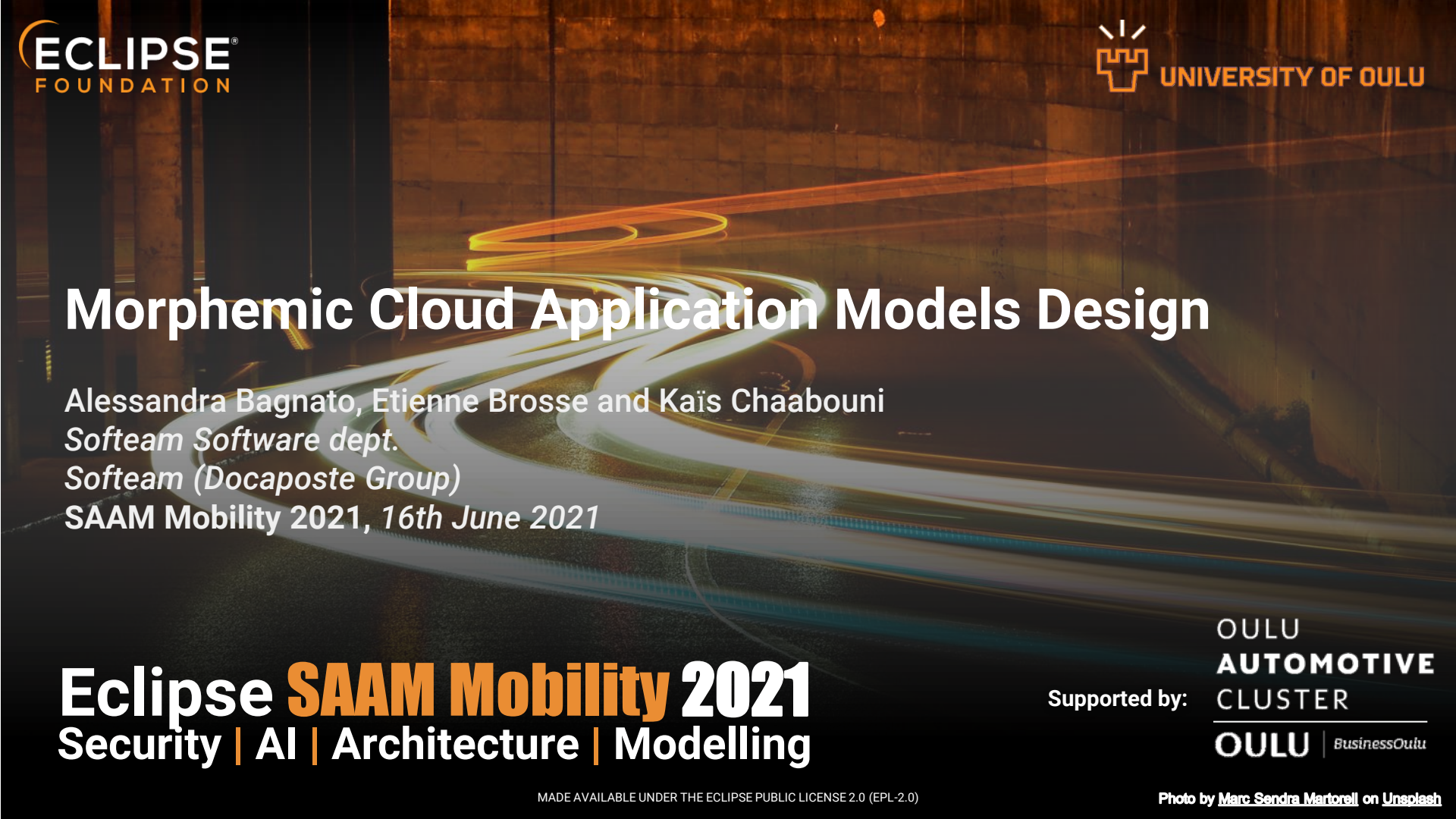

Morphemic Cloud Application Models Design

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Softeam Software dept.
Softeam (Docaposte Group)
SAAM Mobility 2021, *16th June 2021*

Eclipse SAAM Mobility 2021
Security | AI | Architecture | Modelling

Supported by:

MORPHEMIC

Vision

MORPHEMIC projects aims to simplify **Cloud application modelling** and **continuously optimize and morph the deployment model** to take advantage of beneficial Cloud capabilities

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 871643

Cloud Applications context

- MORPHEMIC is an extension of the MELODIC multi-cloud platform and is a single universal platform that facilitates and optimizes deployment and management of applications cross-cloud.

- *Cloud Applications can have v*ariable resource demand
  - Reactive to changing execution context
  - Balance of cost – performance – experience

- MORPHEMIC will provide the ability to optimally adapt in a reactive manner the form/architecture and deployment plan of a given application based on the application requirements and the current context.

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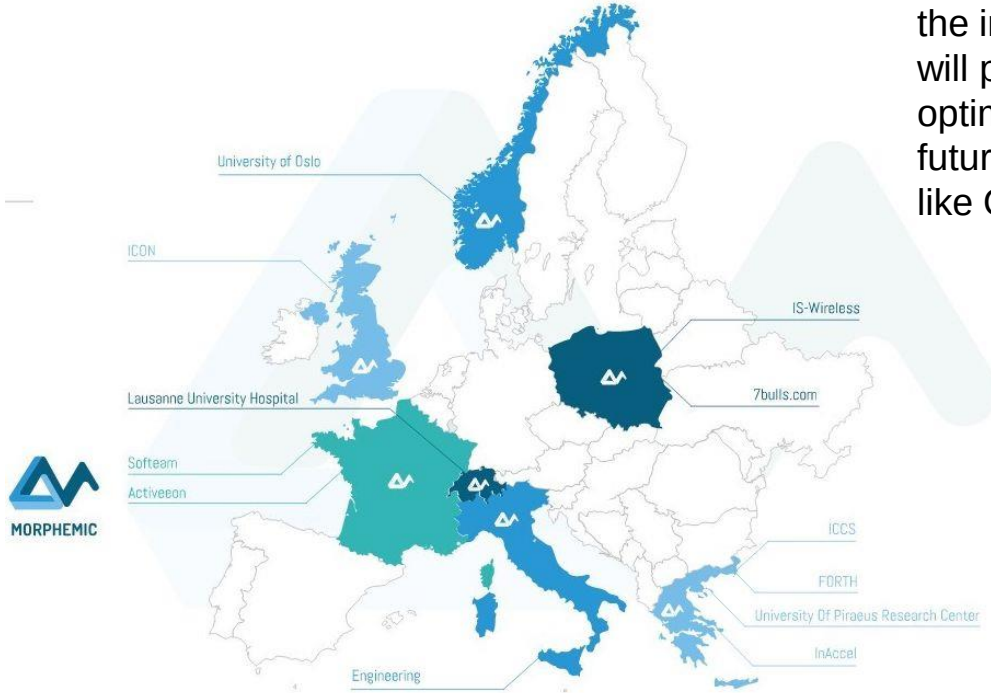
MORPHEMIC Consortium



12 partners from 7 countries are developing the innovative MORPHEMIC platform, which will provide a unique way of adapting and optimizing cloud computing applications for future specialized hardware configurations like GPUs, TPUs, AI chips, FPGA, HPC.

MORPHEMIC Project
https://www.morphemic.cloud/

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MORPHEMIC

Overview

- This talk describes the MORPHEMIC CAMEL Designer tool responsible of the Cloud Application Modelling and Execution Language (CAMEL) design for the modelling Environment Modelio.

- CAMEL Designer is an open source module for graphically creating, editing and exporting CAMEL Models in XMI format

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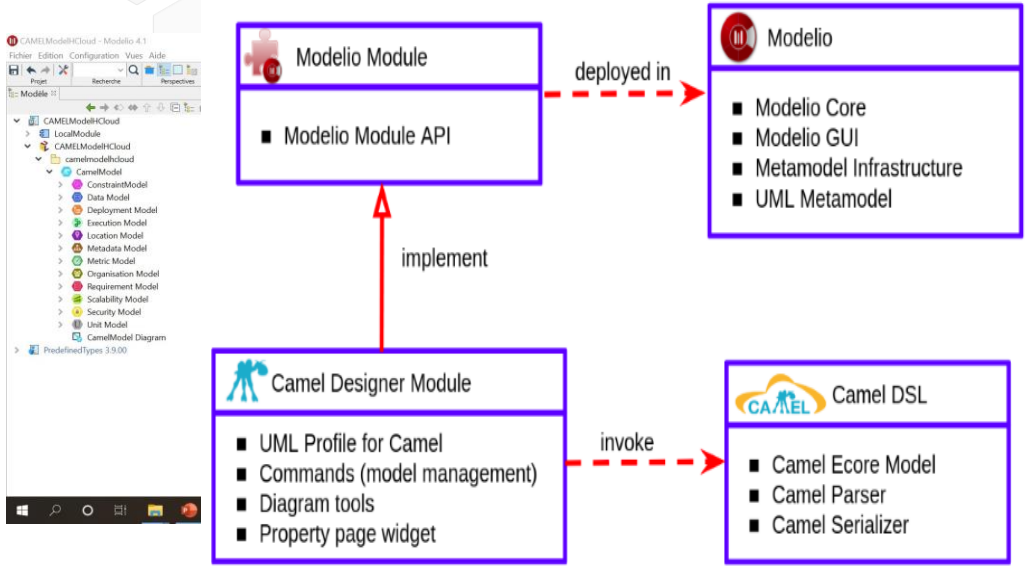
Cloud Application Modeling with the CAMEL Designer

- *The MORPHEMIC CAMEL Designer tool is responsible of the Cloud Application Modelling and Execution Language (CAMEL) design for the modelling Environment Modelio.*
- *CAMEL Designer is an open-source module for graphically creating, editing and exporting CAMEL Models in XMI format.*



modelio
the open source modeling environment

Modelio SOFTEAM UNE MARQUE DE DOCAPOSTE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 871643

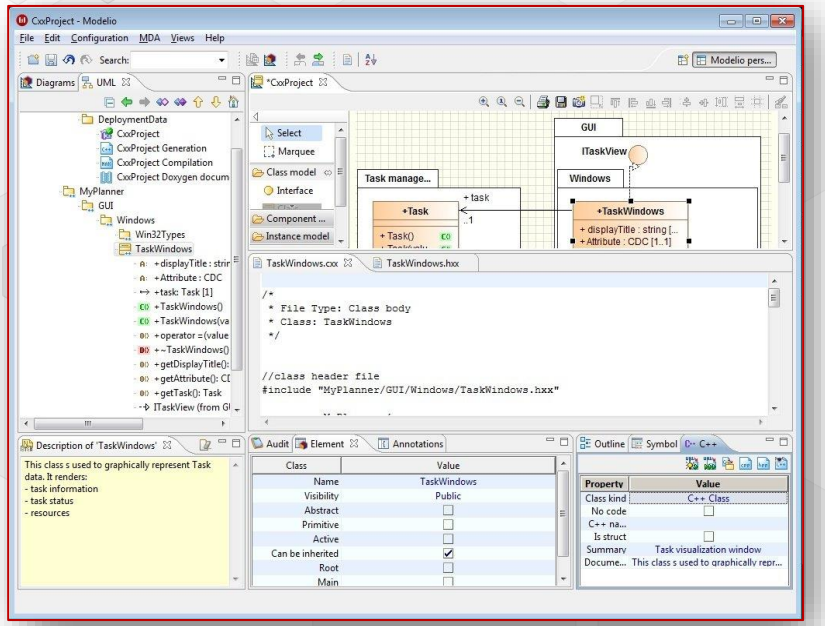
Modelio

Software and System Engineering

- UML editor with 25 years' history
  - Systems Engineering
    - Requirements,
    - SysML
    - Impact Analysis
    - Traceability features
    - MARTE, UTP2
    - TOGAF, BPMN
  - Code generation
  - Documentation
- Available under

  open source at

  Modelio.org



Commercial version at *https://www.modeliosoft.com/en/*

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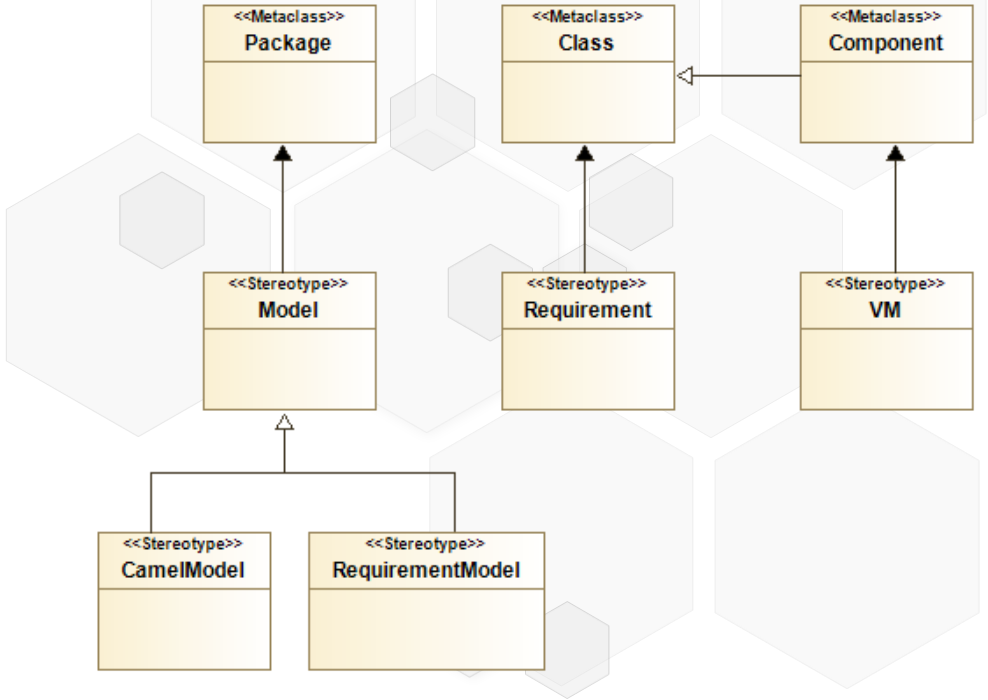
Modelio Development Process (1/2)

- Create the new concepts
  - By extending UML Metamodel
- Requires
  - UML/Modelio Knowledge
  - Concepts Metamodel/Examples
- Allow new concepts creation/modification
  - Commands for creation,
  - Views and tools for creation,
  - Property pages for editing.



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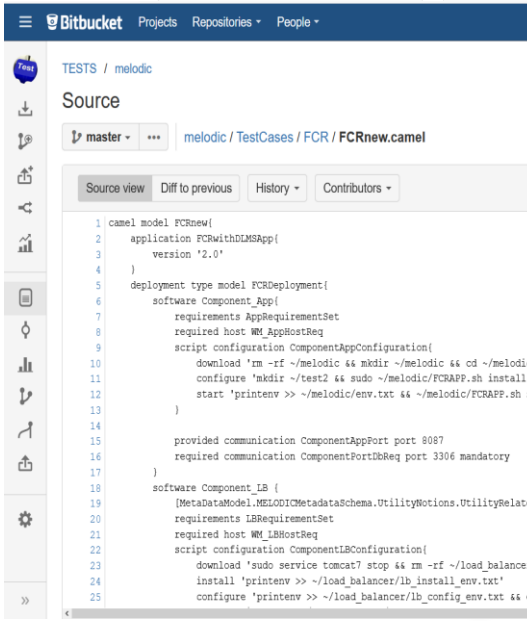
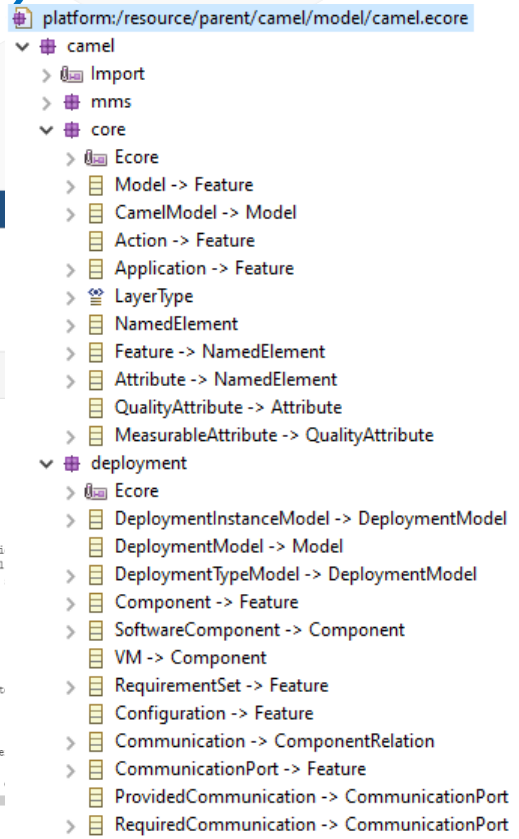
Modelio Development Process (2/2)

- Create customs commands
  - Import/export
- Facilitated by existing:
  - CAMEL DSL,
  - Examples.





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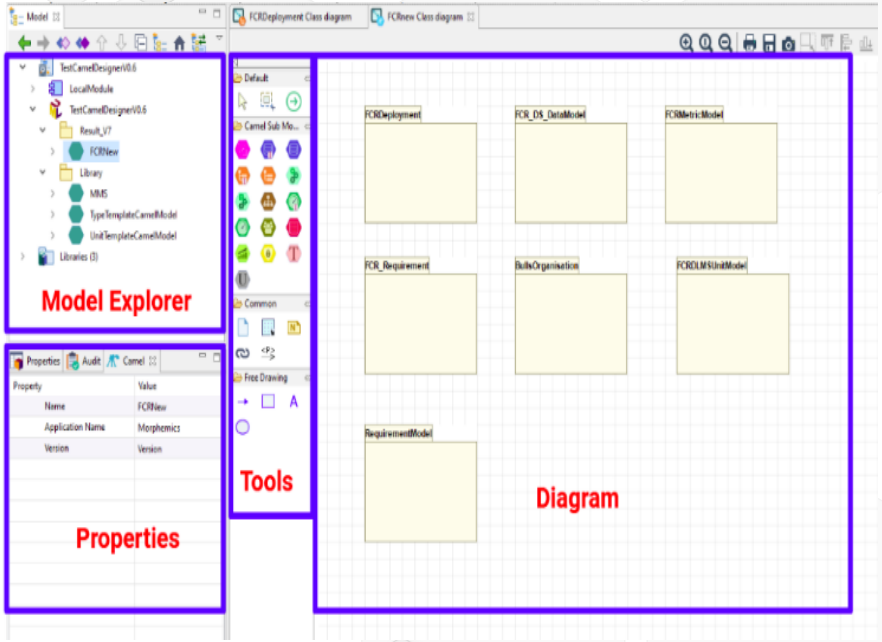
CAMEL Designer in the Modelio Modeling Tool

- *A model explorer shows the hierarchy of the persisted model elements and allows to create, delete and copy/paste other model elements*
- *A set of tools is provided for each diagram to allow the user to modify the model such as adding new elements, properties, dependencies or just customizing the visual appearance of the elements illustrated in the diagram*



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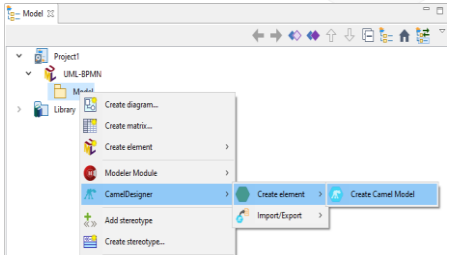
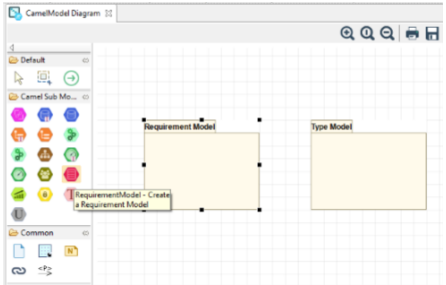
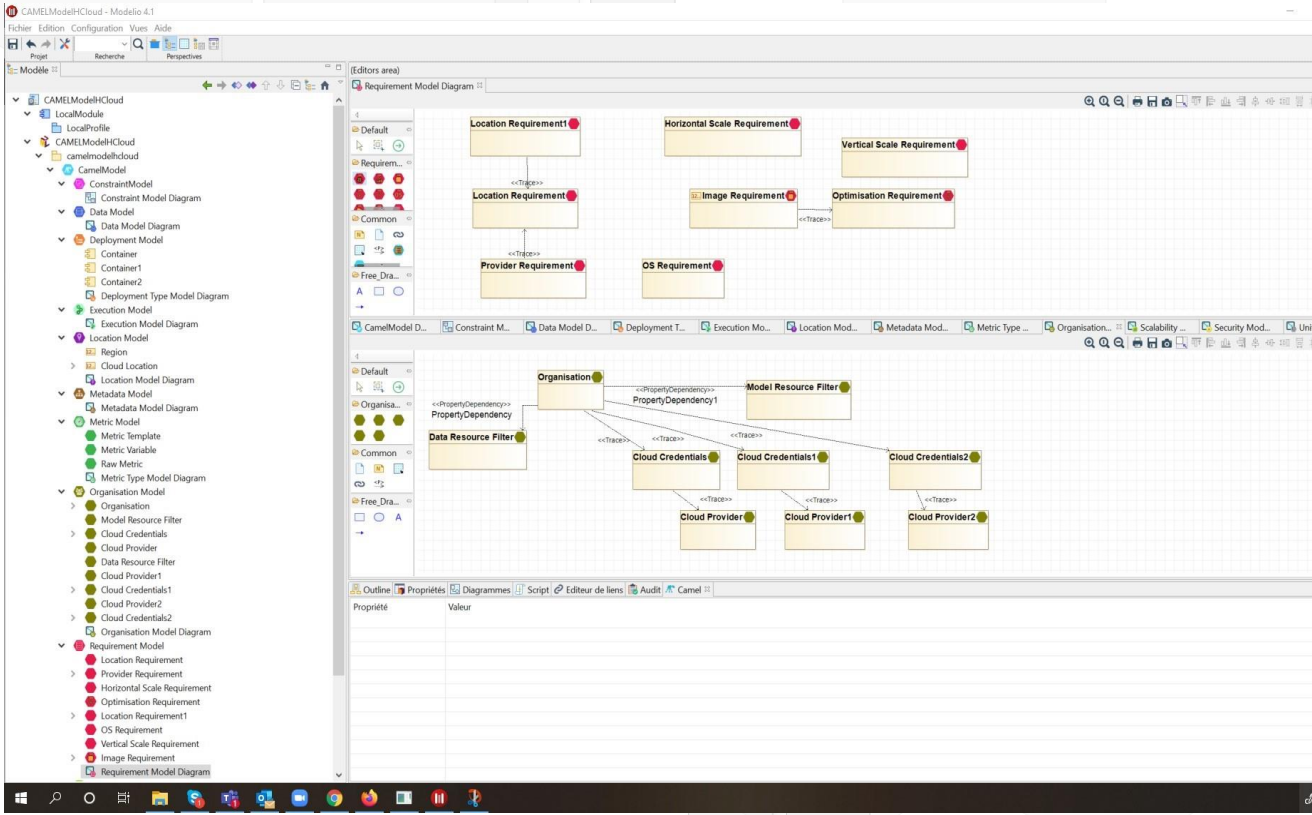
Cloud Application Modeling with the CAMEL Designer







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MORPHEMIC Use Cases & Applications

- MORPHEMIC project & Modelio CAMEL Designer tools currently are aiming at offering the achieved results to **all data and computation intensive organisations in need for the optimization of their existing cloud architecture and resources**.
- The developed module & the whole Morphemic platform will be applied in the next months to MORPHEMIC project's use cases
  - ICON's Computational Fluid Dynamics (CFD) products and expert services that support engineering analysis for a wide range of applications in the Automotive, Aerospace, Buildings, Health, Energy, Motorsport, Consumer Products and Space,
  - IS-Wireless (ISW) use cases showing a 5G software defined base station and
  - Lausanne University Hospital (CHUV) e-brain science and neuroimaging tools use cases.

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Use Case Example

- IS-Wireless has the ambition to deploy and adaptively provision its use-case application, exploiting 5G Software-defined Radio Access Networks (RAN), in cloud and hybrid (cloud & edge) environments.
- The generic requirements are the following:
  - the location of all components should be determined on a regional/country level granularity (e.g. deployment should be done in Poland)
  - each component has the requirements of 5 as minimum number of cores and 2 as the number of GBs for the RAM
  - the application average availability should be at least 99.999%

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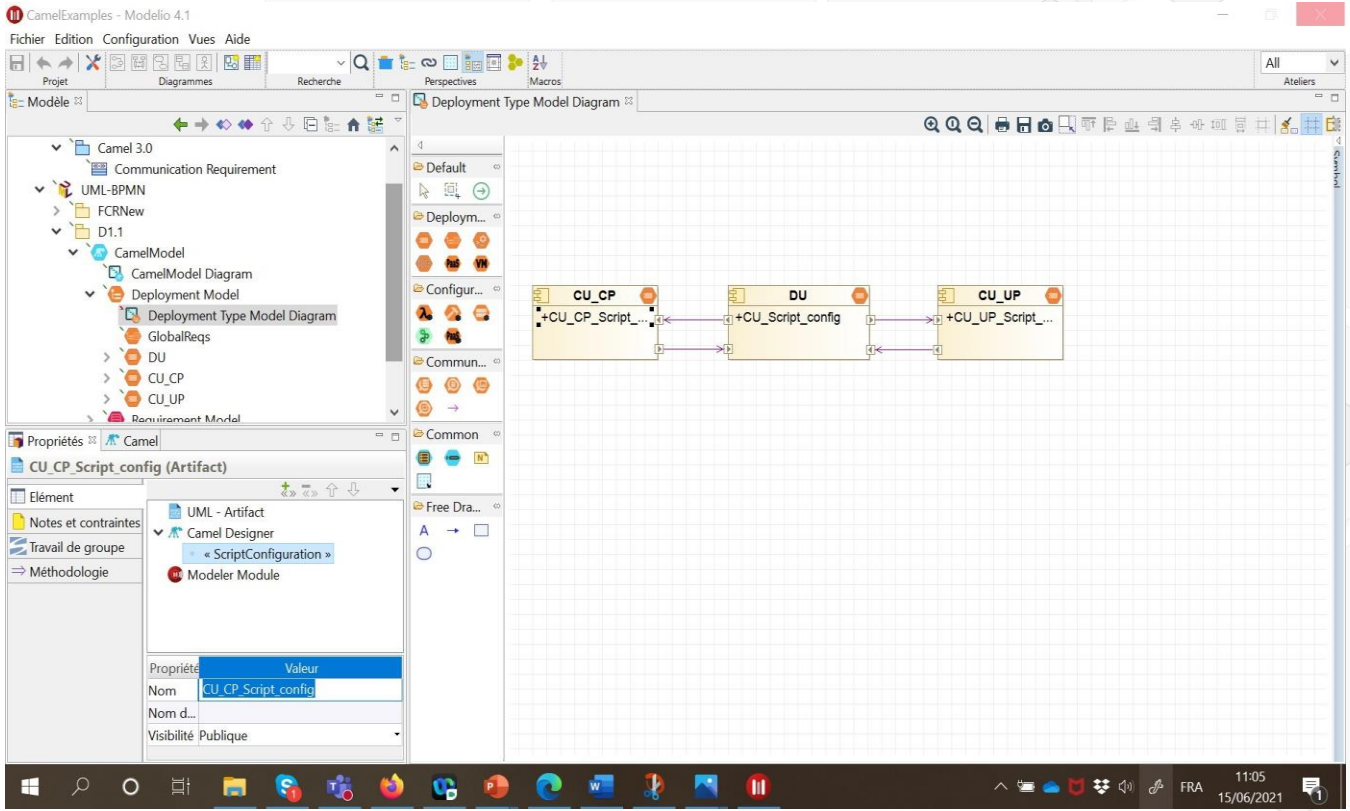
Example (1/3)



A Cloud RAN can comprise three main units on which the different protocols are distributed: the **Radio Unit (RU)** comprising low-level protocols, the **Distributed Unit (DU)** comprising intermediate-level protocols and the and the **Central Unit (CU)** comprising high-level protocols. The CU unit can be also separated into the **control (CP)** and **user plane (UP)** such that the respective parts, i.e., CU-CP and CU-UP can be independently managed and deployed. comprising high-level protocols.

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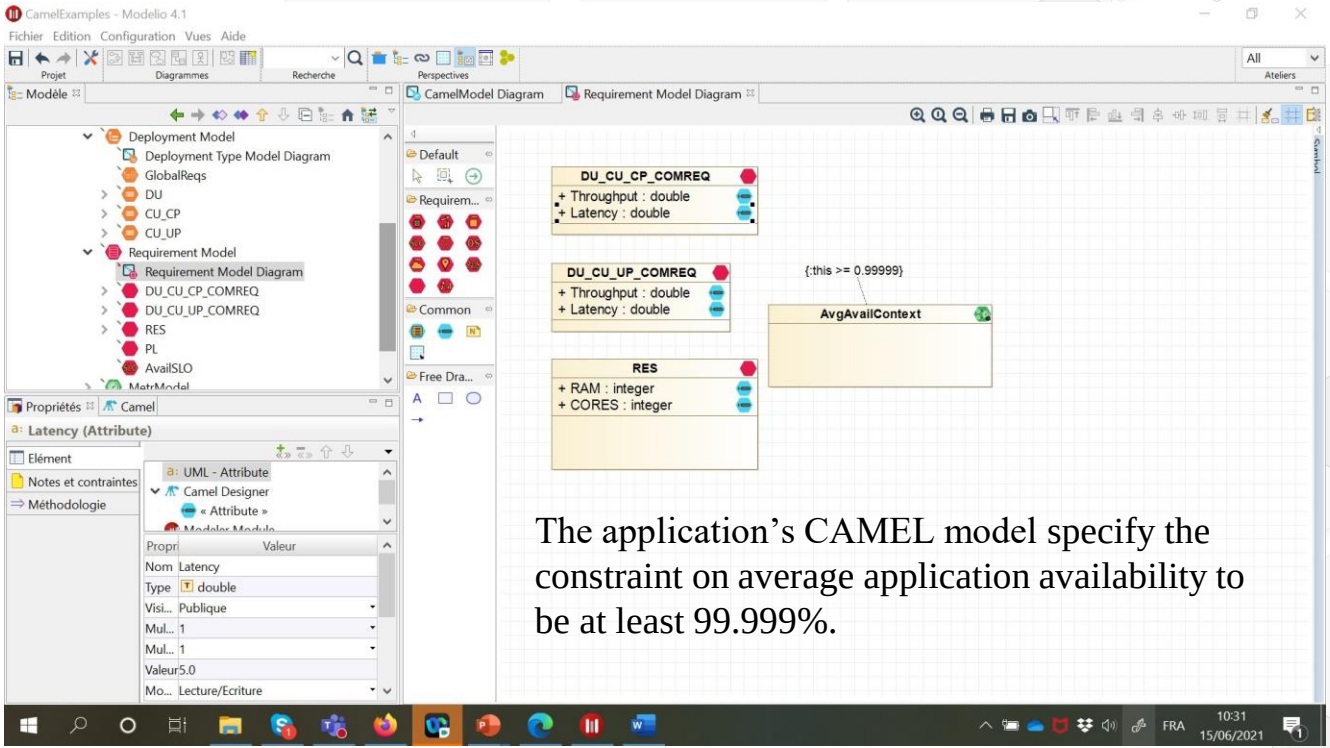
Example (2/3)



The application's CAMEL model specify the constraint on average application availability to be at least 99.999%.

The requirement model includes two link requirements covering the **quality of communication** between DU and CU-CP as well as between DU and CU-UP. Each communication requirement involves the specification of two attributes that define the respective **constraints on communication latency** and **throughput**.

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Example (3/3)

Snippet of application's CAMEL model covering the requirement, metric and constraint domains, each component has the requirements of 5 as minimum number of cores and 2 as the number of GBs for the RAM

```
requirement model ReqModel {
  link requirement DU_CU_CP_COMREQ {
    attribute Throughput
      [MetaDataModel.MELODICMetadataSchema.ApplicationPlacementModel.IaaS.Network
      Entity.Network.NetworkQoS.hasTxput] : double 0.1
    attribute Latency
      [MetaDataModel.MELODICMetadataSchema.ApplicationPlacementModel.IaaS.Network
      Entity.Network.NetworkQoS.hasLatency] : double 5.0
  }
  link requirement DU_CU_UP_COMREQ{
    attribute Throughput
      [MetaDataModel.MELODICMetadataSchema.ApplicationPlacementModel.IaaS.Network
      Entity.Network.NetworkQoS.hasTxput] : double 4.0
    attribute Latency
      [MetaDataModel.MELODICMetadataSchema.ApplicationPlacementModel.IaaS.Network
      Entity.Network.NetworkQoS.hasLatency] : double 1.0
  }
  resource requirement RES{
    attribute RAM
      [MetaDataModel.MELODICMetadataSchema.ApplicationPlacementModel.IaaS.Cloud.V
      MFlavor.hasRAM] : int 2 TrafficSimulationUF.CRMUnitModel.GigaBytes
    attribute CORES
      [MetaDataModel.MELODICMetadataSchema.ApplicationPlacementModel.IaaS.Processi
      ng.CPU.hasMinNumberofCores] : int 5
  }
  location requirement PL [Locations.PL]
  slo AvailSLO constraint ConstrModel.AvailConstr
}
metric type model MetrModel{
  composite metric context AvgAvailContext{
    metric MetricTemplateCamelModel.MetricTemplateModel.AverageAvailability
    grouping global
  }
}
constraint model ConstrModel{
  metric constraint AvailConstr : [ MetrModel.AvgAvailContext] >= 0.99999
  }
}
```

The communication-specific requirements concern the quality of the communication between pairs of components:

- The latency between DU and CU-CP should be at most 5 (milliseconds) while the throughput at least 0.1 Gbps for both directions of communication.
- The latency between DU and CU-UP should be at most 1 (millisecond) while the throughput at least 4 Gbps for both communication directions .

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Cloud Application Modeling with the CAMEL Designer

- *The MORPHEMIC CAMEL Designer tool,* Cloud Application Modelling and Execution Language (CAMEL) *is avalable for Modelio 4.1 on Modelio R&D GitHub at* ***https://github.com/Modelio-R-D/CamelDesigner***
- *Modelio Open-source Community and environnent are available at* ***modelio.org***

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Thanks!!

MORPHEMIC

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Thank you!

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The research leading to these results has received funding from the European Union Horizon 2020 research and innovation programme under grant agreement No 871643. The authors wish to thank all the MORPHEMIC Consortium members and the Softeam Software BU team for their support.

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