Tool Integration and Data Formats for Distributed Airplane Predesign

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Goal

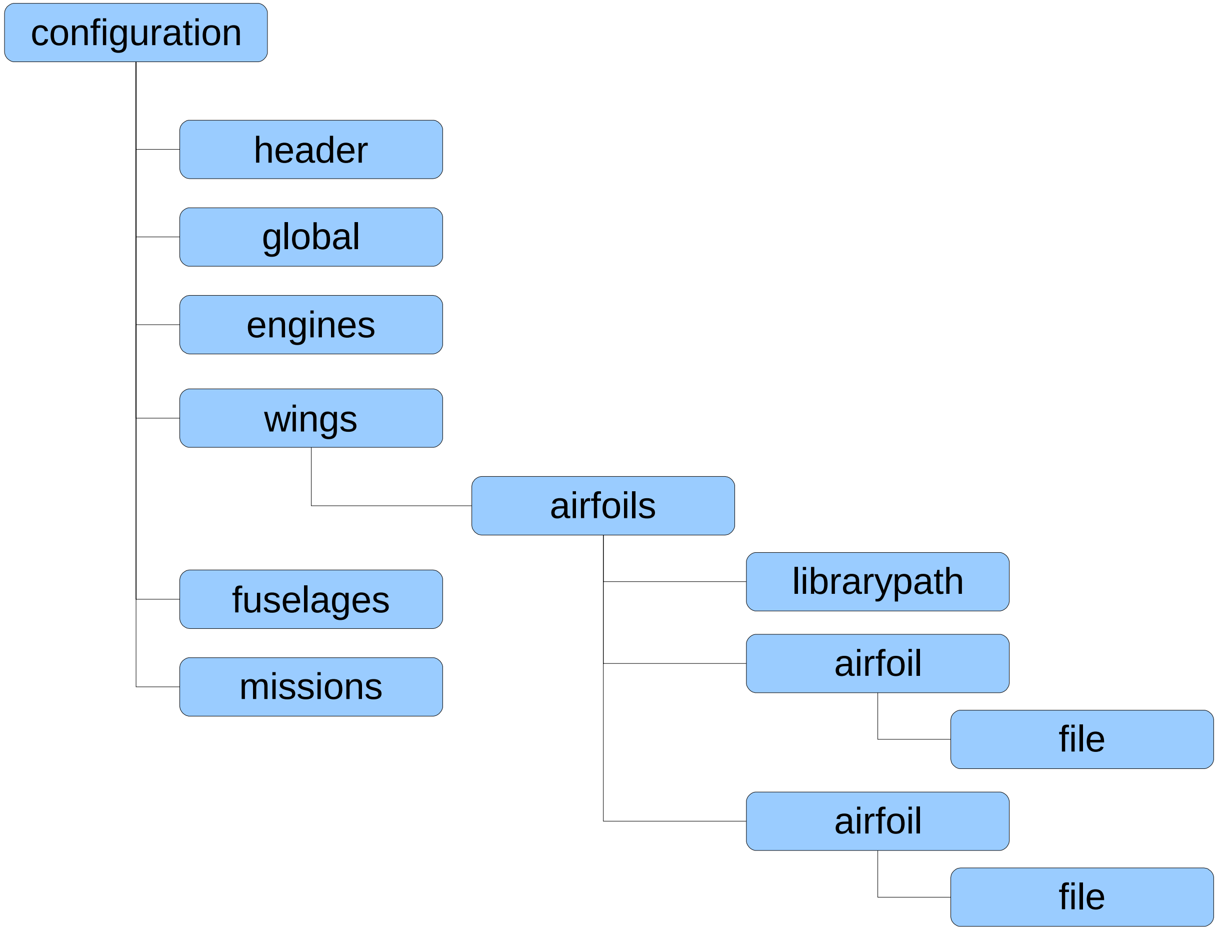
A DLR-wide system to enable the multi-disciplinary design and analysis of airplane configurations in the predesign phase.

- Under development at DLR in the following aeronautics projects:

TIVA I/II	Technology integration for the virtual aircraft
UCAV 2010	Unmanned combat air vehicle
EVITA	Evaluation of innovative turbine engines
CATS	Climate-compatible air transport system

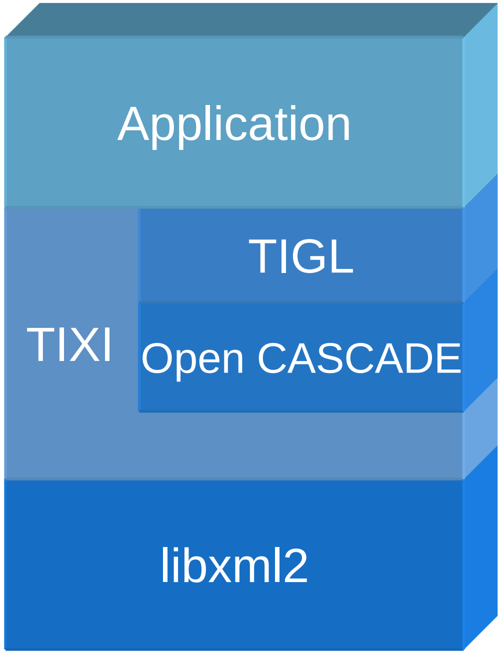
… and more to come!

Common Parametric Aircraft Configuration Standard: General Structure of the CPACS Dataset



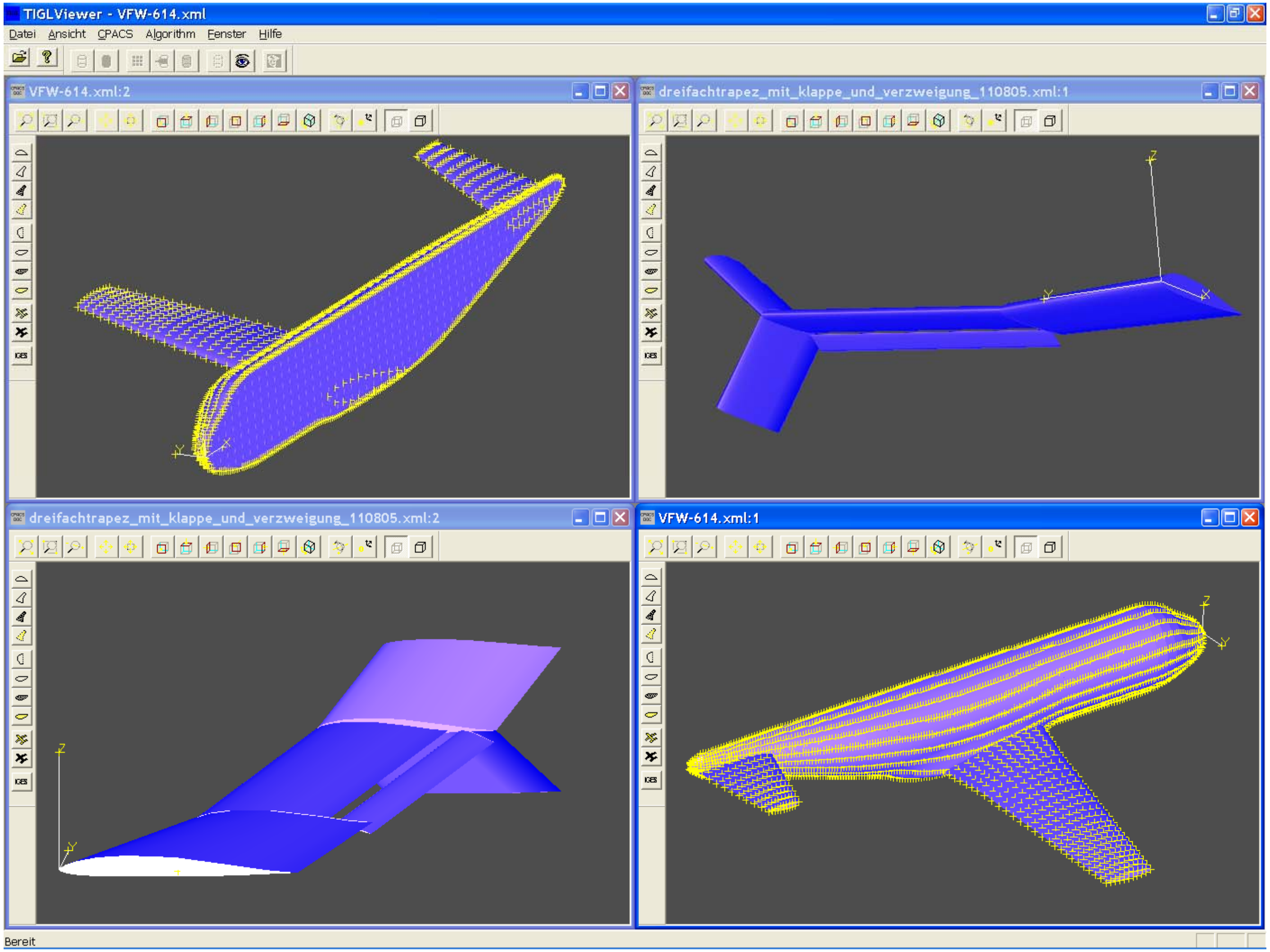
Interface Libraries to the CPACS

- **TIXI** - Library for XML I/O
- Uses `libxml2` of the Gnome project
- Simple access to XML through XPath expressions
  - Functions for reading and writing of Strings, Matrixes, Numbers & 3D-Points



- **TIGL** - Reading and processing the geometry information stored in the central dataset
  - For fuselages and wings; engines planned
  - Uses OpenCASCADE's geometry library
- Construction of the 3D geometry
  - Creation of surfaces from cross sections
  - Used e.g. for calculation of surface points in absolute Cartesian coordinates

TIGLViewer – Visualization Tool for TIGL


TIGLViewer - VFW-614.xml
Datei Ansicht CPACS Algorithm Fenster Hilfe
VFW-614.xml:2
dreifachtrapez_mit_klappe_und_verzweigung_110805.xml:1
dreifachtrapez_mit_klappe_und_verzweigung_110805.xml:2
VFW-614.xml:1
Bereit

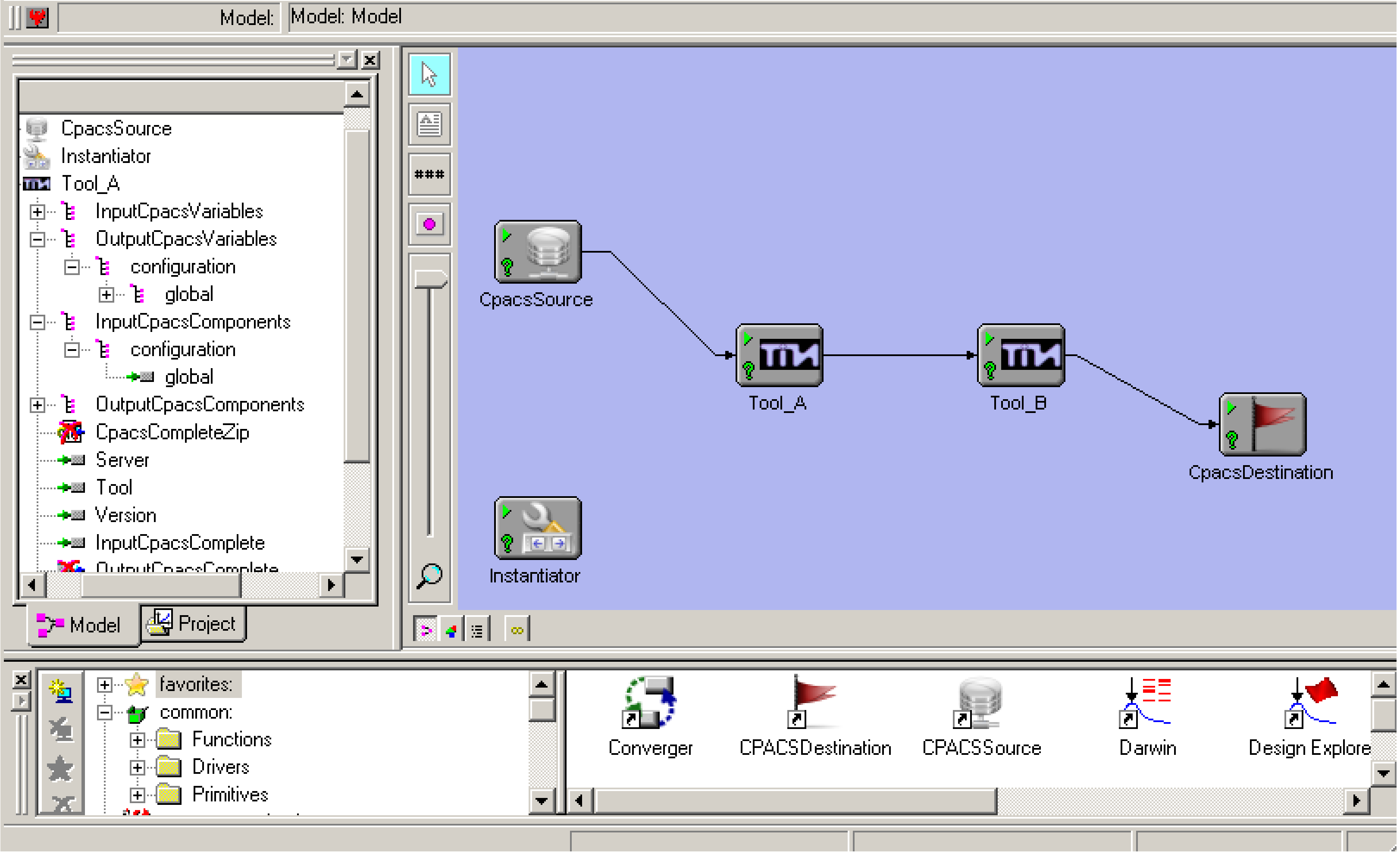
Integration into ModelCenter (Overview)

- All components realized as component plugins using Java™

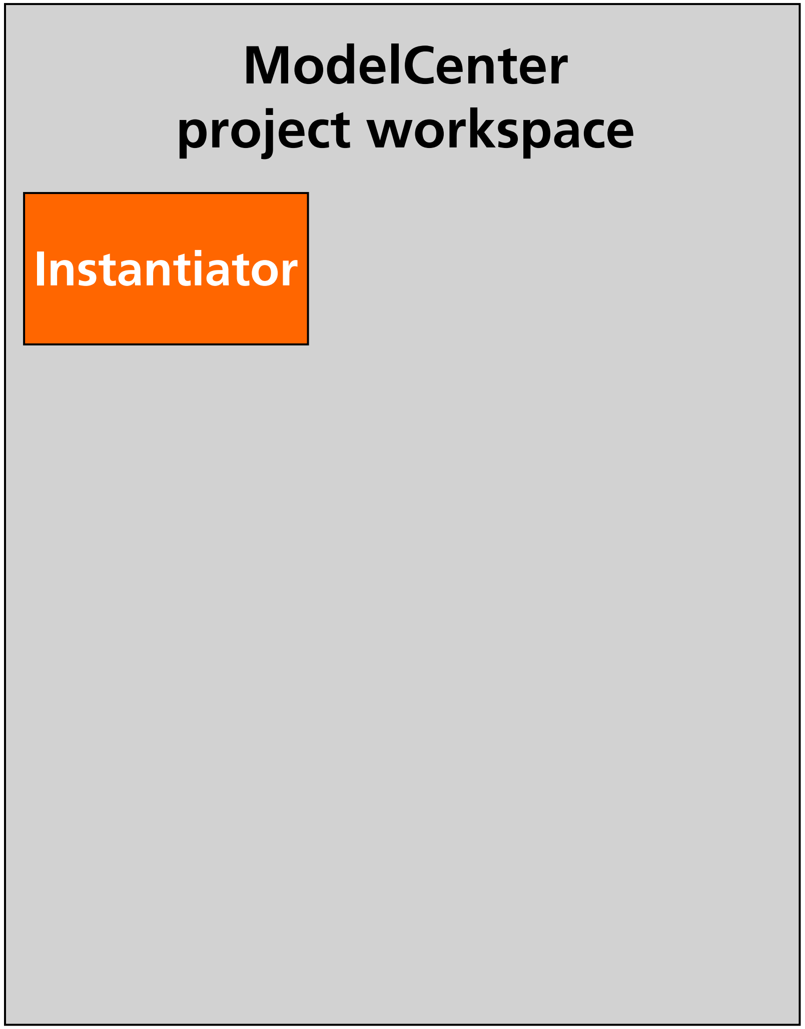
- Client side:
  - CPACSSource.java offers different prepared aircraft configurations
  - CPACSDestination.java writes out final optimized configuration or logs intermediate results
  - CPACSInstantiator.java is the central user GUI for inserting wrapped server-side tools
    - Offers limited palette of servers, tools and versions
    - Centrally managed in a FTP/WebDAV-hosted file

- Server side:
  - *ToolWrapper.java* wraps any executable tool
    - Conversion of tool-specific input/output data
    - Manages additional output files

ModelCenter integration



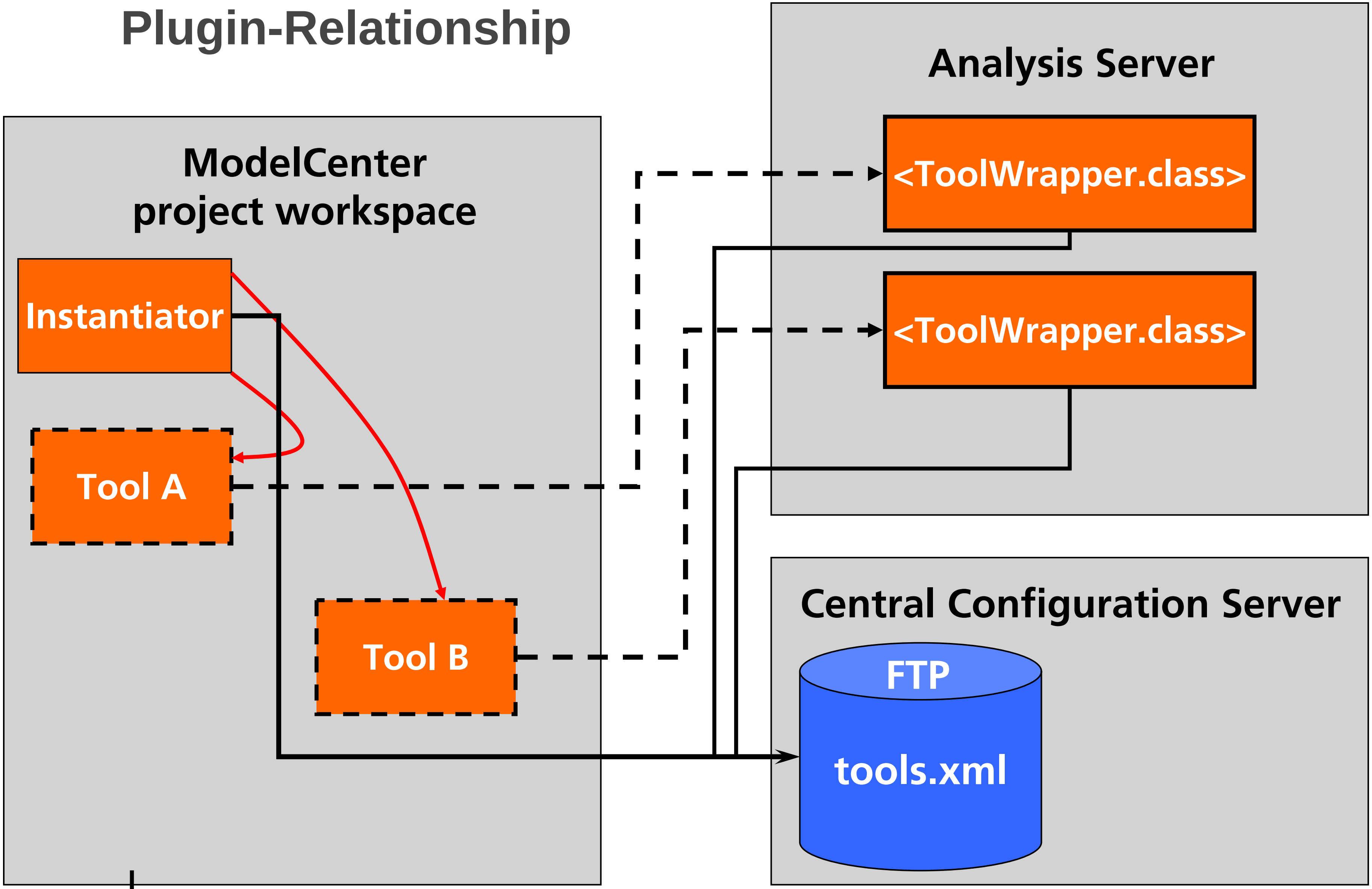
Plugin-Relationship



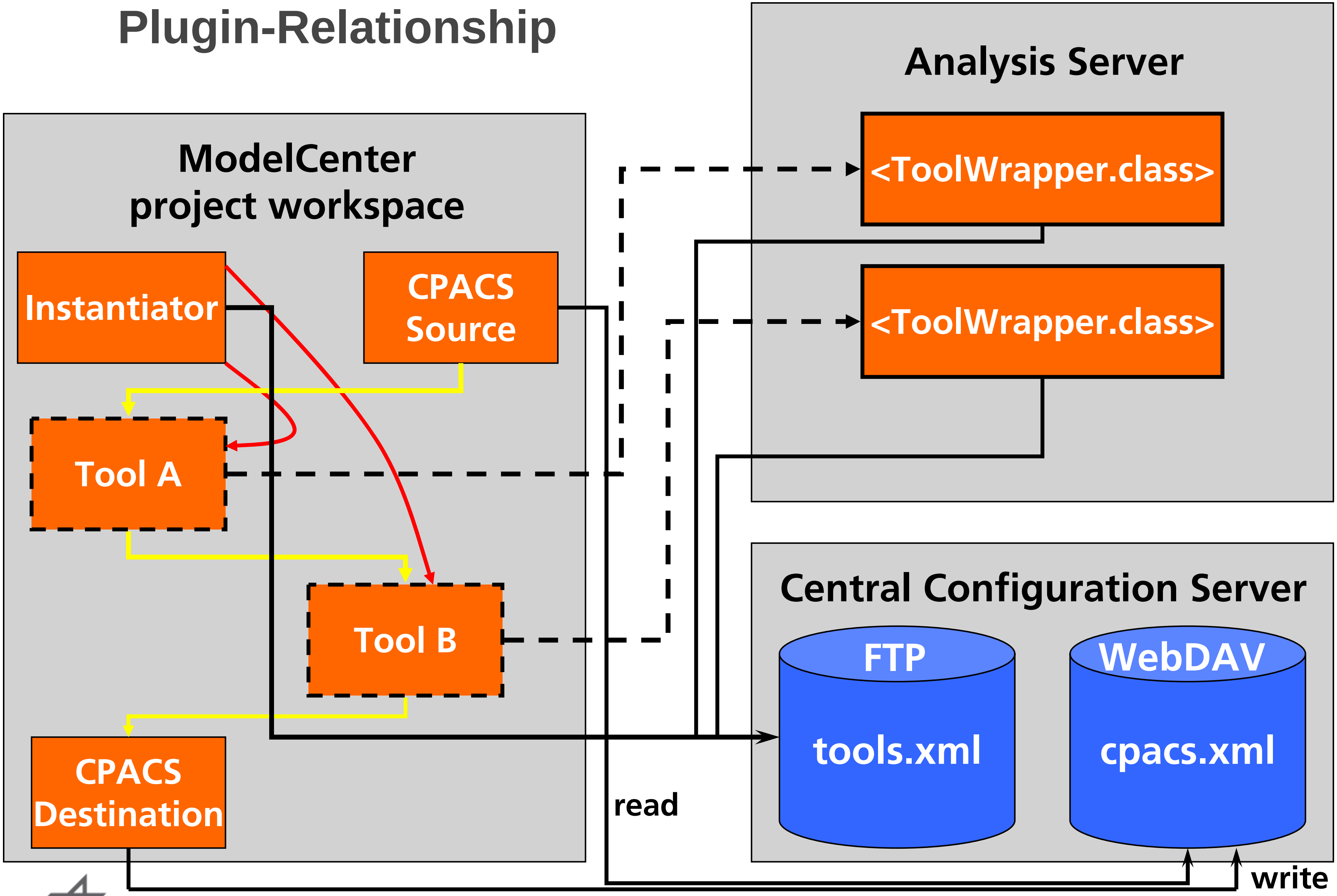
ModelCenter project workspace

Instantiator

Plugin-Relationship



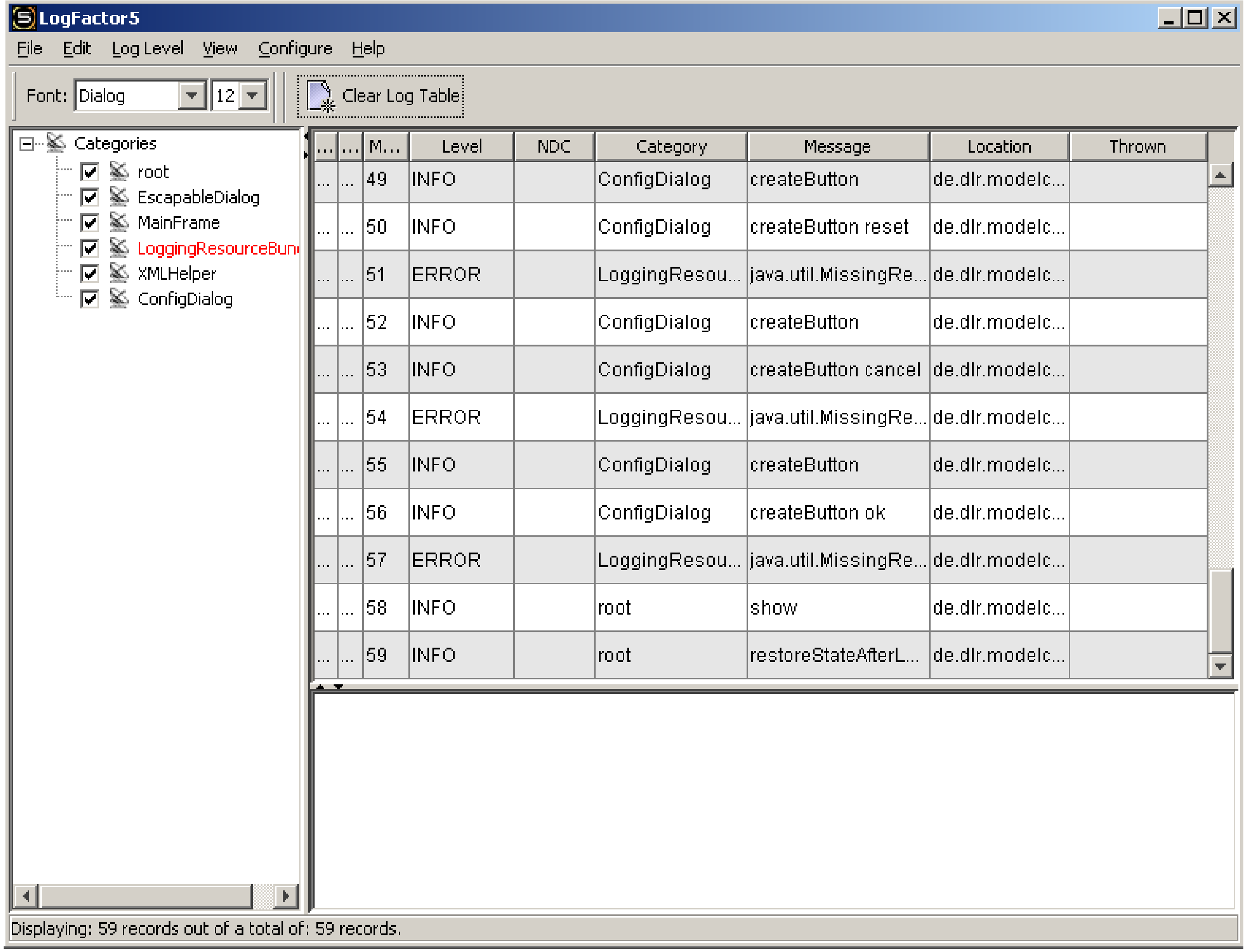
Plugin-Relationship



Client Plugins

- All components provide user-friendly GUIs (Swing), e. g. for
  - Selecting CPACS configurations (from local HD or WebDAV)
  - Selecting a ToolWrapper configuration (Server / Tool / Version)
  - Choosing a plugin's mode of operation
- All exceptions are reported in log files, present errors and stack traces to the user, a graphical logger can be enabled (uses apache log4j / LogFactor 5)
  - Still work to be done to get more user-friendlyness
  - E. g. check availability of a server before telling ModelCenter to instantiate a component

Client Plugins: LogFactor 5



...	...	M...	Level	NDC	Category	Message	Location	Thrown
...	...	49	INFO		ConfigDialog	createButton	de.dlr.modelc...	
...	...	50	INFO		ConfigDialog	createButton reset	de.dlr.modelc...	
...	...	51	ERROR		LoggingResou...	java.util.MissingRe...	de.dlr.modelc...	
...	...	52	INFO		ConfigDialog	createButton	de.dlr.modelc...	
...	...	53	INFO		ConfigDialog	createButton cancel	de.dlr.modelc...	
...	...	54	ERROR		LoggingResou...	java.util.MissingRe...	de.dlr.modelc...	
...	...	55	INFO		ConfigDialog	createButton	de.dlr.modelc...	
...	...	56	INFO		ConfigDialog	createButton ok	de.dlr.modelc...	
...	...	57	ERROR		LoggingResou...	java.util.MissingRe...	de.dlr.modelc...	
...	...	58	INFO		root	show	de.dlr.modelc...	
...	...	59	INFO		root	restoreStateAfterL...	de.dlr.modelc...	

Displaying: 59 records out of a total of: 59 records.

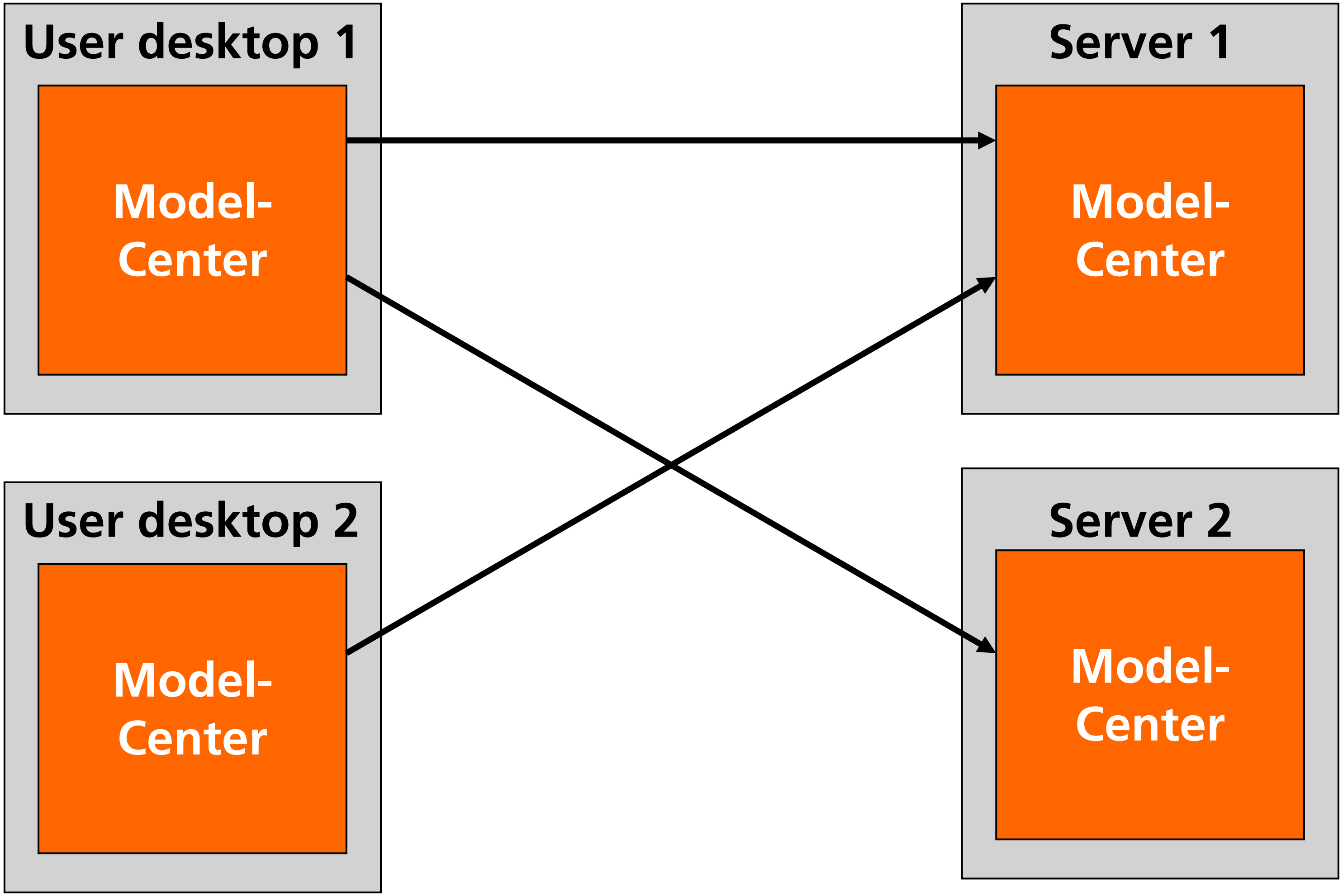
Connecting Components

- Each component may has either or both of
  - Input variables (ToolWrappers and CPACSDestination)
  - Output variables (ToolWrappers and CPACSSource)

- The CPACS XML dataset can be viewed and connected on 3 levels
  - As a whole – one string containing all XML
  - As subtrees – direct children of complete XML as strings
  - As single variables – native ModelCenter variables

- Tags in the XML can be marked
  - *Raw:* Further nestedness won't be resolved, just one XML string
  - *Invisible:* Not shown in single variable tree, but inside XML strings

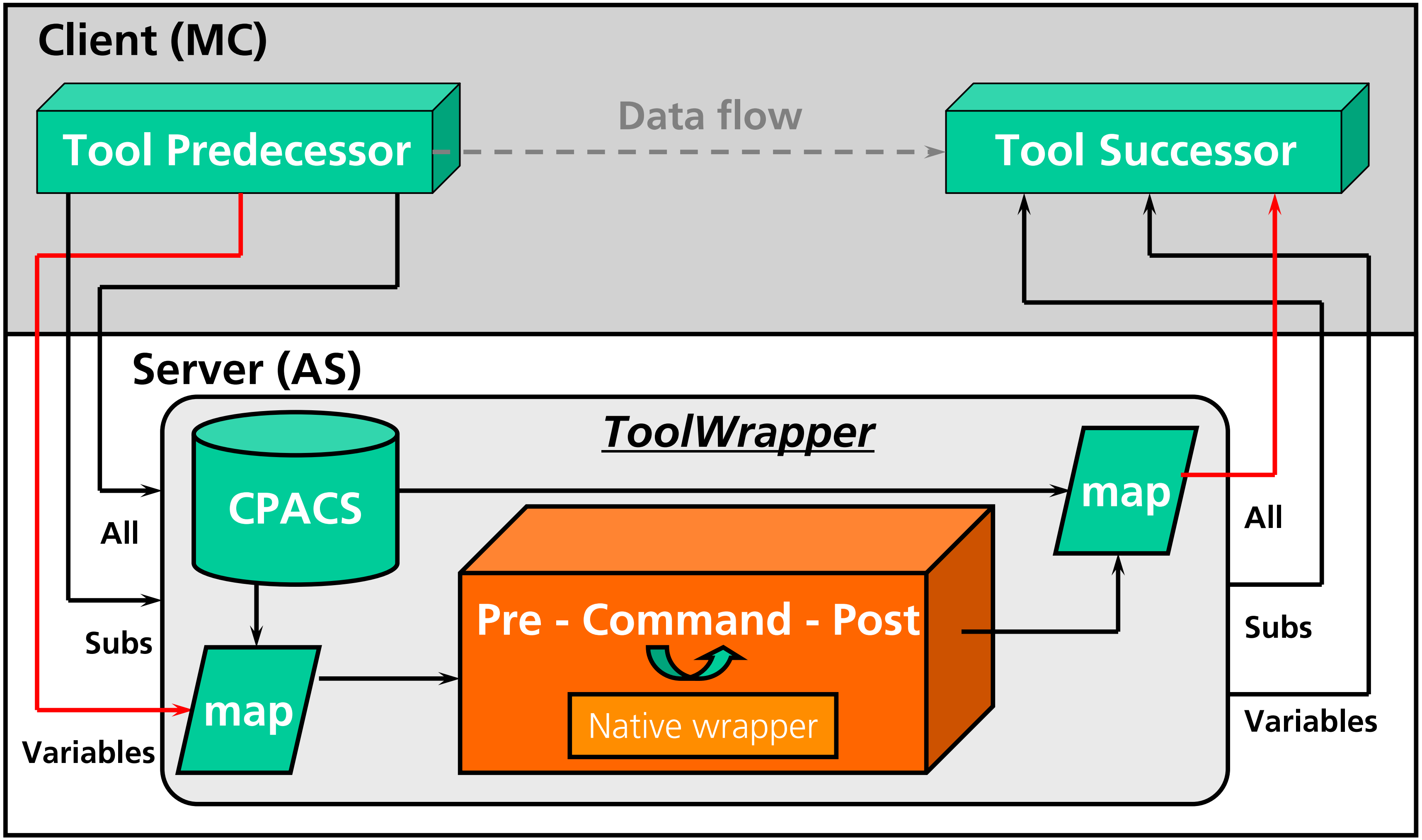
Client- Server Architecture



ToolWrapper Plugin

- Uses **`PHXRunShareContext`** to enable save multi-user execution
  - Each tool is copied to a temporary directory and executed there
- Input data coming from other components is
  - Synchronized between the three input levels / data views
  - Mapped by XSLT to meet a tool-specific XML input format
- Output data from the tool is then
  - Mapped and merged to the original input dataset
  - Provided for the tool's successors on all 3 levels

Data Roundtrip



Example of a Mapping File

```
<?xml version="1.0" encoding="UTF-8"?>
<map:mappings xmlns:map="http://www.dlr.de/sistec/tool/mapping">

  <map:mapping>
    <map:source>/result</map:source>
    <map:target>/configuration/application[@name="IBUCK"]/result</map:target>
  </map:mapping>

  <map:mapping>
    <map:source>/result/values</map:source>
    <map:target>/configuration/common/values</map:target>
  </map:mapping>

 <map:mapping>
    <map:source>/result/old_name</map:source>
    <map:target>/configuration/common/new_name</map:target>
  </map:mapping>
    .
    .
    .
</map:mappings>
```

Outlook

- ModelCenter Plugins
  - Integrating WebDAV support for all kinds of configuration
  - Add a versatile aggregator component to merge interim results
  - Automatic XML validation via XSD, more usability and usage safety
  - Provide linked satellite data in ModelCenter, if required by user

- TIXI + TIGL + **TUHL?** – Provide a new numerical scientific library

- Integration of our plugins into other frameworks

- We're looking forward for the coming features in ModelCenter 8, 9, 10 !

Questions?

http://www.walle-derfilm.de/