Major HCI Challenges Supporting the Dependability, Safety and Security of Evolving "On Demand" Enterprise Computing and Communications Services

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First, a word about terminology:

- Enterprises understand the need for continuity in their mission critical services, despite stresses such as imperfections in system hardware, software and human-computer interactions; damage caused by both environmental stresses and physical attacks; and disruptions caused by both internal and external cyber attacks.

- In effect, they understand the need for service dependability, safety and security, but have not yet agreed on a single term encompassing all three attributes.

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- We have attempted to use “Enterprise Vulnerability Management” to describe the integrated management of Enterprise dependability, safety and security vulnerabilities, with limited acceptance to date

- Users appear to be more attracted to terminology such as “Enterprise Survivability”

- Since there is a major world need for processes that address all threats to mission continuity from an integrated perspective, we are continuing to use all three terms until consensus emerges on how best to describe their integrated effects

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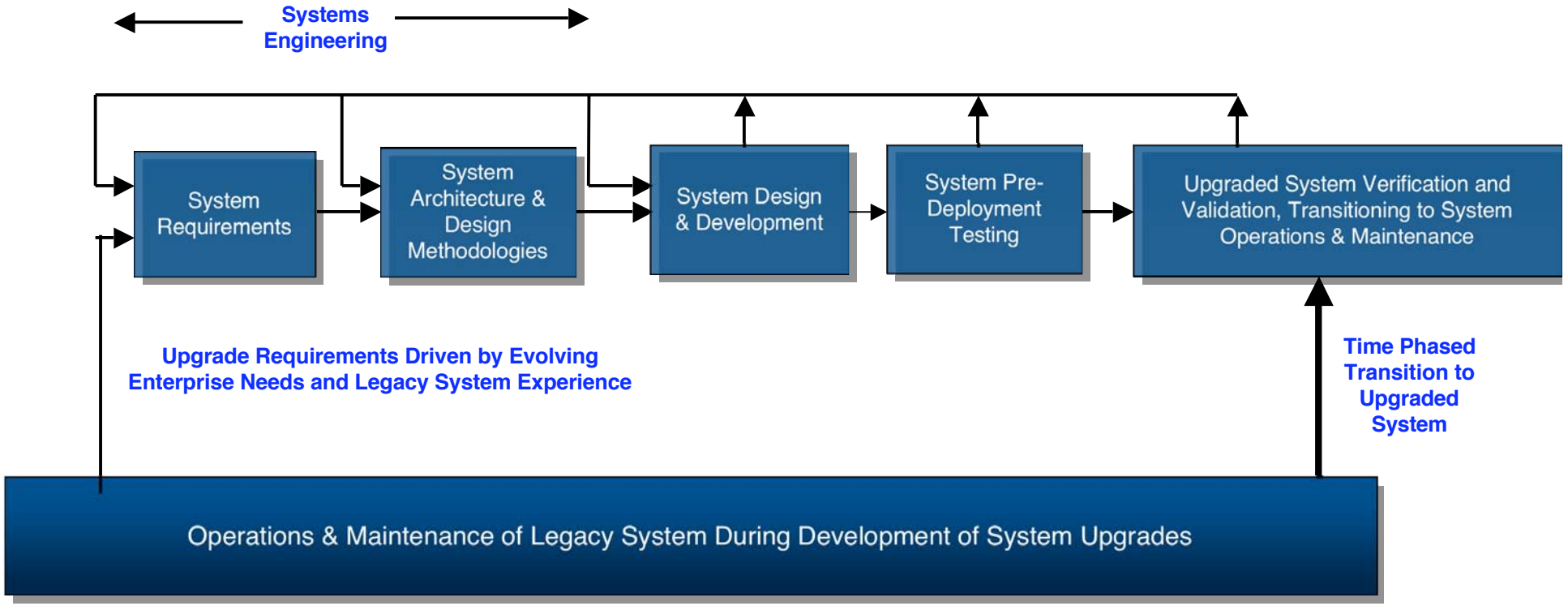
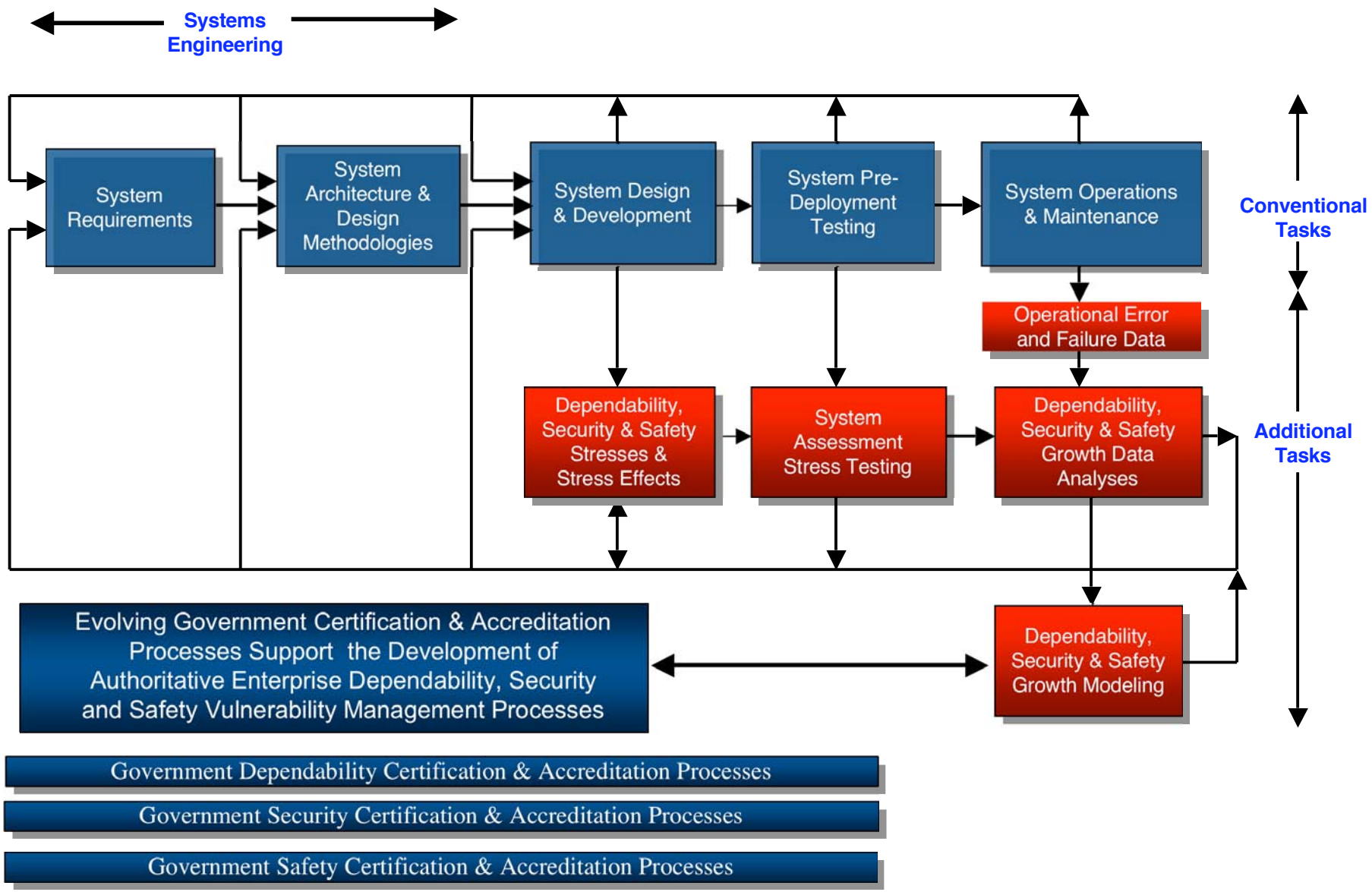
Current System Upgrade Processes Often Do Not Address Important Dependability, Safety and Security Issues



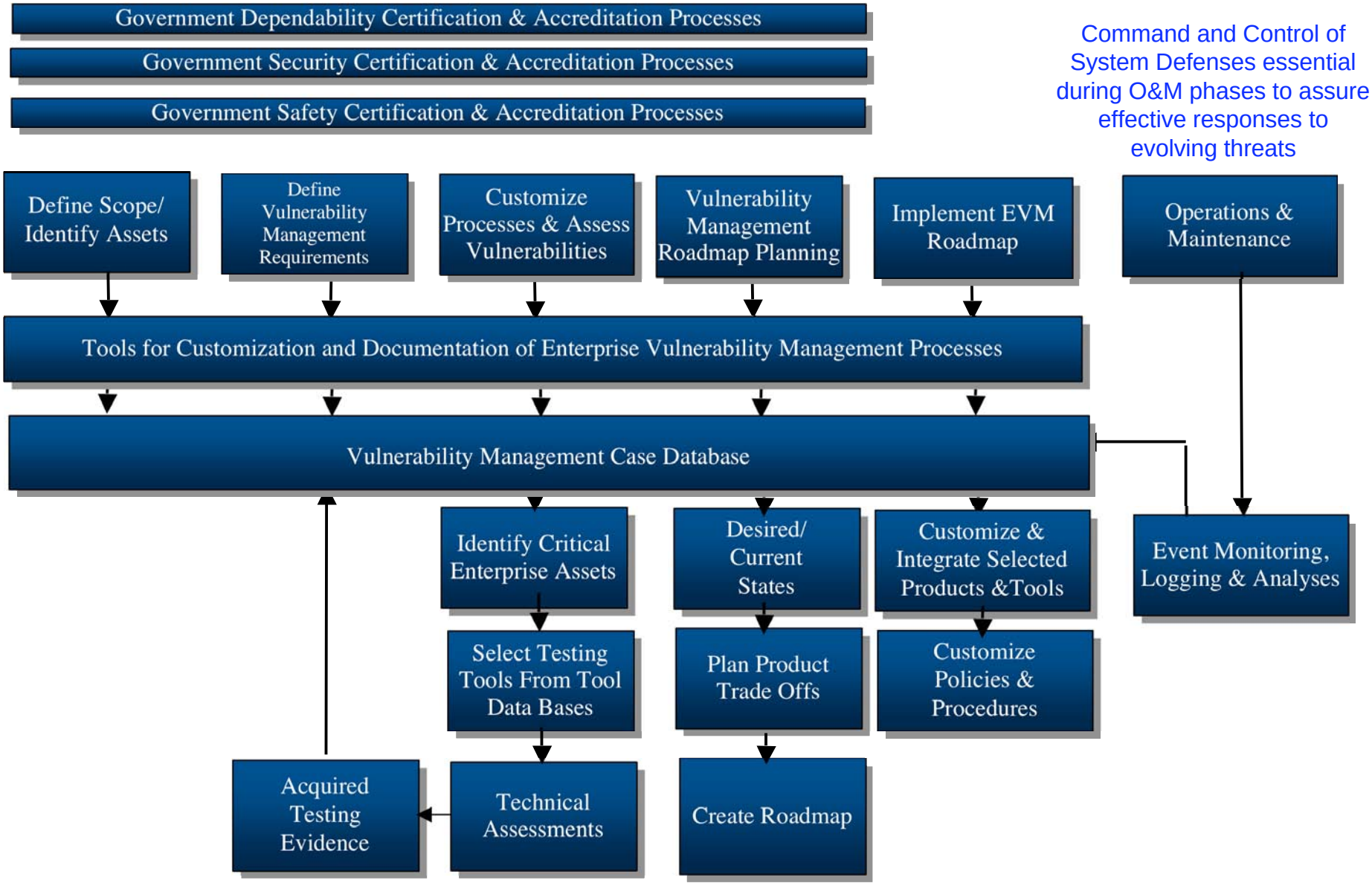
Typical upgrades focus on increasing profits and productivity by increasing demands on:

- **Web Enabling**
- **Collaboration**
- **Distributed Commerce Transactions**
- **Outsourcing**
- **Often without adequately addressing critical system dependability, safety and security issues!**

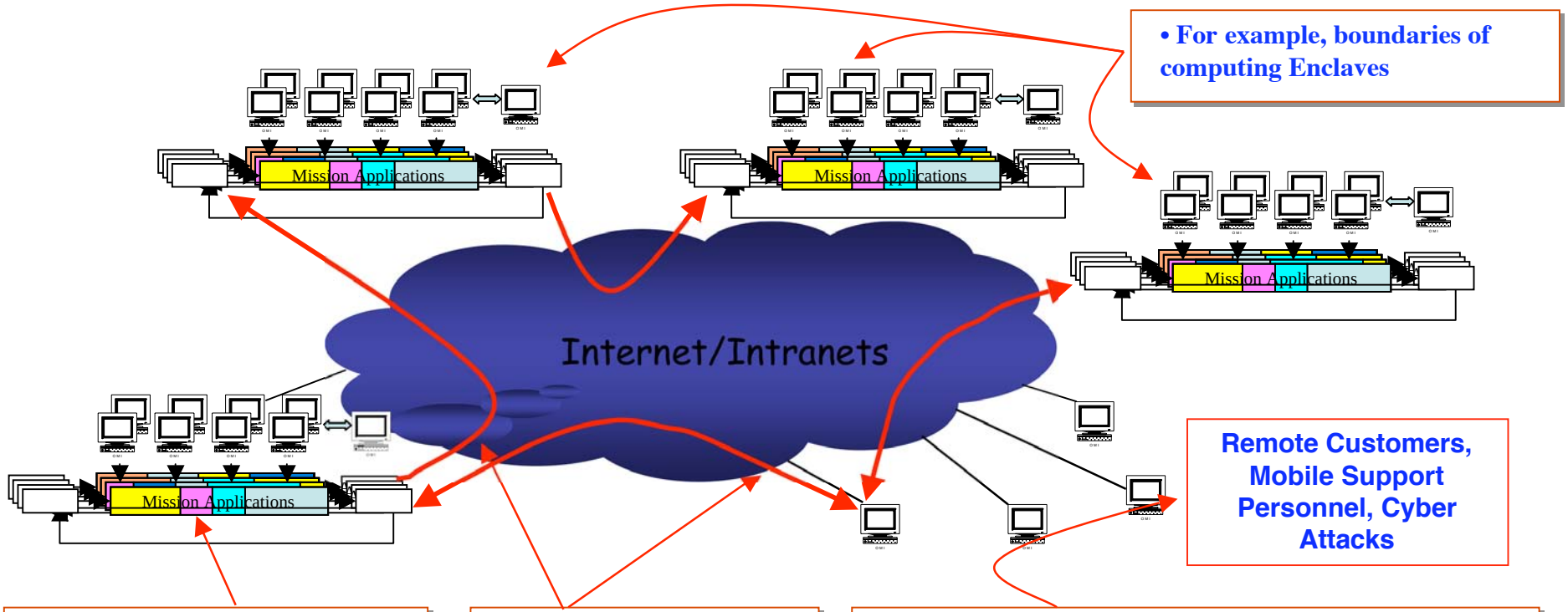
W.G. 10.4 Has Played a Major Role In Identifying the Additional Stress Testing Processes Needed to Assess & Mitigate the Combined Effects of Enterprise Dependability, Security, and Safety Stresses



Approved Certification & Assessment Processes Can Be Used to Drive Enterprise Vulnerability Management (EVM) Planning & Implementation



Evolving "On Demand" Architectures Will Depend on Linked Sequences of Services to Provide Required "End-to-End" Quality of Service (QoS) Capabilities



• For example, boundaries of computing Enclaves

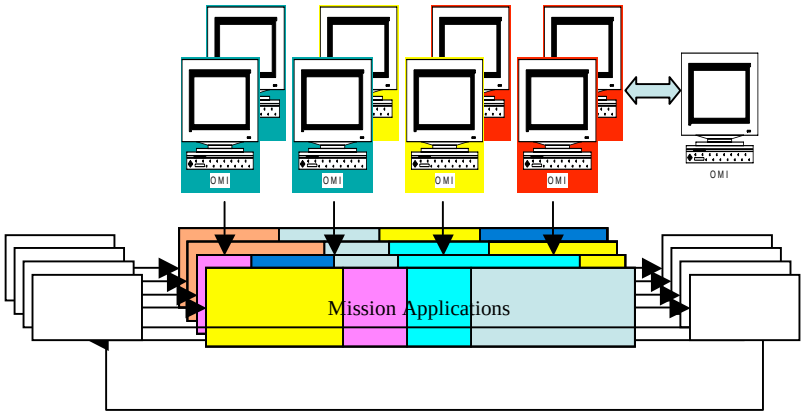
Remote Customers, Mobile Support Personnel, Cyber Attacks

• Personnel supporting a given Enclave are part of its assessment, but may also support other Enclaves and/or move physically between Enclaves
• Personnel within Enclaves may also be sources of Cyber attacks

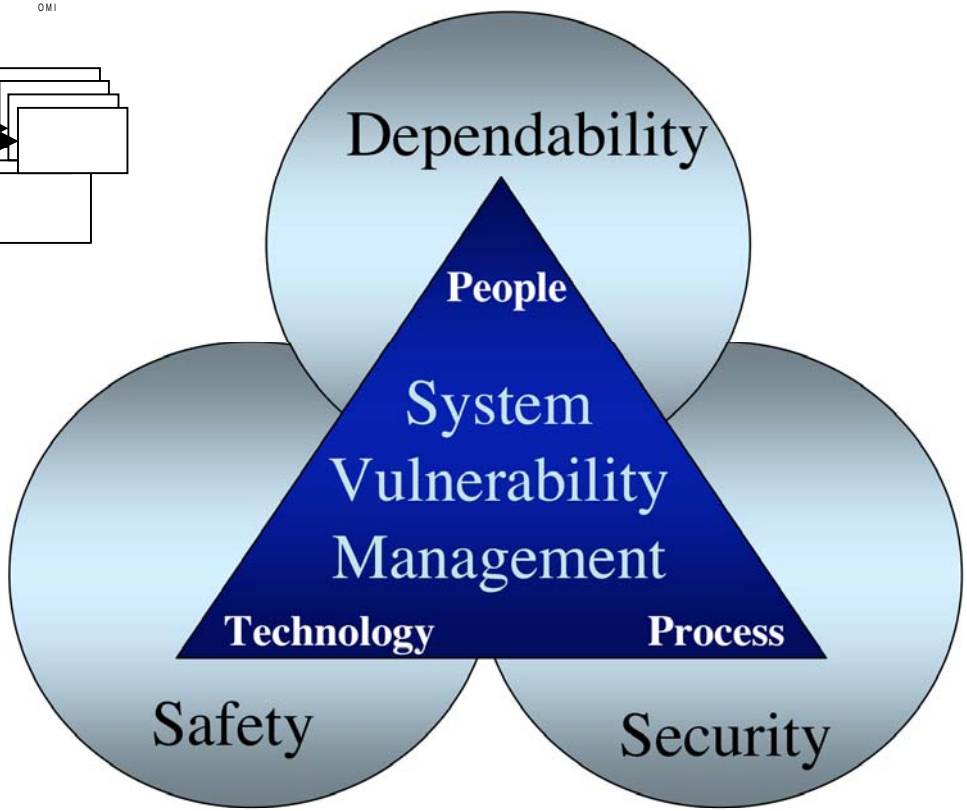
•Boundaries of Enclave to Enclave Communications

Vulnerability assessments and certifications need to also address security, safety and dependability issues associated with Mobile Support Personnel and their interactions with wireless networks

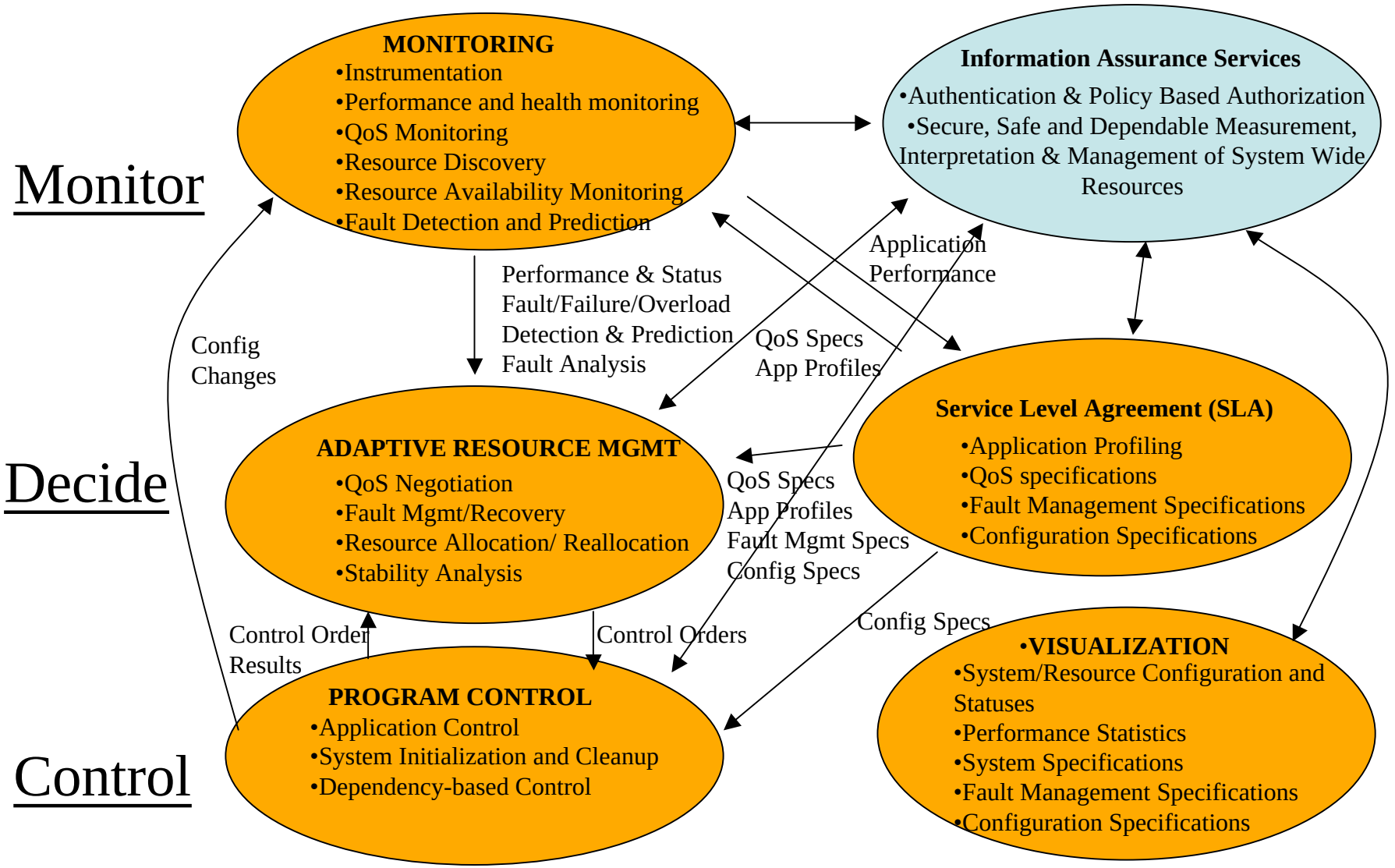
Need to Contend With Multiple Applications With Varying Security Requirements and Current System Benefit/Value, Competing for System Hardware, Software and Human Resources



Increasing Levels of QoS Management Automation Will Enable Initial Reductions in People Support, ***But System Designs Must Assure Human Understanding of Current System Status and Provide Means for Effective Human Participation in Detecting, Interpreting and Recovering From Continuously Evolving Levels of System Stresses***

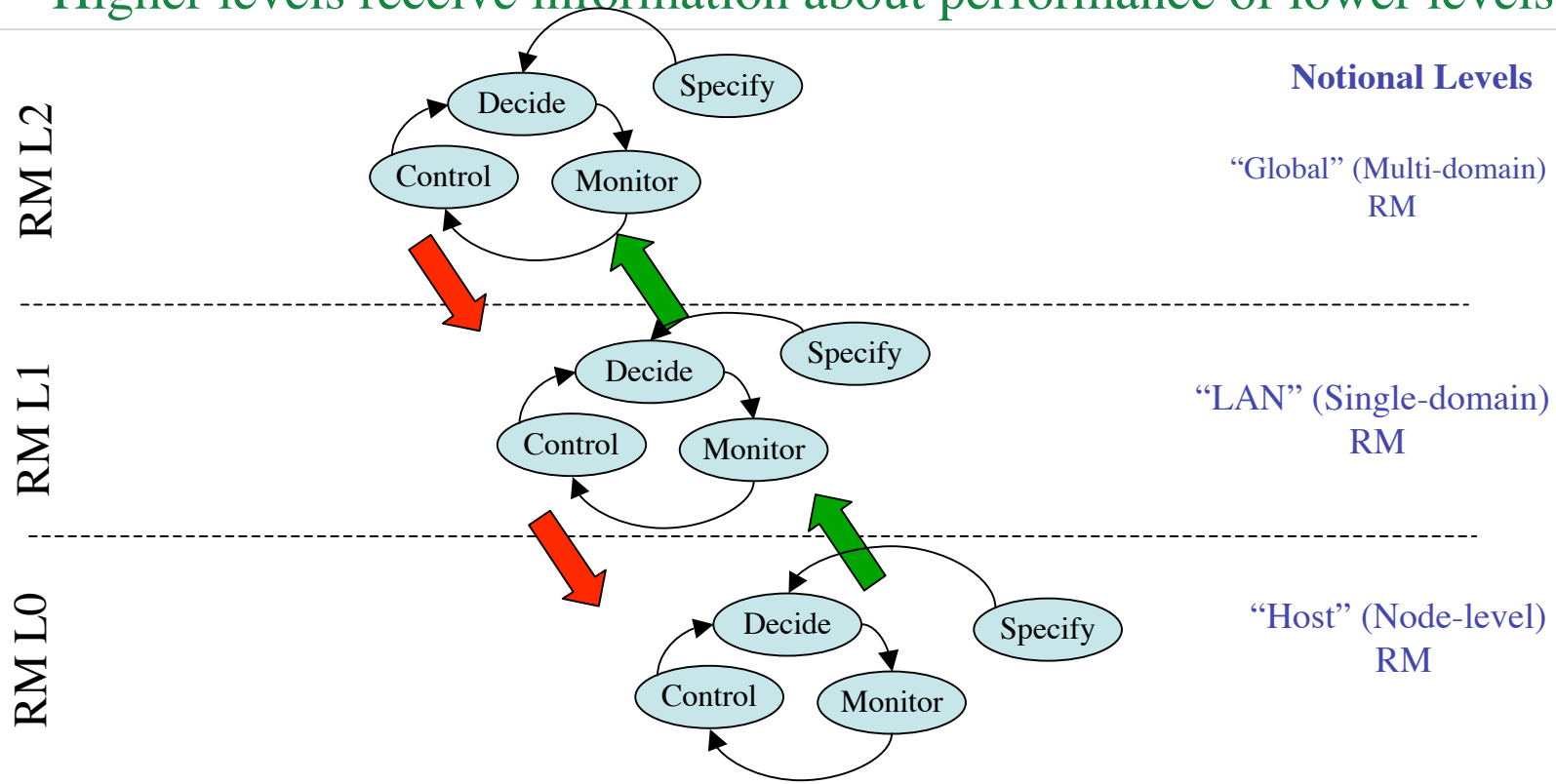


Broad Spectrum of Adaptive Resource Management Advances Under DARPA's "Quorum" Program Established Foundation for Current Industry-Wide Commitment to Providing End-to-End, QoS Controlled, "On Demand" Services



System-Wide QoS Management Will Utilize Multiple, Coordinated, Resource Management Levels

- Accepts directives from higher levels
- Provides status to higher levels
- Manages lower levels
- Higher levels receive information about performance of lower levels



Independent Stress Testing, Monitoring & Control Will Provide Metrics Guiding the Growth in System Performance, Dependability, Security and Safety

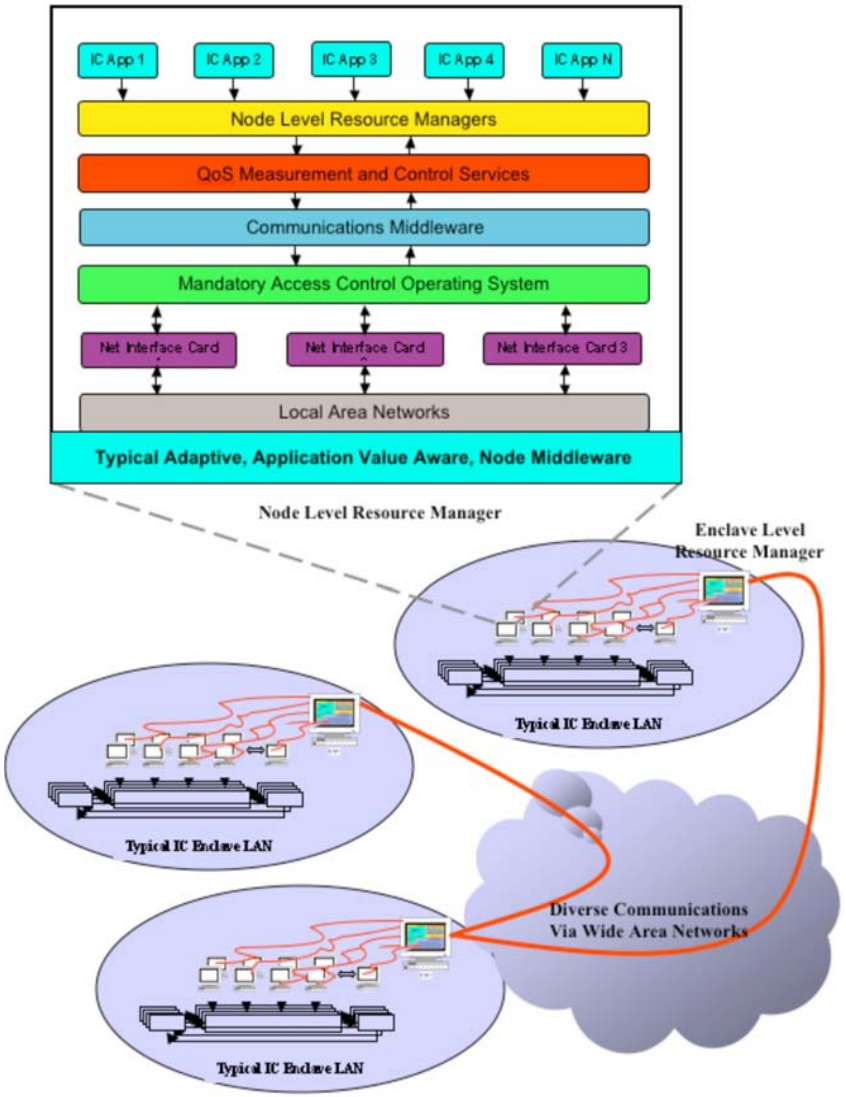


Fig. 1 Typical Secure & Dependable Wide Area System QoS Measurement and Control Spinal Cord

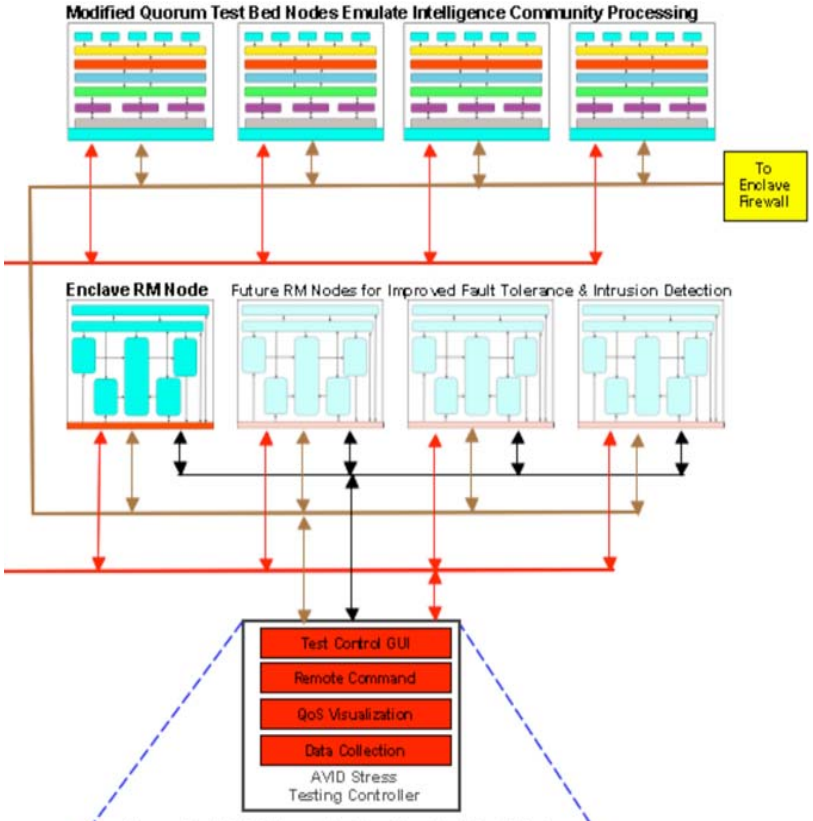
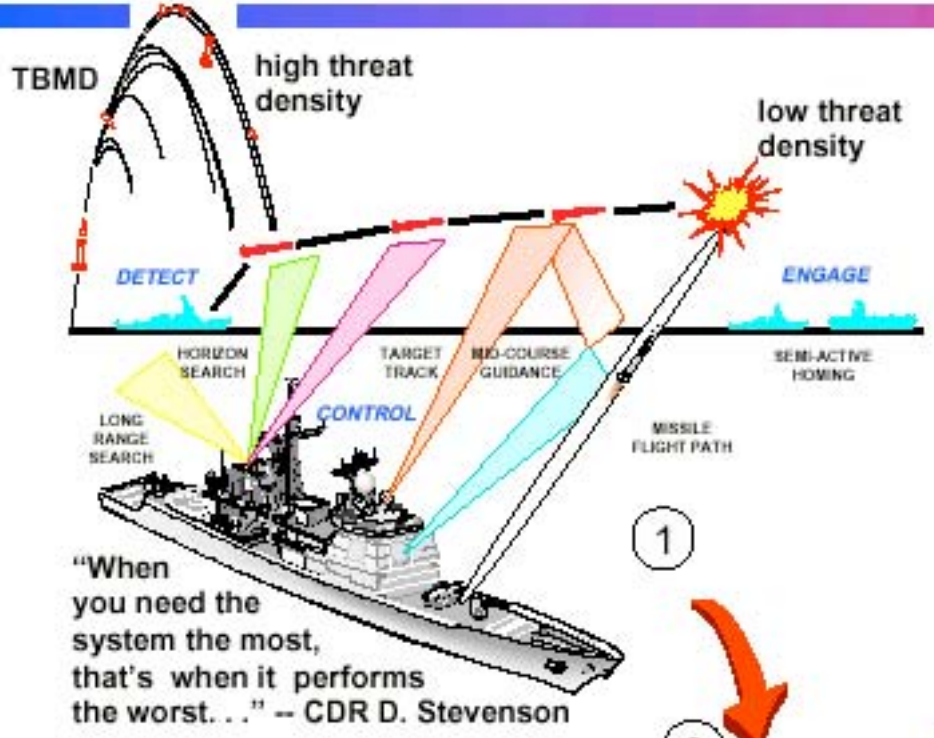


Figure 3 - AVID Stress Testing Enabled Test Bed

NAVAL SEA SYSTEMS COMMAND
NSWC Naval Surface Warfare Center DAHLGREN DIVISION
Panama City Dahlgren

SCALABLE PERFORMANCE

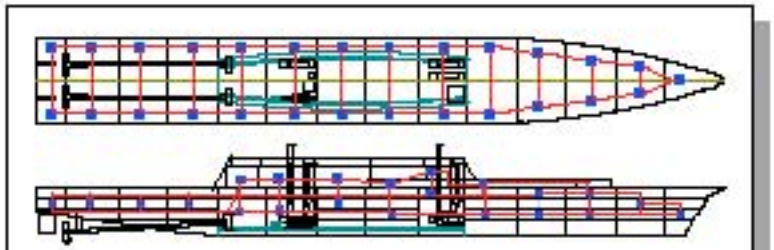


"When you need the system the most, that's when it performs the worst. . ." -- CDR D. Stevenson

1

- Today's systems often exhibit degraded performance as tactical load increases
- Systems may be over-designed for worst case; this increases complexity & cost
- Scalability provides constant performance despite load & allows sharing of resources

2



Scalable Computing Architecture

- Networked computers
- Distributed system middleware
- Scalable computer programs
- Load sharing management

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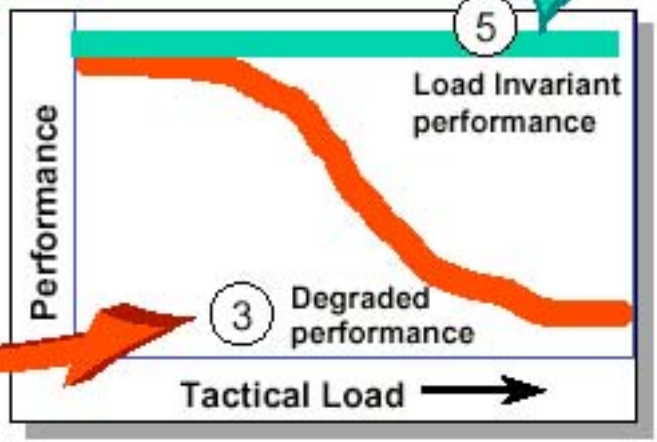
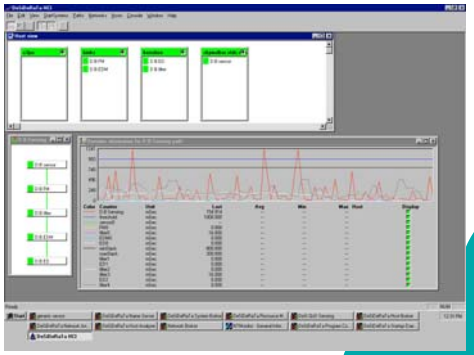
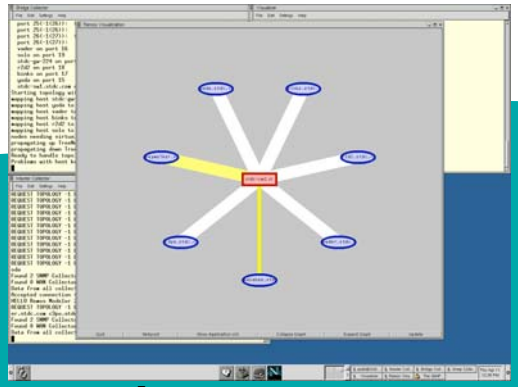
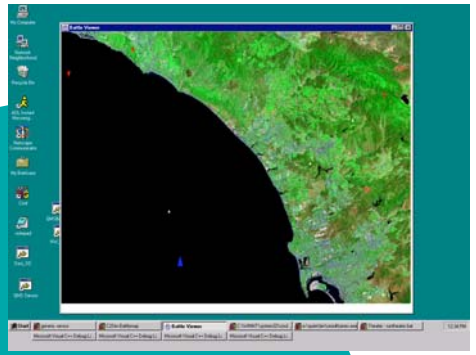




QoS Resource Manager



Network Resource Monitor

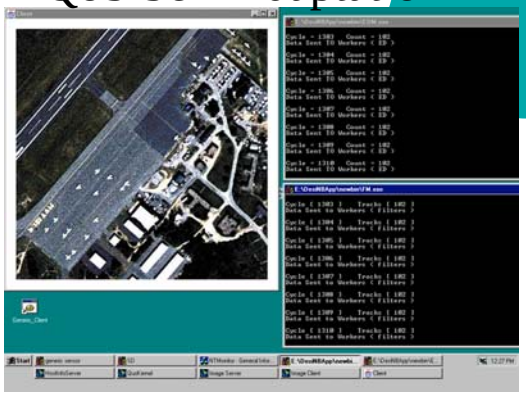


Mission Critical Application

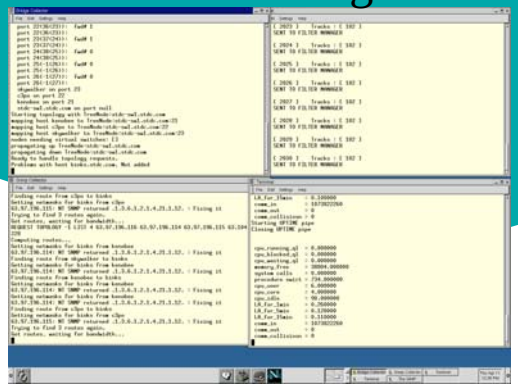
“On Demand” Quality of Service (QoS) Management using QoS Metric Services (QMS)

Sample QMS Application

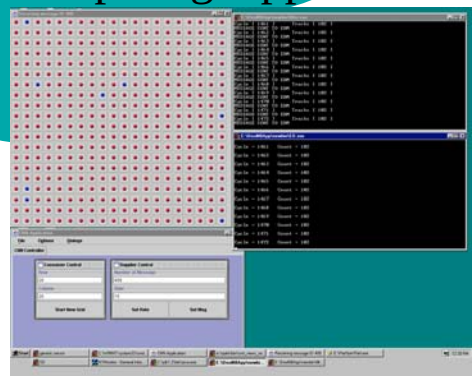
QoS Self Adaptation



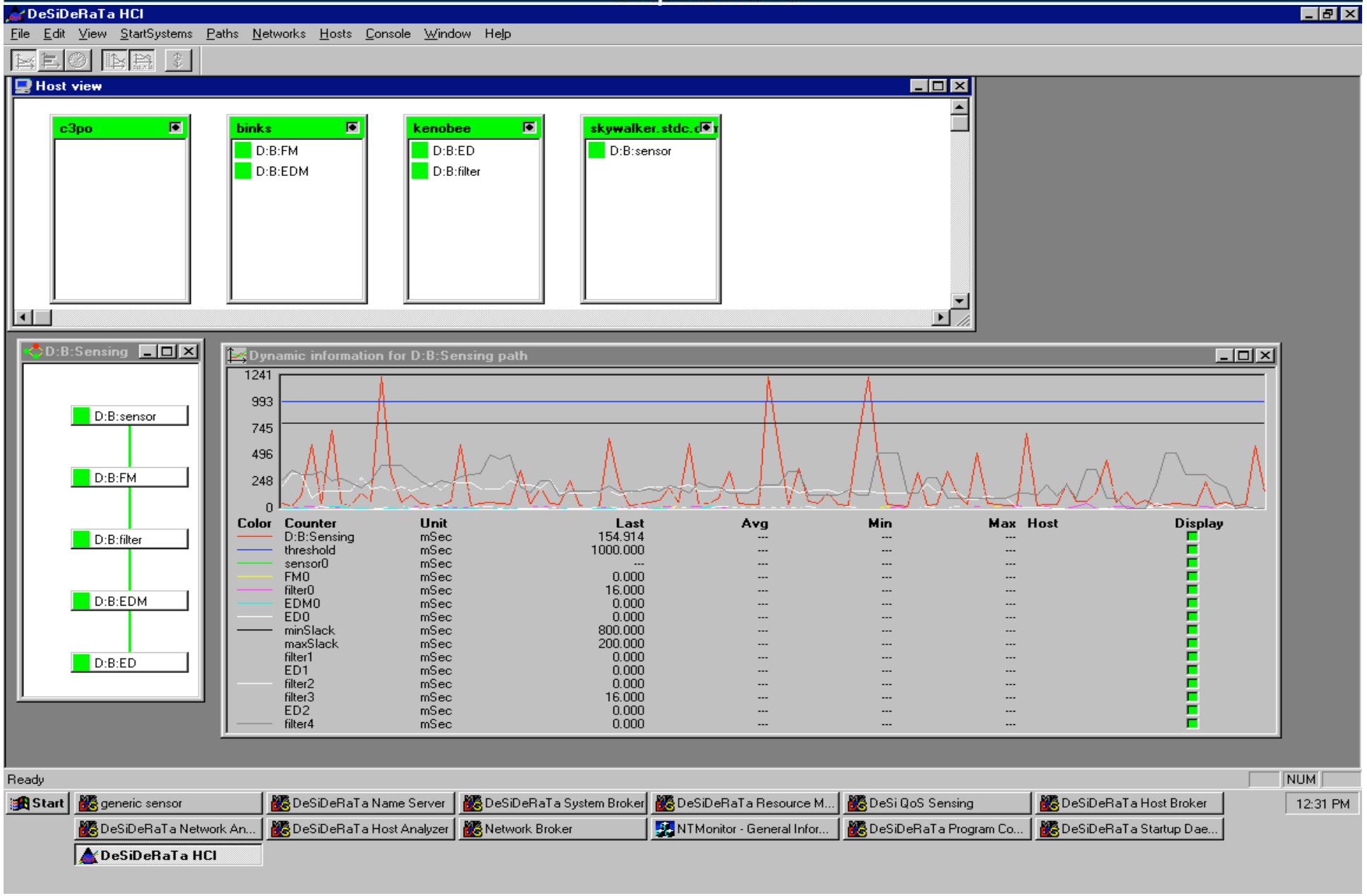
Monitoring of System Resource Allocation Reasoning Processes



Competing Application

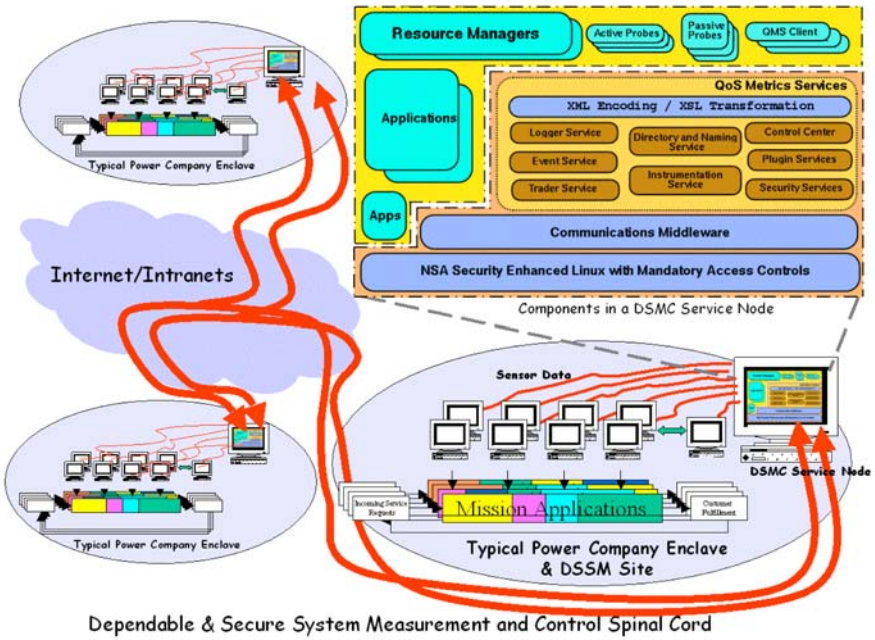


Resilient System Fall Back Modes Will Require Both Automated and Human Based Monitoring, Detection, Interpretation and Recovery Control Capabilities



Also, Continuing Evolution of Cyber Attack Mechanisms and Tactics Will Require Effective Human Participation in Command and Control of Cyber Defenses, Including System Detection, Interpretation and Recovery Processes

- A coherent approach towards assuring their defense requires
  - Ability to provide visibility into the extent of the security attacks
  - Ability to counter the attacks through coordinated control of distributed system resources
- Security is another dimension of the end-to-end service guarantee
- Assured communications of measurement and control information between distributed system resources and their system security management facilities.
- Assured communications to distributed system resources of attack countermeasure control commands generated by the system security management facilities
- Capabilities must be survivable despite failures of individual Node, Group or Enclave defenses



"Dependable and Secure System Spinal Cords"

Cyber Command and Control

Human-Computer Interaction for Strategic Decision Making

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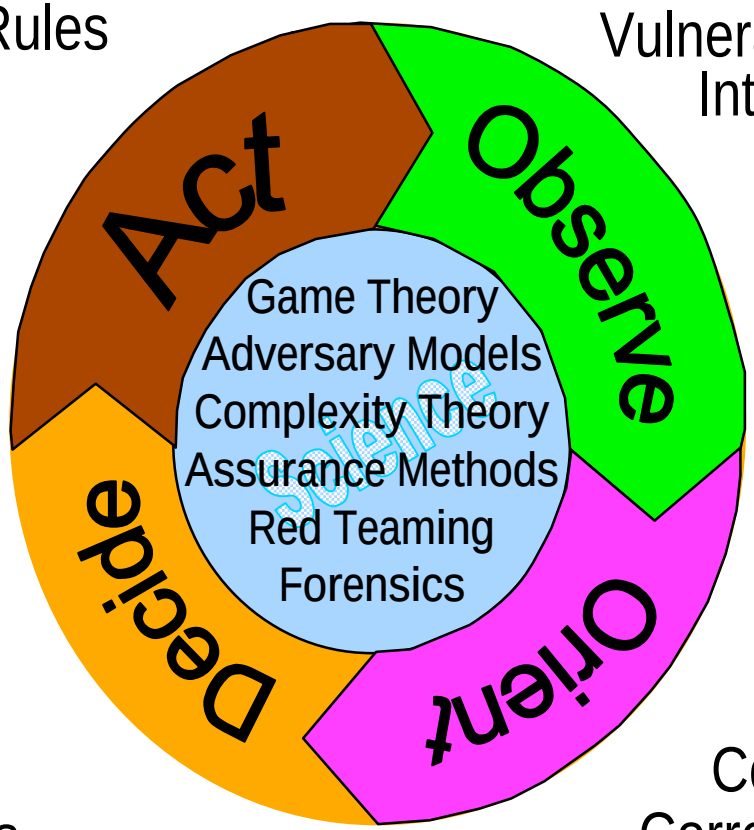
6 July 2004

Problem and Premises

- Attackers are creative
- Missions and values are dynamic
- Defenders are creative
- Human brain recognizes patterns well
- Policies are limited to known

Command Cycle Feedback Loop

Change Firewall Rules
Disable Accounts
Retask Sensors



Vulnerability Assessment
Intrusion Detection
HUMINT

Rapid Response
Tactical Decisions
Strategic Decisions

Visualization
Cognitive Science
Correlation and Fusion

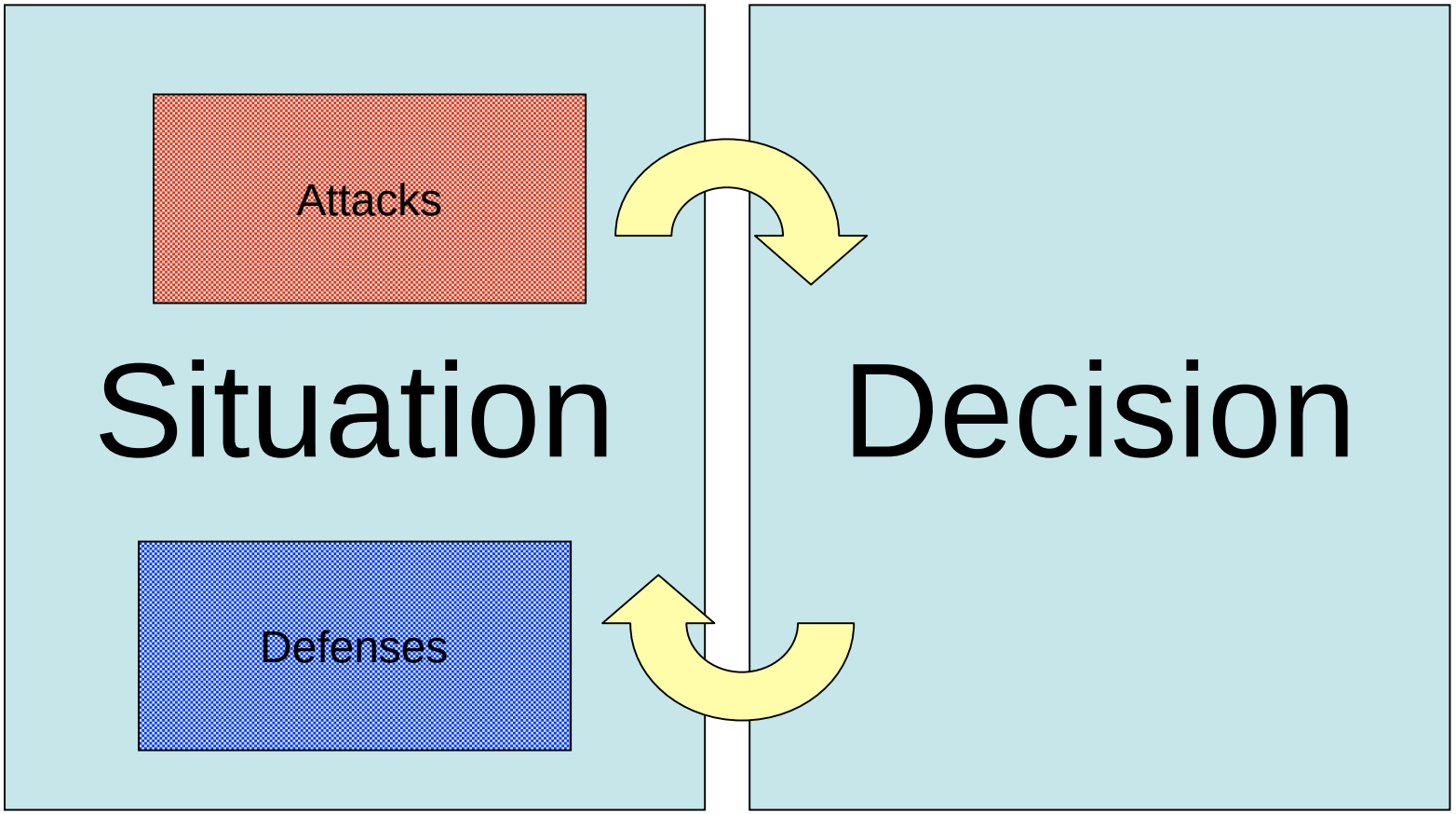
Command and Control

- Command
  - Decision-making process among possible actions given one’s understanding of the situation.
- Control
  - Process of ensuring a command choice is correctly executed and has desired effect

Cyberspace Character

- Butterfly effects
- Super-human tempo
- Poorly understood interdependencies
- Attack-Defense asymmetry

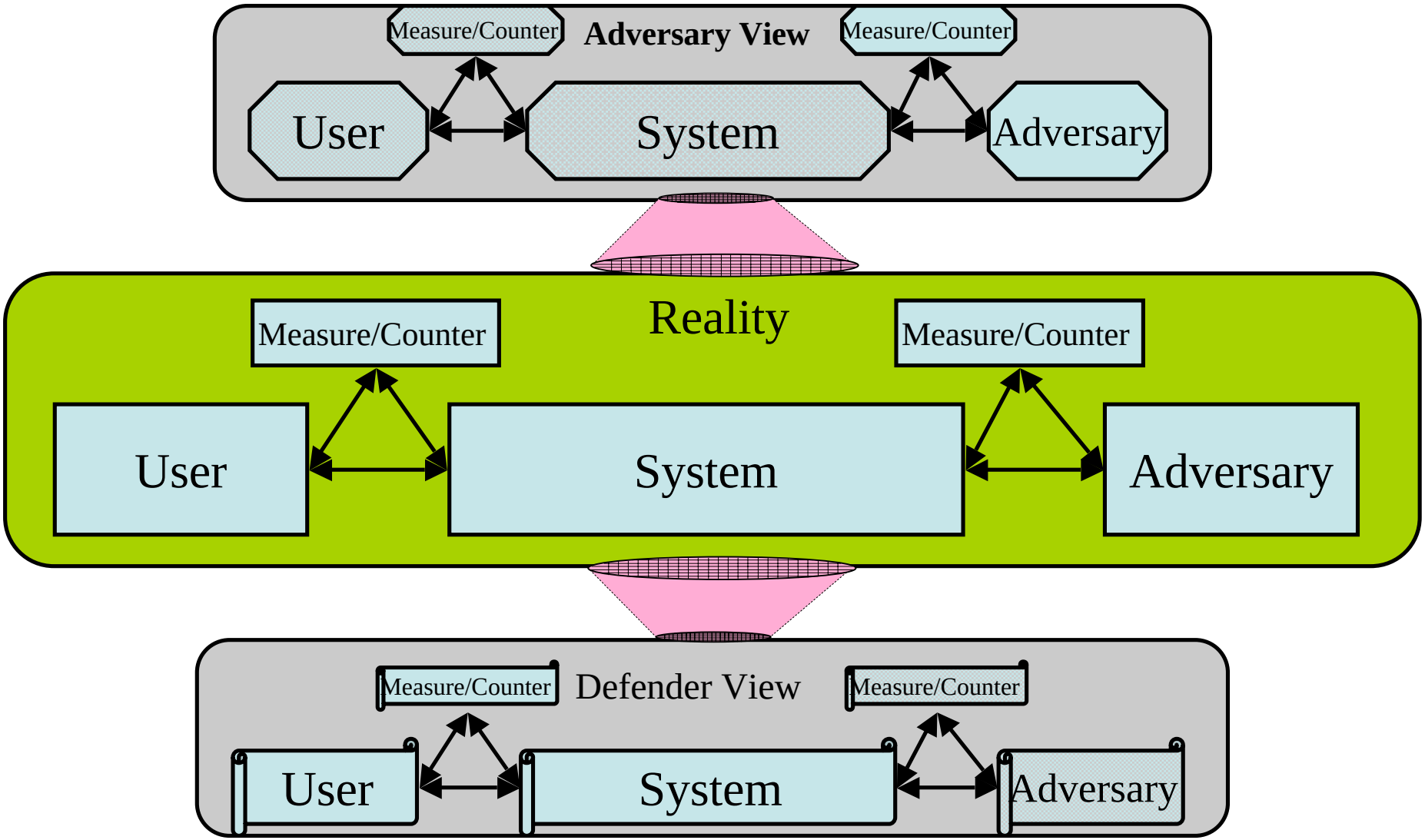
Basic Operation



Situation

- Model defense readiness
- Model attack status – multi-threads
  - Best guess on possible attacker plan
  - What is he doing, and where is he going
- Alert humans when decision is needed
- Status of defensive actions
- Delta to goal state (control)

Models Models Everywhere



Decision

- What are action options given the situation
  - Remind user in stressful situation of choices
  - Give less experienced users benefit
- Which have been most successful
  - In real situations
  - In simulations
- How long do decisions take to execute
- What are the consequences
  - On my mission
  - On attacker’s goal
- What further information do I need
- Where is attacker headed?

Sample Cyber Command and Control Interface