CERTI - Bindings to Matlab and Fortran

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RG Computational Engineering and Automation
University of Wismar, Germany

10. Magdeburger HLA-Forum
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Outline

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- research group at the University of Wismar
- primary research fields:
  - fundamentals of modeling and simulation
  - modeling, simulation and control applications
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  - distributed and parallel scientific computing in the engineering domain
- highly interested in advanced simulation technologies like HLA
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- today's RTIs provide C++ and/or Java APIs
  - but:
    - simulation model design and execution in the engineering domain today characterized by the usage of Scientific and technical Computation Environments (SCEs) → Matlab
    - existing Fortran codes are daily used, Fortran primary programming language in HPC community
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- preferred RTI
  - free, open source → possibility to study RTI implementation and to participate in development
  - C++ bindings → simplifies Fortran binding
  - cross platform RTI (including Windows)
  - advanced implementation status of HLA services
  - active developer community
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EODiSP HLA	P&P Software	IEEE 1516 partial	Java	GPL
GERTICO	Fraunhofer IITB	1.3	?	?
Open HLA		1.3 partial, IEEE 1516 partial	Java	Apache License
RTI-S	US JFCOM J9 Directorate	1.3 partial	C++, Java	US Government
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- RTIA process interacts with federate process through UNIX-domain sockets (Windows TCP sockets)
- RTIG interacts with RTIA through TCP/UDP sockets
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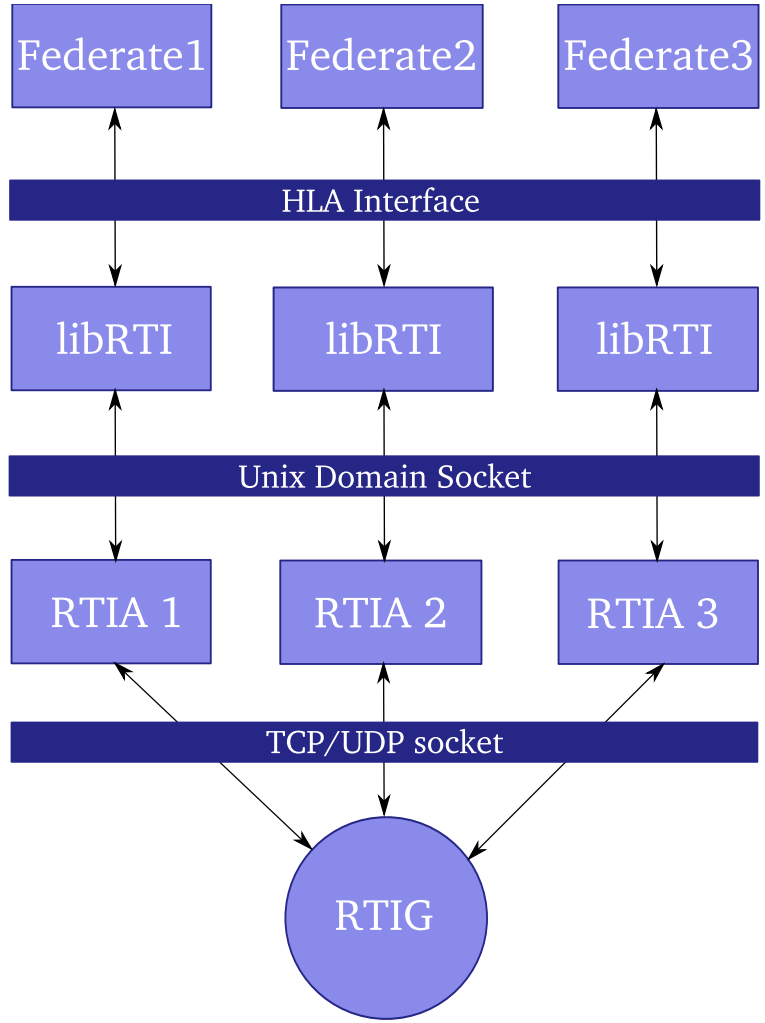

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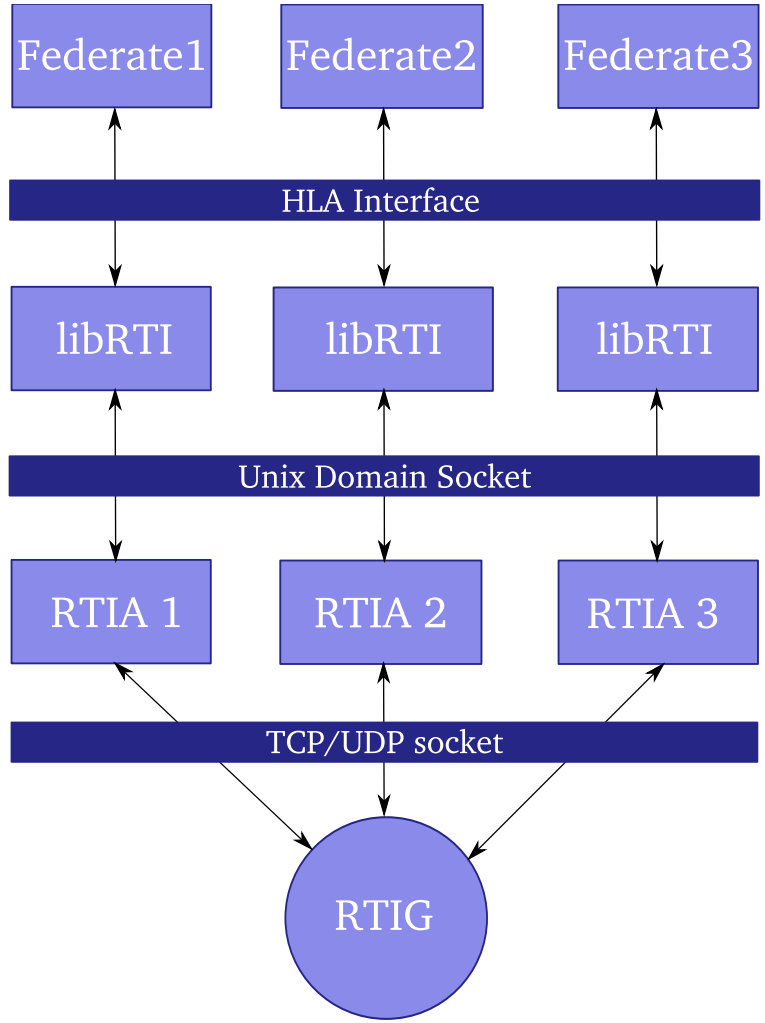

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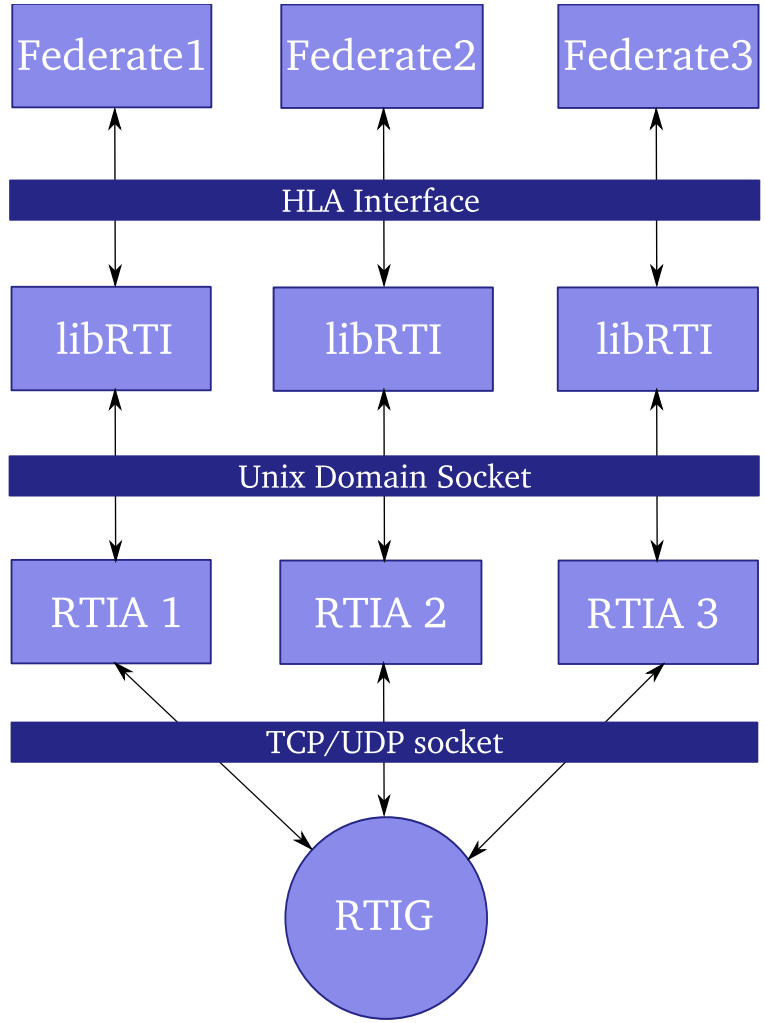

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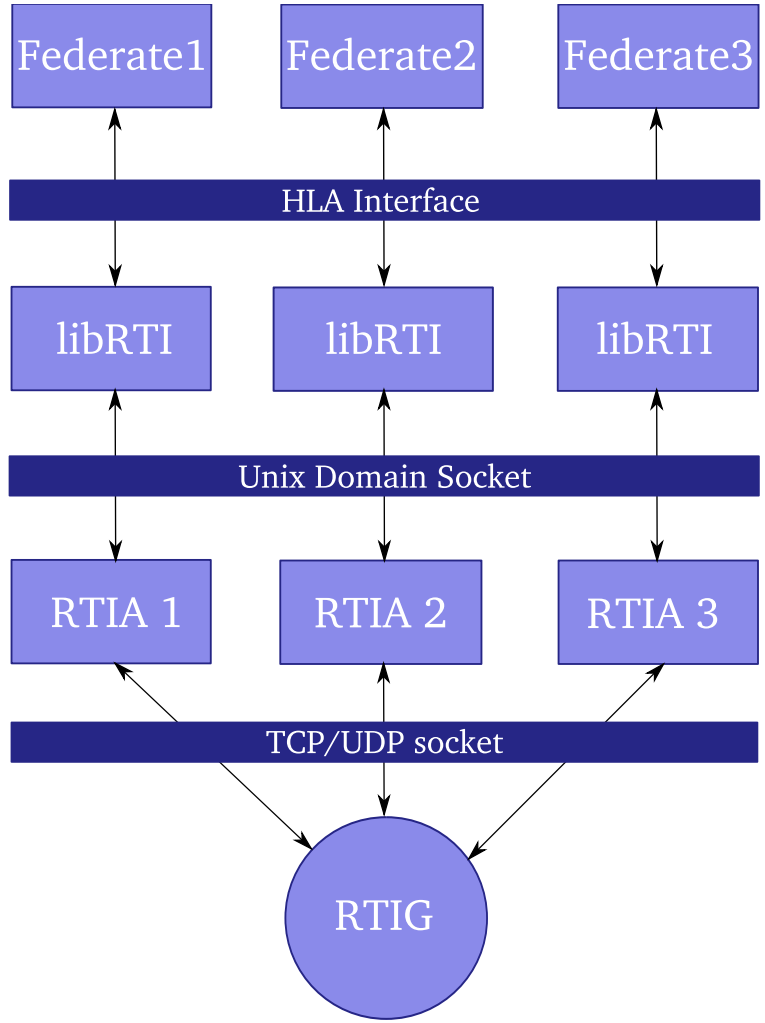

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Bindings to Procedural Language Environments

- object oriented HLA interface $\Longleftrightarrow$ procedural Matlab, Fortran
- mapping not straightforward, general problems:
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- RTI Services
  - Matlab federate calls RTI service m-function
  - m-function directly calls function within C++-wrapper (m2RtiSrv)
  - type conversion (m2c)
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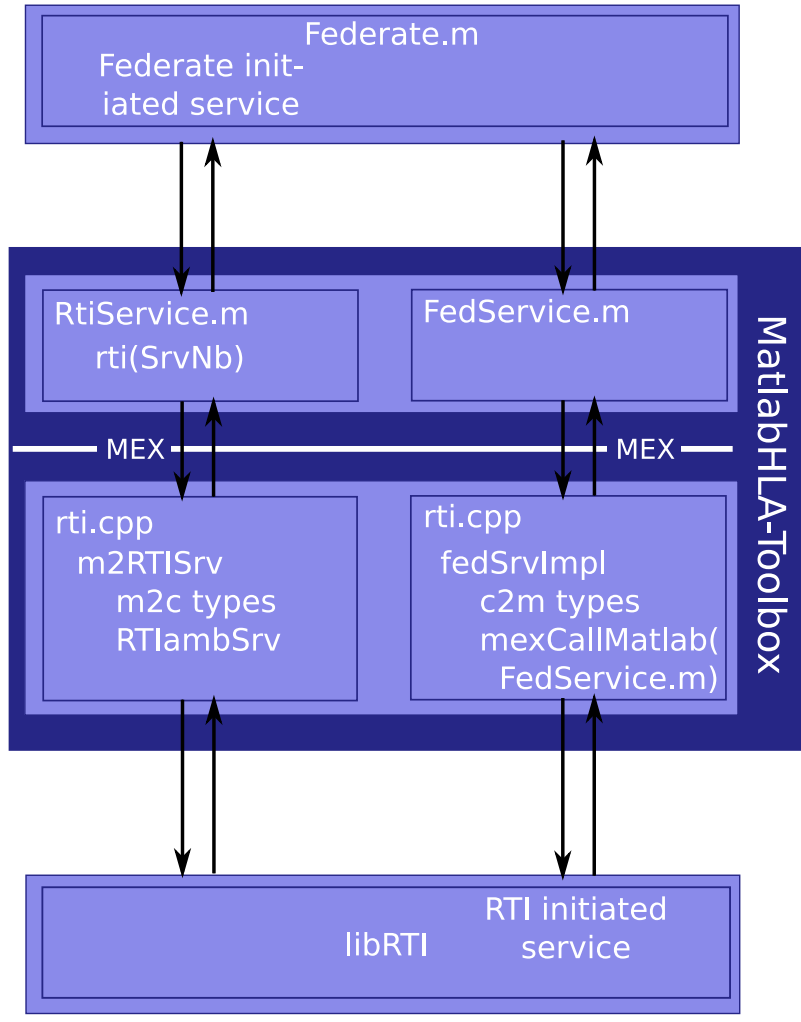

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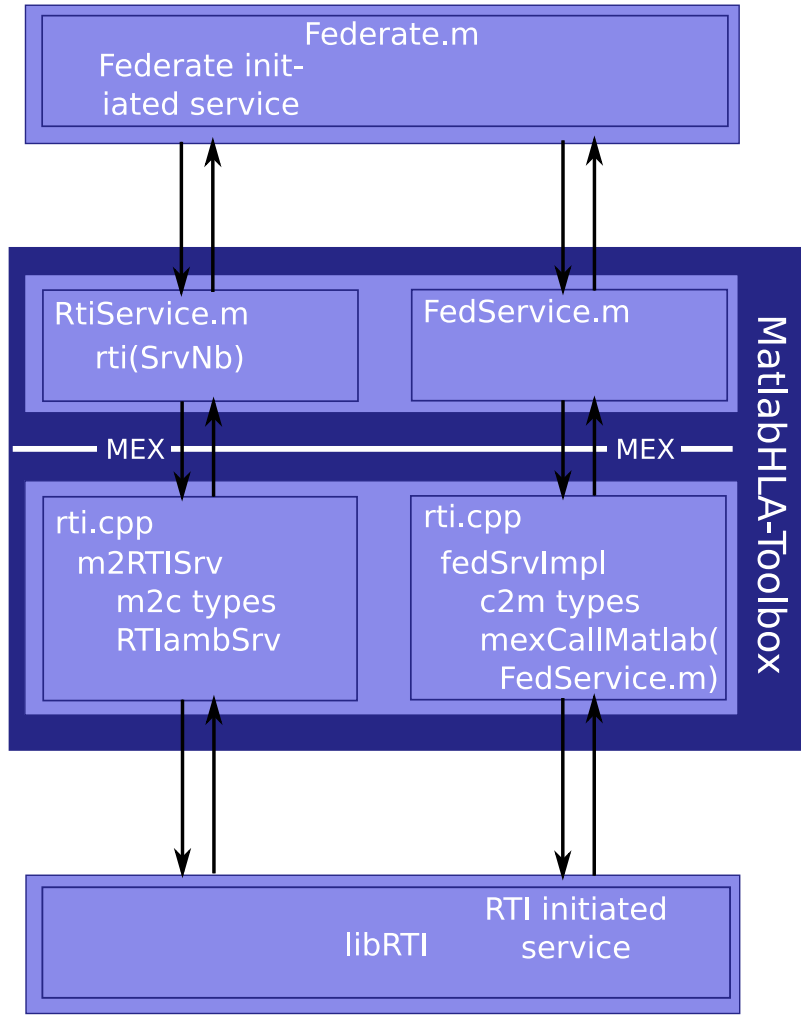

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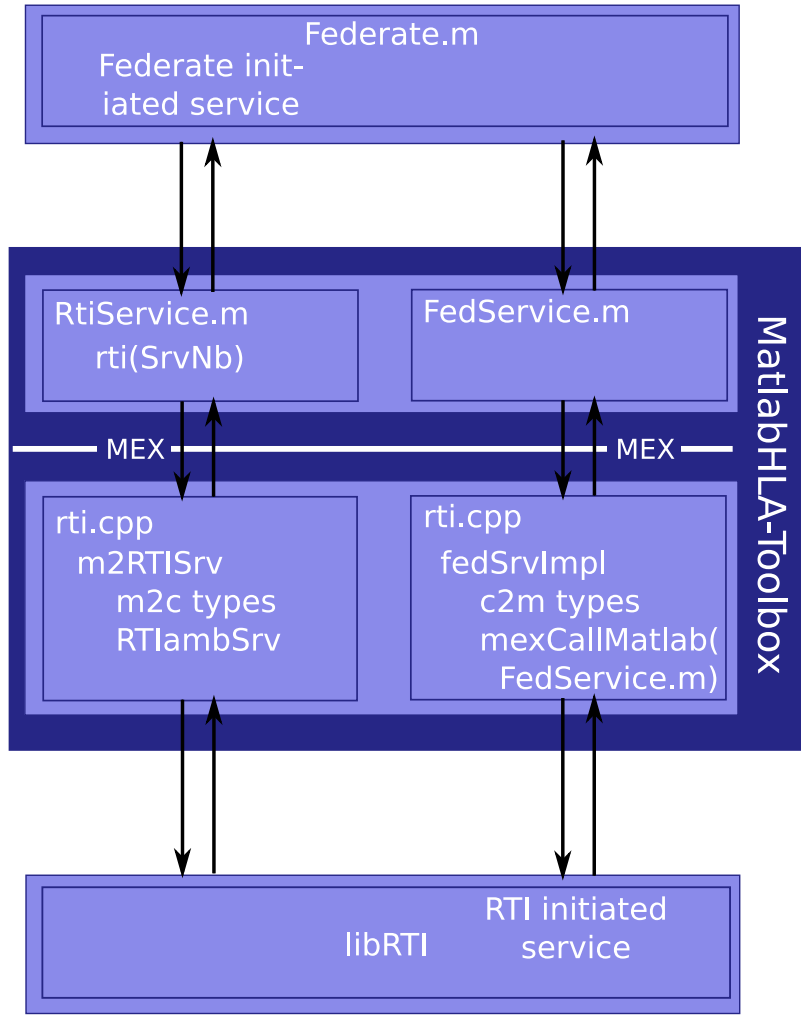

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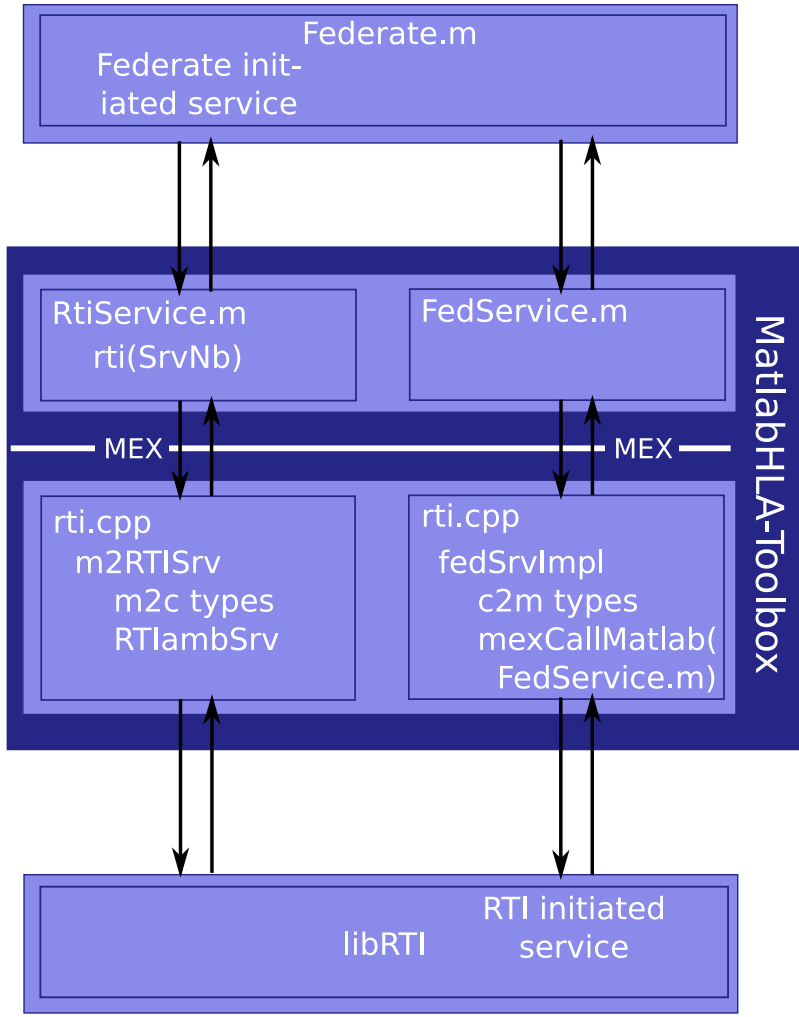

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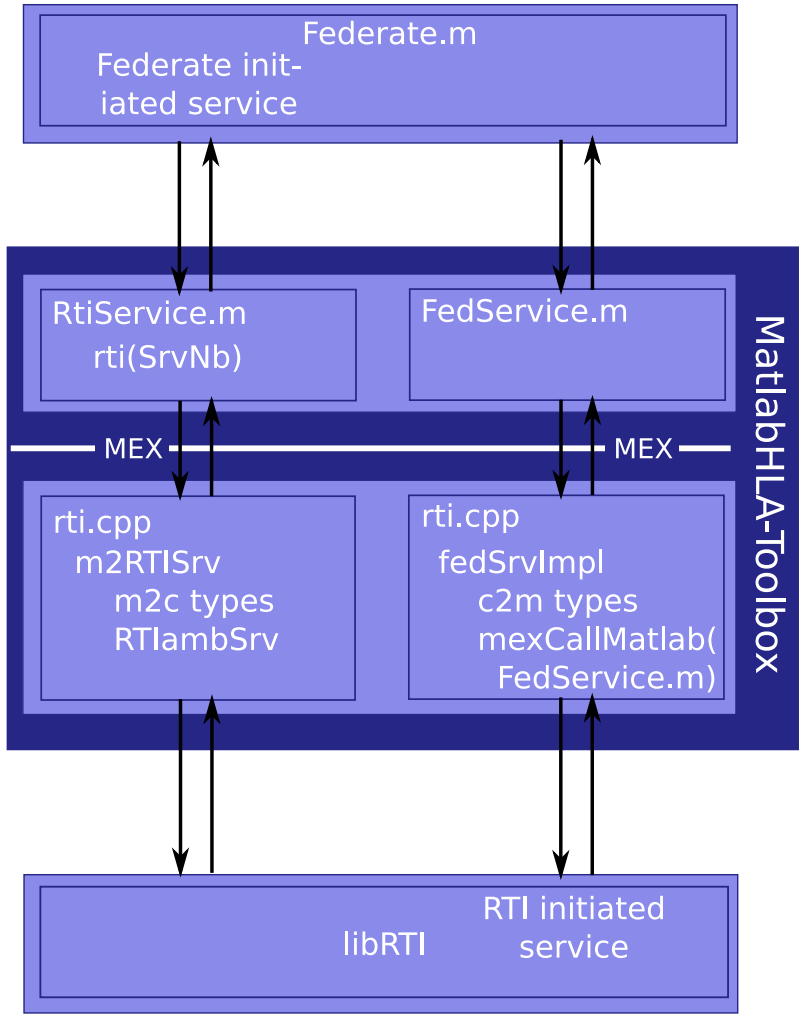

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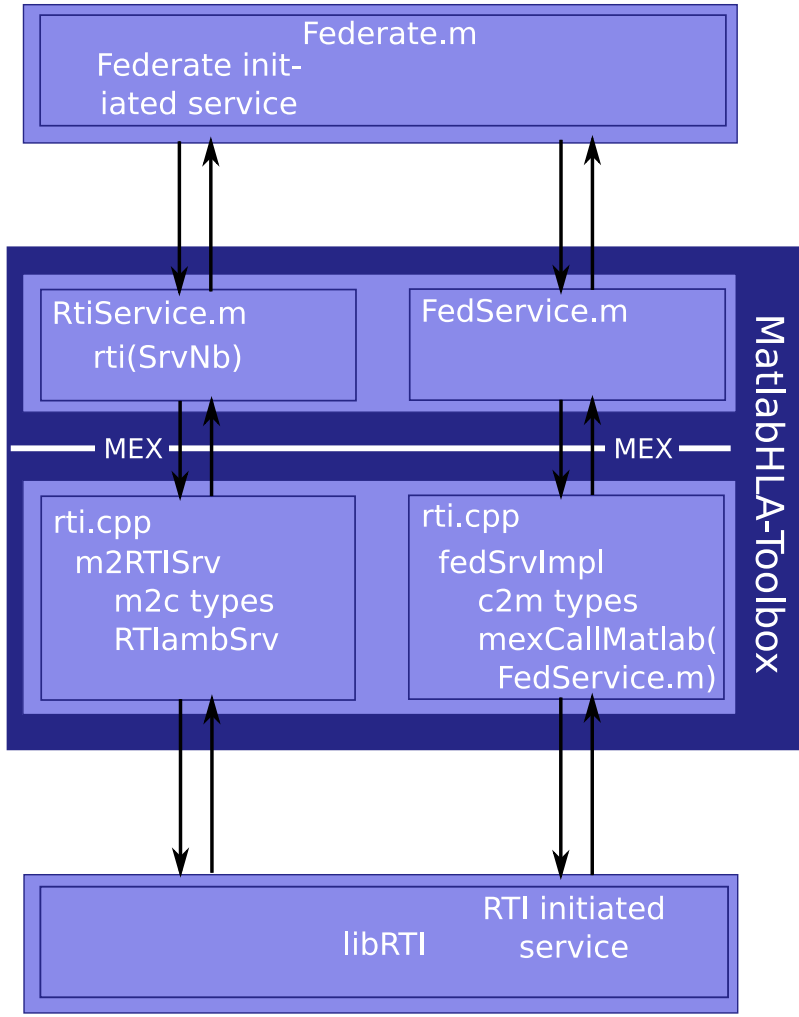

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else
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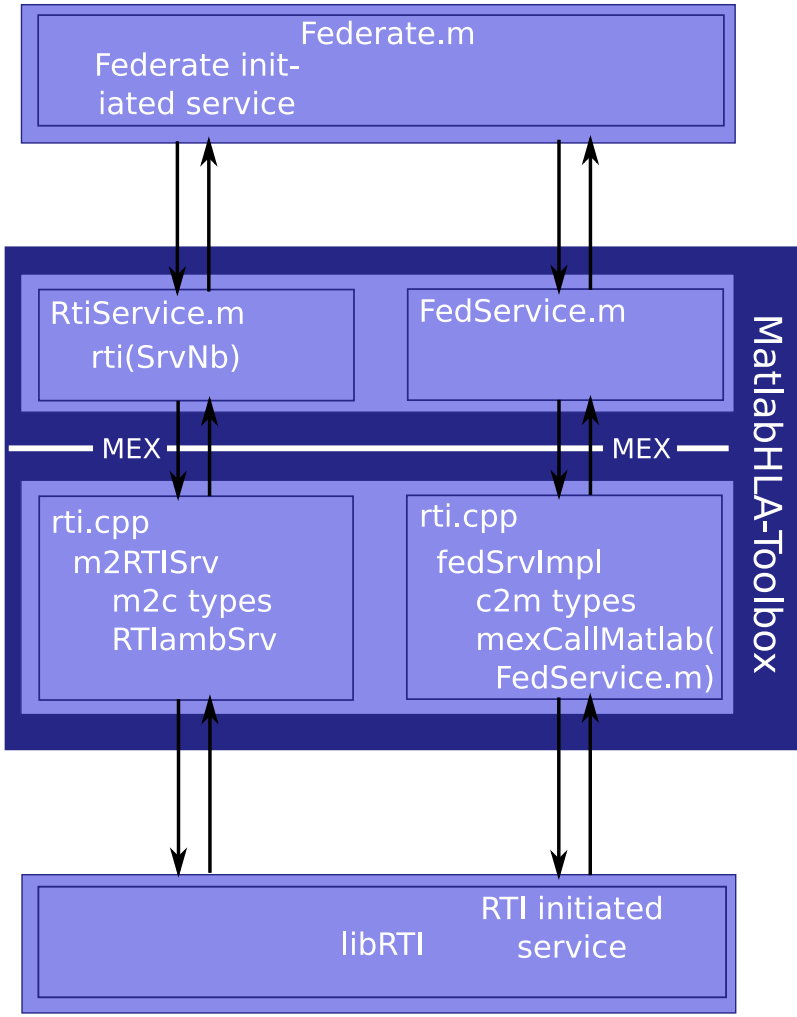

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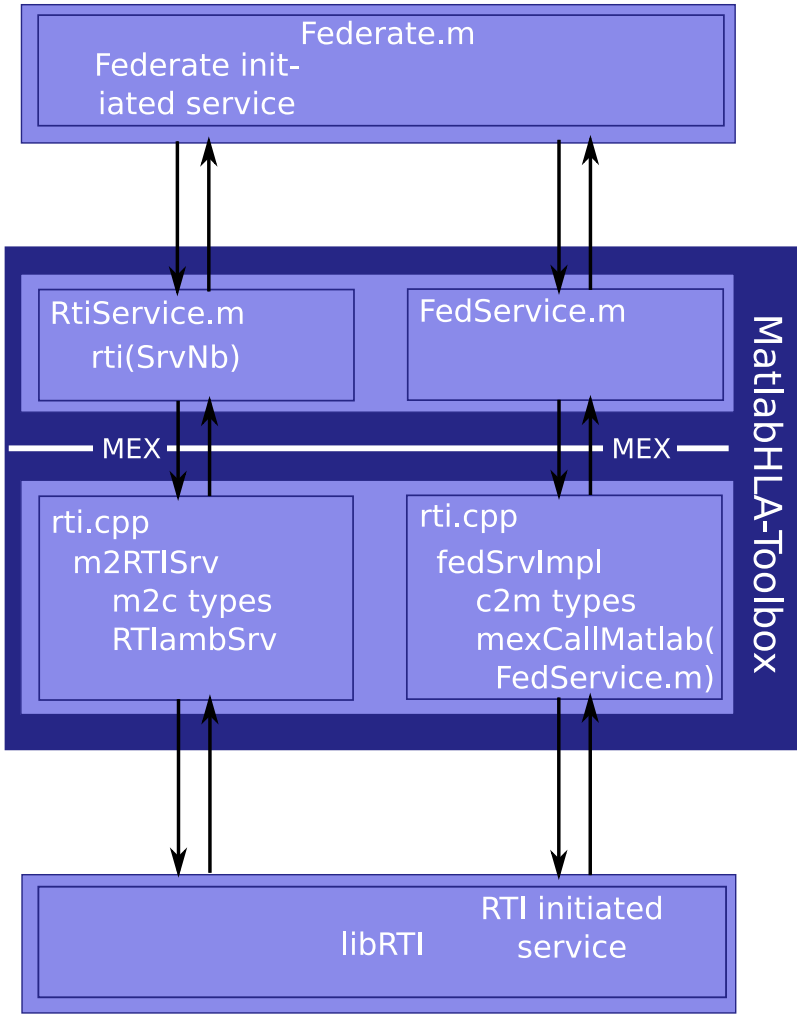

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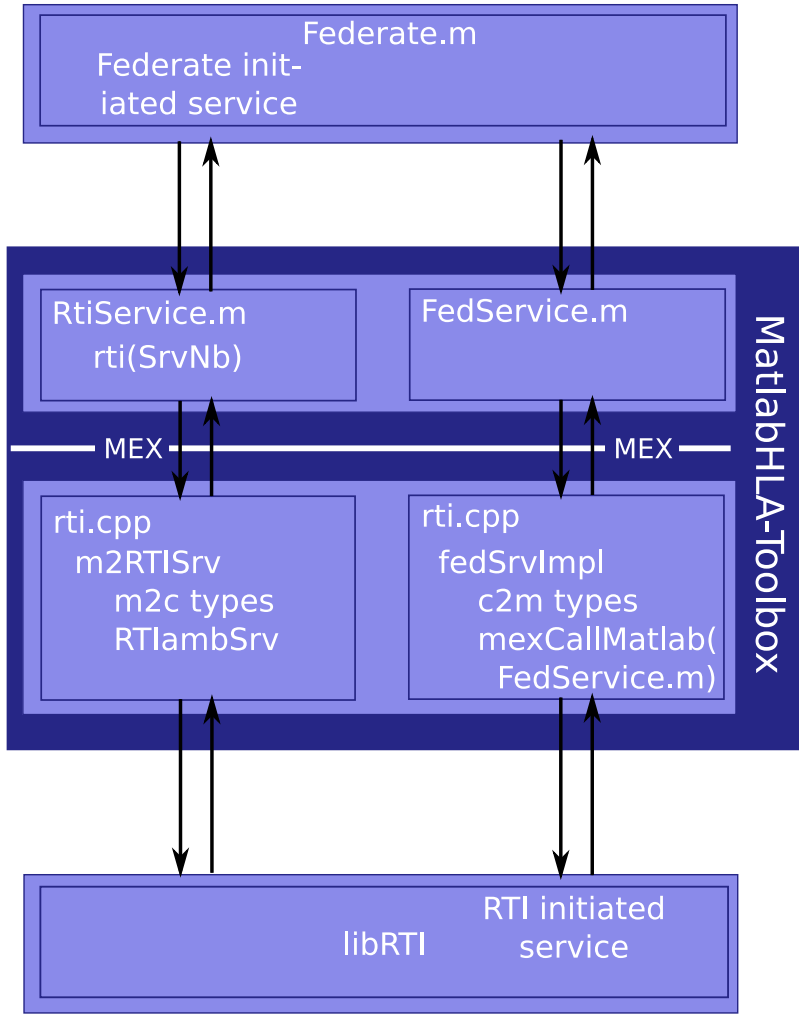

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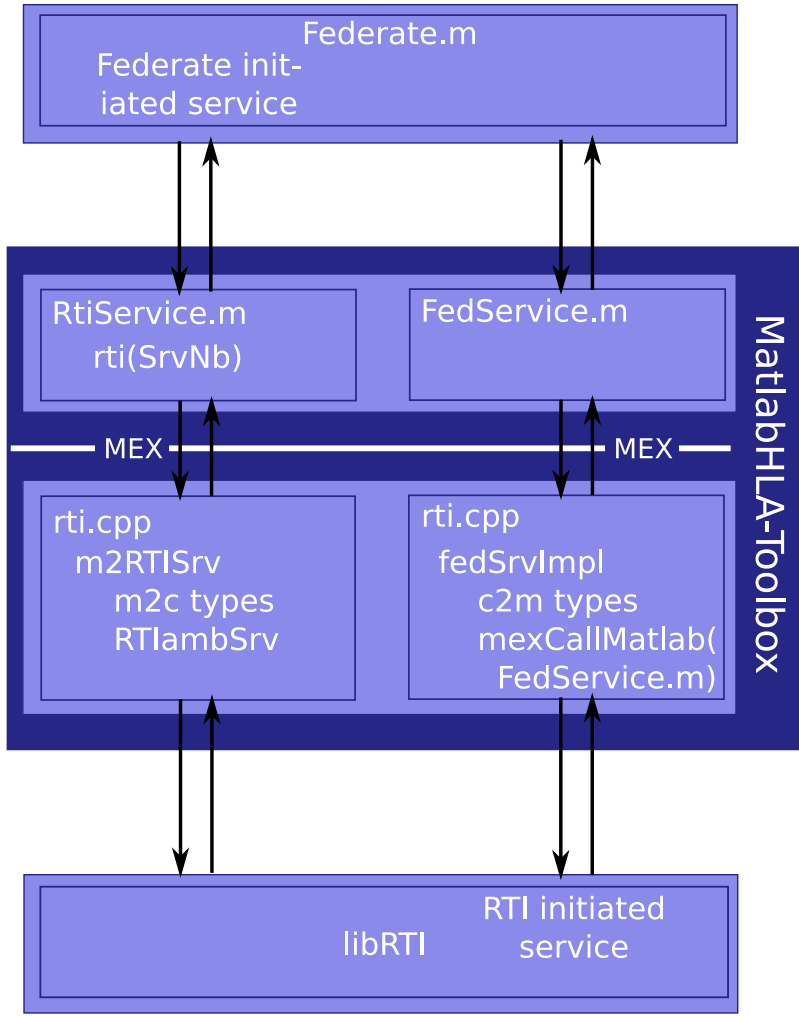

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Exception Handling

- possible exception catched (C++-Wrapper) and returned to Matlab
- MatlabHLA m-files provide optional error return value
- complex error handling in Matlab federate possible

Matlab Example

```
...
rtiSrv(in1, in2)
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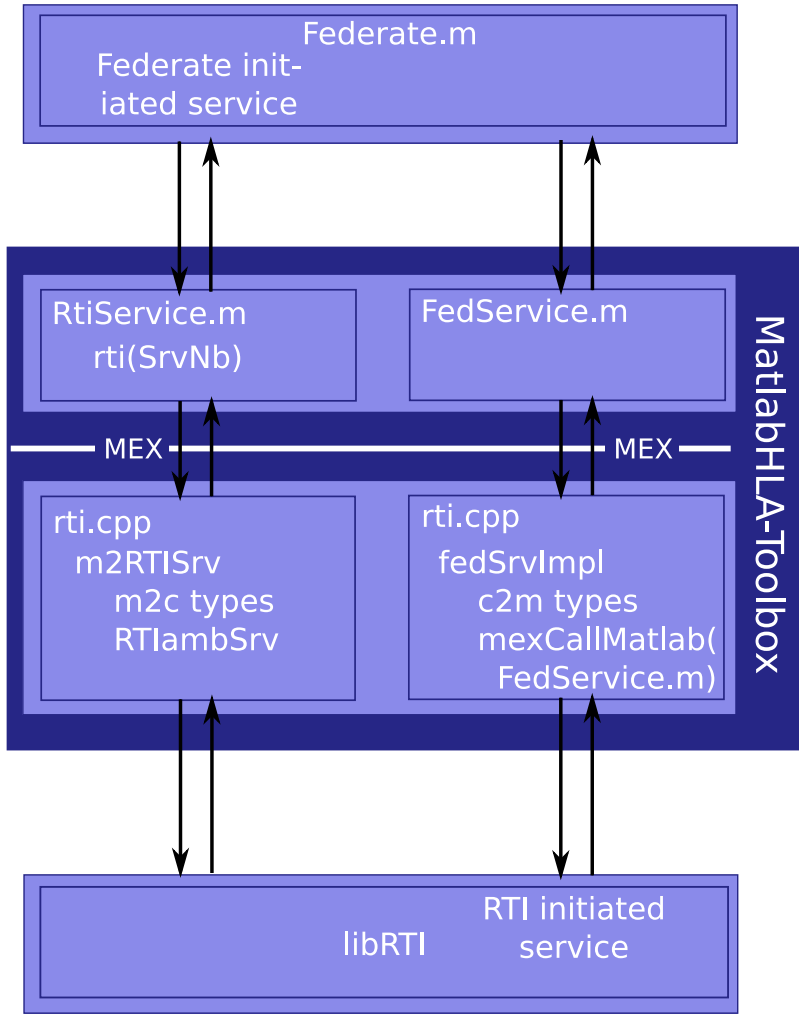

MatlabHLA-Toolbox

Exception Handling

- possible exception catched (C++-Wrapper) and returned to Matlab
- MatlabHLA m-files provide optional error return value
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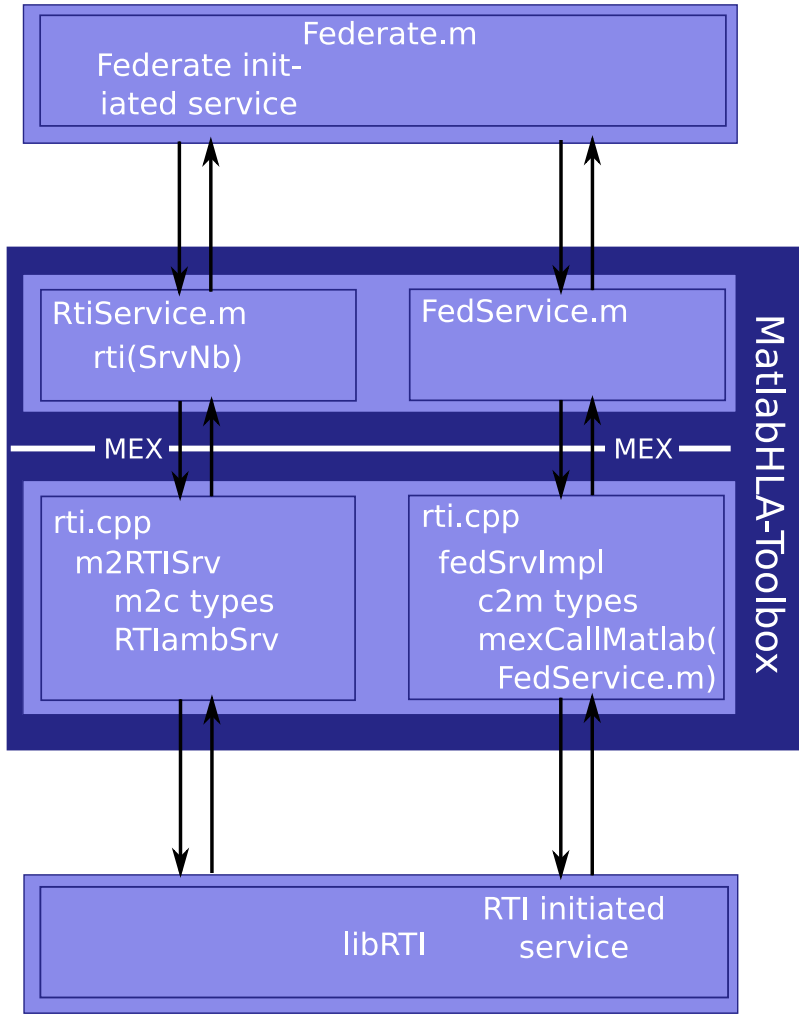

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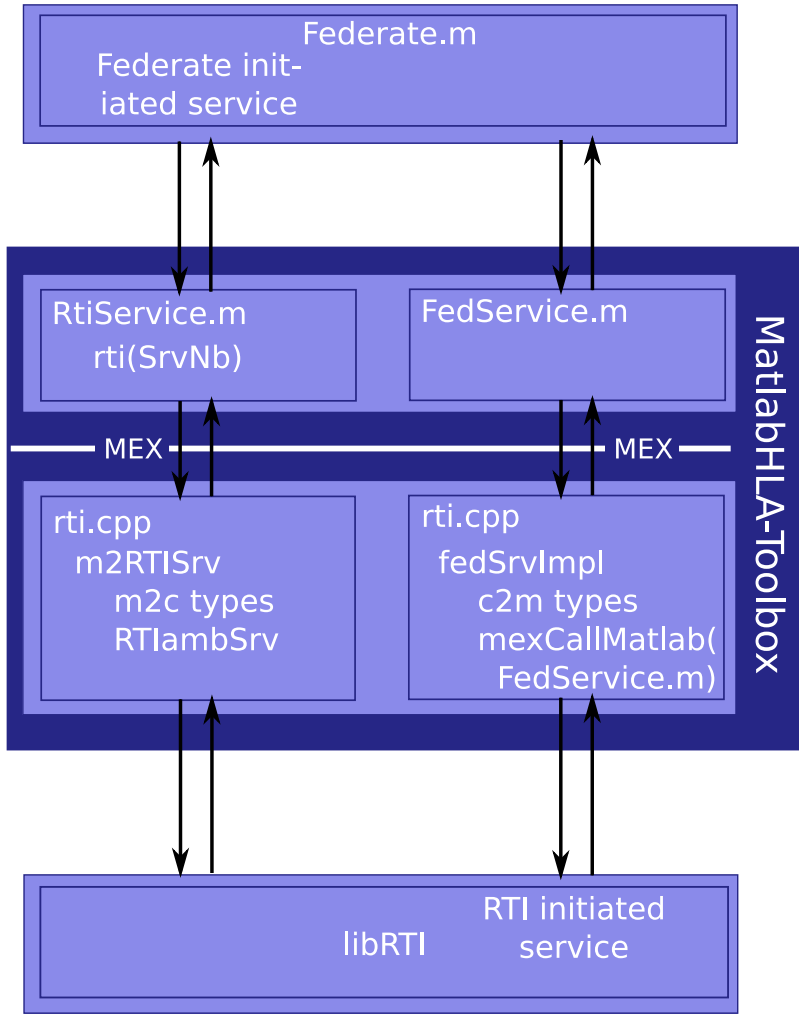

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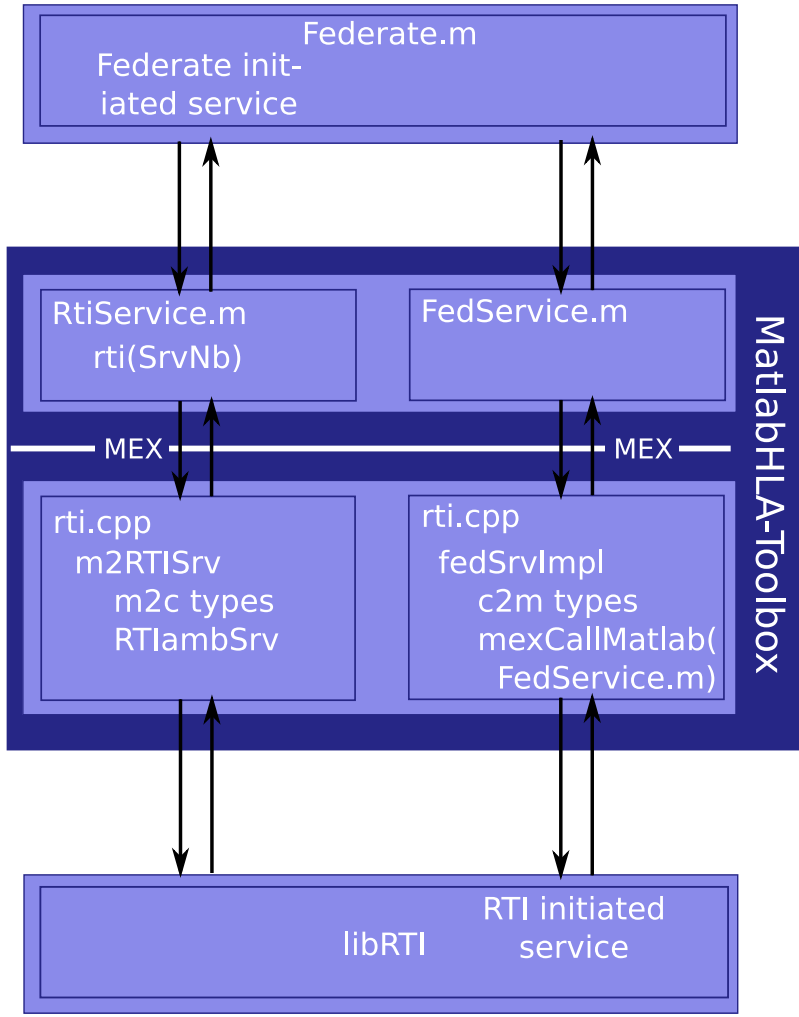

Outline

libF90HLA

- general information:
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  - library for use with Fortran90, FORTRAN77 subset of Fortran90
  - MatlabHLA used as design pattern
  - homepage: http://www.mb.hs-wismar.de/cea/sw_projects.html
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  - abbreviated RTI service designators
  - selectable exception handling
  - default federate services
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Linkage against libRTI

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Bidirectional Communication

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  - signature analysis and C fcn call
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- Federate Services
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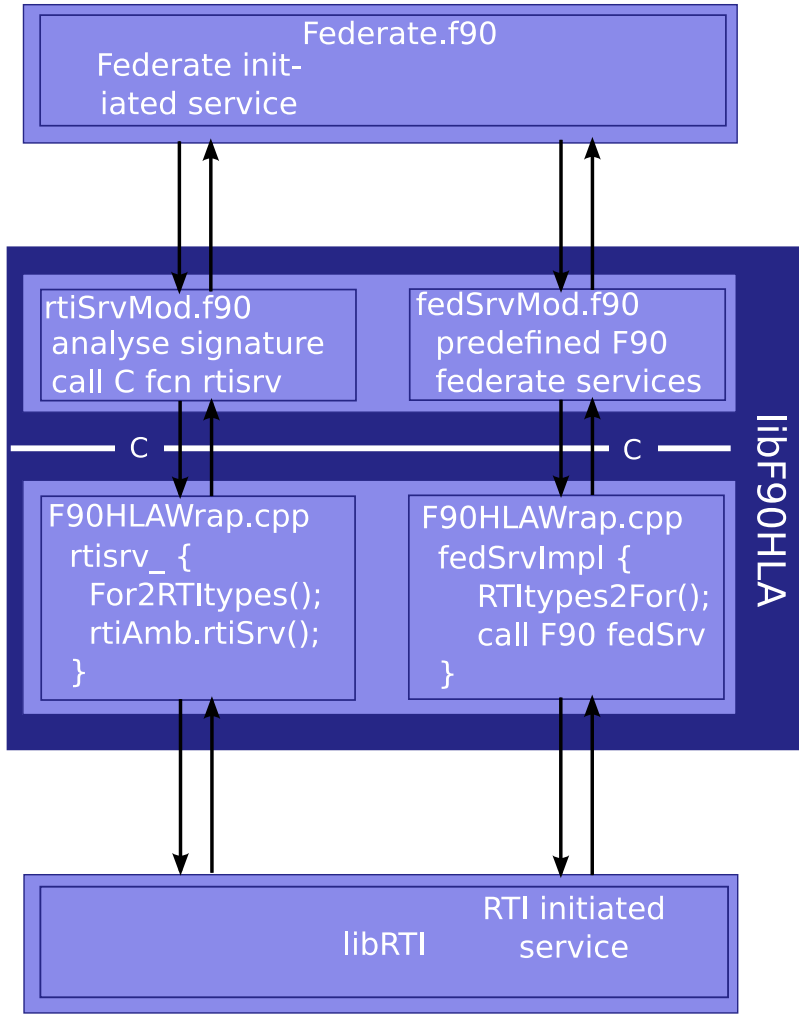

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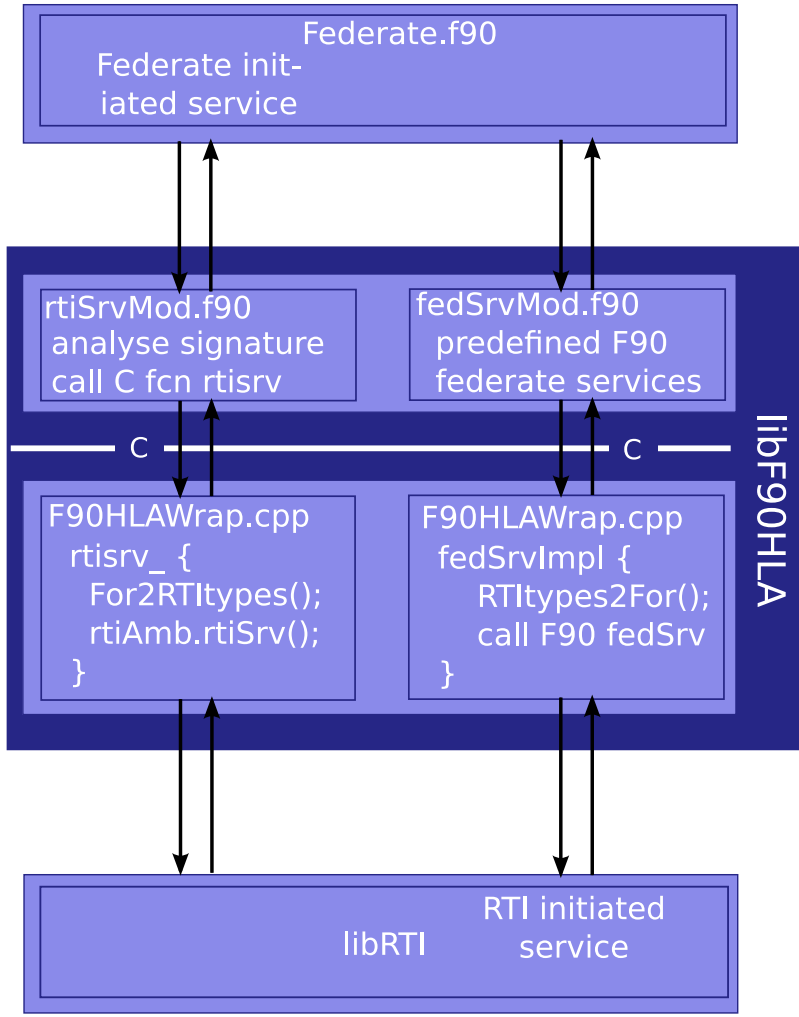
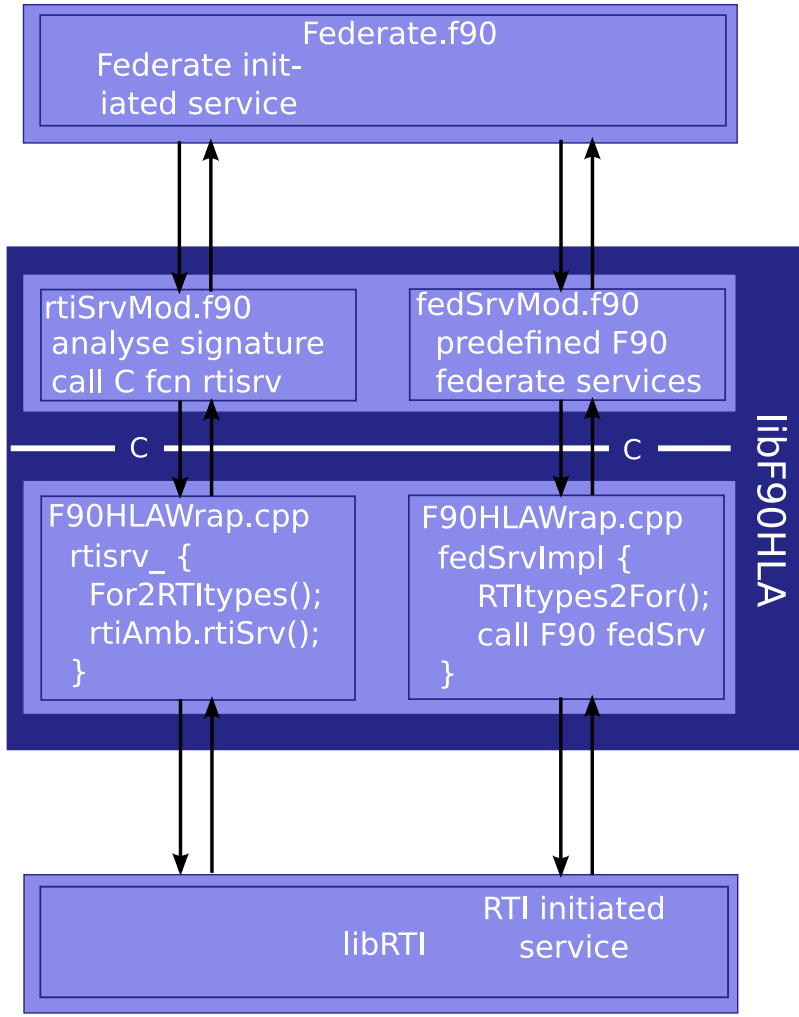


libF90HLA

Object Instantiation

- similar to MatlabHLA-Toolbox
- RTIamb, fedAmb statically instantiated in libF90HLA (rtiOn)
- plain procedural interface towards libRTI



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Function Overloading

- F90 allows optional function parameters
- intrinsic function *present* can test existence of optional parameters
- tests performed in F90 module

rtiSrvMod.f90

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subroutine rtiSrv(in1, in2)
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implicit none
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integer, intent(in) :: in1
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if (present(in2)) then
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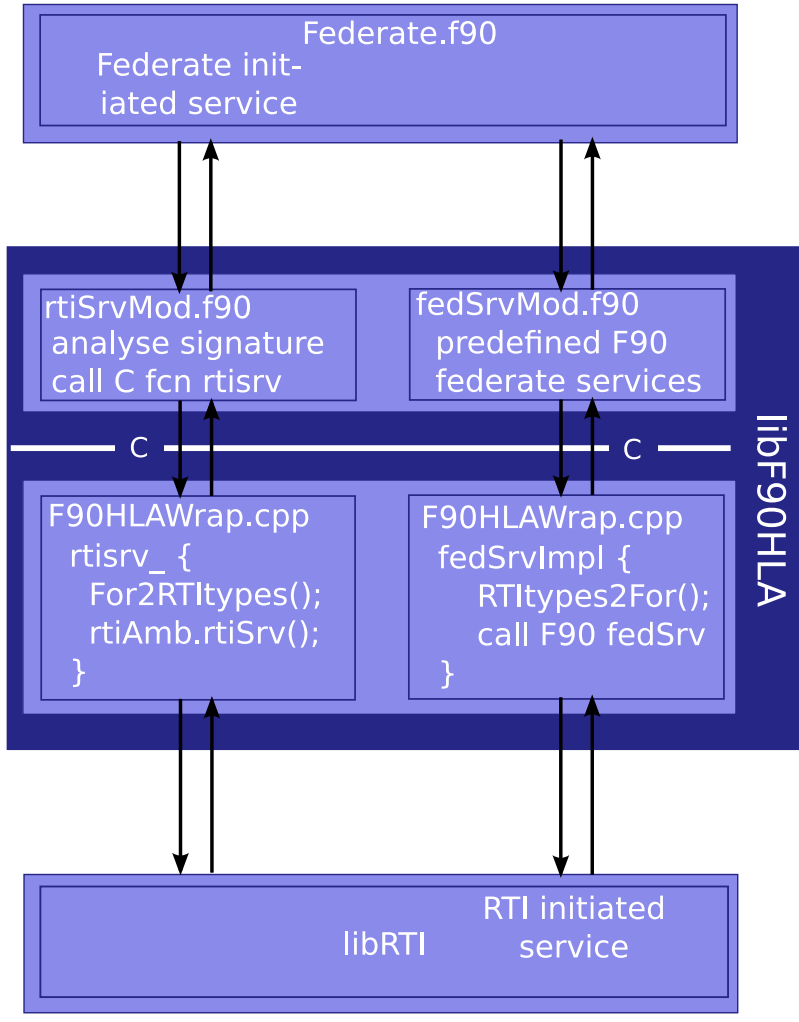

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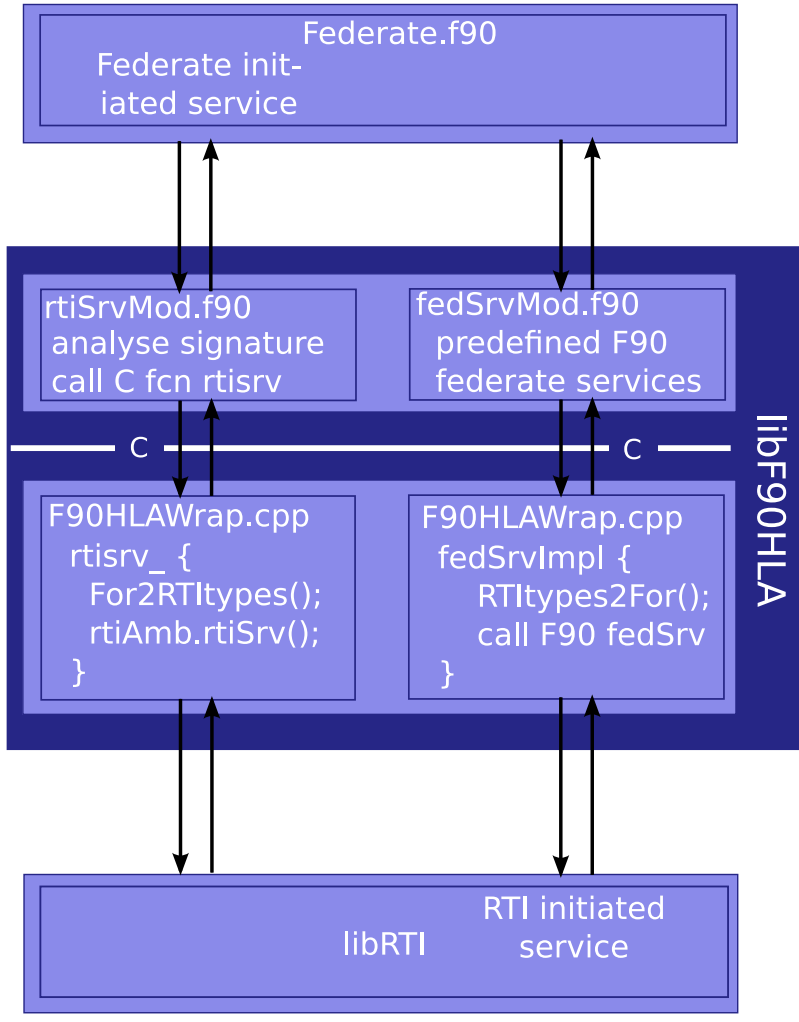

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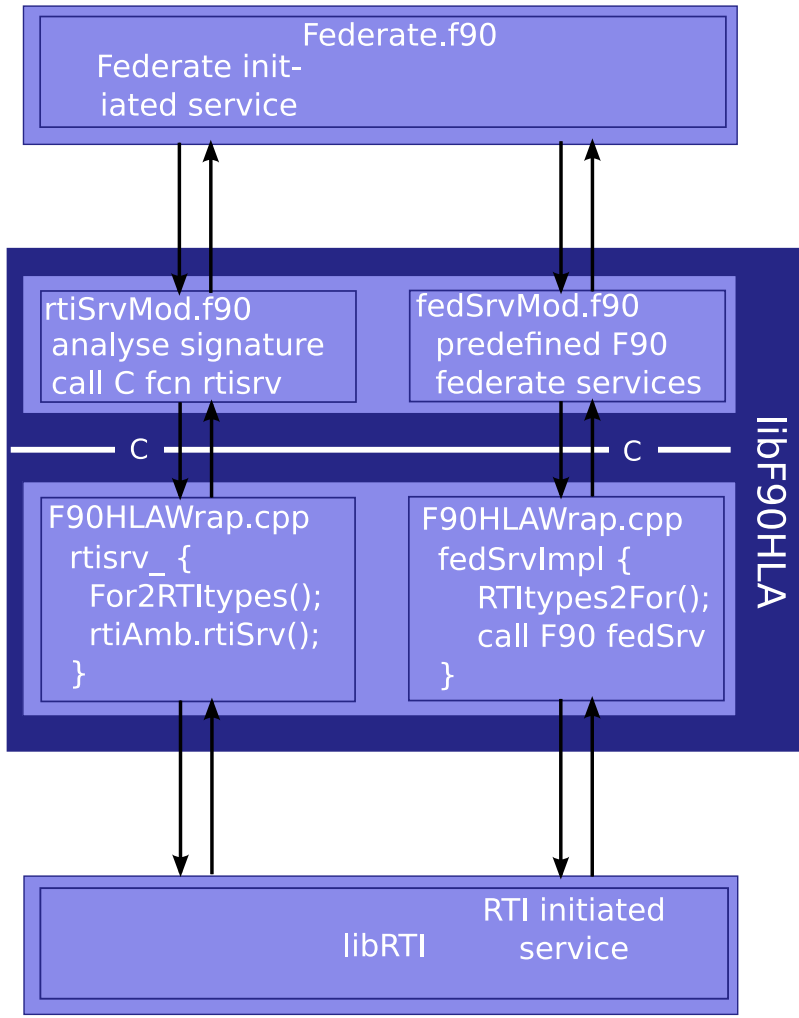

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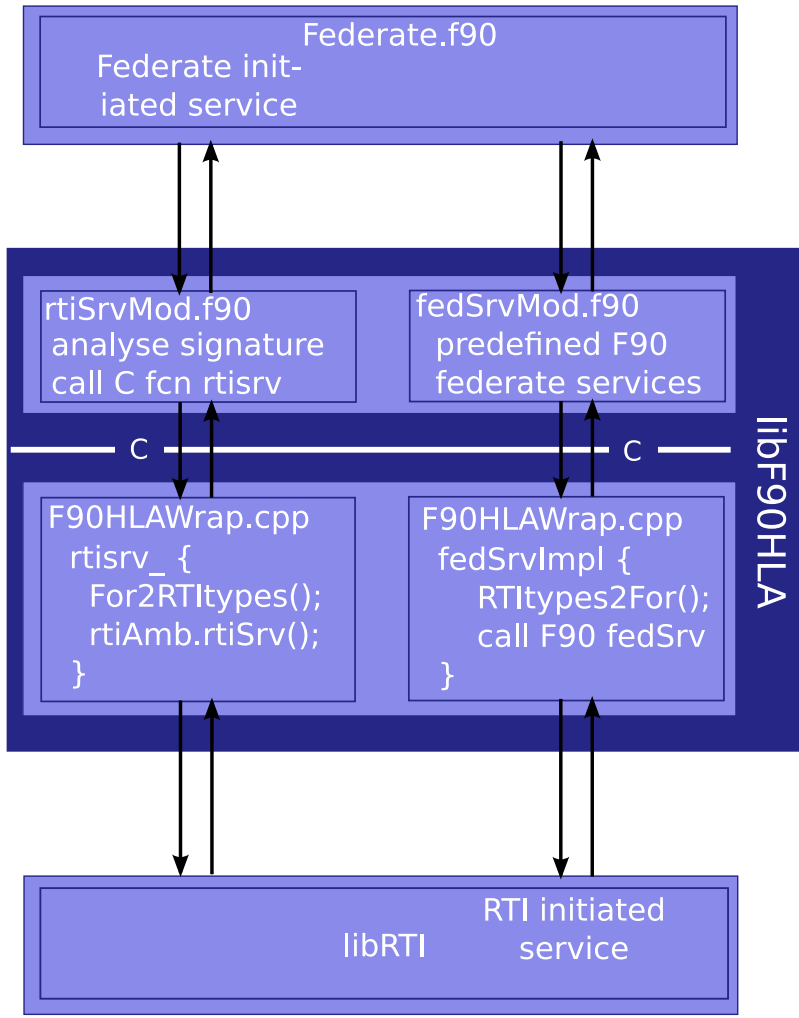

Outline

Summary and Outlook

- Summary
  - at present two noteworthy open source RTIs: poRTIco, CERTI $\rightarrow$ *CERTI*
  - CERTI well tested RTI, remarkable development site at Savannah
  - introduction of two new open source projects: MatlabHLA, libF90HLA
  - CERTI first RTI with native bindings to Matlab and Fortran
- Outlook
  - completing work at libF90HLA
  - Simulink-Toolbox on basis of HLA-Toolbox, HLA integration into other free SCEs (e.g. Octave)
  - finding bugs, applying patches and looking for help ...