Defending Enterprise Systems from the Inside Out

A Multidimensional Cyber Protection Strategy for the 21st Century

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Complexity

Millions, Billions, and Trillions of Everything

Today's systems…

Present a uniform attack surface

Rely on a single-dimension protection strategy based on penetration resistance

Are highly susceptible to destructive cyber-attacks

Cyber Attacks

The adversaries are relentless….

Exfiltrate information

Preposition malicious code

Bring down capability

Create deception

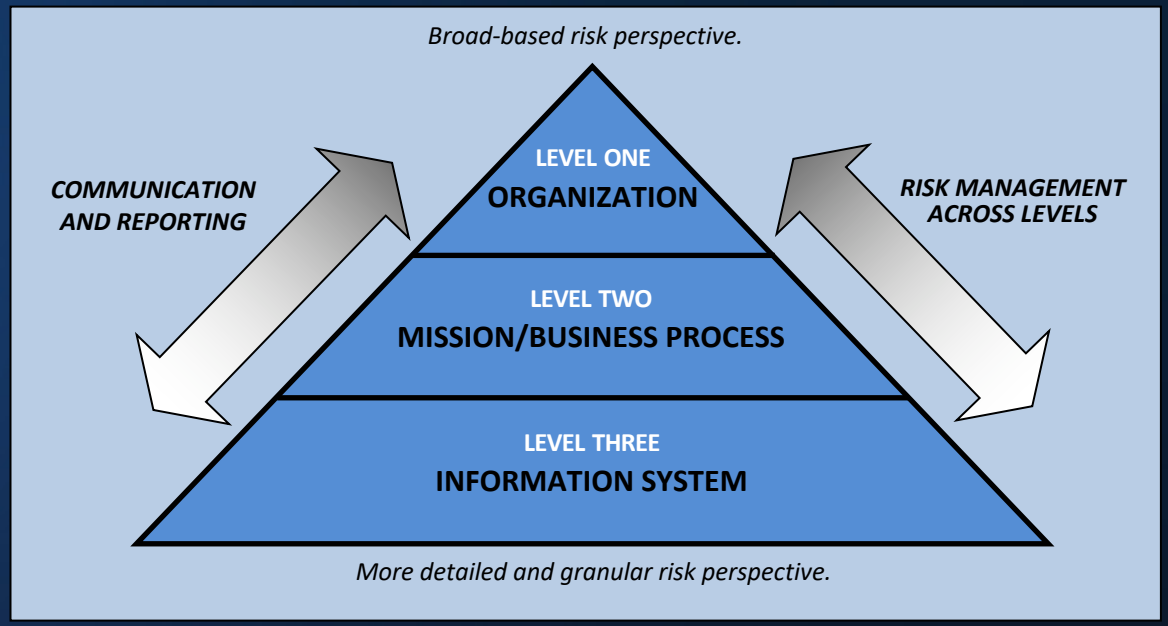
Defense Science Board Reports

Risk Management

An Organizational Perspective

Key Elements

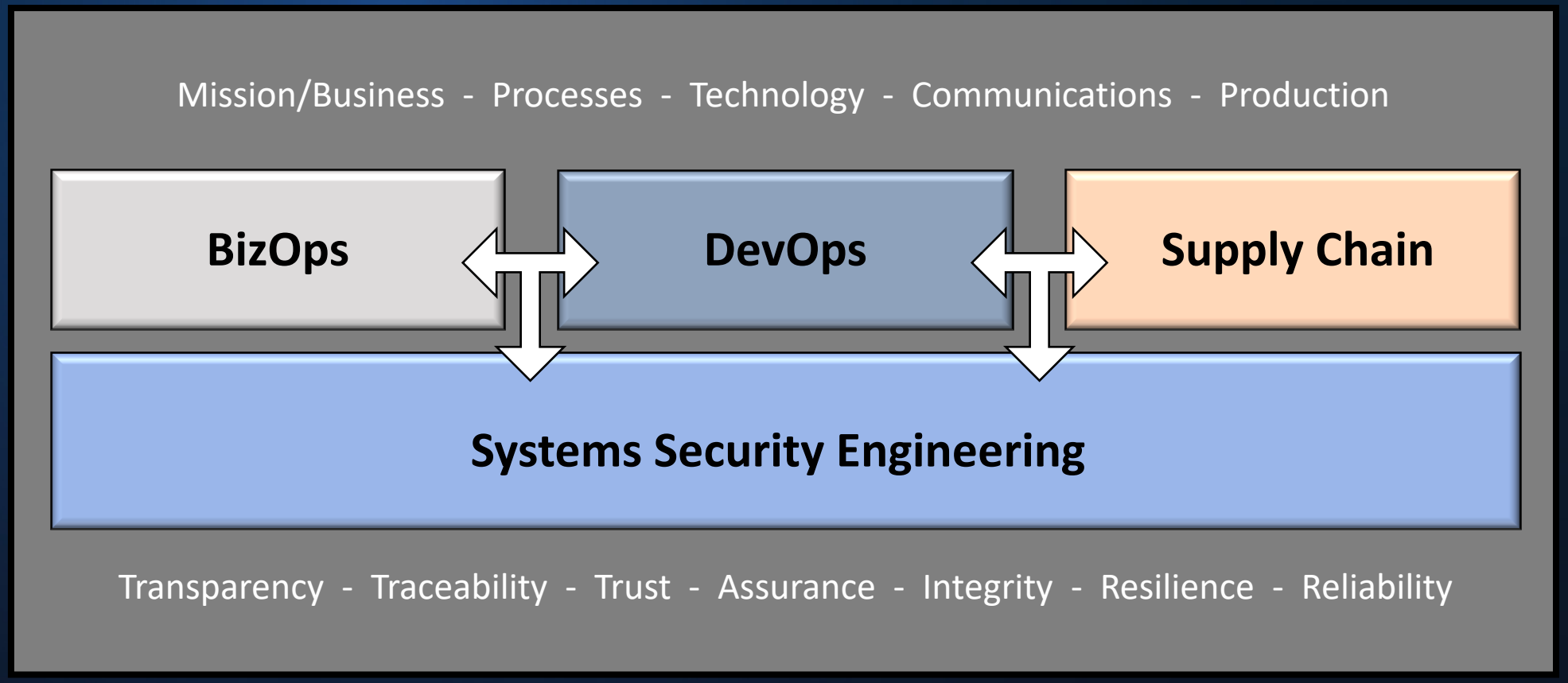
- **Mission and business driven security requirements**
- **Traceability of security requirements from the boardroom to implementation**
- **Transparency of security architectures**
- **Trust and assurance in organizational systems**

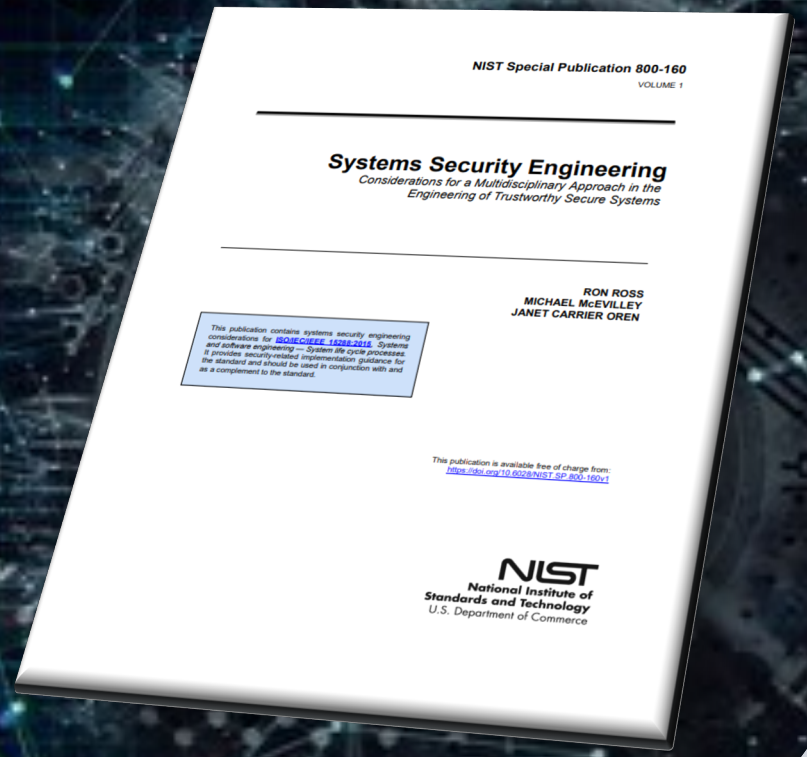


Courtesy: NIST Special Publication 800-37, Revision 2

The Vision

Framework for Securing Organizational Systems and Assets





Multidimensional Protection Strategy

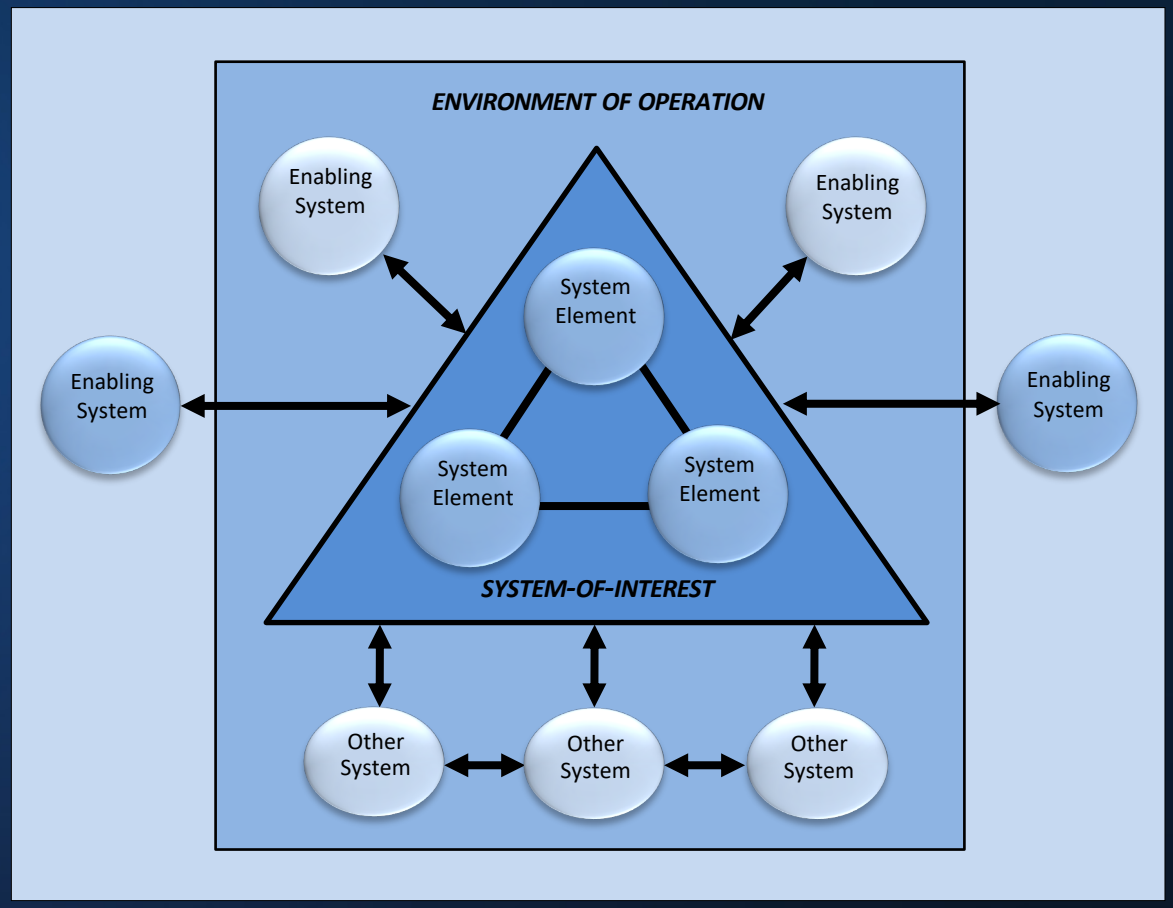
- Penetration-resistant architecture
- Damage-limiting operations
- Designs to achieve cyber resiliency and survivability

Stop the incursion…
Limit the damage after the incursion has occurred…
Continue to operate even in a degraded or debilitated state.

Protecting Critical Systems and Assets

Systems Engineering View

Critical interdependencies and relationships among internal system elements, systems within enterprise environments, and systems in external environments that affect security solutions.



Courtesy: NIST Special Publication 800-160, Volume 1

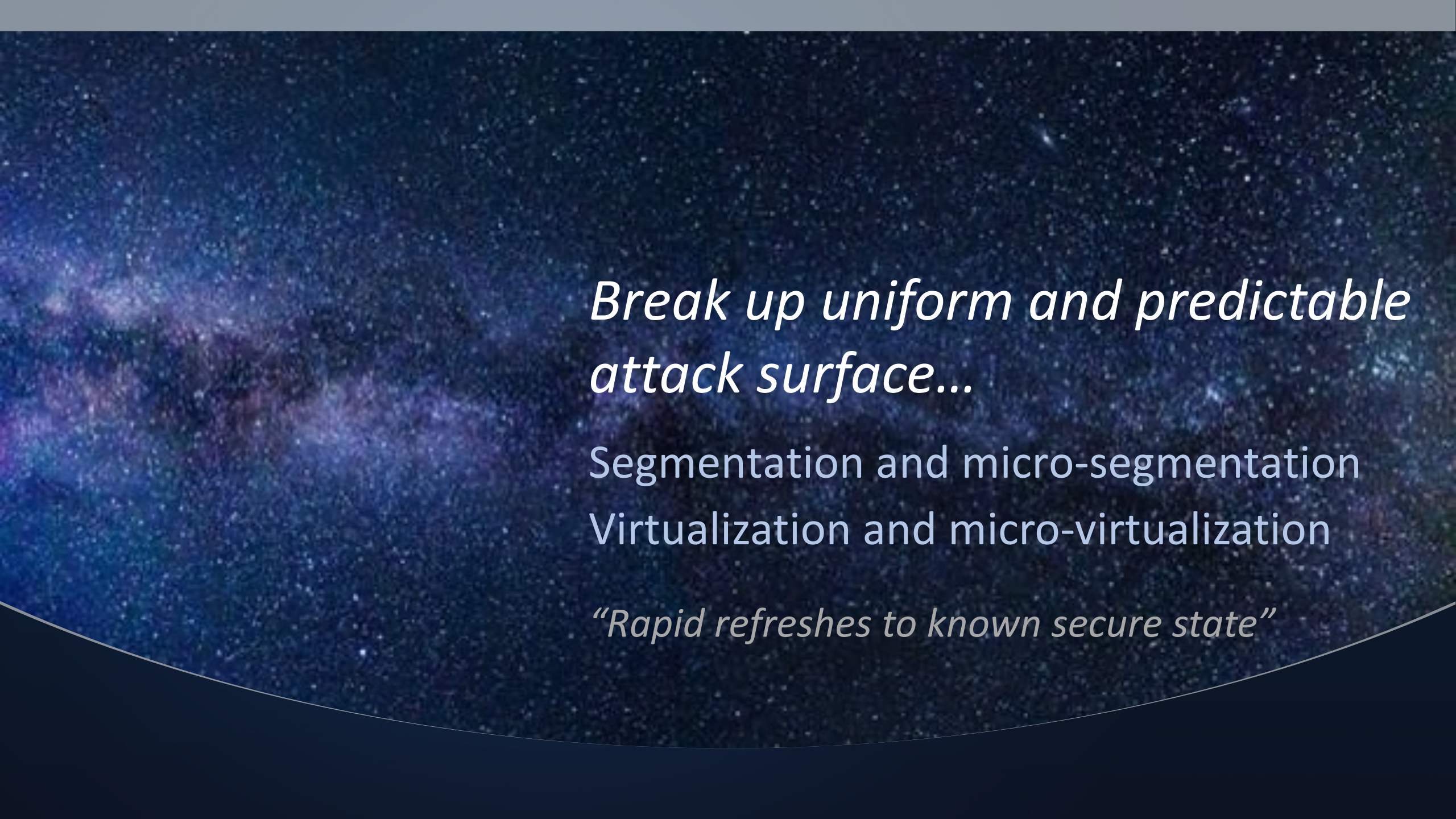
Disrupt the adversary's game plan in time and space…

Impede adversary lateral movement

Increase adversary work factor

Reduce adversary confidence

Limit adversary time on target


Break up uniform and predictable attack surface…
Segmentation and micro-segmentation
Virtualization and micro-virtualization
“Rapid refreshes to known secure state”

Systems Security Engineering

ISO/IEC/IEEE 15288:2015

Systems and software engineering — System life cycle processes

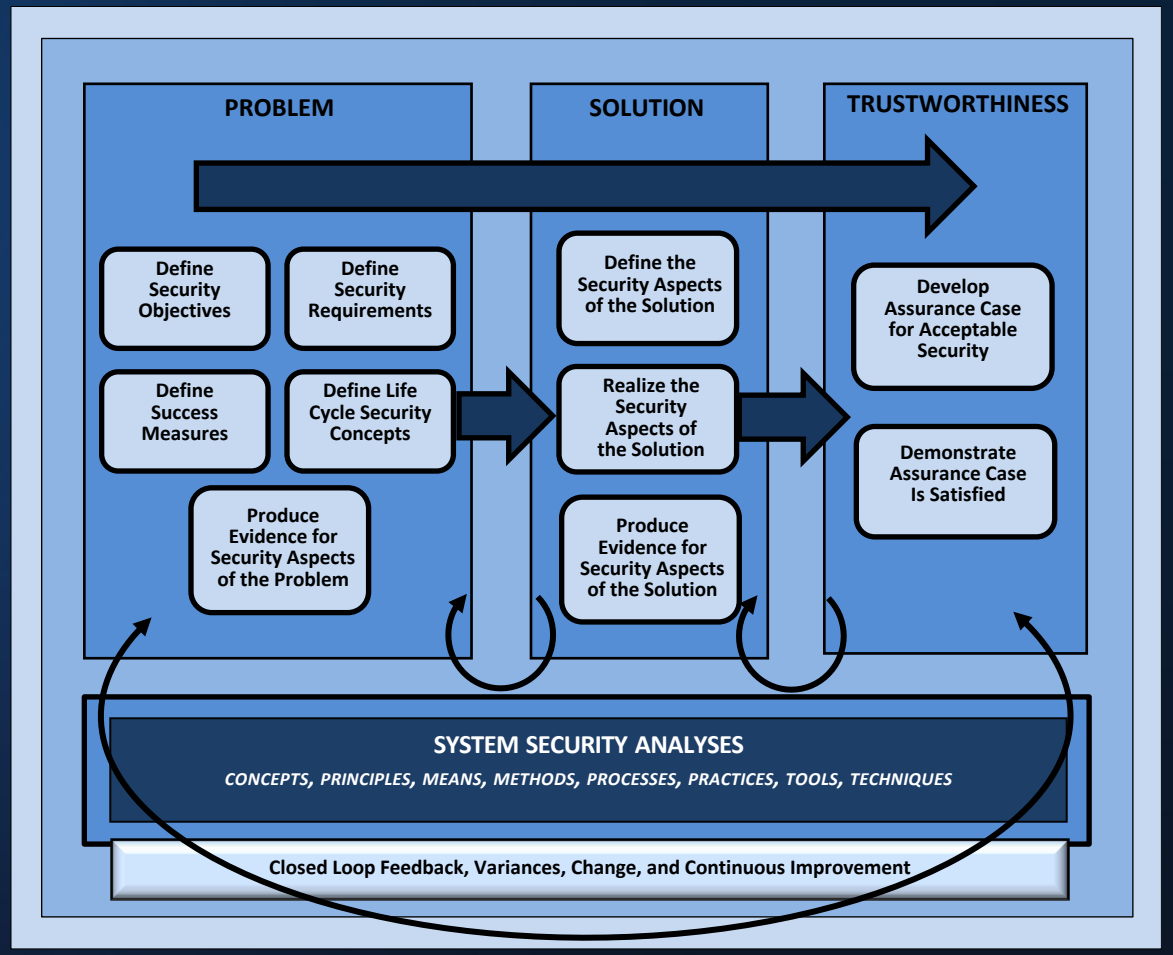
- Business or mission analysis
  - Stakeholder needs and requirements definition
    - System requirements definition
      - Architecture definition
        - Design definition
          - System analysis
            - Implementation
            - Integration
          - Verification
        - Transition
      - Validation
    - Operation
  - Maintenance
- Disposal

NIST SP 800-160 Volume 1

Systems Security Engineering

Characteristics

- Disciplined and structured development process
- Integrates security into the system life cycle
- Applied to all elements in the system stack
- Can be tailored and implemented in agile development processes
- Provides needed traceability of requirements and transparency into development processes leading to greater trust in systems and system elements



Courtesy: NIST Special Publication 800-160, Volume 1

Systems Security Engineering

Key Concerns

- Architecture
- Assurance
- Behavior
- Cost
- Criticality
- Design
- Effectiveness
- Emergence
- Ergonomics
- Exposure
- Fit-for-purpose
- Human performance
- Life cycle concepts
- Penetration resistance
- Performance
- Privacy
- Protection needs
- Requirements
- Risk
- Security objectives
- Strength of function
- Security performance
- Threat
- Trades
- Training
- Uncertainty
- Vulnerability
- Verification
- Validation

Cyber Resiliency

The ability to anticipate, withstand, recover from, and adapt to adverse conditions, stresses, attacks, or compromises on systems that use or are enabled by cyber resources.

CYBER RESILIENCY SOLUTION

RISK MANAGEMENT STRATEGY

Programmatic

- Organizational Level
- Mission/Business Process Level
- System Level

Inform selection and prioritization

Why

Interpret, determine priorities of, and define strategies for achieving

GOALS

- Anticipate
- Withstand
- Recover
- Adapt

OBJECTIVES

- Understand
- Prevent/Avoid
- Prepare
- Continue
- Constrain
- Reconstitute
- Transform
- Re-architect

Can be further decomposed into sub-objectives and capabilities.

What

Inform selection and prioritization

How

Selection, prioritization, and application informed by programmatic, operational, and technical considerations, including threat considerations.

STRATEGIC DESIGN PRINCIPLES

Inform selection and prioritization

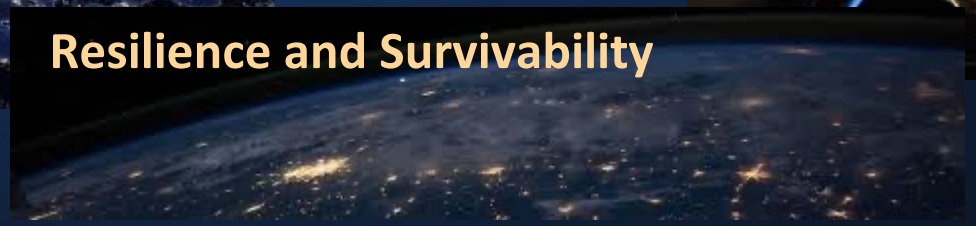
STRUCTURAL DESIGN PRINCIPLES

APPROACHES

TECHNIQUES

Inform selection and prioritization

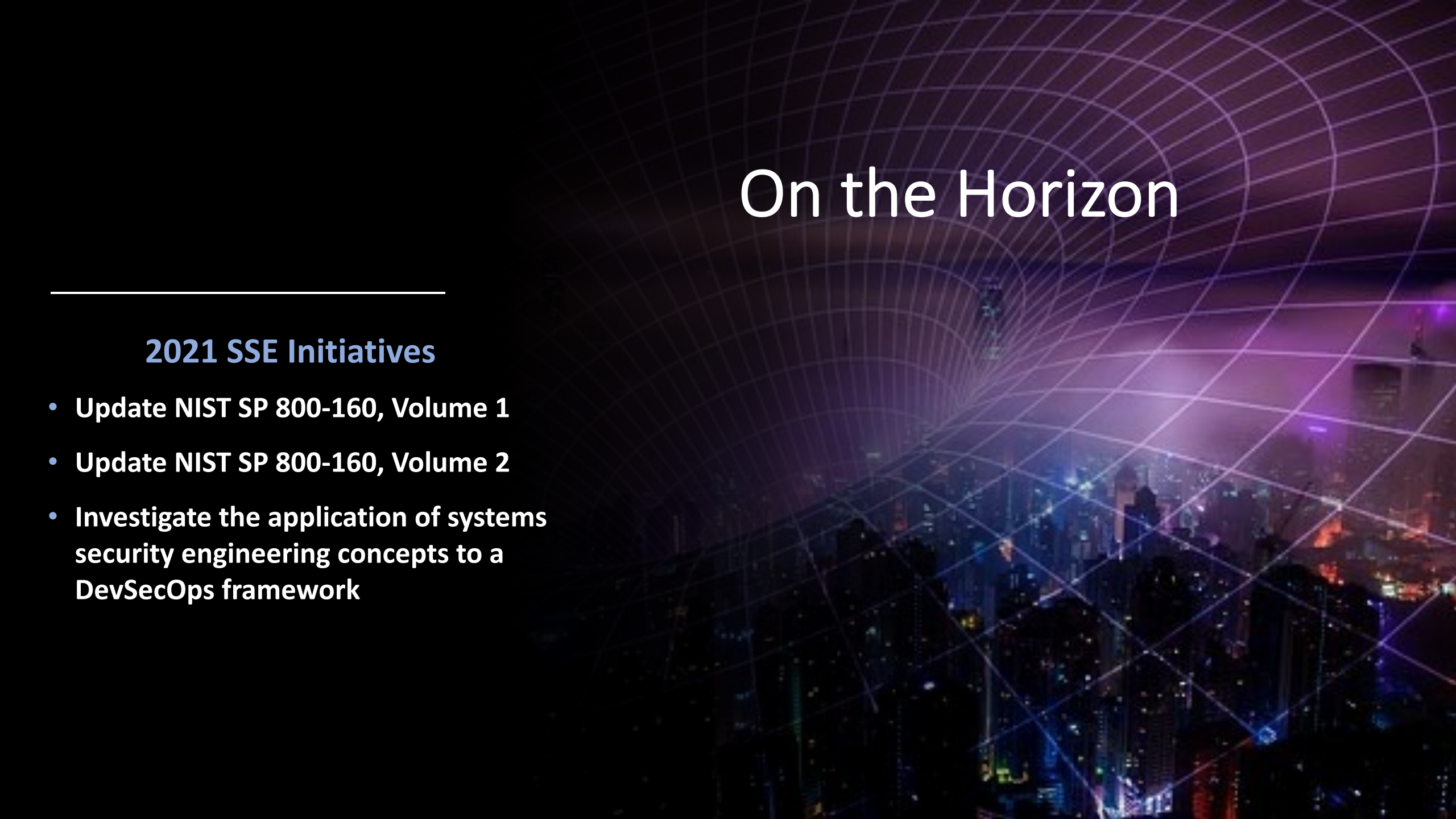
Cyber resiliency relationships with other specialty engineering disciplines



On the Horizon

2021 SSE Initiatives

- **Update NIST SP 800-160, Volume 1**
- **Update NIST SP 800-160, Volume 2**
- **Investigate the application of systems security engineering concepts to a DevSecOps framework**



“If a full on ‘turn the lights off’ cyber war were to happen today, we would lose. Think about that. We would lose a cyber war. With a few clicks of the mouse, and in just a few seconds, hackers in Beijing or Moscow could turn off our electricity, millions would lose heat, groceries would spoil, banking machines would not work, and people could not get gasoline. It would be what we have seen down in Texas, but on national scale and with no end in sight. That we have escaped a digital catastrophe thus far is not due to skill. It is due to blind luck and restraint from our adversaries.”

Mike Rogers, February 23, 2021
Former Member of Congress, House Intelligence Committee
https://thehill.com/opinion/cybersecurity/539826-we-would-not-survive-true-first-strike-cyberattack

Questions?

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