Formal Arguments for Large-Scale Assurance (FALSA) Kick-off

February 6, 2023

Software Engineering Institute
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Pittsburgh, PA 15213

JADC2/LSA Provides Motivation

JADC2 vision: Rapid deployment of new mission capability with confidence by composing capabilities across multiple domains from existing systems.

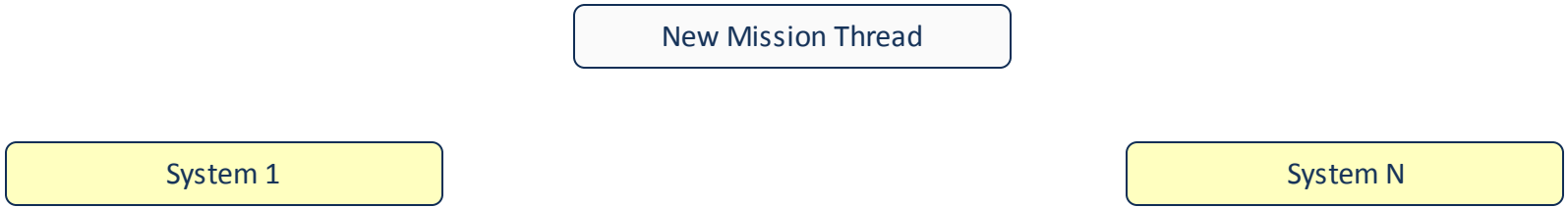
Our focus: rapid assurance with confidence through

- increased formality
- maximal reuse of prior assurance results

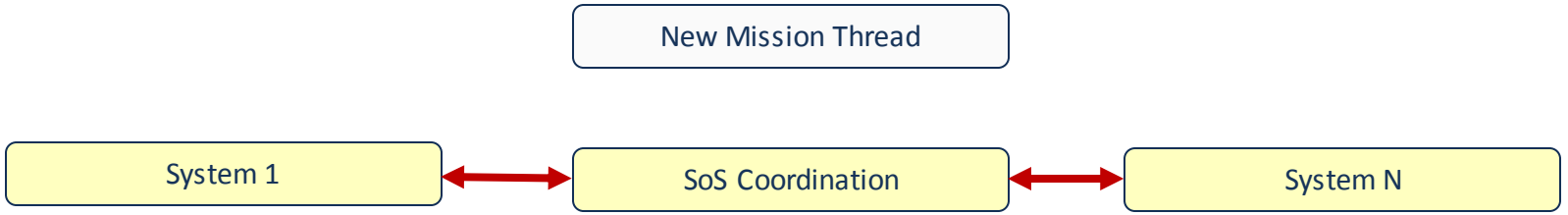
Our approach:

- Incrementally coalesce and structure prior assurance results of existing systems into assurance architectures and
- compose those assurance architectures to assure new capabilities provided by systems of systems (SoS).

LSA Approach



LSA Approach



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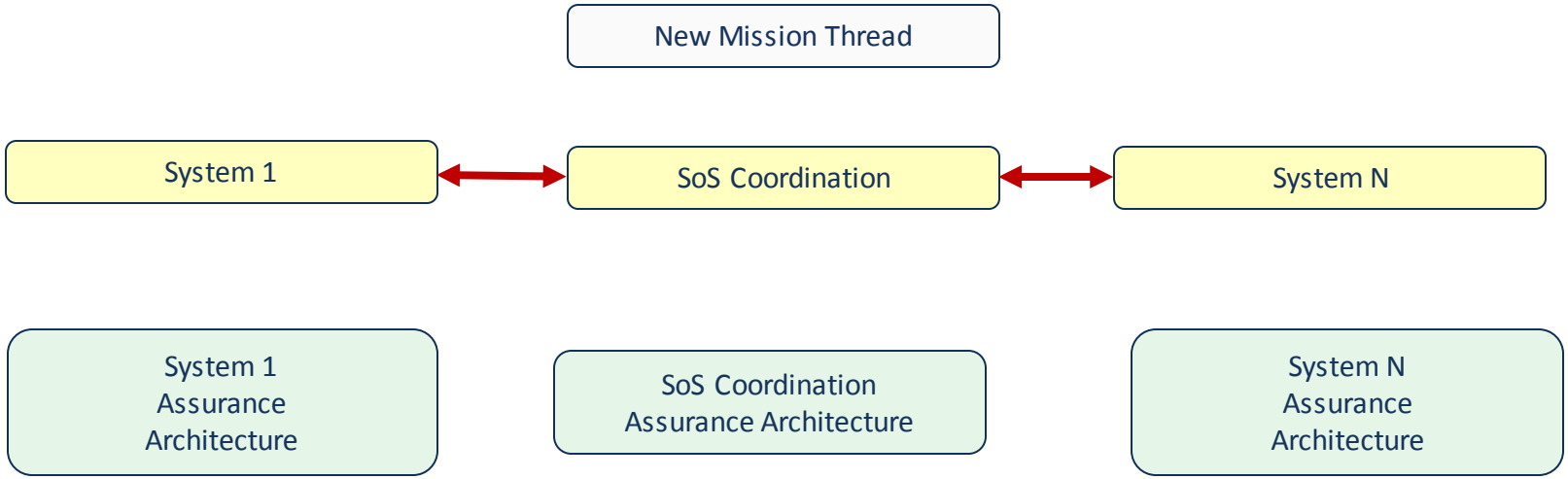

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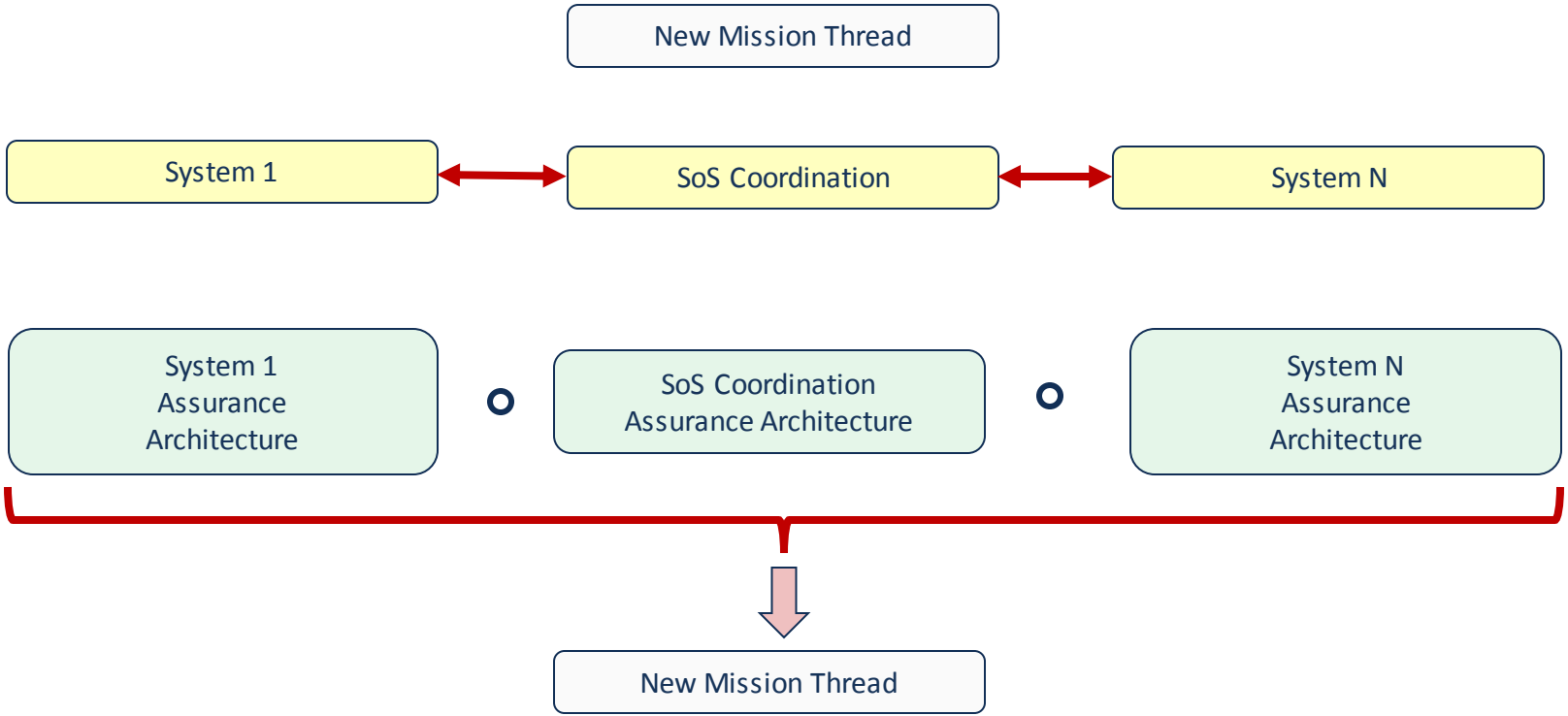
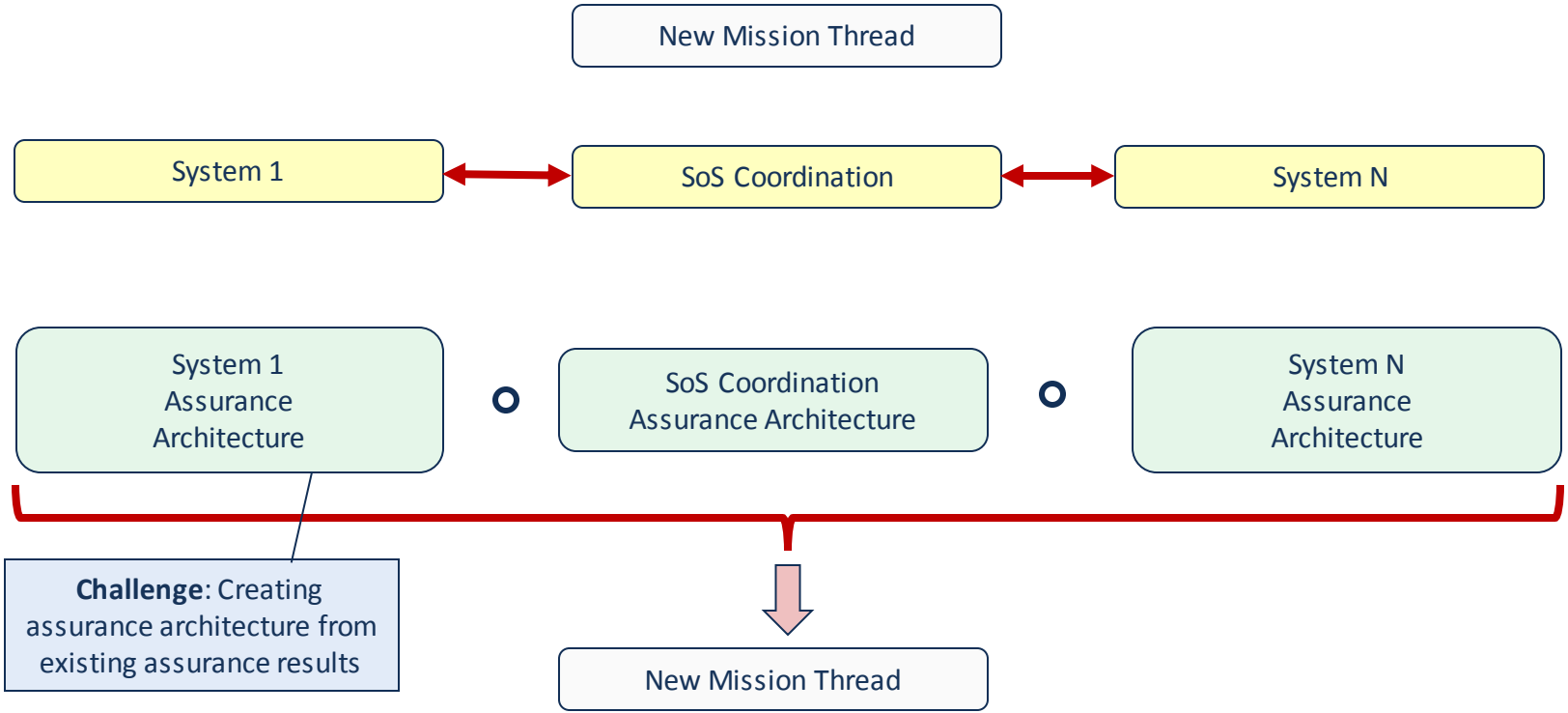


Challenges



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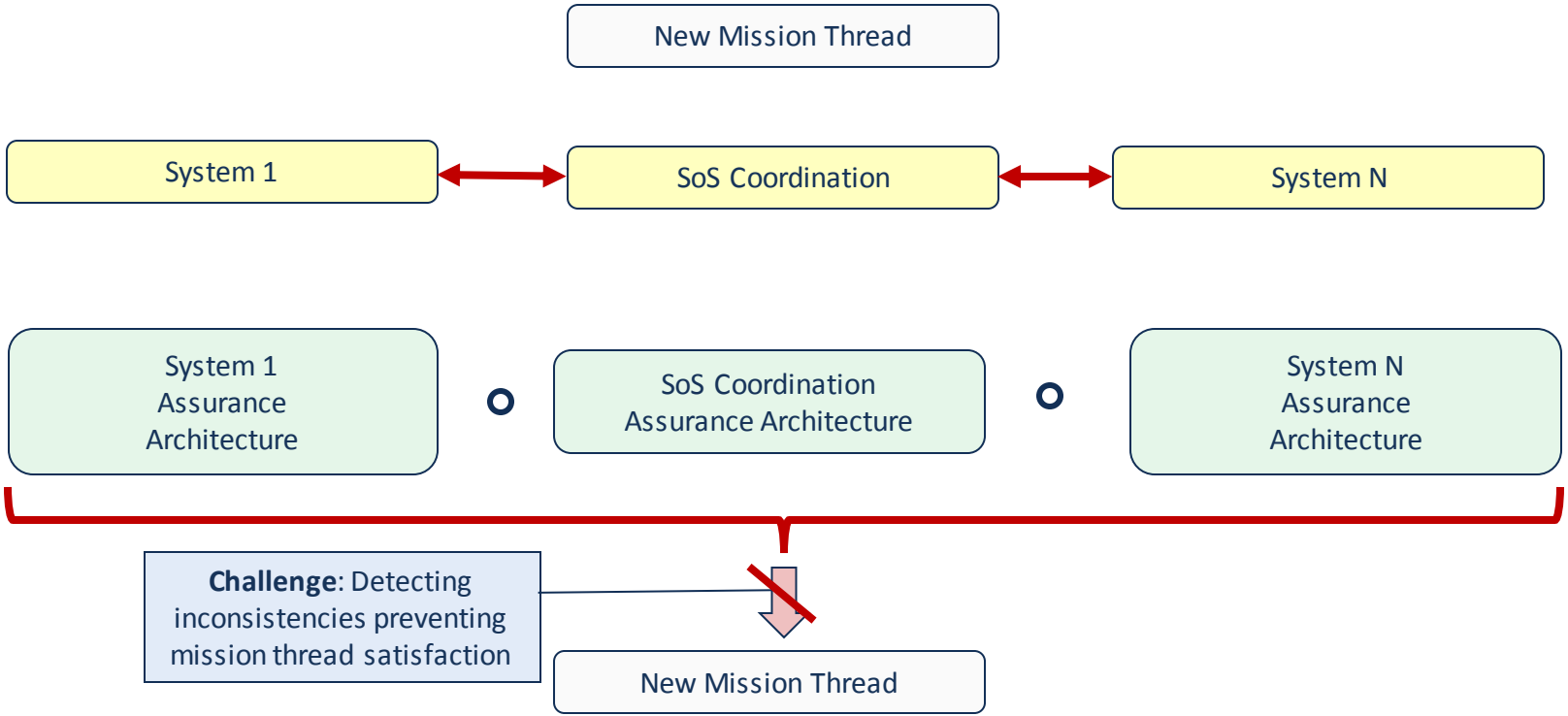

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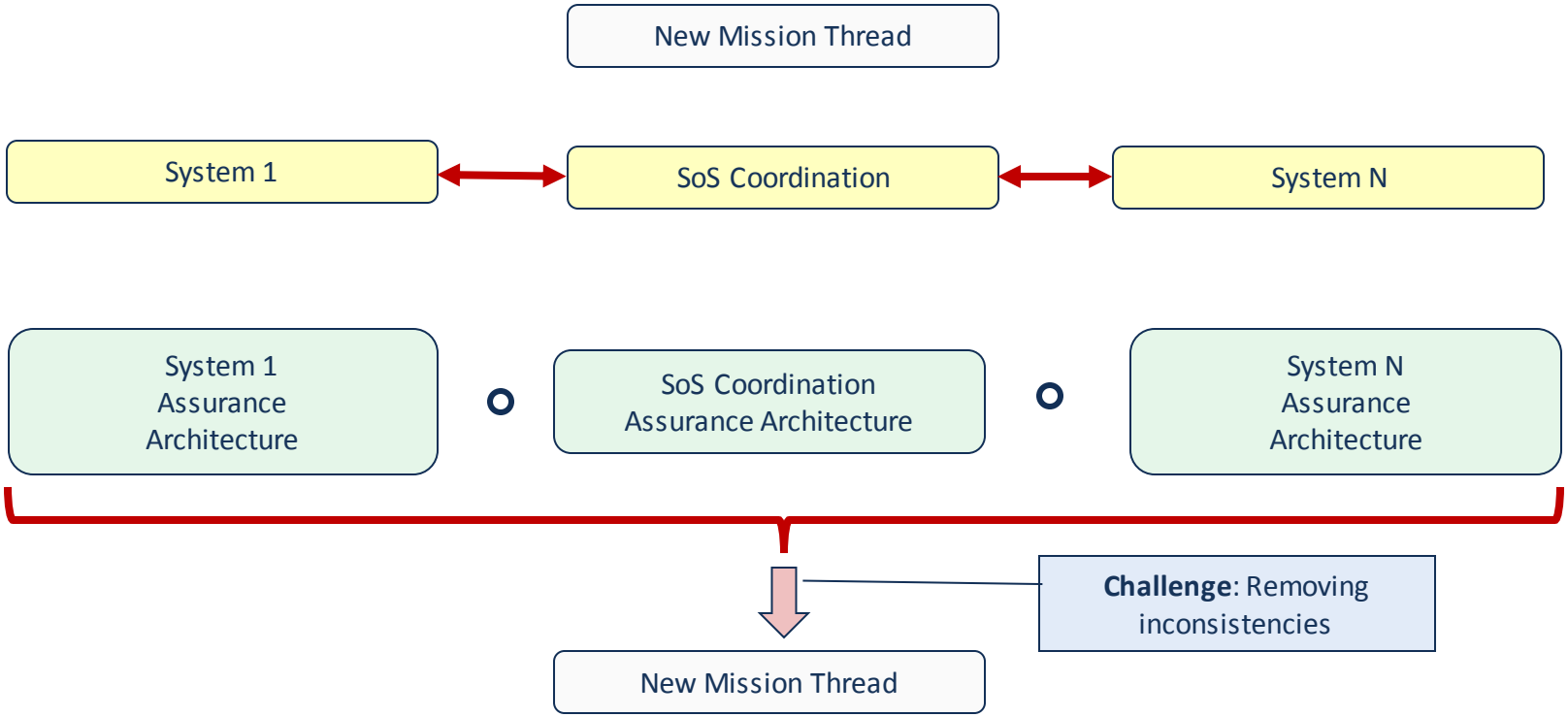

	FY23 ETP	FY24 MTP	Beyond FY24
Model problem	• Start with existing in-house system • Control, timing, security • DoD Collaborator sandbox	• Representative of DoD Collaborator • Unclassified model problem related to classified parts of DoD Collaborator	• SoS
Representing assurance architectures	• Representing formal and informal • New definition of SAT	• Representative assurance architecture • Representing composed assurance architectures	
Runtime conformance	• Determining conformance	• Develop example of using assurance argument for ML • TBD	• Runtime enforcement • Runtime adaptation
Refining assurance architectures	• Using scientific ML • Thoughts on generalizing		• Incorporating runtime experience
Composing assurance arguments		• Detecting inconsistencies • Resolving inconsistencies	• Dynamic composition • System recommendations

FALSA Tasks and Milestones

Task 1 - Designing, developing, and representing an assurance argument. Milestones:

- Model problem created
- Requirements for representation of assurance architecture and technologies to satisfy them

Task 2 - Monitoring runtime behavior vis-à-vis the conformance to system's assurance argument. Milestone:

- Strategies for conformance checking

Task 3 - Learning from runtime data. Milestone

- Applying scientific ML to the control aspects of the model problem

LSA Tasks

Task 1 - Creating assurance architectures with formal and informal parts

Task 2 - Compositional Assurance: Identifying inconsistencies

Task 3 - Compositional Assurance: Resolving inconsistencies

Model Problem

Define experiments for ETP and MTP

Model problem – ETP

- Start with something we have on hand
- Probably should have control, timing and security aspects

Model problem – MTP

- Work with DoD collaborator

For milestone:

- Define experiments for ETP
- Model problem running
- Assurance architecture for subset of model problem with only formal parts

Representing Assurance Architecture

Do some logic homework

Gain deeper insight into System M

Redefining SAT for formal / informal

Get Py-Z3, System M, etc tooling running

Develop an initial assurance architecture for the model problem

For milestone:

- Draft paper on representing formal and informal and new definition of SAT

Conformance Checking

Question: Does runtime behavior conformance to assurance architecture?

- How to determine conformance?
- How to distinguish between erroneous behavior and imprecise assurance architecture?

For milestone:

- Results of conformance experiments

Applying Scientific ML

Applying scientific ML to refine control models

Applying scientific ML to refine timing models

Using scientific ML for conformance checking

For milestone:

- Draw some conclusions about refining assurance architectures based on runtime behavior perhaps leading to an ETP

Administrative

Subteams

- Model problem: John, Anton, Gabe, Dio, Raffaele
- Representation: Amit, Limin, Gabe, Mark, Dio
- Conformance: Gabe, Mark, Raffaele, Anton
- Learning: Mark, Jasmine, Raffaele, Gabe

Tools

- Jira Kanban board
- Zotero group library