Gateways: The Center of Complexity for Update

Ned Smith
Open IoT Summit
October 2016
Translation is Essential to IoT Interoperability
IoT Frameworks Improve Development

IoT Framework Layer is Rich in Application Semantics
Object Model Facilitates Interoperability

But, Multiple Models Require Object Translation
Vendors Must Update Gateway Too!

Applications Have the Illusion the Server is Located in the Local Network
Gateway is Host to Multiple Virtual Nodes

The Combinatorics of Translation Means the Gateway is Effected by Every Update
Gateway Must be Designed for Availability

MTBF_A = \int_0^\infty U_A f(U_A) \times U_B f(U_B) \times U_C f(U_C) \, dt

Gateway is a Single Point of Failure
Impossible that Gateway will Always be Available

If the Framework Translator Changes, the Gateway must be Updated!

\[
MTBF_A = \int_0^\infty U_A f(U_A) \cdot U_B f(U_B) \cdot U_C f(U_C) \cdot U_{GW} f(U_{GW}) \, dt
\]
Gateway Must Verify Updates From All Vendors

- Vendor A Update Package [Device Image] $K_{A}^{-1}$
- Vendor A Factory
- Vendor A Device
- Image Memory
- Secure Storage
- Package Verification Key $K_{A}$
- Installer
- Vendor Keys Change
- [[$K_{A}] K_{GW}^{-1}$]
- Gateway
- Image Memory
- Secure Storage
- $K_{B}$, $K_{C}$, $K_{GW}$

Gateway needs to Establish and Maintain Trust with all Vendors

$K^{-1}$ – Asymmetric private key
$K$ – Asymmetric public key
[[]]$K^{-1}$ – Denotes signing operation
Scalable Update is Essential

• Automation
  – Notification of update availability
  – Install package customization
  – Automated rollback (if install fails)

• Security
  – Signed images
  – Root of trust in devices
  – Trusted image repository
  – Trusted installers

• Testing and Validation
  – Vendor testing
    – Real and virtual device images
  – Interoperability testing
    – Translator

• Open source technology
  – Common images
    – Bundles, Packages, Manifests
  – Messaging Framework
  – Image Repository
Pub-Sub for Update Scalability

Cloud Repository

Vendor 1
Vendor 2
Vendor 3

Publisher Topics Subscribers
V1.1 V2.0 V2.0 V2.0

Installer 1
- Virtual A
- Virtual B
- Virtual C

Gateway
- Virtual A v1.0
- Virtual B v1.0
- Virtual C v1.0

Installer 2
- Virtual C

Device A
- v1.0
Device C
- v1.0
Device B
- v1.0

Vendor Publications Notify Installers of Pending Release
Cloud Repository for Update

Vendor Driven Update

Vendor 1
Vendor 2
Vendor 3

Vendor Repository
Outsourced Repository
Vendor Repository
Vendor Repository

Device 1
Device 1
Device 2
Device 3

Secure Update Methods Embed Trust in Secure Storage
Scalable Key Management

PKI Approach

Cloud Repository Approach

Vendor Retains Control of Keys and Key Management; Including Established Trust in Cloud Repository
Do IoT Repositories Exist Today?

• OpenT2T - Translators to Things
  – Schemas are created by industry, standards organizations or open source projects
  – Developers create translators from schemas
  – Translators run on devices, cloud-connected things and gateways

• OBR - OSCAR Bundle Repository
  – Bundles of OSGI objects
    – OSGI defined manifest
    – Programmatic access to web repository
  – Developers submit bundle to repository
    – “Currently, there is no automated way to submit a bundle to OBR”

... not a comprehensive list.
Conclusion

• Reliance on IoT Frameworks implies a need for Translation

• Gateway Architectures add Update Complexity

• Update Automation is Needed to Ensure Scalability

• Secure Hardware is Essential to Trusting Update Automation
Ned Smith
ned.smith@intel.com