Gateways: The Center of Complexity for Update

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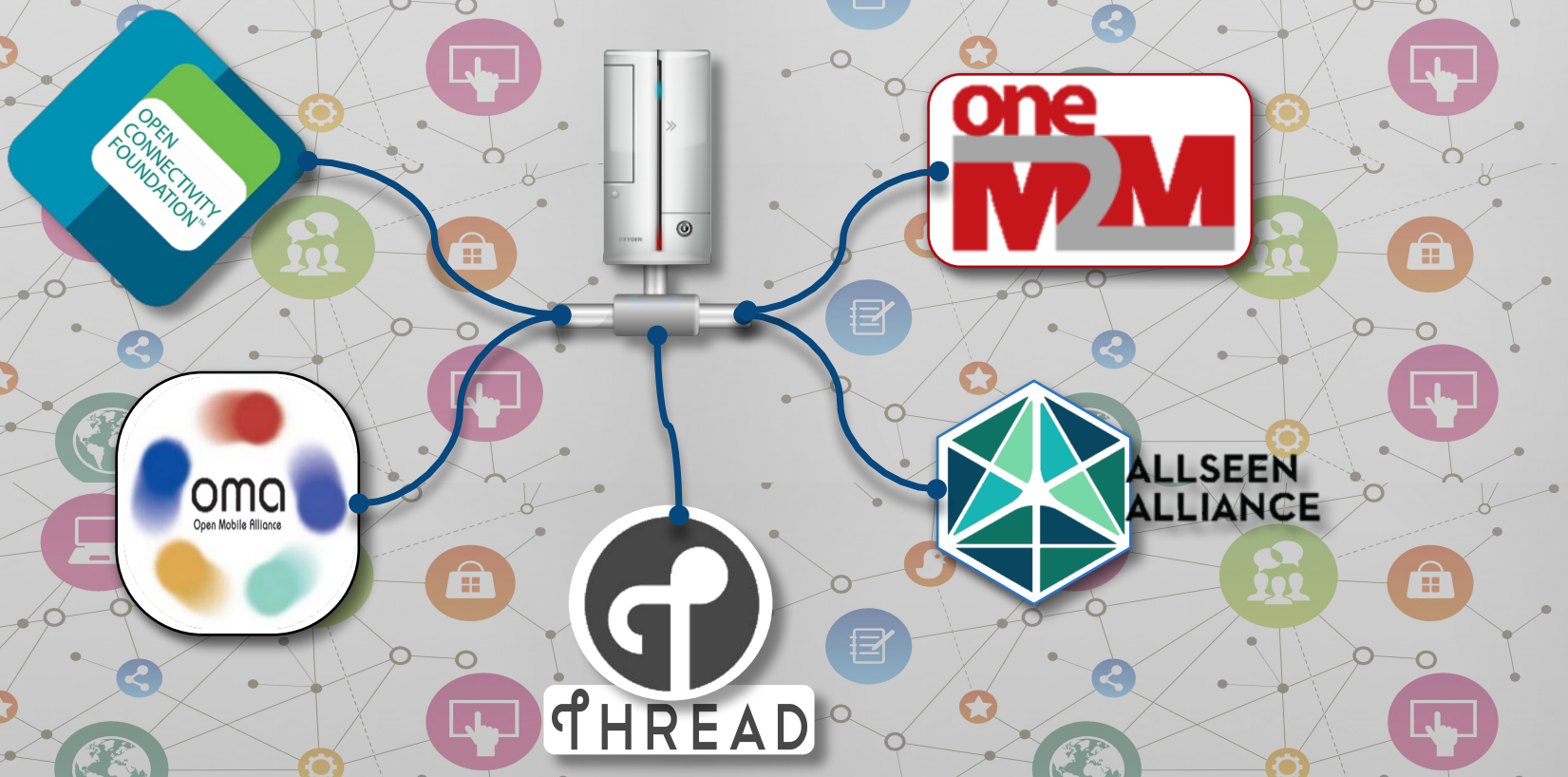
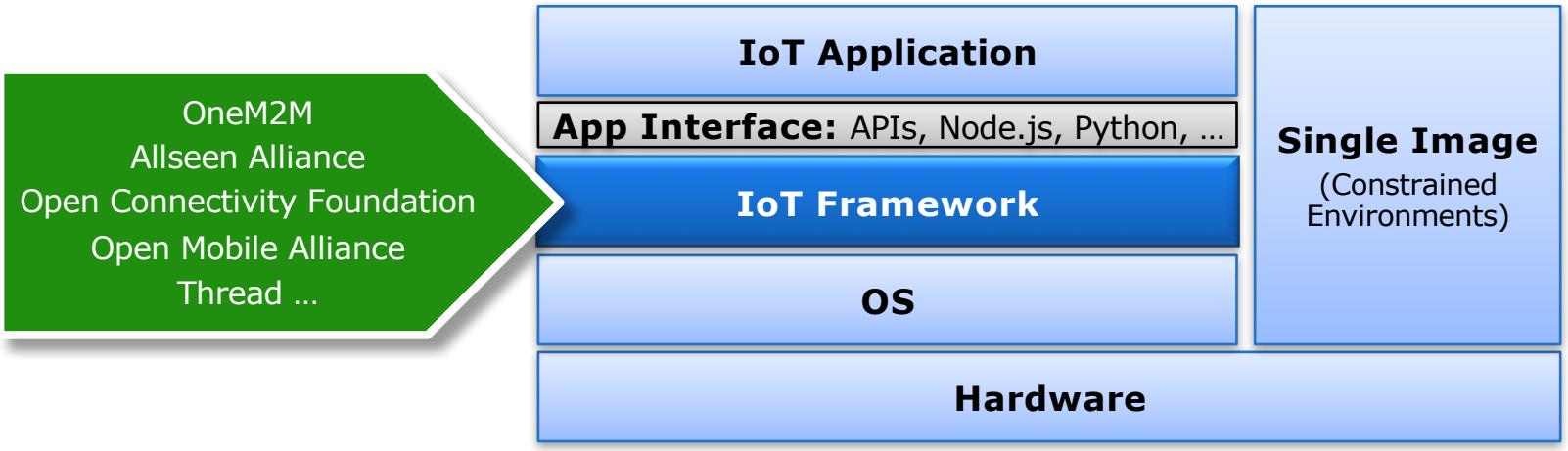
IoT Interoperability Through Standards



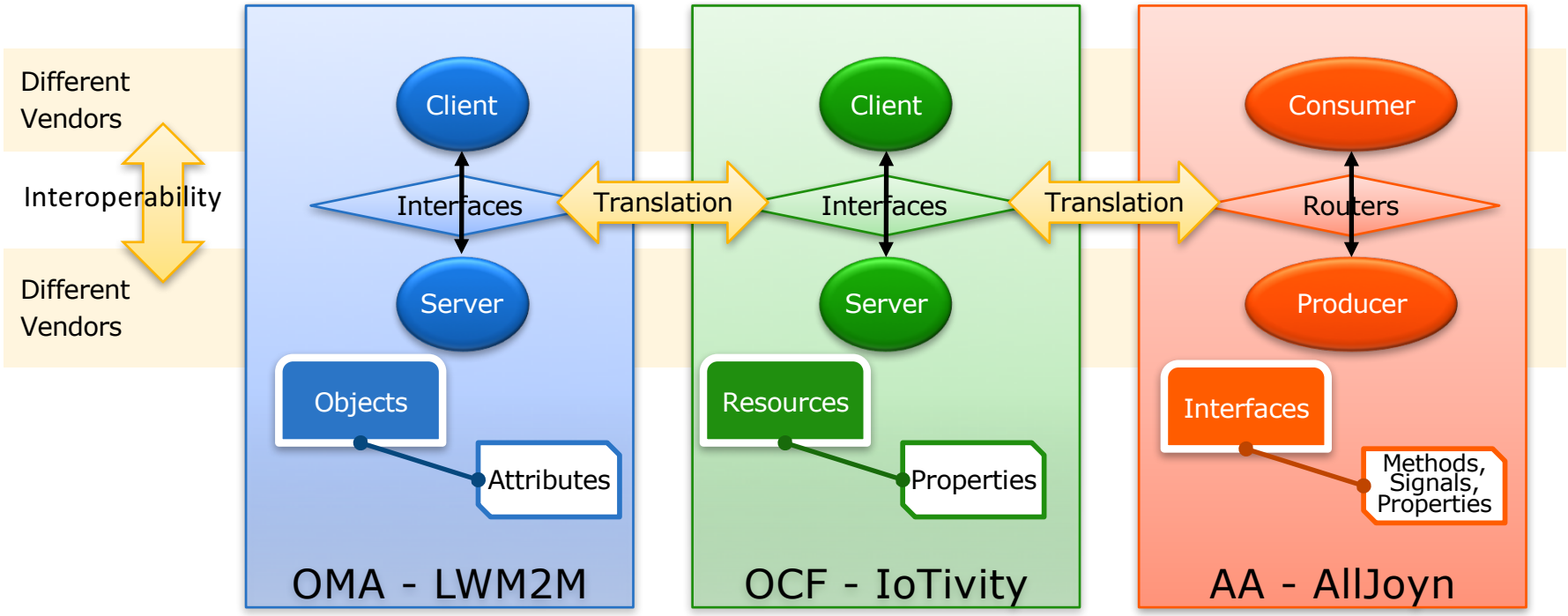
Translation is Essential to IoT Interoperability

IoT Frameworks Improve Development



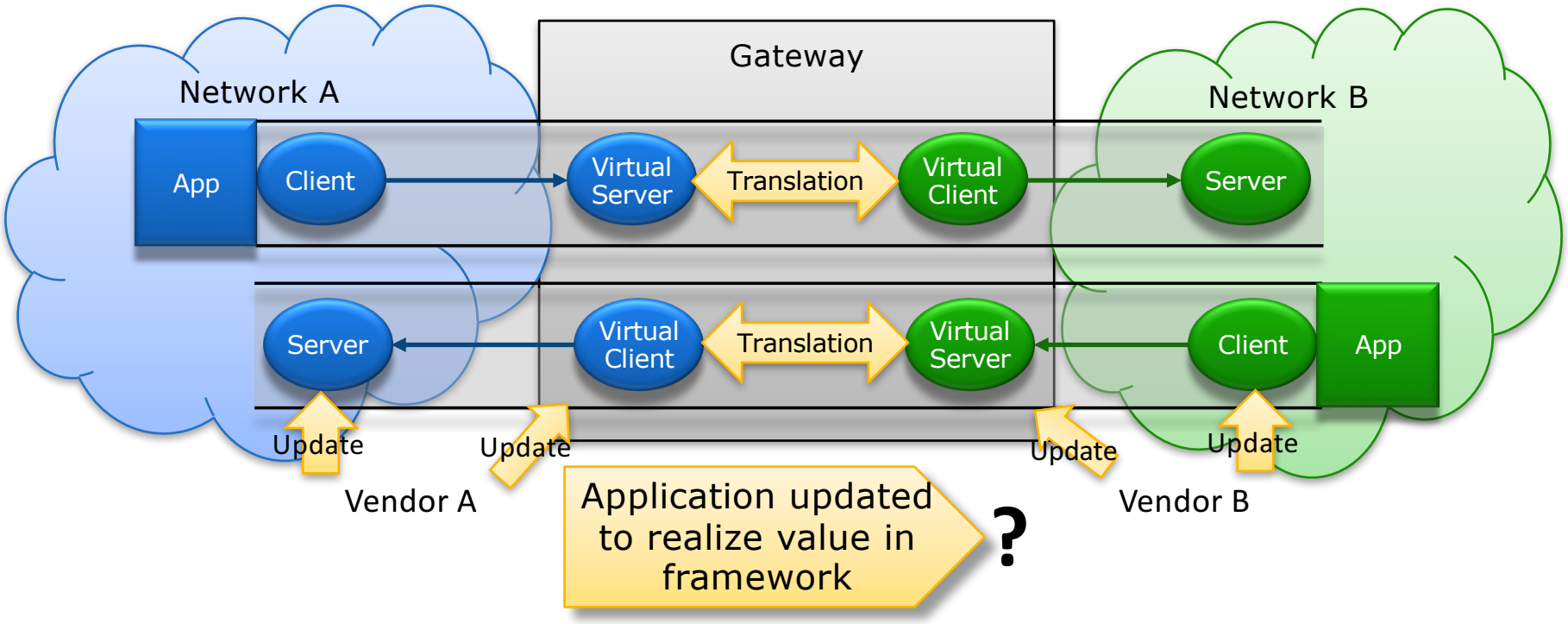
IoT Framework Layer is Rich in Application Semantics

Object Model Facilitates Interoperability



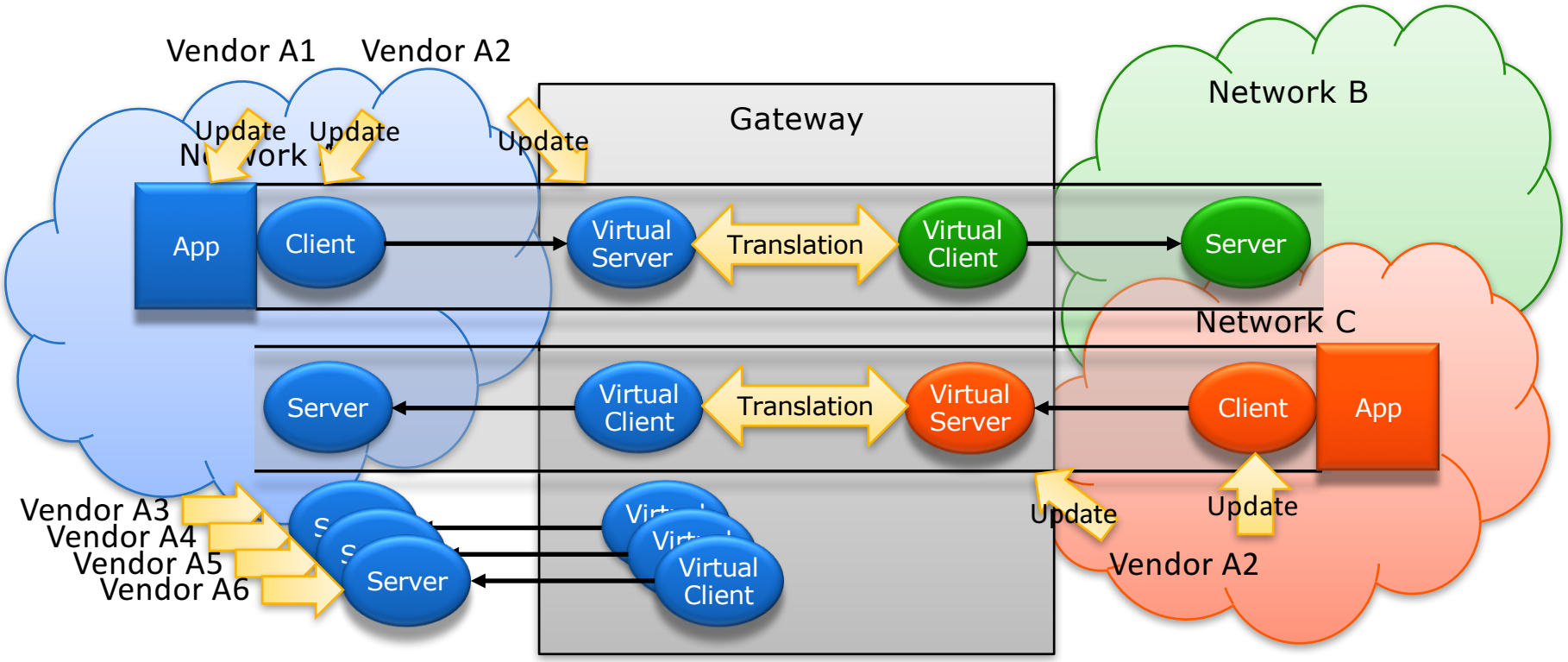
But, Multiple Models Require Object Translation

Vendors Must Update Gateway Too!



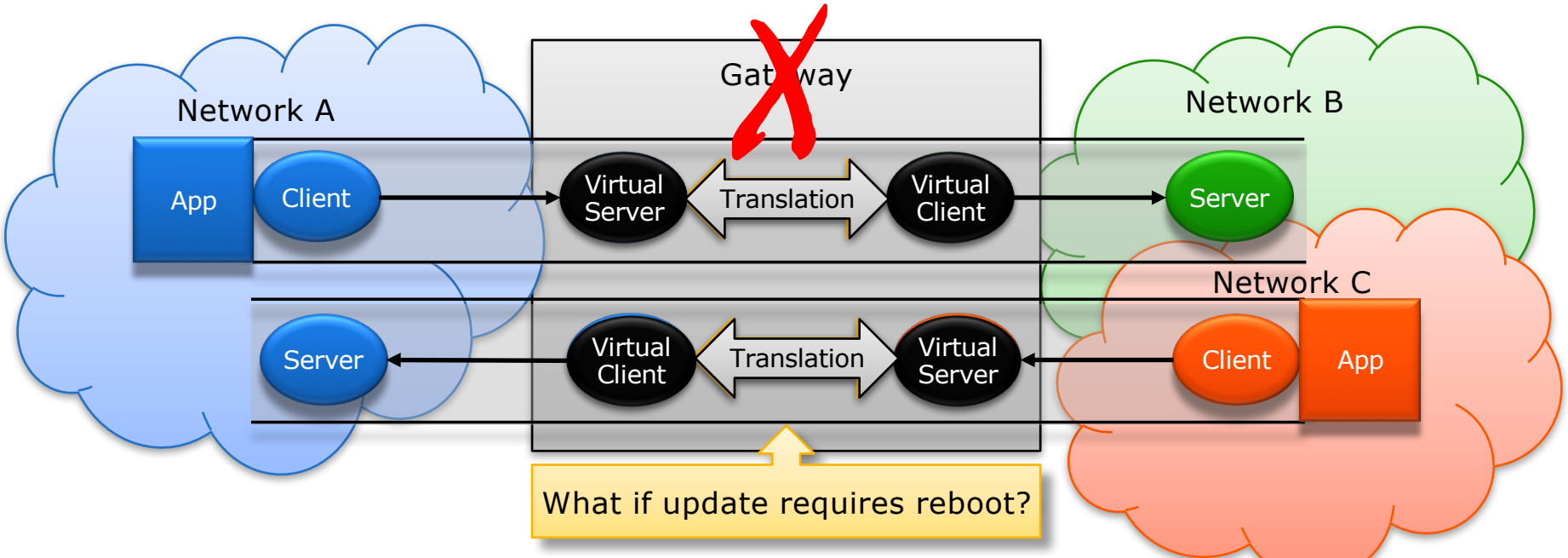
Applications Have the Illusion the Server is Located in the Local Network

Gateway is Host to Multiple Virtual Nodes



The Combinatorics of Translation Means the Gateway is Effected by Every Update

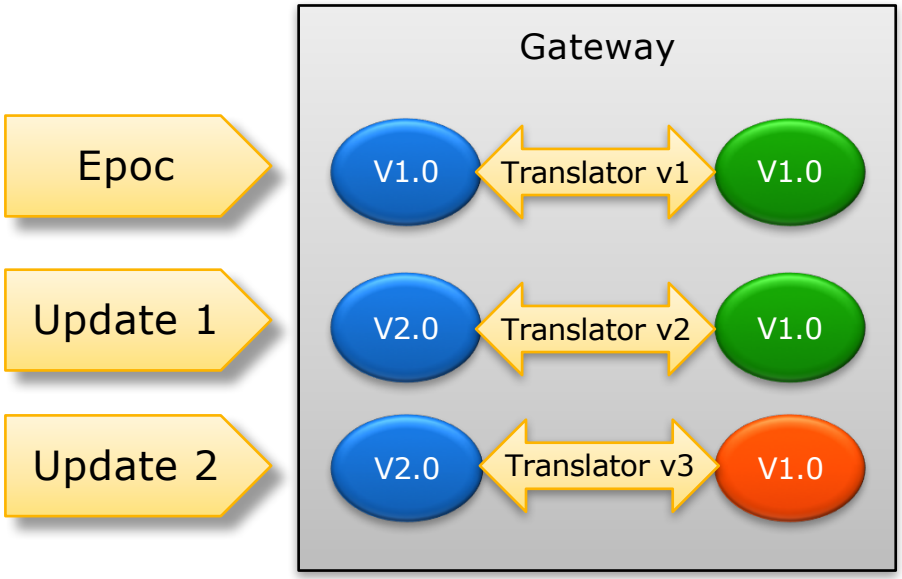
Gateway Must be Designed for Availability

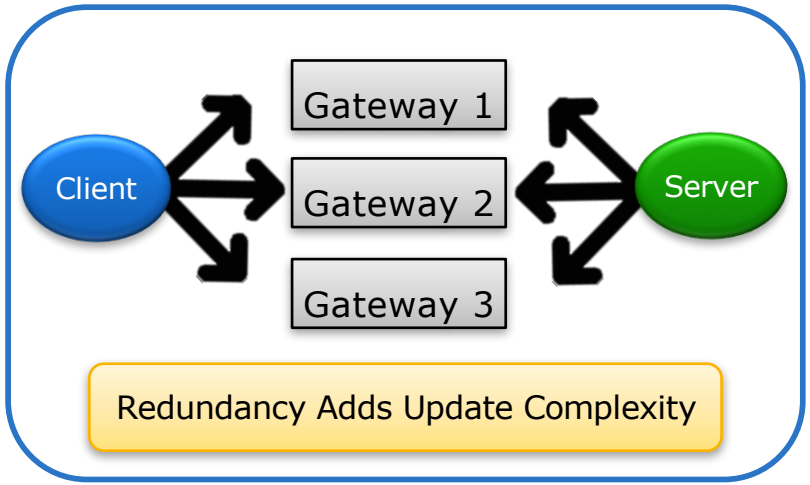


$$MTBF\_A = \int_0^{\infty} \mathrm{U_A}\, f(\mathrm{U_A}) * \mathrm{U_B}\, f(\mathrm{U_B}) * \mathrm{UC}\, f(\mathrm{U_C})\, dt$$

Gateway is a Single Point of Failure

Impossible that Gateway will Always be Available

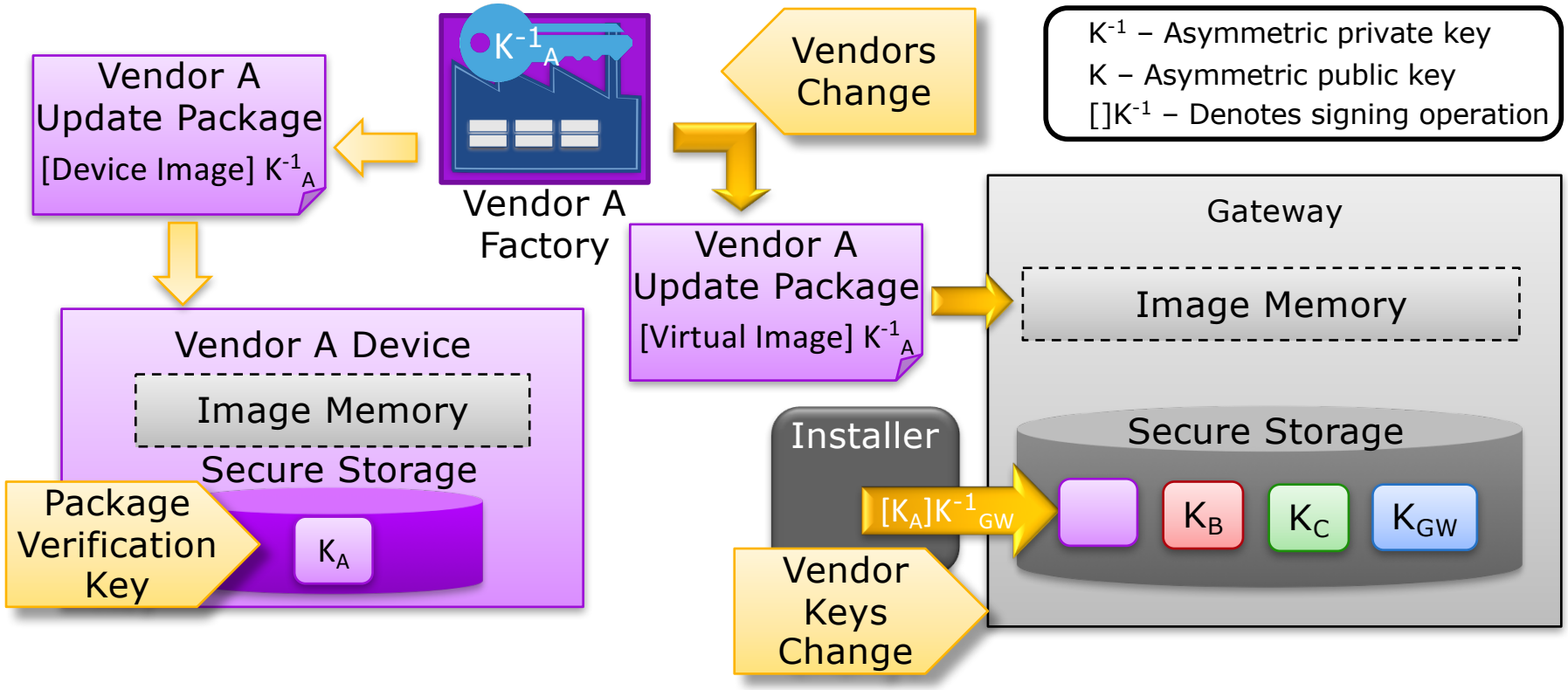




$$MTBF\_A = \int_0^{\infty} \mathrm{U_A}\, f(\mathrm{U_A}) * \mathrm{U_B}\, f(\mathrm{U_B}) * \mathrm{UC}\, f(\mathrm{U_C}) * \mathbf{U_{GW}}\, \boldsymbol{f}(\mathbf{U_{GW}})\, dt$$

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

Gateway Must Verify Updates From All Vendors

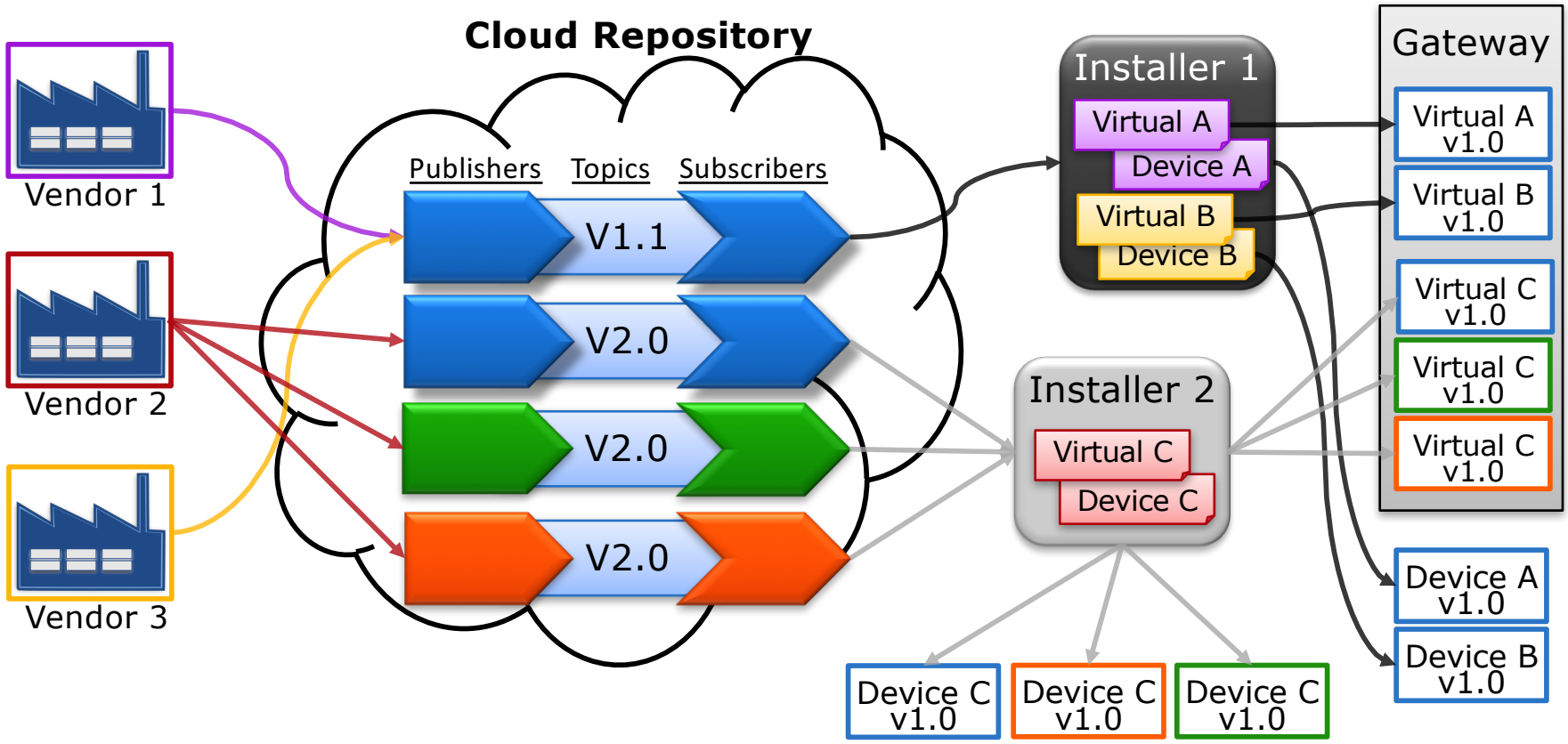


Gateway needs to Establish and Maintain Trust with all Vendors

Scalable Update is Essential

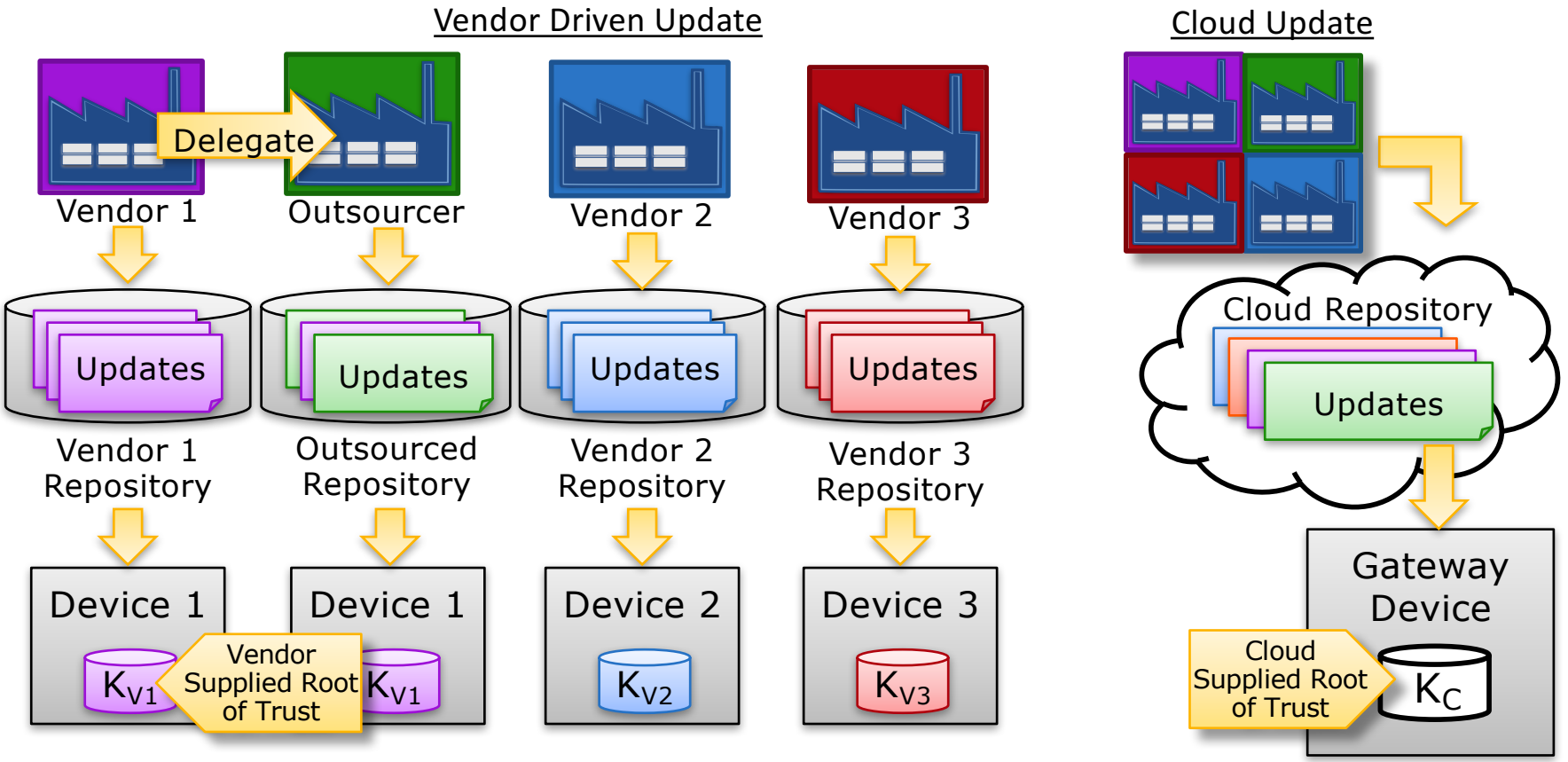
- Automation
  - Notification of update availability
  - Install package customization
  - Automated rollback (if install fails)
- Security
  - Signed images
  - Root of trust in devices
  - Trusted image repository
  - Trusted installers
- Testing and Validation
  - Vendor testing
    - Real and virtual device images
  - Interoperability testing
    - Translator
- Open source technology
  - Common images
    - Bundles, Packages, Manifests
  - Messaging Framework
  - Image Repository

Pub-Sub for Update Scalability



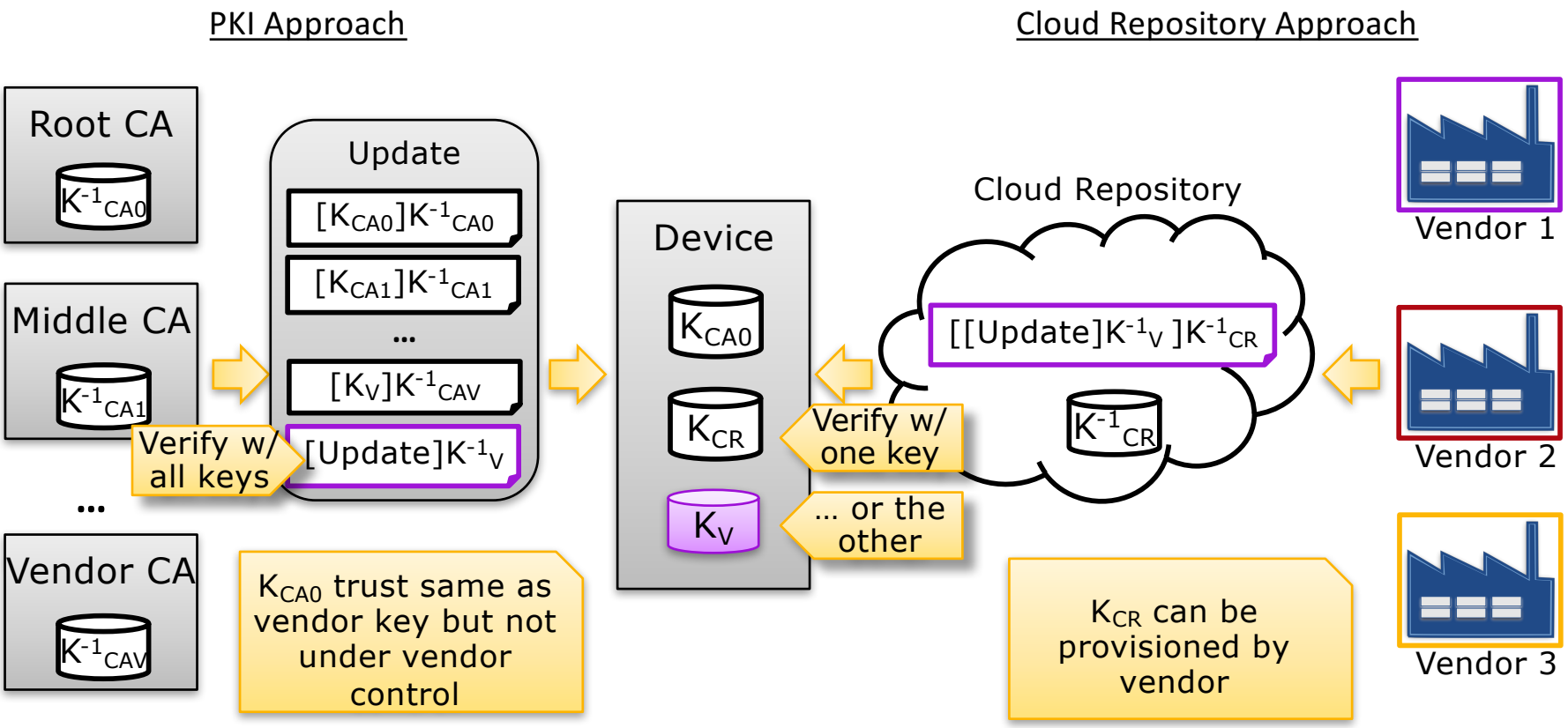
Vendor Publications Notify Installers of Pending Release

Cloud Repository for Update



Secure Update Methods Embed Trust in Secure Storage

Scalable Key Management



Vendor Retains Control of Keys and Key Management; Including Established Trust in Cloud Repository

Do IoT Repositories Exist Today?

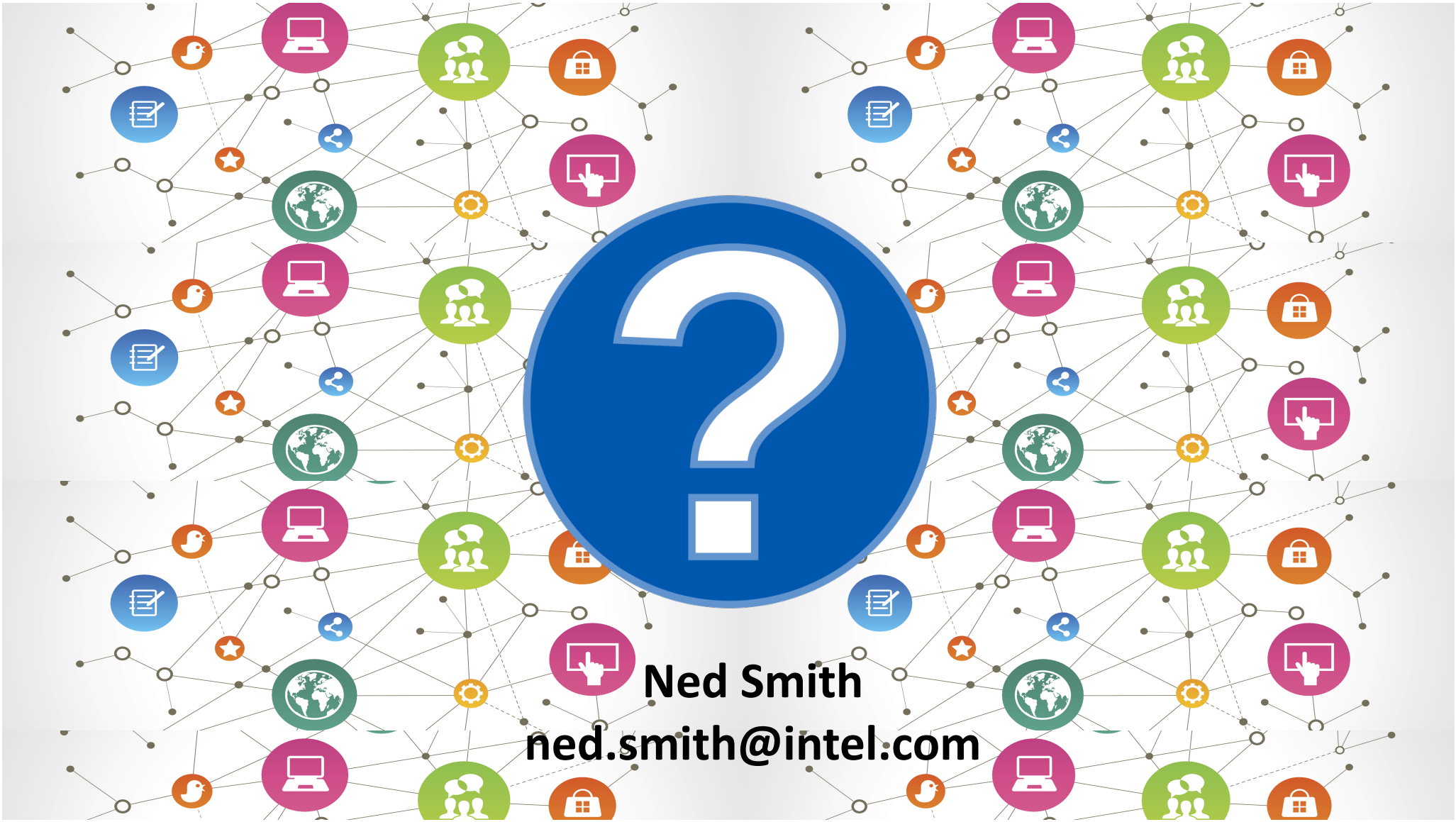
- OpenT2T - Translators to Things
  - Schemas are created by industry, standards organizations or open source projects
  - Developers create translators from schemas
  - Translators run on devices, cloud-connected things and gateways
- OBR - OSCAR Bundle Repository
  - Bundles of OSGI objects
    - OSGI 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.

OpenT2T – Schemas must be standardized – vendor differentiated?
OBR – Lacks developer automation – OSGI specific?

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



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