Cybersecure Modular Open Architecture Software Systems for Stimulating Innovation

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Overview

- Background: Problem and Solution
- Blockchains and Smart Contracts
- Software Supply Chains and Ecosystems
- Software Development and Evolution Update Transactions
- *Case Study*: Evolving installed software configurations of Open Architecture command and control/business systems
- Conclusions

Background

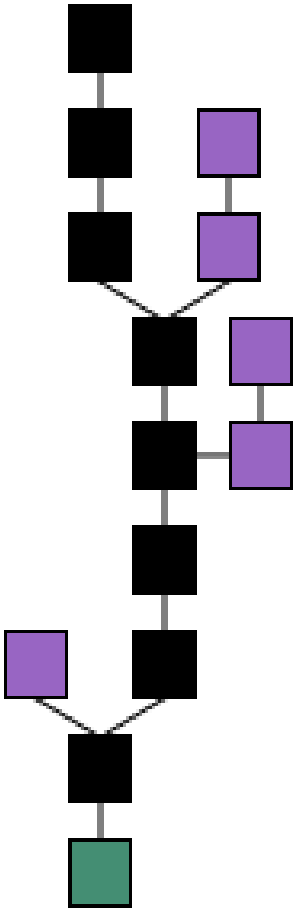
- Problem: *How best to develop and demonstrate new* **conceptual approach** *to providing continuous cybersecurity assurance with OA C2 software systems subject to frequent evolutionary updates?*
  - This is our *stimulus* for innovation

Background

- Solution: Utilize tools and techniques for *Blockchains* and *Smart Contracts* to continuously assure the cybersecurity of OA software systems as they undergo software development and evolutionary updates.
  - *Why?* to assure the integrity of updates to individual systems distributed across open networks, and to prevent cyber attacks to software supply chains and ecosystems.
  - This requires software development and evolution process *innovation*!

Blockchains

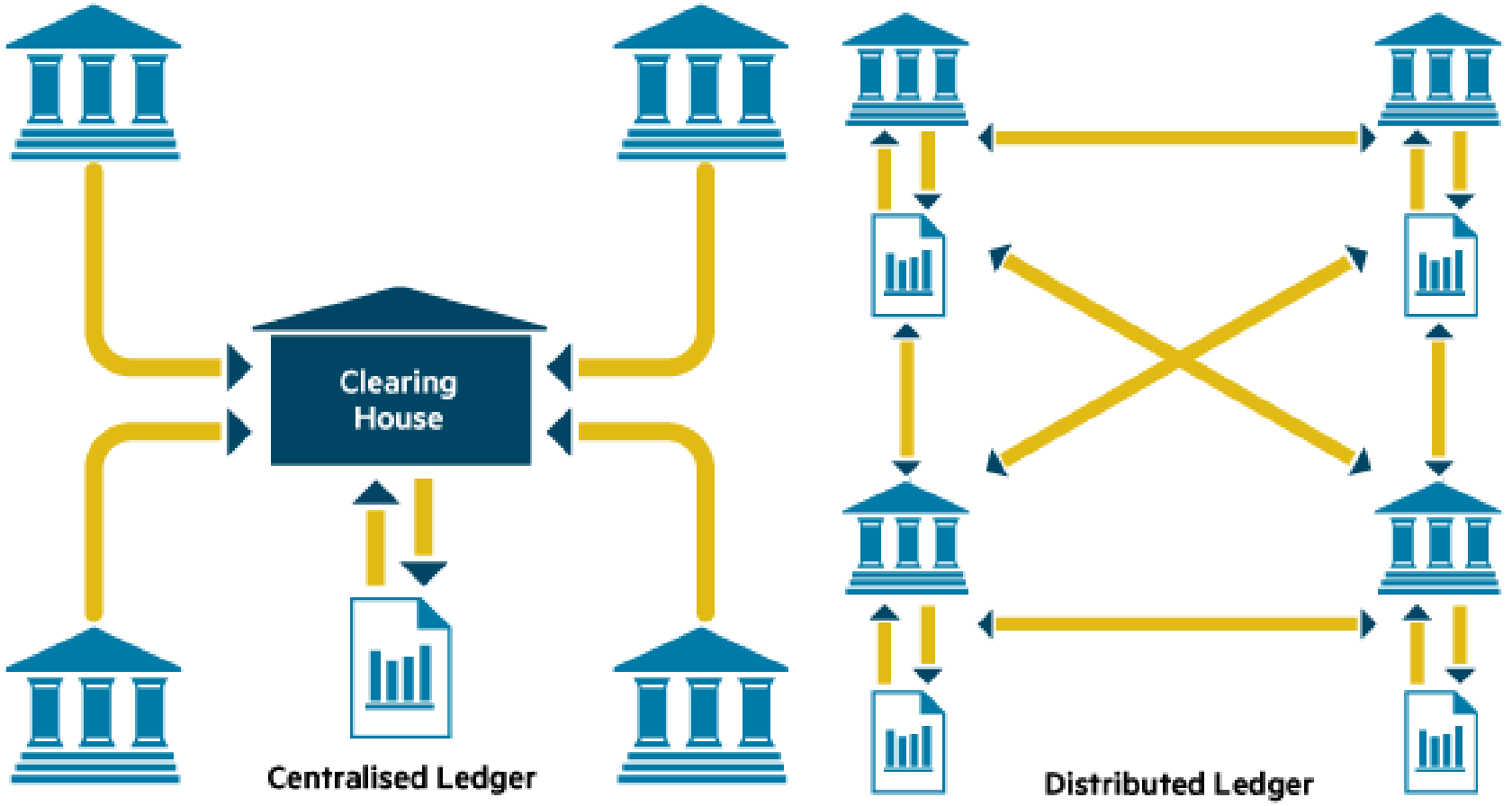
Blockchains represent *append-only,* decentralized “bookkeeping” *ledgers* of incoming/outgoing *enterprise transaction blocks* in a denominated currency or resource (e.g., BitCoin, Gold, Artworks).



- Decentralized counterpart to “centralized ledgers with central authority” (e.g., bank accounts).
- Accommodate *anonymized transactions and transaction verifications* without central authority.
- Updates to blockchain can require update providers *to pay a fee* for an update transaction verification.

Embedding distributed ledger technology

A distributed ledger is a network that records ownership through a shared registry



In contrast to today's networks, distributed ledgers eliminate the need for central authorities to certify ownership and clear transactions. They can be open, verifying anonymous actors in the network, or they can be closed and require actors in the network to be already identified. The best known existing use for the distributed ledger is the cryptocurrency Bitcoin

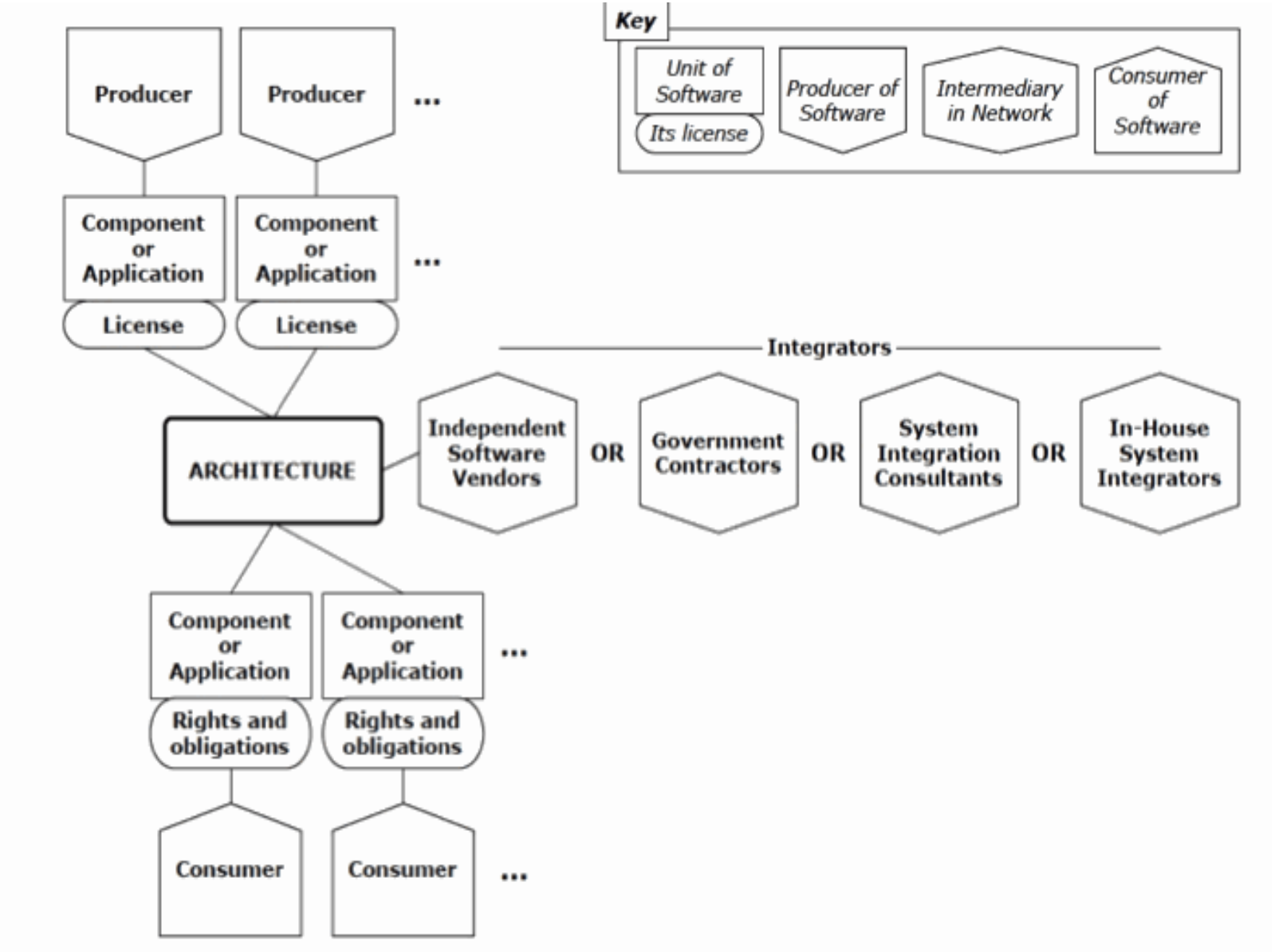
FT graphic. Source: Santander InnoVentures, Oliver Wyman & Anthemis Partners

Smart Contracts

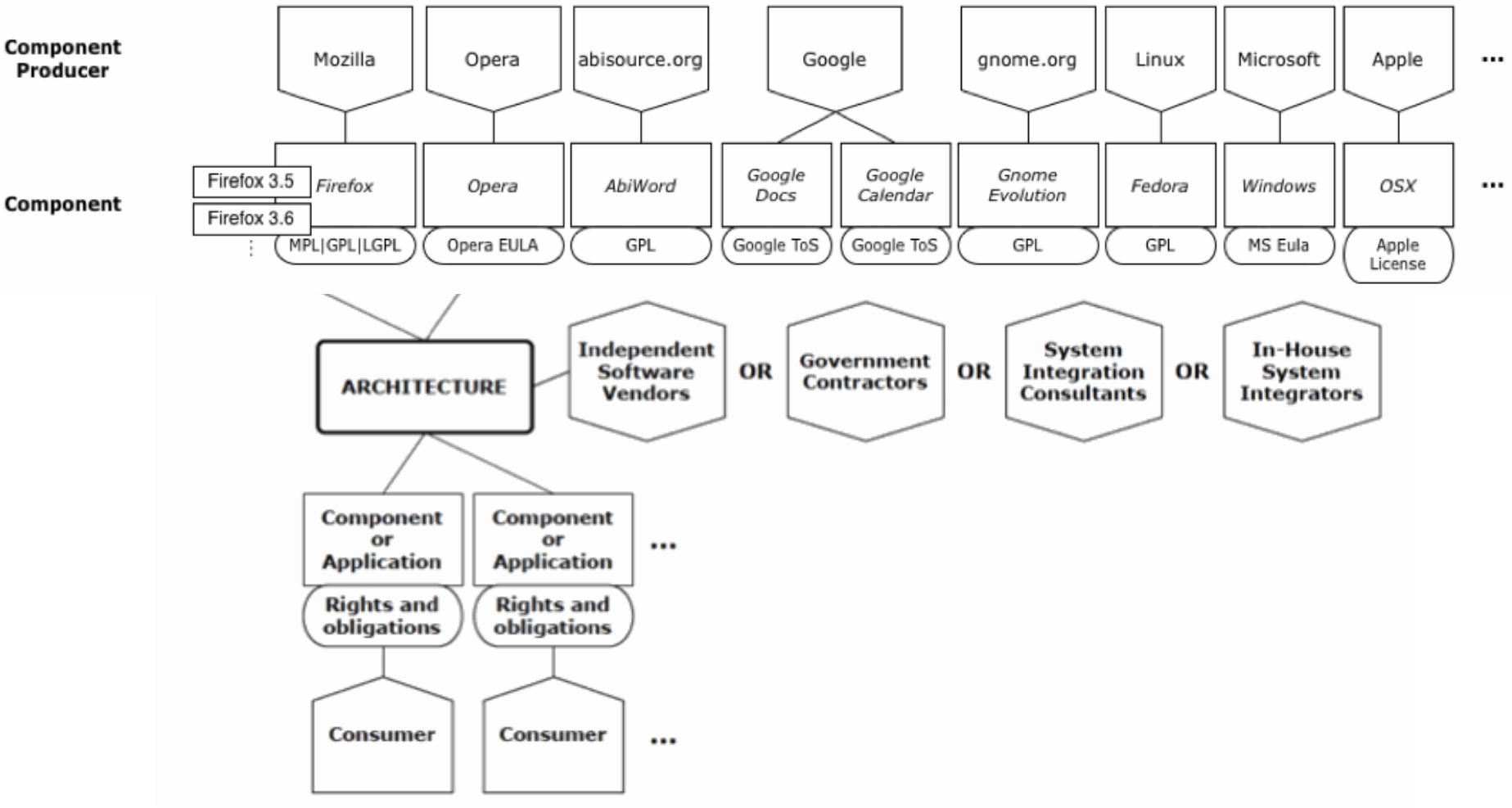
Contracts that *specify a block of transactions* (including *obligations and rights*) between parties that can be formally expressed using computational (source) code.

- Computational contracts can be *interpreted and enforced automatically* via computer-based transaction processing systems.
- Accommodates establishment of complex *multi-party trading/sharing agreements* between known, unknown, or untrusted parties.

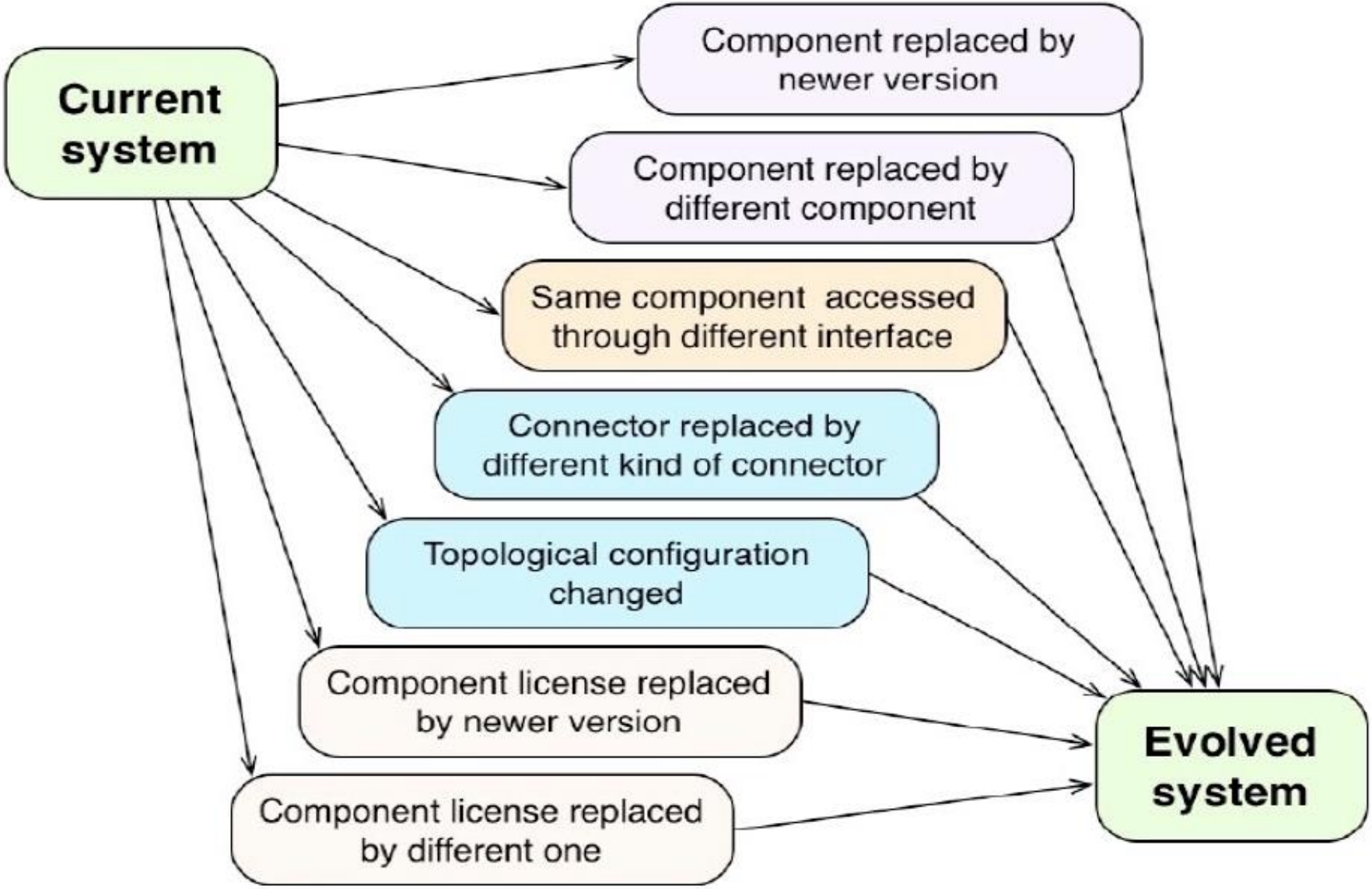
Software supply chains across an OA software system ecosystem



Software supply chains across *multiple component producers* in an OA software system ecosystem



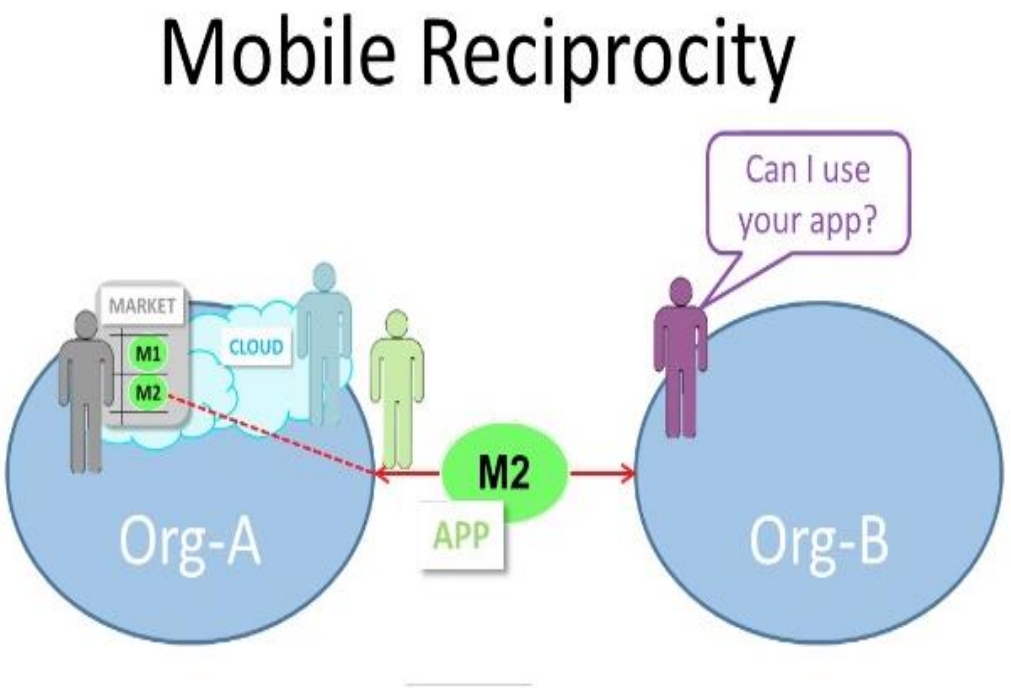
Types of software evolution updates

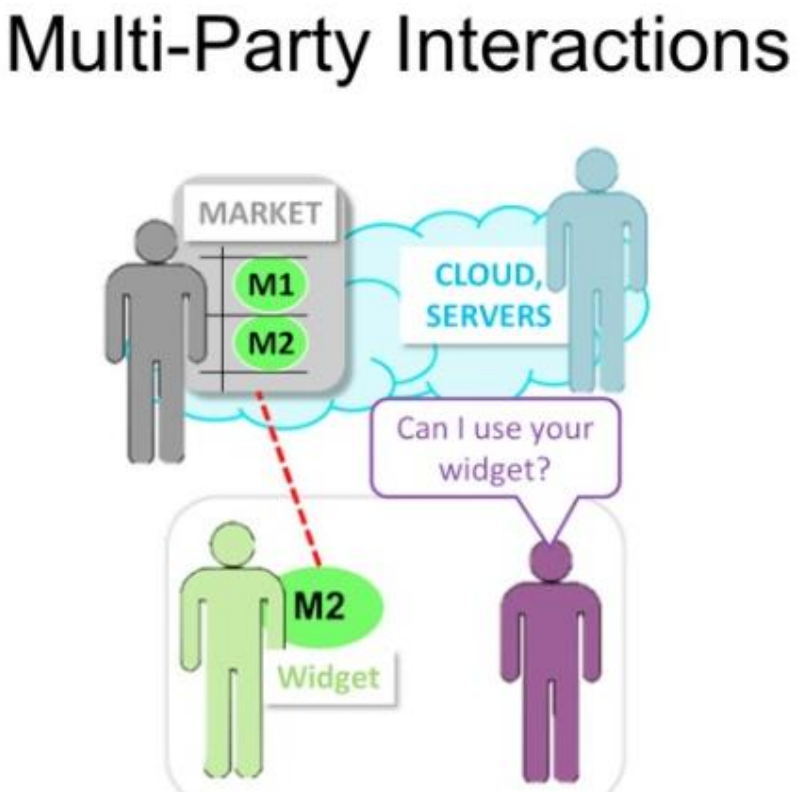


Case Study:
Evolving installed software configurations of Open Architecture command and control/business (C2/B) systems

C2/B enterprises moving to multi-party acquisition of OA software elements within ecosystems

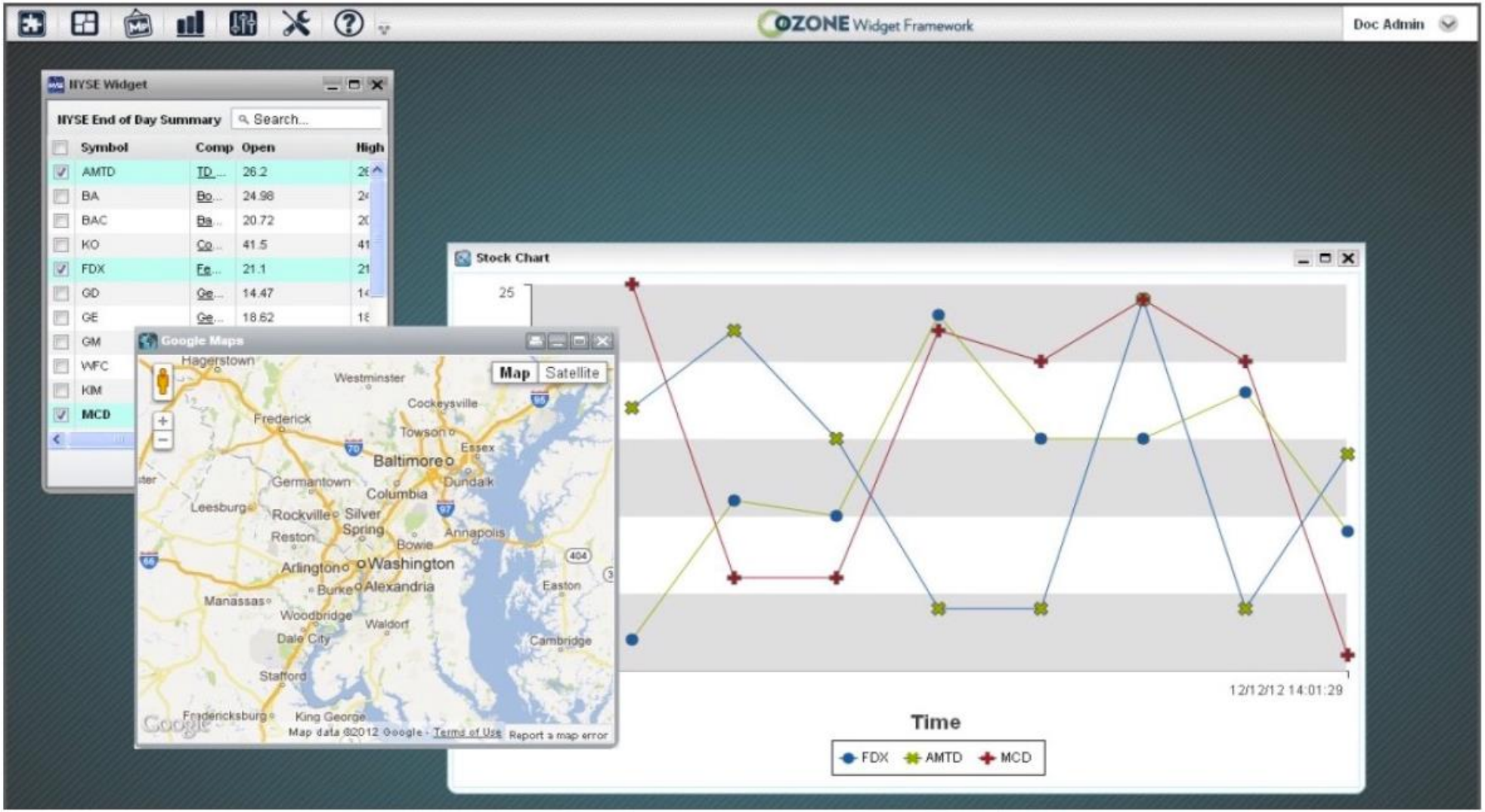
(Scacchi and Alspaugh 2015, 2016)





Customer/end-user organizations now looking for ways to reduce acquisition cost and effort through *shared development/use of common OA software system components* (apps, widgets).

OA system development using inter-communicating widgets/apps acquired from online App Stores



Installed software configuration using Ozone apps and widgets as OA system components for desktop/mobile laptop computers

Deployment scenario for Apps and Widgets as OA system components

CAS Sign In

App Launcher

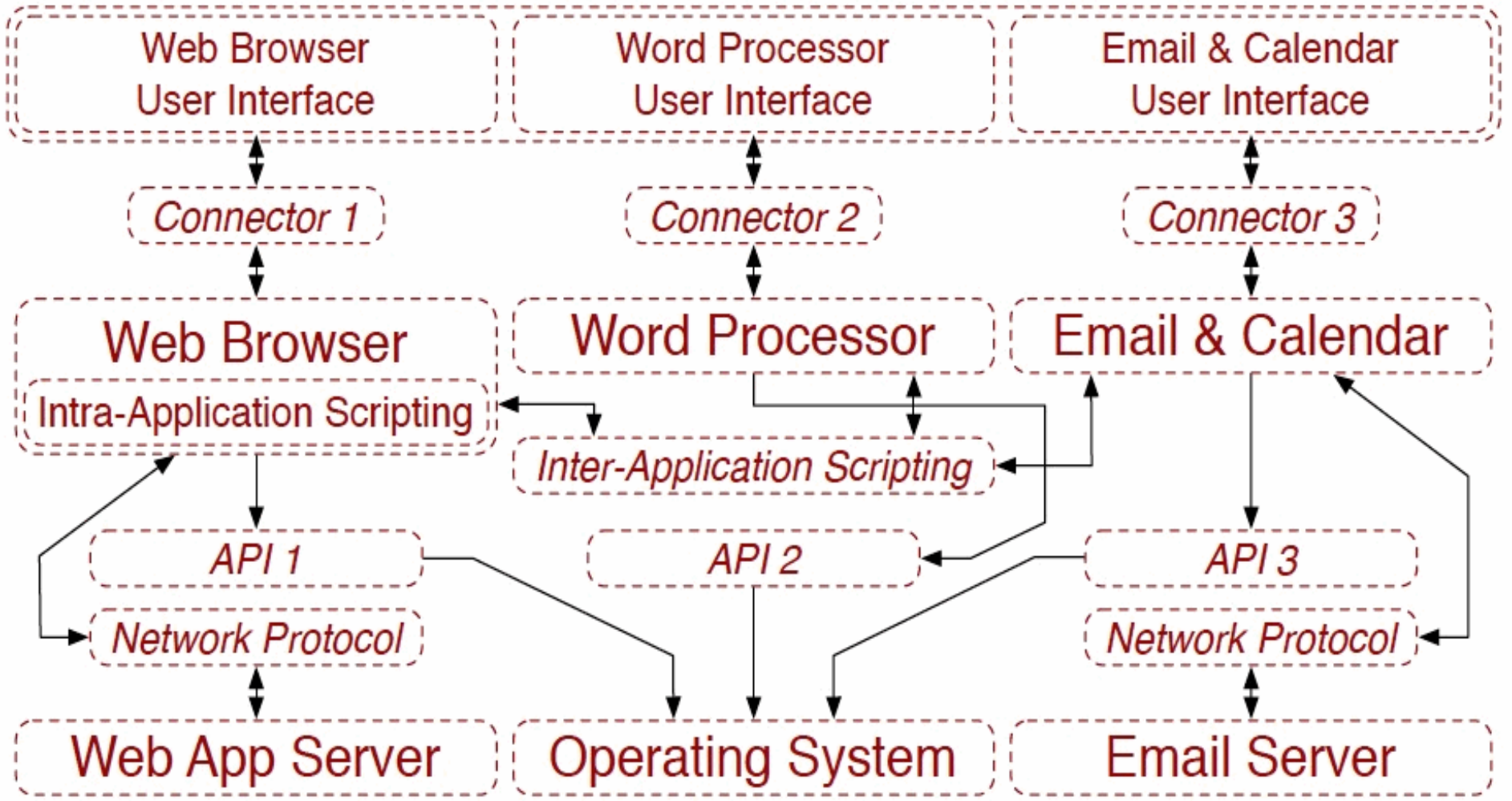
Ozone Mobile Drawer Menu

Installed software configuration for *mobile devices*

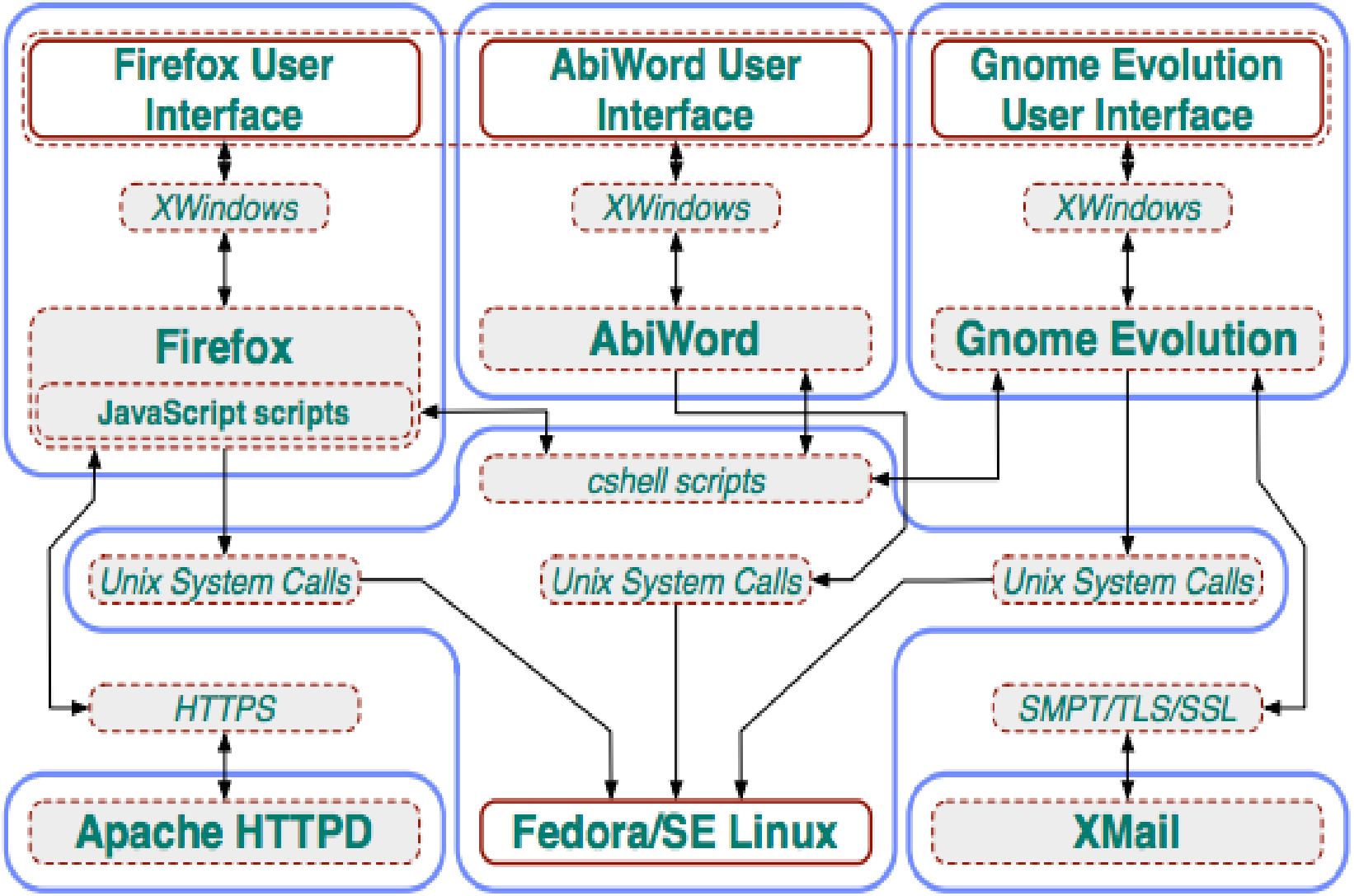
Deployment scenario for Apps and Widgets as OA system components

Installed software configuration for *Future Command Center*

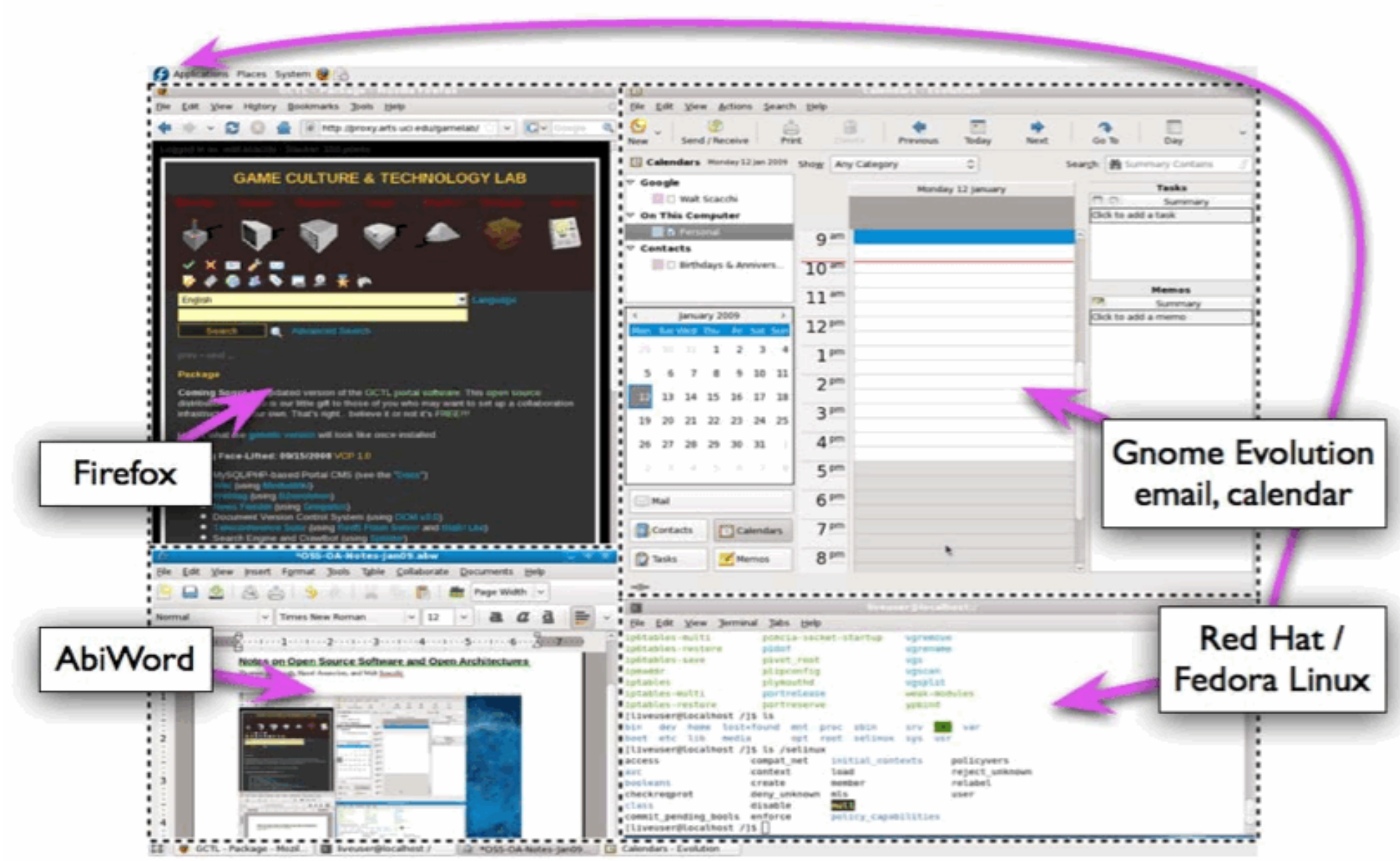
Design-time view of an OA system configuration



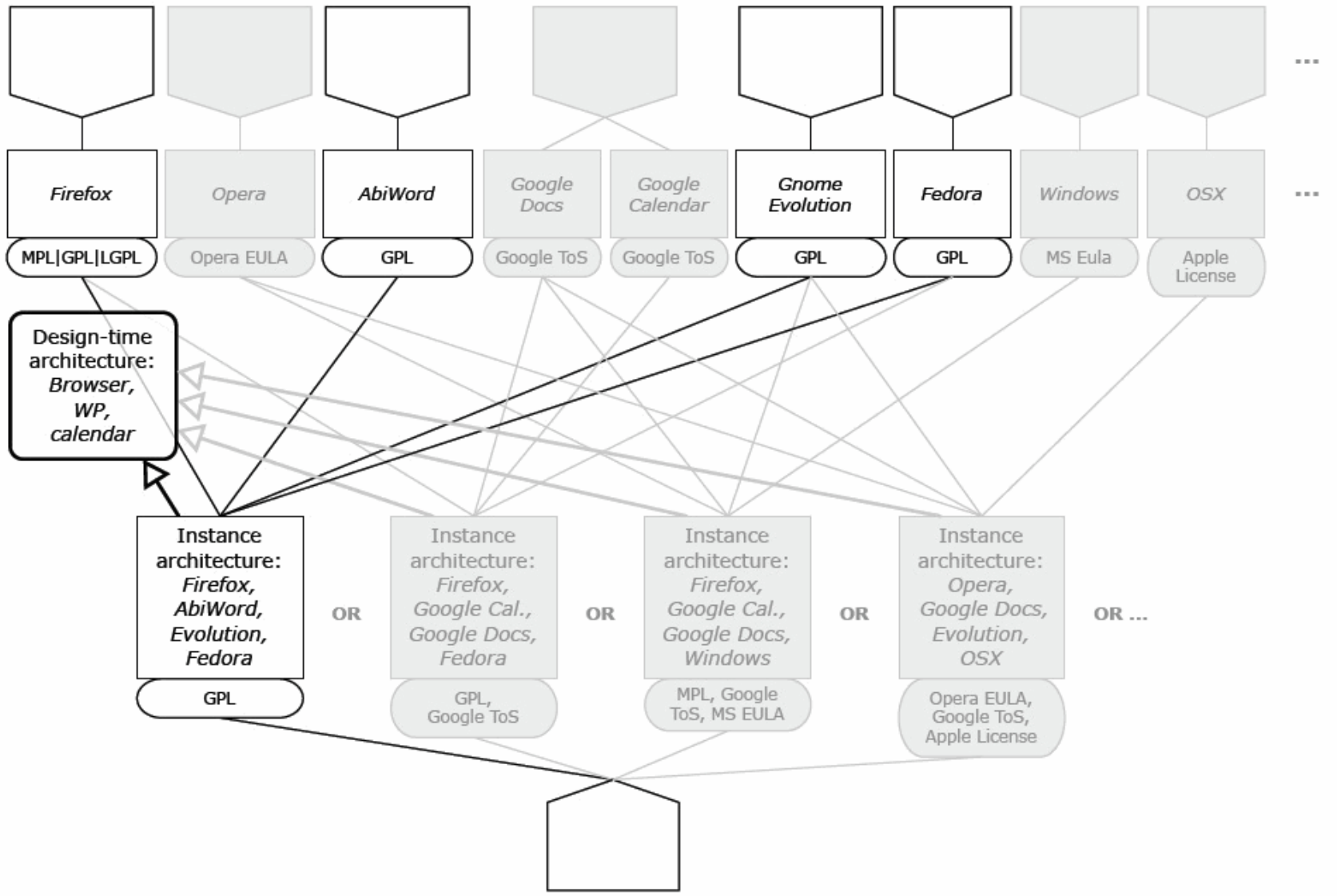
Build-time view of OA system configuration incorporating component security encapsulations



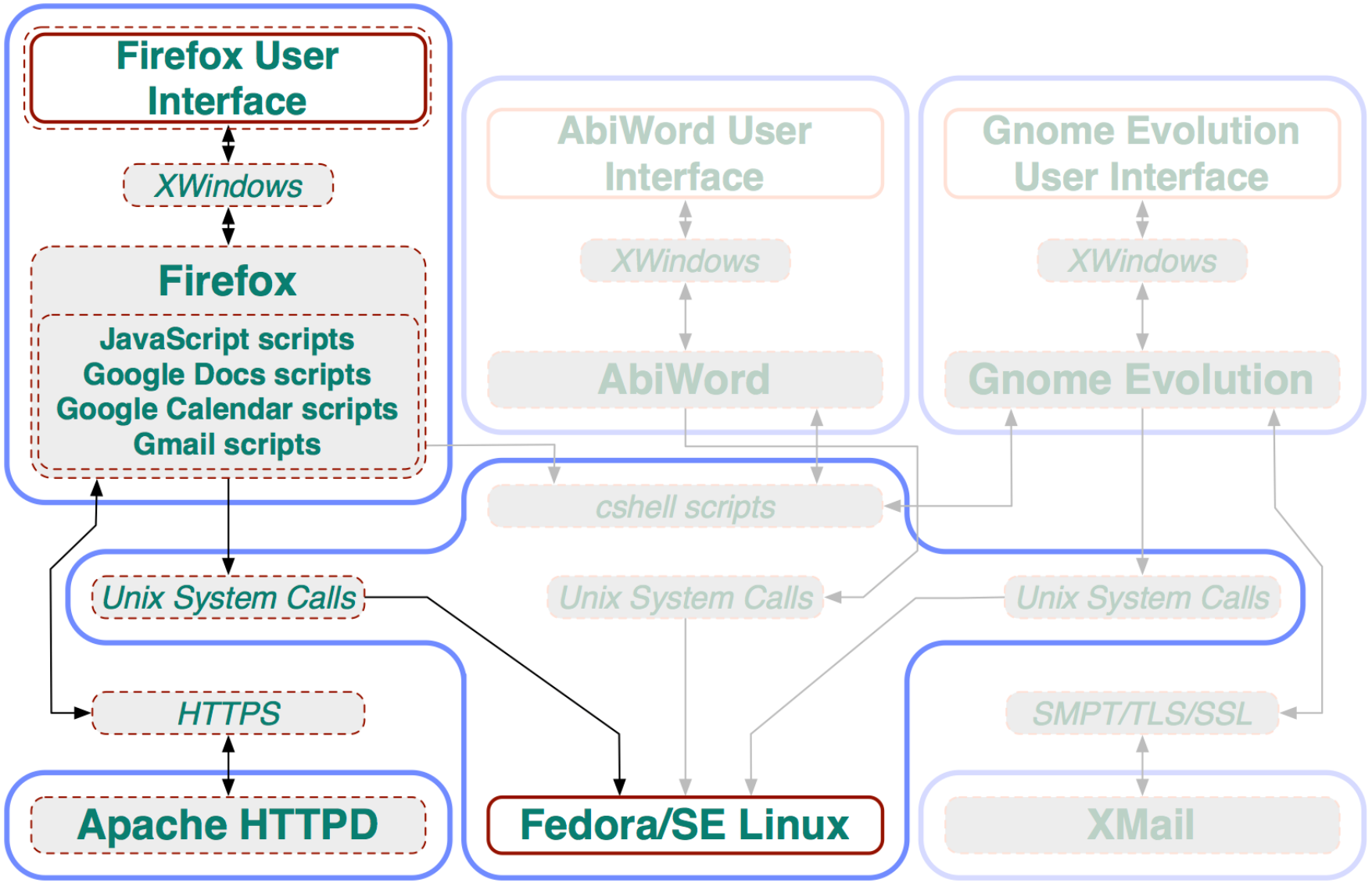
Run-time deployment view of OA *installed software configuration*



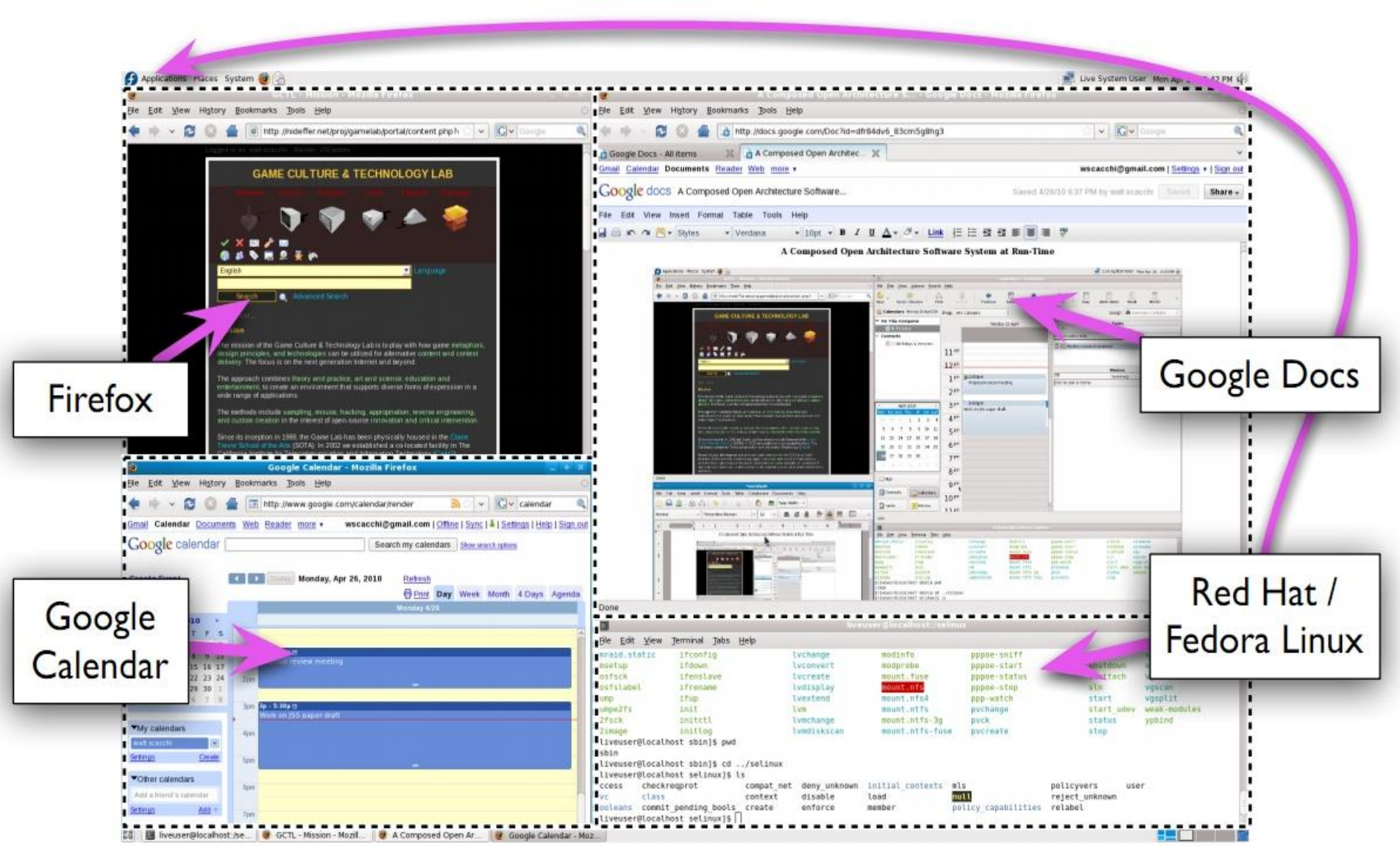
Software supply chain giving rise to the installed software configuration



Build-time view of OA installed software configuration *after* evolutionary update transactions



New run-time deployment view of installed software configuration following multiple evolutionary updates



Observations

- Blockchains and smart contracts can be utilized to specify and implement evolutionary updates to installed software configurations of OA C2/B systems
  - assure the integrity of ISC updates to individual systems distributed across open networks.
    - smart contracts can be used to automate ISC update processes
    - transaction verifiers can manage/track anonymous parties providing updates, and charge fees for verification!
  - prevent cyber attacks to Defense/commercial software supply chains and ecosystems that produce and integrate software component updates.
    - blockchains can be used to identify compromised ISC before/after planned evolutionary updates!

Conclusions

Software supply chains are the primary channel through which large scale cyber attacks are transmitted.

Blockchains and smart contracts are a promising new approach to assuring the cybersecurity of OA software systems, and the software supply chains that provide ongoing streams of evolutionary updates to installed software configurations.

Blockchains and smart contracts are also applicable to other acquisition activities

Blockchains and smart contracts merit further research and development for use in acquisition of OA software systems for command and control/business enterprises.

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Thank you!

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