Decades-Long Relationships With the World’s Largest Enterprises

SAP is in a unique position to transform change into an opportunity for our customers
Change Is Disruptive

Timeline of Major Business Events and Innovations

- 1980: NMT, Windows
- 1990: GSM, SMS
- 2000: iMac, BlackBerry
- 2010: iPhone, Android

- Deregulation, Japanese management techniques, Privatization, Ozone hole
- Chernobyl, Black Monday, Berlin Wall, Decentralization, BPR
- Hong Kong and China, e-Commerce, The Euro, Computer Viruses, Dot Com Bust, Enron, BRIC
- Oil $50, Global Warming, Oil $147, Lehman Brothers collapse

SAP

R/2

R/3
The Governing Dynamic
Preparing for Change

Is there an architecture that assumes continuous change?
Can our systems non-disruptively consume innovation?
Even fundamental innovation?
Timeless Software
Design-thinking

Focus on the needs and expectations of the user
Timeless Software
Separation of concerns between layers

Introduce a limited number of layers with clear contract to allow different speed of innovation
Identify a reasonable set of components to reduce dependencies, increase flexibility and allow for reuse
Timeless Software
Decoupling of “content” and “container”

Separate content from container to allow new content without the need for a container upgrade. Allow partners and customers to create their own content.
Optimize design experience for the user. LOB developer should stay in one environment, SAP expert maybe in another.
Timeless Software
Adaptable provisioning

Reduce assumptions about usage of content of a component in upper layers
Ensure that optimizations in a container can be done without changes to the content
Timeless Software
Optimizing across layers of abstraction

Optimize across layers without violating the overall contract.
What are the security aspects of timeless software?

Does the endeavour to be “timeless” destroy or support security properties?

Can security properties be enhanced and integrated with timeless software principles?

Can security built in a way that it assumes and support continues change?
Application Security is a Challenging Area

- Applications are complex
- Continuously evolving architectural paradigms and new software delivery models
- Attackers are focusing on the application layer, getting smarter and using sophisticated tools
Why is traditional industry approach not enough?
Reason #0
Security is Not Properly Embedded into CS/Engineering Curricula

Reason #1
Majority of Security Architectures and Governance Processes Do Not Assume Continuous Change

Reason #2
Shipping Vulnerability Free Software is Hard
What should we do?
Evolve From a “Today” Centric Security Thinking to a **Timeless** Software Security Thinking Which Assumes Continuous Change
How can we do this?
Example Approaches For Timeless Software Security

- Decoupling of content and container
  - Self-Defending Data
  - Attack Surface Measurement & Reduction

- Separating intent from optimization
  - Model Driven Security
  - Attack Surface Measurement & Reduction
History of Attack Surface Measurement and Reduction

- **1975** Design Principles by Saltzer and Schroeder
- **2003** Relative Attack Surface Quotient by Michael Howard of Microsoft
- **2003** Generalized Attack Surface Method by Howard, Pincus and Wing
- **2007** Formalized Attack Surface Measurement Method by Manadhata and Wing of CMU
- **2009** Refined Attack Surface Measurement Method for SAP Software Systems and The MASUBA Tool by Karabulut (SAP) and Manadhata (CMU)
Why to Minimize the Security Risk with Future Vulnerabilities

A system’s attack surface is defined in terms of the system’s resources <Methods, Channels, Data Items>

Smaller attack surface → less security risk

Makes the exploitation harder

Lowers the damage potential

<table>
<thead>
<tr>
<th>Code Quality</th>
<th>Attack Surface</th>
</tr>
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<tbody>
<tr>
<td>Good</td>
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<tr>
<td></td>
<td>Low Security Risk</td>
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<td></td>
<td>Medium Security Risk</td>
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<tr>
<td>Bad</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>High Security Risk</td>
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</table>
**Abstract Attack Surface Measurement Method**

Manadhata and Wing, 2007

1. **Determine**
   - M: set of entry points and exit points
   - C: set of channels
   - I: set of untrusted data items

2. **Estimate**
   - Damage potential-effort ratio ($\text{der}$) for each individual m, c, and i

3. **Compute Attack Surface (AS)**

\[
\text{AS} = \langle \sum_{m \in M} \text{der}(m) , \sum_{c \in C} \text{der}(c) , \sum_{d \in I} \text{der}(i) \rangle
\]

The higher the damage potential, the higher the contribution

The higher the effort, the lower the contribution
Chose a core SAP NetWeaver component implemented in Java

The component doesn’t use any persistent data items and open only one TCP socket

Hence we only considered the method dimension of the attack surface in our measurement

Two Key Steps
1. Identification of Entry Points and Exit Points
2. Estimation of the Damage Potential-Effort Ratio
Attack Surface Measurement Steps

Source Code → Call Graph Generator → Attack Surface Computation → Attack Surface Measurements

- Interface Methods of Other Systems
- Java I/O Library Methods
- Entry Points and Exit Points
- Interface Methods
- Numeric Values
**Numeric Value Assignment**

- Assign numeric values to *sources of input* and *access rights levels* to compute damage potential-effort ratio.

- Internal threat modeling process
  - Identified possible attacks on the component
  - Assigned severity ratings to the attacks

- We **correlated** the sources of input with possible attacks on the component.

- Total ordering among the access rights level: internal > public.

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<tr>
<th>Attribute</th>
<th>Avg. Rating</th>
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<tbody>
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<td>Other System</td>
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<table>
<thead>
<tr>
<th>Access Rights</th>
<th>Value</th>
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<tbody>
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<td>Public</td>
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<tr>
<td>Internal</td>
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</tbody>
</table>

*P. Manadhata, Y. Karabulut, J. Wing: Measuring the Attack Surfaces of Enterprise Software, ESSOS 2009, Belgium*
Open Questions in Timeless Software Security

- **Data-centric security** How can we associate usage policies with content in a container-independent way, such that these policies can be enforced or checked as the content is migrated between containers?

- **Verifiable Secure Composition:** How can we prove that different compositions of security policies, protocols and mechanisms are overall secure?

- **Updating features without breaking security** As technologies change what happens to the security properties? How can we update features without breaking security? How can the impact of technological change on existing architectures be systematically assessed?

- **Updating security without breaking features** How can security controls be designed and integrated into software in such a way that they can be updated without breaking the functional properties and qualities of software?
What Does This Mean for Cloud Computing?

- Cloud Computing is not necessarily more or less secure than current on-premise environments

- Old security problems in new setting... Some new security problems...

- Two main areas of innovation needed for Cloud security
  - Security controls
  - Secure software development processes
Concluding Remarks...

- We live in a networked world... Threats have changed
- We are under no illusion that we’re done with security
- But we need to change our outlook...

Evolve From a “Today” Centric Security Thinking to a Timeless Software Security Thinking Which Assumes Continuous Change

LAST BUT NOT LEAST...

- Balancing security and usability is hard but extremely important
- Balancing security and performance is hard but extremely important
Thank you!