CC3: An Identity Attested Linux Security Supervisor Architecture

Richard Engen MSFS, Johannes Grosen MS
Scott Stofferahn, Greg Wettstein R.Ph., Ph.D.*
IDfusion, LLC

* = Primary Author/Presenter

The State of Security

5dc9dc532fa80824ff12380d08aaf00a

vs

5dc9dc532fa80824ff12380d08aaf00A

Security is economically constrained.

Irreversible Compromises

- Life safety systems.
- Privileged healthcare information.
- Personally sensitive information.

No ex-post-facto redress.

In the Beginning - NHIN

- Greatest identity problem in the world.
- 2008 CC1/2
  - Deterministic location of medical records in under five seconds over 3 million+ provider identities.
- Network perimeter defined by integrity verified platforms.
- Required mobile/autonomous devices.

CC3 Architecture

"All things equal, complexity loses. All things not quite equal – ditto."

– Al Viro, LKML

Will general purpose OS distributions remain relevant?

IDFusion

ComDel Innovation
ISO 9001:2000

System Components

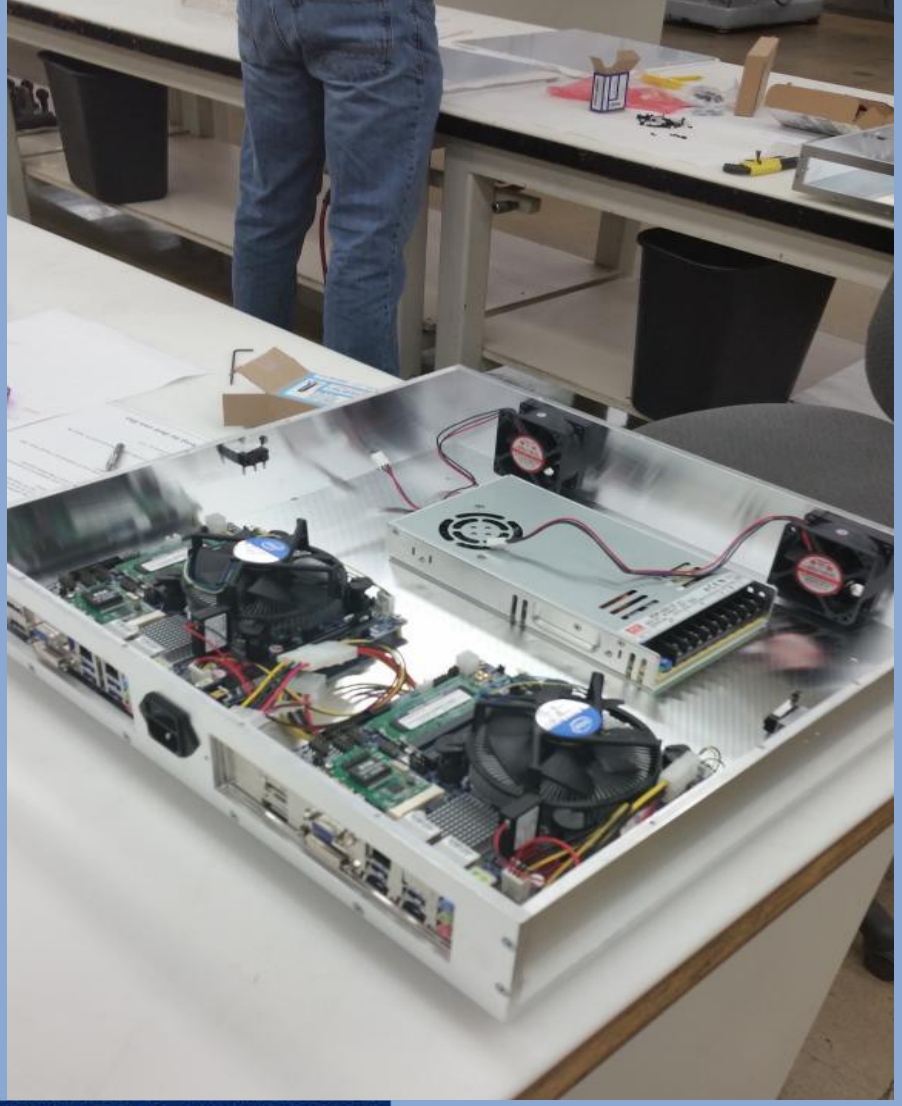
- Security bootloader – sboot.
  - Initializes system identity and root filesystem.
- System security supervisor – sinit.
  - Attests and maintains platform behavioral status.
- Environment launchers:
  - Native binaries.
  - Virtual machines.
  - Containerized systems.

13 megabyte base system load

Identity Attested Remote Attestation

- Implemented with POSSUM.
- Authenticated with OTEDKS.
  - Epoch/identity based key generation.
  - Validated with NIST randomization tests over a 32 bit time epoch.
- IVY 'identity cartridges' encapsulate counter-party information.

Autonomous Attestation



IDFusion

DakTech Assembly
And Support

Iso-Identity Integrity Measurement Architecture

"In the future, company names will be a 32 character hex string"

– Bruce Schneier

$$I_M = H_M(R_M \| H_M(C))$$

I3MA Platform Model

- Premise 1
  - Interaction of actor and subject identities yield a behavior identity.
- Premise 2
  - Platform behavior is full set of behavioral identities.
- Premise 3
  - Platform measurement is time invariant extension sum of device identity extended platform behaviors.

Multi-variate platform behavioral modeling.

Behavioral Compromise Modeling

- Extra-dimensional.
  - Platform behavior goes 'off-contour'.
  - Detectable by integrity measurement.
- Intra-dimensional.
  - Platform behavior remains 'on-contour.
  - Requires probabilistic methods.

Mathematical limt of integrity measurement.

iso-identity IMA policy

Policy:

```
map func=BPRM_CHECK capability=any
map func=FILE_MMAP mask=MAY_EXEC capability=any
map func=MODULE_CHECK uid=0
map func=FILE_CHECK mask=^MAY_READ capability=any
```

Capability based measurement triggers:

$$A_{\mathrm{MASK}} = P_{\mathrm{MASK}} \wedge \left(Eff_{\mathrm{MASK}} \vee Per_{\mathrm{MASK}} \right)$$

Subject Pseudonyms

- Implemented to avoid issues with writable files, eg password, log files.
- Configured by security supervisor during system initialization process.
- Synthetic file hash derived from platform identity.
- Overrides TOMTOU/open-writers violations.
- Removed by security_inode_unlink().

Securityfs Interface
/sys/kernel/security/ima/iso-identity

```
-r--r-----  1 root root 0 Aug 11 02:31 contours
-r--r-----  1 root root 0 Aug 11 02:31 forensics
--w-------  1 root root 0 Aug 11 02:31 host_identity
--w-------  1 root root 0 Aug 11 02:31 map
-r--r-----  1 root root 0 Aug 11 02:31 measurement
--w-------  1 root root 0 Aug 11 02:31 pseudonym
--w-------  1 root root 0 Aug 11 02:31 sealed
```

Sealing platform disables further configurations and enables forensics.

Development and mgmt. of behavioral model.

Current Work

- System upgrade management.
- Integrating mandatory access labels.
- Support for ambient capabilities.
- Implementing behavioral namespaces.

Role of behavioral attestation in re-insurance and indemnification?