Accommodating Openness Requirements in Software Platforms

A Goal-Oriented Approach

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Background

Open Innovation: Software companies open up their platforms to 3rd party applications

Open Platforms: Platforms on top of which 3rd party applications can be built

Extension mechanisms allow sufficient access

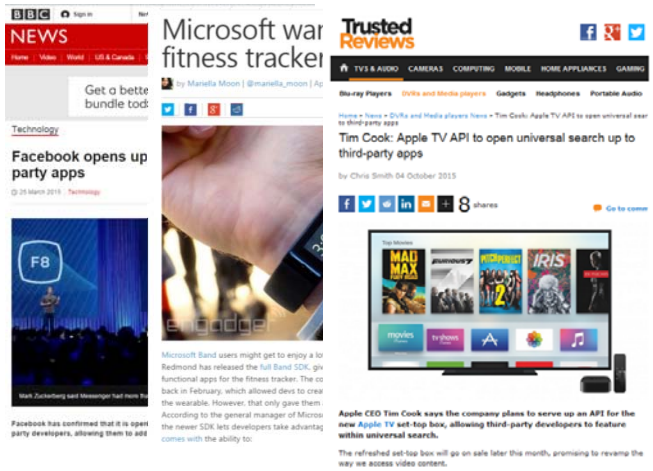
Boudreau, K. (2010). Open platform strategies and innovation: Granting access vs. devolving control. Management Science, 56(10), 1849-1872.

Fitzgerald, B. (2006). The transformation of open source software. MIS Quarterly, 587-598.

West, J. (2003). How open is open enough?: Melding proprietary and open source platform strategies. Research policy, 32(7), 1259-1285.

Example – Mobile Platforms

Other Examples of Open Platforms



Problem Statement - 1

Opening up software platforms is a difficult transition

Openness requirements pose serious risks to:

Security, Performance, Controllability

Boudreau, K. (2010). Open platform strategies and innovation: Granting access vs. devolving control. Management Science, 56(10), 1849-1872.

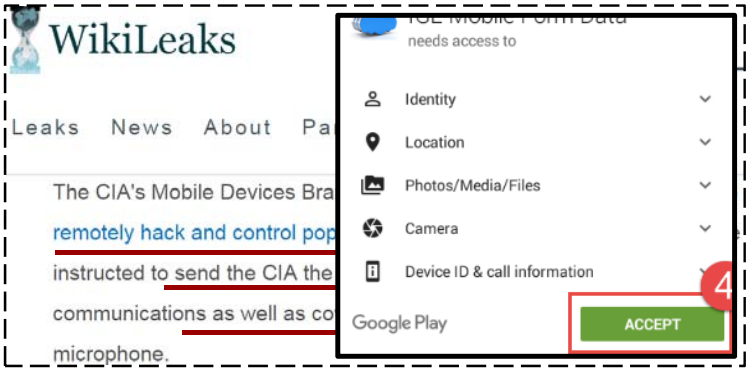
Scacchi, W., & Alspaugh, T. A. (2013). Processes in securing open architecture software systems. In Proceedings of International Conference on Software and System Process.

Baresi, L., Di Nitto, E., & Ghezzi, C. (2006). Toward open-world software: Issue and challenges. Computer, 39(10), 36-43.

West, J. (2003). How open is open enough?: Melding proprietary and open source plat-form strategies. Research policy, 32(7), 1259-1285.

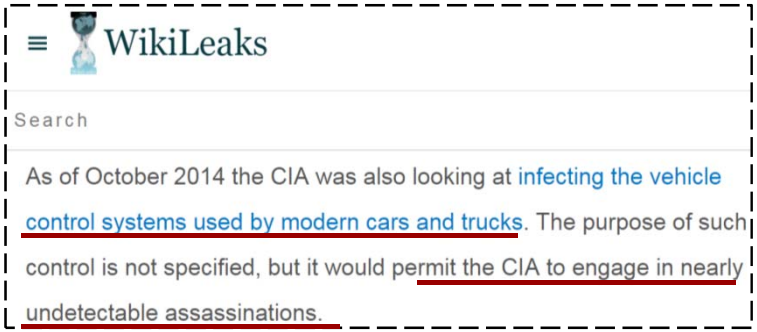
Example Problems in Open Platforms -1

WikiLeaks Press Release – March 7, 2017



Example Problems in Open Platforms -2

WikiLeaks Press Release – March 7, 2017



The Proposed Approach

- Treat openness as a distinct class of non-functional requirements
- Refine openness requirements in parallel with competing design concerns

Using a goal-oriented modeling approach

Sadi, M. H. & Yu, E. (2017).
Modeling and analyzing openness trade-offs in software platforms: a goal-oriented approach.
In **REFSQ 2017**.

Contributions of this Study

Extending the Non-Functional Requirements analysis framework with:

Openness Catalogues

Alternative paths for specifying and refining openness requirements

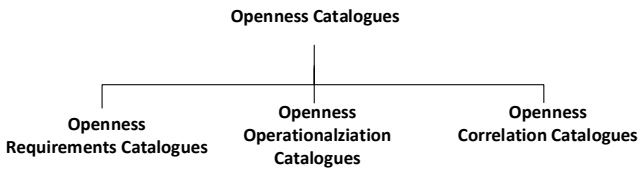
Chung, L., Nixon, B. A., Yu, E., & Mylopoulos, J. (2000). Non-functional requirements in software engineering. Springer Science & Business Media.

The Outline of the Rest of the Talk

1. Proposed Openness Catalogues

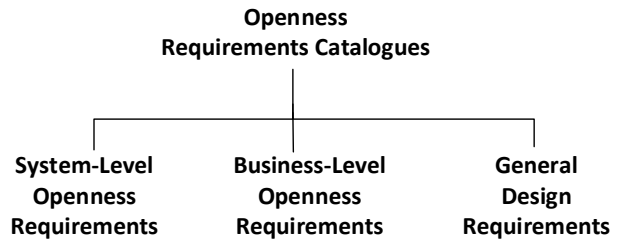
2. Using the Proposed Catalogues

Proposed Openness Catalogues



1. **Openness Requirements Specification and Refinement Catalogues**

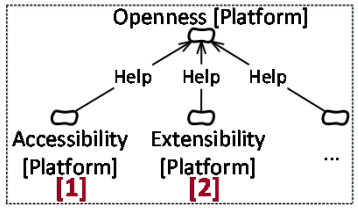
Openness Requirements Catalogues



Openness Catalogues

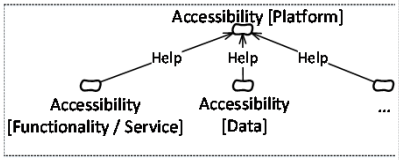
System-Level Openness Requirements

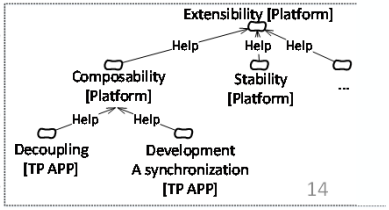
The technical and quality requirements for openness



[1] Anvaari, M., & Jansen, S. (2010). Evaluating architectural openness in mobile software platforms. In Proceedings of 4th ECSA: Companion Volume.

[2] Bosch, J., & Bosch-Sijtsema, P. (2010). From integration to composition: On the impact of software product lines, global development and ecosystems. JSS.



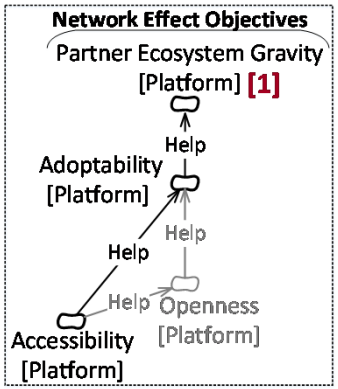


Openness Catalogues

Business-Level Openness Requirements

The non-technical requirements driving the need for openness

Their relation to system-level openness requirements



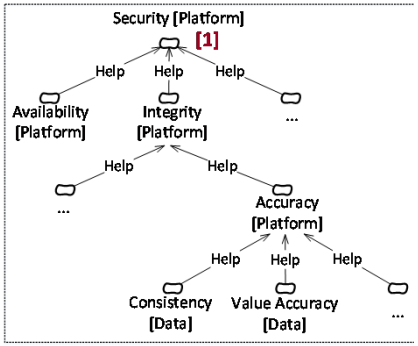
[1] Popp, K. M. (2010). Goals of Software Vendors for Partner Ecosystems–A Practitioner´s View. In Software Business (181-186).

Openness Catalogues

General Design Concerns

General concerns raised in opening up platforms

e.g. Security



[1] Chung, L., Nixon, B. A., Yu, E., & Mylopoulos, J. (2000). Non-functional requirements in software engineering. Springer Science & Business Media.

2. Openness Operationalization Catalogues

Openness Catalogues

Operationalization Catalogues

- The specific features and functionalities designed for openness
- Alternative mechanisms and patterns to design these functionalities

Openness Catalogues

Operationalization Catalogues – Example (1)

Design Objective:

To provide data service to third-party applications

Decisions about:

- How platform communicates data with 3rd party applications
- How 3rd party applications communicate data with each other

Openness Catalogues

Operationalization Catalogues – Example (2)

Design Objective: To provide data service 3rd party applications

Design 1: (CDP): Centralized Data Provision [1]

The platform controls ***all data and information*** interactions …

Design 2: (SDP): Semi-Centralized Data Provision [2]

3rd party applications can communicate data ***directly in some cases***…

Design 3: (DDP): Decentralized Data Provision [3]

3rd party applications can ***directly exchange data*** …

[1] Eklund, U., & Bosch, J. (2014). Architecture for embedded open software ecosystems. JSS.

[2] Shabtai, A., Fledel, Y., Kanonov, U., Elovici, Y., Dolev, S., & Glezer, C. (2010). Google android: A comprehensive security assessment. IEEE Security & Privacy.

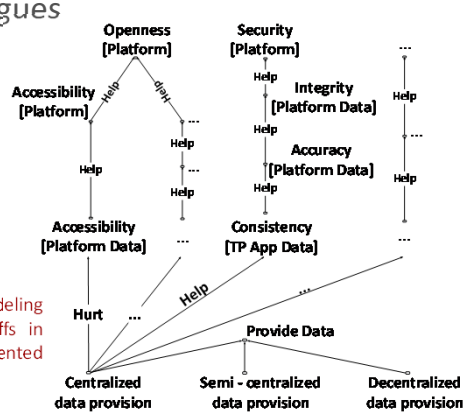
[3] Scacchi, W. (2007). Free/open source software development: Recent research results and methods. Advances in Computers.

3. Openness Correlation Catalogues

Openness Catalogues

Correlation Catalogues

Reasoning about the impact of design alternatives on the requirements



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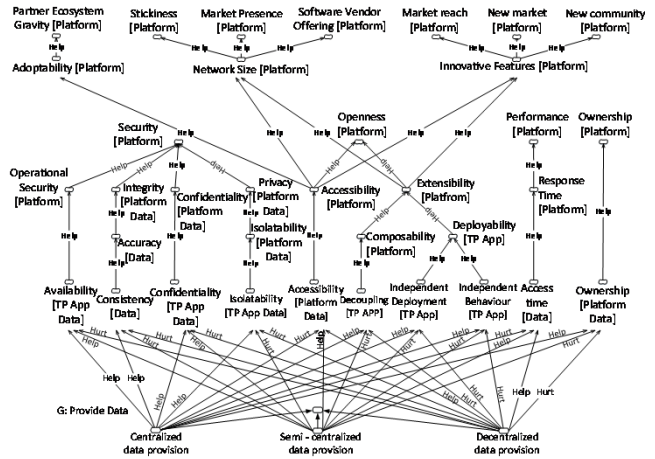
Openness Correlation Catalogues



The Outline of the Rest of the Talk

1. Proposed Openness Catalogues

2. Using the Proposed Approach

Applying the Proposed Approach

- An open mobile platform
- An open automotive platform

The Case Under Study

An Open Embedded Mobile Platform

An Operating system for mobile platforms

> **Functionalities**: Controlling the operations of smartphone devices

Open to a wide variety of 3rd party applications

Objective: Revisiting the Data Provision Service Using the Proposed Approach

An Open Embedded Mobile Platform

Openness Design Requirements

Design Requirement	Text Description
…	…
"Low Entry Barriers" Priority: "**High**"	"***Entry barriers of*** *both monetary and* ***technical nature****,* including entry barriers for application market, development resource needs and programing languages, will be ***a significant factor*** for developers in selecting which mobile platform to join."

Koch, S., & Kerschbaum, M. (2014). Joining a smartphone ecosystem: Application developers' motivations and decision criteria. Information and Software Technology, 56(11).

An Open Embedded Mobile Platform

Other Design Requirements

Design Requirement	Text Description
*****Privacy [data] | Priority: Medium**	**Privacy** of 3rd party application **data**
…	….

Open Embedded Mobile Platform

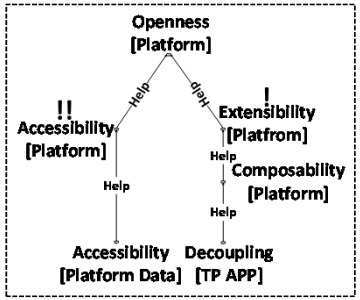
Using the Proposed Catalogues

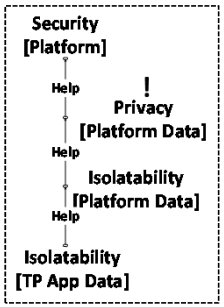
- To refine the design requirements
- To analyze alternative design mechanisms
- To identify an appropriate design mechanism

An Open embedded Mobile Platform

Refining Design Requirements - Example

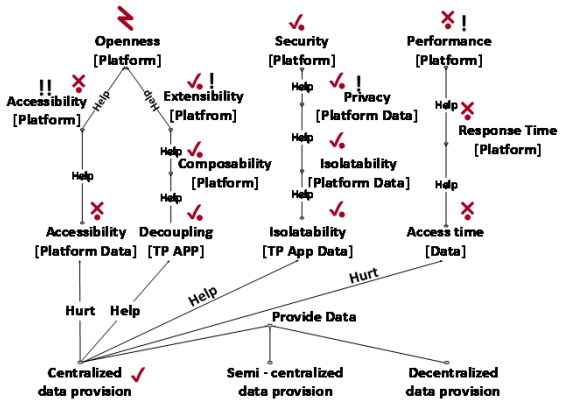
"Low Entry Barriers" Priority: "**High**"	"***Entry barriers of*** *monetary and* ***technical nature****..."*





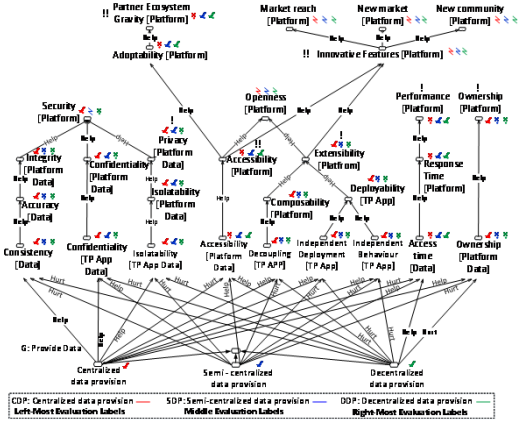
Open Mobile Software Platform

Analyzing Alternative Design Mechanisms



Open Mobile Software Platform

Analyzing Alternative Design Mechanisms



An Open Mobile Software Platform

The Most Appropriate Design Mechanism

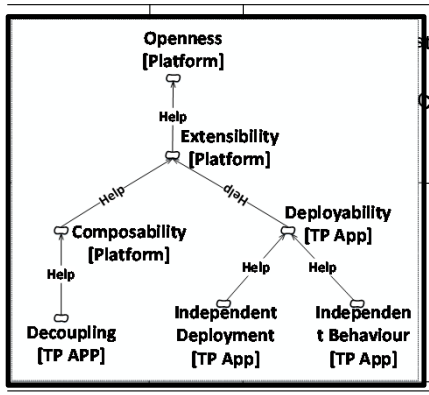
Requirements	Security	Openness: System-Level			Performance
	*Privacy	Accessibility	*Composability	…	*Response Time
Priority	*Medium	High	*Medium		*High
CDP	PSat	PDen	PSat	…	PDen
SDP	PSat	PSat	PDen		PSat
DDP	PDen	PSat	PDen		PSat

Semi-Centralized data provision is the best design mechanism

PDen: Partially Denied PSat: Partially Satisficed

An Open Mobile Software Platform

Deciding about the design mechanism



tem-Level		Performance
Composability	…	*Response Time
*Medium		*High
PDen		PSat

Summary - 1

Objective:

To provide a systematic treatment for dealing with openness requirements

Proposed Solution:

1. Consider openness as a distinct class of non-functional requirements

2. Refine it in parallel with other design concerns

   Openness catalogues that facilitate reasoning about openness requirements

Summary - 2

The benefit of the proposed approach:

To detect potential conflicts

Between openness and other critical requirements

To help identify openness design mechanisms

That balance the fulfillment of openness requirements against other critical requirements

Future Work

1. To extend the content of the proposed catalogues
2. To assess the effectiveness of the proposed approach in case studies of open platform projects

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