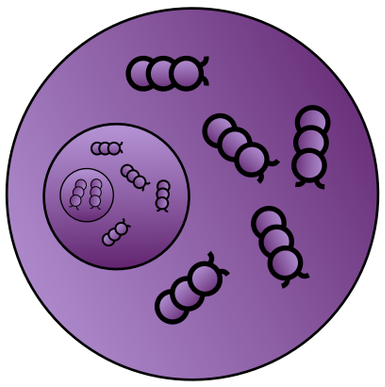


AMP
Agent Modeling Platform

Docuware for Creation Review

April 22, 2009

Please address comments to:

news://news.eclipse.org/eclipse.amp

metascape

Overview

- Executive Summary
- Background
- Scope and Motivation
- Architecture and Ecosystem
- Project and Community
- IP
- Scope
- Project Plan
- Technical Supplement

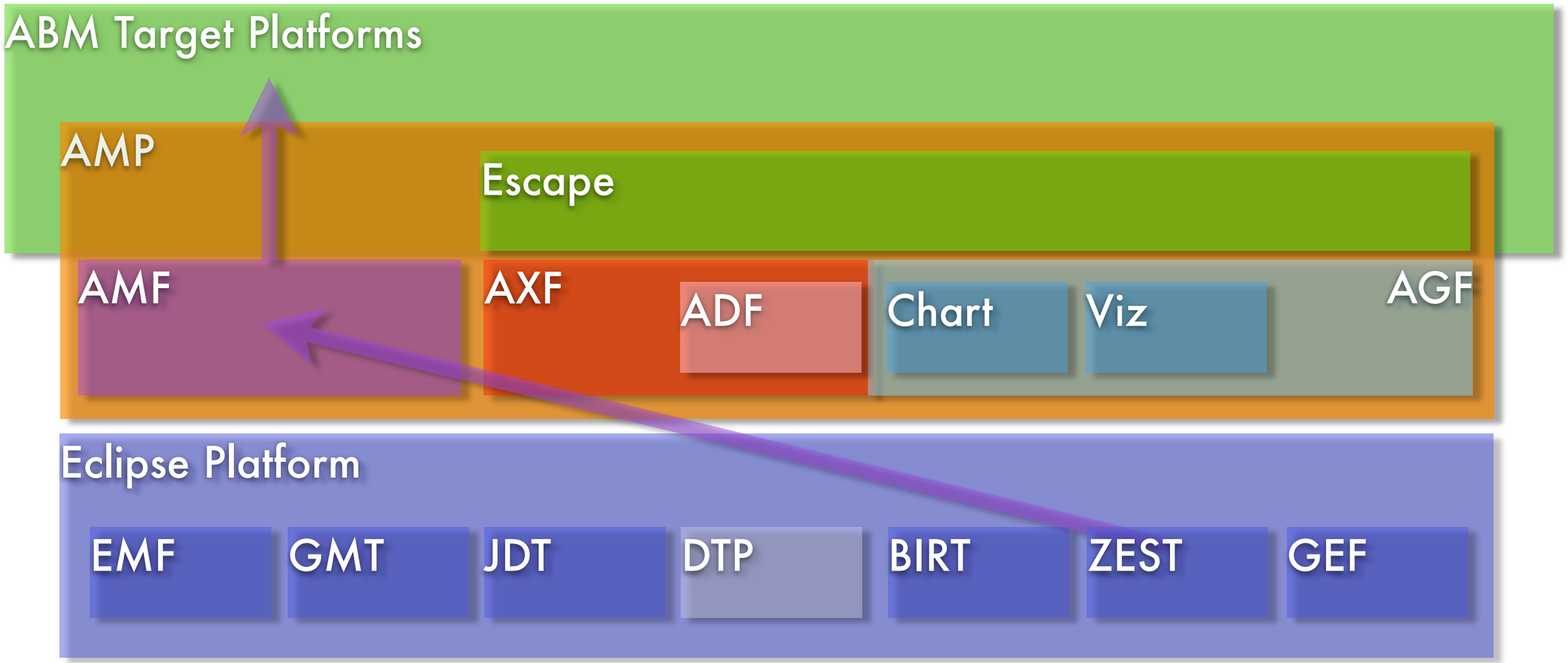
Executive Summary

- AMP provides extensible frameworks and exemplary tools for agent models:
  - AMF: representing, editing, generating
  - AXF: execution and management
  - AGF: visualization and charting
  - Escape: exemplar ABM tool
    - Code base is the MetaABM (AMF) project and previously unreleased contributions (AXF, AGF) from Metascape, LLC.

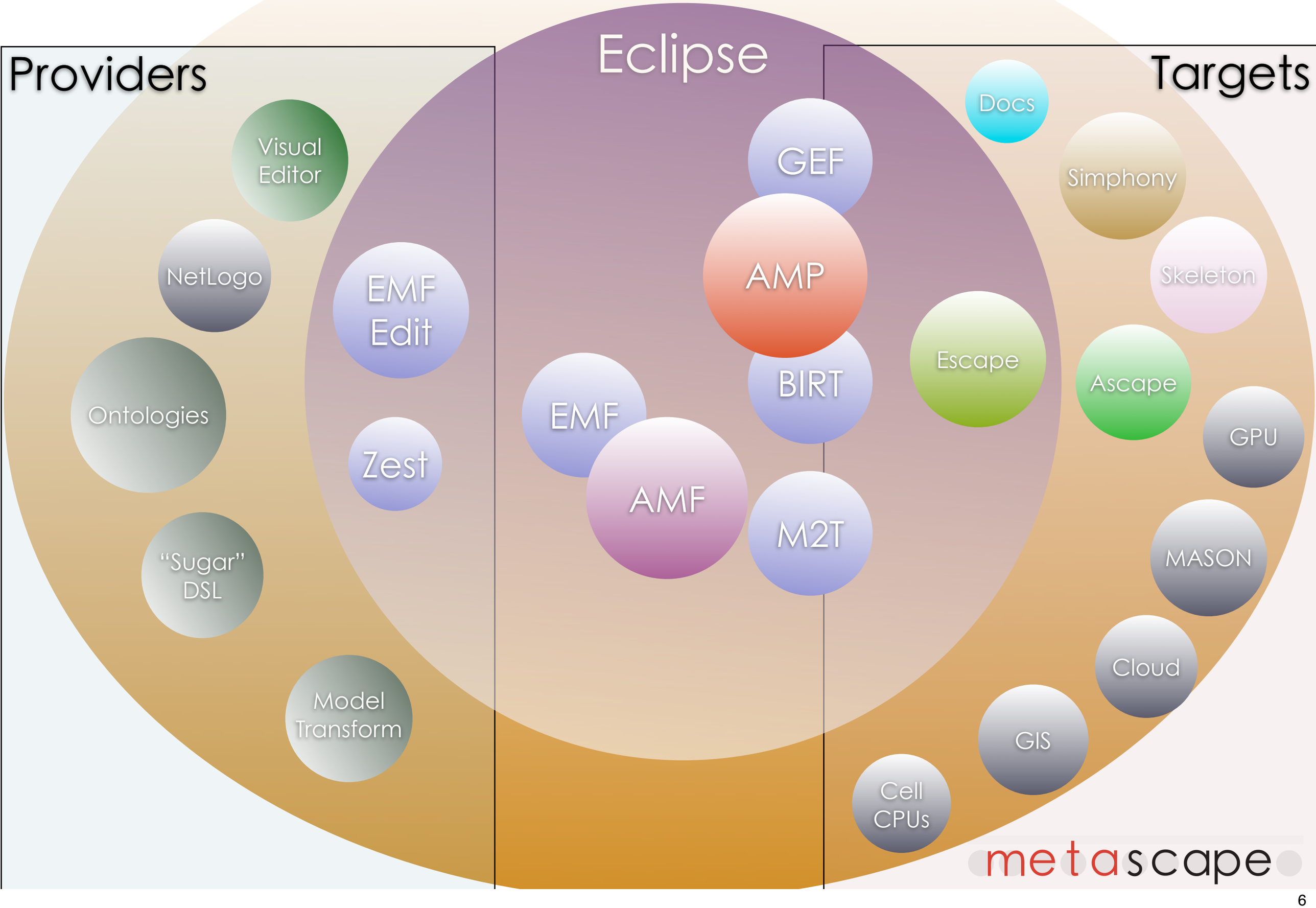
Motivation

- ABM community needs:
  - Common meta-model representation
  - Infrastructure that is pluggable, extensible and based on a platform with large ecosystem and functionality
  - Reference implementations that demonstrate the above capabilities and encourage contributions and collaborations
- Proposed code base starts with:
  - AMF: mature meta-model and tools
  - AXF, AGF: initial infrastructure
  - Escape: working reference implementation based on mature toolset

Architecture



amp ecosystem



People

- Mentors:
  - Ed Merks
  - Sven Efftinge
- Initial Committer and Project Lead
  - Miles Parker

    Principal, Metascape LLC. A leader in the development of Agent-Based Modeling (ABM) tools and computational approaches to complex systems. Miles has over fifteen years of software development experience. Previously he was Distinguished Software Architect at NuTech Solutions, Inc. (formerly Bios Group) where he lead software teams in developing groundbreaking complex system models for a variety of government and commercial applications and continued development of tools. Prior to that Miles was at the Brookings Institution where he worked on developing ABMs of important social and economic systems and pioneering ABM tools.
- Interested Parties
  - Gary An

    President, Swarm Development Group; Assistant Professor of Surgery, Division of Trauma/Critical Care, Northwestern University Feinberg School of Medicine (Ontologies)
  - Lyle Wallis

    Partner, Decisio Consulting (Dynamic Systems)
  - Daniel Ford

    Research Staff Member, Department of Computer Science, IBM Almaden Research Center (Disease Modelling, Eclipse STEM Project)

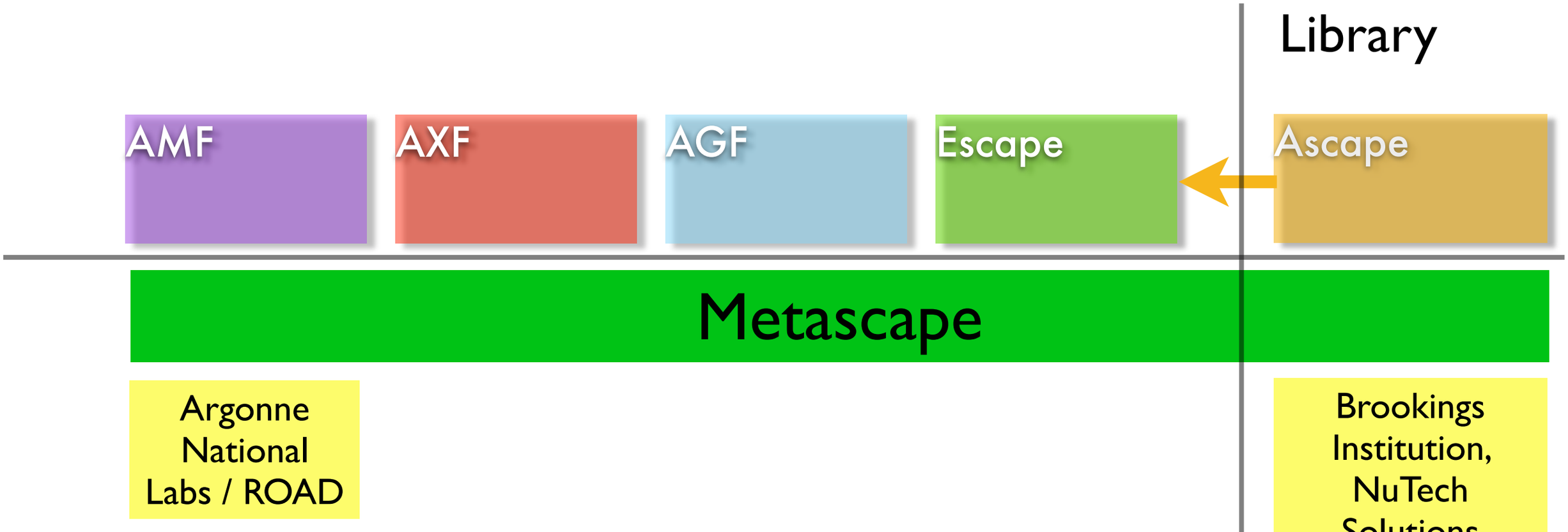
Community

- Eclipse Community
  - Two new interested parties / potential collaborators.
  - All positive interest, somewhat limited by domain.
    - "Chicken and egg". Generic implementation examples should generate broader interest.
- ABM community
  - Non-committer interest from a number of quarters
  - Large potential committer community
    - Eclipse Open Development process and practices encourage and facilitate broader collaboration. Eclipse and AMP provide context for this to happen without imposing a single methodology or tool-chain.
  - "Show, don't tell"
  - MetaABM experience showed need for integrated execution support.
- General Science Community
  - Longer-term potential for broad collaboration across disciplines and methodologies both within AMP and perhaps as part of broader science focussed platforms.

Project Relations

- Under discussion:
  - STEM: Generic experiment, scenario and results meta-modeling, domain model docking / examples.
  - BIRT: Chart Engine: Live charting and data.
  - M2T,MWE: Potentially useful contributions to end-user focussed workflow and code generation integration.
- Other potentials:
  - GEF / Zest: Edit Part and object location abstractions for agents.
  - PTP: Parameterization and run-time control.
  - BPMN: In silico execution and testing of real-world process models.
  - Ontologies: AMP project participants would be very interested in any resurrection of projects with EMF based OWL / RDF components.
- Your project here..

IP Provenance



Argonne National Labs / ROAD

Author: Miles Parker

ECL

Currently BSD

Brookings Institution, NuTech Solutions

Author: Miles Parker

Contributors:
Mario Inchiosa,
Josh Miller

Scope: Use Cases

- Agent Modeling and Simulation
  - Meta-model representation, editing, validation
  - Generation to arbitrary APIs
  - High-Level API supporting implementations
  - Exemplar implementation (Escape)
- Agent Management
  - Execution, Exploration, Control, Parameterization, Persistence…
- Dynamic Visualization
  - 2D, 3D, Graph, Tree
- Dynamic Charting (and Data)

Scope Detail: AMF

- Meta-model for:
  - Structure: Overall model design, including support for multi-scales, common space types (e.g. N-dimensional, continuous, discrete, GIS, graph)
  - Behavior: Actions framework with evaluation, query and transformations functions allowing models to identify agents, change agent state, move agents in space, and create network connections between agents.
  - Functions: Support for built-in and arbitrary functions, including high-level support for spatial search, random values, and statisitcal distributions.
- Hierarchical editor (EMF.Edit)
- Model generation support, including built in targets for:
  - Documentation
  - Java skeletons and
  - Escape, Ascape and Repast exemplar implementations.
- IDE integration
  - Model generators, builders and launchers.
  - Model correctness validation.
  - Workflow logging and user interaction.

Scope Detail: AMF Extensions

- Additional meta-model, editor, generation and ide integration support for:
  - Parameterization and other experimental (ranges, sweeps) support
  - Model execution context persistence (views, selected features)
- Potentially in scope..
  - Acore -> Ecore transformation + associated services.
  - Data output persistence and navigation

Scope Detail: AXF

- Agent Modeling API
  - High-level model structure
    - Multi-scale agent collections and intra-model relationships
    - Spatial location
    - Execution life-cycle
  - Interfaces and extension points for execution engines, models, views and events.
- Model Execution Tools
  - Execution managers, controls, views and related widgets for multiple asynchronous models.
  - View management and support.
- AXF Extensions
  - Parameterization, testing and view persistence (based on AMF extensions.)

Scope Detail: AGF

- Agent Visualization Infrastructure
  - GEF Edit Part based visualization.
  - Controls for visualization tools (e.g. zoom, feature selection).
  - Property editor and selection support.
- Charting Support
  - Dynamic real-time creation customization and data-source selection for common graph types.
  - Potential for Data Providers + Dynamic Support

Project Plan

	AMF	AXF/AGF	Escape
June 2009 Commit	0.5.0 Basic repackaging / renaming. Move dependencies from oAW to M2T. Automated build and tests, update site. API and meta-model Provisional.	0.2.0 Basic repackaging / renaming. Move dependencies from oAW to M2T. Automated build and tests, update site. API Experimental.	0.6.9 Basic repackaging / renaming. Automated build and tests, update site. API provisional++. (External)
September 2009 M1	0.7.0 Improvements (generalization, features) to meta-model from MetaABM. Builds to Modeling project specs. Eclipse Quality Standard. (?) API Platform, meta-model Provisional.	0.7.0 Core APIs and service non-internals feature complete. Eclipse Quality Standard. (?) API Provisional.	0.7.0 Feature Complete. API Platform. (+ External?)
December 2010 M2	0.8.0 Improvements to meta-model based on community feedback. UI Polish. AMF Extensions. API core Platform, API meta-model Provisional.	0.8.0 Feature and API additions /improvements. Internals (UI) improvements. UI Test coverage. API Provisional.	0.8.1 (QA, Version Synch)
Early 2010 M3	0.8.1 Join 3.6 release train. AMF Extensions frozen. API core, meta-model Platform.	0.8.1 QA, bug fixes, internals and runtime improvements. API Platform.	0.8.1 (Version Synch)
2010 M3+	0.8.n Features frozen. Bug fixes, minor internals.	0.8.n Features frozen. Bug fixes, minor internals.	0.8.n (Version Synch)
2010 3.6	???	???	???

Technical Suplement

Implementation

- We need a tool that…
  - Is "better" than OO
  - Supports Modeling across Scales and Biases
  - Supports high-level "declarative" Representation
  - Supports multiple APIs, Platforms and Languages
  - Has no Syntax
  - Is Transformable
  - Allows Cooperation while Preserving Innovation
  - World Peace?

Model Structure / Space

- Extensible
  - New structures can be easily introduced
- Adaptable
  - Same models can be applied
  - Challenging issue
- Multi-scale
  - Critical current issue
  - History
    - Swarm (Burkhardt): Hierarchical
    - Ascape (Parker): Scapes
    - Simphony (Howe, Collier): Contexts and Projections

Model Behavior

- Model:
  - ABM = Agents + Structures + Behaviors
- Realization (execution):
  - R_t (Realization) = ABM(Type, Space, Time)
  - $R_{t+p} = R_t + \{Behavior(p)\}^*$
- Actions:
  - Behavior = Transformation(Query(R_t), p)
  - Query(R_t) = Query(Type, Space, Time)!
  - Behavior = Transformation(Query(Type, Space, Time), Period)
  - ABM = Agents + Space + Transform Queries (Time)

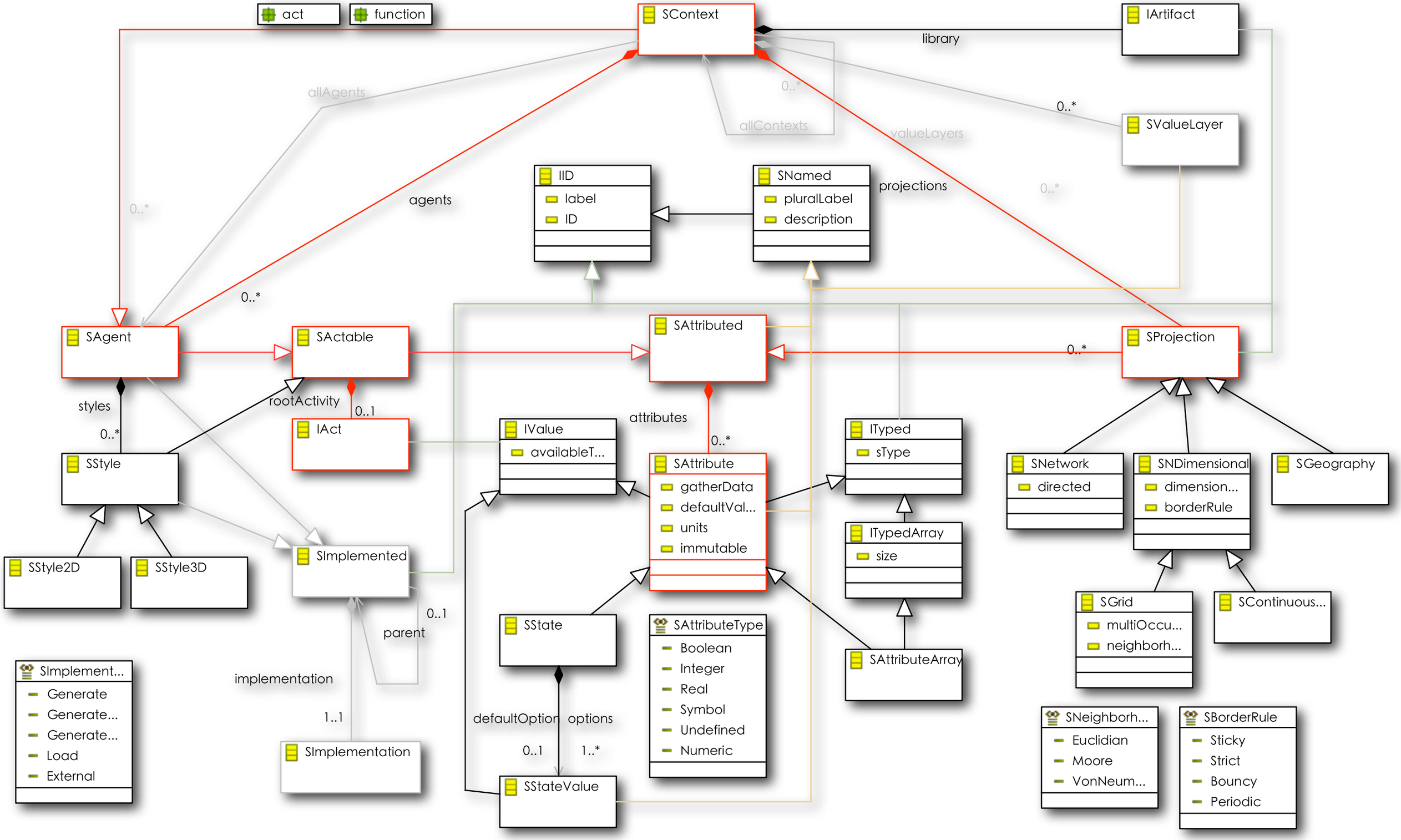
Model Time

- Time
  - Initial Scheduling Mechanisms:
    - Scheduled
    - Rules
    - Life-cycle
  - Outstanding Issues
    - Multi-Scale?
    - Other Representational
- Can we also support?
  - Traditional Discrete Event Simulation
  - Dynamic Systems Models (Decisio)
  - Equation-Based / Analytical

"Acore" Meta-Model

- Best Practices + Innovations
- Like EMF Ecore, but more specialized
- OO Structure with Containment and explicit spatial constructs mediated through behaviors
- Supports Inference over Model
- Graphical component and other implementation issues

MetaABM (proto Acore) Structure



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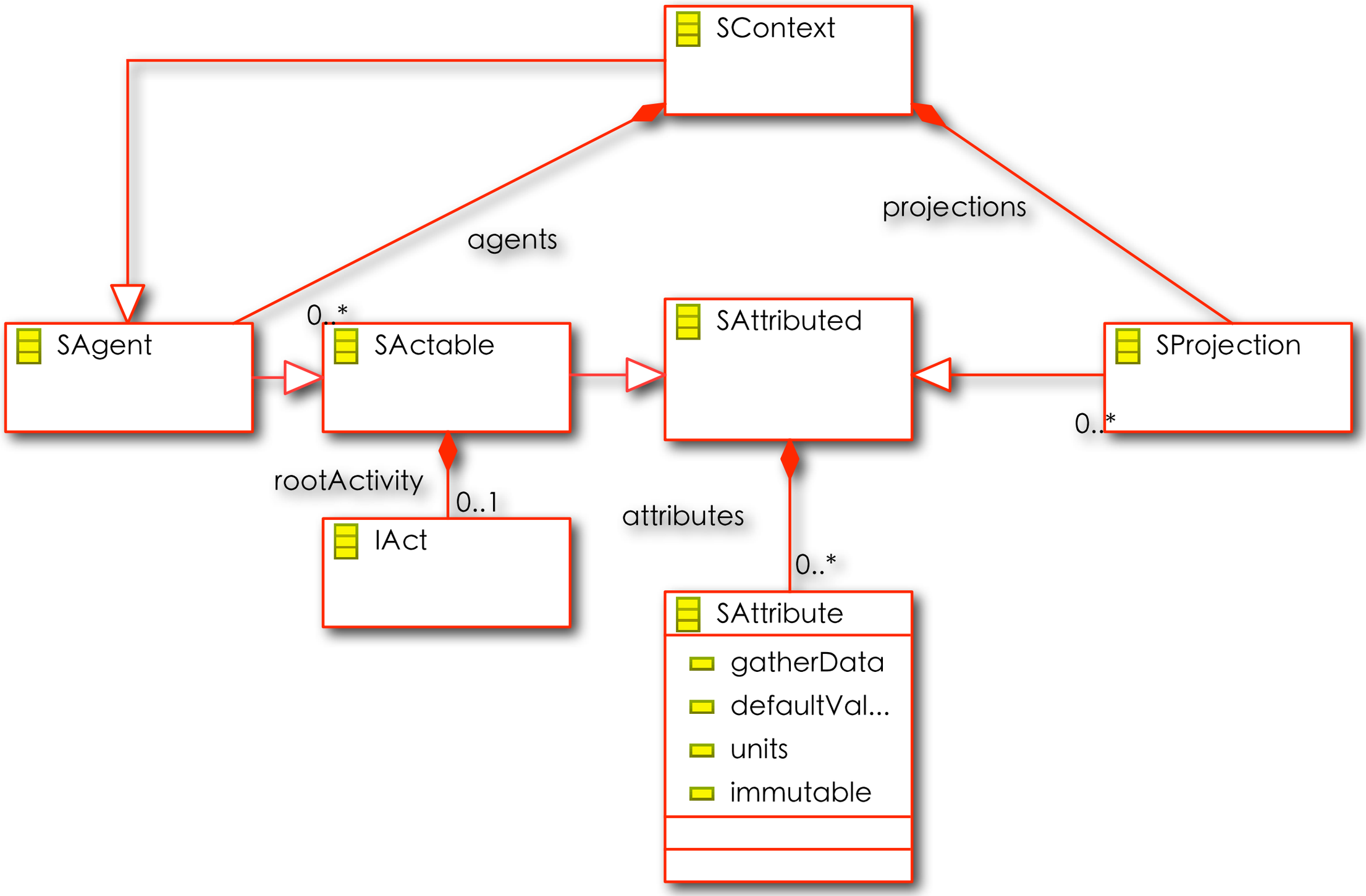
MetaABM (proto Acore) Structure



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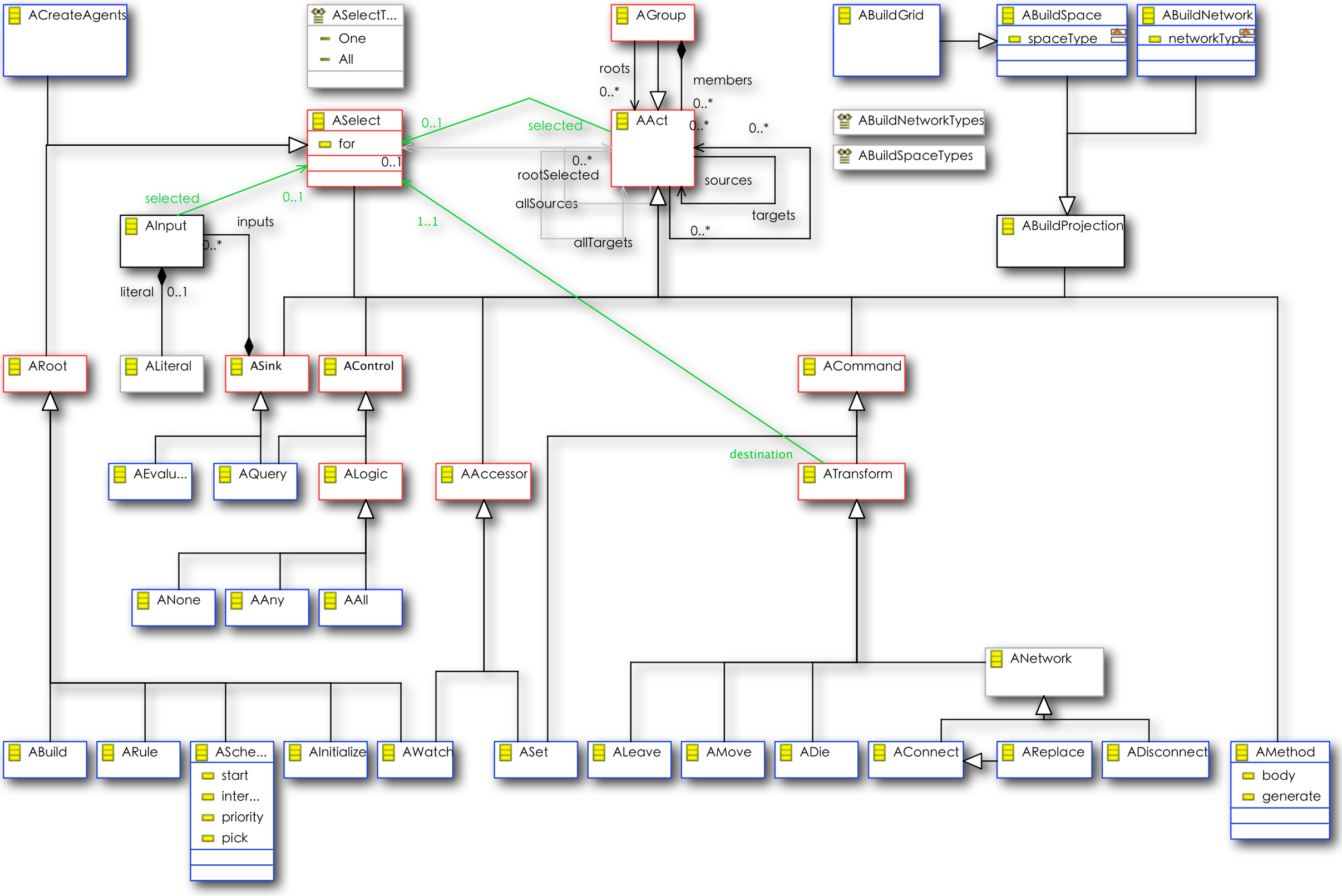
AMF Actions



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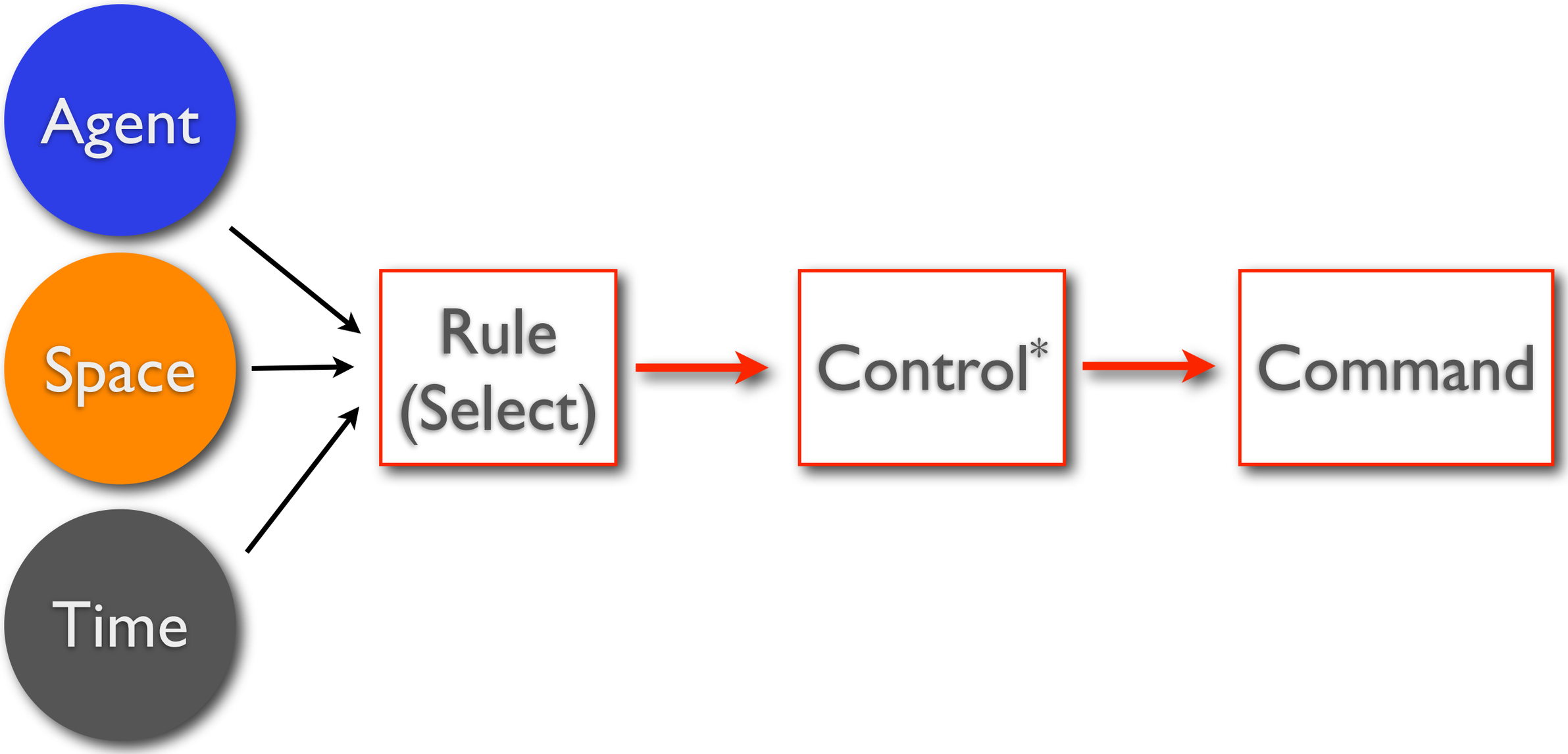
AMF Actions



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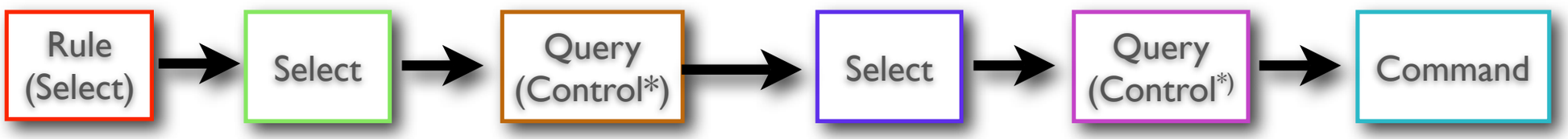
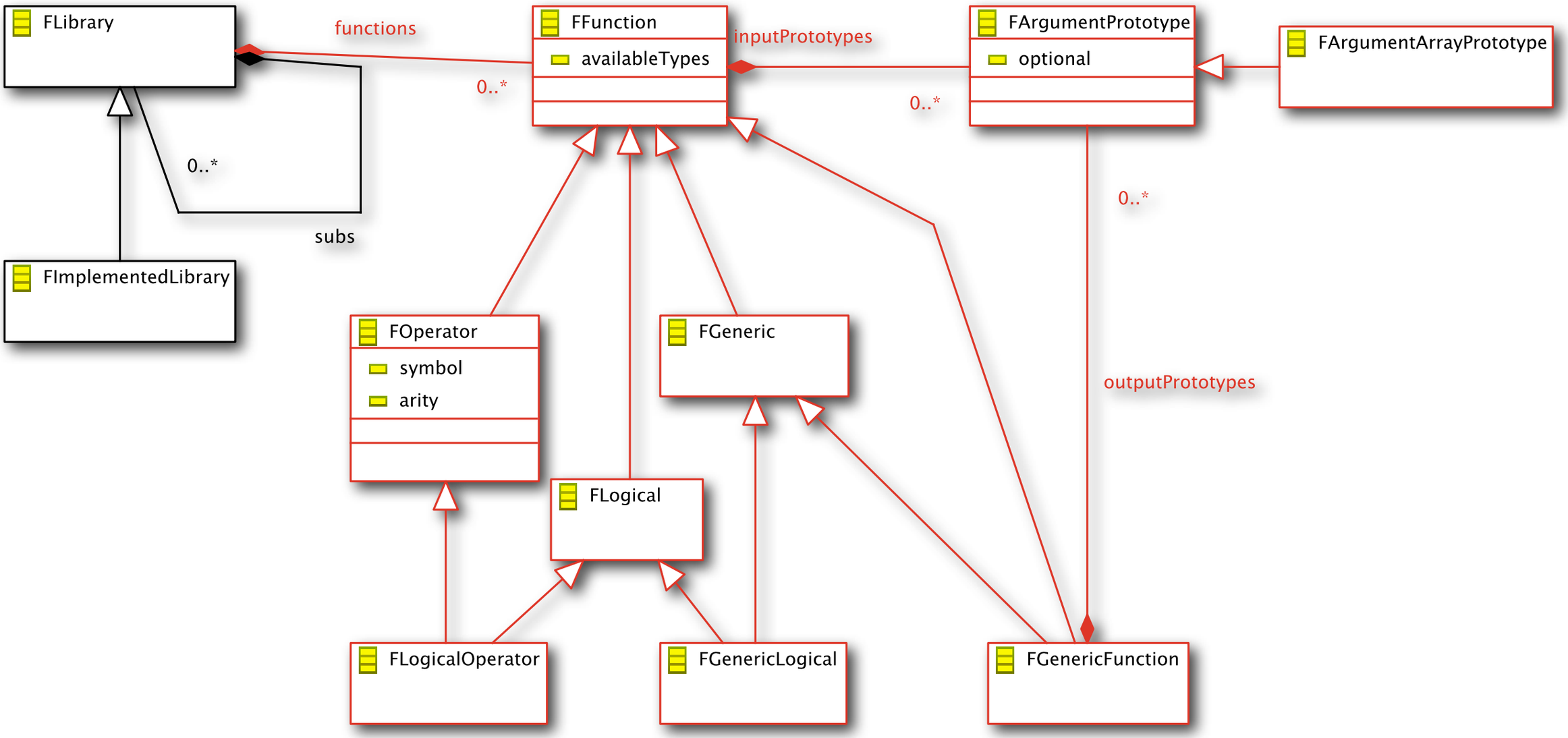
AMF Actions Example



Move Neighbor:
Partner: SELECT Move Neighbor WHERE within(vision) AND Age = Player.Age
Next to Neighbor: SELECT Partner WHERE neighbor() and available()
Move to Partner: MOVE Move Neighbor to Next to Neighbor

AMF Functions



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