Open Source Ecosystems: Challenges and Opportunities

Walt Scacchi
Institute for Software Research
and
Institute for Virtual Environments and Computer Games
University of California, Irvine
Irvine, CA 92697-3455 USA
Http://www.ics.uci.edu/~wscacchi
Overview

- Definition of terms (for this presentation)
- Personal history of OSS ecosystem studies
- OSS requirements practices and processes
- OSS role sets and role migration
- Component-based open architecture software systems
  - Intellectual property licenses
  - Cybersecurity
- Conclusions
What is open source?

- Open source software (OSS) denotes specifications, representations, socio-technical processes, and multi-party coordination mechanisms in *human readable, computer processable* formats.
- Socio-technical control of OSS is elastic, negotiated, and amenable to decentralization.
- OSS development subsidized by participants.
What is a (software) ecosystem?

- An ecology of systems with diverse species juxtaposed in adaptive prey-predator food chain relationships.
- Economic network of processes that transform the flow of resources, enacted by actors in different roles, using tools, to produce products, services, or capabilities.
- Software supply network of component producers, system integrators, and consumers.
Personal History of OSS Ecosystem Studies

• 2000-2015 (60+ publications)
  – Computer games, defense, X-ray astronomy, Internet/Web infrastructure, bioinformatics, higher education, e-commerce, neuroscience, virtual reality.

• Discovering requirements practices and processes across OSS communities of practice.

• Participant role sets, role migration, and social movements within/across OSS projects.

• Open architecture (OA) systems with heterogeneously licensed components.
Legend: Boxes are activities (using informalisms); Ellipses are resources required or provided; Actor roles in boldface; flow dependencies as arrows.
**Artifact ecologies and repositories enable collaboration in OSS development**

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<td>Project repositories</td>
<td>Software bug reports</td>
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<td>Blogs, videos, photos, etc.</td>
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A meritocratic role sets, role hierarchy, and role migration paths for OSSD

Figure 2. An “onion” pyramid representation of a generic OSSD project organizational hierarchy with multiple role-sets and advancement tracks.

OA software ecosystems

Software supply network for OA system components: Component IP license and cybersecurity requirements propagate from/to Producers, Integrators, and Consumers
OA development ecosystems

A sample elaboration of producers (vendors), software component applications, and IP licenses for OA system components.
Open Architectures, OSS, and OSS license analysis

- **Goal**: identify software architecture principles and IP licenses that mediate OA
- OSS elements subject to different IP licenses
- Govt/business policies and initiatives now encouraging OA with OSS elements
- How to determine the requirements needed to realize OA strategies with OSS?

Legend: Grey boxes are components; ellipses are connectors; white boxes are interfaces; arrows are data or control flow paths; complete figure is architectural design configuration.
OSS elements subject to different IP/Security licenses

- Intellectual Property and Security licenses stipulate rights and obligations regarding use of the software components/systems
- How to determine which rights and obligations will apply to a component-based configured system?
  - At design-time (maximum flexibility)
  - At integration build-time (may/not be able to redistribute components at hand)
  - At release deployment run-time (may/not need to install/link-to components from other sources)

Design-time view of an OA system
Software product line of functionally similar OA system alternatives

Design-time architecture: Browser, WP, calendar

Instance architecture: Firefox, AbiWord, Evolution, Fedora
  GPL

Instance architecture: Firefox, Google Cal., Google Docs, Fedora
  GPL, Google ToS

Instance architecture: Firefox, Google Cal., Google Docs, Windows
  MPL, Google ToS, MS EULA

Instance architecture: Opera, Google Docs, Evolution, OSX
  Opera EULA, Google ToS, Apple License

OR

OR

OR

OR...
Product line selection of one alternative system configuration

Design-time architecture: Browser, WP, calendar
A security capability specification encapsulating the design-time configuration via multiple virtual machine containers
Build-time view of OA design selecting OSS product family alternatives
Run-time deployment view of OA system family member configuration
Product line selection of different functionally similar alternative

Design-time architecture: Browser, WP, calendar
Run-time deployment view of a similar alternative OA system configuration
Build-time view of OA design selecting *proprietary* product family alternatives
Conclusions

• OSS ecosystems can be:
  - modeled, analyzed, and understood, via
  - discovery of actor practices and processes, that
  - manipulate artifact ecologies, with
  - different tools and repositories, across
  - diverse OSS project communities.

• OSS ecosystems pose new challenges and opportunities in Intellectual Property and Cybersecurity.

• OSS ecosystems can be shaped and stimulated to act via strategic actions.
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