



iPST project

2016-2017 Roadmap

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Plan

- **Partners and organization**
- **Current state of the project**
- **Future functional perimeter**
- **Usability improvements**
- **Communication**

Partners and organization

1 TSO:



6 industrials:



3 research centers:



The partners decide on the roadmap in order to guarantee the consistence of the iPST project. There is no need to be a partner to contribute (through the github). Once a years a governance meeting allows new partner to enter.

Current state

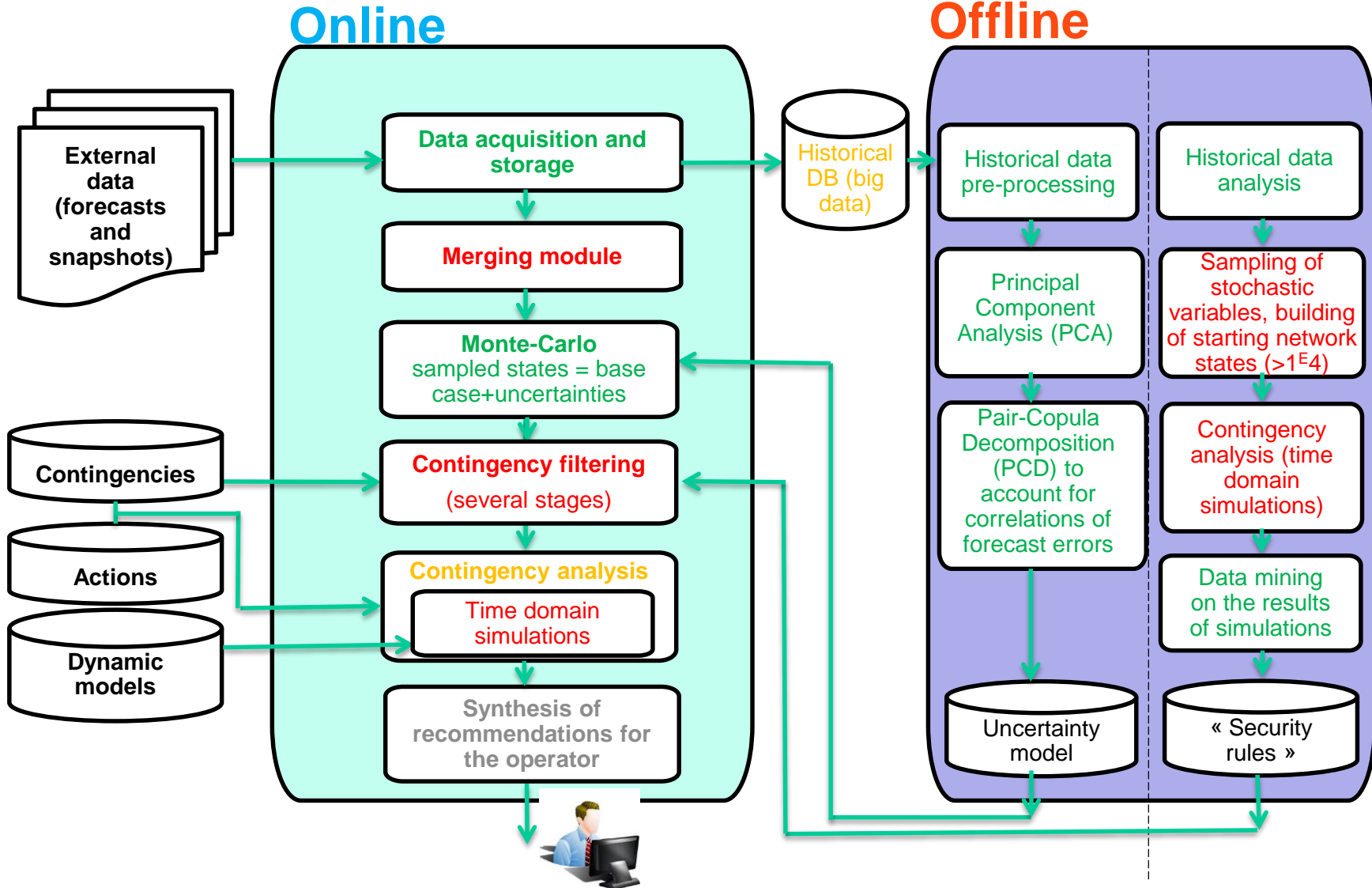
What is open-source, what is not.

Legend:

Open-sourced

Partially open-sourced

Closed source



→ Store grid data into HistoDB:

- Platform integration code: Open-sourced by the consortium, free and best effort support by the project.
- HistoDB module: Closed source code by Pepite but free to use (<http://maven.pepite.be:8444/>).

→ Sample consistent grid states

- Platform “glue” code: Open-sourced by the consortium, free and best effort support by the project.
- Modules:
 1. Withdrawals + RES stochastic models: Open-sourced by Imperial College. *The models are generic and can be reused in other contexts.*
 2. Topology random model: by RTE. Closed-source code. Requires Ampl and FICO Xpress.
 3. OPFs to obtain a consistent grid state: by RTE and Artelys. Closed-source code. Requires Ampl and Knitro.

→ Simulate and analyse the grid behaviour

- Simulators: Hades, Eurostag, Helm, Dymola: see detailed in following slides.
- Security indicators: open-sourced but:
 - Eurostag extraction routines requires a library based on private Eurostag code.
 - The inter-area oscillation security index needs a small 50 line file with dubious IP that cannot be published. A replacement might be possible (prony analysis).

→ Build rules

- Platform “glue” and 2 modules for the same function:
 - Pepite’s Decision Trees (Closed-source code licensed by Pepite. Free access to Datamaestro platform for R&D)
 - Matlab-based Decision Trees (Open-sourced by RTE)

→ Test rules

- Platform code to test the rules on another dataset (based on historical data).

→ **Full process:** only up to Imperial stochastic model.

→ **Simplified process OK:**

1. Direct simulation on historical data,
2. Build rules,
3. Test rules.

This process requires only code from:

- Platform code to handle the workflow
- Free network simulator (see later)
- Matlab-based Decision Tree module
- *No need histoDB from Pepite (just directories with grid data)*
- *No need of sampling*

→ **Contact the project for help to set up the workflow!**

→ Merging

- “Topological” merging (OK for snapshots):
 - Open-source platform code + Hades/Helm
- Mixed Forecast/Snapshot merging (Needed if some snapshots are missing)
 - Closed source-code by Artelys and RTE.
 - Licensing and support to be studied on demand. Requires AMPL and KNITRO.

→ Worst-Case Analysis: uncertainty model and OPFs

- Closed source-code by RTE. Requires FICO Xpress.
- Still at R&D stage.

→ Fuzzy power flow. On demand licensing by INESC.

→ Monte-Carlo Like Analysis (MCLA)

- Platform integration and reporting code: open-sourced.
- Modules:
 - HistoDB: Closed source code by Pepite but free to use (<http://maven.pepite.be:8444/>).
 - Uncertainty analysis: open-sourced by RSE and Imperial College.
 - Simulators and indexes: as in the offline workflow.
 - Post-contingency analysis with CTA: closed-source by Tractebel. Licensing on demand. Free for R&D purposes. Requires AMPL and FICO Xpress.

→ **Full MCLA process up to post-contingency analysis but without the curative remedial actions (IPSO)**

→ **Simplified process OK:**

- No HistoDB from Pepite
- Default uncertainty model (collinear variation of all loads)
- Hades/Helm
- CTA post-contingency optimization.

Zoom on the support to simulation modules in the platform

→ Power-flows: Helm and Hades

- Standard API to power-flow module: open-source.

→ Dynamic simulators: Eurostag and Dymola

- Enrichment of static data with dynamic data (dynamic data database, dictionaries...): open-source.
- PSSE to Modelica and Eurostag to Modelica regulators converters: open-source.
- “Event” creations (Line tripping...) for Eurostag and Dymola: open-source

→ OPFs (CTA, Worst Case, Starting point initialization, FPF):

- XML format for curative remedial action optimization (open-source API)

→ **Distributed computation based on MPI (open-source).**

- High scalability from 1 machine to 10000 cores.
- MPI is an API with various implementation available in most computer and supercomputer environments.
- Standard CPU code (no GPU) compiled as “normal” executable.

Zoom on the iIDM – iTesla Internal Data Model

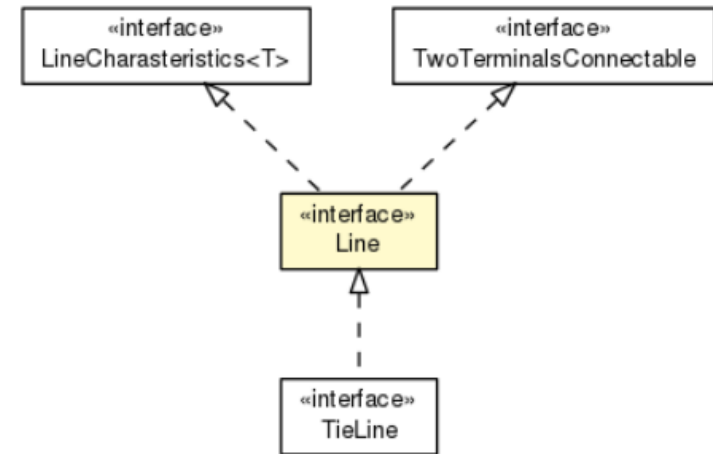
- **Importers:** UCTE, CIM14, IIDM-XML
- **Exporters:** Modelica, .ech, IIDM-XML
- **APIs**
 - Now:
 - Java API (HADES, HELM, DYMOLA, EUROSTAG, IPSO)
 - AMPL API (Merging, Offline OPFs, Worst Case OPF, FPF)
 - Future: C++ IIDM-XML API

iIDM Java API

- Javadoc is already existing
- XSD for the XML part, obtained by serialization/deserialization.
 - The XSD is relatively small (500 lines)



Interface Line



All Superinterfaces:

Connectable, Identifiable, **LineCharasteristics<Line>**, TwoTerminalsConnectable

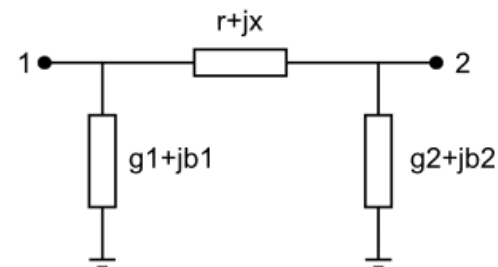
All Known Subinterfaces:

TieLine

```
public interface Line
extends TwoTerminalsConnectable, LineCharasteristics<Line>
```

An AC line.

The equivalent π model used is:



Future functional perimeter

New features in 2016-2017



Completion of software releases

→ Project partner software needed for some workflows

	Module	Vendor	License	Support and maintenance	Availability
Offline	HistoDB	Pepite	Free binaries, no restriction.	Common interest	http://maven.pepite.be:8444/
	Decision Trees	RTE	MPL V2.	Common interest	September 2016 on github. Matlab needed as binaries are not yet distributed.
	Datamaestro Decision Trees	Pepite	Free binaries for academic, R&D and trials. Commercial licensing.	Free: Common interest Commercial: Yes	http://mydatamaestro.com/
Simulators	Hades Power Flow	RTE	Free binaries for academic, R&D and trials. No commercial licensing.	Common interest	November 2016 (Linux only binary)
	Helm Power Flow	Gridquant	Free binaries, no restriction but size limited. Commercial licensing.	Free: Common interest Commercial: Yes.	Free version expected in 2017. http://www.gridquant.com/solutions/helm-flow/
	Eurostag	Tractebel / RTE	Free binaries for academic, R&D and trials in IPST. Commercial licensing.	Free: Common interest Commercial: Yes.	http://www.eurostag.be/
	Merging module	Artelys / RTE	Free binaries for academic, R&D and trials. Commercial licensing on request.	Yes.	https://www.artelys.com/ AMPL and KNITRO provided by Artelys
Online	Fuzzy Power Flow	INESC TEC	On request.	Common interest.	https://www.inesctec.pt/cpes-en/about-us/about-us?set_language=en&cl=en
	CTA	Tractebel	Free binaries for academic, R&D and trials in IPST. No commercial licensing.	Common interest.	http://www.eurostag.be/ AMPL and Xpress provided by Artelys.

Non project partner non-free software that may be needed: Dymola, Matlab, Ampl, Xpress, Knitro

Exchange capacities

→ Release of a **CIM CGMES importer and exporter**

- According to ENTSO-E roadmap and given that CIM 14 is becoming obsolete.
- Expected delivery in March 2017.
- Includes iIDM development to support new models.

→ Participation to ENTSO-E interoperability tests if possible

Reinforce iIDM as a pivot format

→ **Already used in 5 available modules**

- The platform “Artelys Crystal Suite” (Optimal dispatch, capacity expansion planning, unit commitment) will be connected with iPST through the iIDM format.

→ **Development of an iIDM-json format**

- In order to ease the integration of Optimal Power Flows into the platform by hiding the complexities of CGMES exchange format to the scientific programmer.

→ **Release of a C++ iIDM-XML importer/exporter.**

- Indeed, RTE plans to use iIDM as an exchange format between its own tools.

Dynamic simulations

- Ensure OpenModelica works for small systems (and not only Dymola)
 - In particular, improve the conversion from iIDM to modelica.
- Reorganization of the dynamic database (XML instead of SQL)
- Improve the binding of the static grid data with the dynamic data.
- Keep the compatibility with the iPSL open source project (iTesla Power System Library):
 - Both Modelica and iPSL change fast so that continuous work has to be done.

Usability improvements

Decrease the learning curve

Usability for developers

- **Building is currently organized with Maven**
- **Ansible scripts will be released**
 - In order to automatize the installation of the development environment.
- **Code quality will be improved (unit testing).**
 - A code coverage tool has been set up.

Usability for final users

- Release binary distributions
 - No need for Matlab anymore (MCR compiled binaries).
 - Linux will be the only supported platform.
- Pepite proposes to organize advanced analytics training and a user group on data-mining
- Tutorials will be developed
- The "[handbook](#)" will be reorganized.
- Synthetic grid data produced during the iTesla FP7 project will be integrated when it will be released.

Communication

- iTesla-Garpur event at CIGRE on August 24th.
<http://www.itesla-project.eu/cigre>
- Contacts with the future WG Monitoring Results and Application of the RDIC (Research, Development and Innovation Committee) of ENTSO-E.
- 2 presentations at PMAPS 2016 conference (Probabilistic Methods Applied to Power Systems).
- Presentations to TSOs.