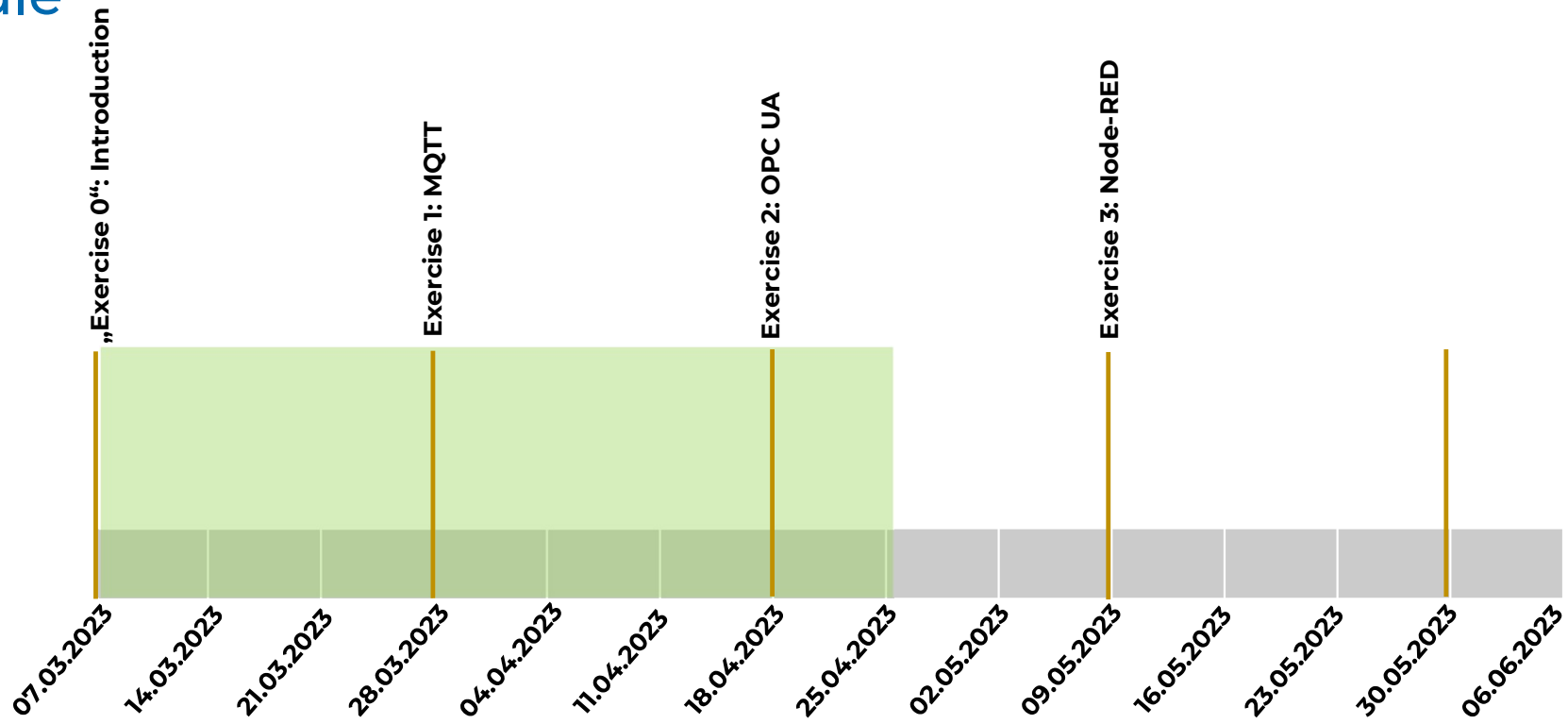
Exercise 2

Implementation of a small OPC UA Server application using a custom modeled OPC UA node set

Schedule


„Exercise 0“: Introduction
Exercise 1: MQTT
Exercise 2: OPC UA
Exercise 3: Node-RED
07.03.2023
14.03.2023
21.03.2023
28.03.2023
04.04.2023
11.04.2023
18.04.2023
25.04.2023
02.05.2023
09.05.2023
16.05.2023
23.05.2023
30.05.2023
06.06.2023

Requirements for Exercise 2

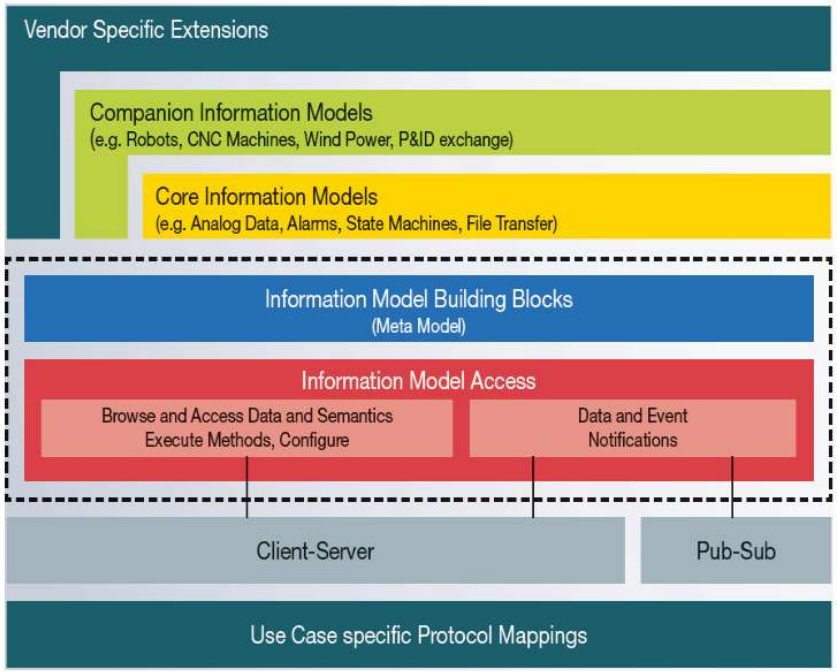
- Knowledge
  - Basic understanding about the concept of Service-oriented Architectures
  - Basic understanding about the OPC UA protocol
  - Basic understanding about the OPC UA information model and its components (Nodes, Objects, Methods, Types, Views, etc.)

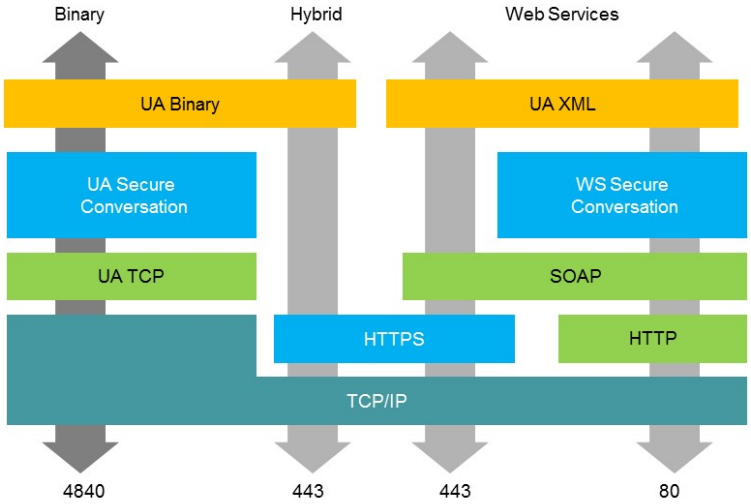
- Installed Libraries/Tools
  - OPC UA library: FreeOpcUa (asyncua) for Python
  - OPC UA Client: UaExpert
  - OPC UA Model: UaModeler

OPC UA

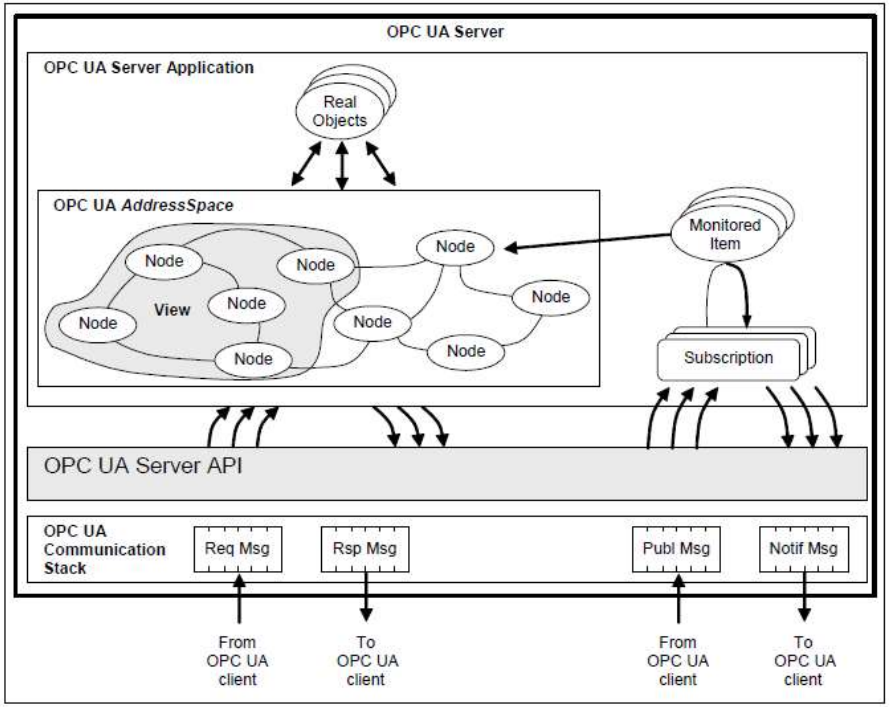
„The OPC Unified Architecture (UA), released in 2008, is a platform independent service-oriented architecture that integrates all the functionality of the individual OPC Classic specifications into one extensible framework.“
(OPC Foundation)

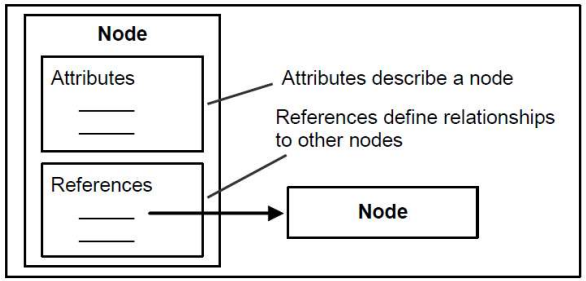
OPC UA

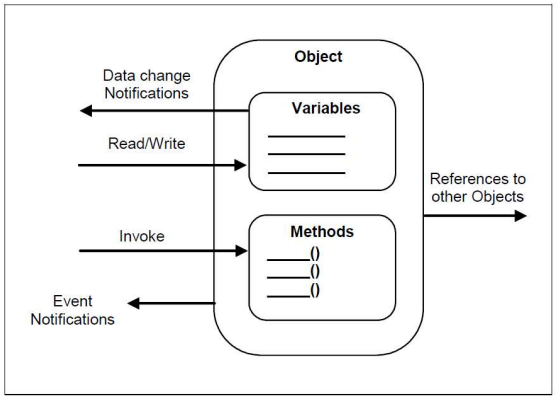

Vendor Specific Extensions
Companion Information Models
(e.g. Robots, CNC Machines, Wind Power, P&ID exchange)
Core Information Models
(e.g. Analog Data, Alarms, State Machines, File Transfer)
Information Model Building Blocks
(Meta Model)
Information Model Access
Browse and Access Data and Semantics
Execute Methods, Configure
Data and Event
Notifications
Client-Server
Pub-Sub
Use Case specific Protocol Mappings


Binary
Hybrid
Web Services
UA Binary
UA XML
UA Secure
Conversation
WS Secure
Conversation
UA TCP
SOAP
HTTPS
HTTP
TCP/IP
4840
443
443
80

OPC UA Server



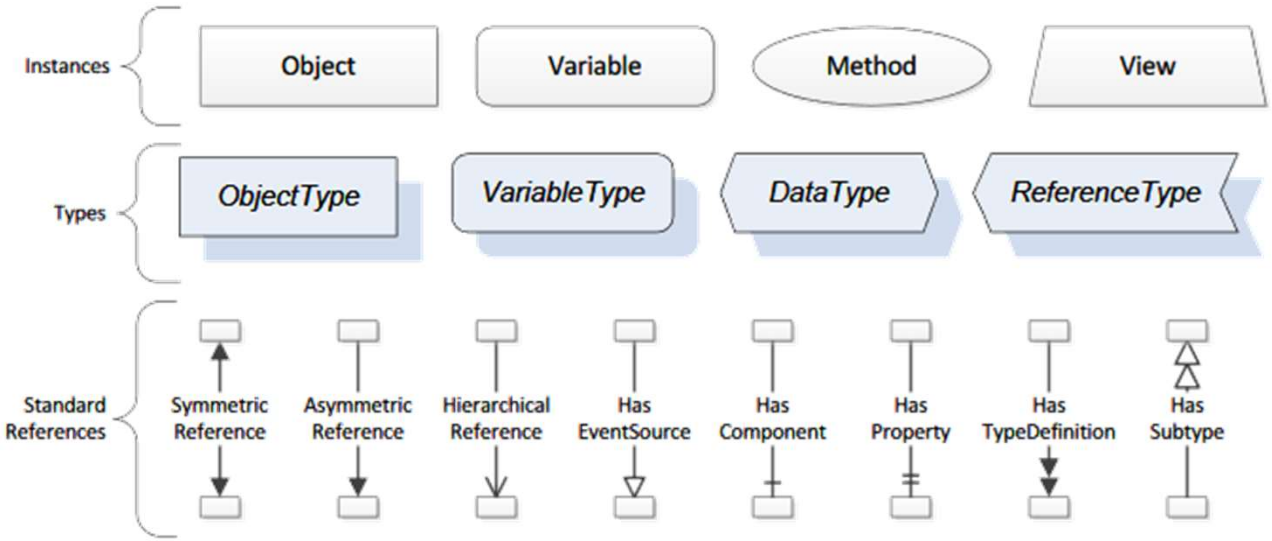




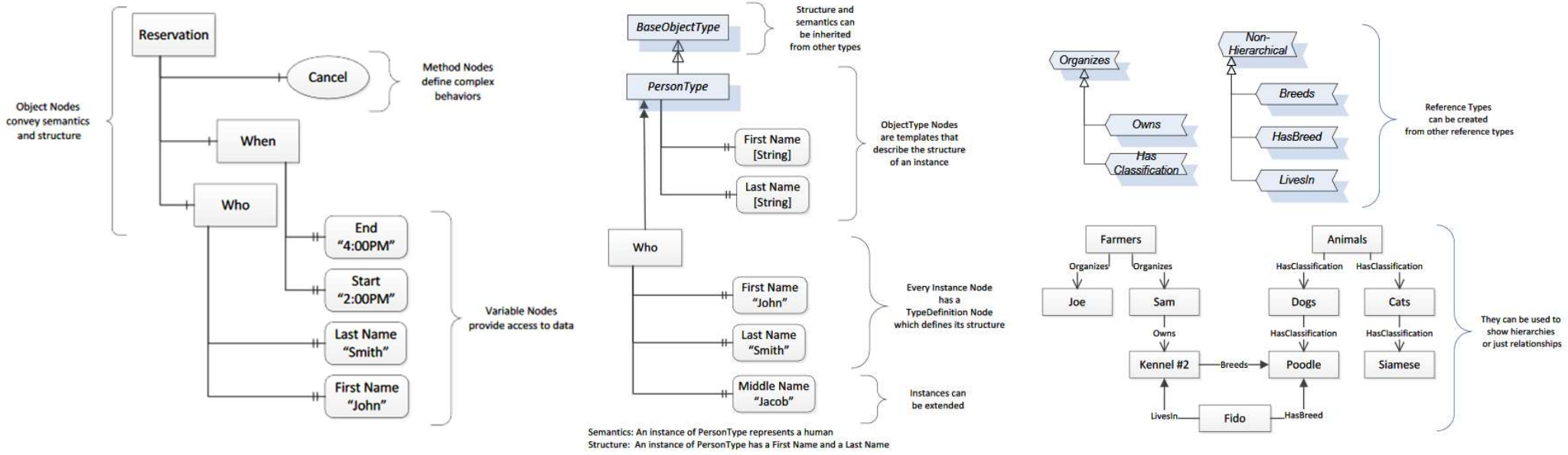
Nodes

- Can have different NodeClasses, e.g.:
  - Variables
  - Objects
  - Methods
- Depending on NodeClass, Nodes can have different NodeTypes, e.g.
  - VariableTypes: BaseVariableType, ServerStatusType
  - ObjectTypes: BaseObjectType, FolderType, FileType

OPC UA Information Model



OPC UA Information Model



OPC UA Client with UA Expert

- How to get UA Expert:
  - https://www.unified-automation.com/downloads/opc-ua-clients.html

OPC UA Modelling with UA Modeler

- How to get UA Modeler:
  - https://www.unified-automation.com/products/development-tools/uamodeler.html

OPC UA Stacks and SDKs

Name	Developer	Language	Type	Licence	Comment
OPC UA Stack	OPC Foundation	.NET/Java/C	Stack	Open Source	Only .NET Stack is still maintained
Eclipse Milo	Eclipse Foundation	Java	SDK	Open Source	
Open62541	Fraunhofer IOSB, RWTH Aachen, TU Dresden and others	C	SDK	Open Source	
freeOpcUa	Open Source Community	C++/Python	SDK	Open Source	certified
OPC UA SDK	Unified Automation	C/C++/.NET/Java/Delphi	SDK	Commercial	certified
PubSub SDK	Unified Automation	C++	SDK	Commercial	
dataFEED SDK	Softing	C++/.NET	SDK	Commercial	certified

Task Description

1. Use the same example module as in Exercise 1
2. Use an **OPC UA Modeler** to model your module in an OPC UA node set
3. Build an **OPC UA Server** using the FreeOpcUa Framework
4. Use an **OPC UA Client** to test your server

Minimal Requirements for your solution

- Executable OPC UA Server
- Server offers at least **5** different **data points**
  - Error messages
  - Regular updates of sensor/machine data
  - Status information
- Server offers at least **1** OPC UA **method**
- Model your system in an object-oriented manner
- Create at least **1** custom **ObjectType** for your system
- Create at least **1** custom **reference** between two nodes in your node set
- Results must be able to be demonstrated in the lecture

OPC UA implementation in Python

- How to get OPC UA for Python (requires python installation):
  - https://github.com/FreeOpcUa/opcua-asyncio

Tutorials/Examples

- Python OPC UA tutorials/examples:
  - Server:
    - Minimal example: https://github.com/FreeOpcUa/python-opcua/blob/master/examples/server-minimal.py
    - Youtube Tutorial: https://www.youtube.com/watch?v=NbKeBfK3pfk
  - Client:
    - Minimal example: https://github.com/FreeOpcUa/python-opcua/blob/master/examples/client-minimal.py
    - Youtube Tutorial: https://www.youtube.com/watch?v=12dnhcEmrU0

Companion Information Models for Download

https://github.com/OPCFoundation/UA-Nodeset

Questions?