

# Cyber Challenges for Space Systems\*

PRESENTED AT THE  
**GSAW 2010 Workshop**

**J. W. Haines**

**3 March 2010**

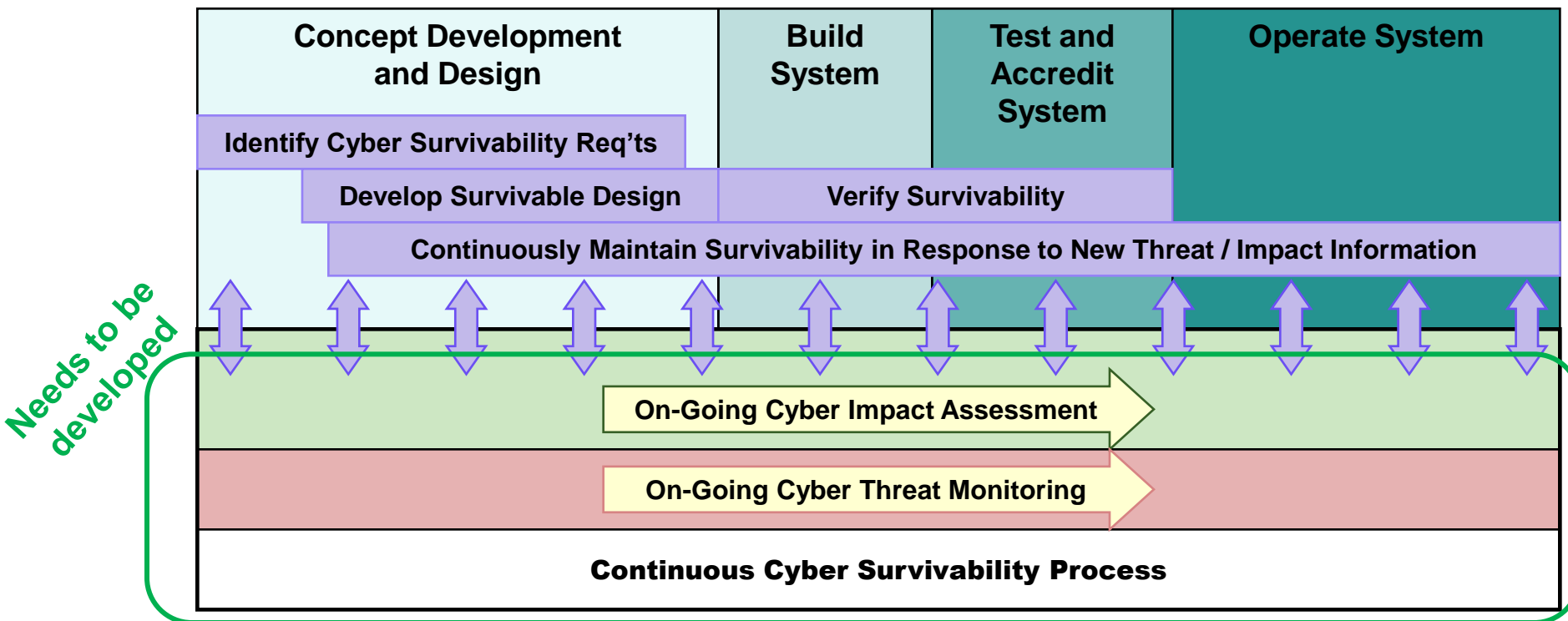
**MIT Lincoln Laboratory**

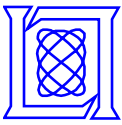
\* This work is sponsored by the Department of Defense under Air Force Contract FA8721-05-C-0002. Opinions, interpretations, conclusions, and recommendations are those of the authors and are not necessarily endorsed by the United States Government.



# The Vision: Acquiring Cyber Survivable Systems

- **Cyber Survivability:** The ability of a system to withstand a specified level of cyber attack while continuing to provide a specified level of mission function
- Approach should be on-going, repeatable and evolvable to:
  - Enable system architects and designers to design for cyber threat
  - Enable program office to show how well their system will work in the face of each threat
  - Ensure cyber survivability is incorporated in each phase of the system life cycle

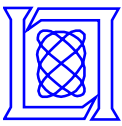




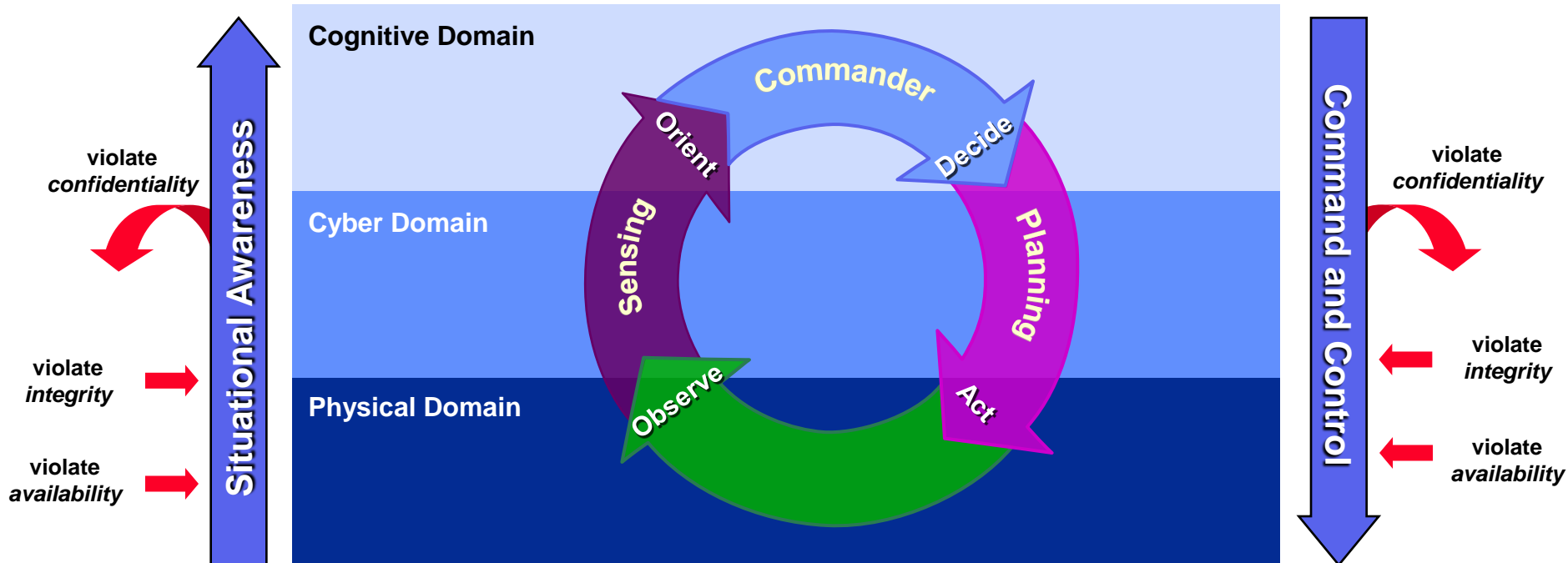
# Dynamic Aspects of Security

- **People will make mistakes and attackers will get in (by our mistakes or otherwise)**
- **Model cyber security with a control loop**
  - To get ahead, we must execute our OODA loop more quickly than the adversary
- **Current weaknesses are two-fold**
  - Adversary is not sufficiently resource-constrained
  - We often get stuck in the Orient step
- **Structure information environment to aid in executing our dynamic processes and hinder adversarial processes**





# Cyber and the Space Domain



Adapted from Air Force Doctrine Document 2-5, 11 January 2005, adapted from Understanding Information Age Warfare (D.S. Alberts)

- **Concern that adversary may launch coordinated cyber/kinetic attack**
- **Cyber security: integrity, availability, and confidentiality**
- **Cyber services framework**
  - Provides cyber survivability (mission operates through cyber attack)
  - Facilitates cyber countermeasures



# Cyber C2 Services

## Example of SOA-Based Cyber Battle Manager

### Cyber Services

#### Cyber Alert



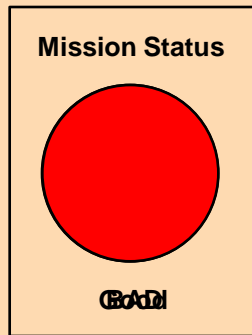
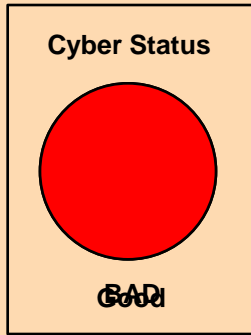
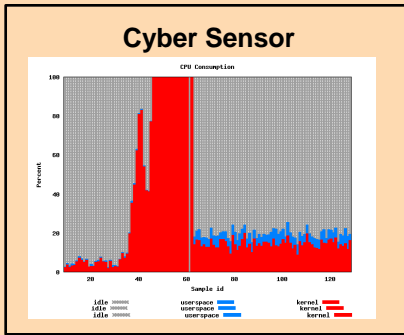
#### Cyber Network Status



#### Cyber Mission Alert



#### Cyber Response



### Cyber Situational Awareness Processing Chain

Cyber Alert

Cyber Network Status

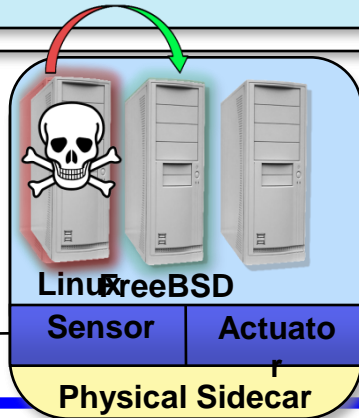
Cyber Mission Alert

BMD Battle Manager

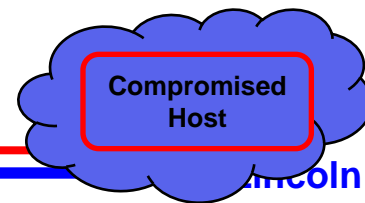
Cyber Response



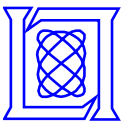
TRADEX



Linux-specific DOS



Compromised Host



# Engineering Cyber Survivable Systems – The Larger Picture

## Cyber Assessment

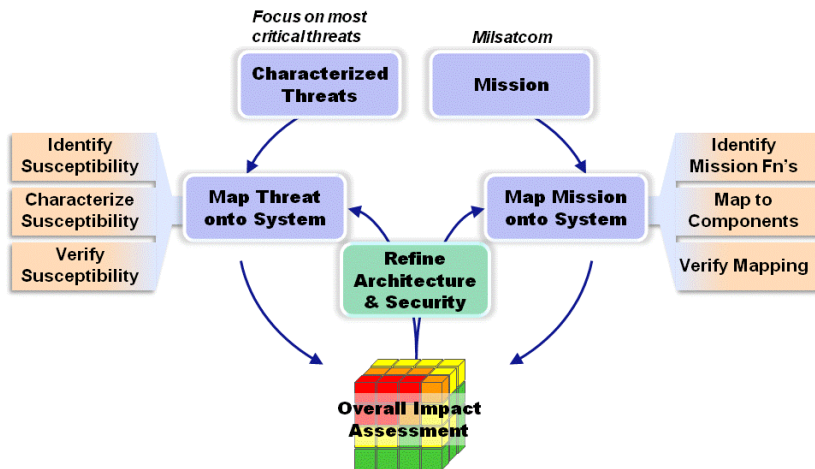
- Understanding the current and potential future threats
- Understanding the system and mission
- Understanding risk to mission from threats

## Survivable System and Architecture Development

- Applying cyber defense techniques
- Applying fault tolerance and resiliency techniques

## Technology Development and Rapid Prototyping

- Prototyping assessment tools
- Prototyping architecture frameworks and interfaces
- Prototyping components of survivable system



SMC and MCSW will need these capabilities for operation of current systems and development of future systems



# Cyber Survivability for Space Systems

## Bringing it All Together

- **POLICY:** Develop and implement a SMC-wide policy for Cyber Survivability
  - The policy should define Cyber Survivability, set high-level expectations for SMC systems, and assign organizational responsibility for the activities necessary to achieve and verify Cyber Survivability
- **CAPABILITIES:** Cyber domain equivalents of several existing activities & capabilities will need to be initiated:
  - Threat identification, mission impact evaluation
  - Development of technical and architectural mitigations
  - Development of technology, tools, and best practices
- **INTEGRATION:** Integrate Cyber Survivability into all phases of the acquisition process
  - This should include requirements generation, development, deployment, and operations. The mitigation of Cyber threats will likely require a development tail that persists for the operational life of the system

*Main Engineering Roles, Tailor specifically for space systems*