Issues, Challenges, and Opportunities for Open Source Software Development

Walt Scacchi

Institute for Software Research

University of California, Irvine

7 January 2010

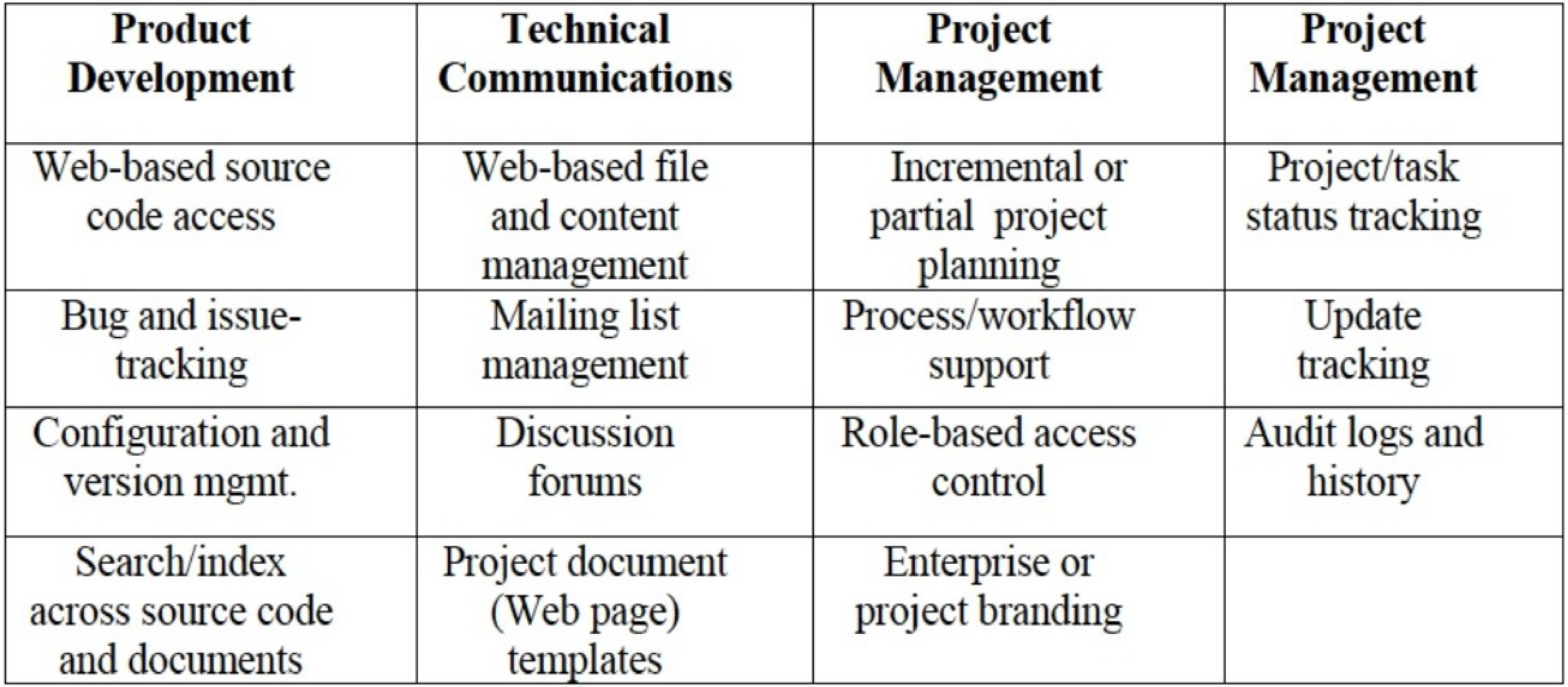
Background

- What is Free/Open Source Software Development?
- FOSSD project characteristics and practices
- Open Architectures and secure computing

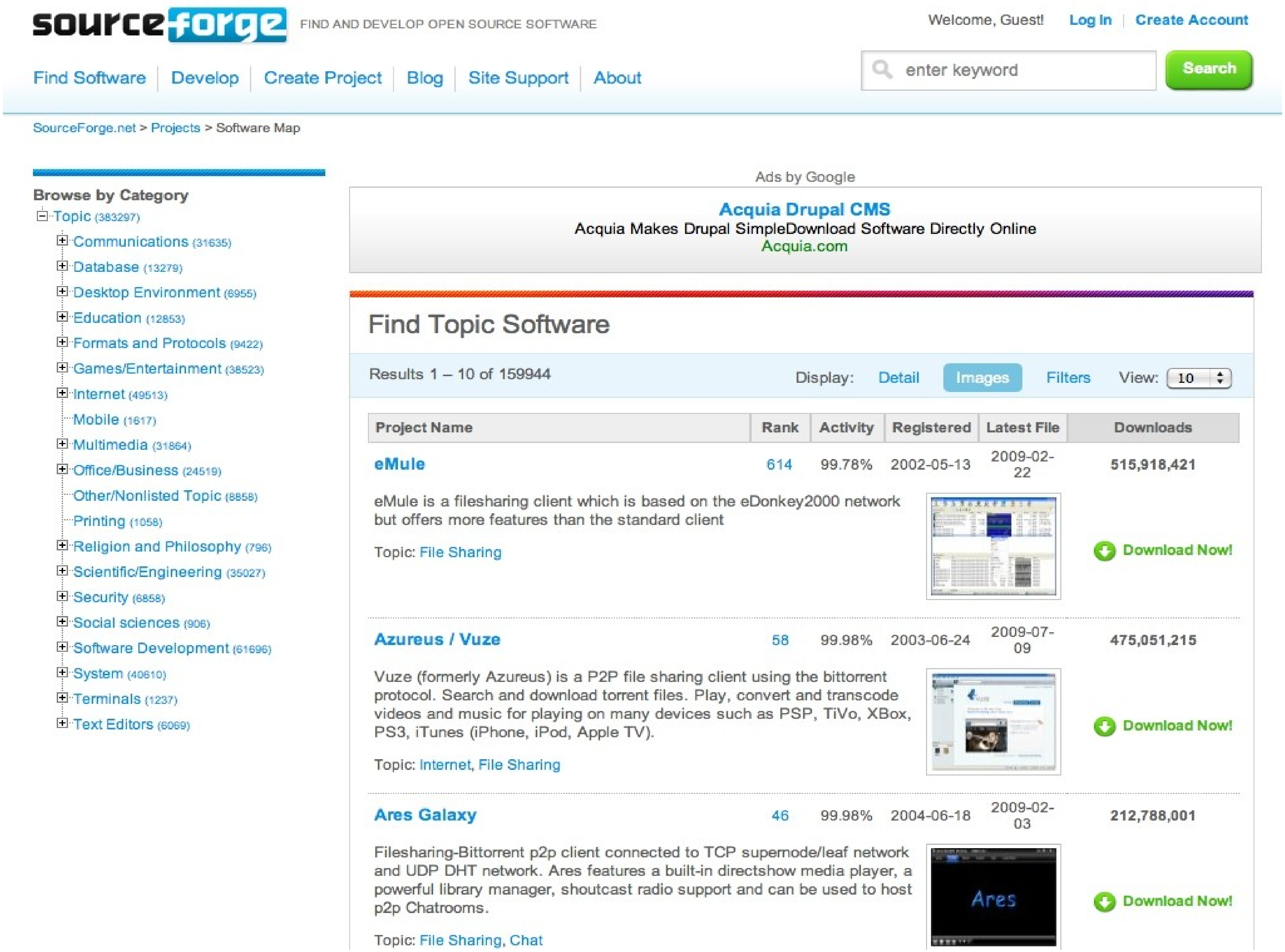
What is free/open source software development?

- Free (as in "freedom" or liberty) vs. open source
  - Freedom to access, browse/view, study, modify and redistribute the source code
  - Free is always open, but open source is not always free
- FOSSD is not "software engineering"
  - *Different*: FOSSD can be faster, better, and cheaper than SE in some circumstances
  - FOSSD teams use 10-50+ OSSD tools and communications applications to support their development work

Collaborative OSS tools



Product Development	Technical Communications	Project Management	Project Management
Web-based source code access	Web-based file and content management	Incremental or partial project planning	Project/task status tracking
Bug and issue-tracking	Mailing list management	Process/workflow support	Update tracking
Configuration and version mgmt.	Discussion forums	Role-based access control	Audit logs and history
Search/index across source code and documents	Project document (Web page) templates	Enterprise or project branding	



sourceforge FIND AND DEVELOP OPEN SOURCE SOFTWARE

Welcome, Guest! Log In | Create Account

Find Software | Develop | Create Project | Blog | Site Support | About

enter keyword **Search**

SourceForge.net > Projects > Software Map

Browse by Category

- Topic (383297)
  - Communications (31635)
  - Database (13279)
  - Desktop Environment (6955)
  - Education (12853)
  - Formats and Protocols (9422)
  - Games/Entertainment (38523)
  - Internet (49513)
  - Mobile (1617)
  - Multimedia (31864)
  - Office/Business (24519)
  - Other/Nonlisted Topic (8858)
  - Printing (1058)
  - Religion and Philosophy (796)
  - Scientific/Engineering (35027)
  - Security (6858)
  - Social sciences (906)
  - Software Development (61696)
  - System (40610)
  - Terminals (1237)
  - Text Editors (6069)

Find Topic Software

Results 1 – 10 of 159944

Display: Detail | Images | Filters View: 10

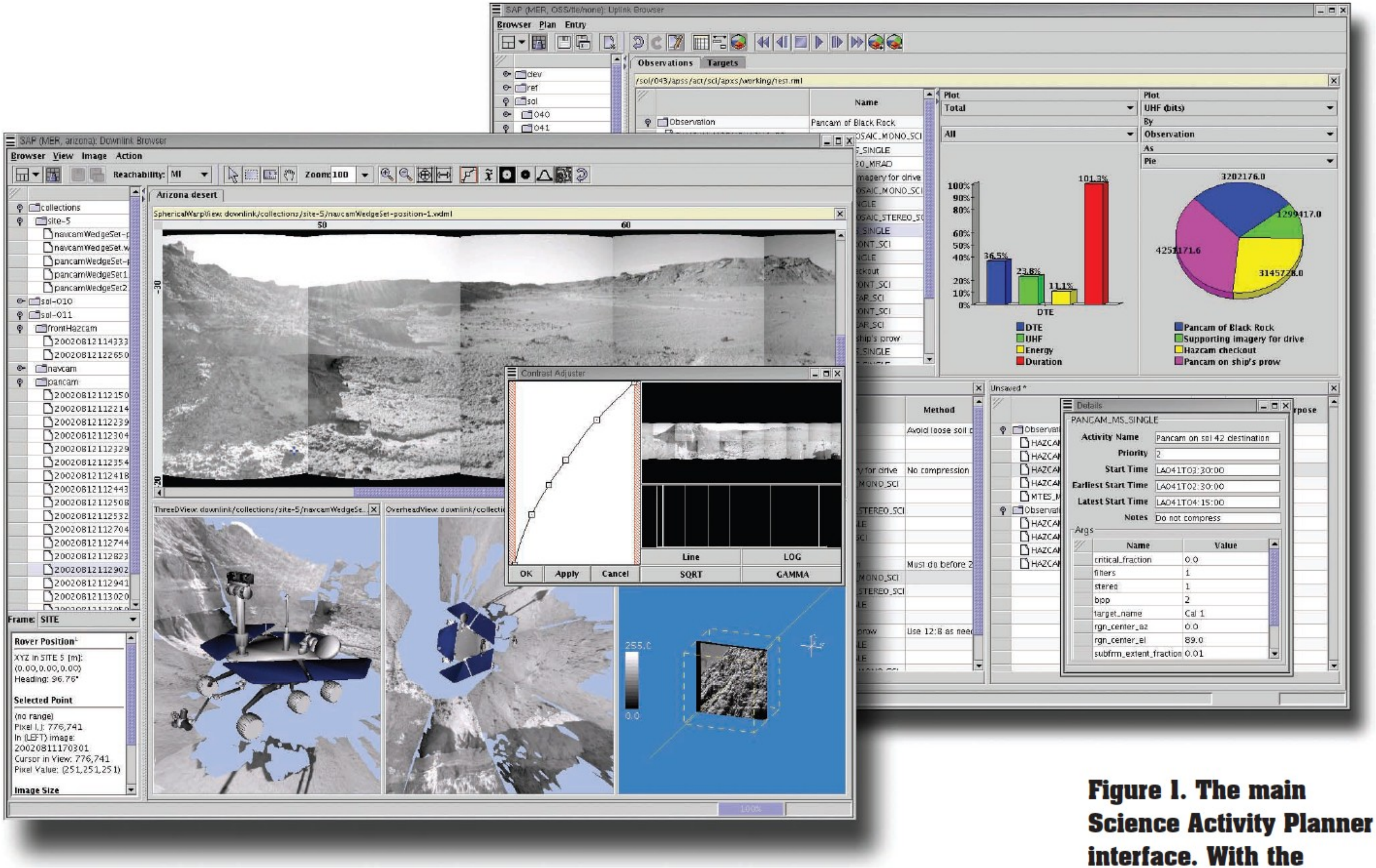
Project Name	Rank	Activity	Registered	Latest File	Downloads
eMule eMule is a filesharing client which is based on the eDonkey2000 network but offers more features than the standard client Topic: File Sharing	614	99.78%	2002-05-13	2009-02-22	**515,918,421** Download Now!
Azureus / Vuze Vuze (formerly Azureus) is a P2P file sharing client using the bittorrent protocol. Search and download torrent files. Play, convert and transcode videos and music for playing on many devices such as PSP, TiVo, XBox, PS3, iTunes (iPhone, iPod, Apple TV). Topic: Internet, File Sharing	58	99.98%	2003-06-24	2009-07-09	**475,051,215** Download Now!
Ares Galaxy Filesharing-Bittorrent p2p client connected to TCP supernode/leaf network and UDP DHT network. Ares features a built-in directshow media player, a powerful library manager, shoutcast radio support and can be used to host p2p Chatrooms. Topic: File Sharing, Chat	46	99.98%	2004-06-18	2009-02-03	**212,788,001** Download Now!

FOSSD Project Characteristics

- Operational code early and often--actively improved and continuously adapted
  - Short-cycle (FOSS) vs. long-cycle (SLC) time processes
- *Post-facto* software system requirements and design
  - FOSSD has its own "-ilities" which differ from those for SE
- *Caution*: the vast majority (>90%) of FOSSD projects fail to grow or to produce a software release.

FOSSD Project Characteristics

- FOSS developers are typically users of what they build, while FOSS users (~1%) are also FOSS developers
- Requires "*critical mass*" of contributors and FOSS components connected through socio-technical interaction networks
- FOSSD projects can emerge/evolve via *bricolage*
  - Unanticipated architectural (de)compositions
  - Multi-project component integrations
  - Even for mission-critical systems



Frame: SITE

Rover Position

XYZ in SITE 5 [m]:
(0.00,0.00,0.00)
Heading: 96.76°

Selected Point

(no range)
Pixel I,J: 776,741
In (LEFT) image:
20020811170301
Cursor in View: 776,741
Pixel Value: (251,251,251)

Image Size

Details

PANCAM_MS_SINGLE

Activity Name: Pancam on sol 42 destination
Priority: 2
Start Time: LA041T03:30:00
Earliest Start Time: LA041T02:30:00
Latest Start Time: LA041T04:15:00
Notes: Do not compress

Args

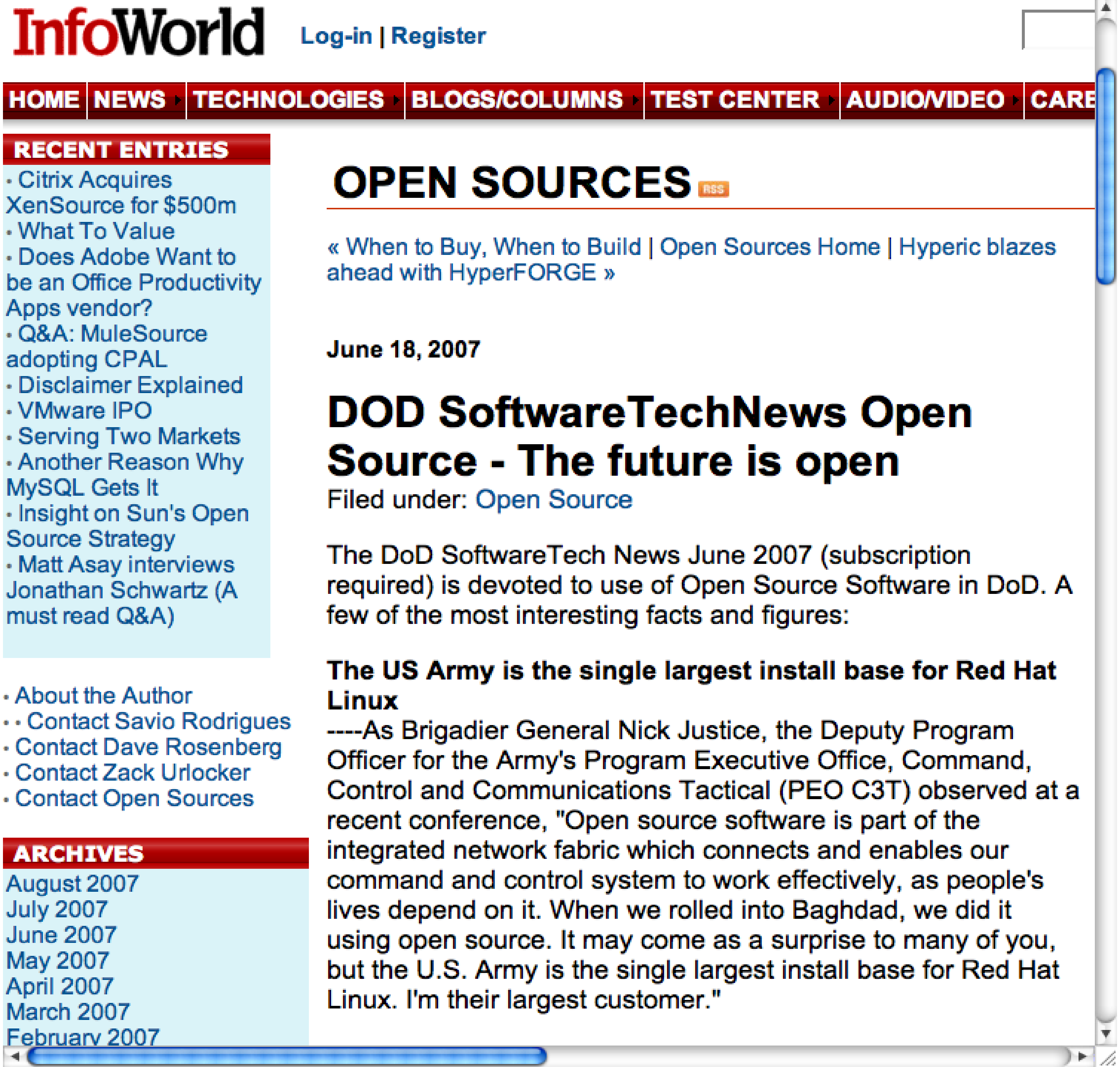
Name	Value
critical_fraction	0.0
filters	1
stereo	1
bpp	2
target_name	Cal 1
rgn_center_az	0.0
rgn_center_el	89.0
subfrm_extent_fraction	0.01

Figure 1. The main Science Activity Planner interface. With the downlink browser

Source: J.S. Norris, Mission Critical Development of Open Source Software: Lessons Learned, *IEEE Software*, 21(1), 42-49, Jan 2004.

European Space Agency

- Adopted standardized processes for developing open source software systems for mission-critical space applications like TerraSAR [Peccia 2007]
- Built open source spacecraft operating system, SCOS 2000 [Kaufeler 2001]
- Conform to international software engineering standards established by the ESA [Aldea 2003, ESA 2007].
  - *European Cooperation for Space Standardization* (ECSS)
  - Aldea, F., Jones, M., and Schabe, H. (2003). Checking Whether SCOS is up to SPEC, *ESA Bulletin 115*, 58-60, August.
  - ESA (European Space Agency), (2007). European Cooperation for Space Standardisation (ECSS), http://www.esa.int/TEC/Software_engineering_and_standardisation/TECMKDUXBQE_2.html
  - Kaufeler, J-F., Jones, M., and Karl, H-U., (2001). Promoting ESA Software as a European Product: The SCOS-2000 Example, *ESA Bulletin 108*, 72-772, November.
  - Peccia, N. (2007). WSA open-source software supports Germany's TerraSAR-X, http://www.esa.int/esaCP/SEMDV1T4LZE_index_2.html



RECENT ENTRIES

- Citrix Acquires XenSource for $500m
- What To Value
- Does Adobe Want to be an Office Productivity Apps vendor?
- Q&A: MuleSource adopting CPAL
- Disclaimer Explained
- VMware IPO
- Serving Two Markets
- Another Reason Why MySQL Gets It
- Insight on Sun's Open Source Strategy
- Matt Asay interviews Jonathan Schwartz (A must read Q&A)

- About the Author
- • Contact Savio Rodrigues
- Contact Dave Rosenberg
- Contact Zack Urlocker
- Contact Open Sources

ARCHIVES

August 2007
July 2007
June 2007
May 2007
April 2007
March 2007
February 2007

OPEN SOURCES

« When to Buy, When to Build | Open Sources Home | Hyperic blazes ahead with HyperFORGE »

June 18, 2007

DOD SoftwareTechNews Open Source - The future is open

Filed under: Open Source

The DoD SoftwareTech News June 2007 (subscription required) is devoted to use of Open Source Software in DoD. A few of the most interesting facts and figures:

The US Army is the single largest install base for Red Hat Linux

----As Brigadier General Nick Justice, the Deputy Program Officer for the Army's Program Executive Office, Command, Control and Communications Tactical (PEO C3T) observed at a recent conference, "Open source software is part of the integrated network fabric which connects and enables our command and control system to work effectively, as people's lives depend on it. When we rolled into Baghdad, we did it using open source. It may come as a surprise to many of you, but the U.S. Army is the single largest install base for Red Hat Linux. I'm their largest customer."

Empirical findings from OSSD practices

- **Individual participation**
- **Resources supporting FOSSD activities**
- Governance: cooperation, coordination, and control in FOSSD projects
- Alliances, social networking and community development
- **Multi-project software ecosystems**
- FOSS as a social movement

Individual participation in FOSSD projects: motives and consequences

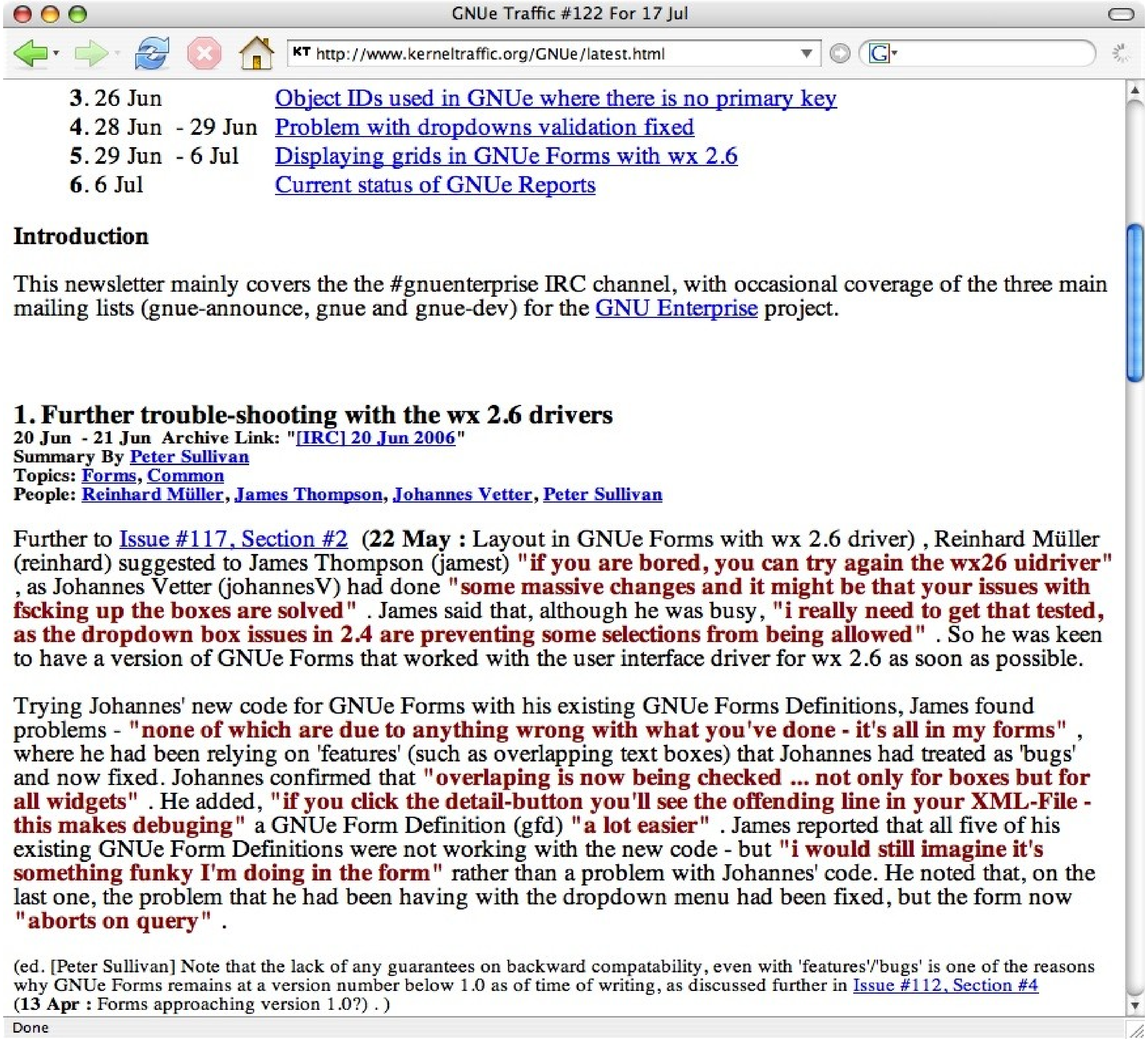
- FOSS developers want to:
  - learn about new tools, techniques, skills, etc.
  - have fun building software
  - exercise their technical skill
  - try out new kinds of systems to develop
  - interconnect multiple FOSSD projects
- FOSS developers frequently:
  - build trust and reputation with one another
  - achieve “geek fame” (for project leaders)
  - spend more time reading online documents and communicating with one another than writing code

FOSSD resources/capabilities

- Personal software development resources
- Beliefs supporting FOSSD
- **FOSSD informalisms**
- Skilled, self-organizing developers
- Discretionary time and effort
- Trust and social accountability

FOSSD Informalisms

- Software *informalisms*--artifacts participants use to describe, proscribe, or prescribe what's happening in a project
- Informalisms capture detailed rationale and debates for what changes were made in particular development activities, artifacts, or source code files
- Informalisms are the media for OSS requirements, design, testing, etc.



GNUe Traffic #122 For 17 Jul
http://www.kerneltraffic.org/GNUe/latest.html
Done

3. 26 Jun — Object IDs used in GNUe where there is no primary key
4. 28 Jun - 29 Jun — Problem with dropdowns validation fixed
5. 29 Jun - 6 Jul — Displaying grids in GNUe Forms with wx 2.6
6. 6 Jul — Current status of GNUe Reports

Introduction

This newsletter mainly covers the the #gnuenterprise IRC channel, with occasional coverage of the three main mailing lists (gnue-announce, gnue and gnue-dev) for the GNU Enterprise project.

1. Further trouble-shooting with the wx 2.6 drivers

20 Jun - 21 Jun Archive Link: "[IRC] 20 Jun 2006"
Summary By Peter Sullivan
Topics: Forms, Common
People: Reinhard Müller, James Thompson, Johannes Vetter, Peter Sullivan

Further to Issue #117, Section #2 (**22 May :** Layout in GNUe Forms with wx 2.6 driver) , Reinhard Müller (reinhard) suggested to James Thompson (jamest) **"if you are bored, you can try again the wx26 uidriver"** , as Johannes Vetter (johannesV) had done **"some massive changes and it might be that your issues with fscking up the boxes are solved"** . James said that, although he was busy, **"i really need to get that tested, as the dropdown box issues in 2.4 are preventing some selections from being allowed"** . So he was keen to have a version of GNUe Forms that worked with the user interface driver for wx 2.6 as soon as possible.

Trying Johannes' new code for GNUe Forms with his existing GNUe Forms Definitions, James found problems - **"none of which are due to anything wrong with what you've done - it's all in my forms"** , where he had been relying on 'features' (such as overlapping text boxes) that Johannes had treated as 'bugs' and now fixed. Johannes confirmed that **"overlaping is now being checked ... not only for boxes but for all widgets"** . He added, **"if you click the detail-button you'll see the offending line in your XML-File - this makes debuging"** a GNUe Form Definition (gfd) **"a lot easier"** . James reported that all five of his existing GNUe Form Definitions were not working with the new code - but **"i would still imagine it's something funky I'm doing in the form"** rather than a problem with Johannes' code. He noted that, on the last one, the problem that he had been having with the dropdown menu had been fixed, but the form now **"aborts on query"** .

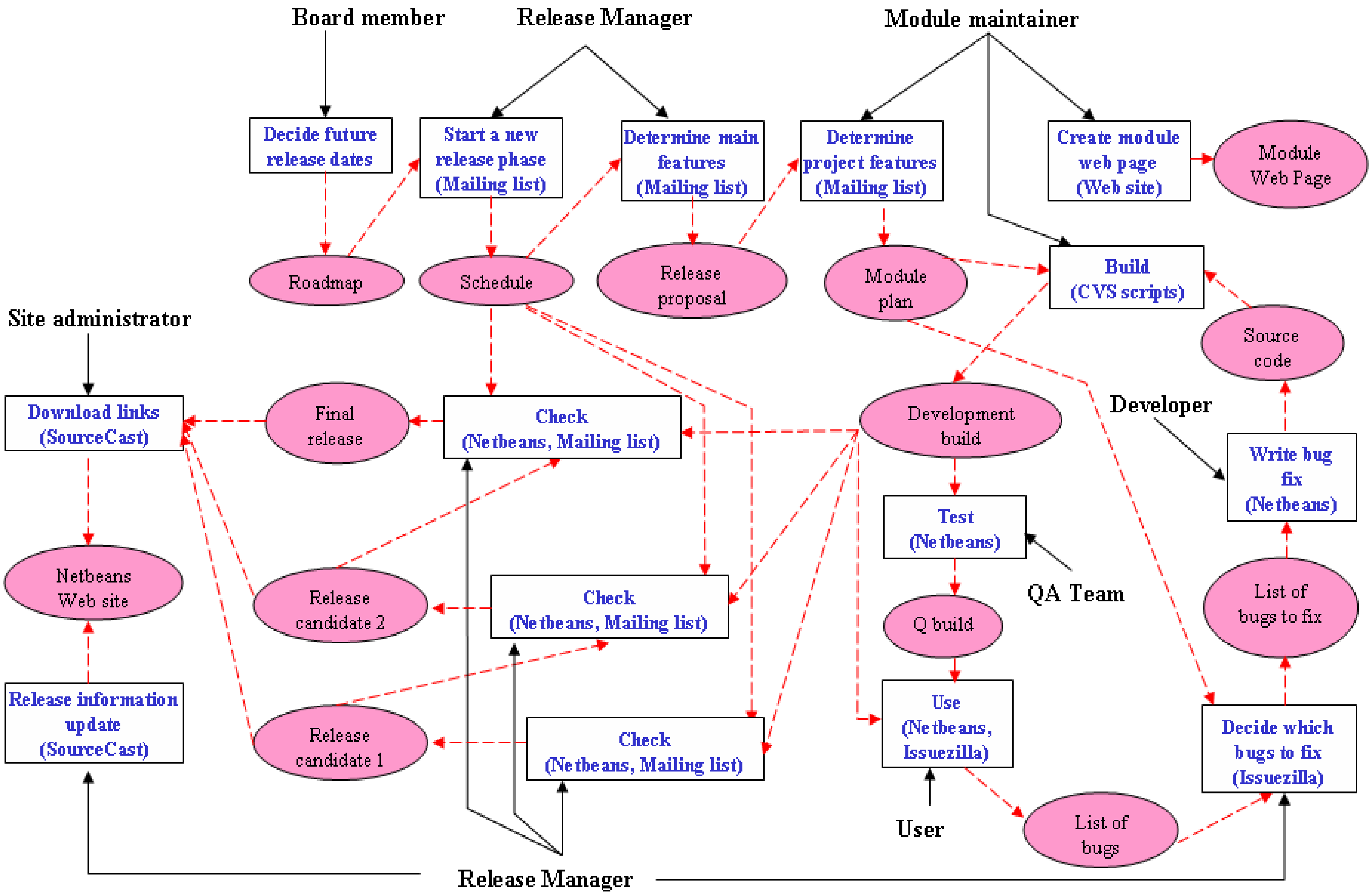
(ed. [Peter Sullivan] Note that the lack of any guarantees on backward compatability, even with 'features'/'bugs' is one of the reasons why GNUe Forms remains at a version number below 1.0 as of time of writing, as discussed further in Issue #112, Section #4 (**13 Apr :** Forms approaching version 1.0?) .)

FOSSD informalisms

Email lists	Discussion forums	News postings	Project digests
IM/Internet Relay Chat	Scenarios of usage	How-to guides	To-do lists
FAQ's and item lists	Project Wikis	System documentation	External publications
Copyright licenses	Architecture diagrams	Intra-app scripting	Plug-ins
Code from other projects	Project Web site	Multi-project Web sites	Project source code web
Project repositories	Software bug reports	Issue tracking databases	etc.

Implicit project management

- FOSSD projects self-organize into a *meritocractic role-hierarchy* that enables *virtual project management*
  - Meritocracies embrace incremental innovations over radical innovations
  - VPM requires people to act in leadership roles based on skill, availability, and belief in project community
- Reliance on evolving web of software informalism content constrains collective action within FOSSD project via traceable and searchable information/content legacy



Board member

Release Manager

Module maintainer

Decide future release dates

Start a new release phase (Mailing list)

Determine main features (Mailing list)

Determine project features (Mailing list)

Create module web page (Web site)

Module Web Page

Roadmap

Schedule

Release proposal

Module plan

Build (CVS scripts)

Site administrator

Source code

Download links (SourceCast)

Final release

Check (Netbeans, Mailing list)

Development build

Developer

Write bug fix (Netbeans)

Test (Netbeans)

QA Team

Netbeans Web site

Release candidate 2

Check (Netbeans, Mailing list)

Q build

List of bugs to fix

Release information update (SourceCast)

Release candidate 1

Check (Netbeans, Mailing list)

Use (Netbeans, Issuezilla)

Decide which bugs to fix (Issuezilla)

User

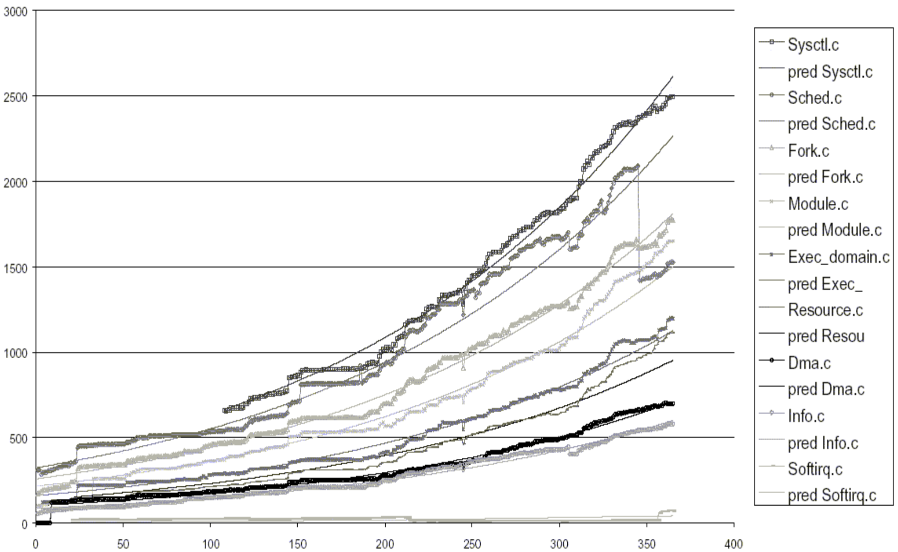
List of bugs

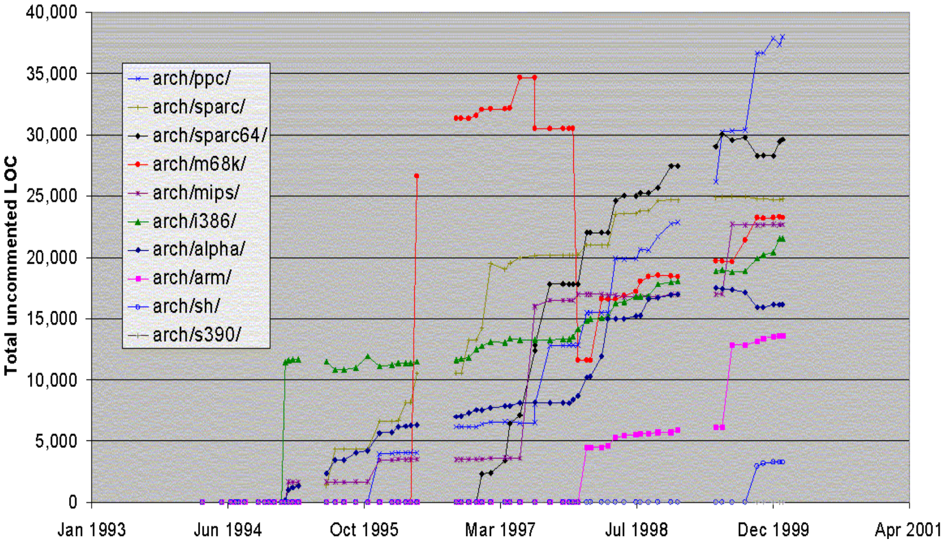
Release Manager

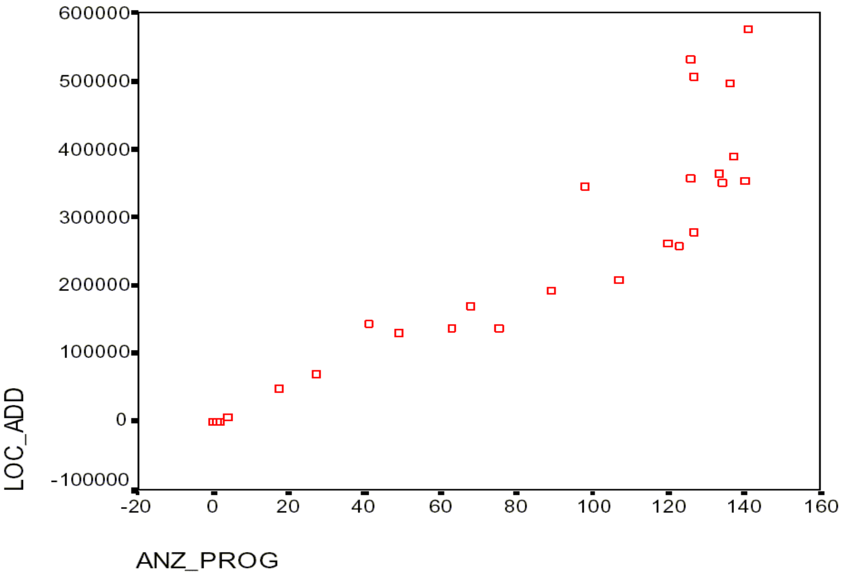
Legend: Boxes are *activities* (using *informalisms*); Ellipses are *resources* required or provided; Actor *roles* in boldface; *flow dependencies* as arrows.

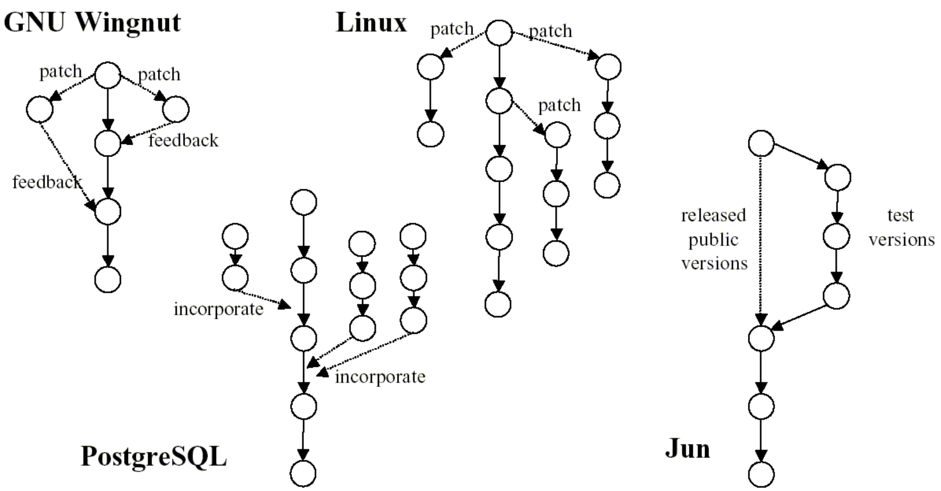
Multi-project software ecosystem

- Mutually dependent FOSS development and evolution propagate functional software cliches/idioms, cloned code, architectural styles, dependencies, and vulnerabilities
- *Architectural bricolage* arises when autonomous FOSSD projects, artifacts, tools, and systems co-mingle or merge
  - Enables discontinuous or exponential growth of FOSS source code, functionality, complexity, contributions


3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250
300
350
400
Sysctl.c
pred Sysctl.c
Sched.c
pred Sched.c
Fork.c
pred Fork.c
Module.c
pred Module.c
Exec_domain.c
pred Exec_
Resource.c
pred Resou
Dma.c
pred Dma.c
Info.c
pred Info.c
Softirq.c
pred Softirq.c


Total uncommented LOC
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Jan 1993
Jun 1994
Oct 1995
Mar 1997
Jul 1998
Dec 1999
Apr 2001
arch/ppc/
arch/sparc/
arch/sparc64/
arch/m68k/
arch/mips/
arch/i386/
arch/alpha/
arch/arm/
arch/sh/
arch/s390/


600000
500000
400000
300000
200000
100000
0
-100000
-20
0
20
40
60
80
100
120
140
160
LOC_ADD
ANZ_PROG


GNU Wingnut
patch
patch
feedback
feedback
Linux
patch
patch
patch
PostgreSQL
incorporate
incorporate
released public versions
test versions
Jun

Open Architectures and OSS (and some secure computing topics)

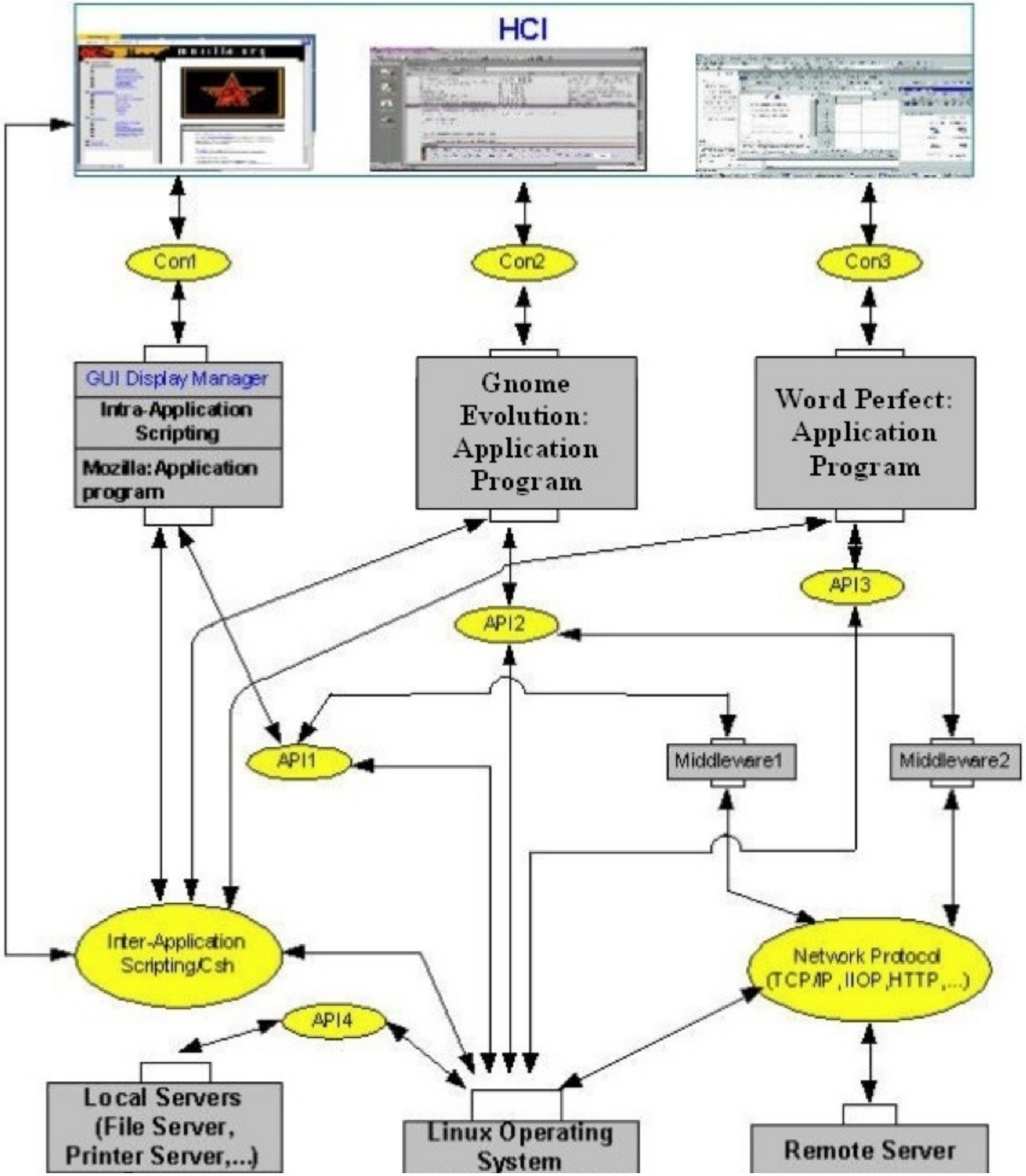
Open Architectures, OSS, and software license analysis

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

Source: W. Scacchi and T. Alspaugh, Emerging Issues in the Acquisition of Open Source Software within the U.S. Department of Defense, *Proc. 5th Annual Acquisition Research Symposium*, Vol. 1, 230-244, NPS-AM-08-036, Naval Postgraduate School, Monterey, CA, 2008.

Open Software Architecture Concepts

- Software source code components
  - Standalone programs
  - Libraries, frameworks, or middleware
  - Inter-application script code (e.g., for mash-ups)
  - Intra-application script code (e.g., for Rich Internet Apps.)
- Executable software components (binaries)
- Application program interfaces (APIs)
- Software connectors
- Configured sub-system or system


HCI
Con1
Con2
Con3
GUI Display Manager
Intra-Application Scripting
Mozilla: Application program
Gnome Evolution: Application Program
Word Perfect: Application Program
API3
API2
API1
Middleware1
Middleware2
Inter-Application Scripting/Csh
Network Protocol (TCP/IP, IIOP, HTTP,...)
API4
Local Servers (File Server, Printer Server,...)
Linux Operating System
Remote Server

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*

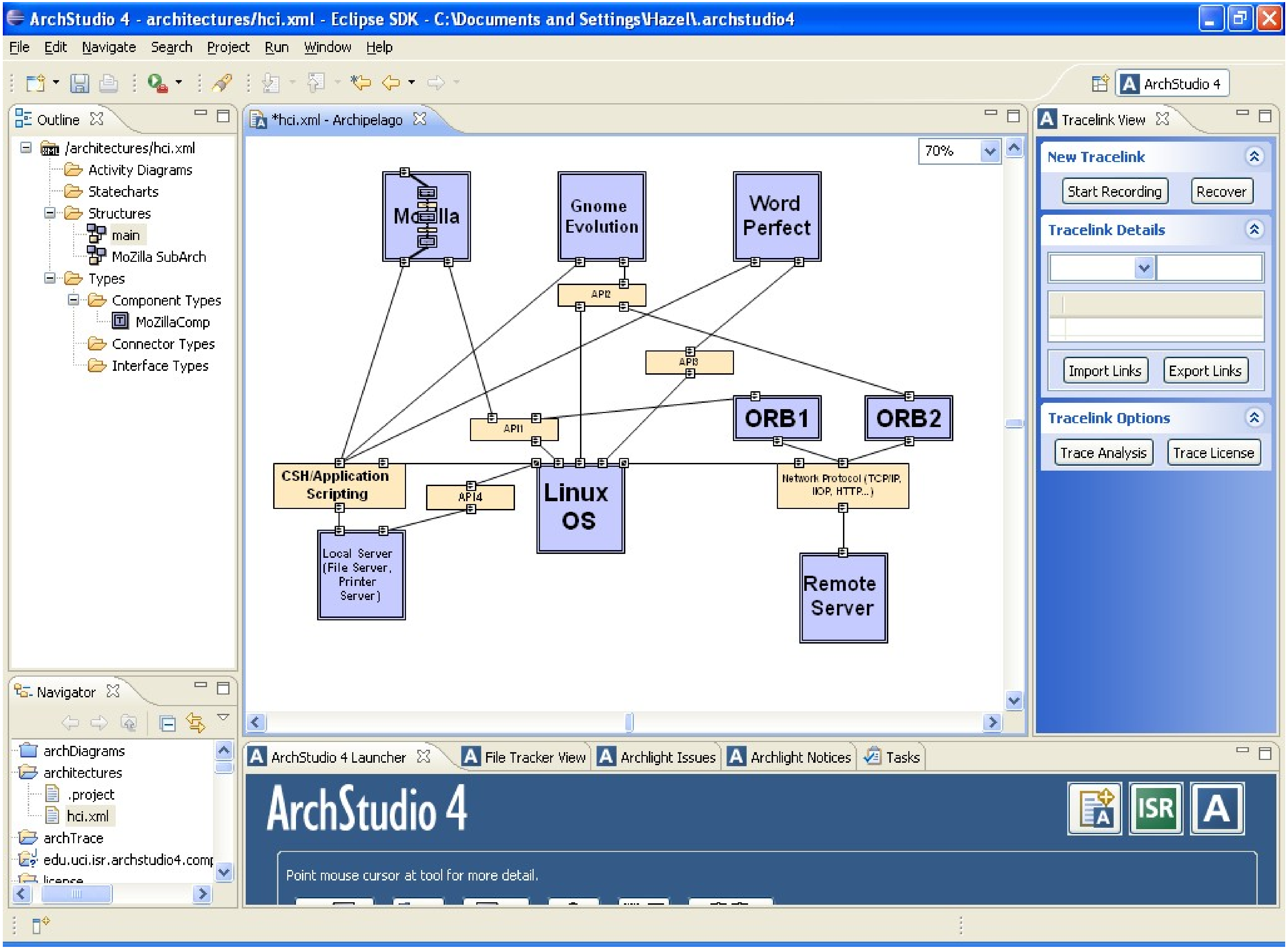
OSS elements subject to different IP/Security licenses

- Intellectual Property/Security licenses stipulate <u>rights</u> and <u>obligations</u> regarding use of the licensed software components/systems
  - GPL (Gnu Public License) stipulate right to access, study, modify, and *reciprocal* obligation to redistribute modified source
  - Mozilla now offers a “tri-license” for its software like Firefox:
    - GPL, MPL (lightweight), or Restricted (accommodating proprietary services)
  - Other OSS covered by different rights and obligations
- How to determine which rights and obligations will apply to a component-based configured system?
  - At *design-time* (maximum flexibility)
  - At *build-time (*may/not be able to redistribute components at hand)
  - At *run-time* (may/not need to install/link-to components from other sources)

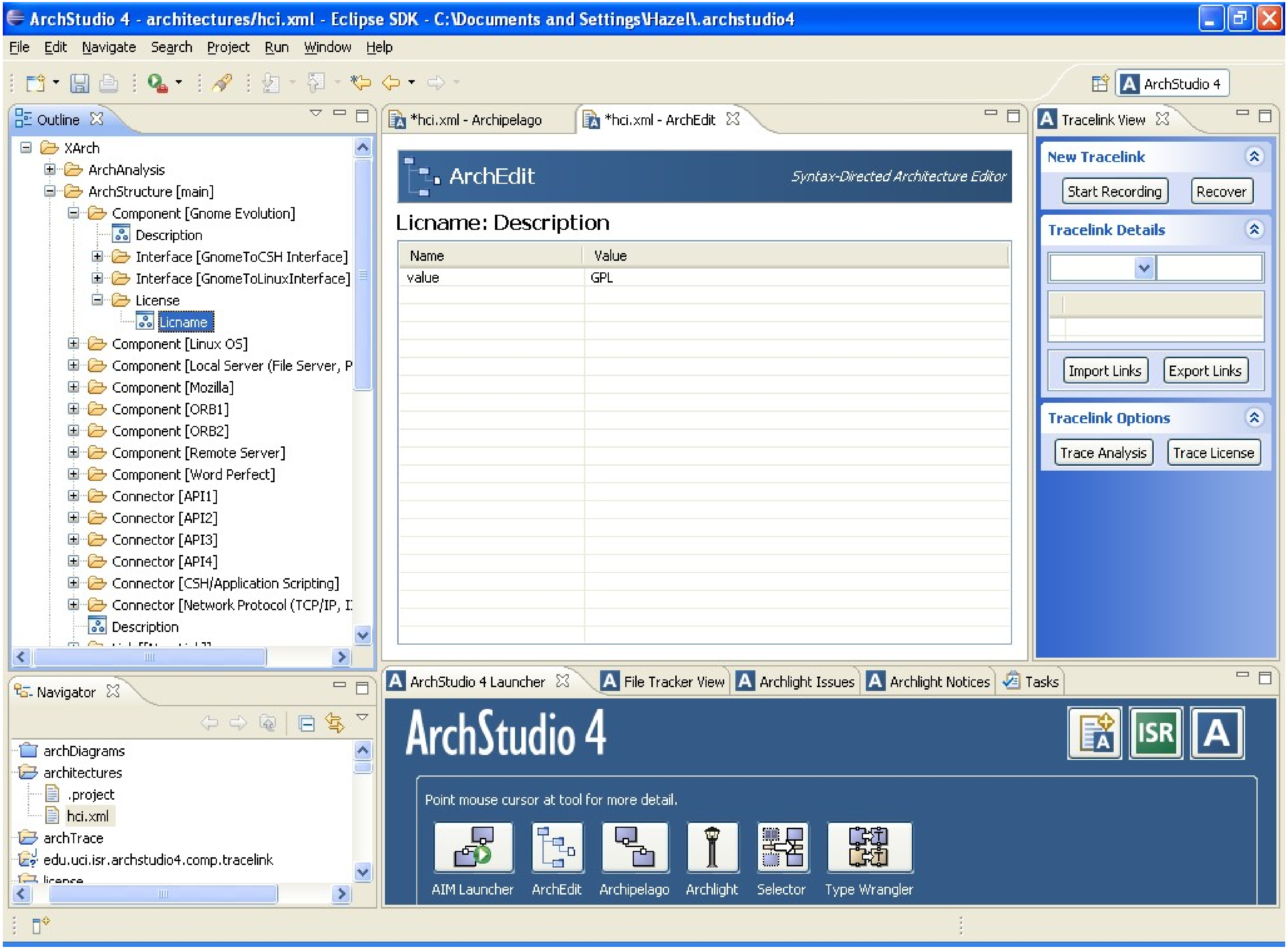
Source: T. Alspaugh, H. Asuncion, and W. Scacchi, Intellectual Property Rights Requirements for Heterogeneously Licensed Systems, in *Proc. 17th. Intern. Conf. Requirements Engineering (RE09)*, Atlanta, GA, 24-33, September 2009.

Specifying software license/security requirements

- Rights Expression Language (REL)
  - A logic of trust, authorization, and action using software meta-data (versions/revisions, authors, certification history, etc.)
- Distinct specifications of rights and obligations
  - "Mature" policy narratives (human readable)
  - Annotated open software architectures
- License/security firewalls
  - Shims or middleware to mitigate rights propagation
- Automated modeling and analysis environment
  - *UCI ArchStudio4* + Traceability plug-in + xADL(REL)
  - (future) source code analyzers and meta-data extractors, automated annotators and compliance assurance, integrated repository, etc.



Point mouse cursor at tool for more detail.

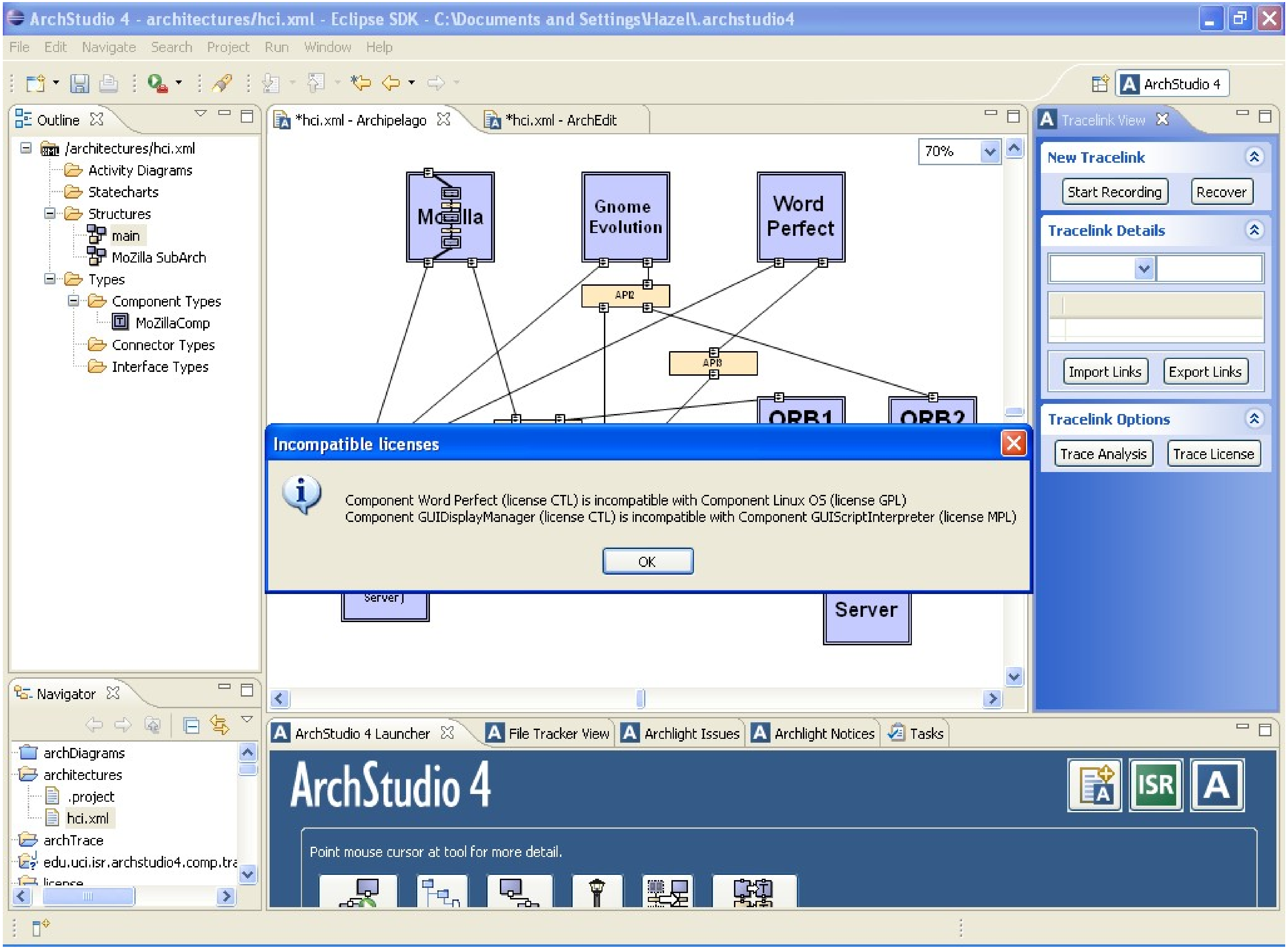


```
XArch
  ArchAnalysis
  ArchStructure [main]
    Component [Gnome Evolution]
      Description
      Interface [GnomeToCSH Interface]
      Interface [GnomeToLinuxInterface]
      License
        Licname
    Component [Linux OS]
    Component [Local Server (File Server, P
    Component [Mozilla]
    Component [ORB1]
    Component [ORB2]
    Component [Remote Server]
    Component [Word Perfect]
    Connector [API1]
    Connector [API2]
    Connector [API3]
    Connector [API4]
    Connector [CSH/Application Scripting]
    Connector [Network Protocol (TCP/IP, I
    Description
```

Licname: Description

Name	Value
value	GPL

```
archDiagrams
architectures
  .project
  hci.xml
archTrace
edu.uci.isr.archstudio4.comp.tracelink
license
```

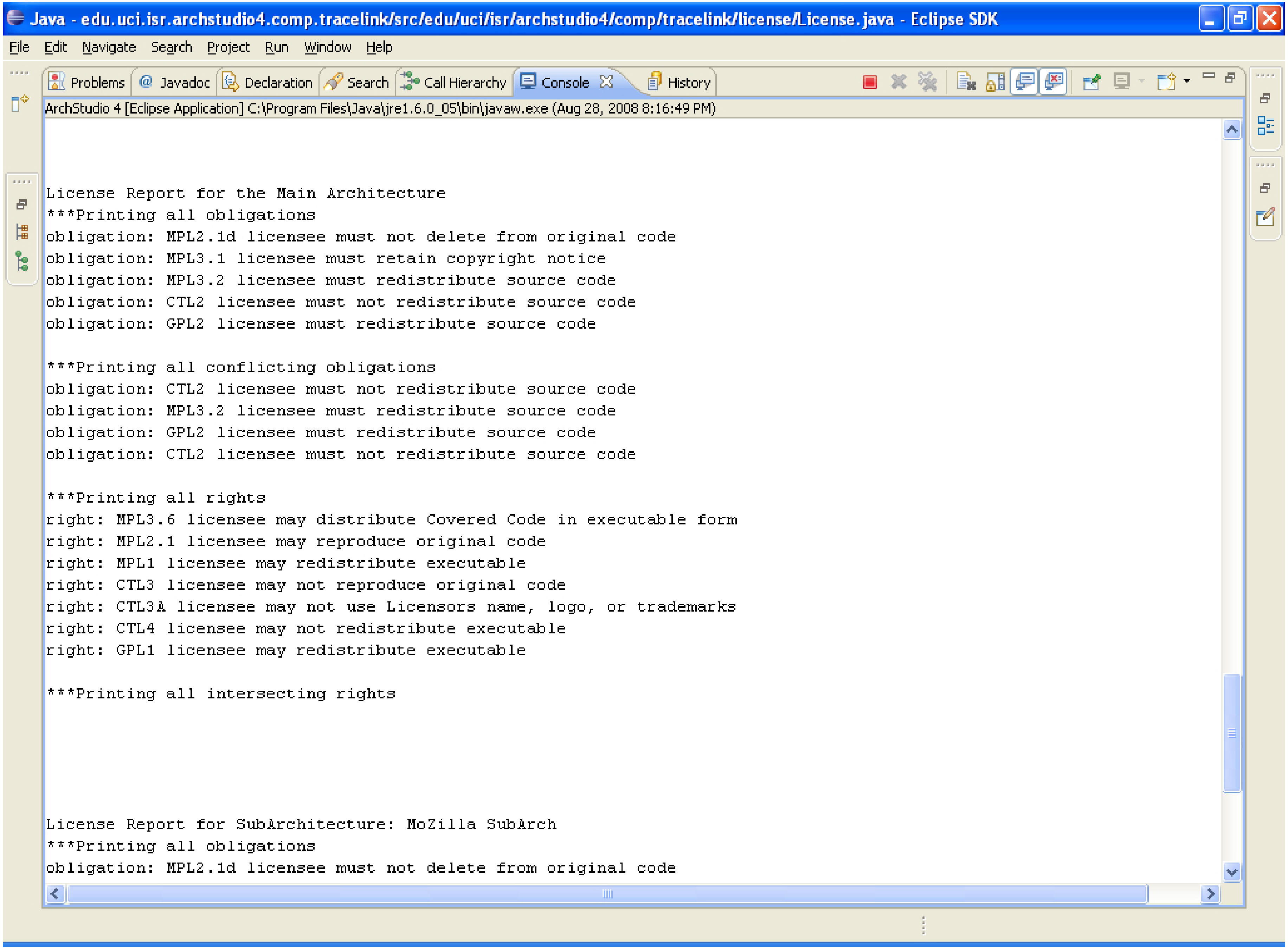


ArchStudio 4 - architectures/hci.xml - Eclipse SDK - C:\Documents and Settings\Hazel\.archstudio4

Incompatible licenses

Component Word Perfect (license CTL) is incompatible with Component Linux OS (license GPL)
Component GUIDisplayManager (license CTL) is incompatible with Component GUIScriptInterpreter (license MPL)

OK


Java - edu.uci.isr.archstudio4.comp.tracelink/src/edu/uci/isr/archstudio4/comp/tracelink/license/License.java - Eclipse SDK
File
Edit
Navigate
Search
Project
Run
Window
Help
Problems
Javadoc
Declaration
Search
Call Hierarchy
Console
History

ArchStudio 4 [Eclipse Application] C:\Program Files\Java\jre1.6.0_05\bin\javaw.exe (Aug 28, 2008 8:16:49 PM)

```



License Report for the Main Architecture
***Printing all obligations
obligation: MPL2.1d licensee must not delete from original code
obligation: MPL3.1 licensee must retain copyright notice
obligation: MPL3.2 licensee must redistribute source code
obligation: CTL2 licensee must not redistribute source code
obligation: GPL2 licensee must redistribute source code

***Printing all conflicting obligations
obligation: CTL2 licensee must not redistribute source code
obligation: MPL3.2 licensee must redistribute source code
obligation: GPL2 licensee must redistribute source code
obligation: CTL2 licensee must not redistribute source code

***Printing all rights
right: MPL3.6 licensee may distribute Covered Code in executable form
right: MPL2.1 licensee may reproduce original code
right: MPL1 licensee may redistribute executable
right: CTL3 licensee may not reproduce original code
right: CTL3A licensee may not use Licensors name, logo, or trademarks
right: CTL4 licensee may not redistribute executable
right: GPL1 licensee may redistribute executable

***Printing all intersecting rights





License Report for SubArchitecture: MoZilla SubArch
***Printing all obligations
obligation: MPL2.1d licensee must not delete from original code
```

Recent reports available

W. Scacchi, Free/Open Source Software Development: Recent Research Results and Emerging Opportunities, *Proc. European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering*, Dubrovnik, Croatia, 459-468, September 2007.

- http://doi.acm.org/10.1145/1287624.1287689

T. Alspaugh, H. Asuncion, W. Scacchi, Intellectual Property Requirements for Heterogeneously Licensed Systems, *Proc. 17th. Intern. Conf. Requirements Engineering (RE09)*, Atlanta, GA, 24-33, September 2009.

Also see http://www.ics.uci.edu/~wscacchi for other papers on FOSS research

Acknowledgements

- *Project collaborators*:
  - Mark Ackerman, UMichigan, Ann Arbor
  - Les Gasser, UIllinois, Urbana-Champaign
  - John Noll, LERO, Irish Software Engineering Research Center
  - Thomas Alspaugh, Hazel Asunction, Margaret Ellliot, Chris Jensen and others at the UCI ISR
- *Funding support*:
  - National Science Foundation: #0534771, #0749353, #0808783
  - Digital Industry Promotion (DIP) Agency, Global R&D Collaboration Center, Daegu, South Korea
  - Naval Postgraduate School: Acquisition Research Program
  - ***No endorsement implied***.