


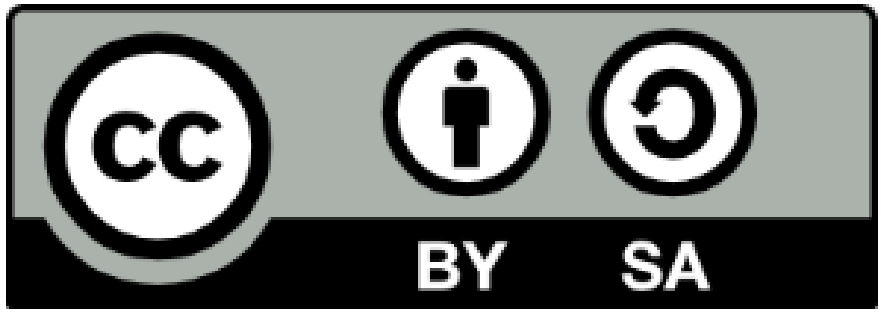

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# eFMI® Tutorial – Agenda

Part 1: eFMI® motivation and overview (40 min)

Part 2: Running use-case introduction (10 min)

Part 3: Hands-on demonstration in Dymola and
Software Production Engineering (former name CATIA ESP) (25 min)

*Coffee break (30 min)*

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Part 4: Live demonstration in TargetLink (30 min)

Part 5: Short presentation of further tooling (5 min)

Part 6: Conclusion (5 min)

**Tutorial leader:**
**Christoff Bürger**

DASSAULT SYSTEMES

**Presenter:**
**Oliver Lenord**

BOSCH
Invented for life

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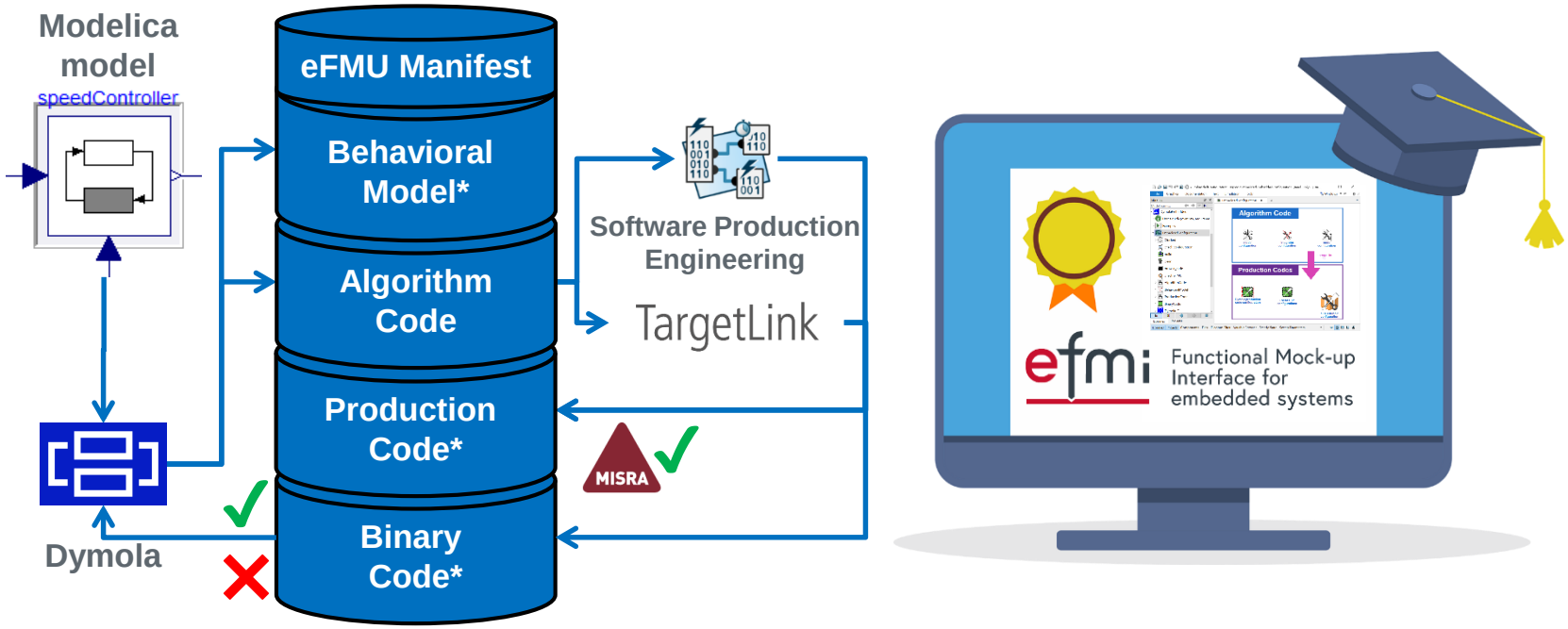
efmi Functional Mock-up Interface for embedded systems



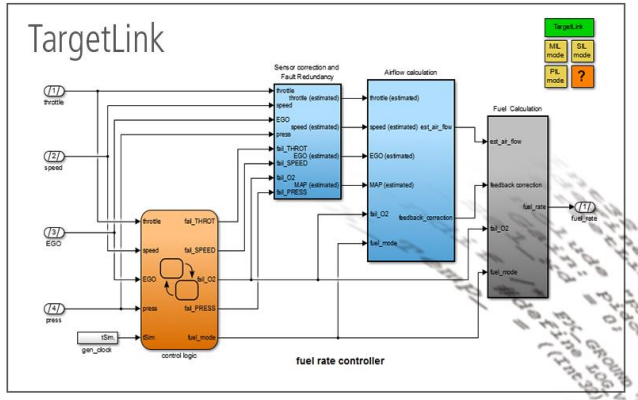

# Part 4: Live demonstration in TargetLink

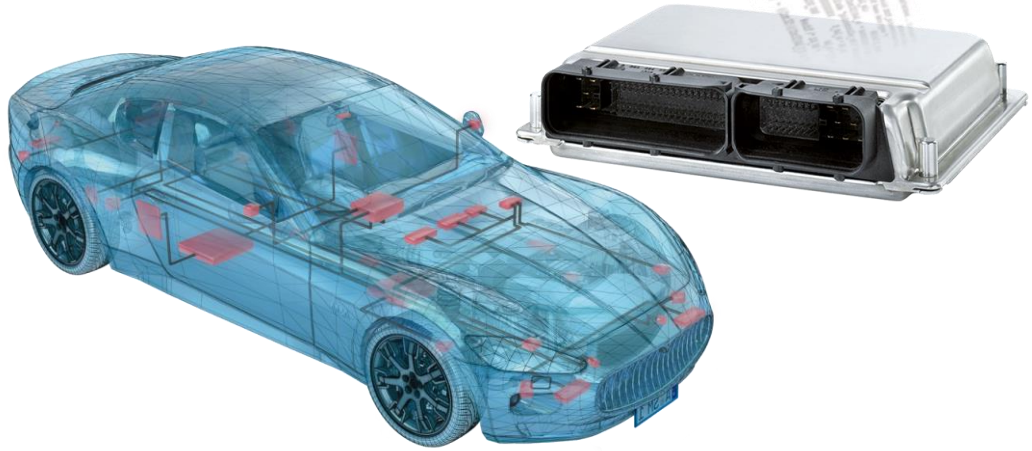
**eFMI® Tutorial – 15th International Modelica Conference – 9th of October 2023**

Jörg Niere
dSPACE GmbH
JNiere@dspace.de

# TargetLink – Driving the Future with Autocode

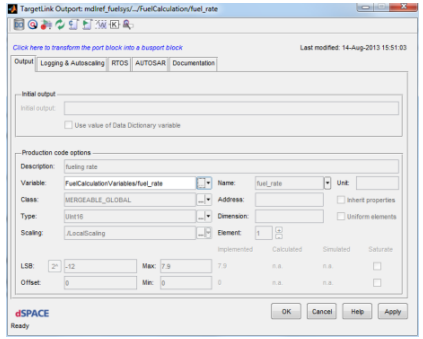
- High-quality production code generation directly from Simulink/Stateflow
  - Highly efficient for fixed-point and floating point
  - Well readable and traceable code
  - Highly configurable
- Powerful software design and testing features
  - MIL/SIL/PIL simulation concept
  - Push-button solution with integrated data logging and plotting concept
  - Code profiling, code coverage analysis and much more …
- High-performance, native AUTOSAR support
- Certified for IEC 61508, ISO 26262 and ISO 25119
- Powerful Ecosystem for model-based development
- TargetLink - Generates exactly the code that you want!



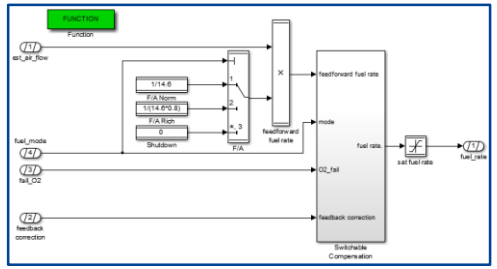



# TargetLink Ecosystem – Powerful MBD Tool Chain

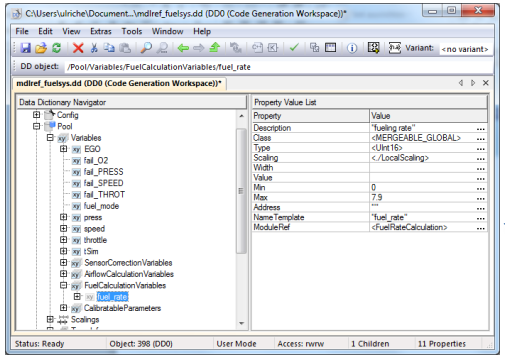
# TargetLink Features (excerpt)



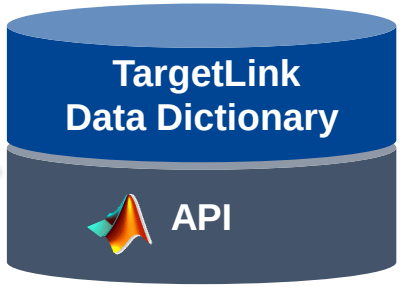
Block dialogs



Separation of model and data

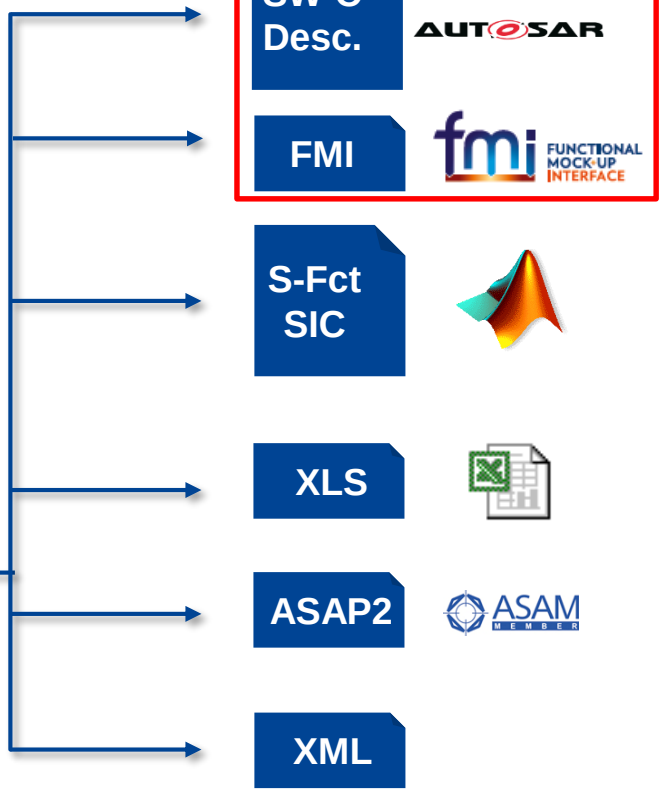


TargetLink Data Dictionary Manager



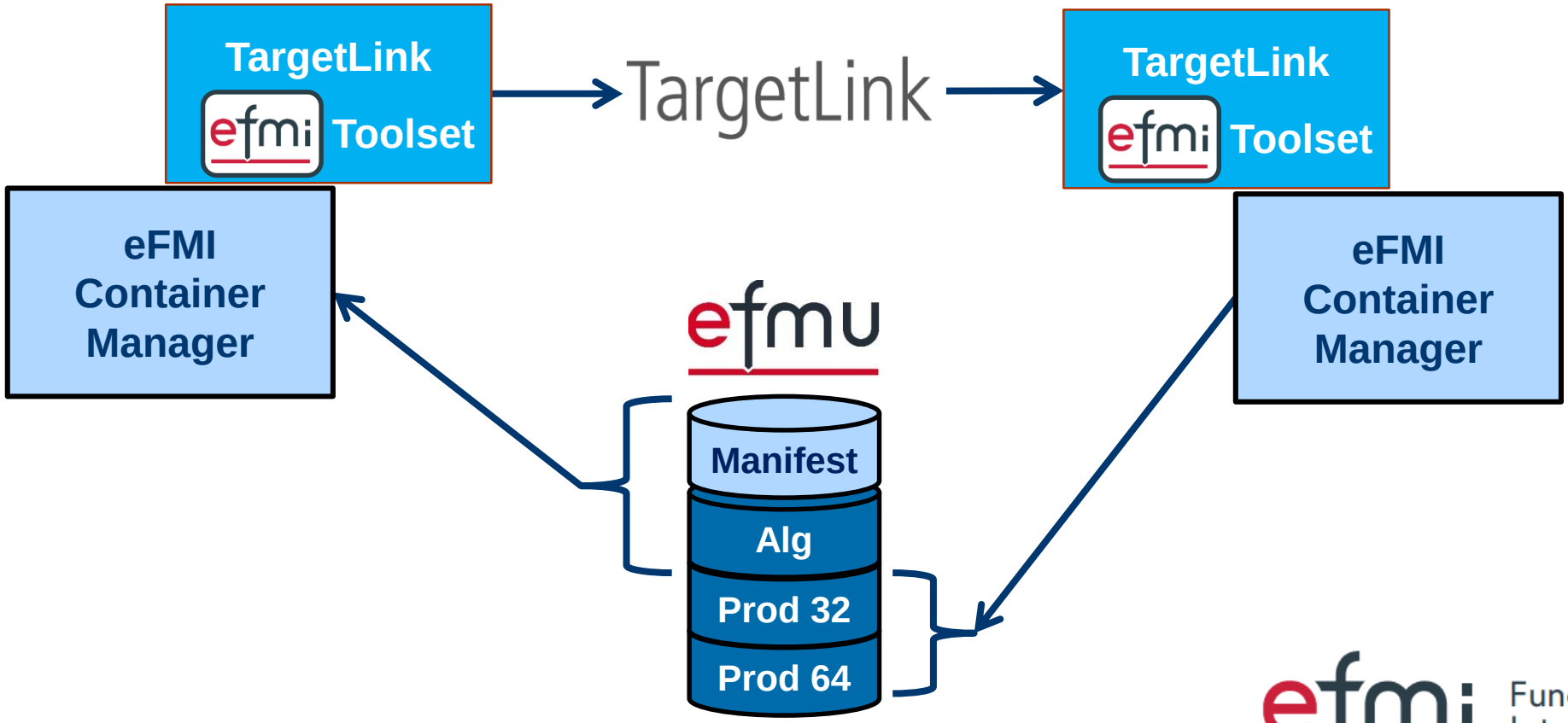

Import

Export




**Dedicated support for AUTOSAR, FMI and other important automotive standards**

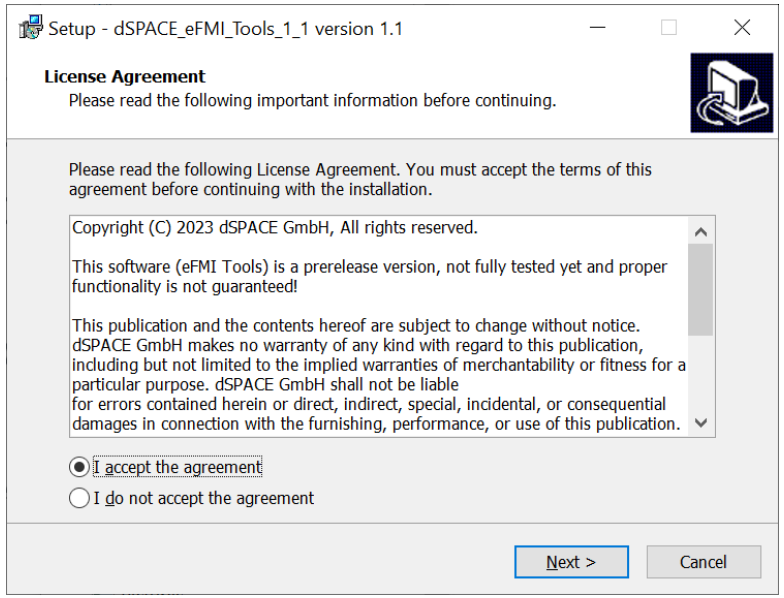
# TargetLink eFMI Support




efmi Functional Mock-up Interface for embedded systems

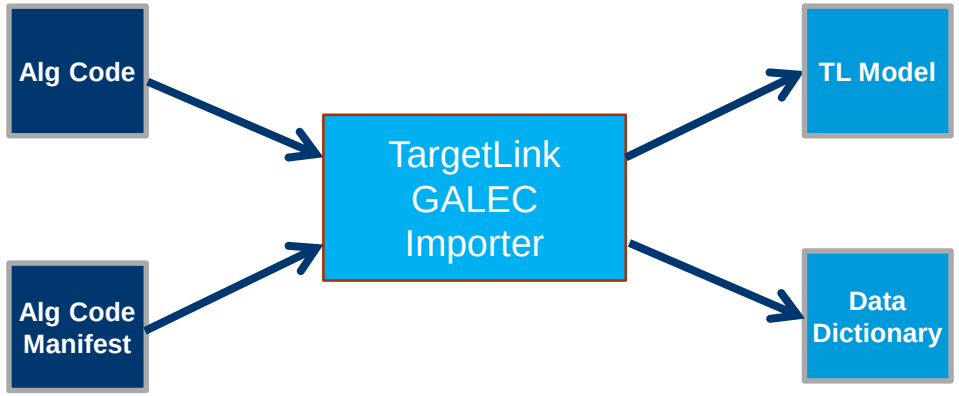
# TargetLink eFMI Toolset

- How to get it?
  - Send mail to support@dspace.de or efmi-info@googlegroups.com
- Toolset based on TL22.1 Release/p4 or TL 23.1 Release
- Comes along as .zip file
  - Disclaimer
  - Involved 3rd party software
  - dSPACE Eula
  - Installer executable
- Installed toolset
  - Is portable, no registry entry or connection to TL version
  - C# CLI applications, easy integration into tool chain (e.g. Python scripts)
    - .NET framework 4.8 or higher is needed
- eFMI Container Manager needed (open source by MAP eFMI)



# TargetLink GALEC Importer

- Input: GALEC code file and associated manifest file
- Output: Generated input for the TargetLink code generator

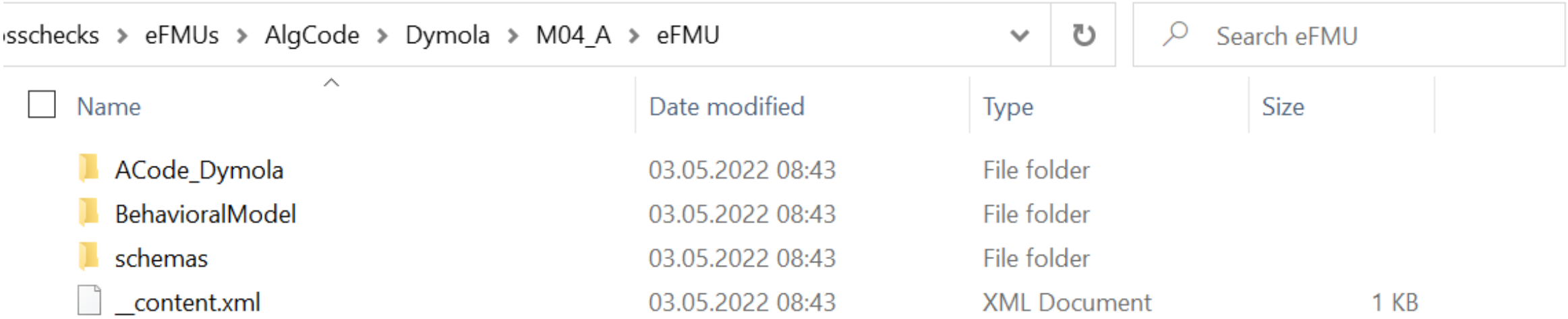


# TargetLink Manifest Creator

- Input: Data Dictionary file augmented by TargetLink code generator
- Output: Manifest file for production code generated by TargetLink


- Consistency checks:
  - Generated XML tree is validated against the schema
  - References within the manifest are checked against the rules of the specification

# Demo: Enhance eFMU with Production Code



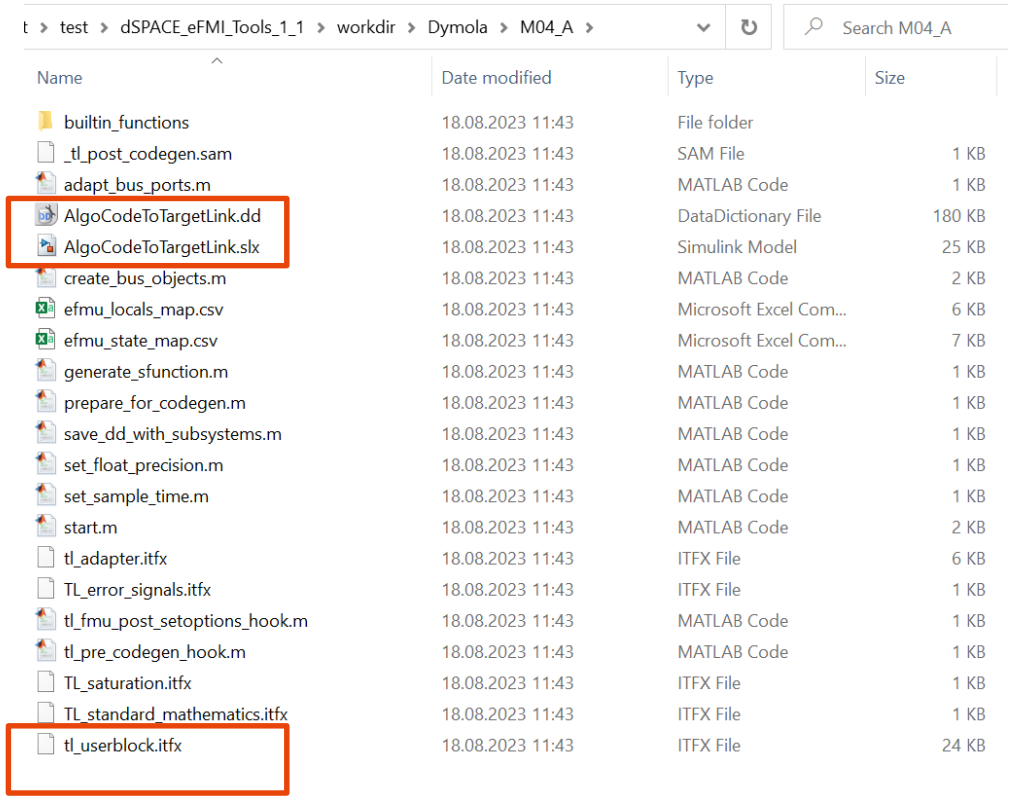
# Demo: Extract and Compile Algorithm Code

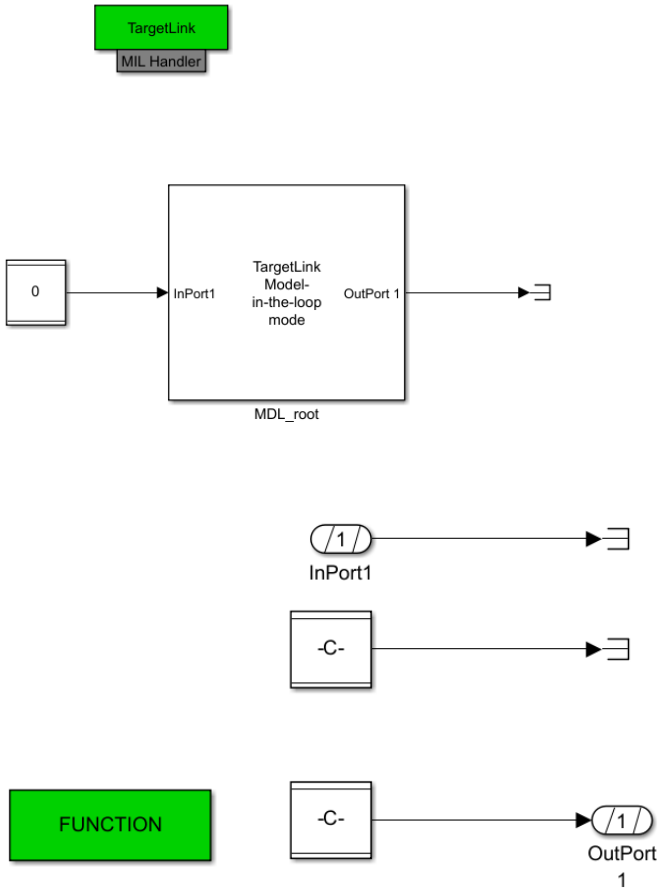
```
>>> Performing semantic analysis

>> Building intermediate code representation from AST (including name analysis)

>> Reading AlgoCode manifest
> Validating XML tree against schema (AlgoCode manifest file)
=> XML tree has been validated successfully
Warning: Found UnitDefinitions element in AlgoCode manifest, but it is not supported yet

>> Checking consistency between AST and manifest

>> Performing type analysis

>>> Generating code generation tree (CGT) from AST and intermediate code representation

>>> Performing analysis and optimization on CGT

>>> Generating input for TargetLink code generator
Generating files to directory: workdir\Dymola\M04_A
IntegrationMode is DISABLED

Note: Interprocedural optimization ignoring initializations in Startup() like constant propagation has been disabled, be
cause no manifest has been provided or some non-interface model variables are missing (maybe due to obfuscation)

Generating data dictionary ...
Generating model ...
```

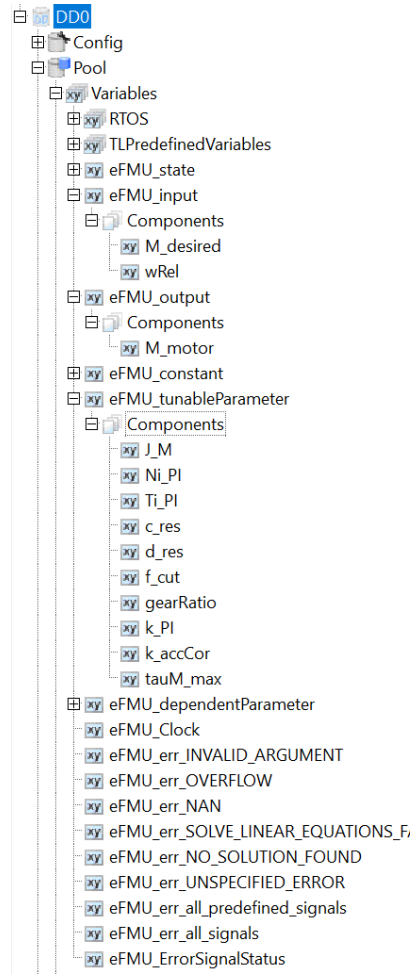
TargetLink GALEC Importer

Functional Mock-up Interface for embedded systems

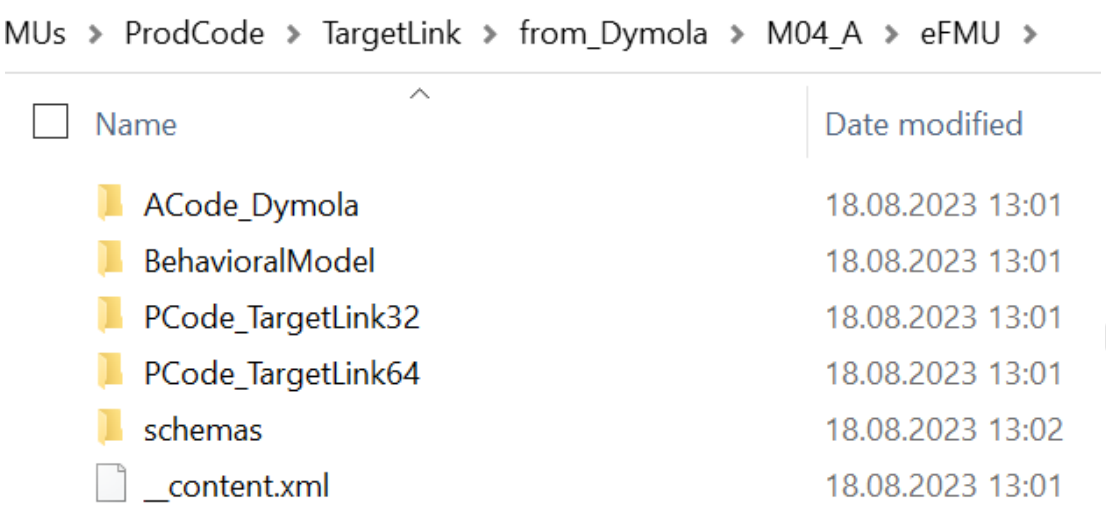
# Demo: Prepared TargetLink Model and Data Dictionary



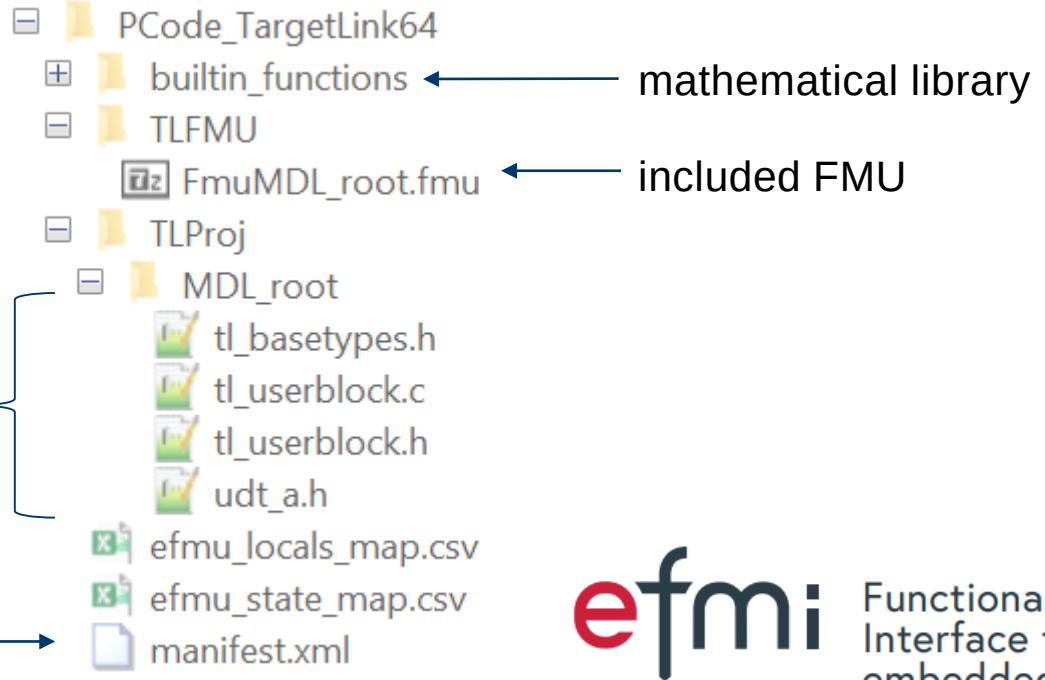



# Demo: Enhanced eFMU with Production Code




TargetLink Manifest Creator

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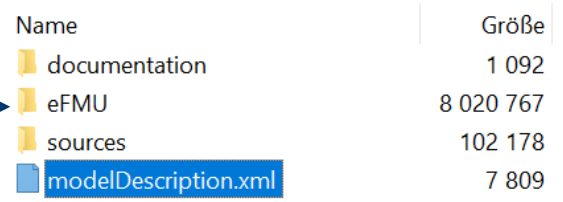
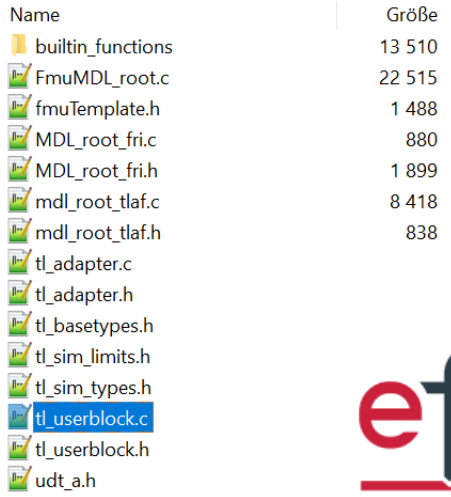
# Demo: Manifest with FMU entry

```
<?xml version="1.0" encoding="utf-8"?>
<Manifest efmiVersion="1.0.0" xsdVersion="0.17.0" id="{ee0d531e-3d0b-46b6-9ade-019cae7ef0de}" kind="ProductionCode" name="AlgoCodeToTargetLink" generationDateAndTime="2
  <ManifestReferences>
    <ManifestReference id="ID_MNFST_1" manifestRefId="{d447bd03-ec94-4ef6-b6d8-778fd76111c5}" checksum="08c46df1a3351dac864ab9b855acad0e5a373929" origin="true" />
  </ManifestReferences>
  <Files>
    <File id="ID_FILE_tl_basetypes.h_1" name="tl_basetypes.h" path="./TLProj/MDL_root/" needsChecksum="true" checksum="6c48b26c85a43185773e4f6179374896f6c3ca73" role="C
    <File id="ID_FILE_udt_a.h_2" name="udt_a.h" path="./TLProj/MDL_root/" needsChecksum="true" checksum="611d17bf0e156e8d68106b98c3d1dfd50006aaad" role="Code" />
    <File id="ID_FILE_tl_userblock.h_3" name="tl_userblock.h" path="./TLProj/MDL_root/" needsChecksum="true" checksum="26b7387d00056321a071ec36fc33defeb85a99bb" role="C
    <File id="ID_FILE_tl_userblock.c_4" name="tl_userblock.c" path="./TLProj/MDL_root/" needsChecksum="true" checksum="009558e9d38a18da2cf28e393f471c44533a79ff" role="C
    <File id="ID_FILE_TL_error_signals.h_5" name="TL_error_signals.h" path="./builtin_functions/" needsChecksum="true" checksum="f06af138be466b9ff95e603529da944d51efc7a
    <File id="ID_FILE_TL_error_signals.c_6" name="TL_error_signals.c" path="./builtin_functions/" needsChecksum="true" checksum="9fafe841e7610c505745246e6ae95dc5df77bfb
    <File id="ID_FILE_TL_saturation.h_7" name="TL_saturation.h" path="./builtin_functions/" needsChecksum="true" checksum="1f7a6a1f60892ba75872b1e0ef989145a7eb8270" rol
    <File id="ID_FILE_TL_standard_mathematics.h_8" name="TL_standard_mathematics.h" path="./builtin_functions/" needsChecksum="true" checksum="5f34c21ef63318c0d628e2f11
    <File id="ID_FILE_TL_standard_mathematics.c_9" name="TL_standard_mathematics.c" path="./builtin_functions/" needsChecksum="true" checksum="bb0dc80b2cf3fbde891e447f2
    <File id="ID_FILE_TL_float_precision.h_10" name="TL_float_precision.h" path="./builtin_functions/" needsChecksum="true" checksum="6188fe4cf59fc429d0894e061fd423b147
    <File id="ID_FILE_TL_primitive_types.h_11" name="TL_primitive_types.h" path="./builtin_functions/" needsChecksum="true" checksum="cc86ea69ab84280b7cf109a50c5272d919
    <File id="ID_FILE_FmuMDL_root.fmu_12" name="FmuMDL_root.fmu" path="./TLFMU/" needsChecksum="true" checksum="4cbed48abbeceea1412534748124acbf18d5ff01" role="FMU" />
  </Files>
```

eFMI Container Manager
unpackFMU

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# What else to do with TargetLink?

- Simulate model in TargetLink (SIL) with data from Behavioral Model
  - E.g., single-precision vs. double-precision
- Reconfigure Data Dictionary to generate AUTOSAR Classic/Adaptive code
- Generate .a2l file to be used in calibration tools
- Generate Matlab S-function to be used in MIL mode
- Use block in other models
  - Copy
  - Library
  - Model referencing
- Use TargetLink Custom Code block to integrate generated code
- Generate V-ECU and simulate with dSPACE VEOS
- …

dSPACE

https://www.dspace.com/en/pub/home.cfm

TargetLink

https://www.dspace.com/en/pub/home/products/sw/pcgs/targetlink.cfm

TargetLink efmi Toolset

support@dspace.com

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