05">
  <desl:Supports>
    <desl:SurvivabilityModes>
      <desl:Mode name="Normal">
        <desl:Operations>... normal delegation of credentials ... </>
      </desl:Mode>
      <desl:Mode name="NationalEmergency">
        <desl:Operations>
          ... limited delegation creds to non-essential personnel
        </desl:Operations>
        <desl:Triggers> ... order from Dept. Homeland Security </>
        <desl:Effects>
          ... desc. of "cost" of mode, e.g. reduced service for some
        </desl:Effects>
      </desl:Mode>
    </desl:SurvivabilityModes>
    <desl:DependabilityInformation>
      <SoftwareProcess> ... </SoftwareProcess>
      <Availability> ... </Availability>
    </desl:DependabilityInformation>
  </desl:Supports>
  <desl:Requires> ... requirements of service: sub-services, performance, etc. </desl:Requires>
</DESL>
```



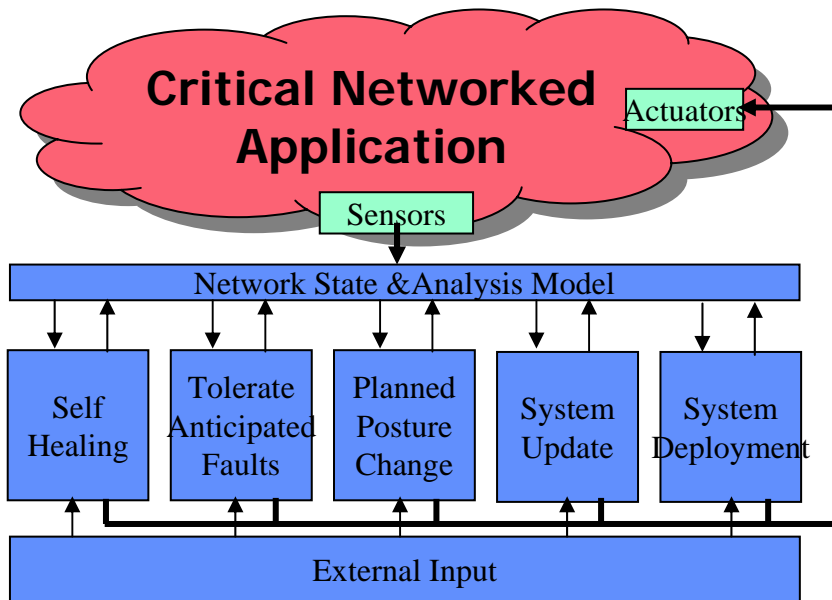
Willow: Survivability As Control



Willow Architecture Logical View



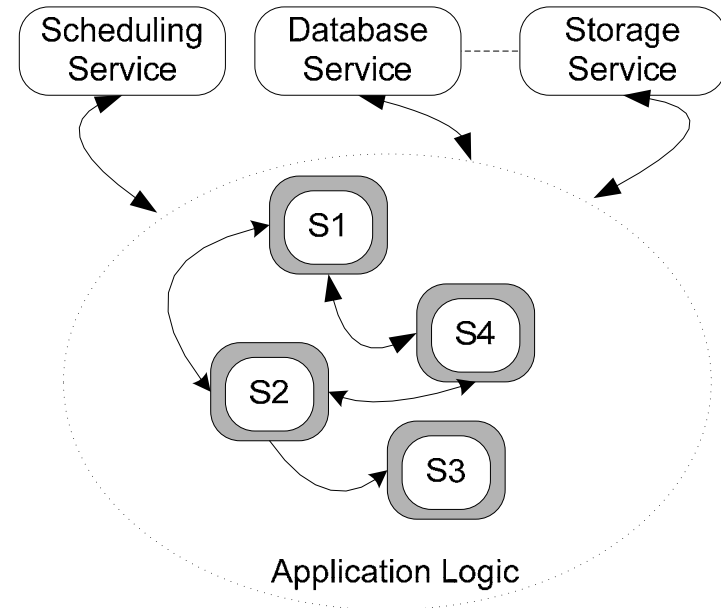
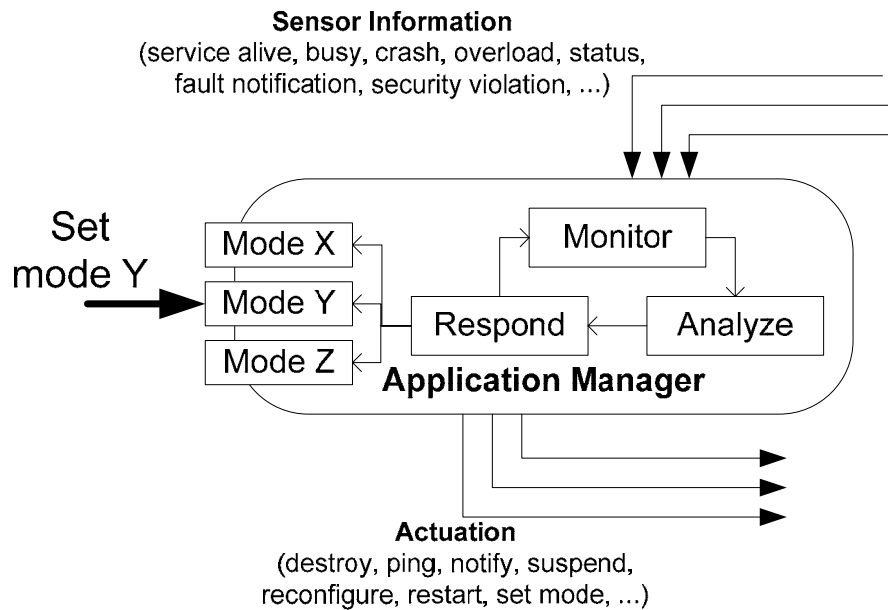
Willow Architectural Issues



- **Hierarchic faults**
- **Control loop interactions:**
 - Asynchronous
 - Priority & resources
 - Conflicting goals
- **Network scale:**
 - Volume of software
 - State model
 - Wide area change
- **Exceptions and results:**
 - Dynamic app'l membership
 - Absolute vs. statistical
 - Result "harvesting"
- **Target system actuation:**
 - Lightweight
 - Standard interface & protocol



Grid Dependability and Survivability Architecture (GDSA)



Progress / Plans (1/2)

- **Balance “independent subprojects” vs. ONE effort**
- **Balance of top-down vs. bottom-up**
 - Bottom-up:
 - Write the DESL for a service (using WSRF.NET)
 - Get Willow to “speak Web services”
 - Top-down: Extensive requirements gathering
 - In-depth discussion with UVa Hospital Health Records people (Electronic Health Record)
 - In-depth study of NCSA requirements/operating constraints



Progress / Plans (2/2)

- **WS-Naming**
- **Next version of MyProxy will support server replication**
 - Working on making DESL doc
- **Key: Balance**
 - Basic Research vs. Applied Research vs. ONE key Grid (e.g., TeraGrid)
 - ONE application domain/scenario (e.g., emergency healthcare) vs. many domains



Summary

- To date, Grids have been very valuable for *highly-tolerant* e-scientists, but...
- Grids are becoming critical infrastructure
- This project is developing techniques to make Grids survivable
- Balance basic research vs. applied research

