

Connect data across apps for traceability using only add-ons

INCOSE IW 2024

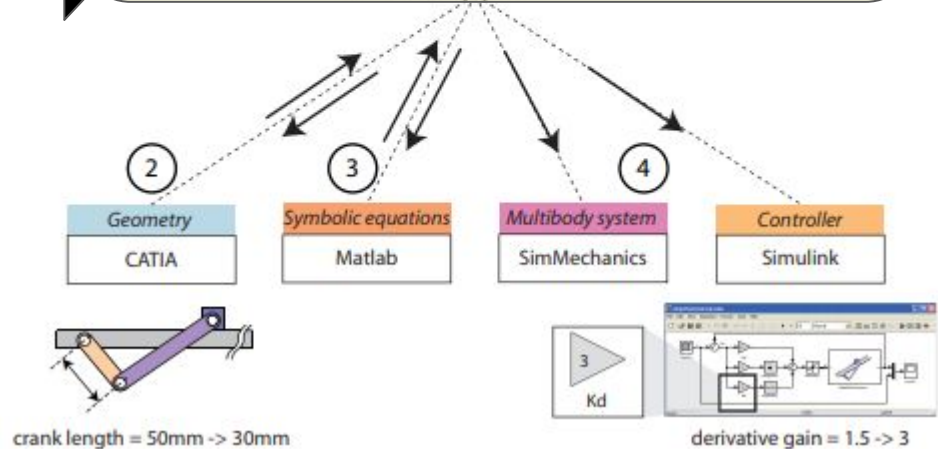
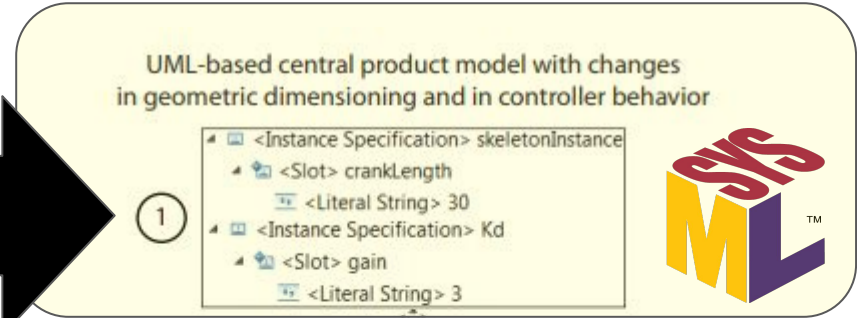
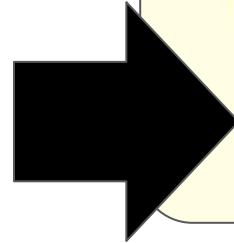
From 2005 to 2012: Focus on using data standards

PhD and postdoc focused on tradeoff studies

Reconfiguring architecture model to then automatically sync detailed discipline-specific models

Applying rule-based design in engineering

Centralized Link Creation Strategy



From 2012 to 2022: Focus on using API standards

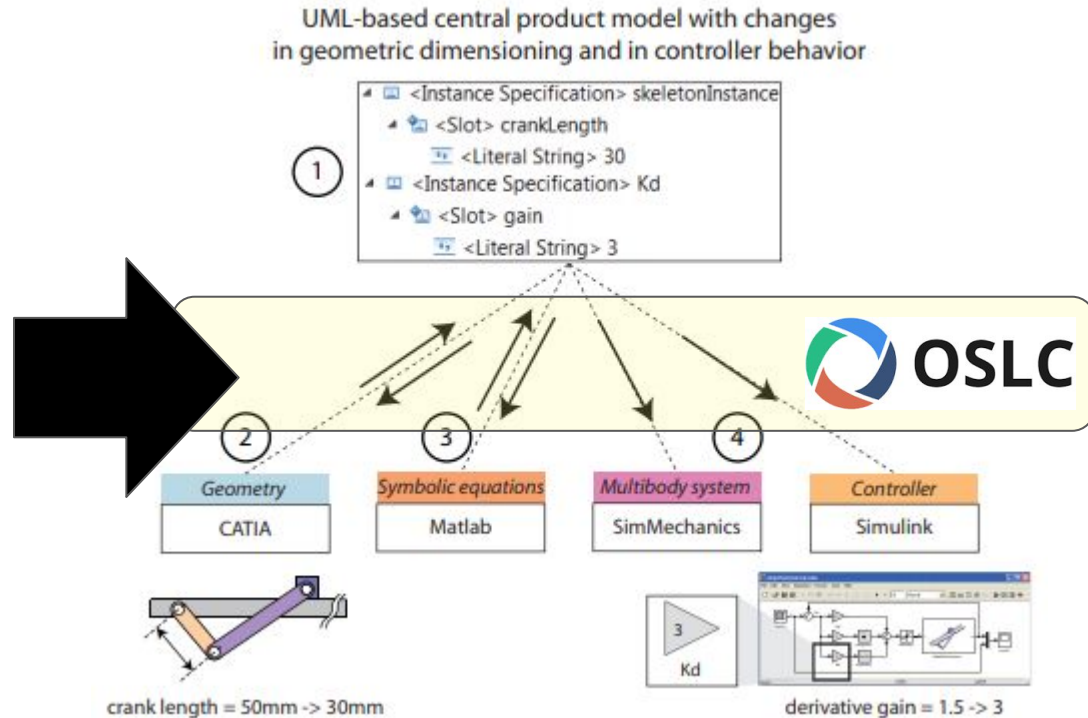
Using Web APIs

Using widely adopted open standards like HTTP, URLs, and RDF

Data integration inspired by the World Wide Web

Distributed Link Creation Strategy

Koneksys



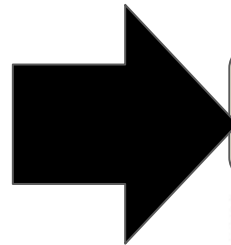
From 2023: Focus on in-app link creation

Inspired by OSLC

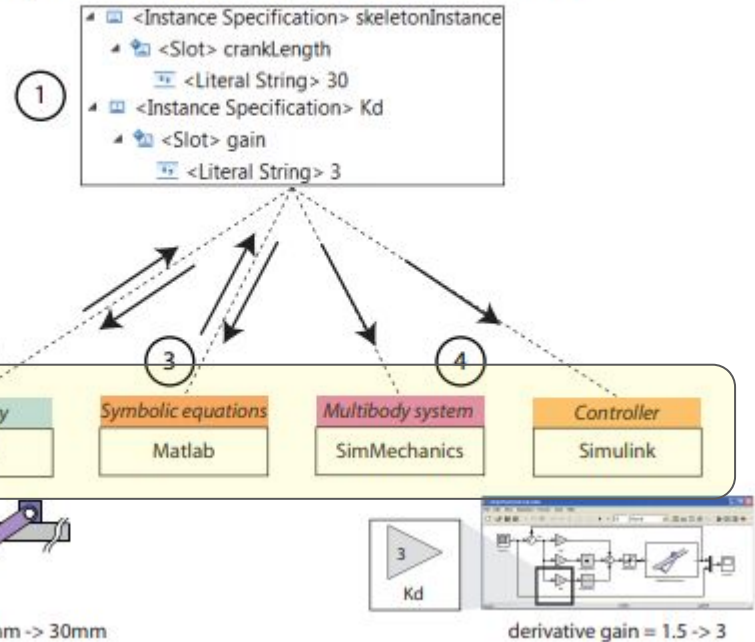
Taking advantage of the common interface of Web applications (HTML and REST API)

Creating lightweight Web browser extensions for traceability

TraceLynx




UML-based central product model with changes in geometric dimensioning and in controller behavior



Koneksys

Main Milestones

- 
- 2012
- US company created to offer **consulting services to integrate engineering data**
 - First consulting projects related to OSLC
 - Participated in several **R&D projects** for large aerospace companies as OSLC experts
- 2017
- Integrated **3rd party apps with IBM ELM using OSLC**
 - Developed first open-source OSLC API SDK in Python named **PyOSLC**
 - Created our own OSLC API software factory named **Koatl**
 - Developed first cross-application link editor application as **Web browser extension**
- 2024
- Development of **TraceLynx**: new in-app **link management software**

Koneksys Consulting Clients

- Engineering organizations
- Software vendors
- Research organizations
- Universities
- Standards organizations



AIRBUS

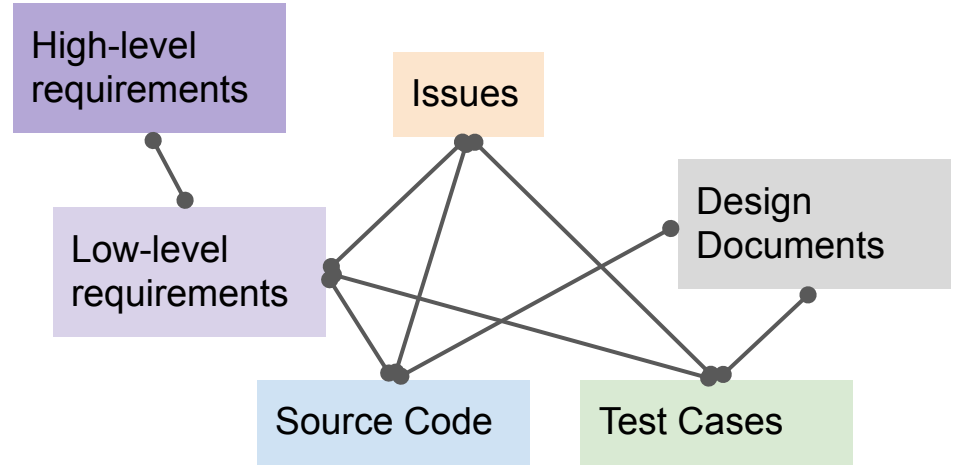


NIST



Use Case to Connect Data: Traceability

Traceability Required for Safety



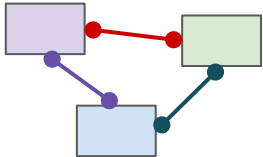
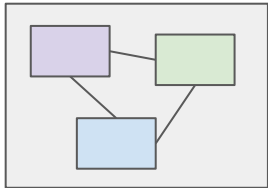
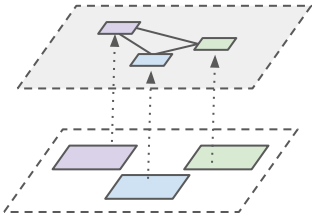
Problem

Engineers cannot easily create traceability links (too much manual copy/paste of data and identifiers across engineering software applications)

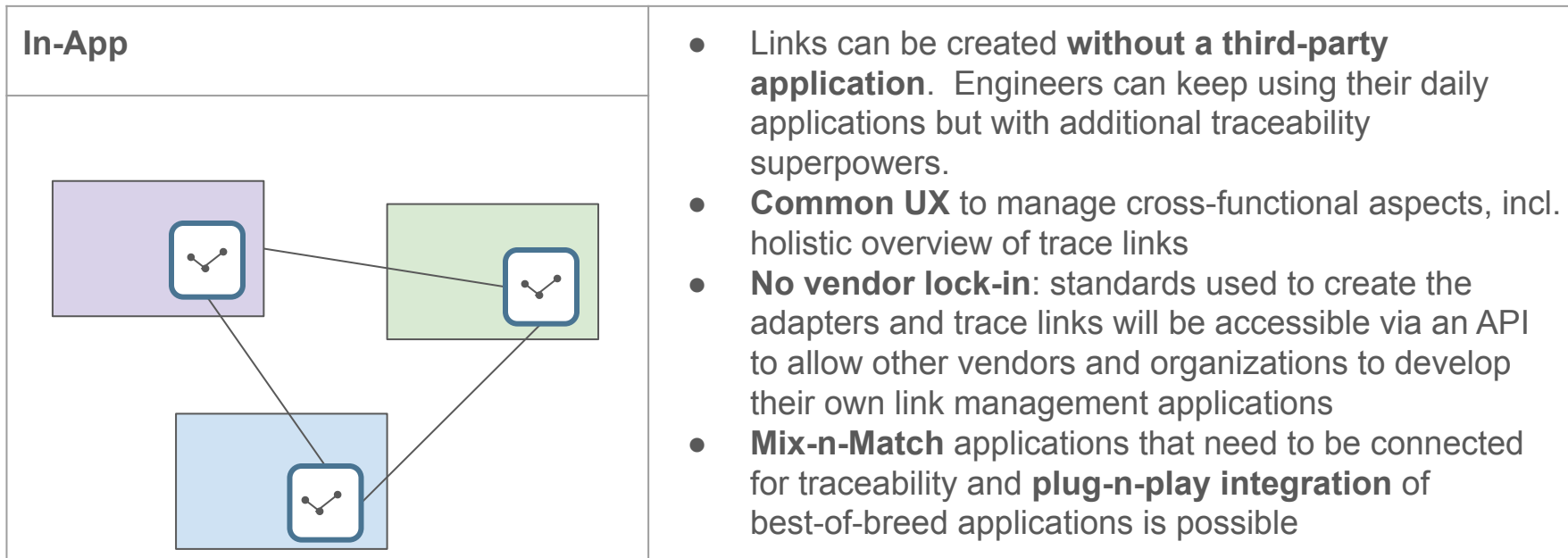
Lack of traceability leads to more design errors, less safety, more costs to fix issues, more production delays, and in the worst case loss of life

Approaches to Connect Data

Existing Traceability Approaches

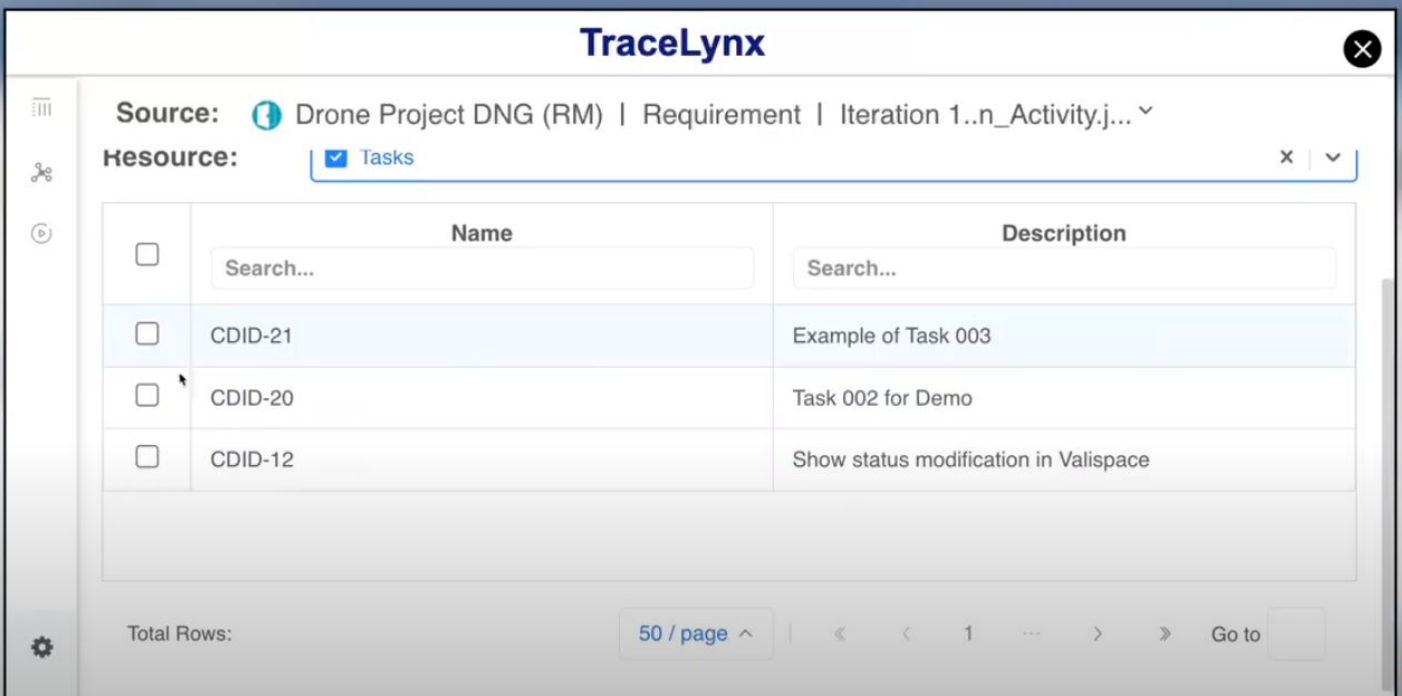
Point-to-point	 A diagram showing three colored squares (purple, green, blue) connected by individual, non-overlapping lines of different colors (red, purple, teal). This represents separate, non-integrated integrations between different applications.	<ul style="list-style-type: none">• Cannot scale• Each point-to-point integration is unique (different UX)• no holistic overview of trace links
All-in-one	 A diagram showing three colored squares (purple, green, blue) connected by lines, all contained within a single larger grey rectangular box. This represents a single application attempting to manage all traceability.	<ul style="list-style-type: none">• No one size fits all (e.g. UX of ALM, PLM, MBSE, and simulation apps are very different, and have never successfully been integrated into a single app)• Vendor lock-in often prevents extensibility
3rd party	 A diagram showing two layers of three colored squares (purple, green, blue). The top layer is enclosed in a dashed box. Dotted lines connect the squares between the two layers, representing a third-party application acting as a bridge between different systems.	<ul style="list-style-type: none">• Loss of context: only a subset of app data is copied into 3rd party app• Bad UX: Engineers need to switch to 3rd party app to create trace links

Solution: In-App Traceability Solution



Quick Demo

Linking Requirement to Task

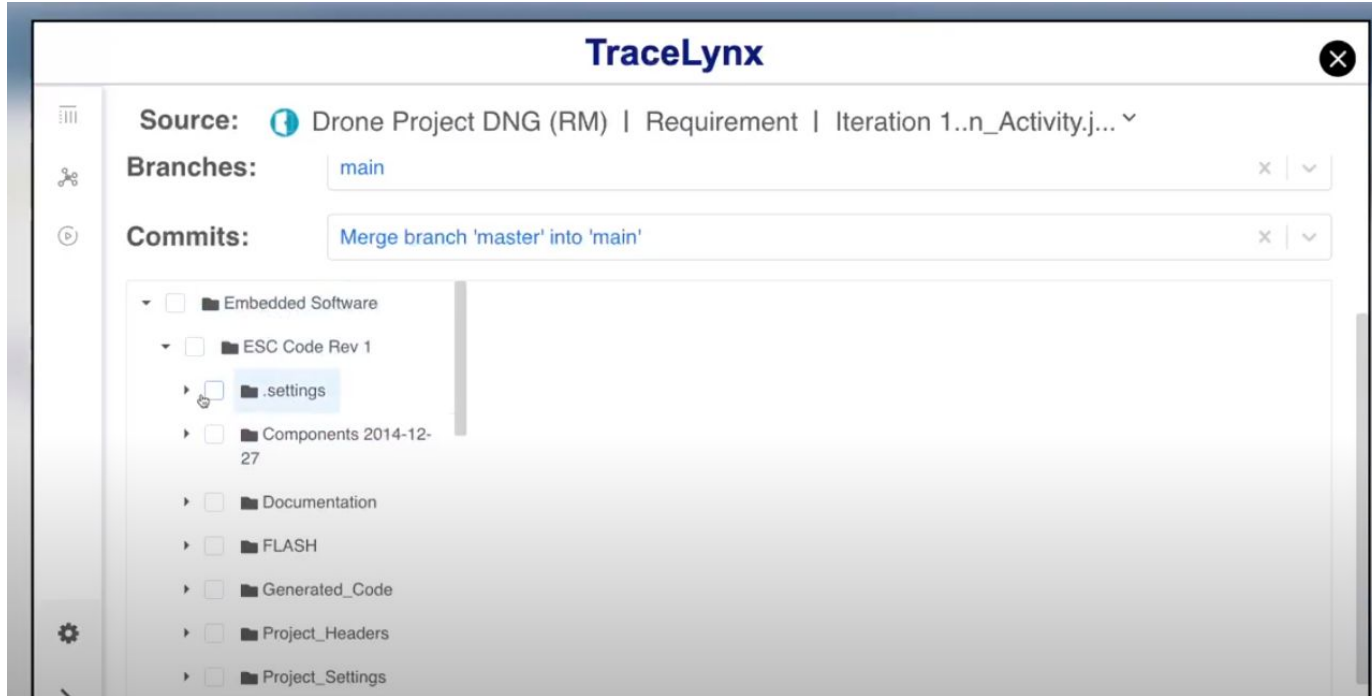


The screenshot displays the TraceLynx application interface. At the top, the title bar reads "TraceLynx" with a close button. Below the title bar, the "Source" is set to "Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j...". The "Resource" is set to "Tasks" with a dropdown menu. A table lists tasks with columns for "Name" and "Description". Each row has a checkbox in the first column. The table contains three rows of data. At the bottom, there is a pagination bar showing "Total Rows:" and "50 / page" with navigation buttons.

	Name	Description
<input type="checkbox"/>	Search...	Search...
<input type="checkbox"/>	CDID-21	Example of Task 003
<input type="checkbox"/>	CDID-20	Task 002 for Demo
<input type="checkbox"/>	CDID-12	Show status modification in Valispace

Total Rows: 50 / page

Linking Requirement to Block of Code



How It Works



← | ... > images > | 67629 Iteration 1..n_Activity.jpeg ?

Download for viewing Download and lock for editing Upload a new version



Lightweight
context-specific UI
extension provided
by Web browser
extension

Overview



67629: Iteration
1..n_Activity.jpeg

No Tags Defined

Description: CLM for IT agility@scale(tm)
solution

Project: Drone Project DNG (RM)

Team Ownership: Drone Project DNG (RM)

Created On: Sep 28, 2023, 2:28:12 PM

Created By: koneksys

Modified On: Sep 28, 2023, 2:28:12 PM

Modified By: koneksys

Is Suspect:

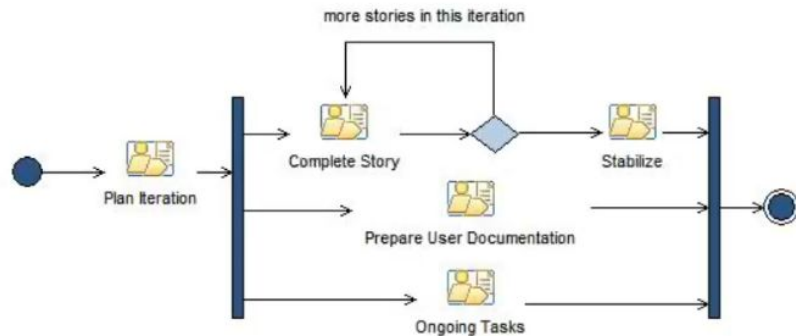
Type: Supporting Resource

Format: File

Comments

Links

Where Used

[←](#) | ... > images > | 67629 Iteration 1..n_Activity.jpeg ?[Download for viewing](#) [Download and lock for editing](#) [Upload a new version](#)

On mouse hover, UI extension becomes more visible

Overview

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Description: CLM for IT agility@scale(tm) solution

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Modified On: Sep 28, 2023, 2:28:12 PM

Modified By: koneksys

Is Suspect:

Type: Supporting Resource

Format: File

Comments

Links

Where Used

⚠ Your ALM license will expire in 17 days

Battery presence sensor

Details

Required Editable All

^ Default

Parent
EPS Hardware requirementsTracker
Hardware Safety RequirementsBusiness
Must haveStatus
DRAFTUpstream Reference
ChargerType
Functional

Risk

Complexity

Reached Coverage

Release

Submitted by
bondSubmitted at
Sep 28 2023 14:22

Lightweight
context-specific UI
extension provided
by Web browser
extension

✓ Drone Project requirements > Hardware Safety Requirements > #1869 Battery presence sensor > HEAD/v1

⚠ Your ALM license will expire in 17 days

Battery presence sensor

Details



Required Editable [All](#)

Default

Parent

EPS Hardware requirements



Tracker

Hardware Safety Requirements



Business Value

Mus



Status

DRAFT



Upstream Reference

Charger



Type
Function



Risk



Complexity

-



Reached

-



Release



Submitted by

bond



Submitted at
Sep 28 2023 14:22



On mouse hover, UI extension becomes more visible

Cross-Domain Integra...
Software project

PLANNING

Timeline

Backlog

Board

DEVELOPMENT

Code

Project pages

Add shortcut

Project settings

You're in a team-managed project

Learn more

Projects / Cross-Domain Integra... / CDID-3 / CDID-21

Example of Task 003

Attach Add a child issue Link issue Add Tempo to plan and track time

Description

Add a description...

Child issues

CDID-34 Example of SubTask 001

Activity

Show: All Comments History Worklogs

Add a comment...

Pro tip: press M to comment

On mouse hover, UI extension becomes more visible

To Do Actions

Details

Assignee

Unassigned

Assign to me

Labels

None

Sprint

None

Story point estimate

None

Quick start development

Link this issue to your code by including issue keys when creating a branch, commit, or pull request below. Learn more

Dismiss

Create branch

Create commit

Add deployment

Add feature flag




Reporter




Mario Jiménez Carrasco

Created December 1, 2022 at 11:13 AM

Updated December 1, 2022 at 11:13 AM

Configure

Search or go to...

Project

Drone Project

Pinned

Issues0

Merge requests0

Manage

Plan

Code

Merge requests0

Repository

Branches

Commits

Tags

Repository graph

Compare revisions

Snippets

Build

Secure

Deploy


Operate

Monitor

Analyze

Settings

Koneksys > Cross-Domain Integration Demo > Drone Project > Repository

 **Initial Commit**
Nathan Zimmerman authored 7 years ago

53547e35

main drone-project / Embedded Software / ESC Code Rev 1 / Documentation / +

History Find file Edit Clone

Name	Last commit	Last update
...		
doxygen	Initial Commit	7 years ago
ESC_Code.txt	Initial Commit	7 years ago
ESC_Code_SIGNALS.txt	Initial Commit	7 years ago
ESC_Code_Settings.previous.xml	Initial Commit	7 years ago
ESC_Code_Settings.xml	Initial Commit	7 years ago
cdc.inf	Initial Commit	7 years ago
cdc.inf_readme.txt	Initial Commit	7 years ago

On mouse hover, UI extension becomes more visible

TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Search...

Search

Create Link



☐ > Link Type

Resource Type

Target

Status

Actions

Search...

Search...

Search...

Search ▾

☐ > issueCompliedByFile

ESC_Code.txt [51-54]



Context-specific
dialog for a specific
artifact → display of
artifact title

Total Rows: 1

10 / page ^



1



TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Search...

Search

Create Link



☐ > Link Type

Resource Type

Target

Status

Actions

Search...

Search...

Search...

Search ▾

☐ > issueCompliedByFile

[ESC_Code.txt \[51-54\]](#)



Context-specific
dialog for a
specific artifact →
display of existing
links for that
artifact

Total Rows: 1

10 / page ^



1



TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Search...

Search

Create Link



☐ > Link Type

Resource Type

Target

Status

Actions

Search...

Search...

Search...

Search ▾

☐ > issueCompliedByFile

ESC_Co... [51-54]



Context-specific
dialog for a
specific artifact →
display of create
link button
whereby artifact
would be link
source

Total Rows: 1

10 / page ^



1



TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Link:

tr|

trackedBy

constrains

constrainedBy

Creation of link →
selection of link
type

Cancel

OK

TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Link:

trackedBy



Target:

Jira



cross



Cross-Domain Integration

Cross-Domain Integration Demo

Creation of link →
selection of link
target application
and project

Cancel

OK

TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Link:

trackedBy



Target:



Jira



Cross-Domain Integration Demo



Resource:

Choose resource type



Tasks



Epics



User Stories



Bugs



Improvements



New Features

Creation of link →
selection of link
target artifact type

Cancel

OK

TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

	Name	Description
	<input type="text" value="Search..."/>	<input type="text" value="Search..."/>
<input checked="" type="checkbox"/>	CDID-21	Example of Task 003
<input type="checkbox"/>	CDID-20	Task 002 for Demo
<input type="checkbox"/>	CDID-12	Show status modification in Valispace

Total Rows:

1 ... > >> Go to

Creation of link →
selection of link
target

Cancel

OK

TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Search...

Search

Create Link



<input type="checkbox"/> > Link Type	Resource Type	Target	Status	Actions
<input type="text" value="Search..."/>	<input type="text" value="Search..."/>	<input type="text" value="Search..."/>	<input type="text" value="Search"/> ▾	
<input type="checkbox"/> > issueCompliedByFile		ESC_Code.txt [51-54]		
<input type="checkbox"/> trackedBy		CDID-21....		

Creation of link →
created link
appears in list of
links

Link successfully created

Total Rows: 2

10 / page ^



1



TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration 1..n_Activity.j... ▾

Search...

Search

Create Link



<input type="checkbox"/> > Link Type	Resource Type	Target	Status	Actions
Search...	Search...	Search...	Search ▾	
<input type="checkbox"/> > issueCompliedByFile		ESC_Code.txt [51-54]	✓	⋮
<input type="checkbox"/> trackedBy		CDID-21....	✓	⋮

Link status
changes if a linked
artifact has been
modified

Total Rows: 2

10 / page ^



1



TraceLynx



Source: Drone Project DNG (Rim) | Requirement | Iteration | ..._Activity.j...

Search...

Search

Create Link



☐ > Link Type

Resource Type

Target

Status

Actions

Search...

Search...

Search...

Search ▾

☐ > issueCompliedByFile

ESC_Code.txt [51-54]



CDID-21....



CDID-21

Overview

Description

Example of Task 003

Status

Valid

Details



Project

Cross-Domain Integration Demo

Label

UI preview on
mouse hover over
link target



1



TraceLynx



Source: Drone Project DNG (RM) | Requirement | Iteration | ... | Activity.j...

Search...

Search

Create Link



☐ > Link Type

Resource Type

Target

Status

Actions

Search...

Search...

Search...

Search ▾

☐ > issueCompliedByFile

ESC_Code.txt [51-54]



CDID-21....



Click to open link in web application.



CDID-21

Overview

Description

Example of Task 003

Status

Valid

Details



Project

Cross-Domain Integration Demo

Click on link target title in UI preview to navigate to link target



1



67629: Iteration 1.n_Activity

[CDID-21] Example of Task 003

+

koneksys.atlassian.net/browse/CDID-21

Search

Jira Software

Your work

Projects

Filters

Dashboards

Apps

Create

Cross-Domain Integra...

Software project

PLANNING

Timeline

Backlog

Board

DEVELOPMENT

Code

Project pages

Add shortcut

Project settings

Projects / Cross-Domain Integra... / CDID-34 / CDID-21

Example of Task 003

Attach

Add a child issue

Link issue

Add Tempo to plan and track time

Description

Add a description...

Child issues

CDID-34 Example of SubTask 001

Activity

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Add a comment...

Pro tip: press **M** to comment

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Sprint

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Story point estimate

None

Quick start development

Link this issue to your code by including issue keys when creating a branch, commit, or pull request below. [Learn more](#)

Dismiss

Development

Create branch

Create commit

Releases

Add deployment

Add feature flag

Reporter

Mario Jiménez Carrasco

Created December 1, 2022 at 11:13 AM

Updated December 1, 2022 at 11:13 AM

Configure

Land on link target in target application in separate browser tab

TraceLynx

Source: Projects | Task | CDID-21

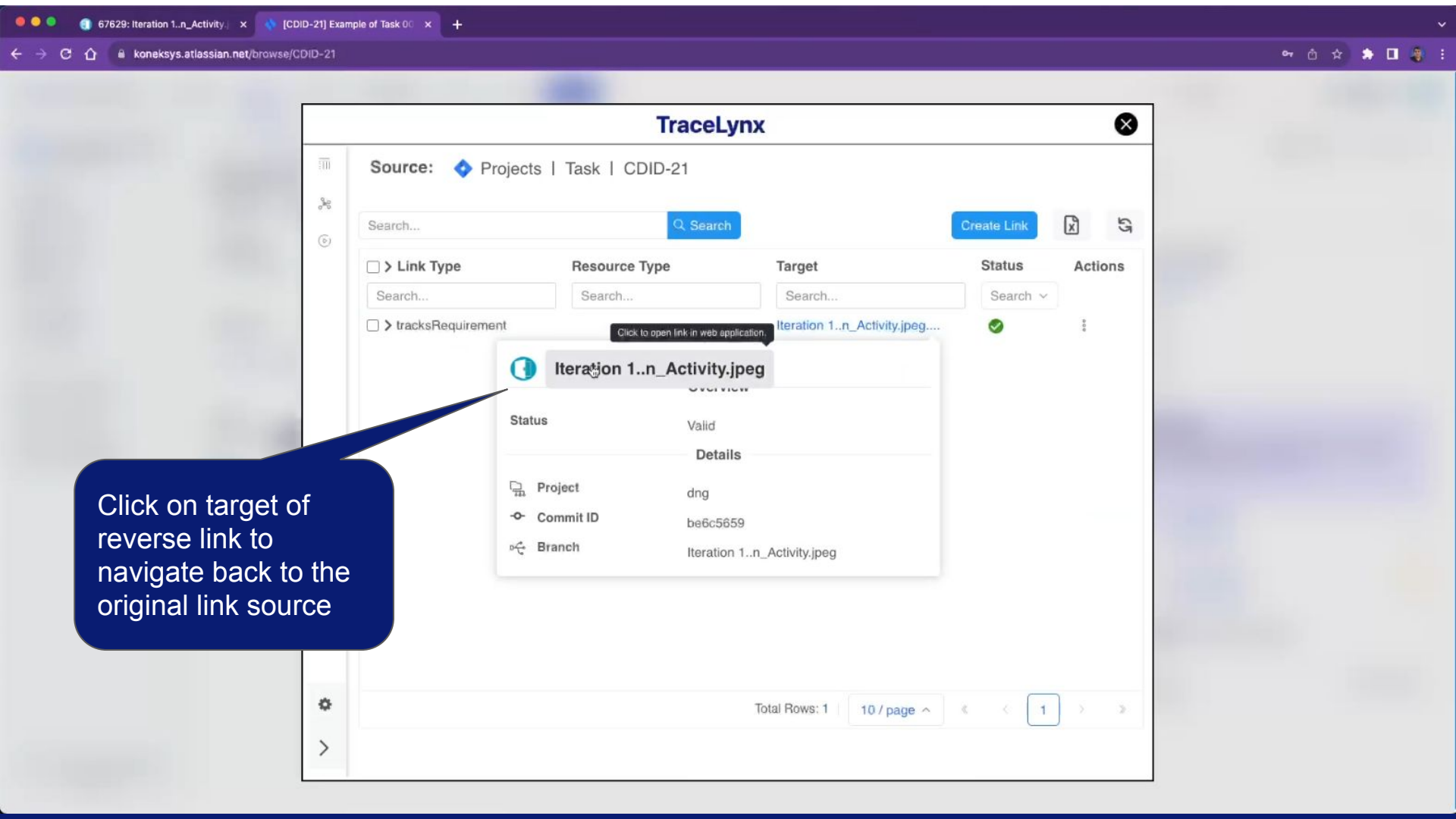
<input type="checkbox"/> > Link Type	Resource Type	Target	Status	Actions
<input type="text" value="Search..."/>	<input type="text" value="Search..."/>	<input type="text" value="Search..."/>	<input type="text" value="Search"/>	
<input type="checkbox"/> > tracksRequirement		Iteration 1..n_Activity.jpeg...	✓	...

Total Rows: 1

10 / page ^

< < 1 > >

TraceLynx dialog of link target has reverse link to previous link source



TraceLynx

Source: Projects | Task | CDID-21

Search...

Search

Create Link

Document icon

Refresh icon

Link Type

Resource Type

Target

Status

Actions

Search...

Search...

Search...

Search

tracksRequirement

Click to open link in web application.

Iteration 1..n_Activity.jpeg...

✓

⋮



Iteration 1..n_Activity.jpeg

Overview

Status

Valid

Details



Project

dng



Commit ID

be6c5659



Branch

Iteration 1..n_Activity.jpeg

Click on target of reverse link to navigate back to the original link source

Total Rows: 1

10 / page

1

67629: Iteration 1..n_Activity

[CDID-21] Example of Task 00

67629: Iteration 1..n_Activity

Not Secure

#action=com.ibm.rdm.web.pages.showArtifact&artifactURI=https%3A%2F%2F192.241.220.34%3A9443%2Frm%2Fresources%2F_e_Mb0V49Ee6ljuBNxNUoBw&vvc.conf...

Requirements Management (/rm)

Drone Project DNG (RM)

Drone Project DNG (RM) Initial Stream | koneksys

Project Dashboard | Artifacts | Reviews | Reports

Search Artifacts

67629 Iteration 1..n_Activity.jpeg

Download for viewing | Download and lock for editing | Upload a new version

```
graph LR; Start(( )) --> PlanIteration[Plan Iteration]; PlanIteration --> Fork1[ ]; Fork1 --> CompleteStory[Complete Story]; CompleteStory -- "more stories in this iteration" --> Fork1; Fork1 --> PrepDoc[Prepare User Documentation]; Fork1 --> OngoingTasks[Ongoing Tasks]; CompleteStory --> Join1[ ]; PrepDoc --> Join1; OngoingTasks --> Join1; Join1 --> Stabilize[Stabilize]; Stabilize --> End((( )));
```

Overview

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Project: Drone Project DNG (RM)

Team Ownership: Drone Project DNG (RM)

Created On: Sep 28, 2023, 2:28:12 PM

Created By: koneksys

Modified On: Sep 28, 2023, 2:28:12 PM

Modified By: koneksys

Is Suspect:

Type: Supporting Resource

Format: File

Comments

Links

Where Used

3rd browser tab shows same artifact as in the first browser tab (original link source)

IBM.

jazz

A Few Link Management Apps

TraceLynx



Link Editor

Graph View

Pipelines

Graph view of
created links









DWA-17

affectedByDefect



The propellant volume mass should be less than 65.00 liters



-  Users
-  Integrations
-  Projects
-  Link Rules
-  Events
-  Pipelines

[Add New](#)

ID	Script	Event	Action
18	update_valispace_status.py	Jira event	 

Total Rows: 1

10 / page ^



1



Configuration
of event-based
pipelines



Search...



Started	Duration (s)	Event	Organization	Status	Action
10/10/2023, 12:1...	5.31	Jira event	Koneksys	✓	
10/10/2023, 12:1...	1.118	Jira event	Koneksys	✓	
10/10/2023, 12:1...	4.421	Jira event	Koneksys	✓	

Total Rows: 3

5 / page ^



1



Results of pipeline execution visible inside the native applications within the TraceLynx dialog

- Users
- Integrations
- Projects
- Link Types
- Link Constraint
- Events
- Pipelines
- Migration

Source

- ☒ Valispace
- Training Workspace
- Valicopter_5000
- ☒ Requirements

Direction

Choose direction

Target

- ☒ Jira
- ADAM
- ☐ Create New Project
- ☒ Tasks

Cancel

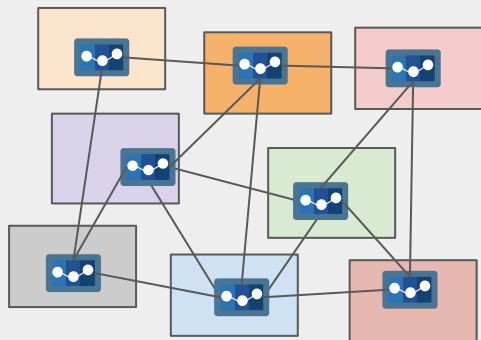
Submit

Shallow syncing configuration

Architecture

Architecture

TraceLynx Adapters



Reference implementation will be released as open-source

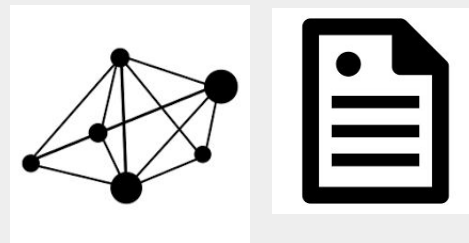
TraceLynx Link Repository

Persistence of links as well as their metadata, events, and pipelines



Open API allowing others to create apps to manage links

Link Management Apps



Apps can be created by other vendors or organizations

Adapters

Current Adapters:

- CodeBeamer
- GitLab
- Glide SysLM
- IBM DOORS NG
- JIRA
- Valispace
- Bitbucket
- Github
- ServiceNow

Recycling old OSLC adapters into TraceLynx adapters :

- Modelon Impact
- TestRail

Potential future adapters on our roadmap

- Excel 365
- SAP ERP
- PTC Windchill

Inspired by OSLC

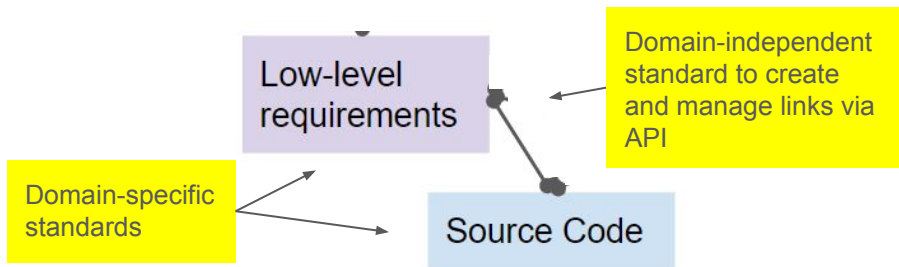
Commonalities And Differences with OSLC

In Common with OSLC

- Usage of Web standards to identify linked artifacts (e.g. HTTP URLs)
- Link description is agnostic to the description of the linked artifacts
- **Standardized API to create and manage links**

Differences with OSLC

- No usage of RDF as API request payload format



Next Steps

Capturing versions of links and versions of linked artifacts

Conducting discovery calls with potential customers

- Which use cases?
- Which pain points?
- Which adapters?
- Which link management applications?

Discovering early adopters

Please contact me if you want to share your perspective!

Thanks and get in touch!
axel.reichwein@tracelynx.com