Handling neuroscientific data with GIN

Present and Future

Michael Sonntag
sonntag@bio.lmu.de

German Neuroinformatics Node
Department Biology II
Ludwig-Maximilians-Universität München

Slides
https://gin.g-node.org/G-Node/PublicResources

LUDWIG-
MAXIMILIANS-
UNIVERSITÄT
MÜNCHEN

LMU

G-Node German Neuroinf

A brief introduction to the G-Node

http://www.g-node.org

Thomas Wachtler

- Funded by BMBF

- Hosted at the Ludwig-Maximilians Universität München

- Bernstein Network of Computational Neuroscience

- Associated Node of the INCF

funded by
Federal Ministry of Education and Research

incf

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Development of Tools for Efficient Data Management

- Well-defined **data model** for neuroscience data that accounts for all types of recorded data

- Flexible methods for **data annotation** and metadata management that can be adapted to the requirements of the experiment and laboratory

- Format and tools for **integrated organization of data and metadata**, including interfaces for common tools and languages, to facilitate data access, data management, and data analysis

- Development and hosting of **data management infrastructure** for **collaboration** and **data sharing**.

Development of Tools for Efficient Data Management

odML (open metadata Markup Language)

http://www.g-node.org/odml

NIX (Neuroscience Exchange format)

http://www.g-node.org/nix

GIN (G-Node Infrastructure services)
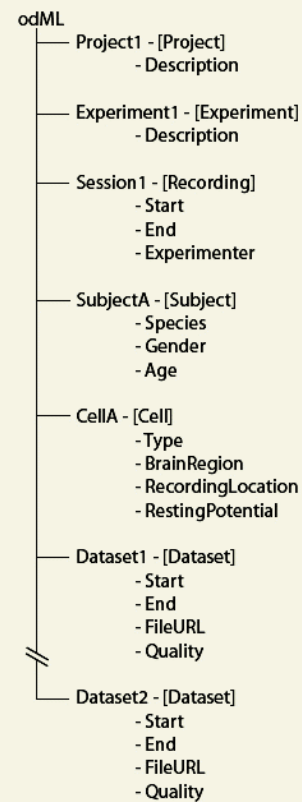
https://gin.g-node.org
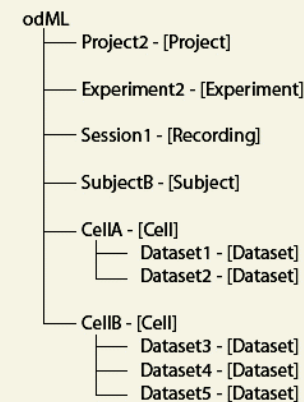
odML (open metadata Markup Language)

- format: hierarchical structure of key-value pairs: simple, flexible, inherently extensible ➜ can be adapted to the specifics of the lab or experiment

- can carry **any metadata**

- machine write- and readable, **facilitates automated collection** of metadata in the laboratory

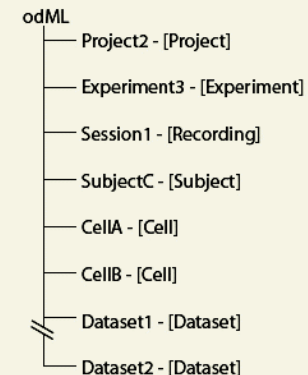- community-driven standardization through shared terminologies [1]

A) Single cell recording several datasets

odML
— Project1 - [Project]
        - Description

— Experiment1 - [Experiment]
        - Description

— Session1 - [Recording]
        - Start
        - End
        - Experimenter

— SubjectA - [Subject]
        - Species
        - Gender
        - Age

— CellA - [Cell]
        - Type
        - BrainRegion
        - RecordingLocation
        - RestingPotential

— Dataset1 - [Dataset]
        - Start
        - End
        - FileURL
        - Quality

— Dataset2 - [Dataset]
        - Start
        - End
        - FileURL
        - Quality

B) Two cells subsequently recorded, several datasets each

odML
— Project2 - [Project]

— Experiment2 - [Experiment]

— Session1 - [Recording]

— SubjectB - [Subject]

— CellA - [Cell]
        — Dataset1 - [Dataset]
        — Dataset2 - [Dataset]

— CellB - [Cell]
        — Dataset3 - [Dataset]
        — Dataset4 - [Dataset]
        — Dataset5 - [Dataset]

C) Two cell simultaneously recorded, several datasets

odML
— Project2 - [Project]

— Experiment3 - [Experiment]

— Session1 - [Recording]

— SubjectC - [Subject]

— CellA - [Cell]

— CellB - [Cell]

— Dataset1 - [Dataset]

— Dataset2 - [Dataset]

[1] https://github.com/G-Node/odml-terminologies   Grewe et al (2011) Front. Neuroinf. 5:16
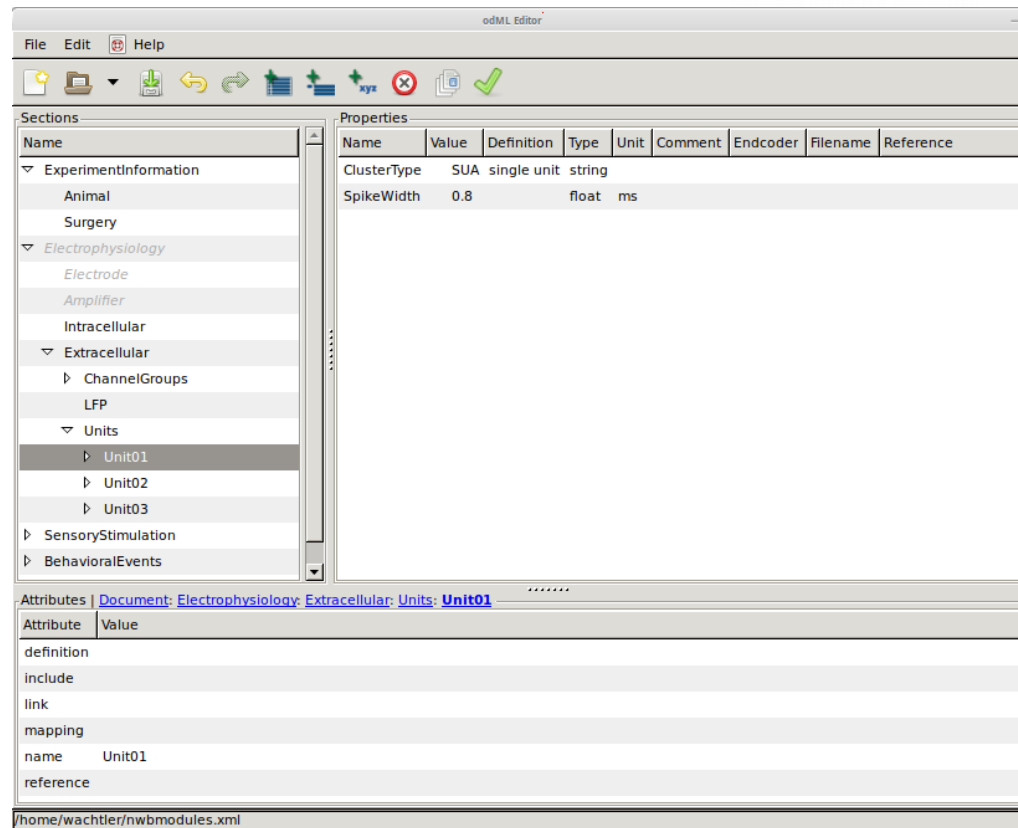
odML: Tools

http://www.g-node.org/odml

- Python core library [1]
  enables integration into software tools

- odml-UI editor [2]

- odmltables plugin [3]
  (by INM-6 FZ Jülich)

[1] https://github.com/G-Node/python-odml
[2] https://github.com/G-Node/odml-ui
[3] https://github.com/INM-6/python-odmltables

Latest odML format developments

http://www.g-node.org/odml

- streamlined data format (1.3 → 1.4)

- support for YAML and JSON

- export to RDF

- prototype odML flavoured Apache Jena Server

- "fuzzy queries": experimental abstract SPARQL language

odML flavoured RDF workflow

http://www.g-node.org/odml
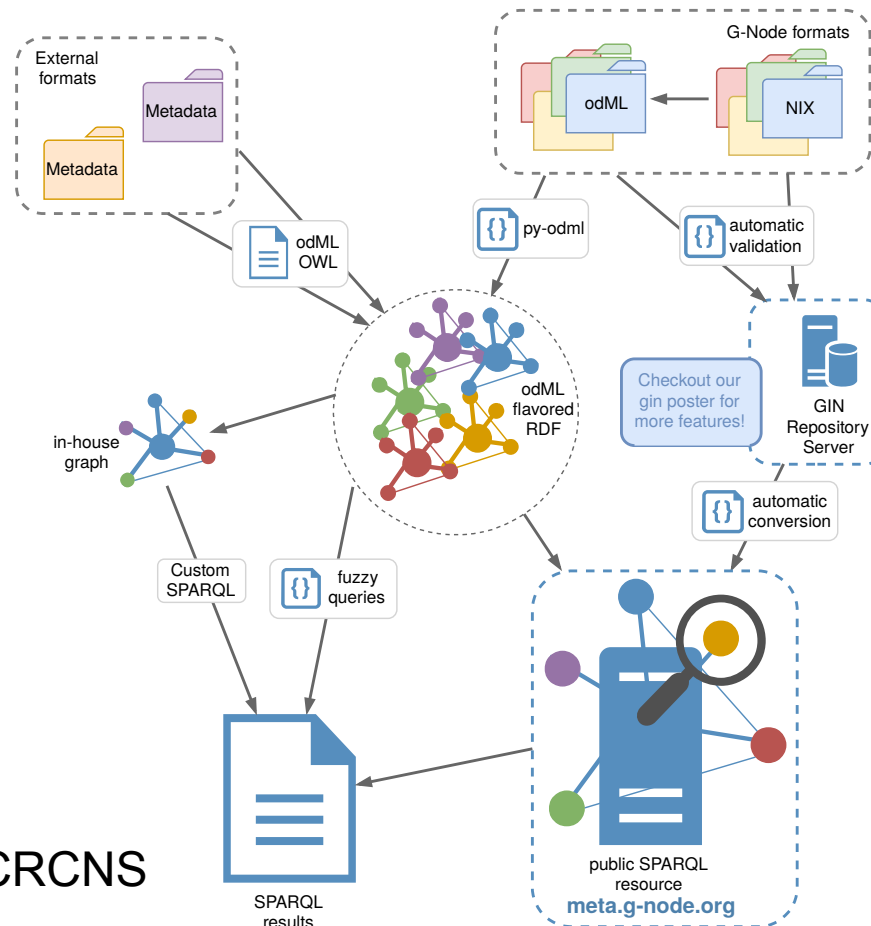
Joint project with the CRCNS

https://crcns.org/

NIX – Format for integration of data and metadata

http://www.g-node.org/nix

- general data model (derived from **Neo**) to represent recorded data, derived data, relations of data

- flexible data model for metadata (**odML**) for comprehensive annotation of data

- file backend: HDF5 file format
  - structure reflects data model, easy to understand
  - other storage backends possible

- libraries for different languages (C++, Python, Matlab, Java)

NIX – Format for integration of data and metadata

http://www.g-node.org/nix
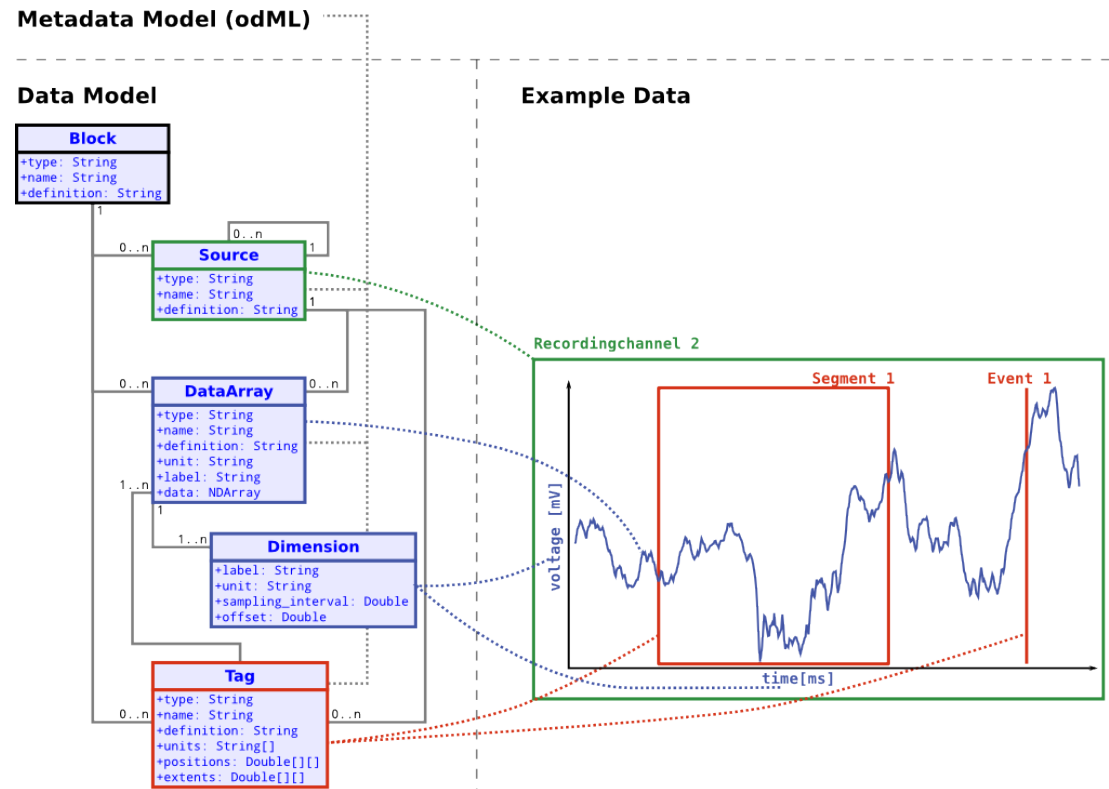
- storage of n-dimensional data

- definition of regions of interest

- linkage of multiple steps of analysis

- storage of data annotation with data
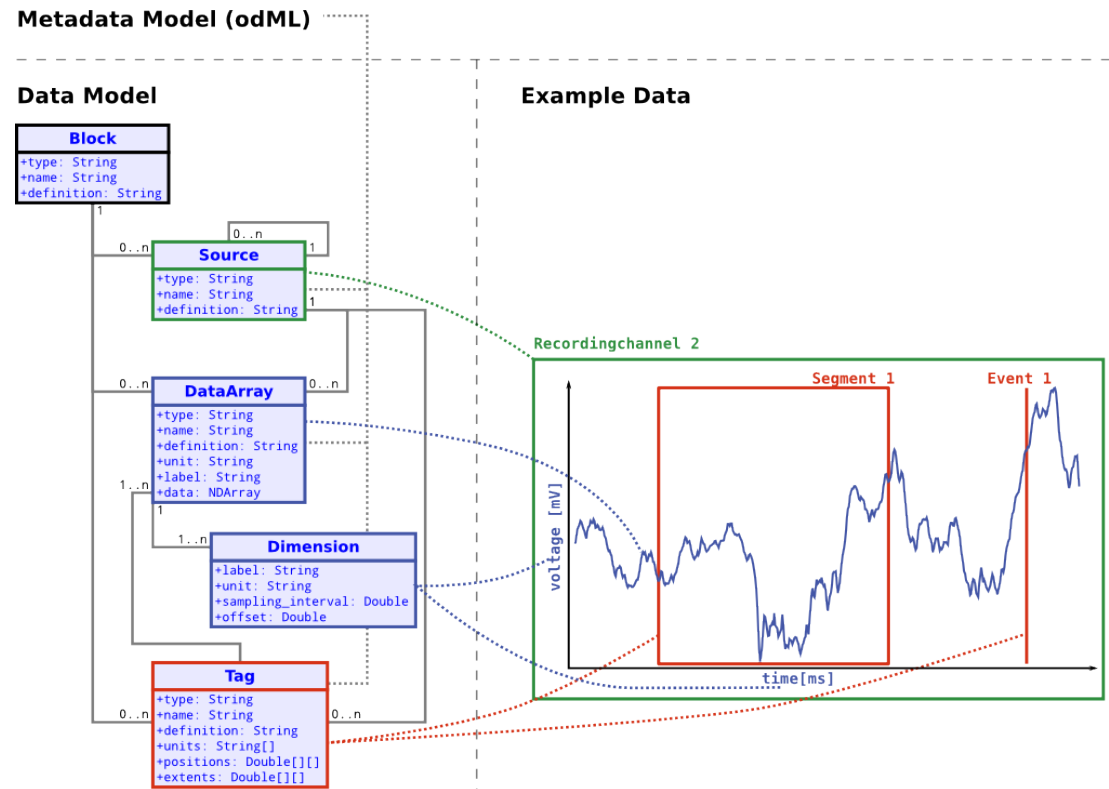
NIX features – Dimensions and tagging

Sampled dimension

Range dimension

Set dimension
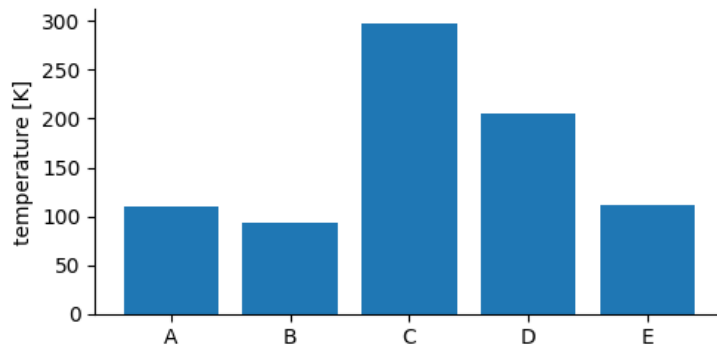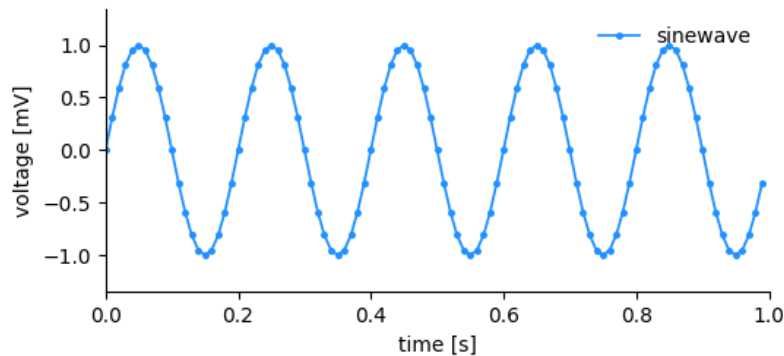
Alias Range dimension

Features automatic SI unit conversion

http://www.g-node.org/nix

NIX features – Dimensions and tagging

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http://www.g-node.org/nix
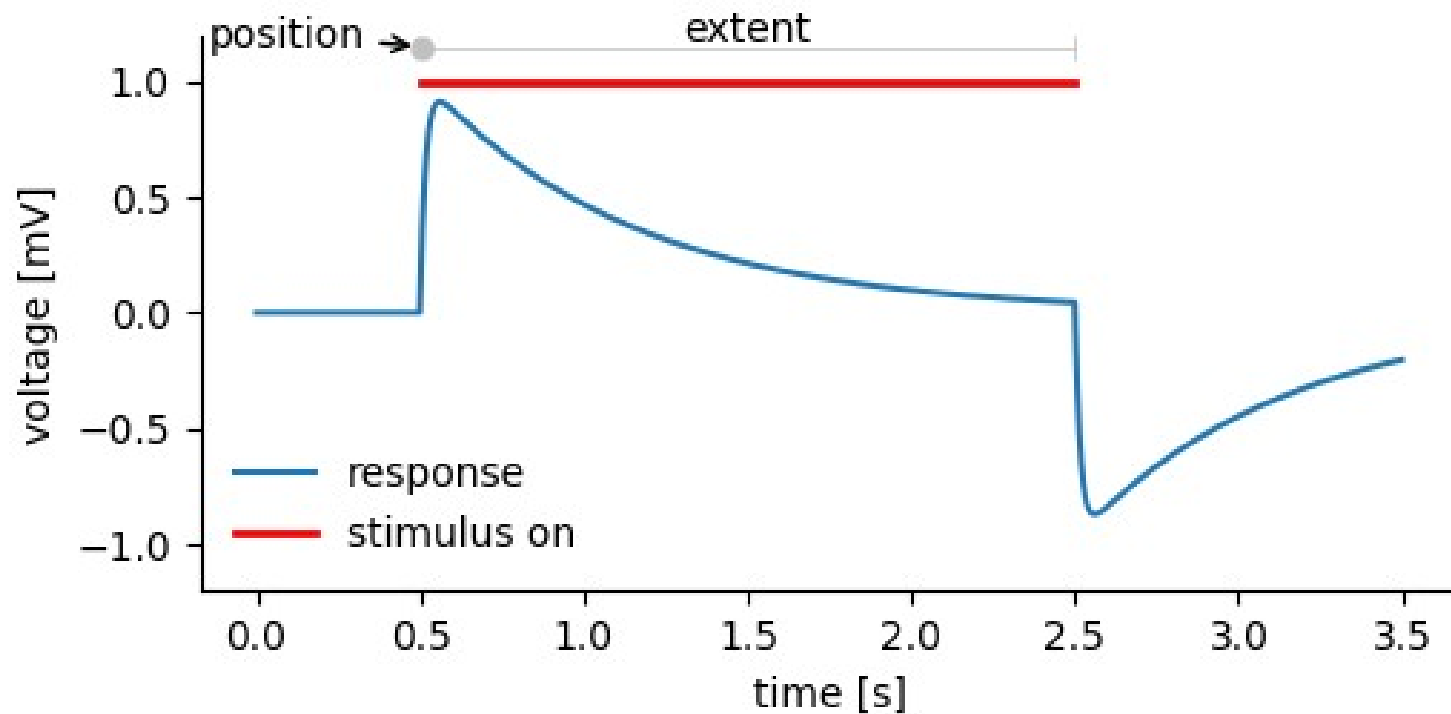
NixView
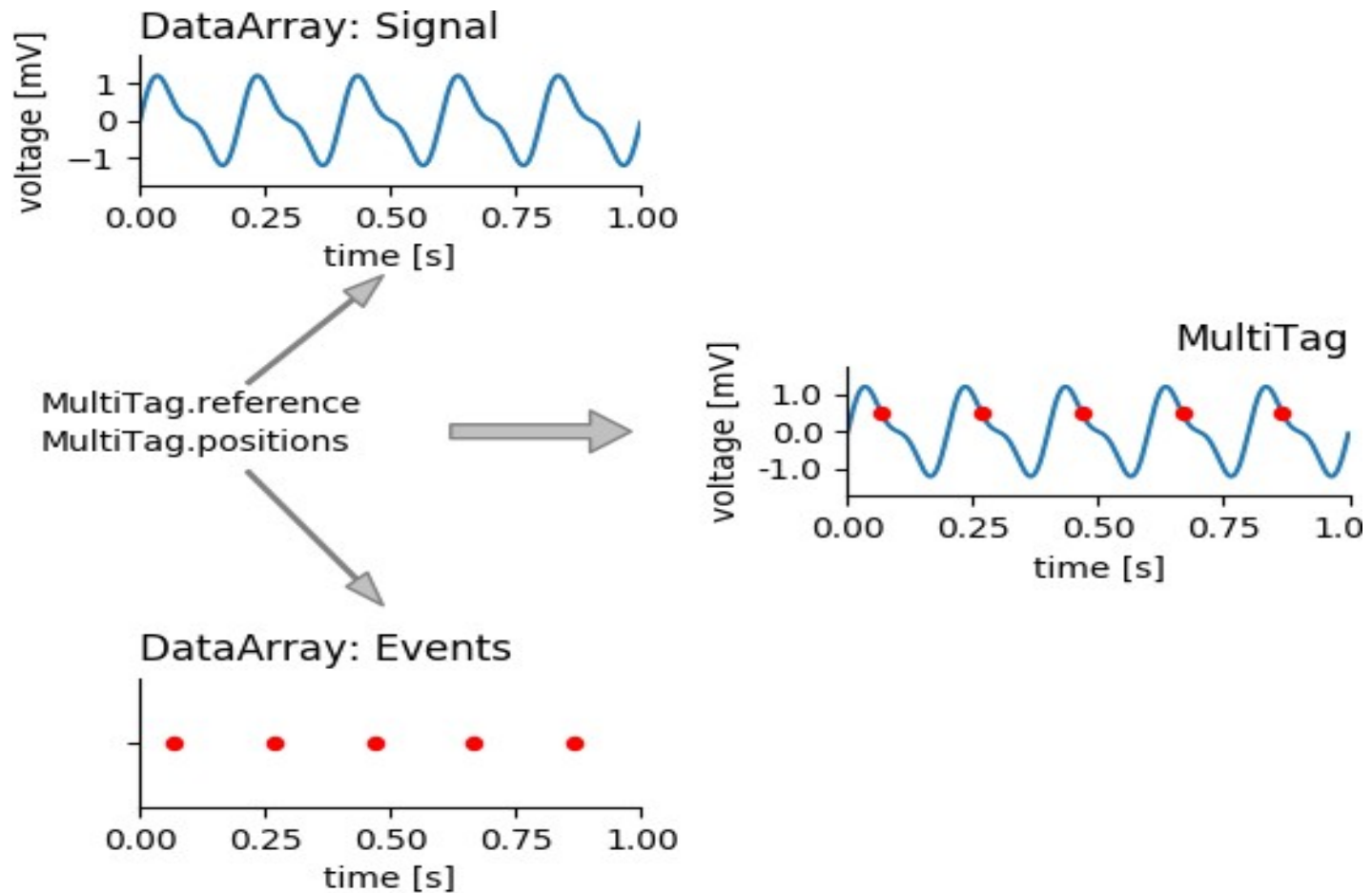
https://github.com/bendalab/NixView
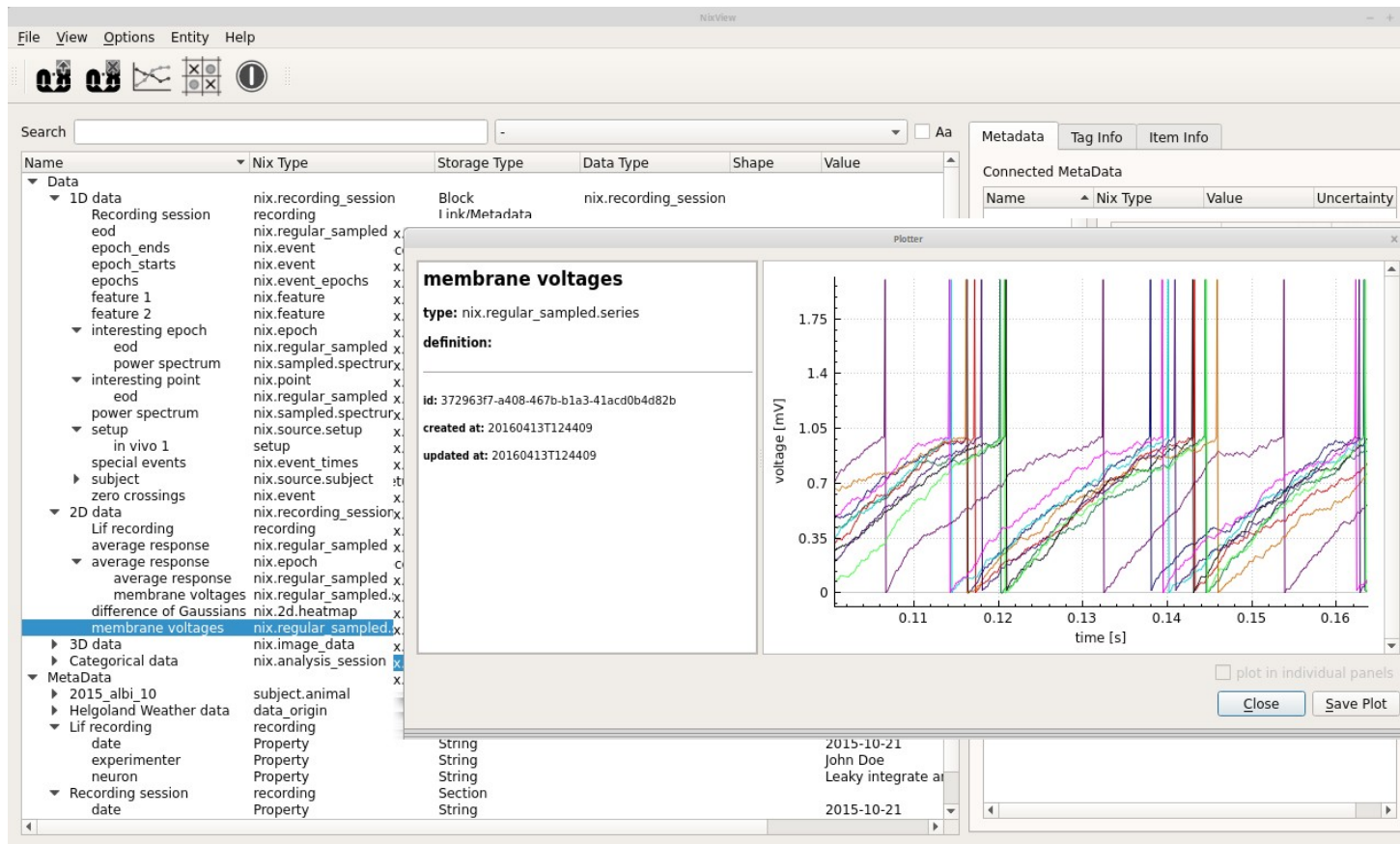
Latest NIX developments

- Pure Python implementation

- Format consolidation NIX ↔ odML

- Suite of tools for conversion [1]

- Visualization tools easy integration into Jupyter notebooks [2]

[1] https://github.com/G-Node/nix-odml-converter
[2] https://github.com/G-Node/nixworks

GIN: Services for Data Organization and Sharing

https://gin.g-node.org

- Versioned management of data repositories (git)

- Distributed data management via file or web browser, or command line client (analysis script integration)

- Secure access and sharing

- Services for search, indexing, and publication (DOI)

- File type plugins

- In house installation

- Extensive usage documentation

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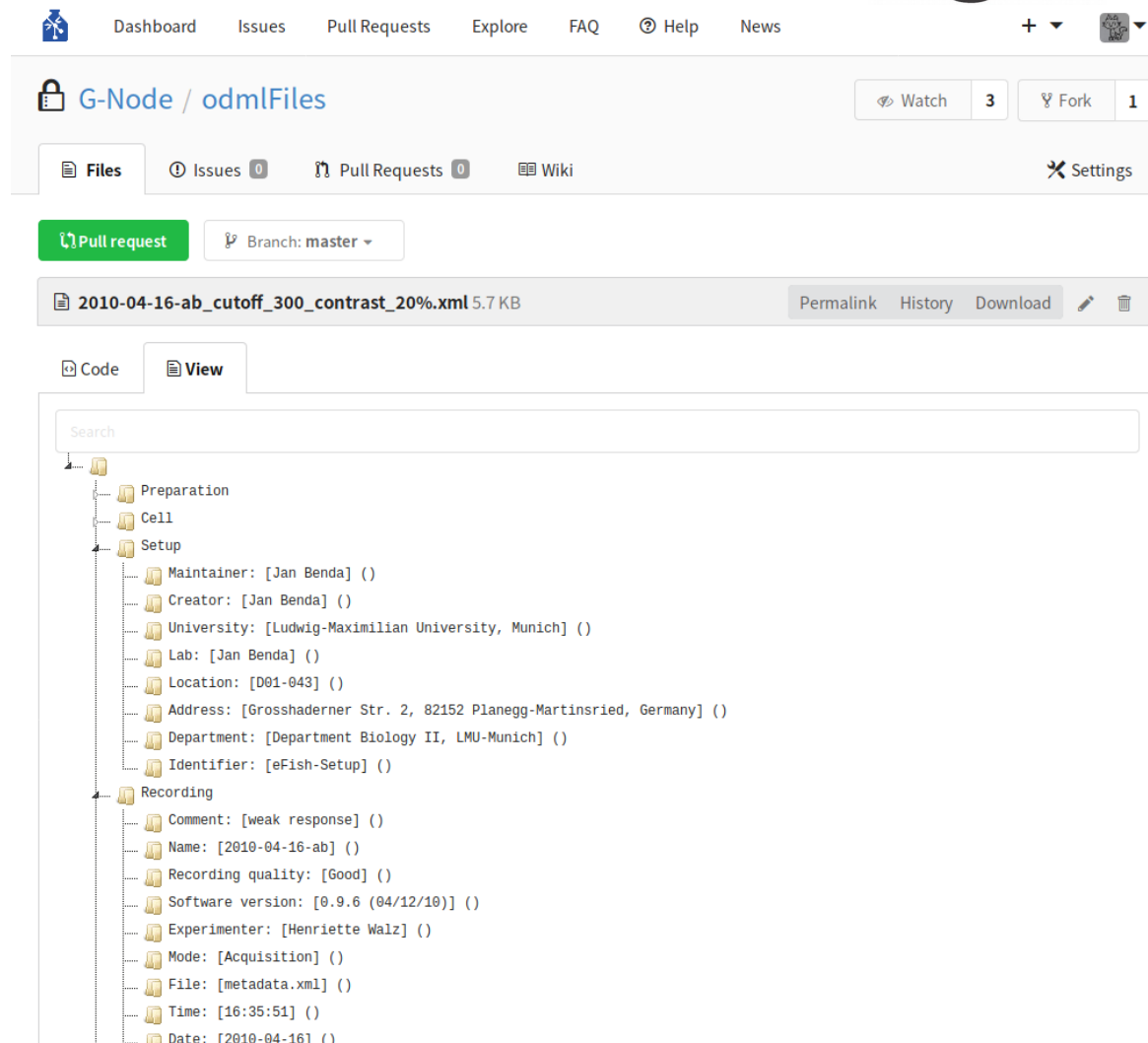
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https://gin.g-node.org/G-Node/Info/wiki

/FaqTroubleshooting
/UsageTutorial
/Webinterface
/DOIfile
/GinCliRecipes
/InHouse

GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

Data Acquisition and Processing   **Data Analysis**   **Data Access and Collaboration**   **Data Publication**

Data Aquisition

Data preparation

Analysis

Synchronisation

Conference

v0.1

v0.2

v0.3

v0.4

v1.0

Versioning / Back in time

Remote access

Collaboration

Publication

v1.0

https://gin.g-node.org
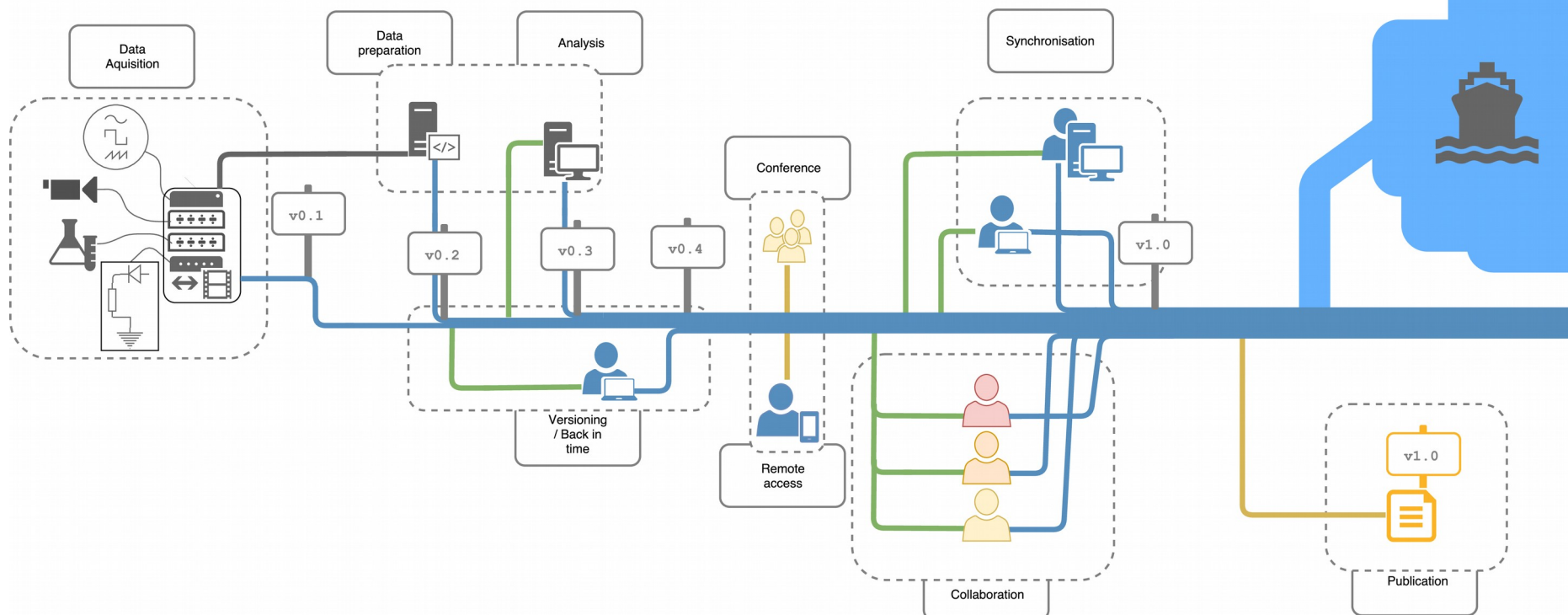
GIN: Services for Data Organization and Sharing

Getting started and Outlook

- Usage documentation at

    https://web.gin.g-node.org/G-Node/Info/wiki/

    https://web.gin.g-node.org/G-Node/Info/wiki/FaqTroubleshooting

- GIN-UI; graphical command line client wrapper on Windows

- Web GIN: odML integration

- Web GIN: NIX integration (upcoming)

- GIN microservice: Format validation service (prototype)

    – BIDS, odML, NIX, [your format here]

- GIN microservice: Continuous Integration service (upcoming)

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Alvaro Tejero Cantero, Kay Thurley, **Lyuba Zehl**

Get involved

Questions

Emails

dev@g-node.org

Chat

gnode.slack.com

Issues and Feature requests

github.com/G-Node

Data sharing and publication

gin.g-node.org

Slides

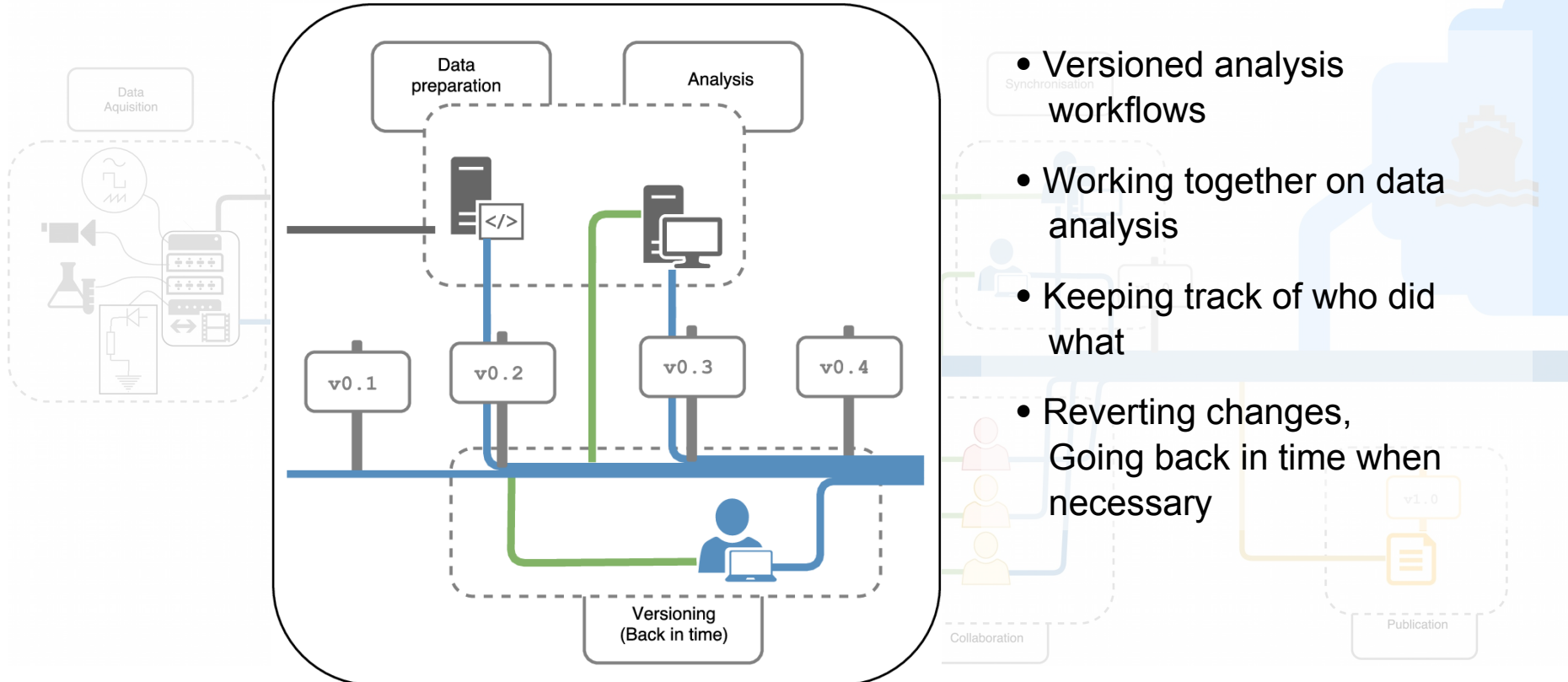https://gin.g-node.org/G-Node/PublicResources

GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

Data Acquisition and Processing

- Versioning of datasets from the beginning

- Workflow automation

- Immediate access for other lab members

- Manage data with minimal data transfer

GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

Data Analysis

- Versioned analysis workflows

- Working together on data analysis

- Keeping track of who did what

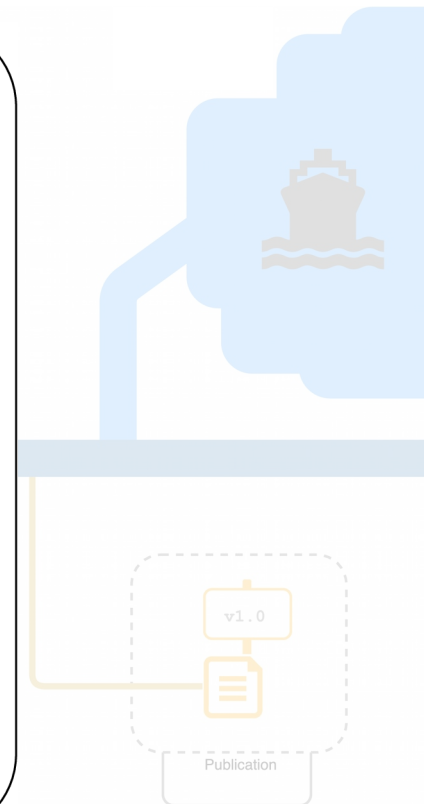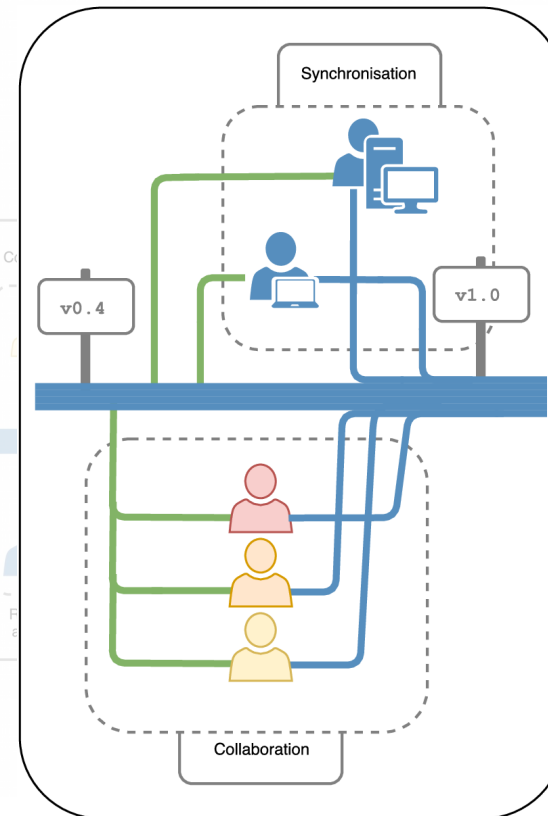- Reverting changes, Going back in time when necessary

GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

Data Access and Collaboration

- Accessing your data from outside the lab

- Keeping datasets in sync at diferent places with minimal data duplication

- Working on datasets remotely while transfering data only when needed

- Access for remote collaborators

GIN: Services for Data Organization and Sharing

Supporting research data management through the entire data lifecycle

Data Publication

- Indexing and data search (gin.g-node.org/explore)

- Making data public with a mouse click

- Dataset publication (supplemental datasets, data publications)

- Citable datasets through Digital Object Identifiers (DOI)