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The Survivable Network Analysis Method: Assessing Survivability of Critical Systems

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Mission Survivability



Changing Environment

- System Evolution
 - expanding network boundaries
 - additional participants with varying levels of trust
 - numerous point solutions: Public Key Infrastructure, Virtual Private Networks, Firewalls
 - blurring of Intranet and Extranet boundaries
 - new technologies -- directory services, XML
- The impact of attacks is on organizations, and hence on the applications which support the organization's mission



Impact on Analysis

- Lack of complete information
 - physical and logical perimeters
 - participants, untrusted insiders
 - software components --- COTS Java, etc.
- Mix of central and local administrative control
- Critical components more exposed
- An attack could impact essential business services



Survivability Defined

Survivability is the ability of a system to fulfill its mission, in a timely manner, in the presence of attacks, failures, or accidents.



Key properties

- Mission Focus
 - Identification of risks and trade-offs
 - Alternative means to meet mission
- Assume imperfect defenses



The “Three Rs”

- *Resistance*
 - Capability to deter attacks
- *Recognition*
 - Capability to recognize attacks and extent of damage
- *Recovery*
 - Capability to provide essential services/assets during attack and recover full services after attack



Techniques and Methods

- Traditional Security
 - fortress model: firewalls, protection, security policy
 - insider trust
 - encryption, authentication, passwords
 - resistance and recognition with recovery secondary
- Survivability is enhanced by
 - security techniques where applicable
 - redundancy, diversity, general trust validation, etc
 - automated recovery support



Example

- E-mail
 - E-mail content tunnels through firewalls
 - Always time lag between initial discovery and upgraded virus signatures required for scans
 - Enhanced e-mail functionality
 - Attachments (Word macros)
 - Rich content such as HTML, Javascript
 - Resistance and recognition limited. Recovery strategies essential.
 - Significant impact on services other than e-mail.



The Survivable Network Analysis Method

- Focus
 - early phase of life cycle
 - applications as well as system infrastructure
 - tailorable depending on stage of development.
- Three options for SNA analysis
 - survivability architecture
 - survivability requirements
 - mission lifecycle



Architectural Focus

- Capture assumptions such as boundaries and users
- Support system evolution as requirements and technologies change
 - evolving functional requirements
 - trend to loosely coupled
 - requirements for integration across diverse systems
- Assist with product selection and integration with respect to rapidly changing security product world



General Method

- Identify essential services with normal usage.
- Generate intrusion scenarios which are use cases for intruder
- Evaluate system in terms of response to scenarios
 - Requirements: propose response to intrusions
 - Architecture: evaluate system and operational behavior
- Mission impact
 - applications as well as system components
 - stakeholders input essential

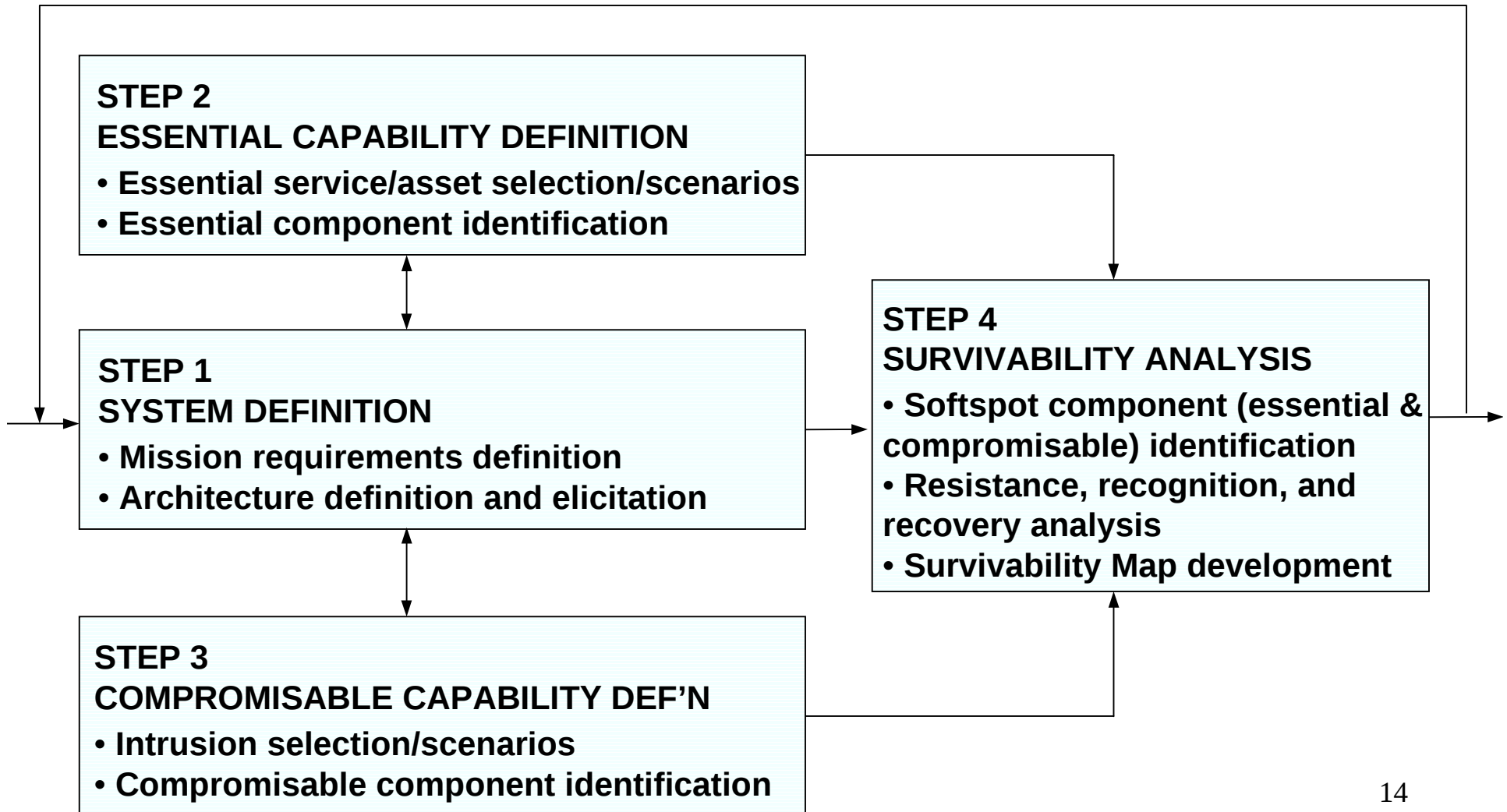


Survivability Architecture

- Make recommendations for survivability improvements
- Identify decision and tradeoff points - areas of high risk
- Identify trade-offs with other software quality attributes
 - safety, reliability, performance, usability

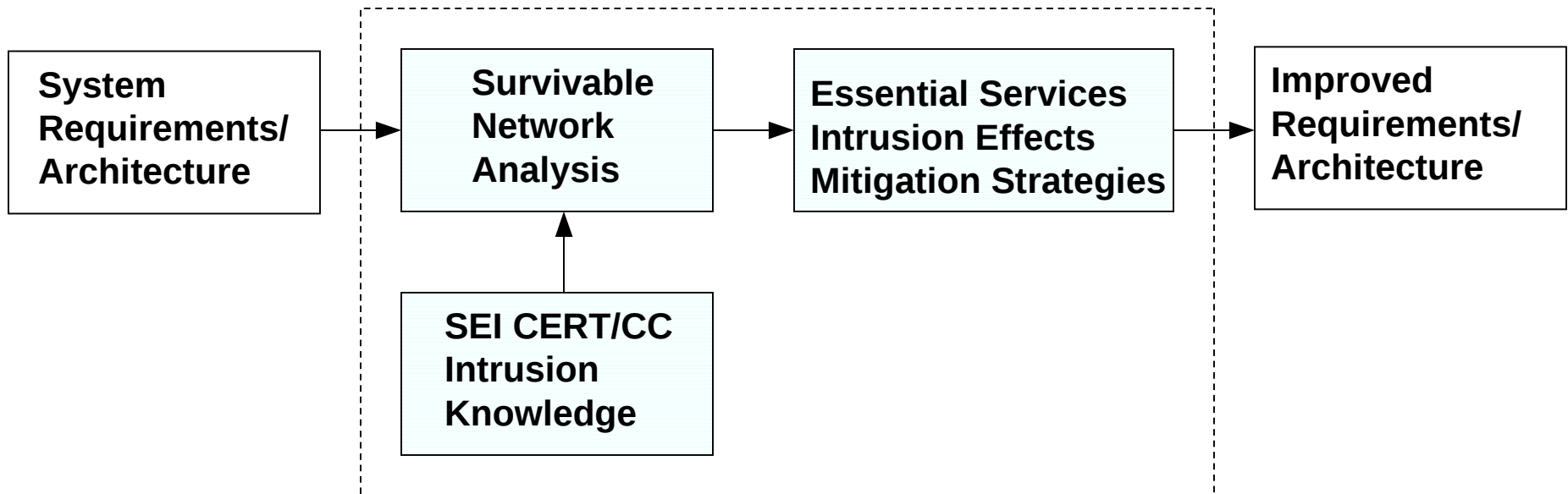


The Survivable Network Analysis Method





Determining Survivability Strategies





Survivability Map

Intrusion Scenario	Softspot Effects	Architecture Strategies for □	Resistance	Recognition	Recovery
(Scenario 1) ...		Current			
		Recommended			
(Scenario n)		Current			
		Recommended			

- Roadmap for management evaluation and action



Option: Survivability Requirements

- Identify requirements for mission-critical functionality
 - minimum essential services
 - graceful degradation of services
 - restoration of full services
- Identify explicit requirements for
 - recovery
 - recognition
 - resistance



Option: Mission Lifecycle

- Factor survivability into the development and operational lifecycle
- Capture security and survivability assumptions
 - boundaries, users
- Identify survivability decision points
 - impact of changes on recovery, intrusion detection, etc.



Benefits of the SNA

- Clarified requirements
- Documented basis for system decisions
- Basis to evaluate changes in architecture
- Early problem identification
- Increased stakeholder communication



Additional Information

- SNA Case Study: The Vigilant Healthcare System
 - IEEE Software: July/August 1999
- Survivability: Protection Your Critical Systems
 - IEEE Internet Computing: Nov/December 1999
- Web site: IEEE article and other reports
www.sei.cmu.edu/organization/programs/nss/surv-net-tech.html