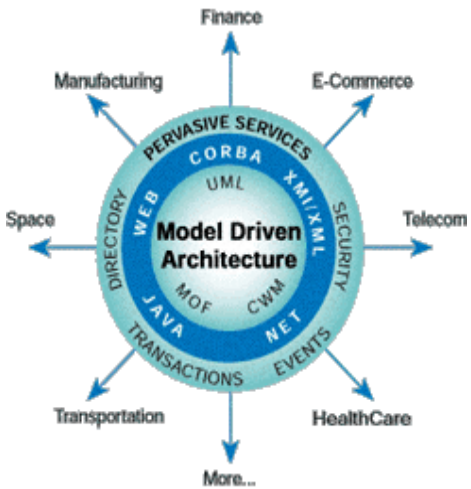
MDA in support of Software Blocking



Enterprise
Collaboration
Architecture

UNIFIED MODELING LANGUAGE™

Applying Model Driven Architecture to Systems of Systems

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Data Access technologies

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Some questions

- Capability driven - Capability of what?
- SoS - System of what?
- Functional decomposition – decomposition of what?
- Multiple views – Views of what?
- Where does interoperability stop?

MDA Standards

- MDA standards are provided by the “Object Management Group”
  - Unified Modeling Language (UML)
  - Meta Object Facility (MDA)
  - Enterprise Distributed Object Computing (EDOC)
  - Common [data] Warehouse Meta Model (CWM)
  - SysML (In progress)
  - More...
- MDA is enjoying broad support, but is still new

www.omg.org/mda

What is OMG?

- Object Management Group - 15-year-old not-for-profit Computer Industry Standards Consortium
- Home of UML, the Industry's Modeling Standard
- and the Model Driven Architecture (MDA)
- and Corba – enterprise middleware
- Open Membership and Adoption Process
  - One-member, One-vote
- Specifications Available Free on our Website
- Buy Implementing Products from Vendors
  - Vendors may be OMG members, or may not
- Over 500 members including Companies, Government Agencies, Universities

www.omg.org/mda

MDA Models

- Separation of concerns
- Information in open repositories
- Semantics behind the models – they mean something
- Can be reverse engineered from dead information
- Designed for value – what do we get out of our architectures?
- Information in multiple diagrams is semantically linked
- Changes are automatically propagated
- Automated production of value
  - Documentation, middleware, simulation, tests, code
- Living information made part of the enterprise and the system

MDA - General

- Representation of models at many levels with tractability and automated transformations between them
- Can be applied to organizations, systems of systems, systems or features of systems or low-level implementation
- There are many MDA standards, and many still evolving to support this general capability

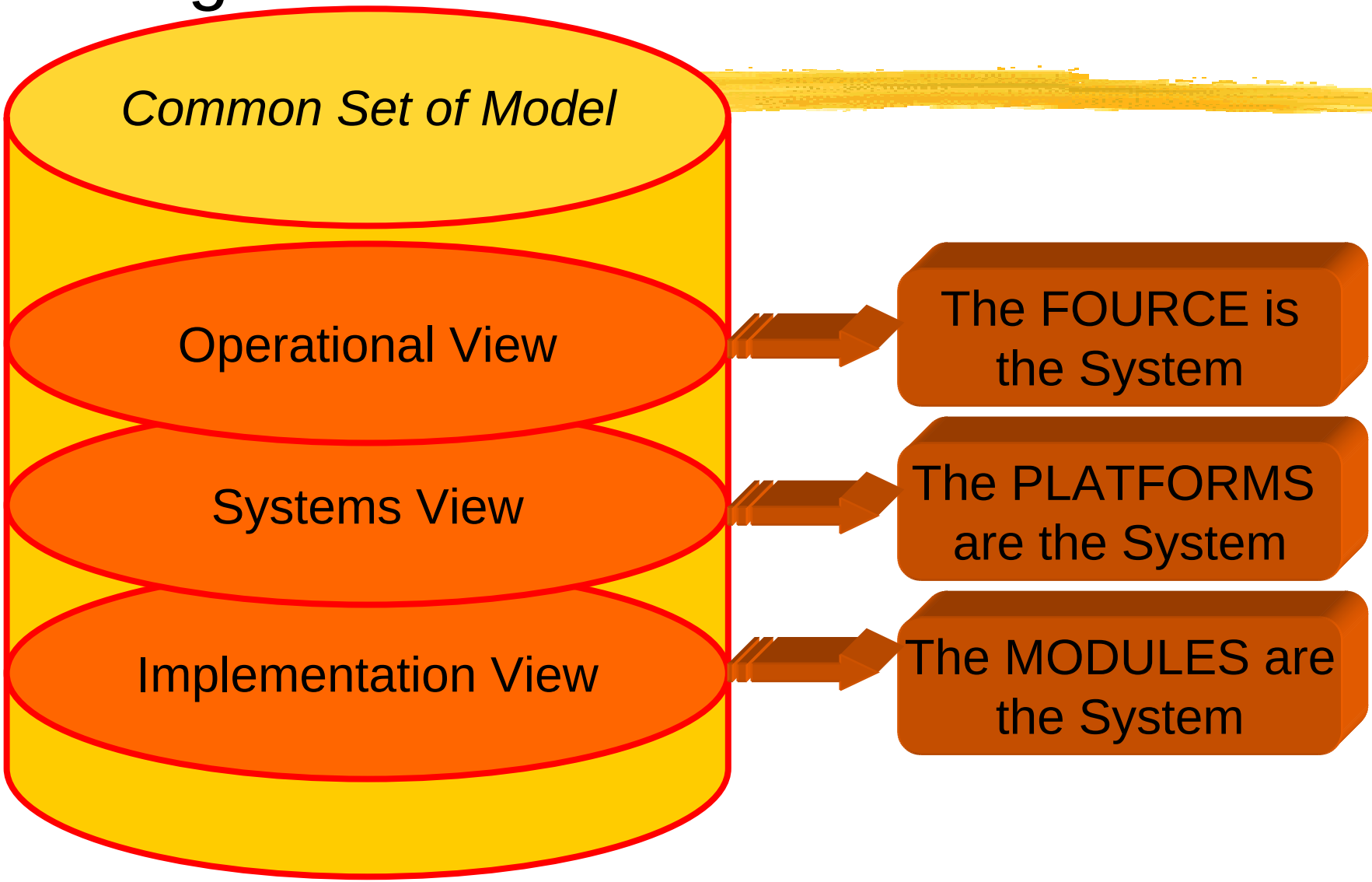
MDA for SoS in Software Blocking

- Our concern
  - Modeling the operational requirements and view – particularly how countries, organizations, units, people and systems collaborate to effect a mission
  - How the operational view is realized with systems of systems
  - The capabilities of the systems and how they work together
  - The Service Oriented Architecture (SOA) middleware capabilities and interfaces to support the SoS
  - Evolving and acquiring systems components to comply with the architecture
  - Validating that systems do comply with the architecture
  - Facilitating systems of systems being dynamically integrated to achieve a mission goal

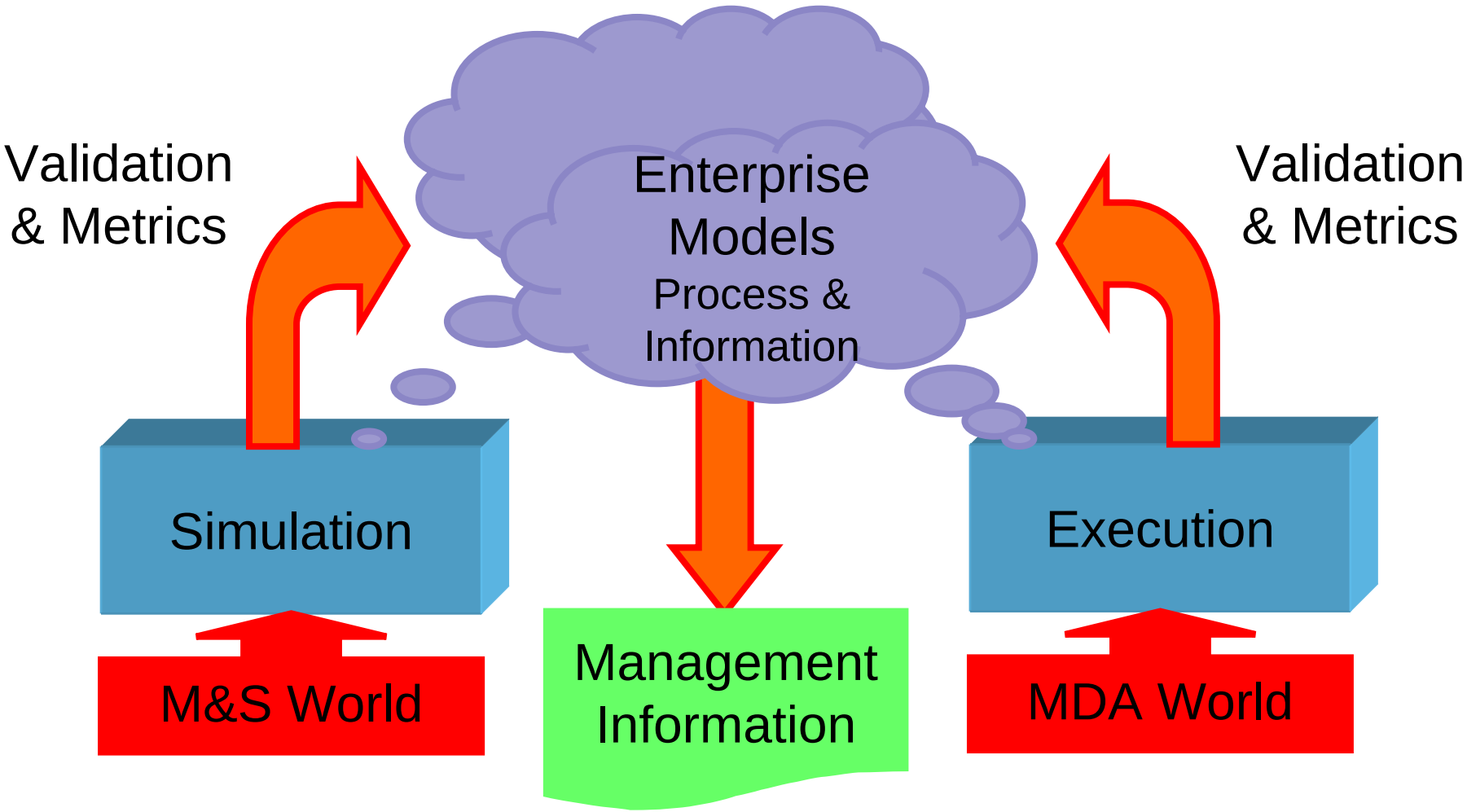
Separation of Concerns

- Multiple views
- Automation
- Integrated in a common model

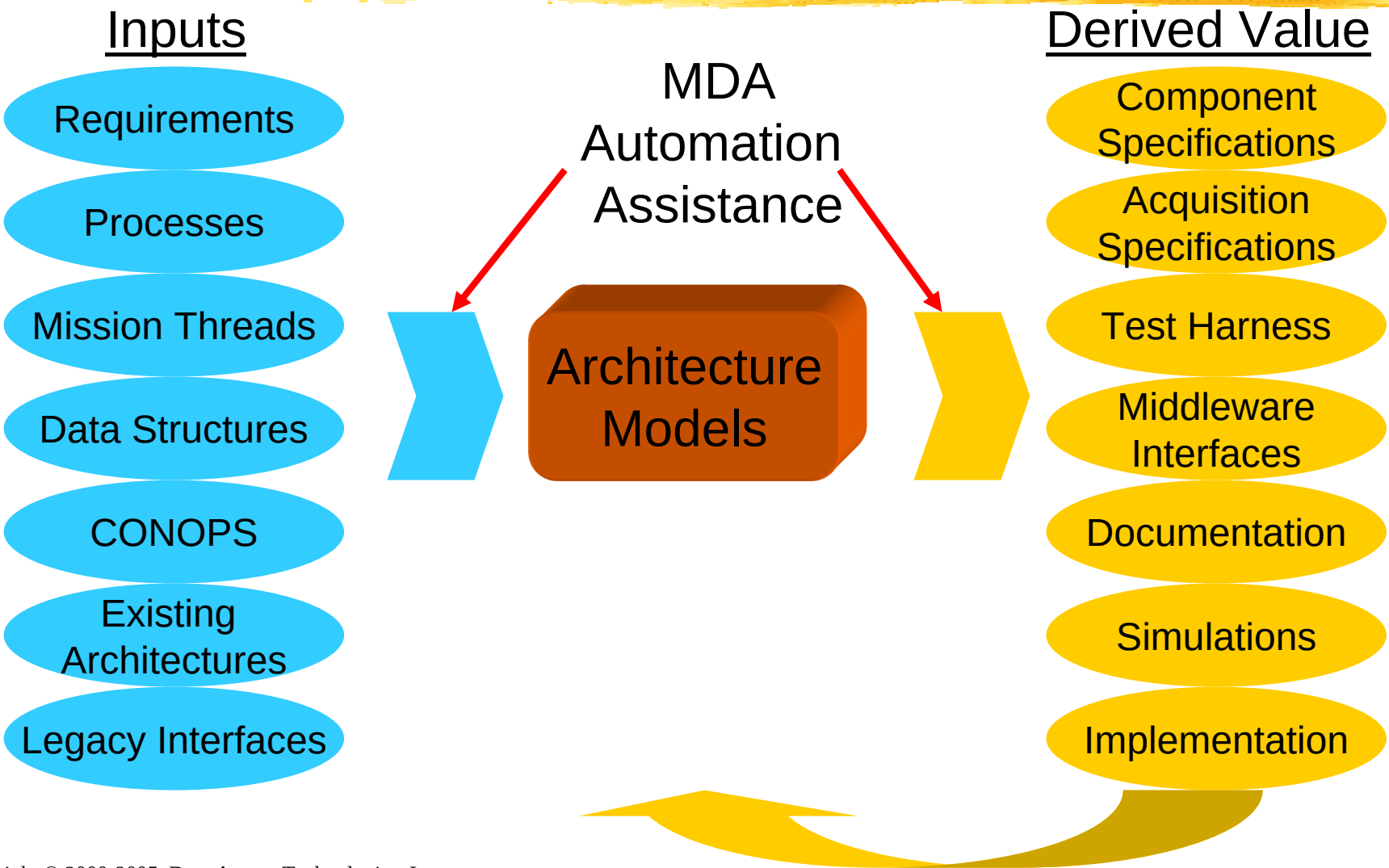
Integration of views



Model What You Simulate & Perform



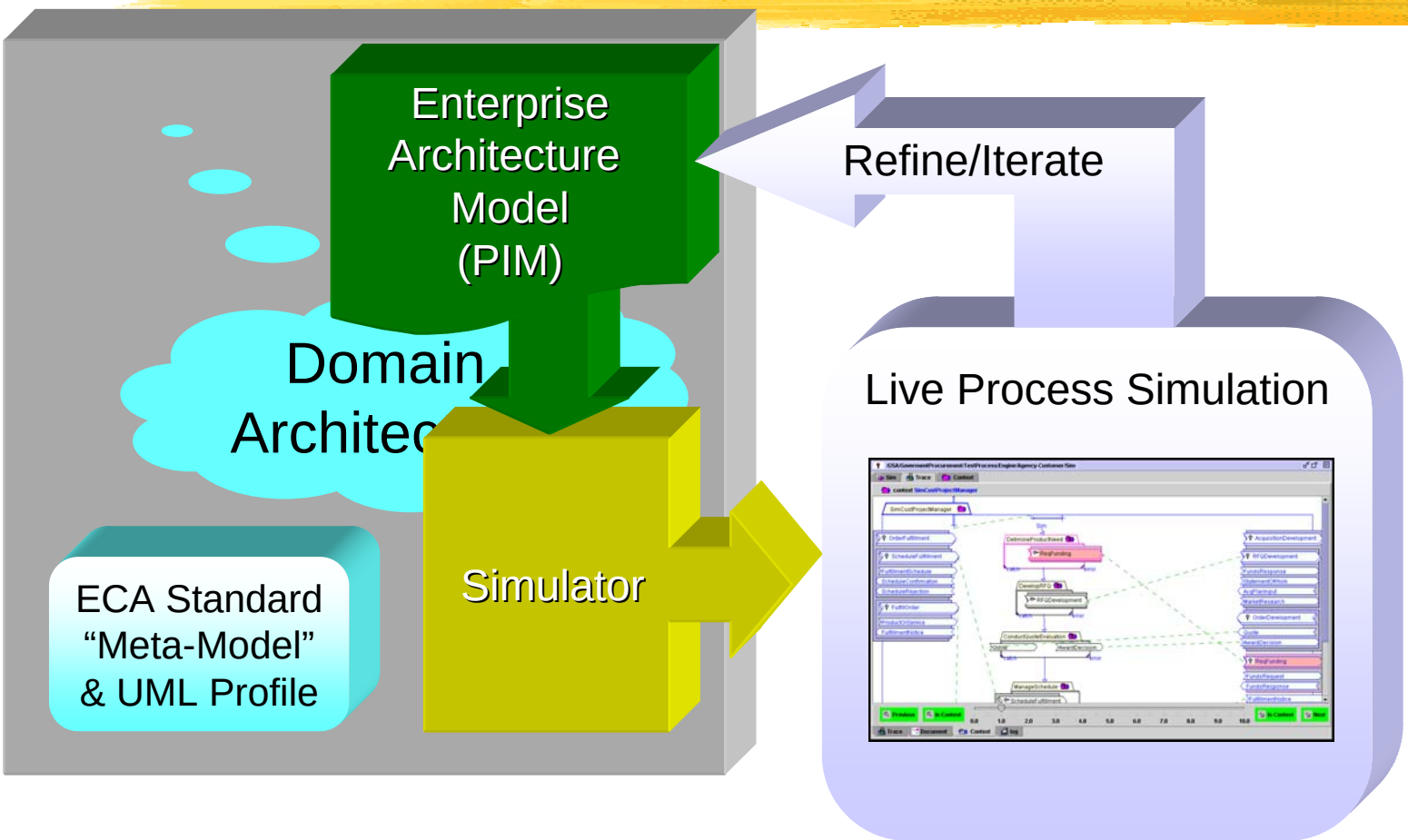
Architecture focus on value



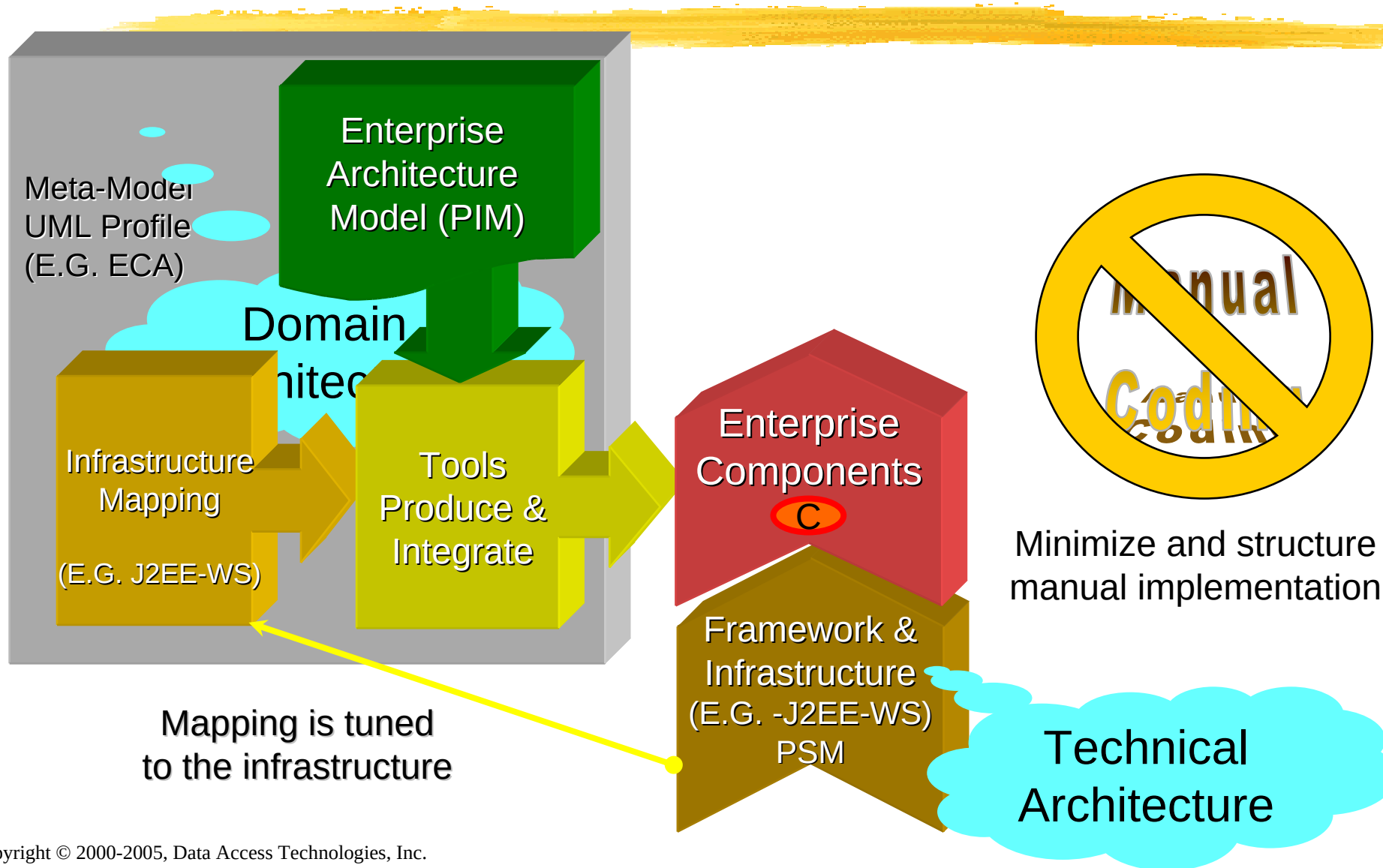
Why Process Simulation?

- Validation – Simulation of processes allows stakeholders to validate and refine new processes prior to deployment
- Training – Simulation is a core requirement for training, systems need to be able to operate in a simulation of real mode and dedicated trainers need to simulate the real world
- Testing – simulation is used to test live systems components for performance and conformance
- Decision Support – Simulation can aid in “projecting the future” for decision support

Simulated Model Driven Architecture



Automated Model Driven Architecture



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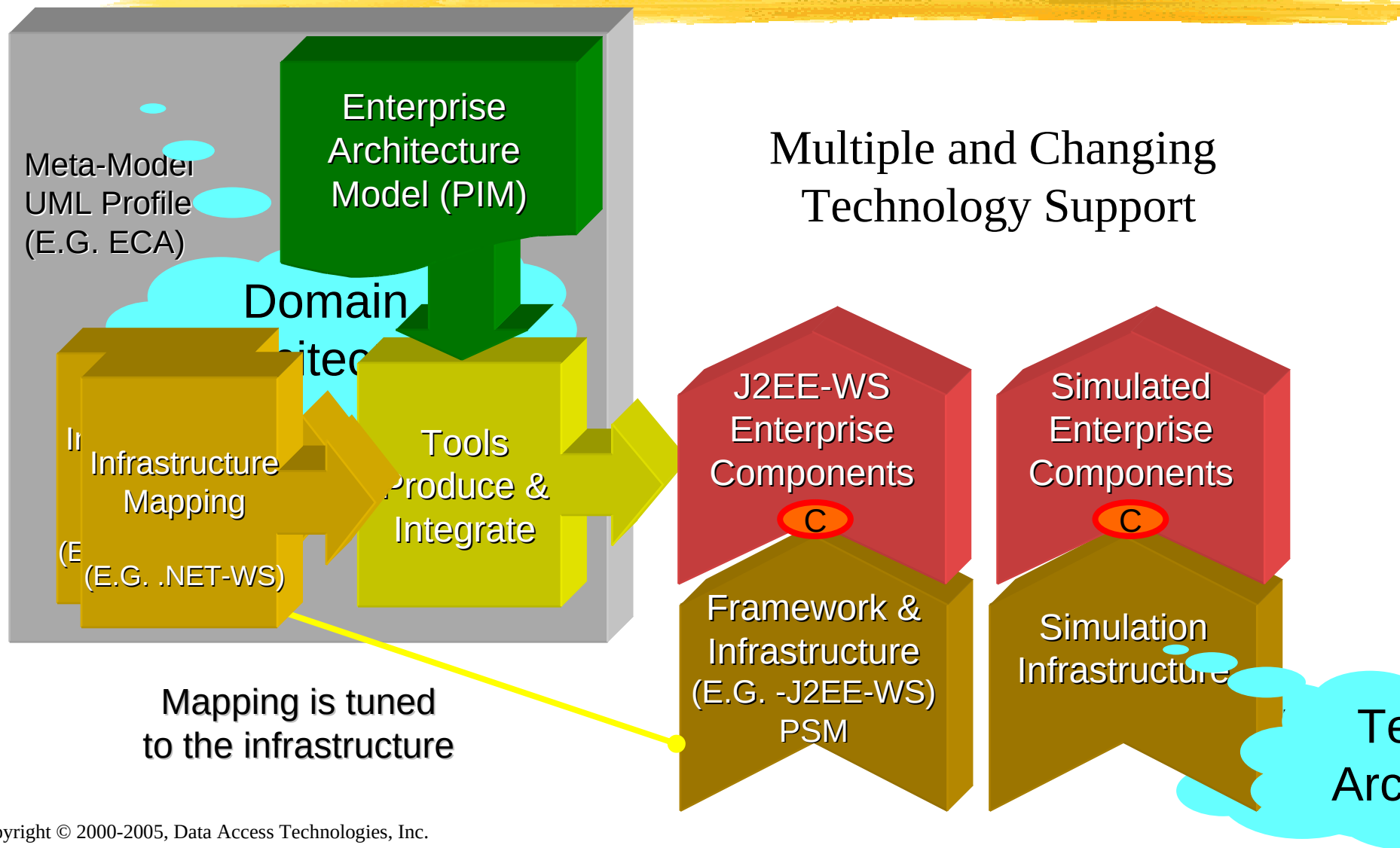


The new center

- The strategic core of you systems must be the enterprise its self
- Only technology independent enterprise focused models will survive the transience of technology and lock-in
- These models can become *part of your solution*, driving enterprise applications and simulations
- Enabler: Model Driven Architecture (MDA) with EDOC-Enterprise Collaboration Architecture

Example

Linking Tactical C2 systems with “Live”, “Virtual” and “Constructive” simulations (SIMCI)

Call for Fire - MLRS

Bde - FSE

Bde- Artillery

Bn-FSE

FA Bn - FSE

Co-FIST

Call For Fire

Fire Ready

Rounds Complete

Fire Shot

Fire Splash

Mission Fire Rpt

End Of Mission

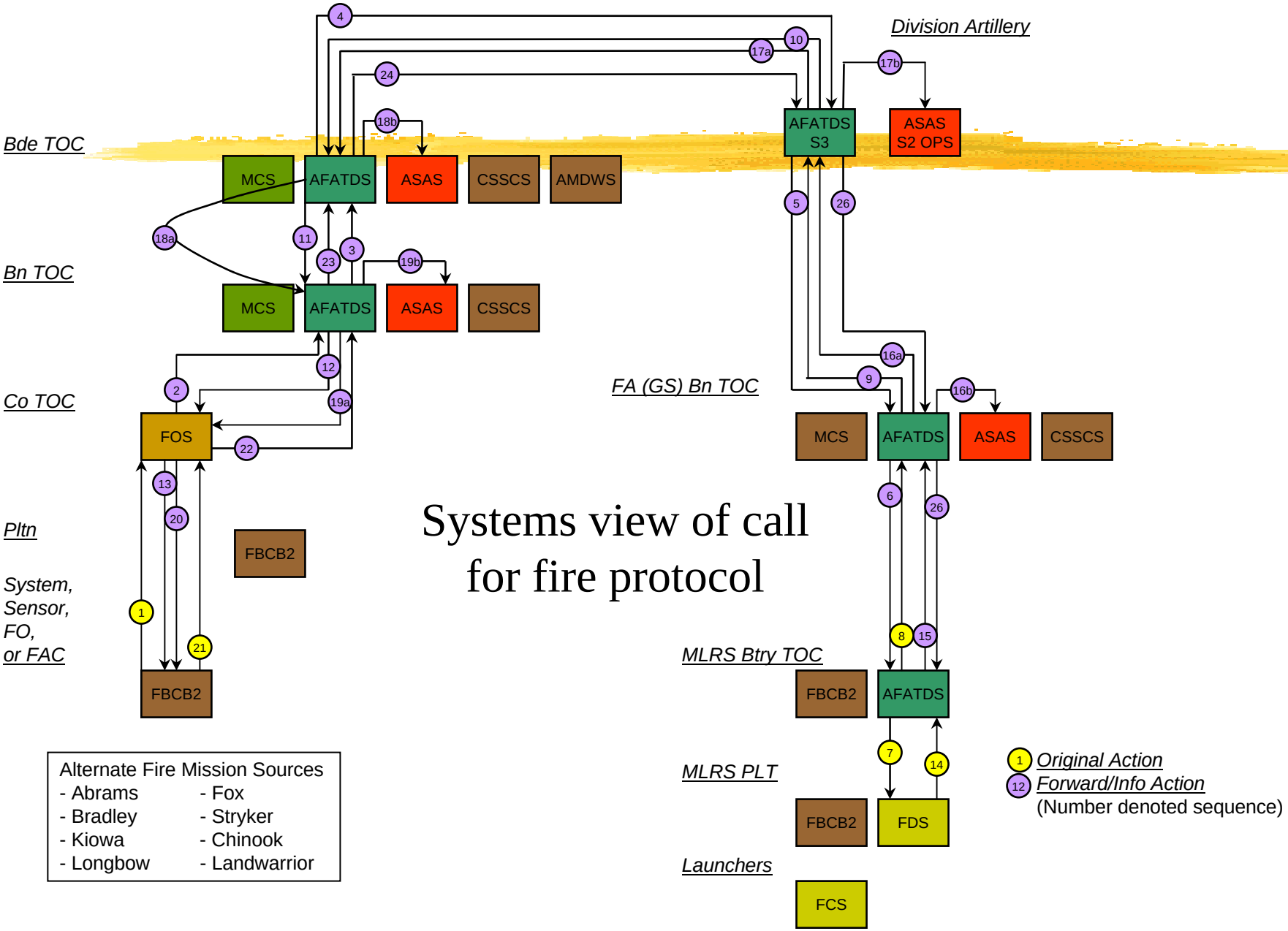
MLRS Battery

Forward Observer

MLRS

Call for fire is a “protocol” of action and information exchange between parties

Existing Info (PPT) - Thread 2b - FS: CFF To GS MLRS (AFATDS)



Existing Info - Thread Detail (Spread Sheet)

Thread 2b - FS: CFF to GS MLRS (FDS)								
CFF mission (immediate suppression) initiated by System, Sensor, FO or FAC and fired by GS MLRS								
Step	Activity/Task	Originating OPFAC	System	Information	Type	Destination OPFAC	System	Info Action
1	System, Sensor, FO or FAC detects target; analzes situation and makes call for fire request	OBS	FBCB2	Call For Fire (CFF)	K02.4	Co FIST	FOS	A
2	Co FIST receives CFF request from platform, does a quick analysis (checking for dual targeting, etc.), and passes CFF to the Bn FSE	Co FIST	FOS	CFF		Bn TOC	AFATDS	A
3	Bn FSE receives CFF, makes determination that Bn assets cannot handle the mission, and passes the request to the Bde FSE	Bn TOC	AFATDS	CFF	Pkg 10/11 Fmt	Bde TOC	AFATDS	A
4	Bde FSE receives CFF, makes determination that Bde assets cannot handle the mission, and passes the request to the FA Bde (Div Arty) FDC	Bde TOC	AFATDS	CFF	Pkg 10/11 Fmt	FA Bde TOC	AFATDS	A
5	FA Bde FDC receives CFF, makes determination that GS FA assets can handle the mission, and passes the request to the FA (GS) Bn FDC	FA Bde TOC	AFATDS	CFF		FA Bn TOC	AFATDS	A
6	FA Bn FDC receives Fire request/order to fire, assigns mission to MLRS battery	FA Bn TOC	AFATDS	CFF	Pkg 10/11 Fmt	MLRS Btry CP	AFATDS	A
7	Btry FDS receives OTF and transmits this OTF to the MLRS platoon FDS	MLRS Btry CP	ATADS	OTF	BCS Fmt	MLRS Platoon	FDS	A
8	4 different messages transmitted back to the observer and as info to other echelons, depending upon the specific fire mission requested, some may not be necessary; "Ready" states that the battery is preparing to fire the mission, "Shot" stastes that the i	MLRS Btry CP	AFATDS	MTO, Shot, Spalsh, Rounds Complete	Pkg 10/11 Fmt	FA Bn TOC	AFATDS	I

Call for Fire – MLRS Model

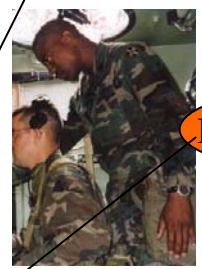
Bde - FSE

Bde- Artillery

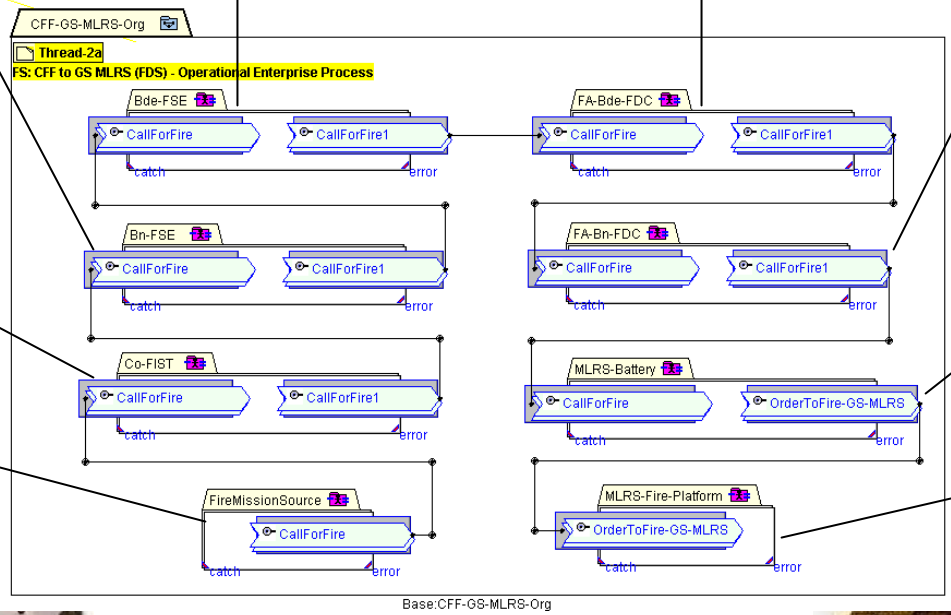
Bn-FSE

FA Bn - FSE

Co-FIST



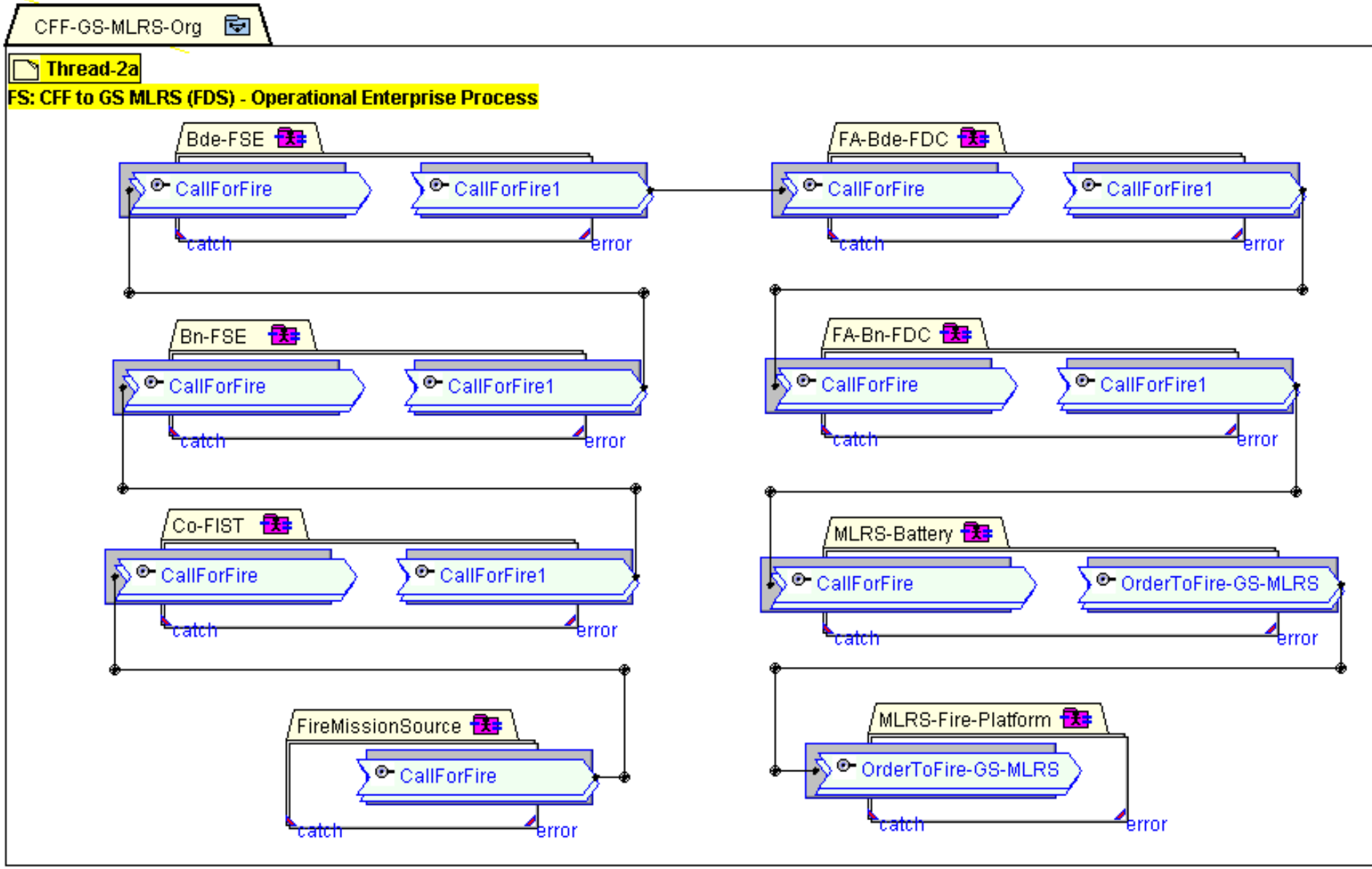
MLRS Battery



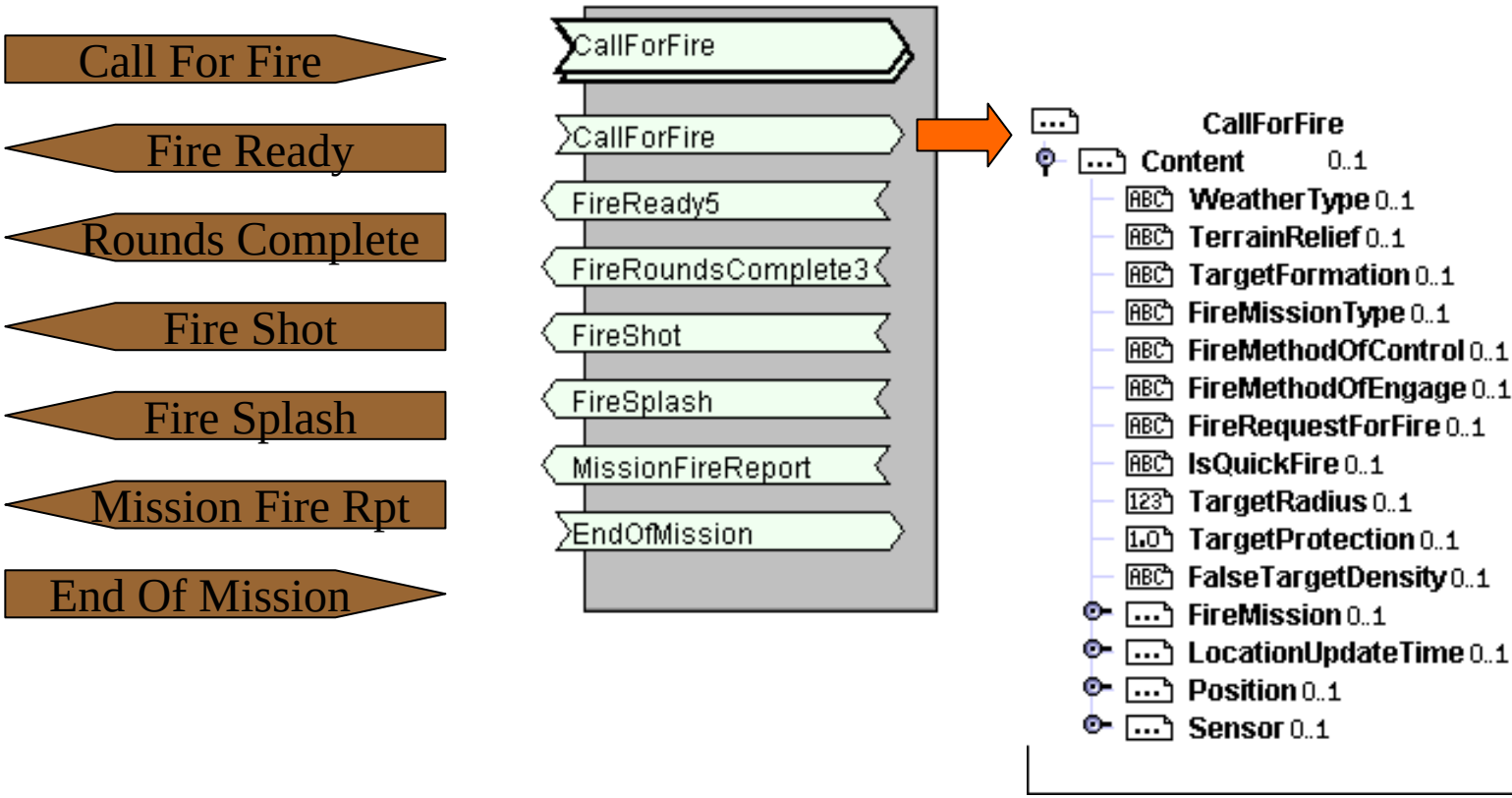
Forward Observer

MLRS

Model Of CFF Thread

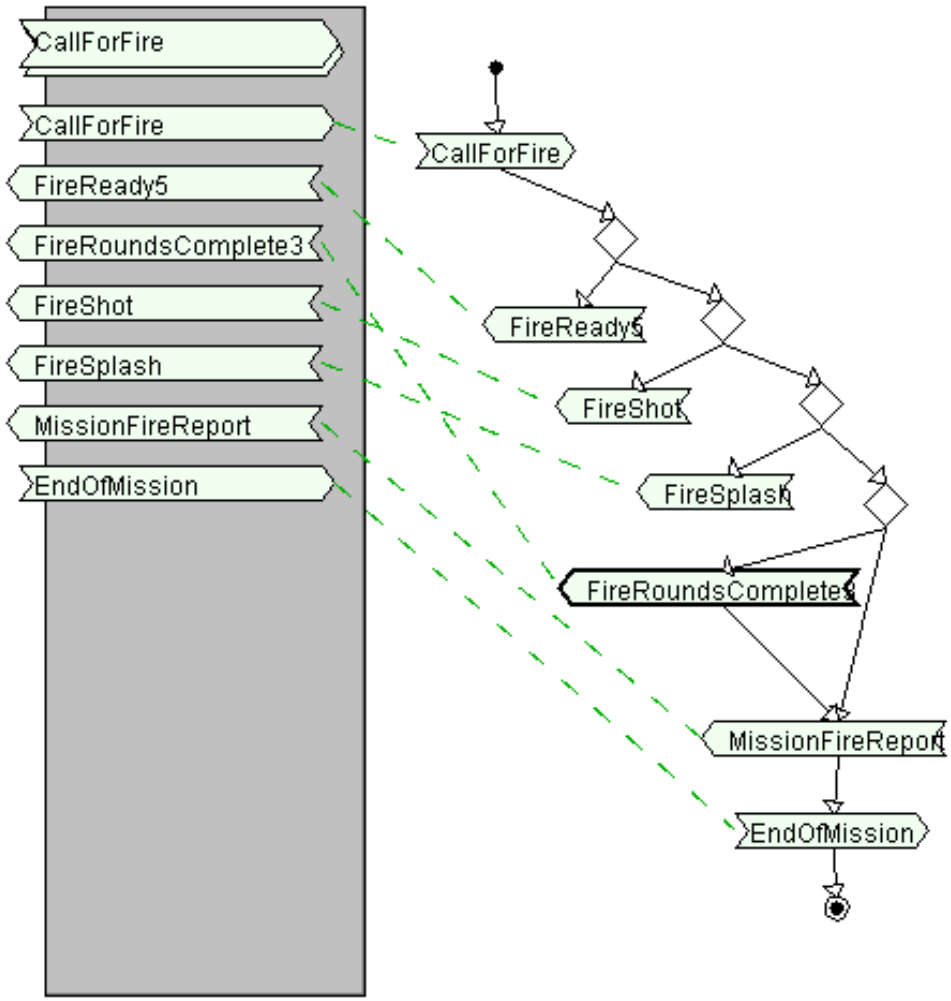


Model Information Flows

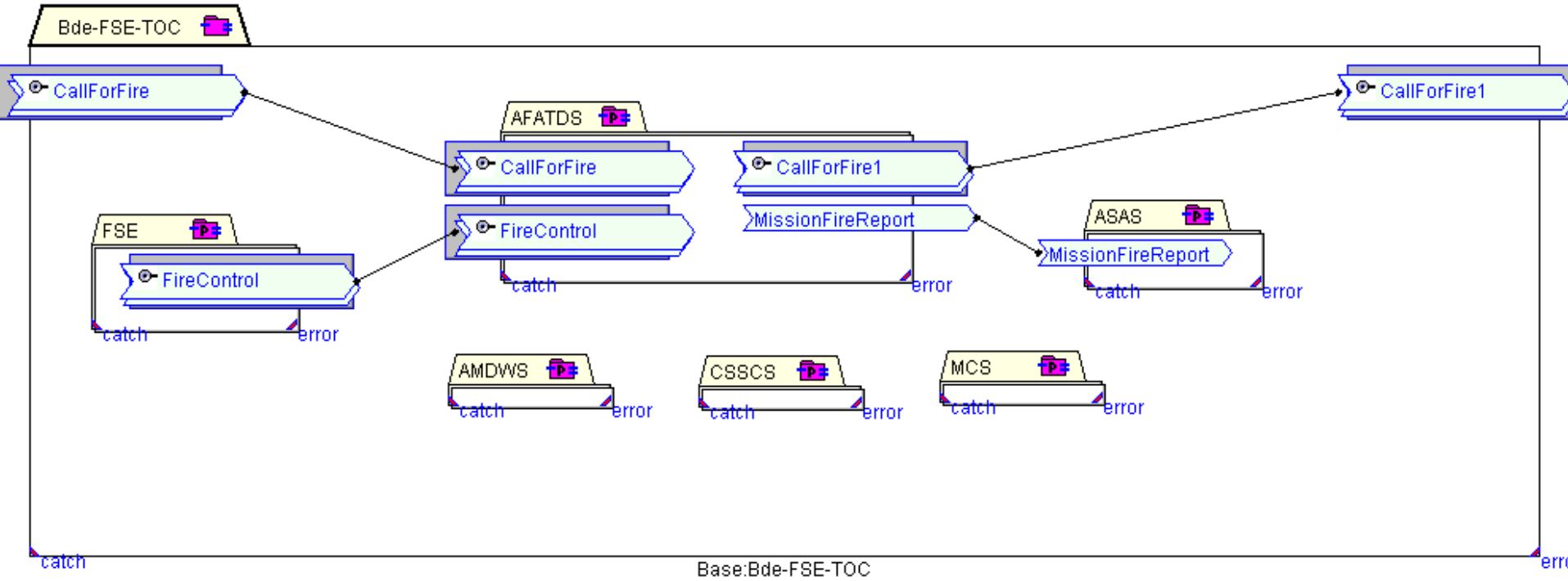


* Not technology details!

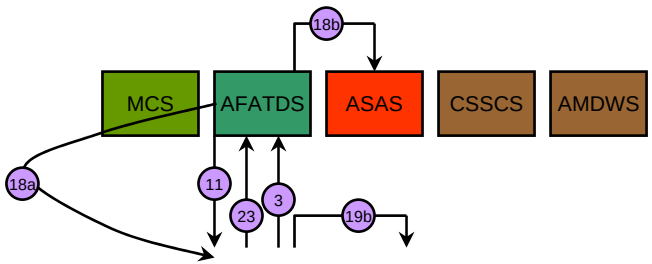
Choreography – Understanding When



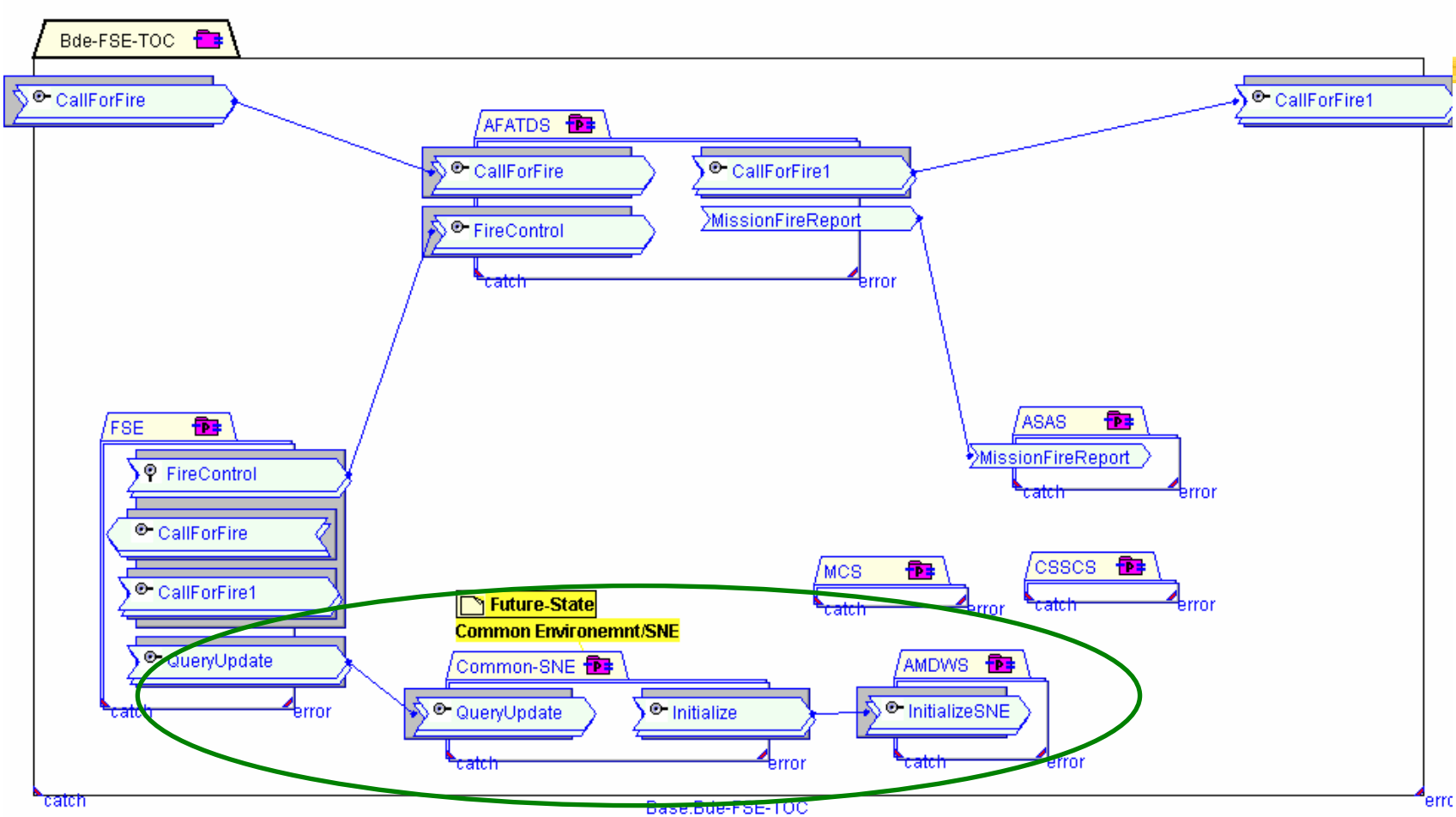
Drill Down - Inside of a TOC



From “threads”

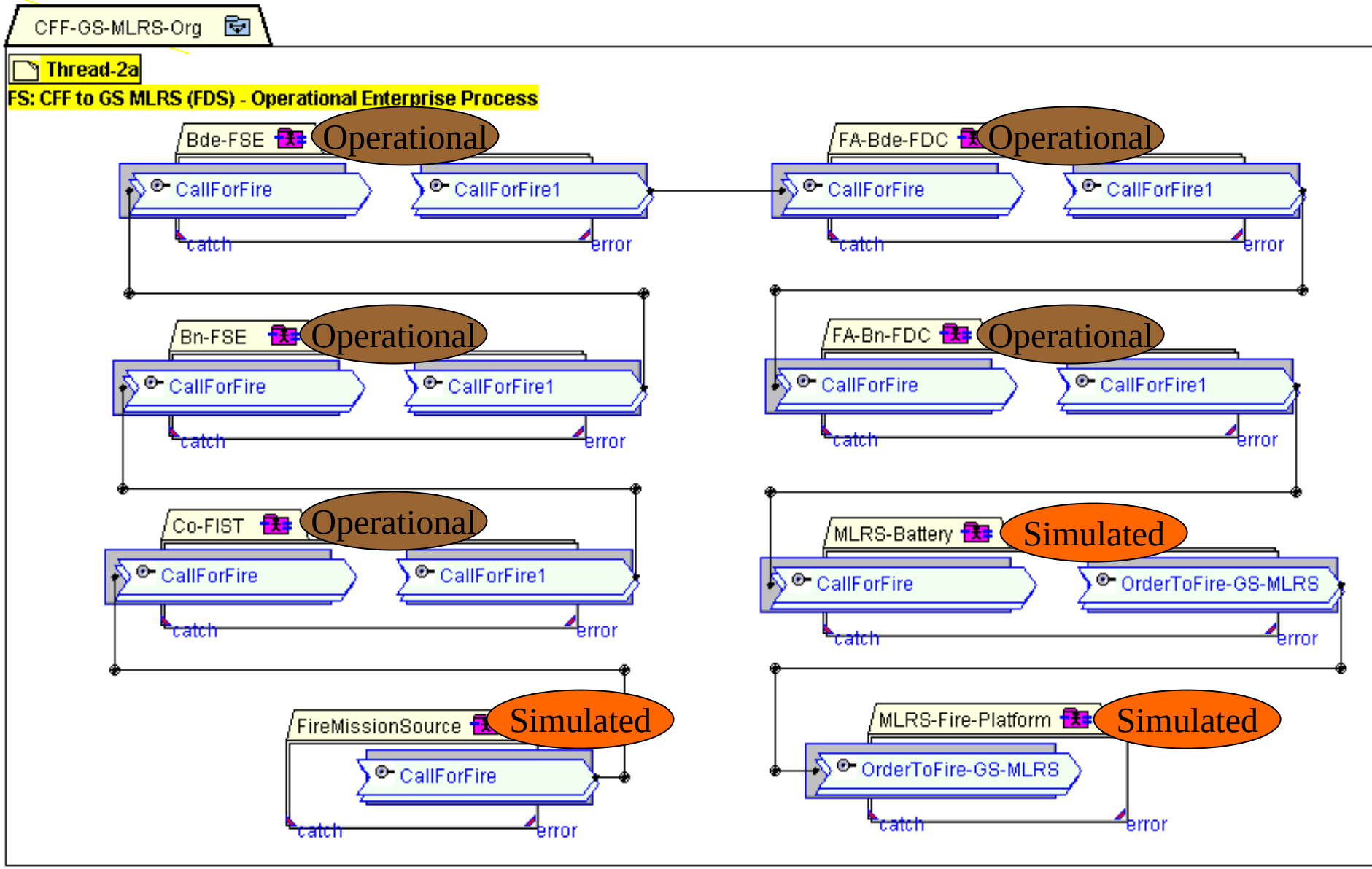


Inside of a TOC



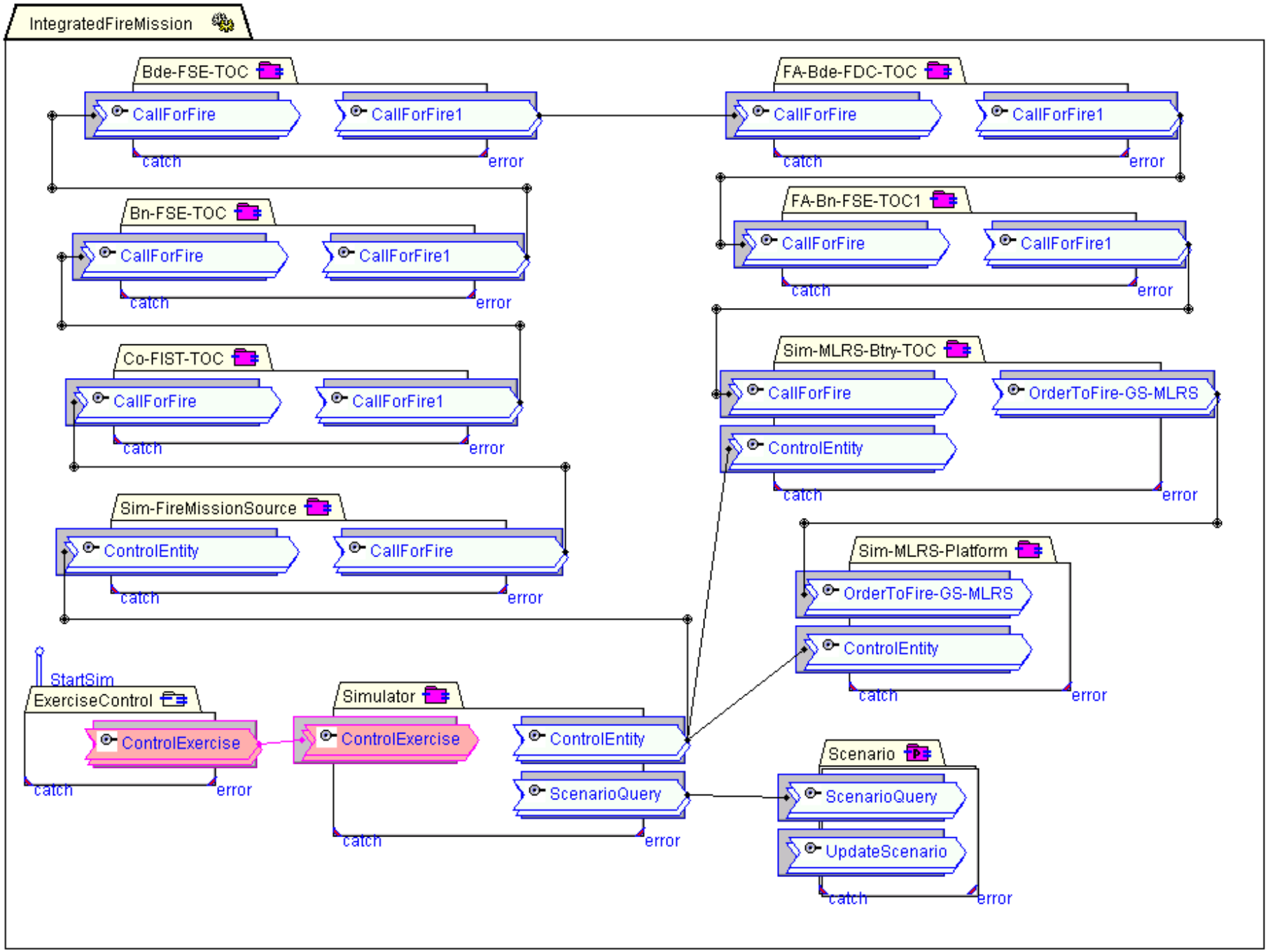
Example Future State

Simulated or Real?



Simulating the Process

Tactical and Simulated components interacting



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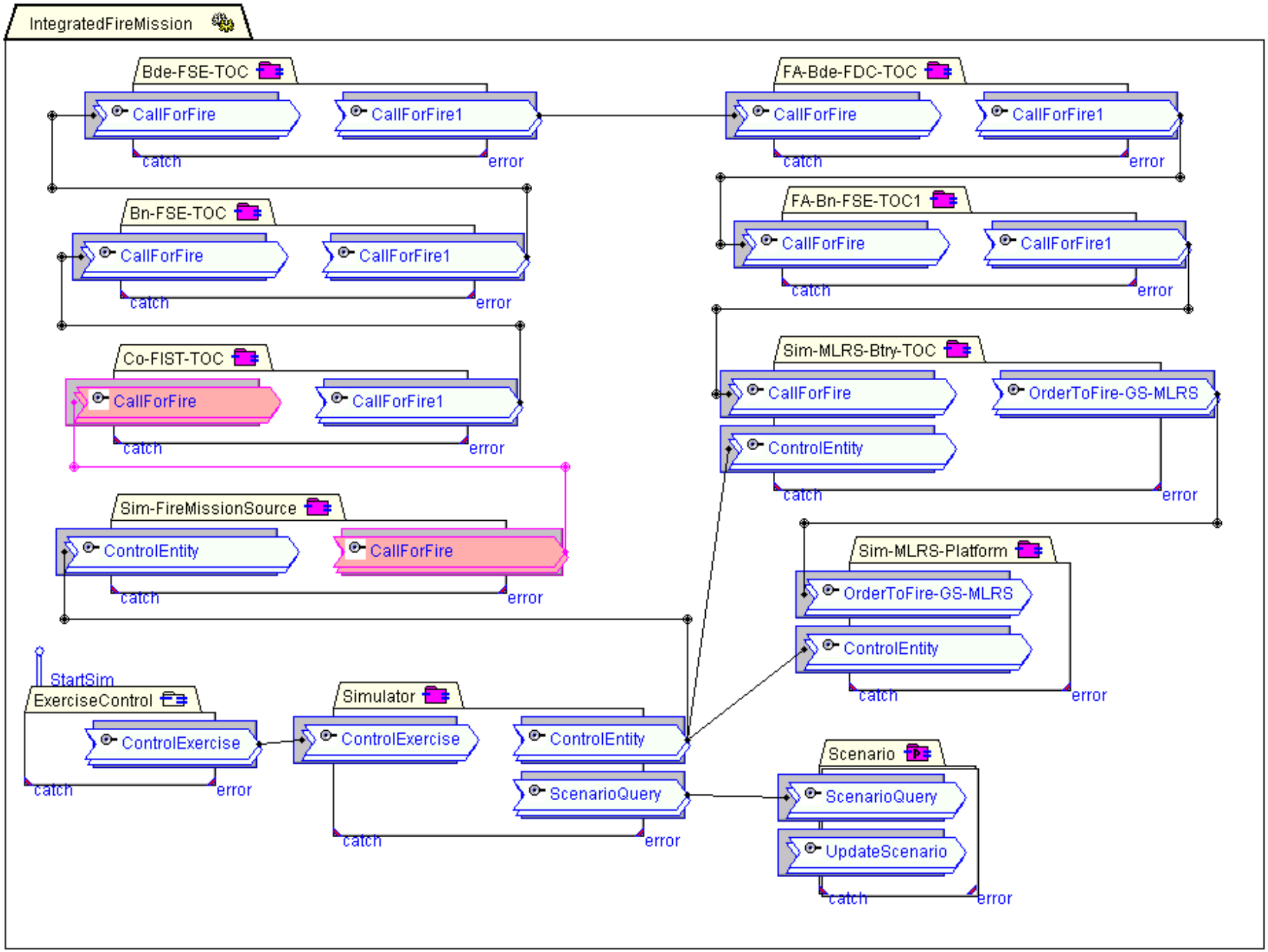

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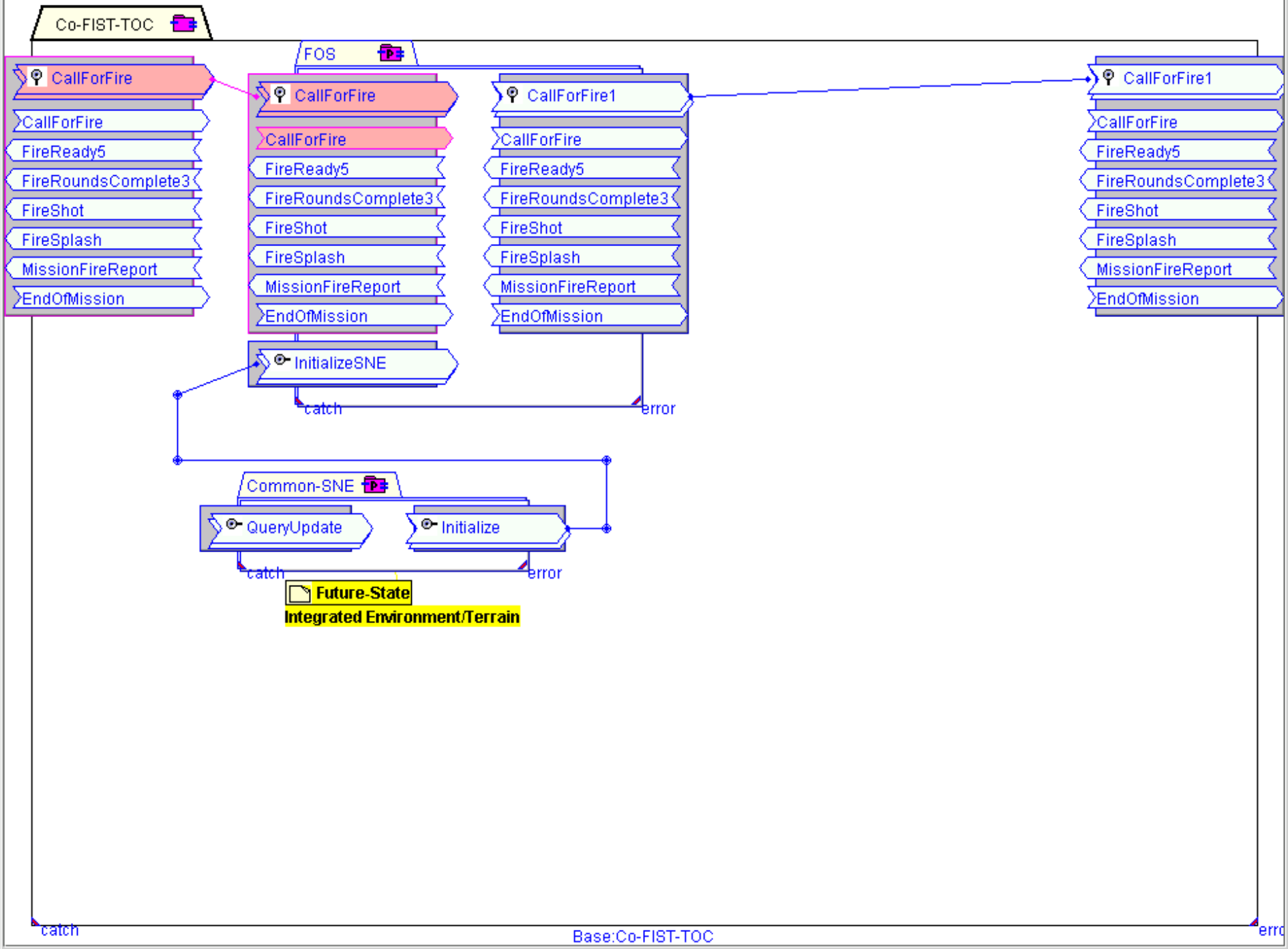
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CallForFire
FireReady5
FireRoundsComplete3
FireShot
FireSplash
MissionFireReport
EndOfMission
FOS
CallForFire
CallForFire
FireReady5
FireRoundsComplete3
FireShot
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MissionFireReport
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InitializeSNE
catch
error
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Common-SNE
QueryUpdate
Initialize
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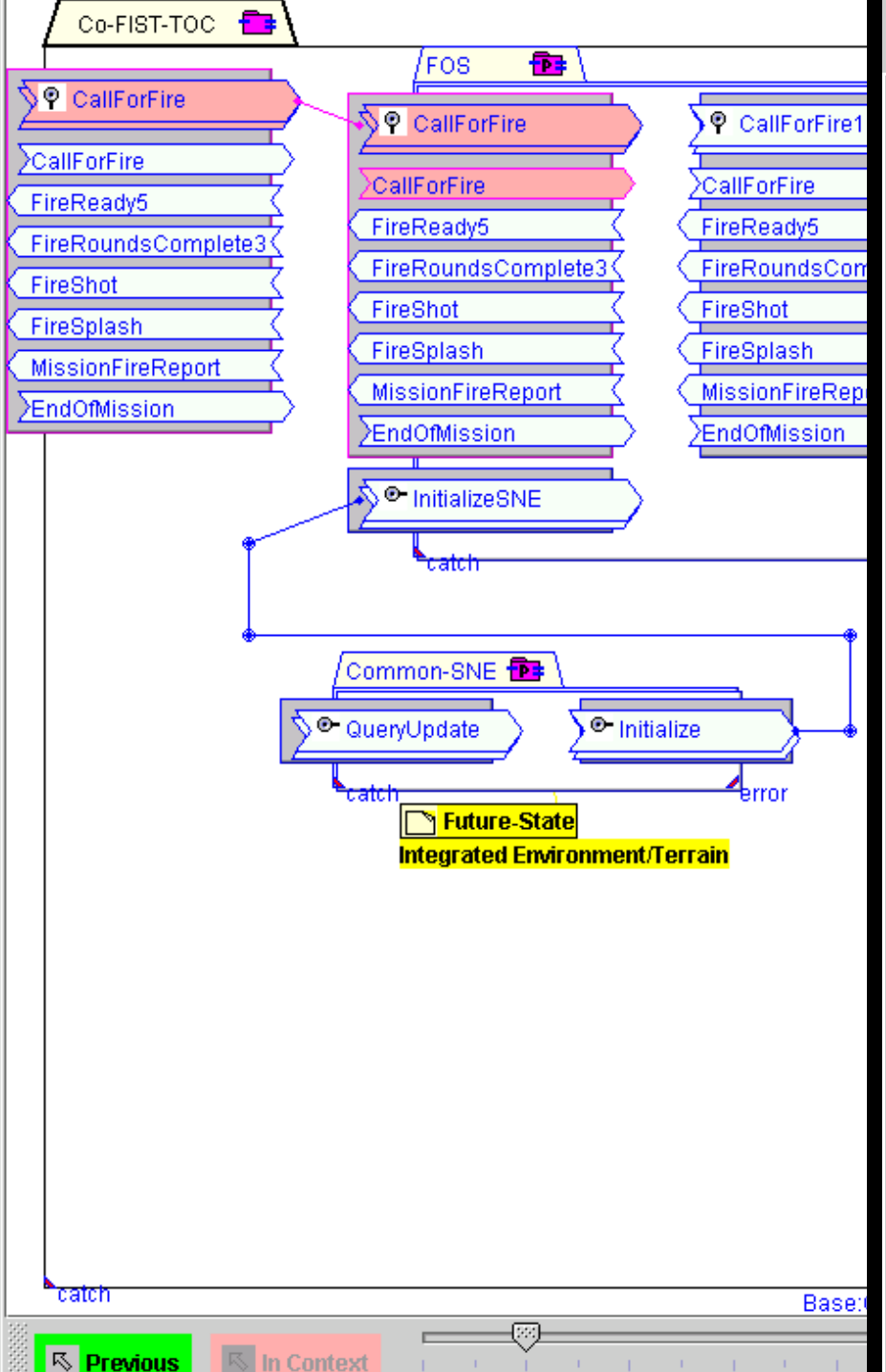
error
Future-State
Integrated Environment/Terrain
catch
Base:Co-FIST-TOC
erro



StartSim | Trace | Context

XML Event - CallForFire

text | form

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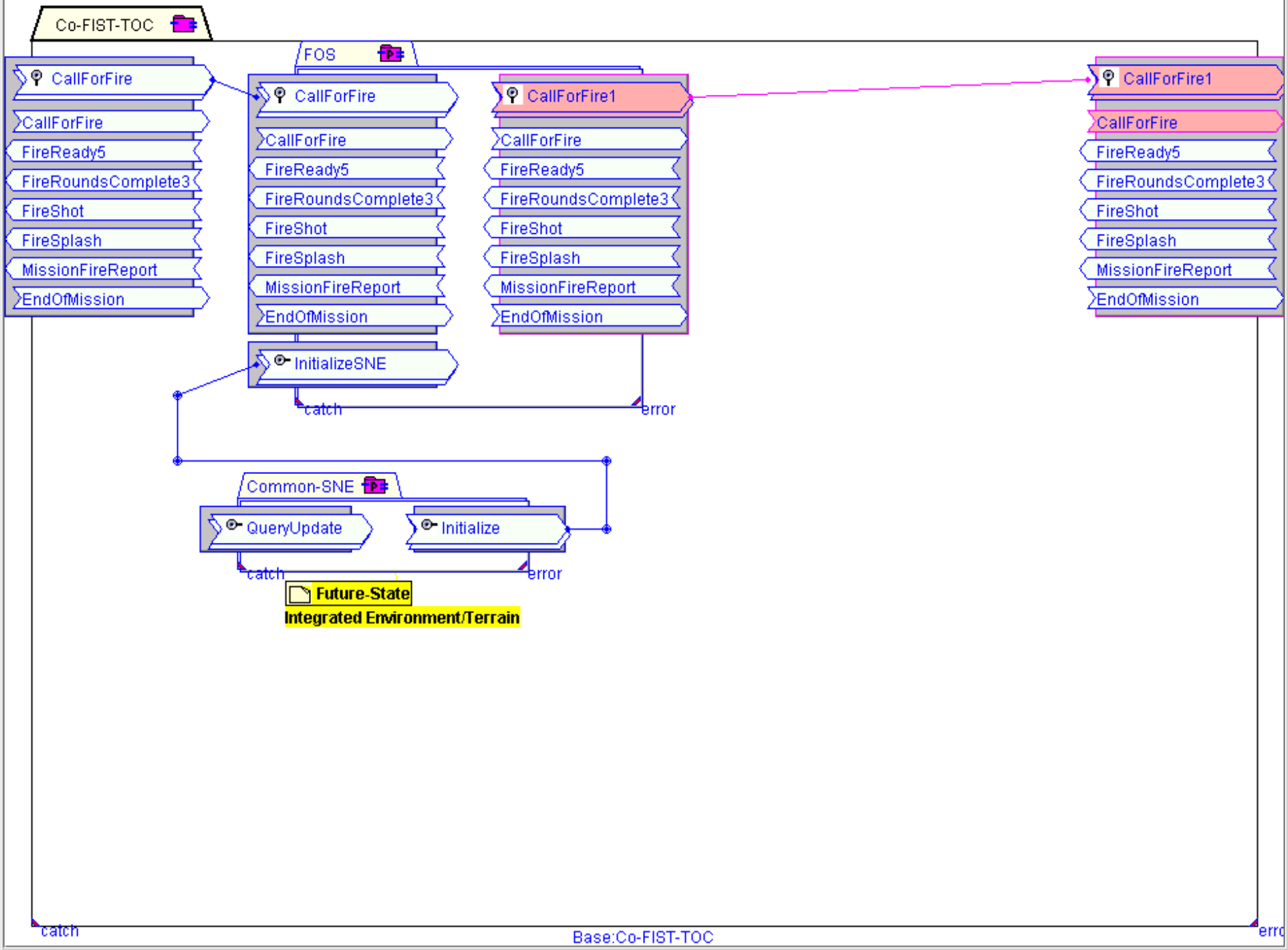
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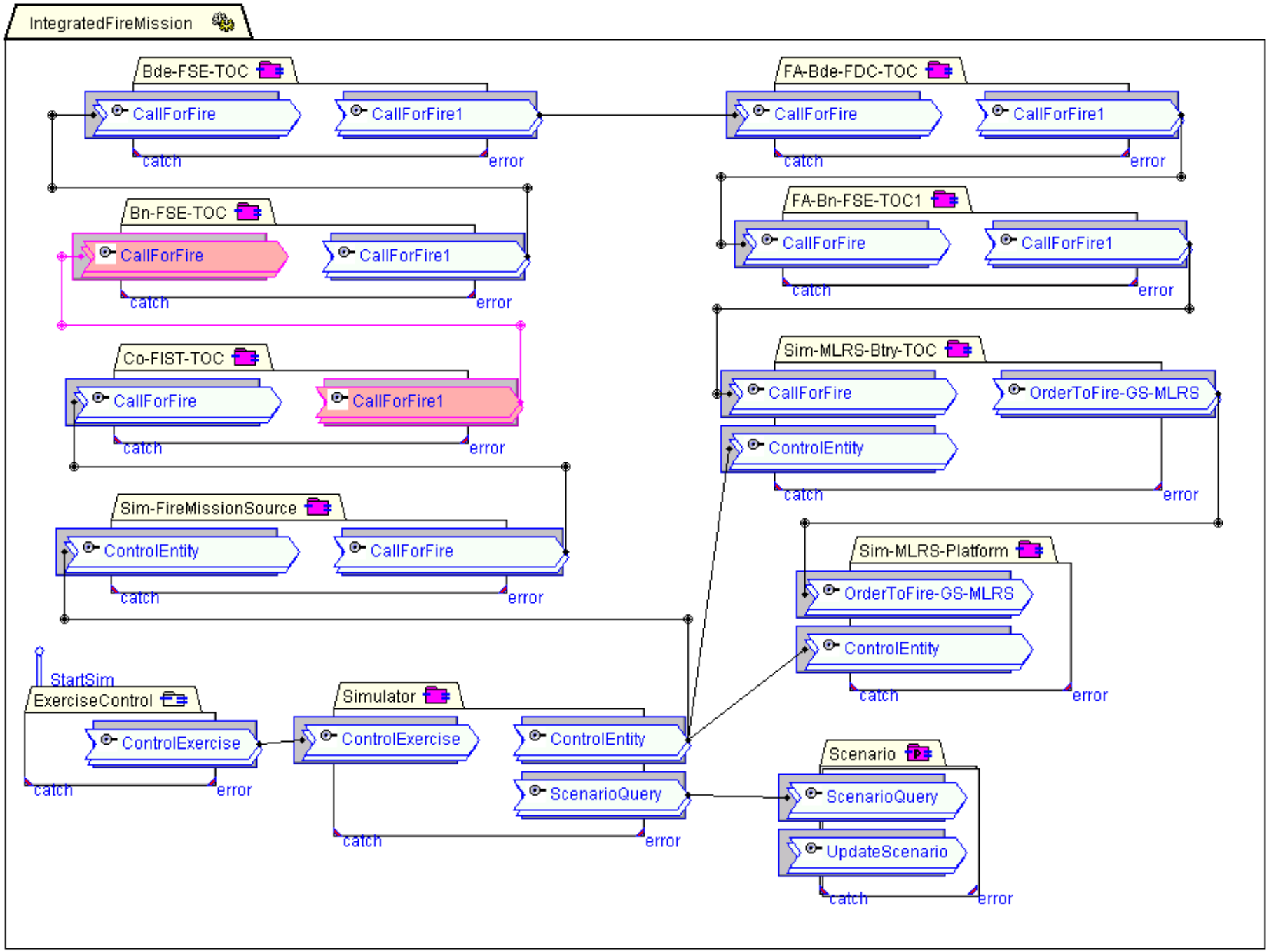

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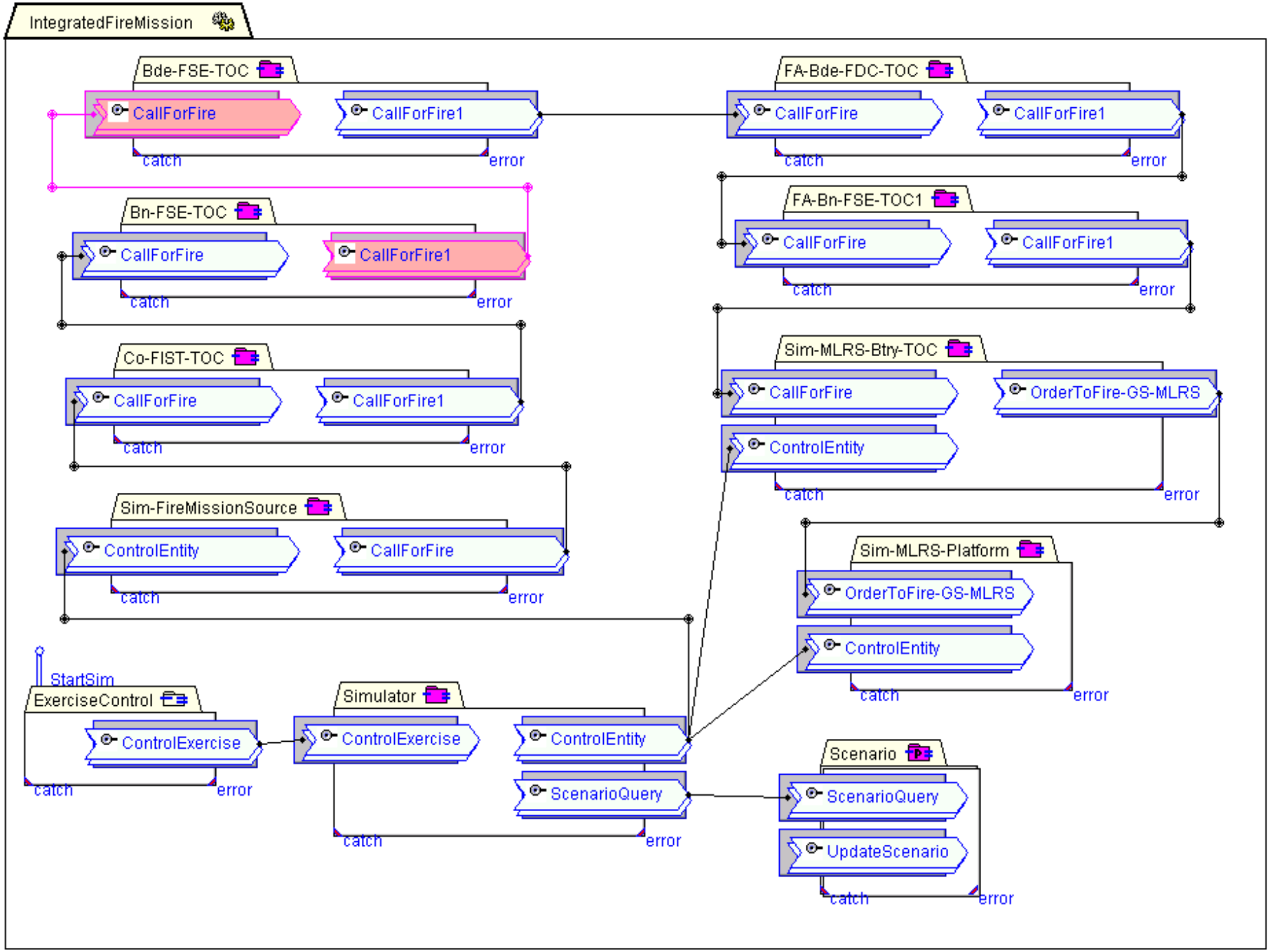

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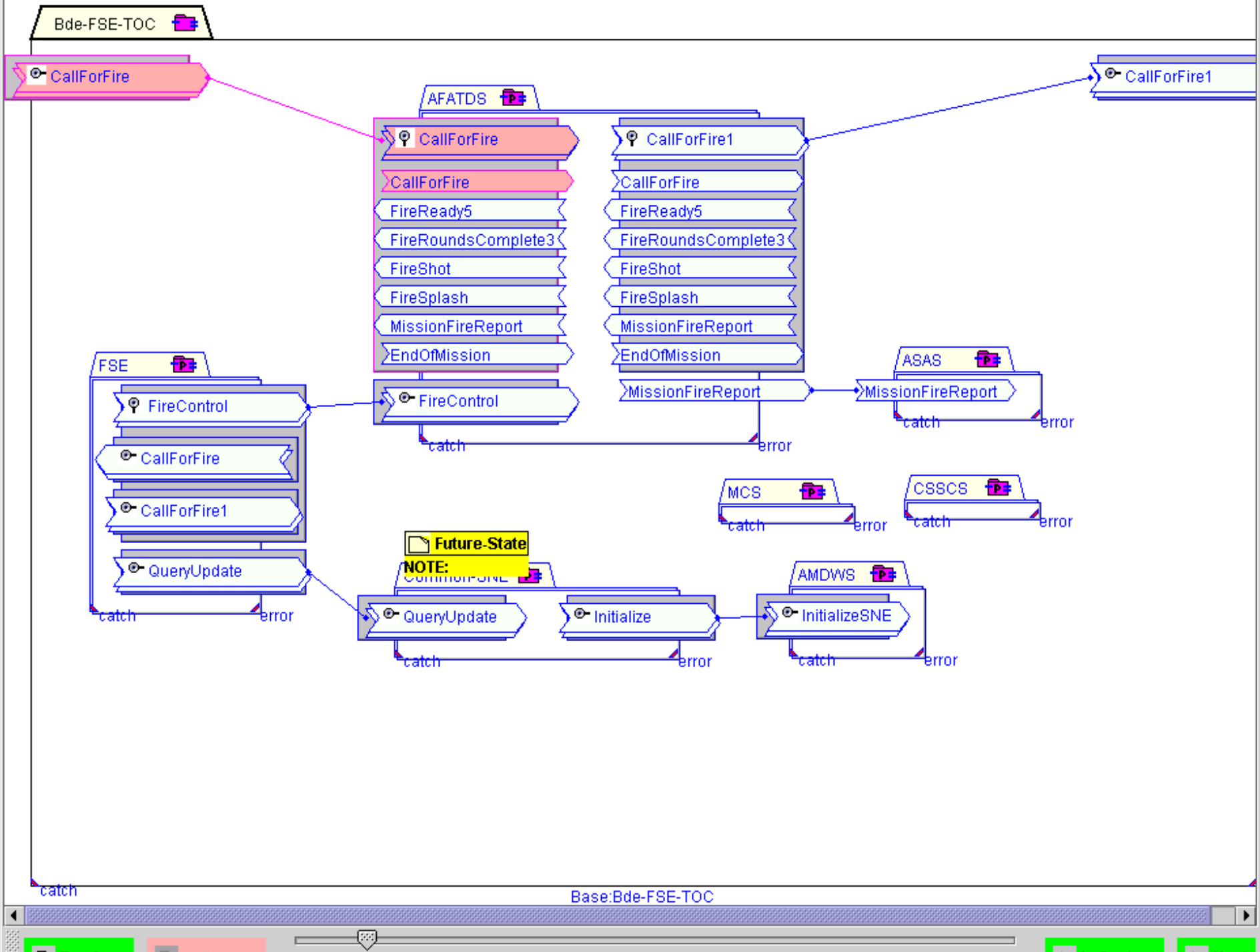
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CallForFire1
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FireControl
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error
MCS
catch
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CSSCS
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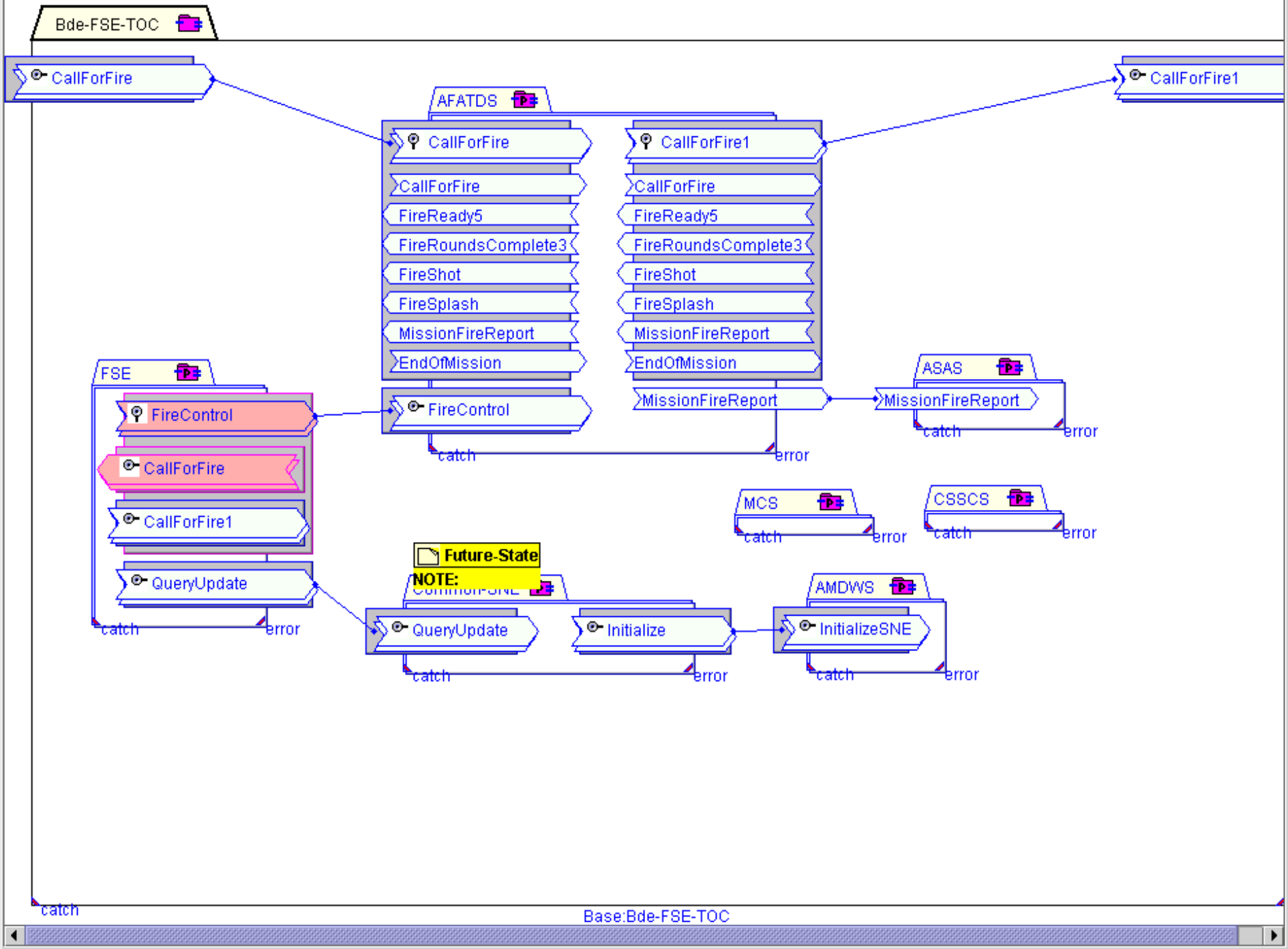
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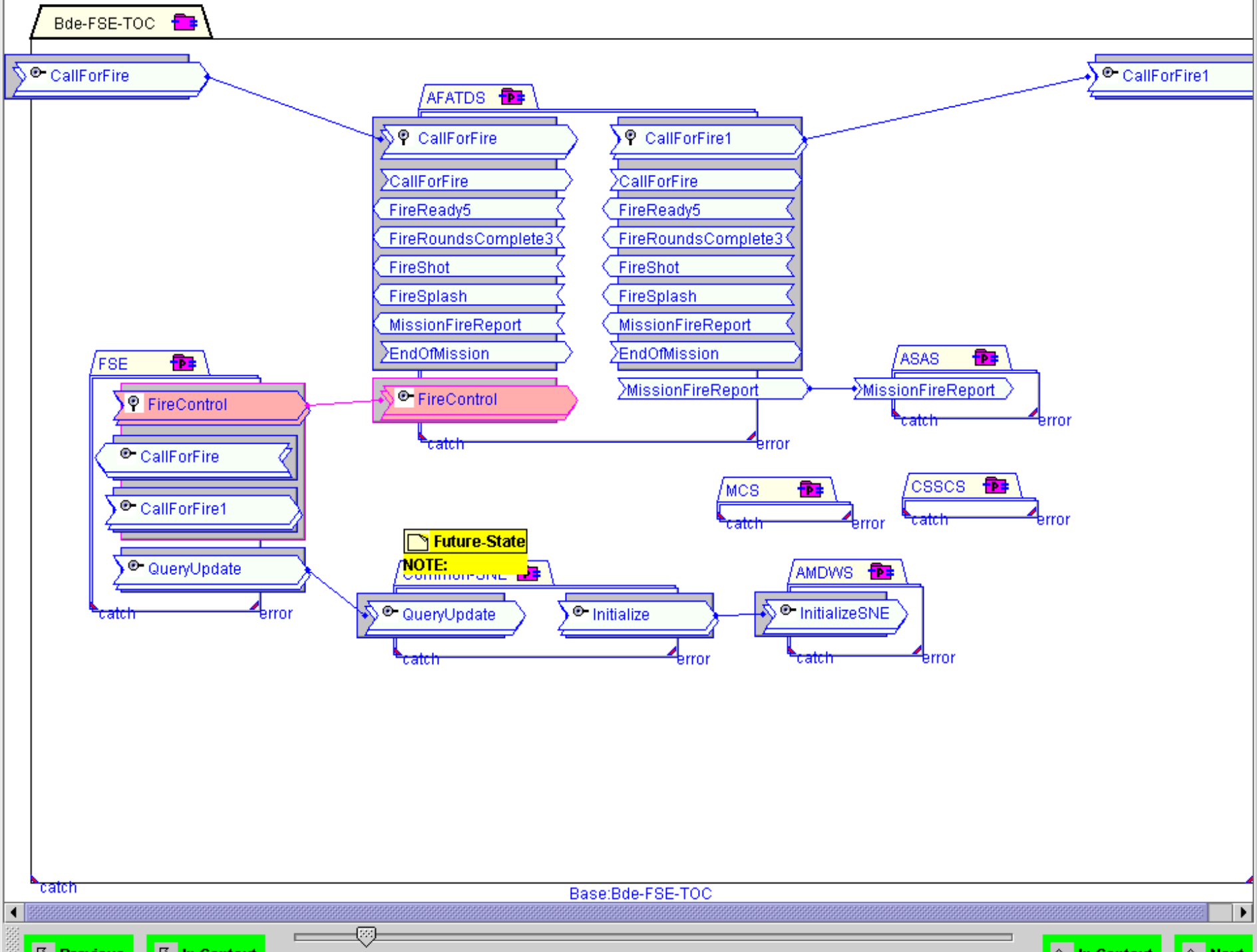
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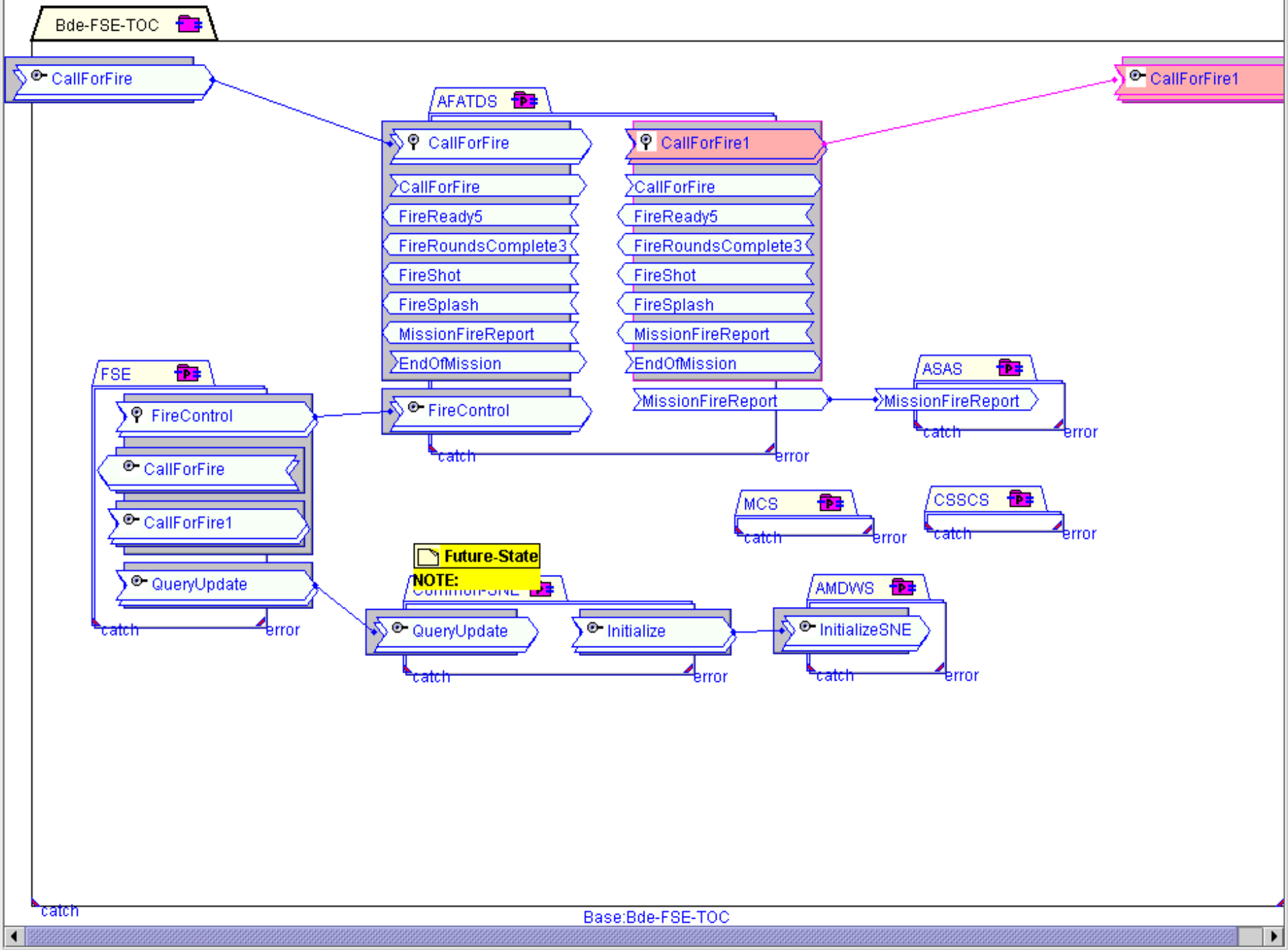
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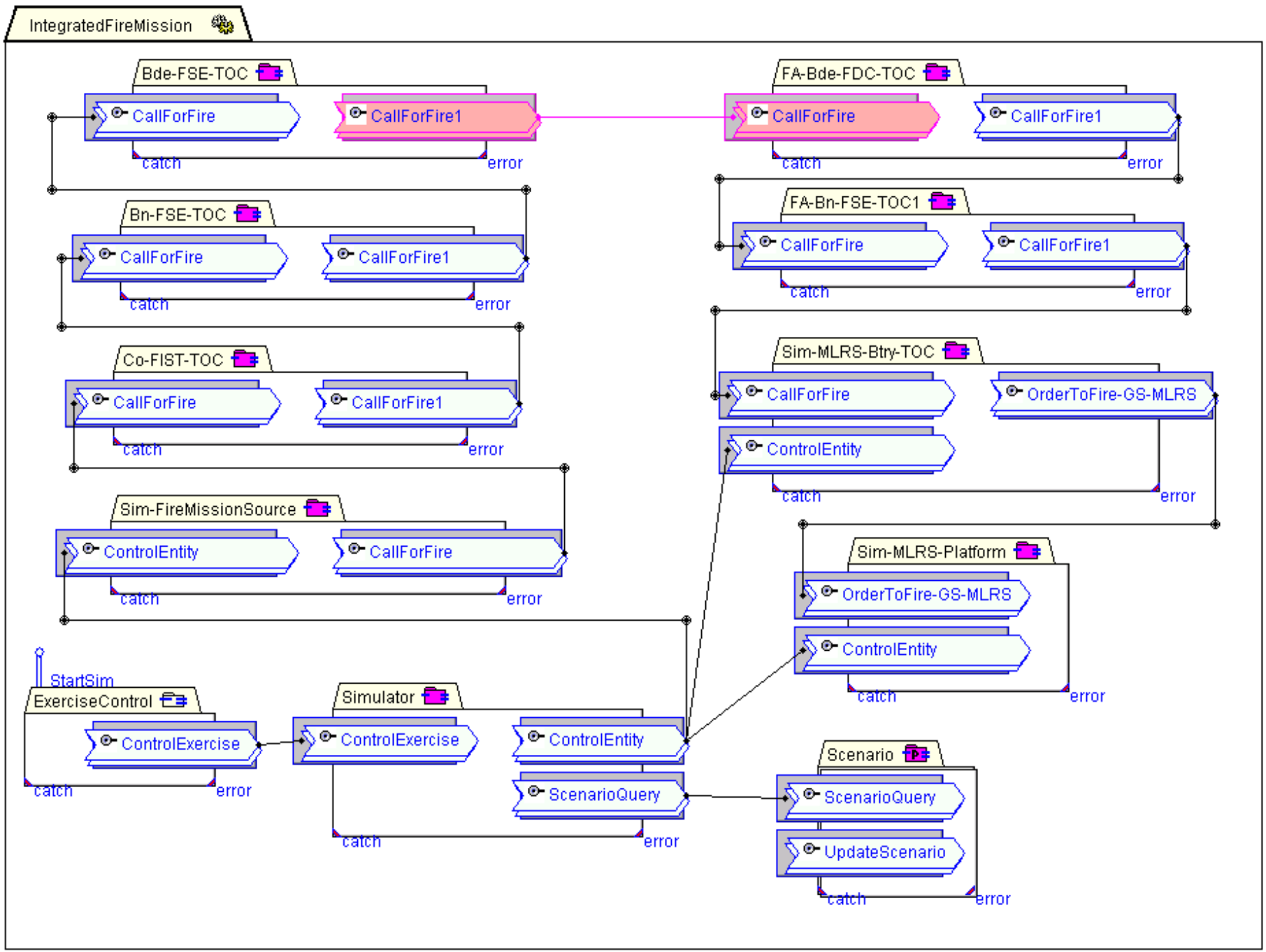

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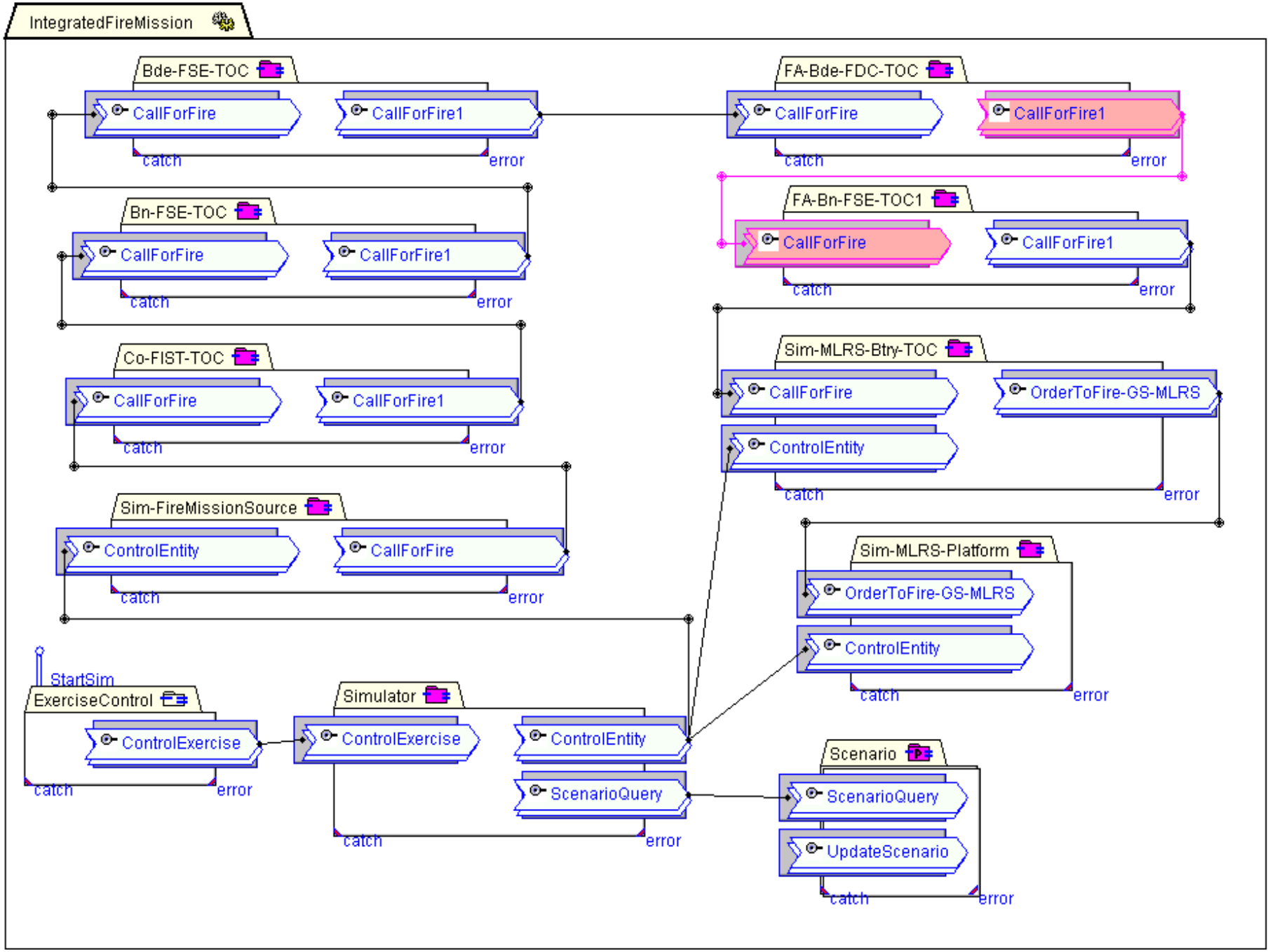

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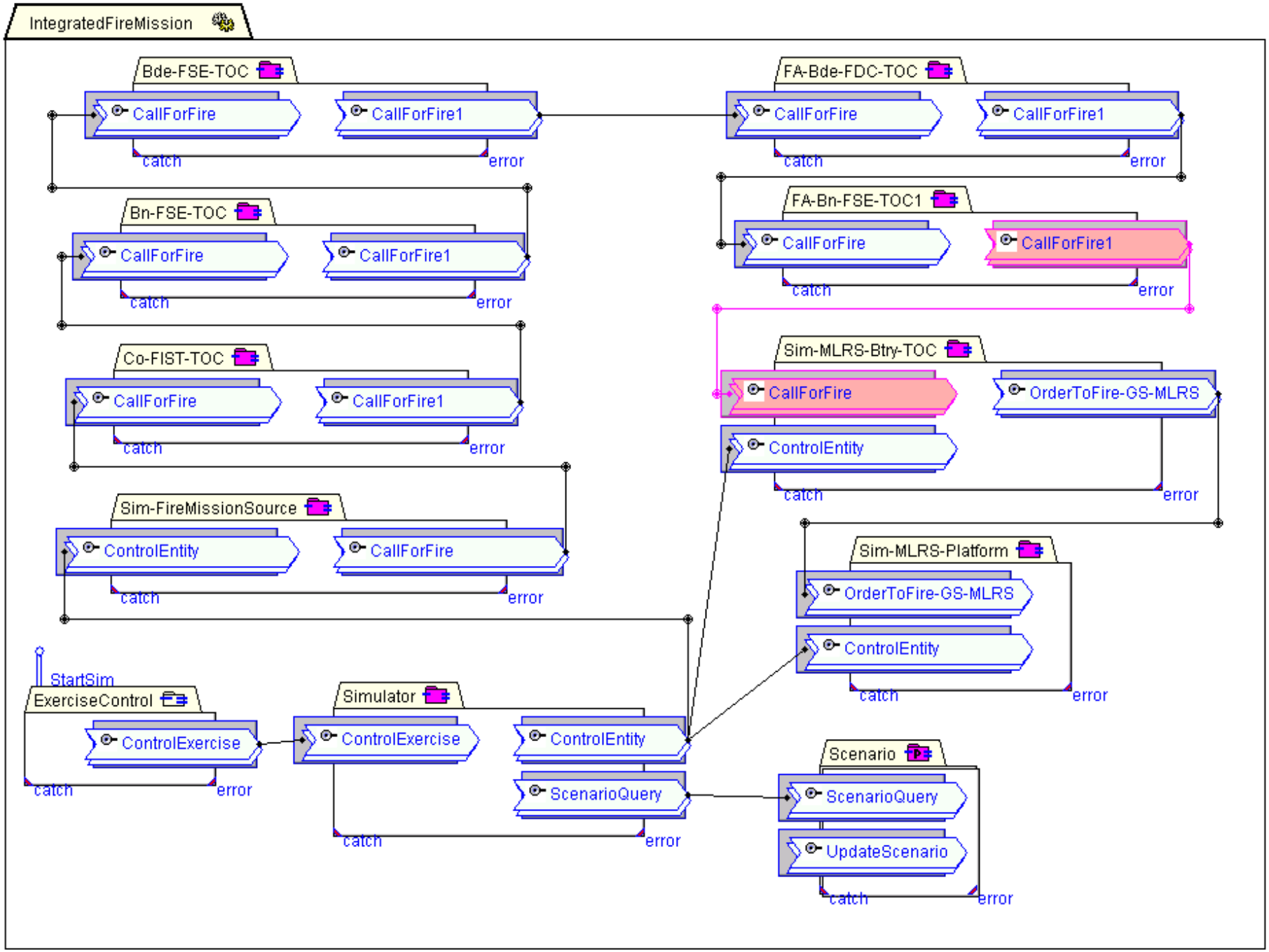

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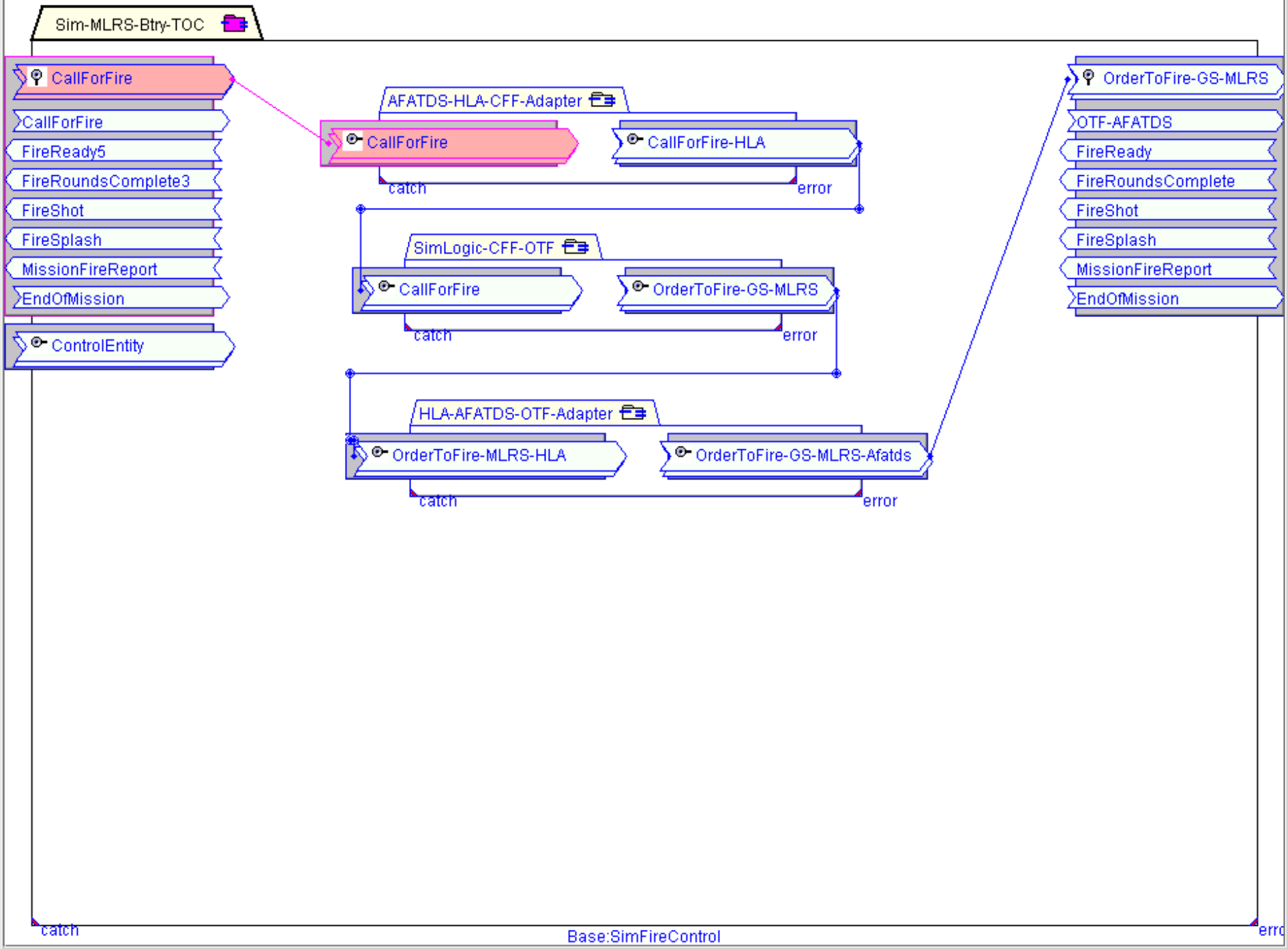
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CallForFire
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FireRoundsComplete3
FireShot
FireSplash
MissionFireReport
EndOfMission
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CallForFire
CallForFire-HLA
catch
error
SimLogic-CFF-OTF
CallForFire
OrderToFire-GS-MLRS
catch
error
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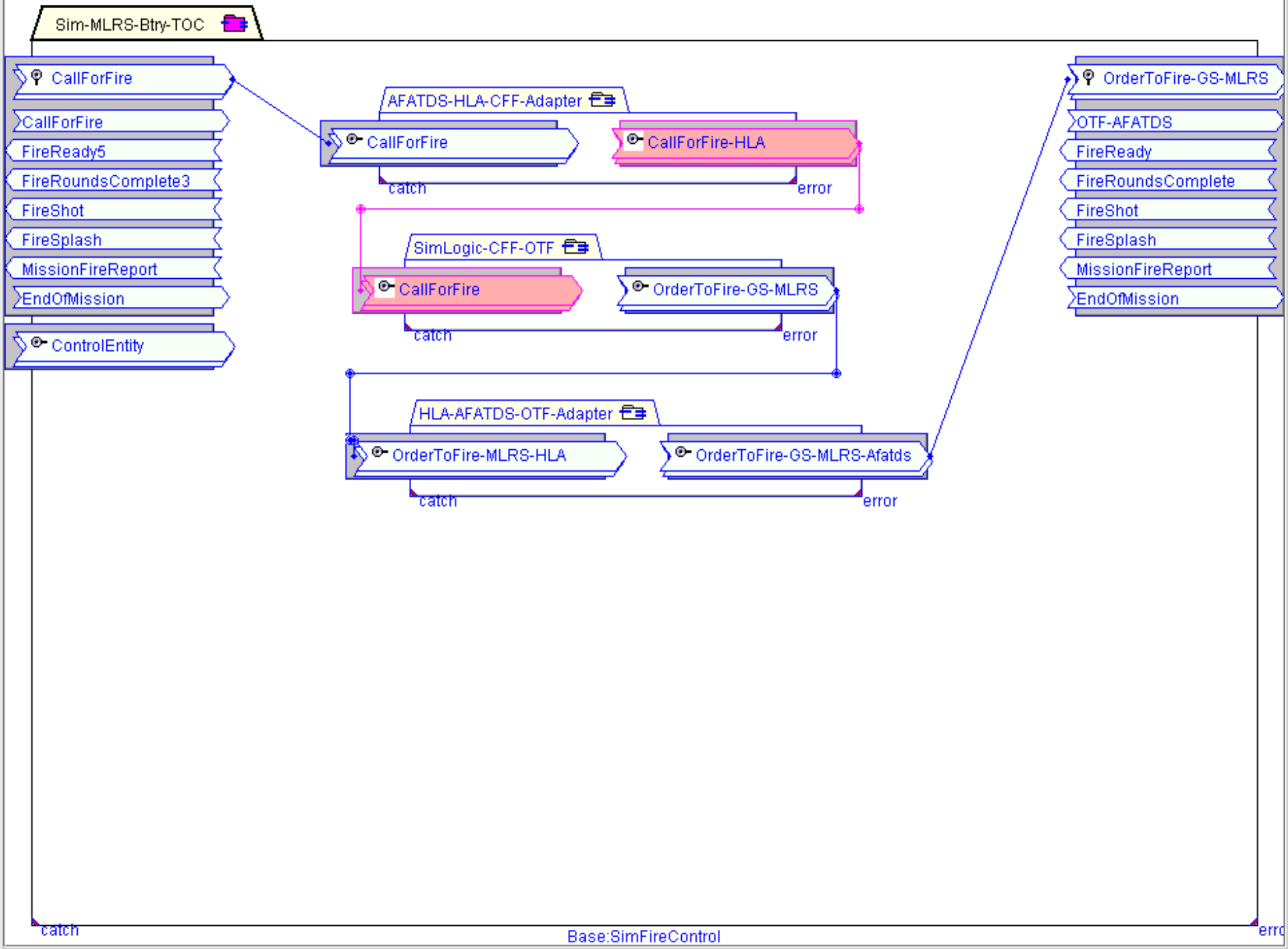
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FireRoundsComplete3
FireShot
FireSplash
MissionFireReport
EndOfMission
ControlEntity
AFATDS-HLA-CFF-Adapter
CallForFire
CallForFire-HLA
catch
error
SimLogic-CFF-OTF
CallForFire
OrderToFire-GS-MLRS
catch
error
HLA-AFATDS-OTF-Adapter
OrderToFire-MLRS-HLA
OrderToFire-GS-MLRS-Afatds
catch
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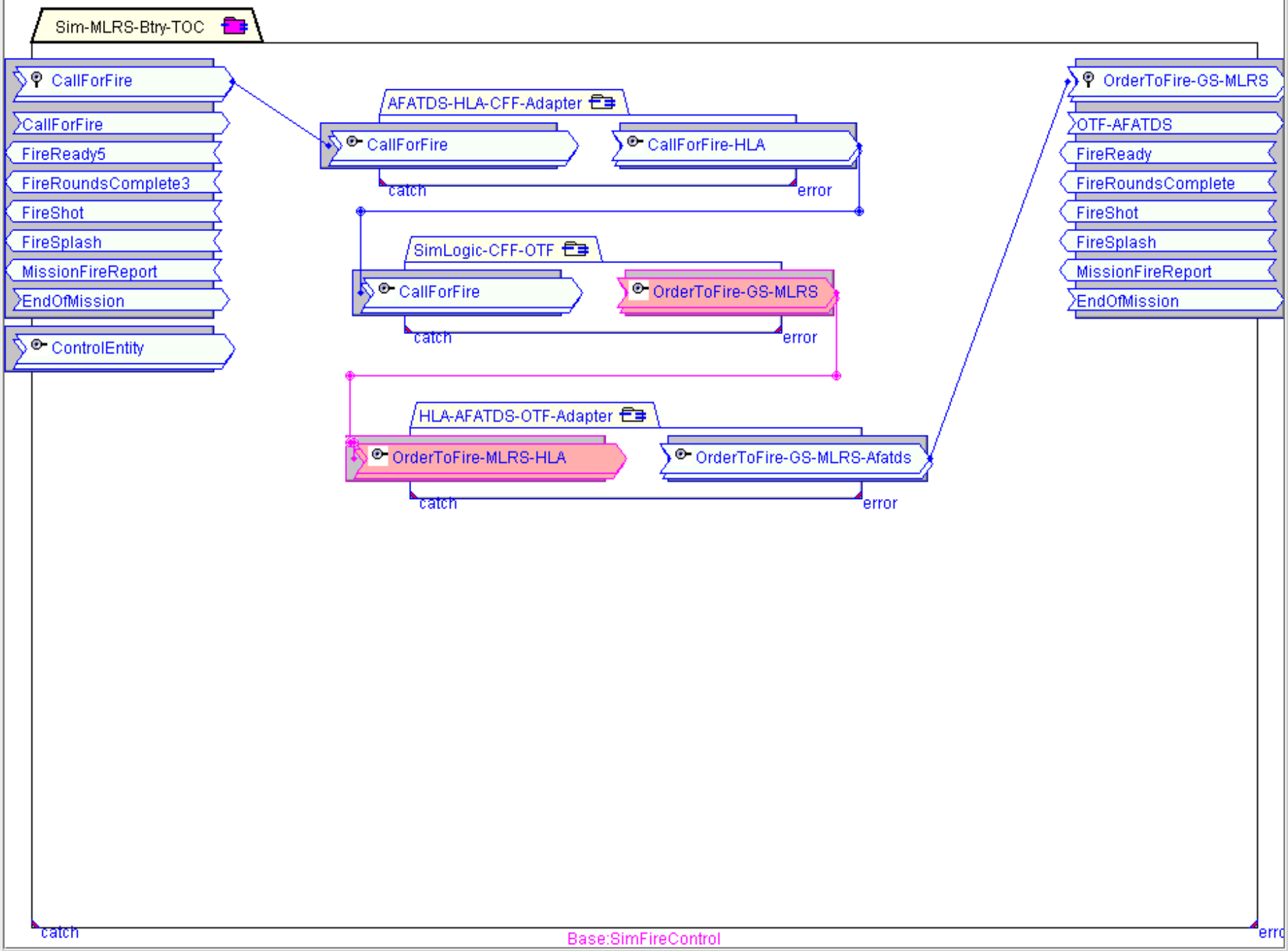
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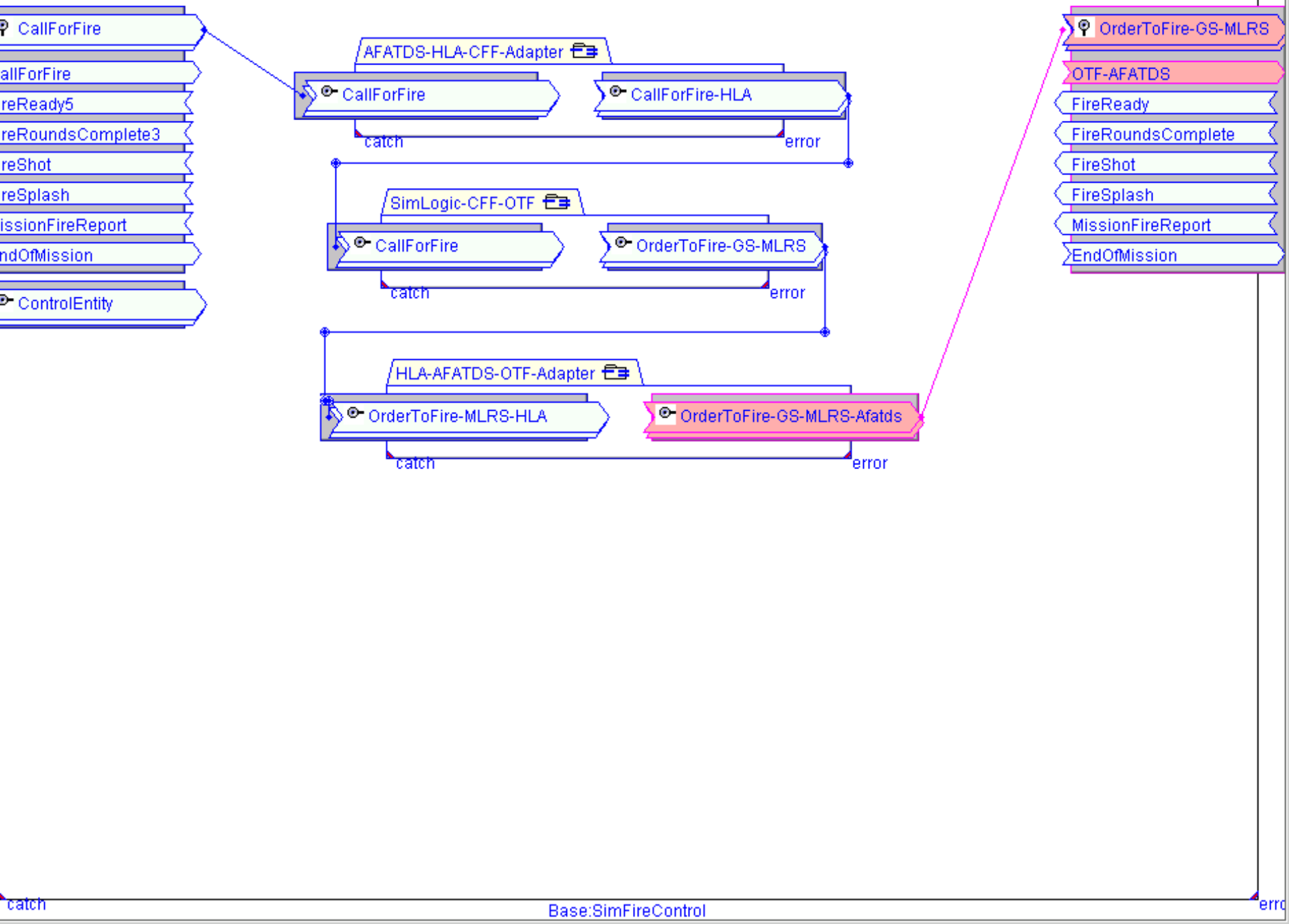
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SimLogic-CFF-OTF
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catch
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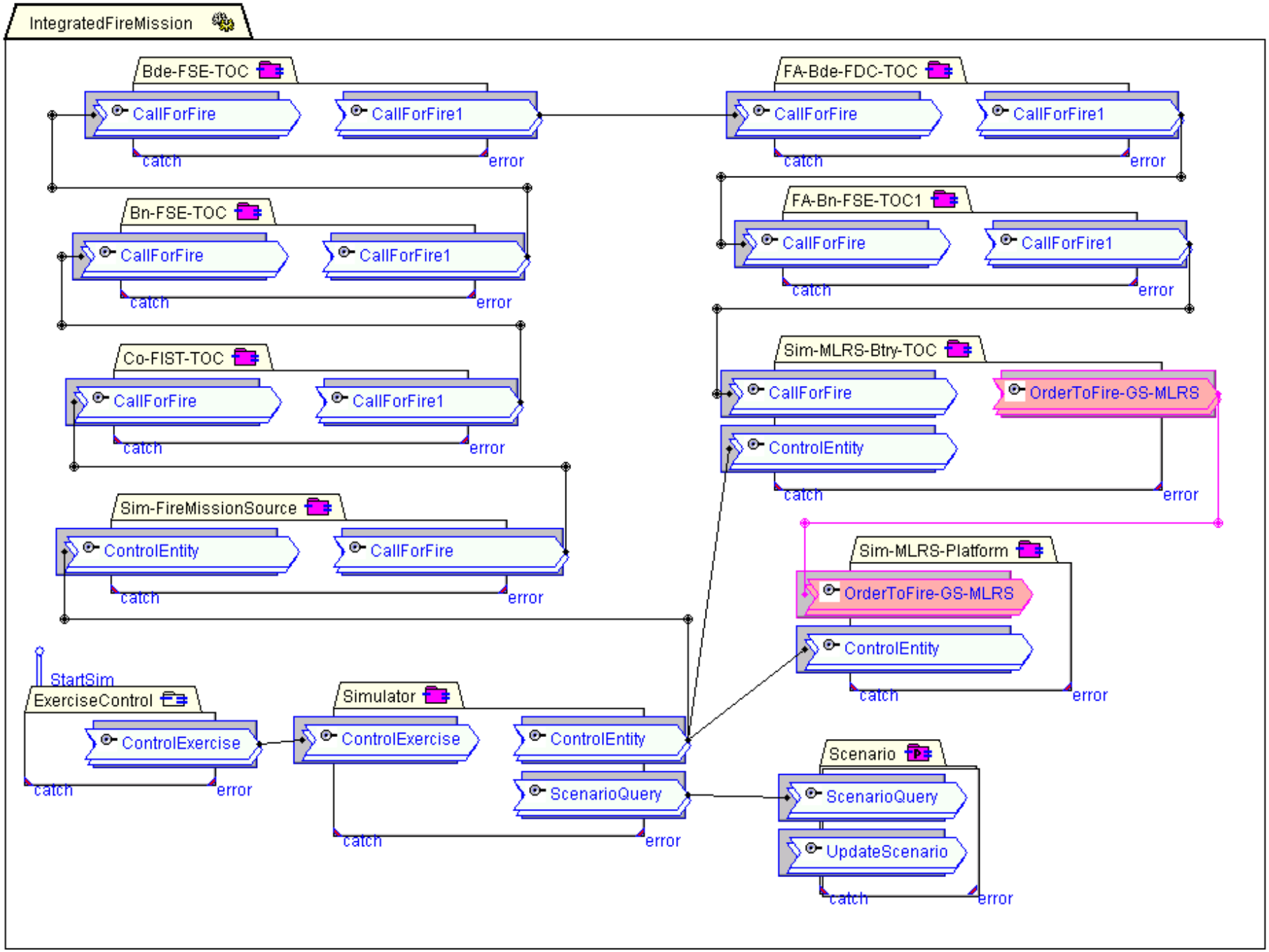

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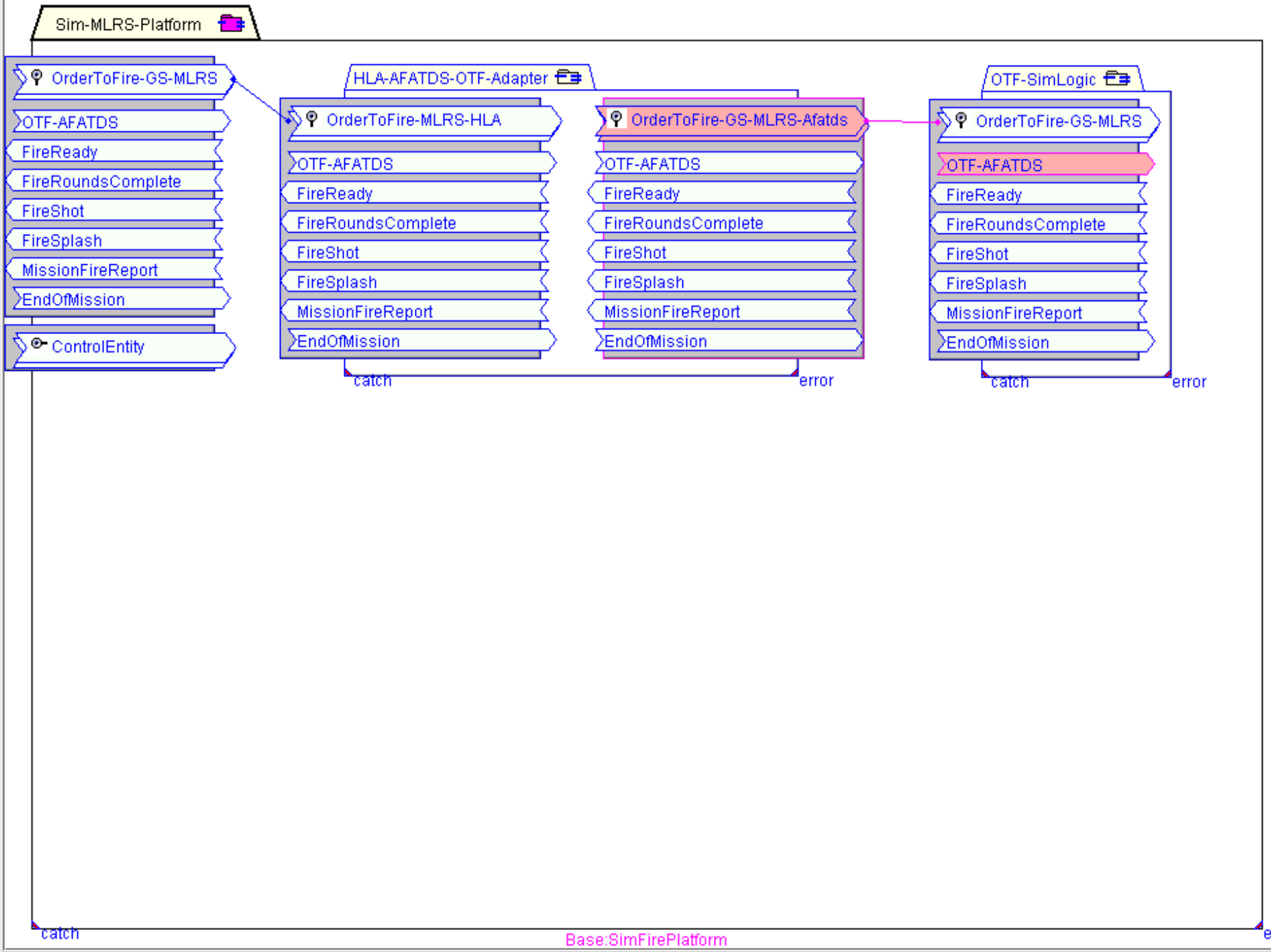
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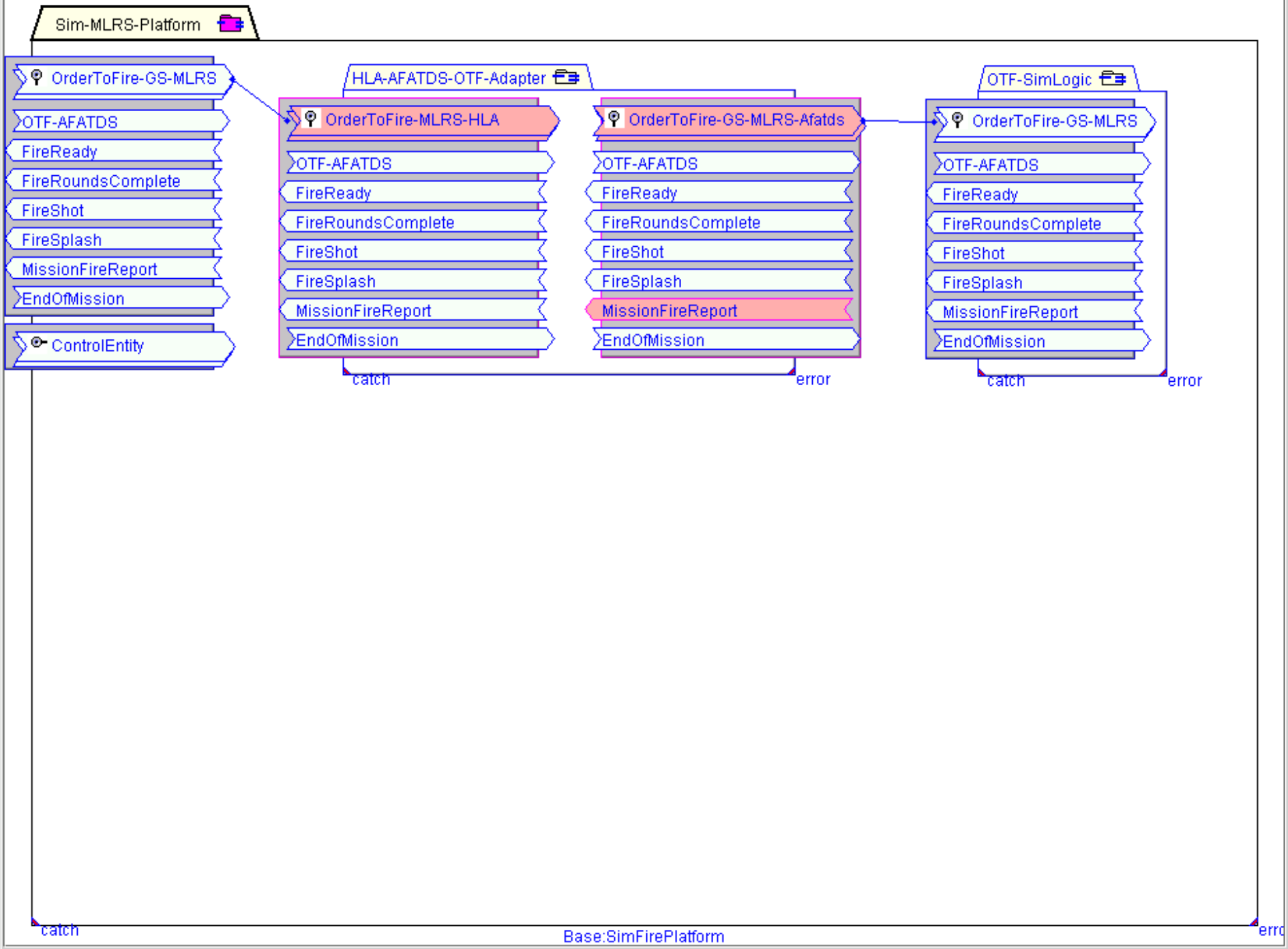
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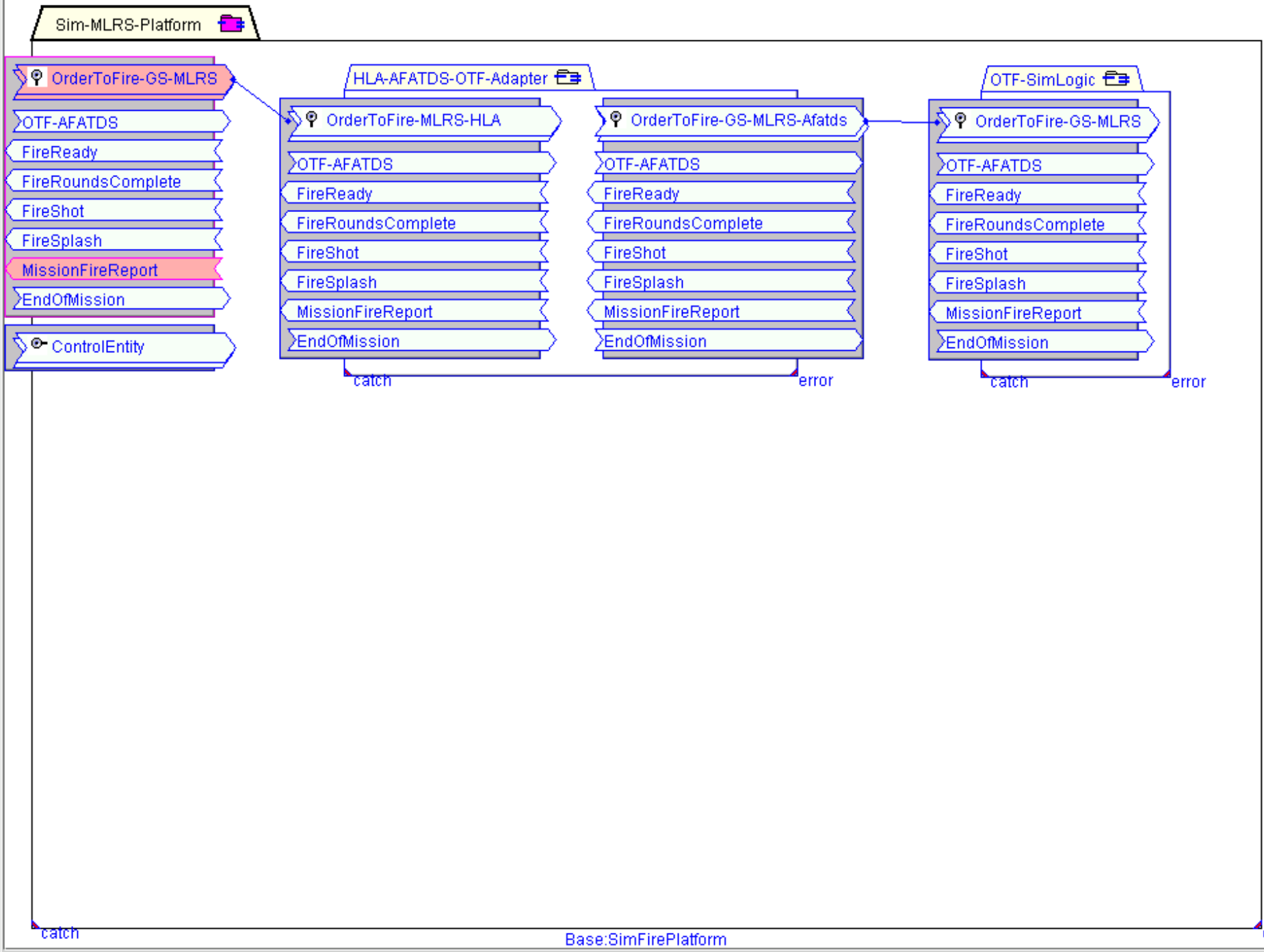
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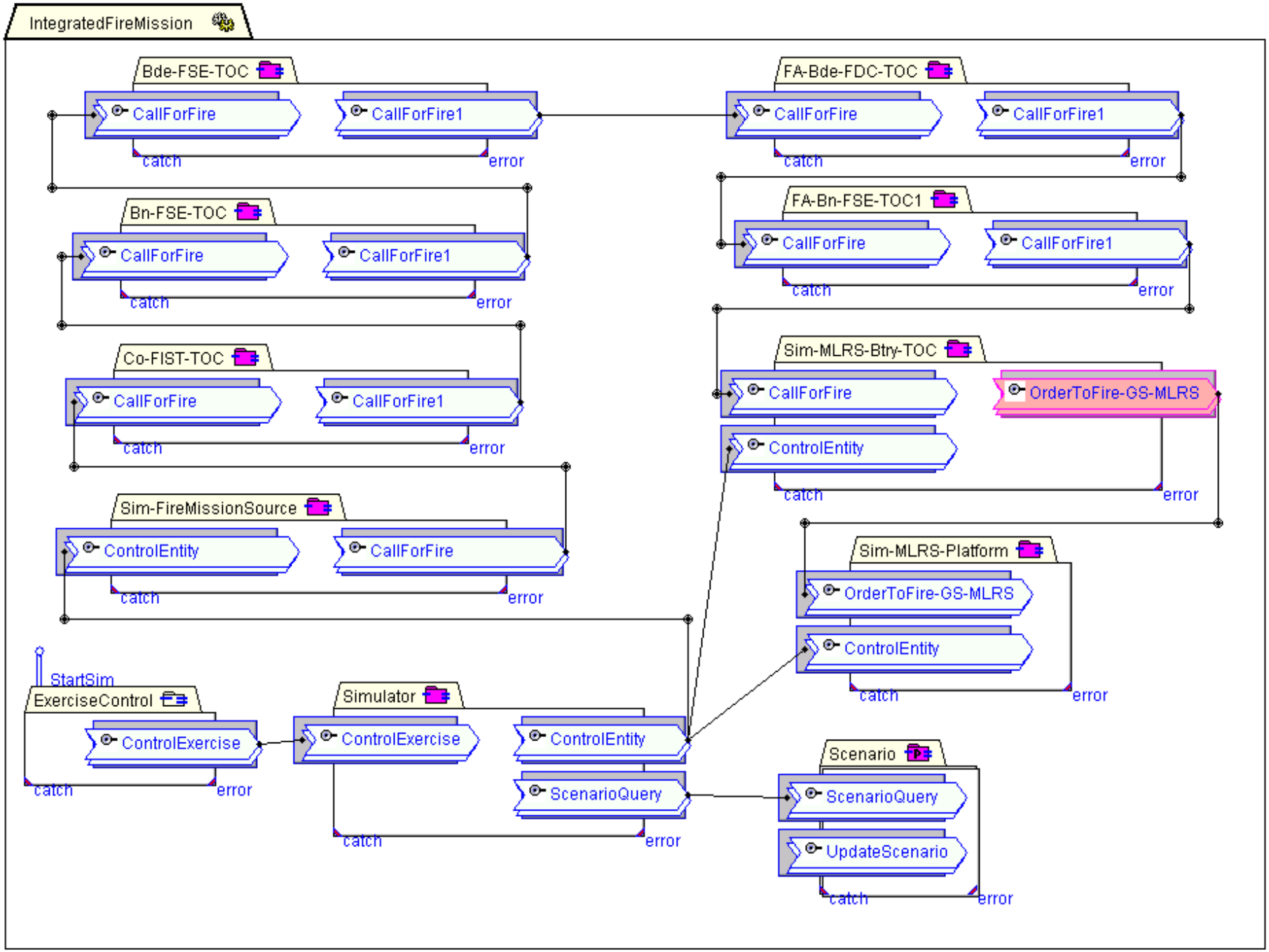

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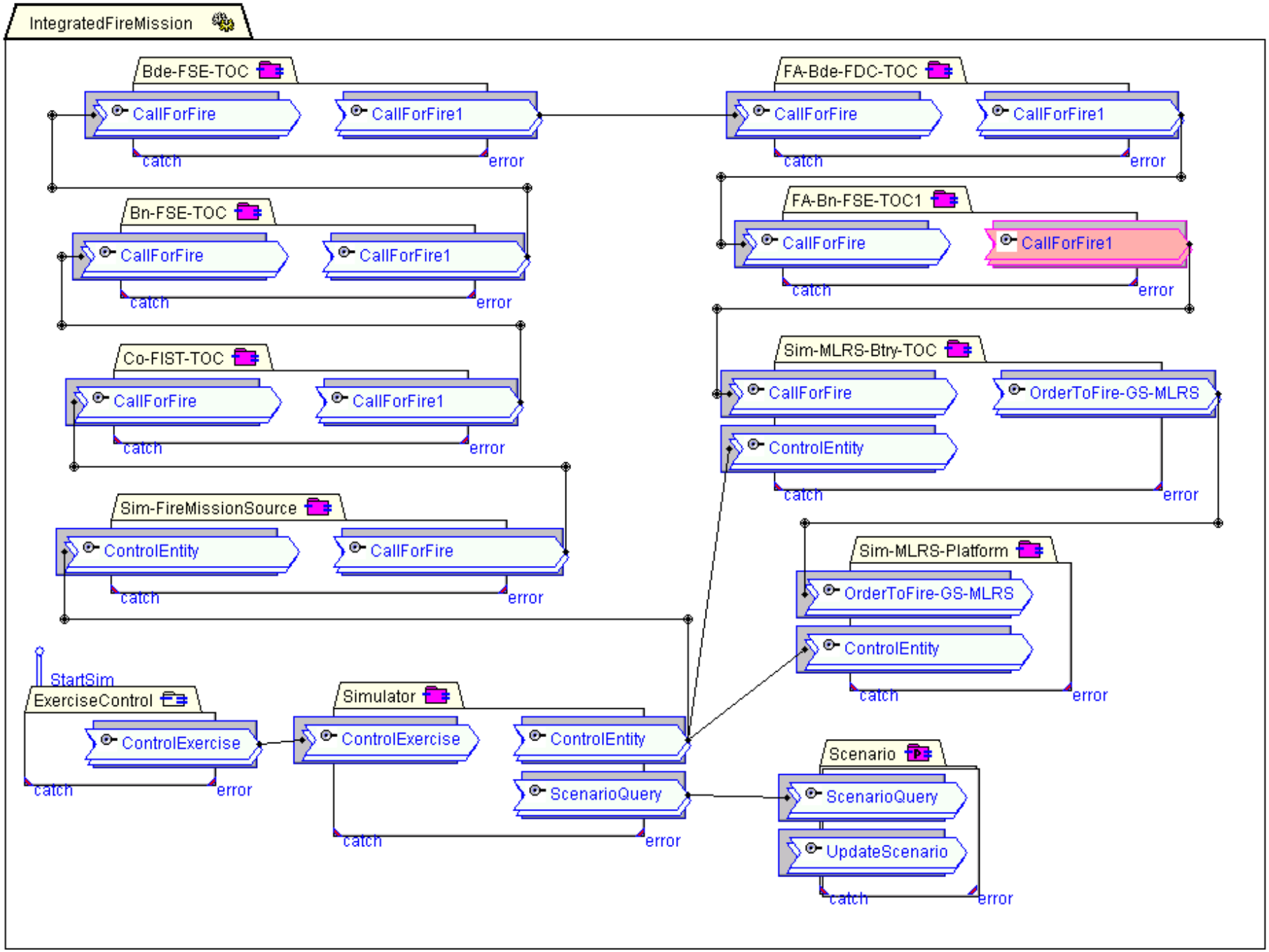

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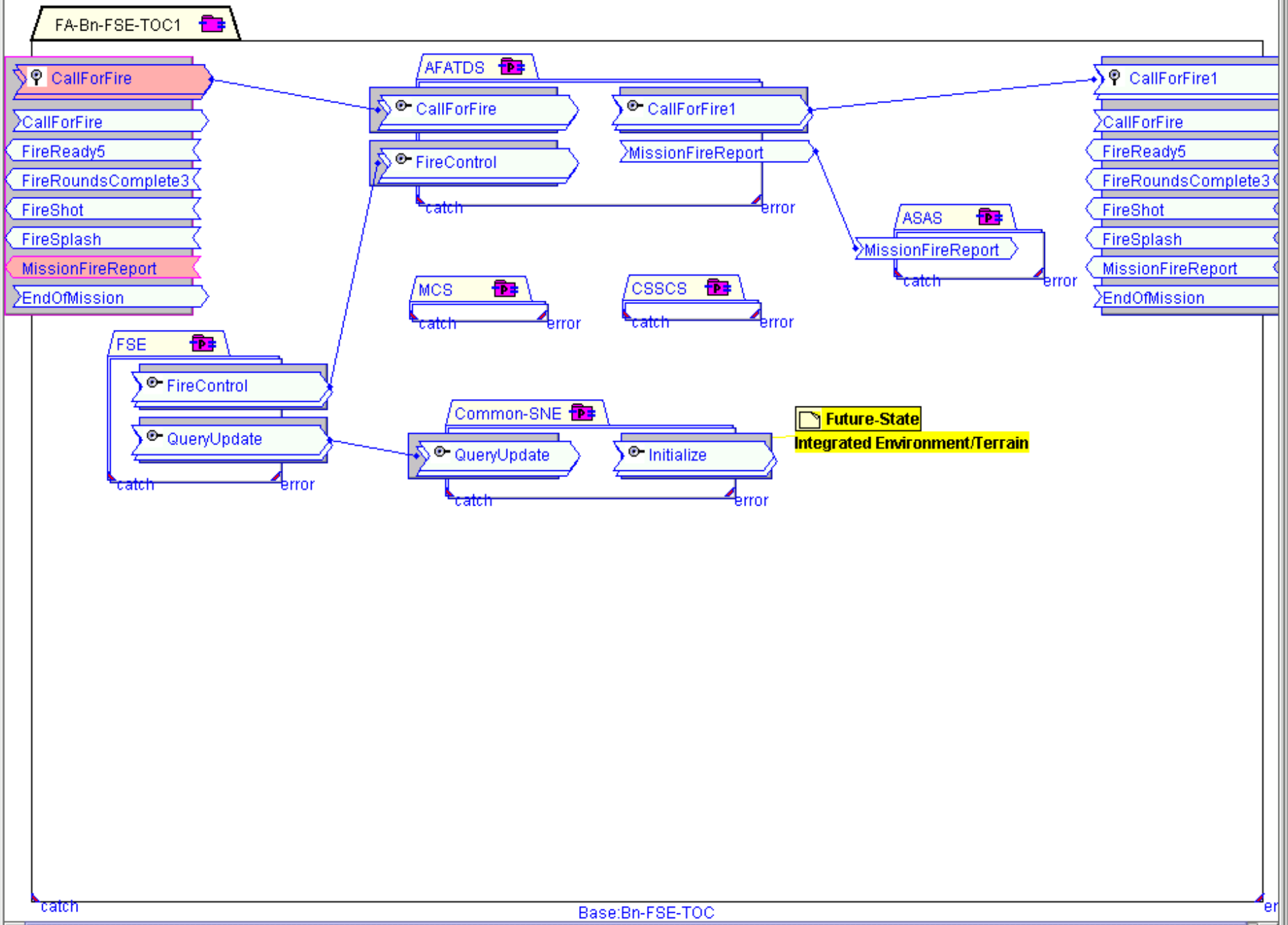
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CallForFire
FireReady5
FireRoundsComplete3
FireShot
FireSplash
MissionFireReport
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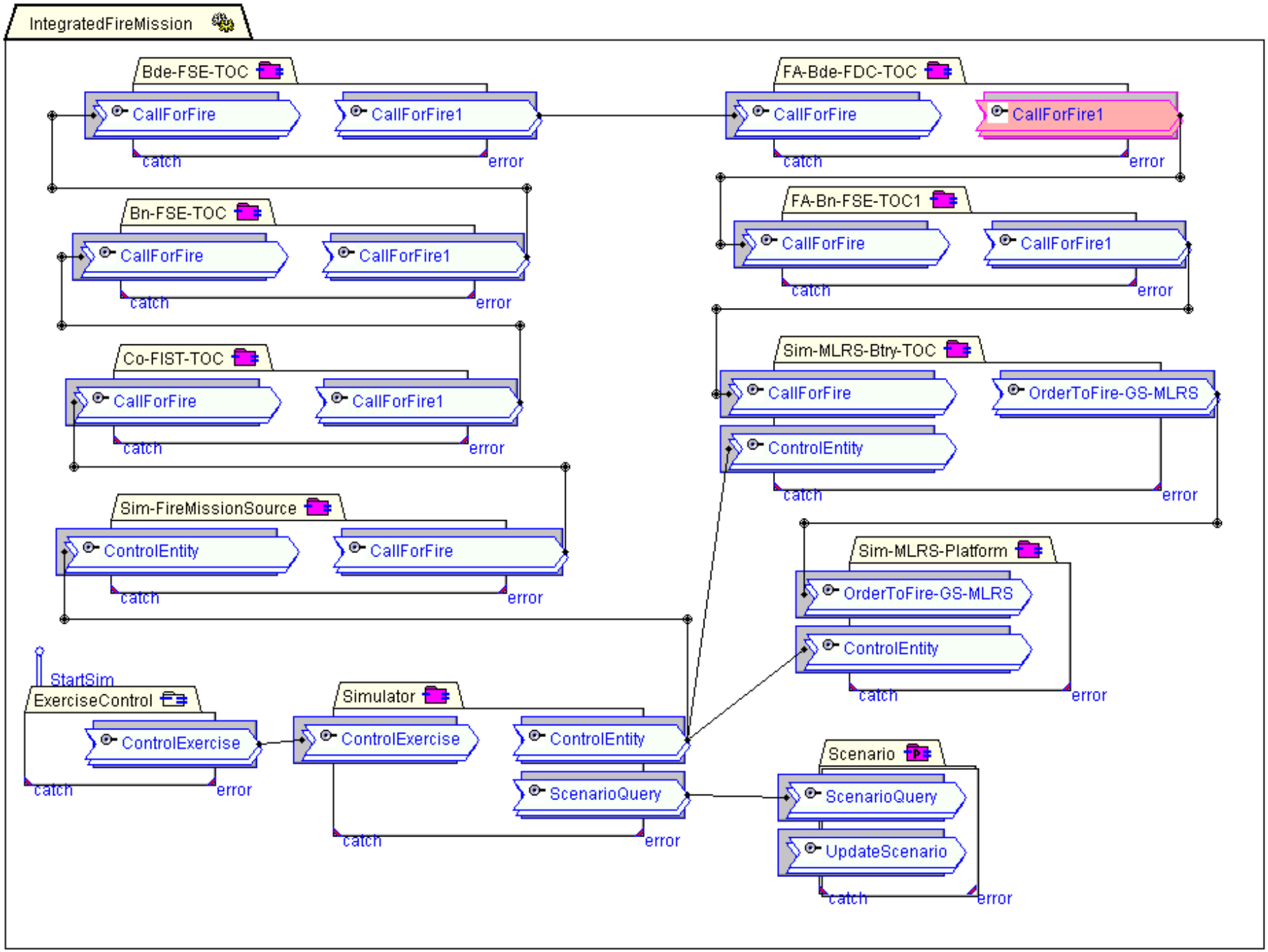
CallForFire
FireControl
catch
error
CallForFire1
MissionFireReport
ASAS
MissionFireReport
catch
error
CallForFire1
CallForFire
FireReady5
FireRoundsComplete3
FireShot
FireSplash
MissionFireReport
EndOfMission
MCS
catch
error
CSSCS
catch
error
FSE
FireControl
QueryUpdate
catch
error
Common-SNE
QueryUpdate
Initialize
catch
error
Future-State
Integrated Environment/Terrain
catch
Base:Bn-FSE-TOC



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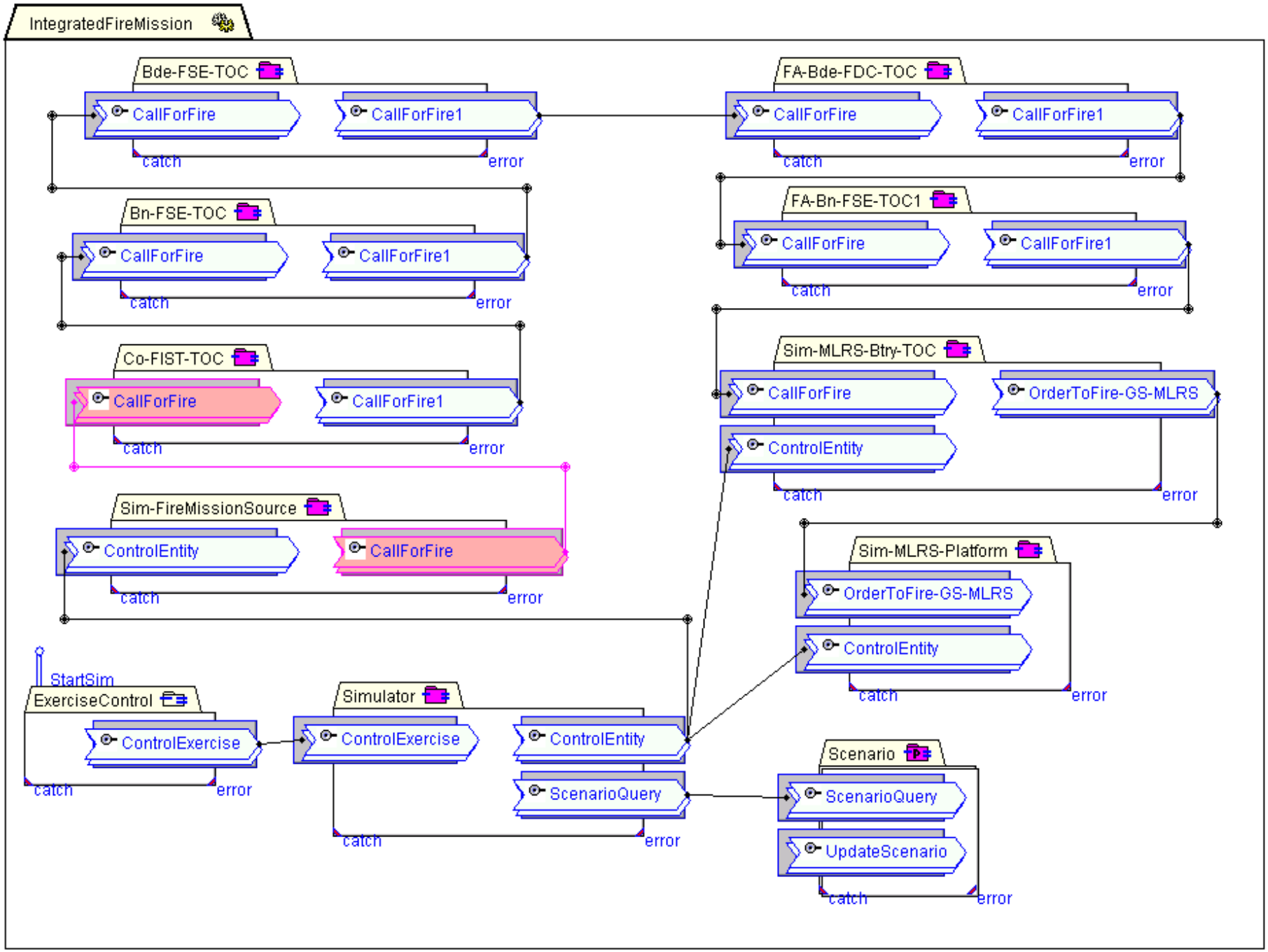


Base:IntegratedFireMission

Simulation Summary

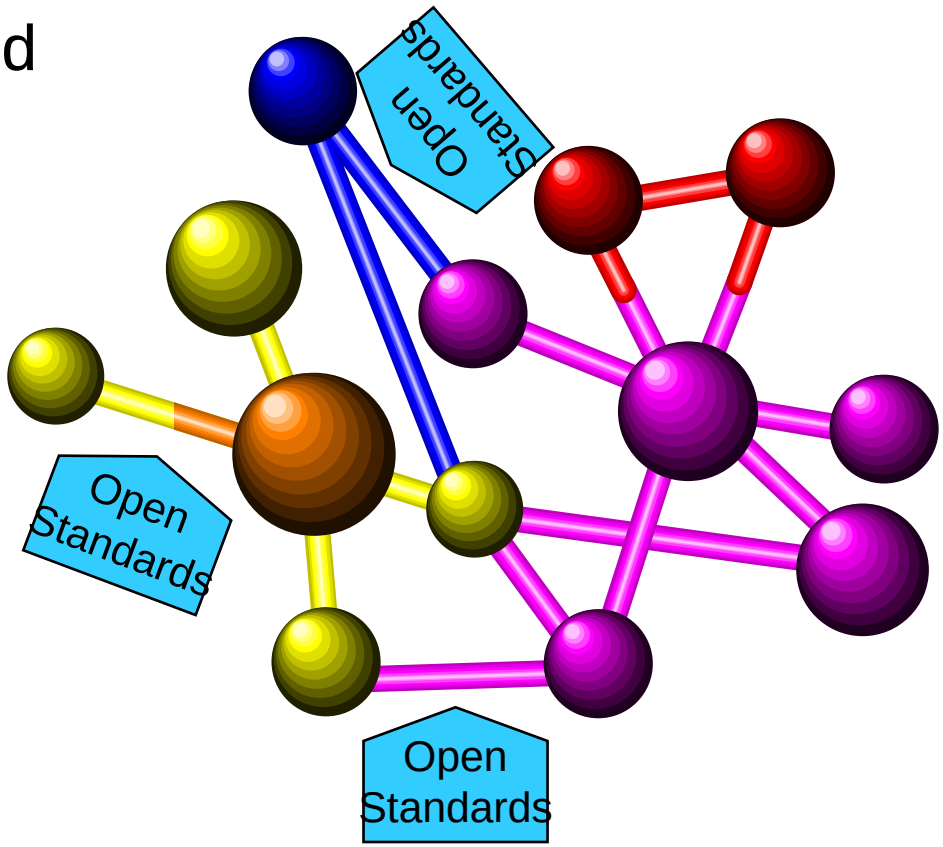
- We can simulate a process
- Integrating real and simulated components
- Understanding the interactions
- At any level of detail

Supporting a Service Oriented Architecture

SOA for real and simulated components

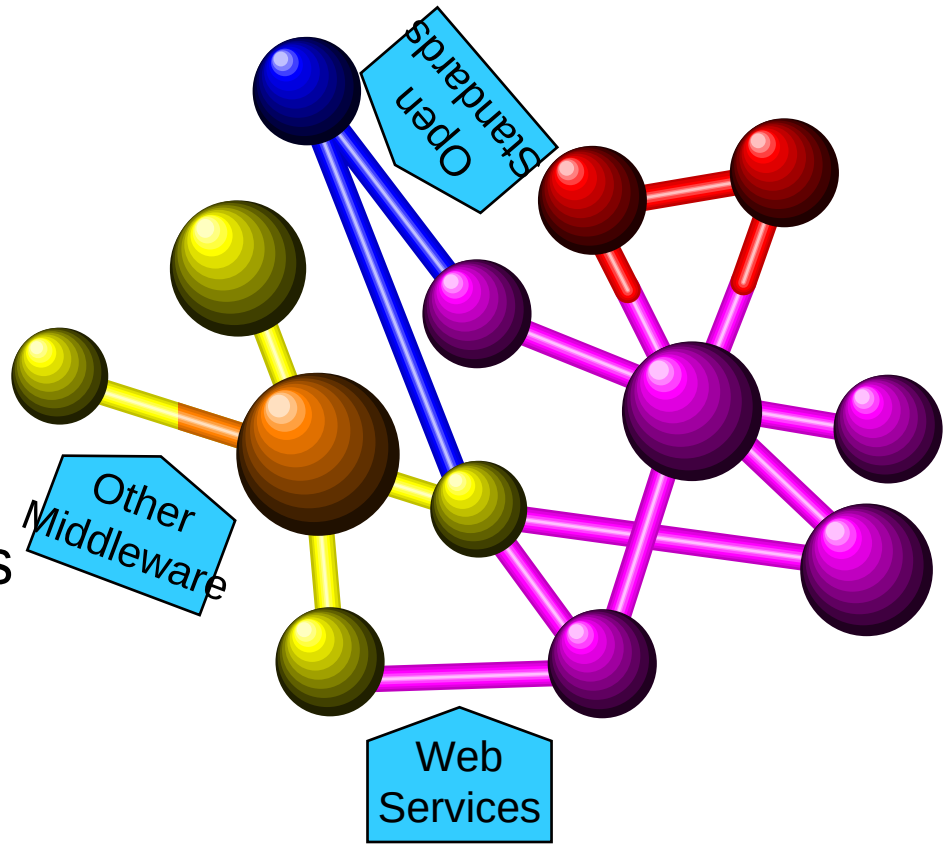
Enterprise Components

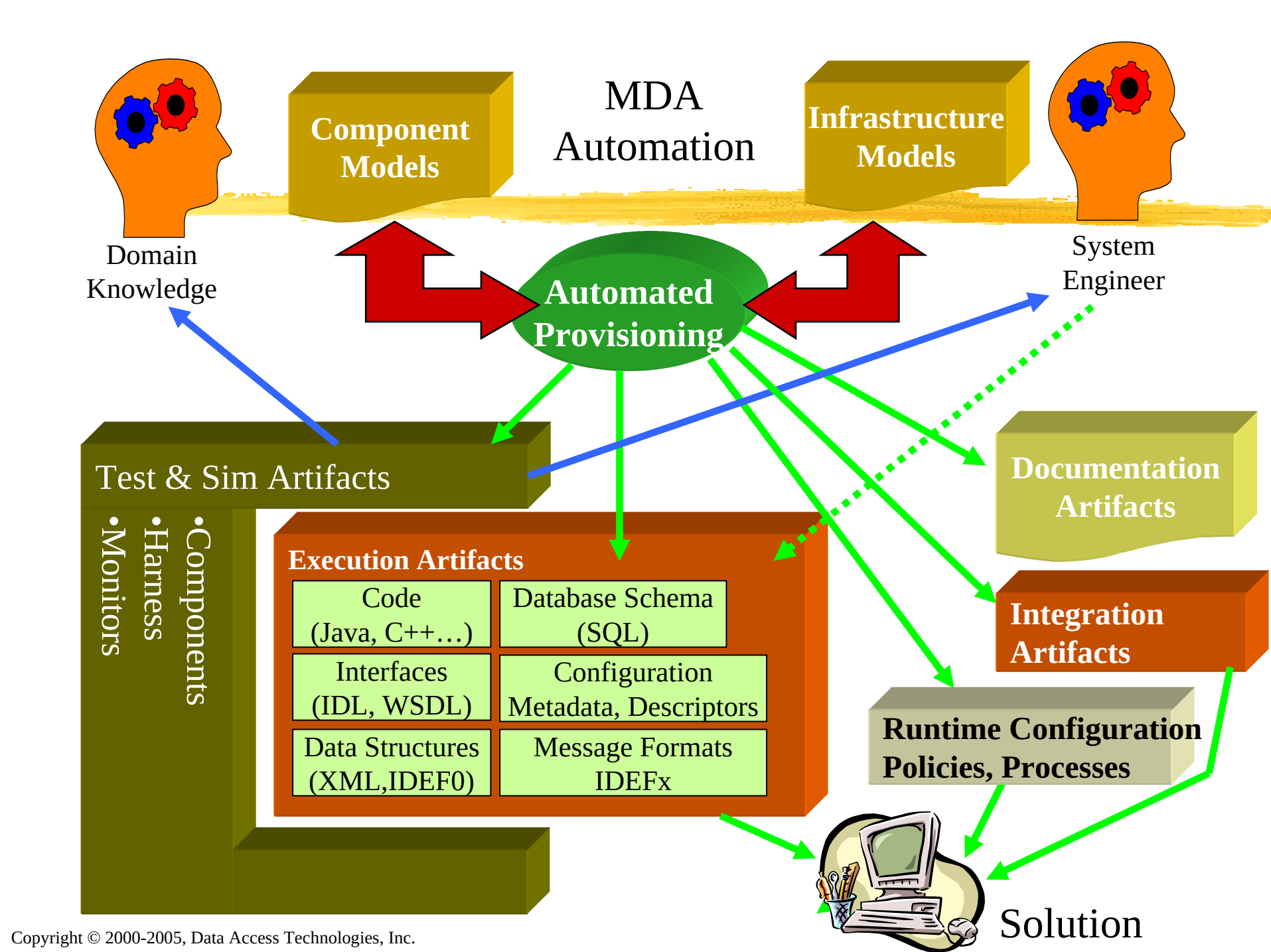
- Enterprise Components must be independent and distributable
- While being able to interoperate with each other
- Making the information system or simulation a lattice of cooperating components
- Simulated or Real
  - Same model, same architecture



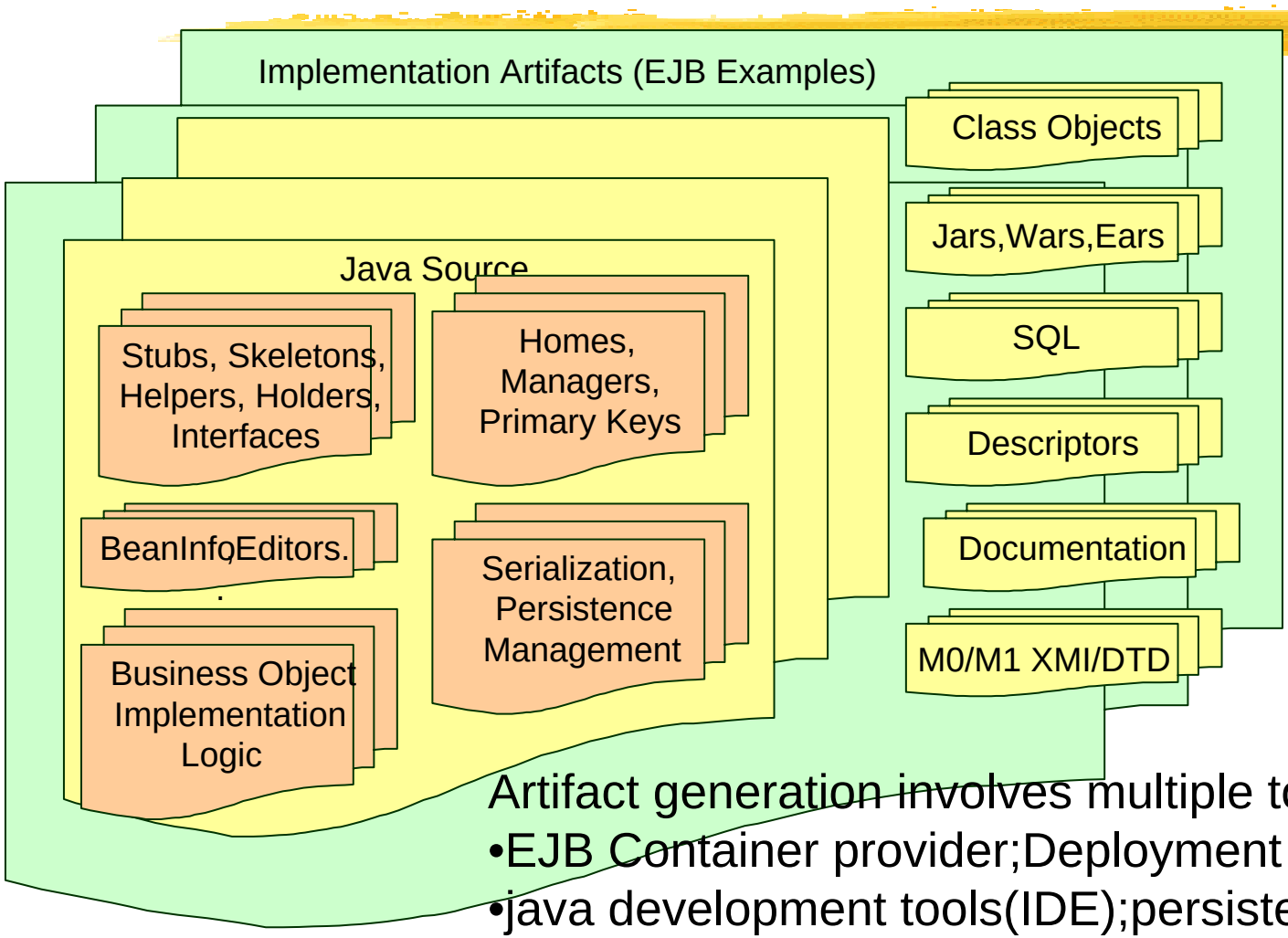
SOA provides open connectivity

- Services allow components to be independently implemented
- While interacting across well defined services
- Making the information system a lattice of cooperating components
- Simulated or Real
  - Same model, same architecture





Example Generated Artifacts



Artifact generation involves multiple tools

- EJB Container provider;Deployment tools;Packagers;
- java development tools(IDE);persistence provider;…

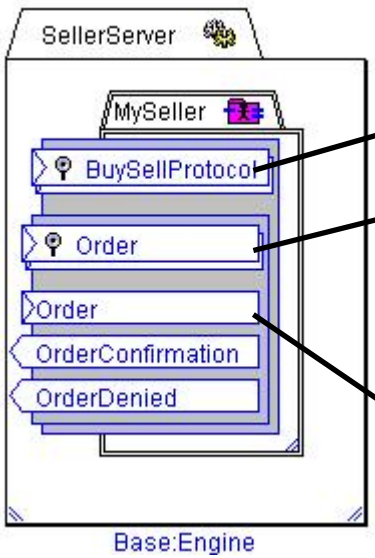
Typical 10-20 per PIM Classifier

0-20% manual override

MDA Models and SOA

- An application could be constructed of hundreds of services
- MDA Models help us understand the context of service interfaces
- How they serve enterprise processes and requirements
- How they work together and (if require), work internally
- MDA can generate the service specifications –
  - completely consistent with the architecture
- MDA can then assist in the generation and implementation of the components behind the interfaces

Mapping of a protocol binding to web service technology



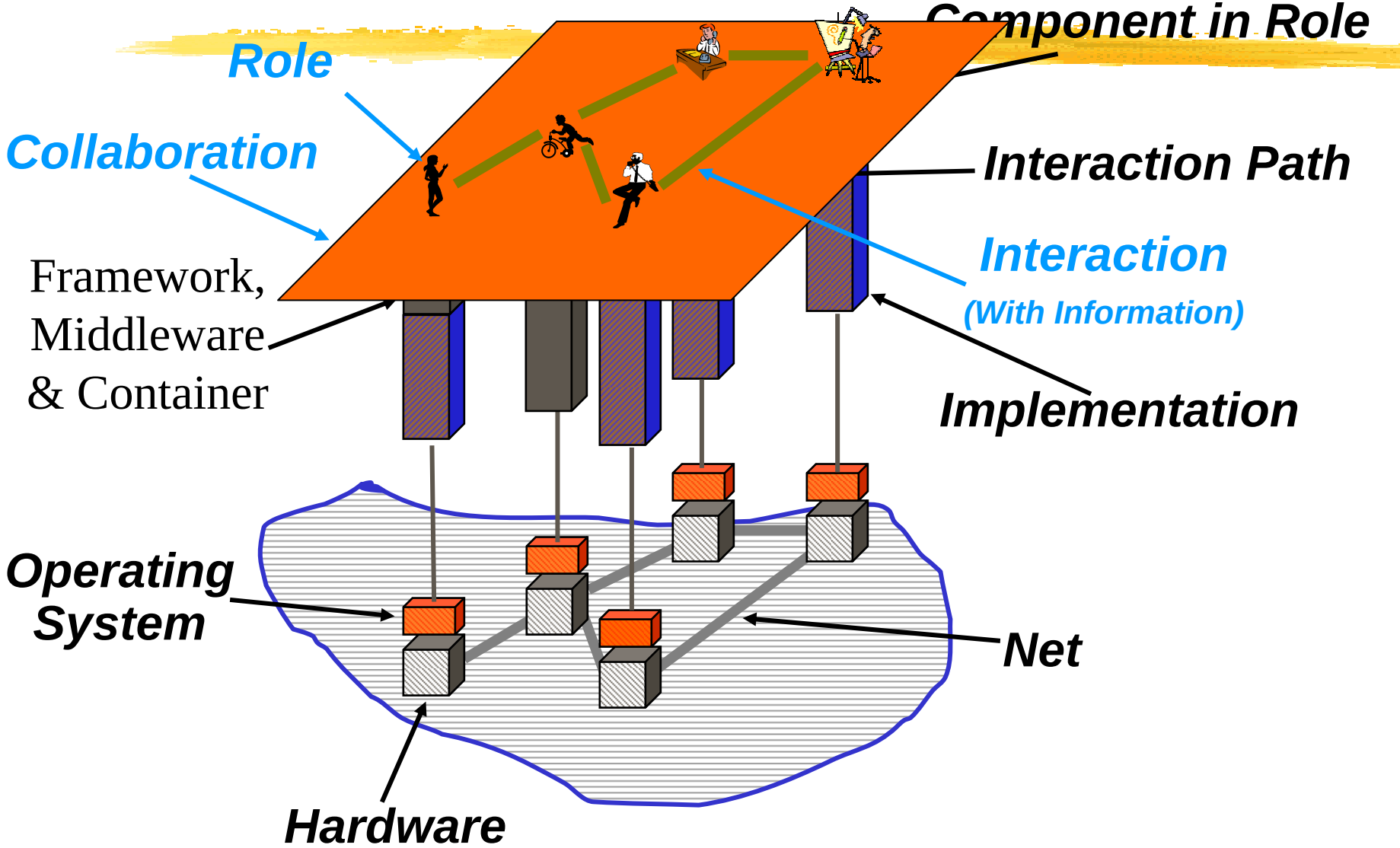
Aspects
WSDL
WSDL-SOAP

```
- <binding name="BuySellProtocol"
  type="tns:BuySellProtocol">
  <soap:binding
      transport="http://schemas.xmlsoap.org/soap/h
      style="rpc" />
- <operation name="Order">
  <soap:operation
      soapAction="urn:/BuySell/Community/BuySellPr
      col/Order" style="rpc" />
- <input name="Order">
  <soap:body use="encoded" namespace="urn:SellerServ
      encodingStyle="http://schemas.xmlsoap.org/soa
      encoding/" />
```

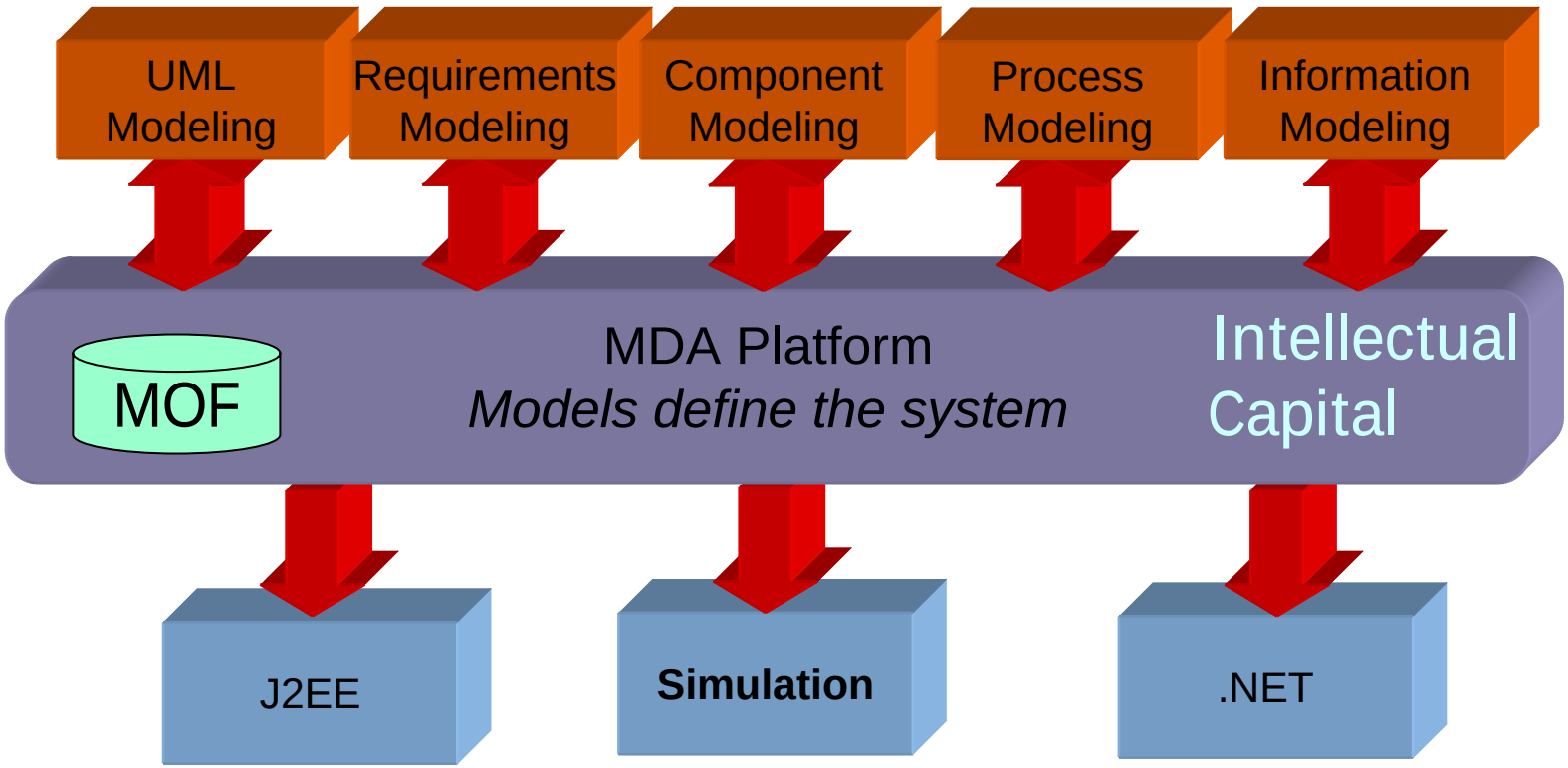
The EDOC Enterprise Collaboration Architecture

- ECA is a “profile of UML”, a way to use UML for a specific purpose - it is an OMG standard
  - That purpose is *modeling enterprise systems and components*.
- You can also think of this as a “modeling framework” for enterprise computing
- ECA is part of the “Model Driven Architecture” (MDA) initiative of the OMG
  - Using precise modeling techniques as part of the development lifecycle to speed development and provide technology independence
- ECA has been adopted by the OMG as part of the EDOC RFP.
- ECA defines an architecture and meta model

Roles to Systems



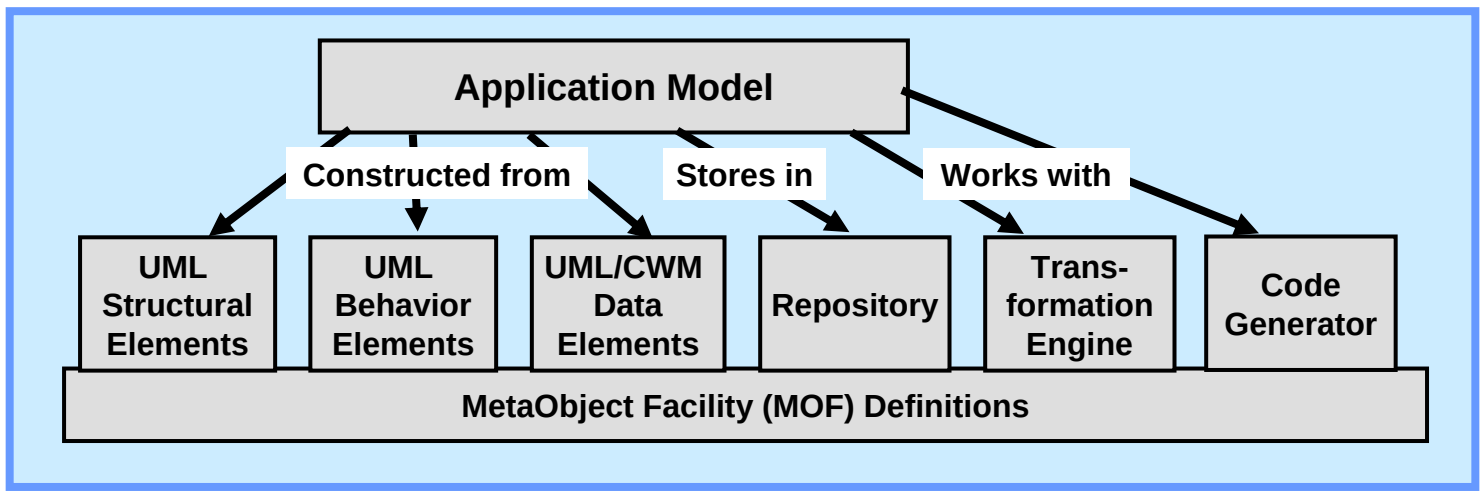
Integration of Intellectual Capital



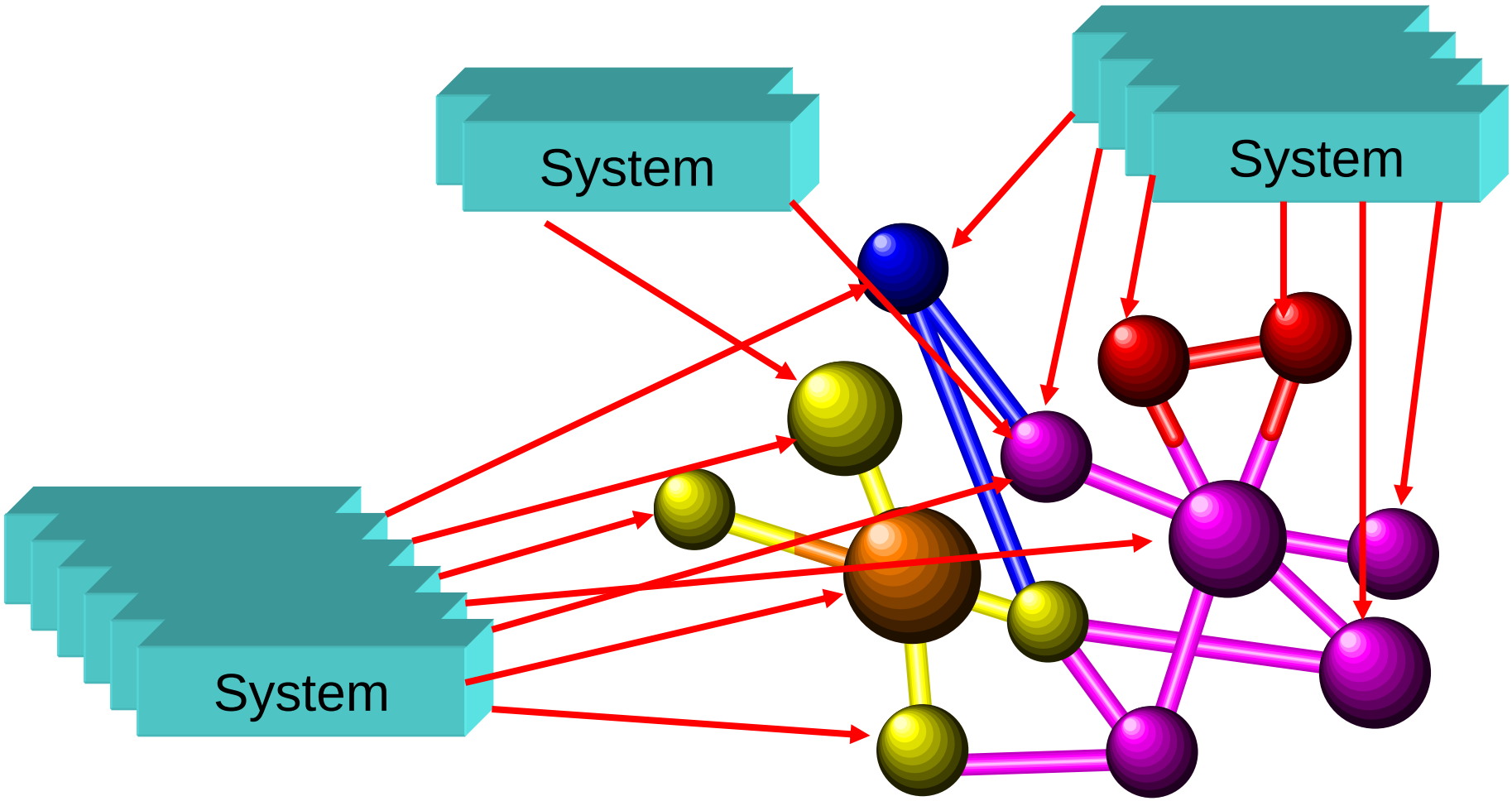
Integration of infrastructure

MOF - Foundation for Modeling

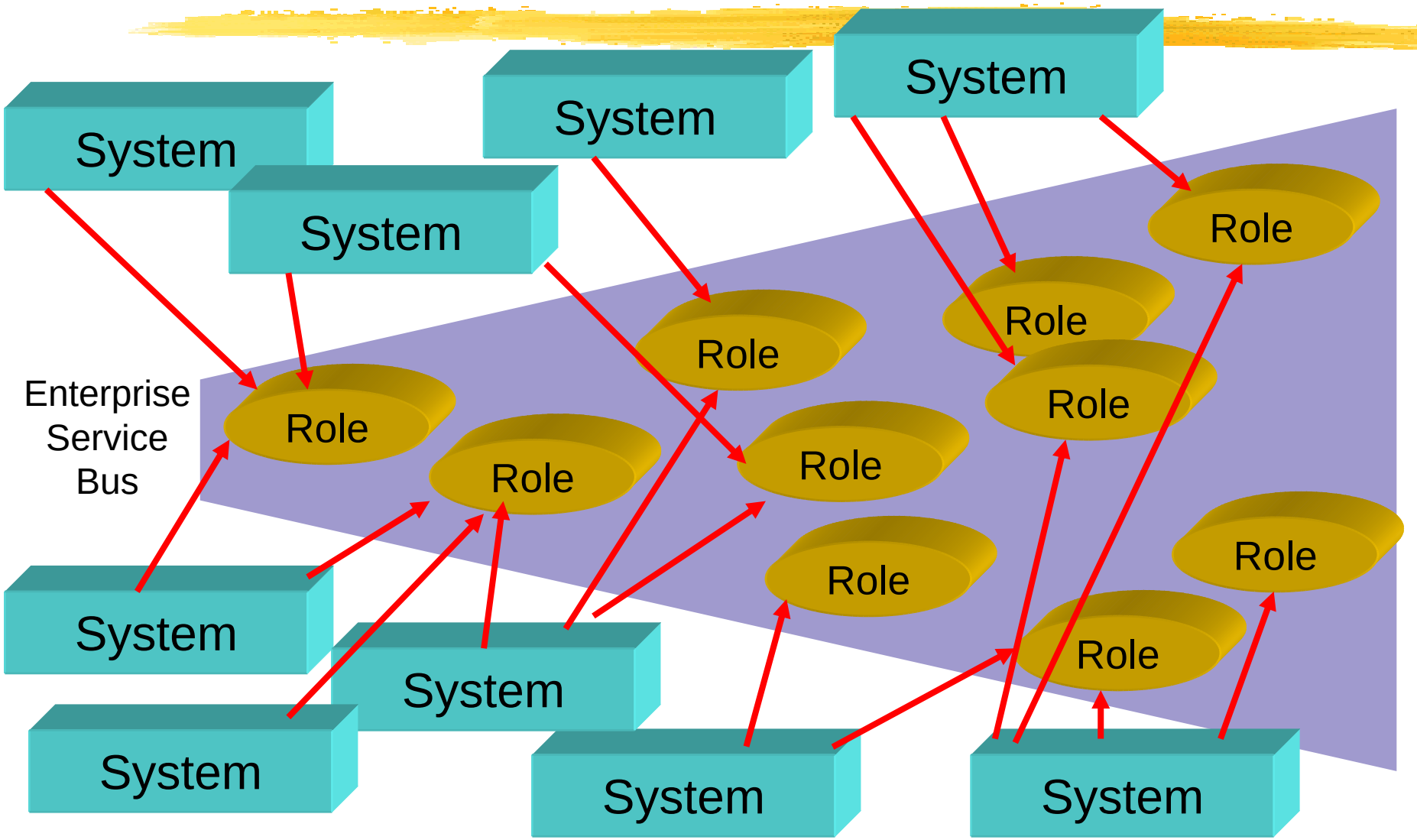
- MOF standardizes the basis for the elements that modeling languages define for you to model with
- Based on MOF, all of these diverse model elements can share repositories and interchange models among compliant tools:
  - Interchange of models and metamodels among toolsets
  - UML, MOF Itself, CWM, SPEM, XMI, UML Profiles
- And Especially, MOF supports the MDA!



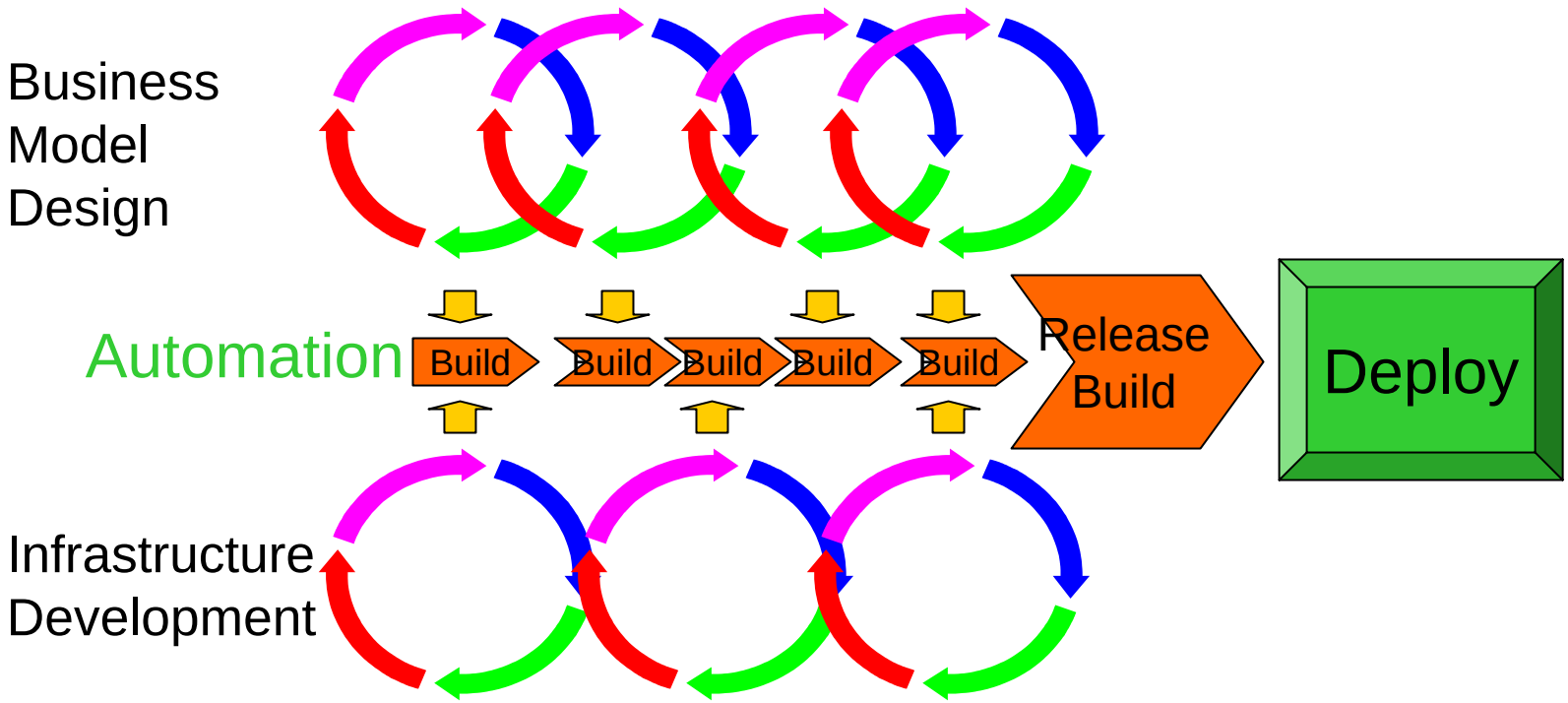
Systems to Role Based Service Components



Transition by role, not system



Iterative Development



Applying MDA

- Defining your methodology
  - Governance Process
  - Selecting standards, specialize to domain as required
  - Processes and procedures
    - Integration with Army processes and standards
  - Tooling
  - Education

Kinds of tooling

- Modeling – E.G. general UML/DoDaf tools as well as purpose-specific tools (Component-X for EDOC) and ADM tools for reverse engineering
- Repository – management and integration of intellectual capital
- Simulation – execute models without full implementation
- Transformation – generation of value from models – interfaces, code, documentation, tests
- Runtime platform – flexible [middleware] infrastructure on which to deploy solutions

Pilot Projects

- Goals
  - Refine the approach for your environment
  - Validate the approach
  - Educate and define methodology
  - Pull together the tooling suite
- Criteria
  - Significant but not huge
  - Sufficiently early that the approach is not fixed
  - Sufficiently developed that it can start
  - Freedom to try the new approach
  - Buy-in from key stakeholders

Summary of MDA benefits

- Isolates domain specifications from platform details
  - Reduces complexity
  - Preserves domain model semantics
  - Increases stability and lifetime
  - Generates to platform/legacy of choice
- Decreased development time
  - fast iterative development
  - separation between the engineering and business requirements
- Increased quality.
- Builds on industry directions