ArmoredSoftware: Trust in the cloud

Annual Demonstration

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Outline

Introduction and Project Goals
- Big Picture
- Implementation

Prototype demonstration and discussion
- Refine big picture to current demo
- Protocol Execution
- Appraisal
- Measurement
- Communication
- Demonstration

Short term goals and milestones

Questions and guidance

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Program Goal

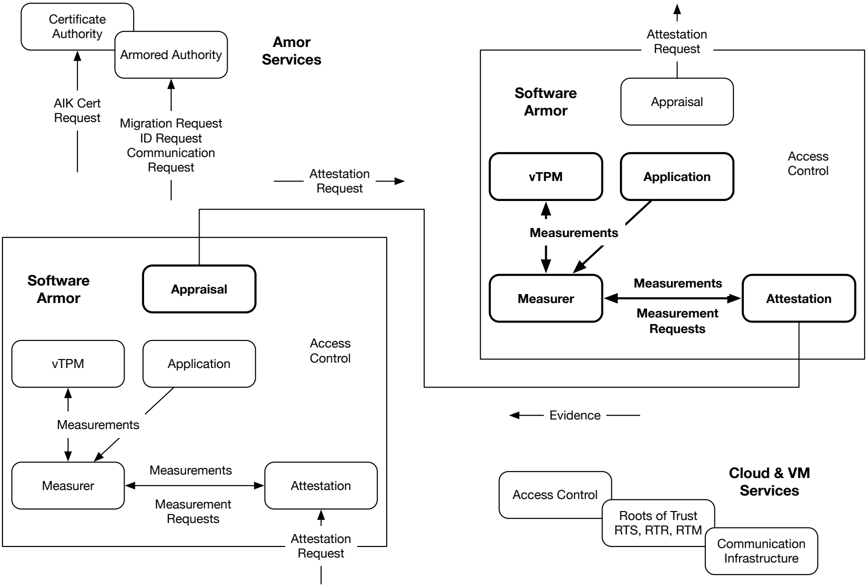
Trust in the Cloud

Provide new capabilities that help establish and maintain trustworthy cloud-based application deployment

New Capabilities

- Establish trust among cloud components
  - trust among cohorts of processes
  - trust among processes and environment
- Promote informed decision making
  - data confidentiality can be confirmed
  - execution and data integrity can be confirmed
- Autonomous run-time response and reconfiguration
  - responds to attack, failure, reconfiguration, and repair
  - response varies based on measurement
- Lightweight integration with existing cloud
  - targeting TXT, Xen, Linux, and OpenStack infrastructure
  - user-space measurement and attestation

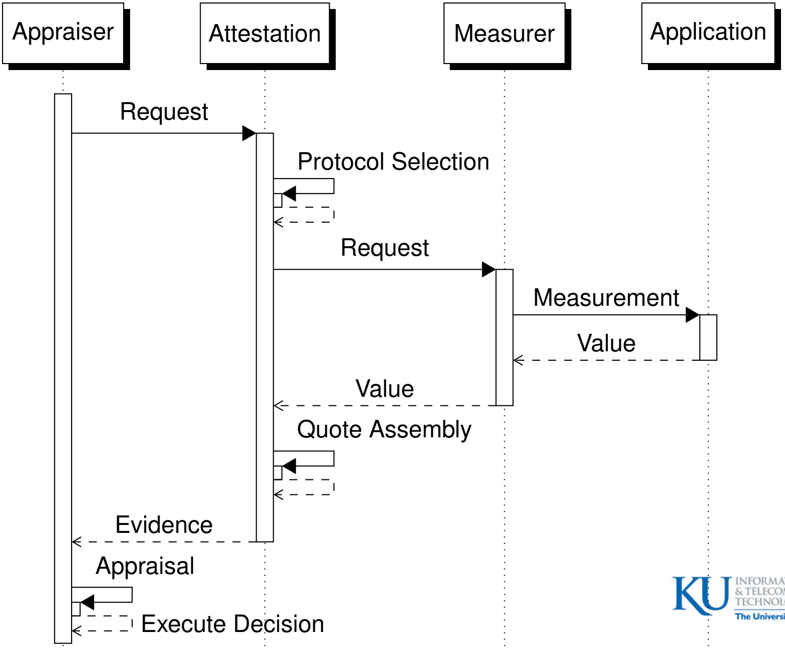
High-Level Architecture



Implementation Decisions

- Standard delivery platform
  - Xen+XSM VM infrastructure
  - OpenStack cloud infrastructure
  - Fedora, HotSpot JVM, GHC
- Standard communication mechanisms
  - JSON structures for all exchanged data
  - *vchan* for on-platform communication
  - TCP/IP for off-platform communication
- Trusted Computing Group standards compliant
  - Trusted Platform Module (TPM) 1.2
  - TCG vTPM in principle
- Executable protocol representation
  - protocol fragments as first-class structures
  - strand space formal semantics

CA-Based Attestation Protocol



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What We Are Demonstrating

3-4 Slides on Attestation Protocol Execution

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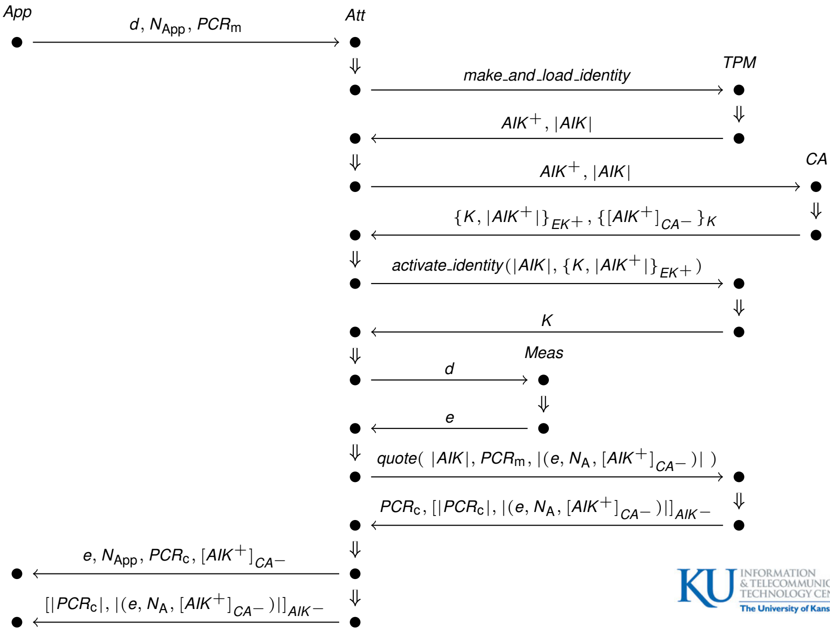
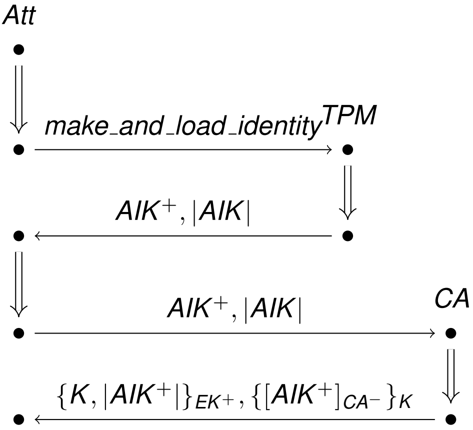
Strand Space Diagram


App
Att
$d, N_{\mathrm{App}}, PCR_{\mathrm{m}}$
TPM
$make\_and\_load\_identity$
$AIK^{+}, |AIK|$
CA
$AIK^{+}, |AIK|$
$\{K, |AIK^{+}|\}_{EK+}, \{[AIK^{+}]_{CA-}\}_{K}$
$activate\_identity(|AIK|, \{K, |AIK^{+}|\}_{EK+})$
K
$Meas$
d
e
$quote(\ |AIK|, PCR_{\mathrm{m}}, |(e, N_{\mathrm{A}}, [AIK^{+}]_{CA-})|\ )$
$PCR_{\mathrm{c}}, [|PCR_{\mathrm{c}}|, |(e, N_{\mathrm{A}}, [AIK^{+}]_{CA-})|]_{AIK-}$
$e, N_{\mathrm{App}}, PCR_{\mathrm{c}}, [AIK^{+}]_{CA-}$
$[|PCR_{\mathrm{c}}|, |(e, N_{\mathrm{A}}, [AIK^{+}]_{CA-})|]_{AIK-}$

Generating and Certifying an AIK

- Request a new *AIK* from TPM (optional)
- Receive public *AIK* and hash
- Request *AIK* signed by CA (*AIK* cert)
- Receive *AIK* cert encrypted with session key *K*
- Receive *K* encrypted with private *EK*


Att
TPM
CA
$make\_and\_load\_identity$
$AIK^+, |AIK|$
$AIK^+, |AIK|$
$\{K, |AIK^+|\}_{EK^+}, \{[AIK^+]_{CA^-}\}_K$

Activating the AIK

$$\begin{tikzcd}[column sep=huge]
\mathit{Att} & & \mathit{TPM} \\
\bullet \arrow[rr, "\mathit{activate\_identity}(|\mathit{AIK}|, \{K, |\mathit{AIK}^{+}|\}_{EK^{+}})"] & & \bullet \arrow[d, Rightarrow] \\
\bullet & & \bullet \arrow[ll, "K"']
\end{tikzcd}$$

- Request TPM decryption of the *AIK* cert
- Receive *K* used to decrypt signed public *AIK*
- Only TPM can gain access to *K*
- Only TPM can obtain signed, public *AIK*
- Oddly, No manipulation of the *AIK* in this “activation” process

Measurement

Generating a Quote

Appraisal

1-2 Slides on Appraisal

3-4 Slides on Measurement

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2-3 Slides on Communication Mechanisms

Step Through Demonstration

Goals and Milestones for 2015

- Push to the cloud
- Establish roots of trust and trust argument
- Executable protocol representation and protocol semantics
- Operational, integrated vTPM prototype
- Name Server / Certificate Authority prototype
- More capable measurement
- Downloadable demonstration

Questions and Guidance

- What problems are interesting?
- What problem would be a nice attention grabber?
- What should we be watching and integrating with?

References