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Software Engineering Institute**

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# **Integrating Software Architecture Evaluation in a DoD System Acquisition**

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# Report Documentation Page

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# Presentation Outline

- CLIP Program Background
- CLIP System and Software Concept
- CLIP Challenges
- Role of Architecture in RFP/contract
- Current Acquisition Status
- Proactive Application of ATAM<sup>®</sup> and QAW<sup>®</sup> to Reduce Software Acquisition Risk
- Impact of Work



Tim



John

® Architecture Tradeoff Analysis Method and ATAM and Quality Attribute Workshop (QAW) are registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.

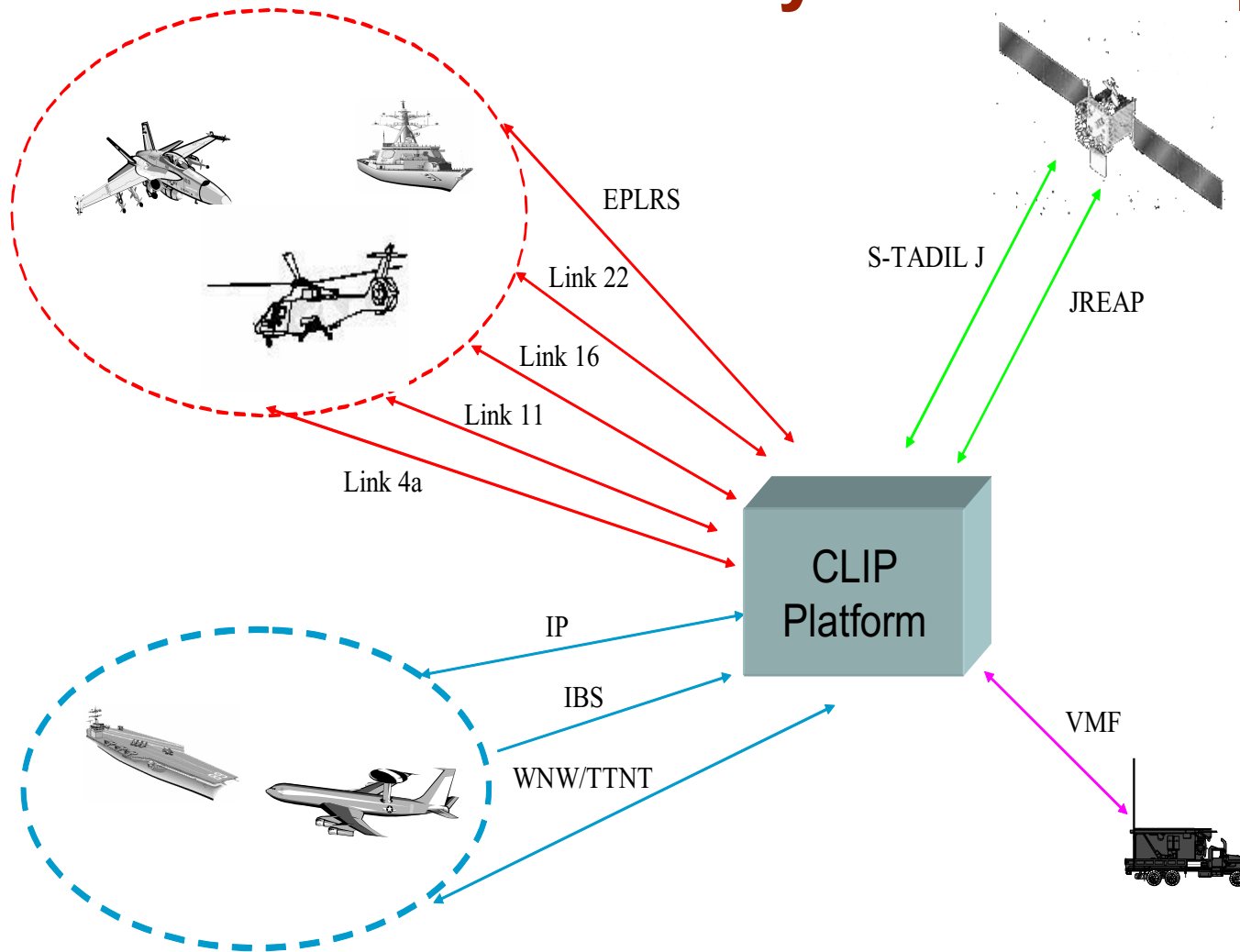


## Common Link Integration Processing (CLIP) – Background

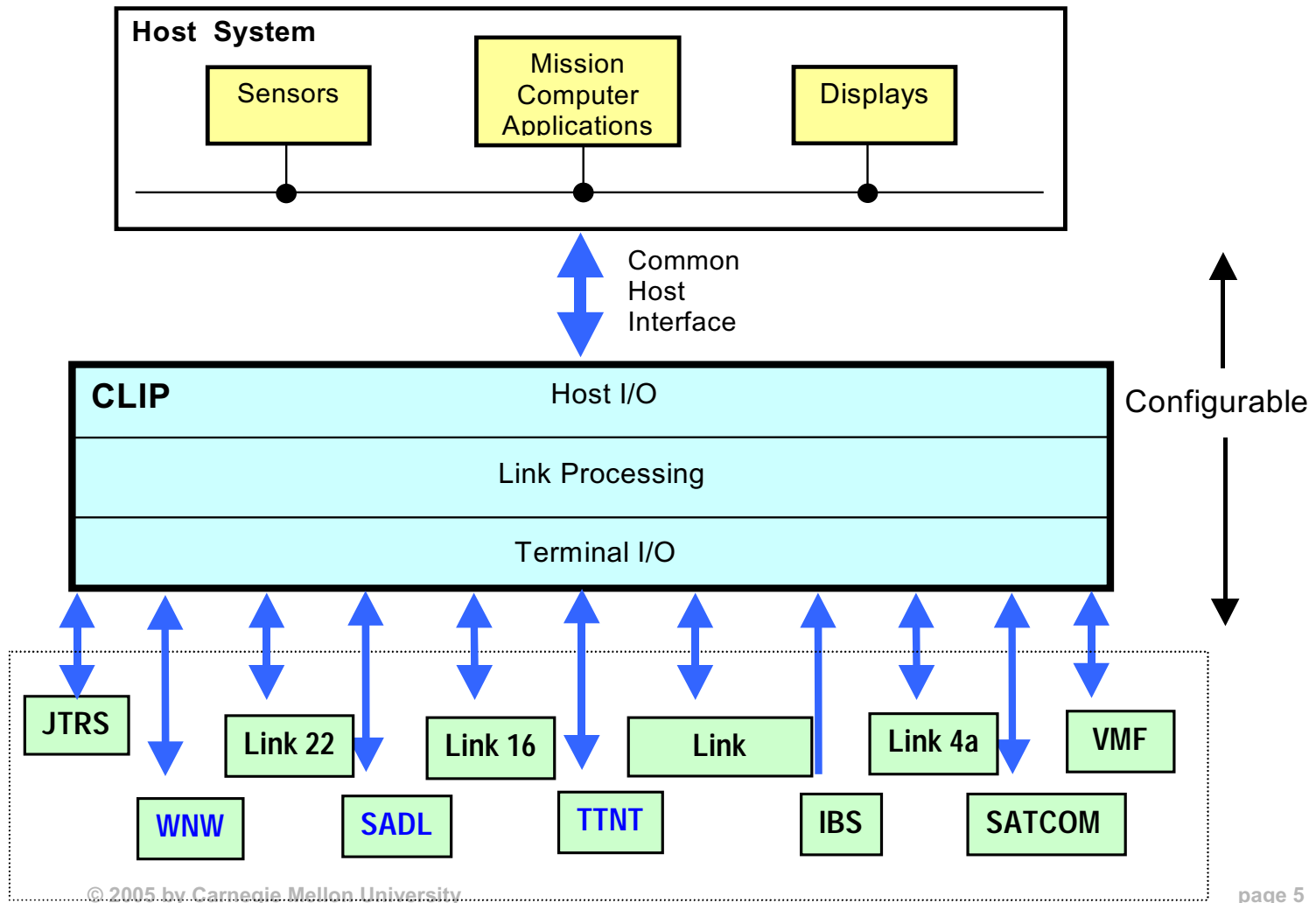
Cooperative Air Force/Navy program

- Integrate Tactical Data Links (TDLs) across platforms with a TDL requirement
- Provide message processing, gateway functionality, and a common interface
- Enable transition of new and legacy platforms to Network Centric Warfare (NCW) environment

# CLIP System Concept



# CLIP Software Concept



# Challenges

- Incremental acquisition supporting different platform integration need dates
- Developing software assets which will be portable to the different platforms using diverse hardware and software
- Ability to forward data “intelligently” from multiple TDLs
- Integration of CLIP with other DoD systems under development
- Development of a common host interface

## Key DoD 5000 Acquisition Documents

- Acquisition Strategy and Acquisition Plan
- System Engineering Plan
- Test and Evaluation Master Plan
- Request for Proposal
  - Statement of Work
  - System Requirements Document
  - Sections B, H, L, and M
  - CDRLs (Deliverables)
- Timeline to support acquisition milestones



**Architecture  
Driven**



## Current Acquisition Status

### CLIP Contract:

- \$275 Meg\*
- In final phase of source selection
- Projected contract award: May 2005

### Software architecture related contractual events:

- QAW to be conducted in July 2005
- Software architecture document to be delivered in support of Preliminary Design Review (PDR)
- First ATAM engagement in Nov 2005

\*Source: FCW.COM News Article:

<http://www.fcw.com/fcw/articles/2005/0207/web-comlink-02-08-05.asp>

## Use of QAW and ATAM to Reduce Software Acquisition Risk

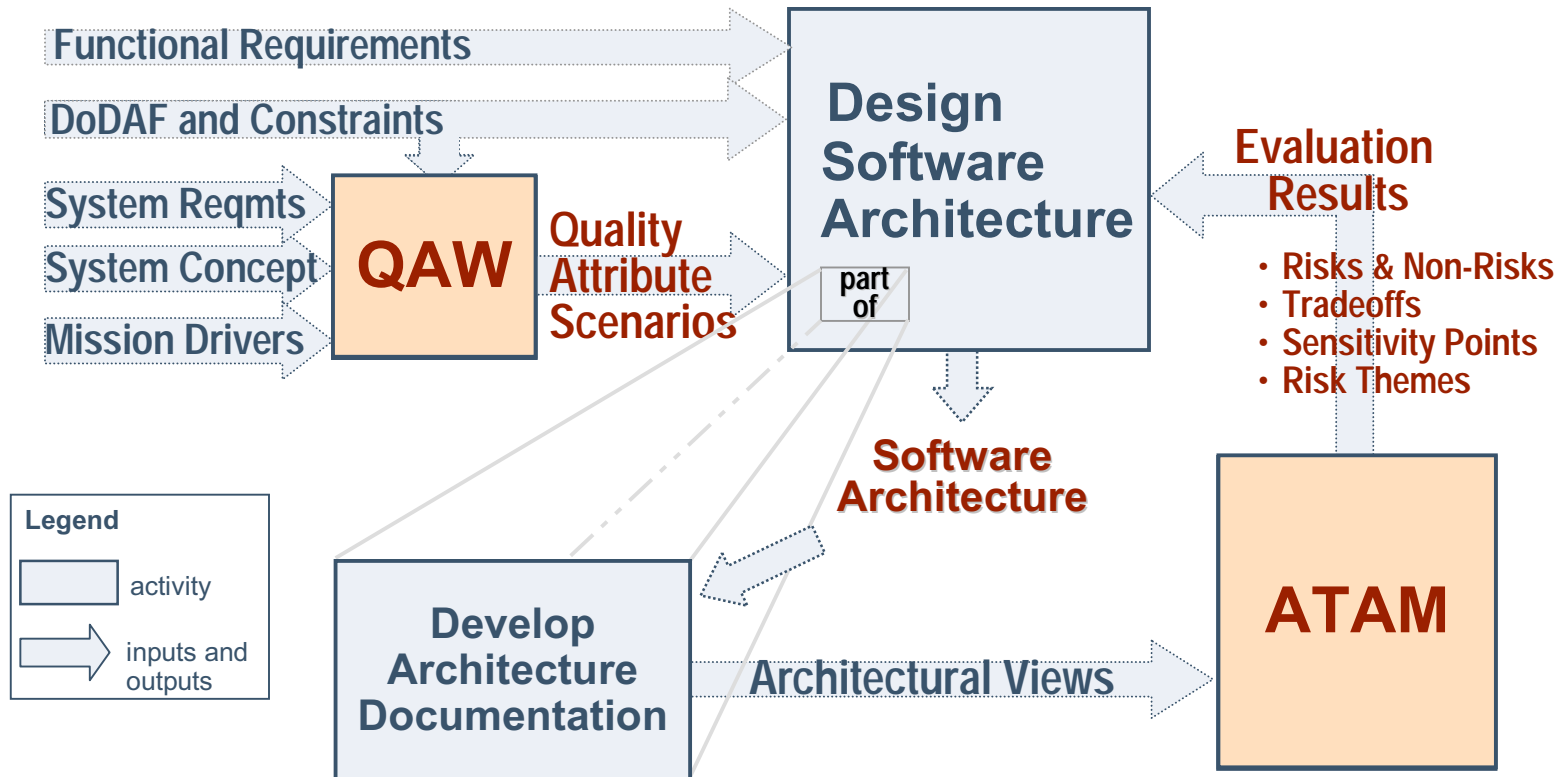
### QAW – Quality Attribute Workshop

- Provide a common forum for discussing quality attribute requirements and architectural implications
- Gain stakeholder buy-in

### ATAM – Architecture Tradeoff and Analysis Method

- Increase communication among stakeholders
- Clarify quality attribute requirements
- Identify software risks early in the development cycle
- Provide documented basis for architectural decisions

# “Big Picture” Development Context



Such a “big picture” view of a contractor’s architecture-centric development approach would be described in its Software Development Plan (SDP).

## Software Architecture Evaluation in an Acquisition Environment

Software architecture evaluation is especially critical when acquiring large, complex systems ...

but, conducting a software architecture evaluation in the DoD acquisition environment is more involved ...

- acquisition focus is on acquiring “systems”
- limited points of contact and leverage
  - exercised from a distance
  - occur at discrete points in the life cycle
  - governed by a stringent set of regulations
- lack of awareness that certain practices are permitted

# Approaches for Conducting ATAM-Based Evaluations

## Reactive

Software architecture evaluations are conducted *opportunistically* and performed in situ under an existing contract at the request of the program manager.<sup>1</sup>

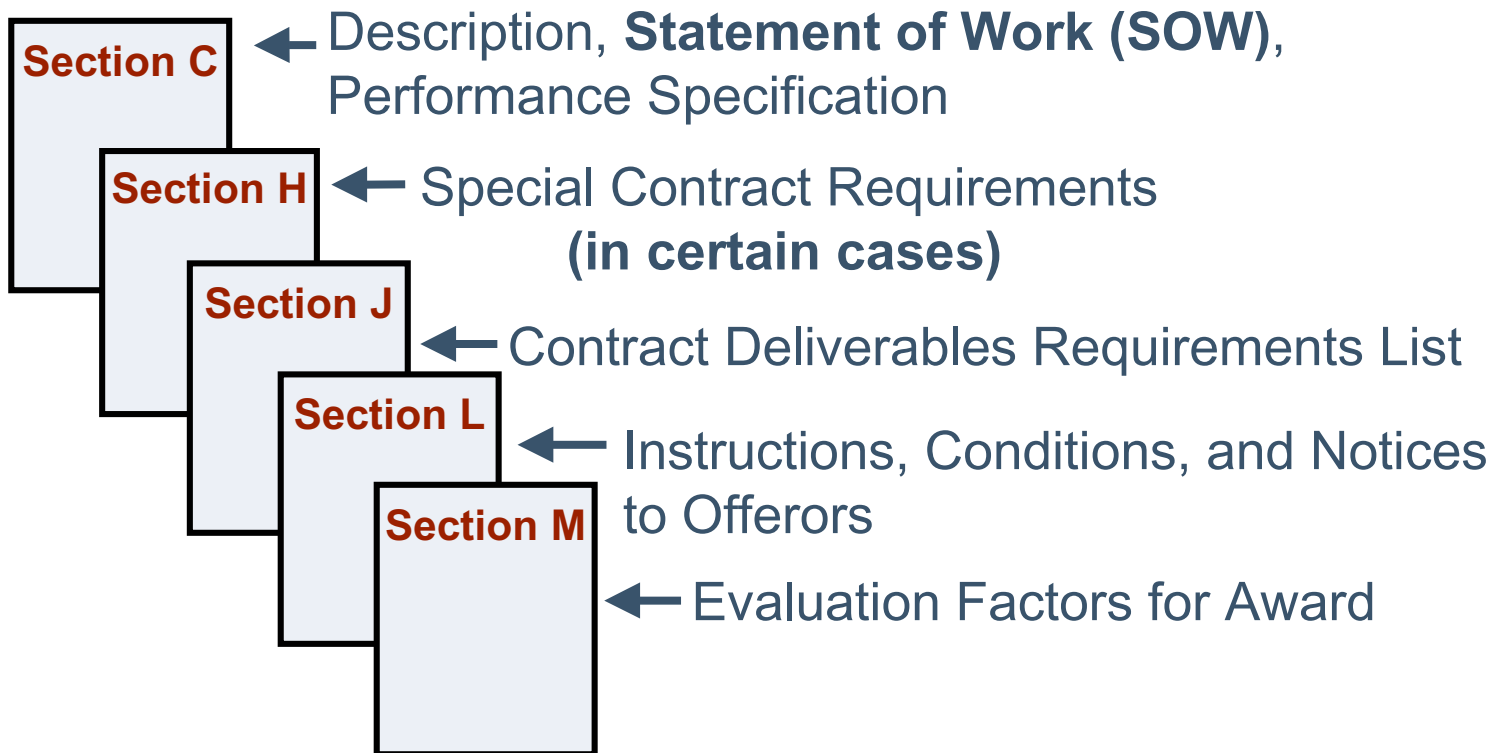
## Proactive

Software architecture evaluations are *preplanned* and integrated up front in a request for proposal (RFP) for a system (or software) acquisition.

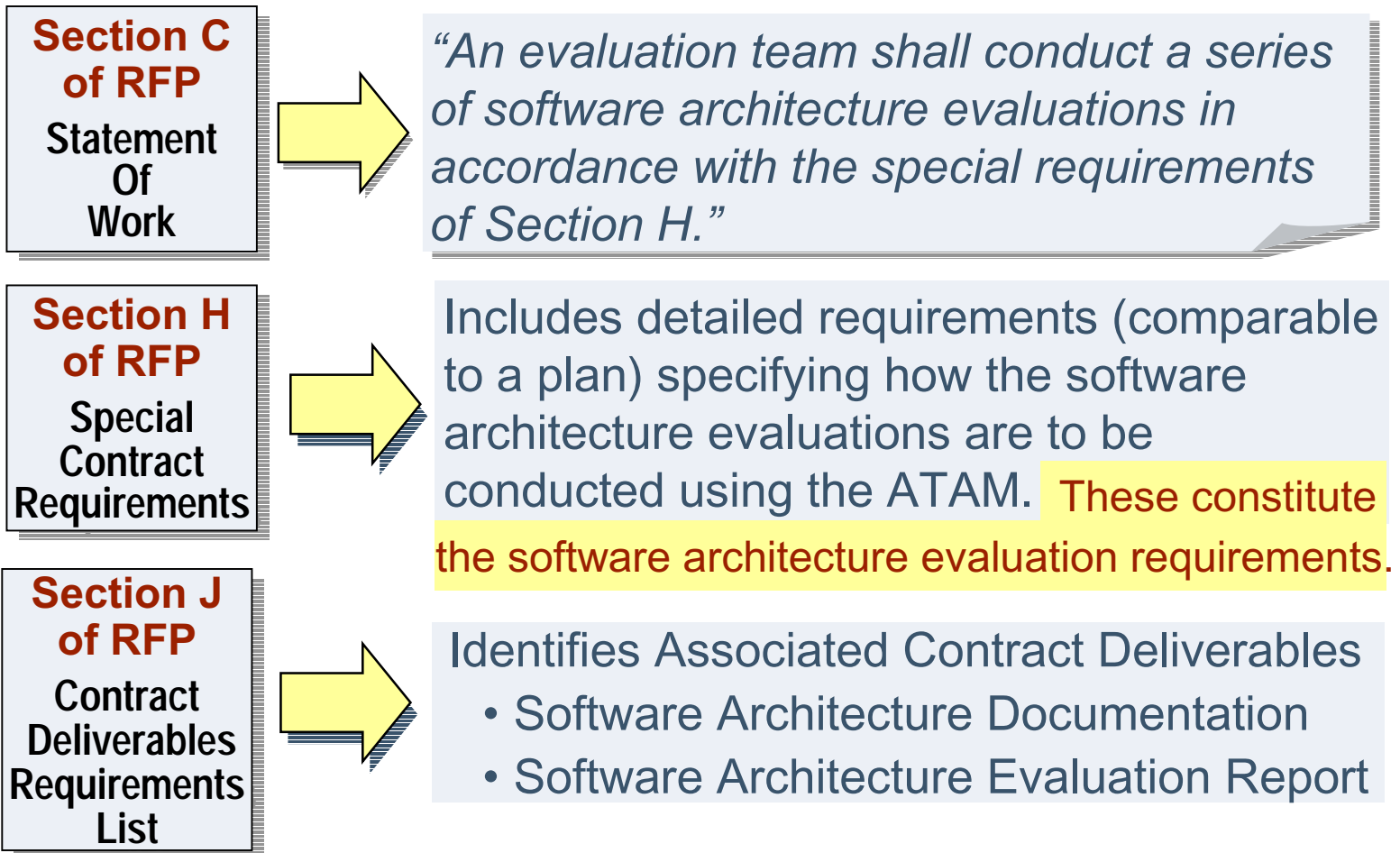
<sup>1</sup> Or at the request of a contractor under a separate agreement

# Request for Proposal (RFP)

Incorporating architecture evaluations in an RFP requires developing appropriate language for the following sections:



# Government Specifies the Method



# What Needs to be Specified?



Developing a coherent approach is nontrivial.

The software **architecture evaluation requirements** must address

- What evaluation method is to be used and what are the steps?
- • **Who are the participants in the architecture evaluation?**
  - What are their roles and responsibilities?
- • **How many evaluations need to be conducted and when?**
- • **If multiple evaluations are involved, how are they to be staged?**
  - What are the prerequisites for conducting the evaluations?
  - What is involved in terms of time, effort, and cost?
- • **How are evaluation team responsibilities to be transitioned?**
  - How will the objectivity of the participants be ensured?
  - How are the evaluation results to be captured and used?
  - What contract deliverables need to be included?
  - How can the evaluations be carried out collaboratively to ensure both government and contractor stakeholders play an active role?
  - What training will be provided for the evaluation team members?
  - And the list goes on ...



Example  
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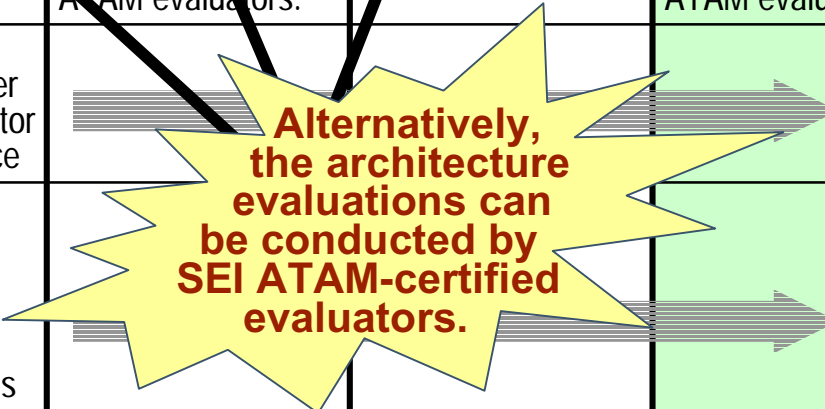


## Participants in the Initial Architecture Evaluation

CLIP Contractor's Software Development Cycle				
<b>ATAM Participants</b>	<b>1st Architecture Evaluation</b> (Increment/Spiral 1)			
<b>ATAM Evaluation Team</b>	SEI conducts full ATAM evaluation. <i>A contractor and program office representative may also attend as observers.</i>			
<b>Project Decision Makers</b>	Includes chief architect and other agents of contractor and program office			
<b>Software Architecture Stakeholders</b> (Only participate in Phase 2 of the ATAM)	Includes program office agents, contractor personnel, and representatives from organizations to be supported by Increment/Spiral 1			

\* External evaluators can be an agent of the government program office or an agent of the contractor organization; contractor agents, though, must be external to the project whose architecture is being evaluated.

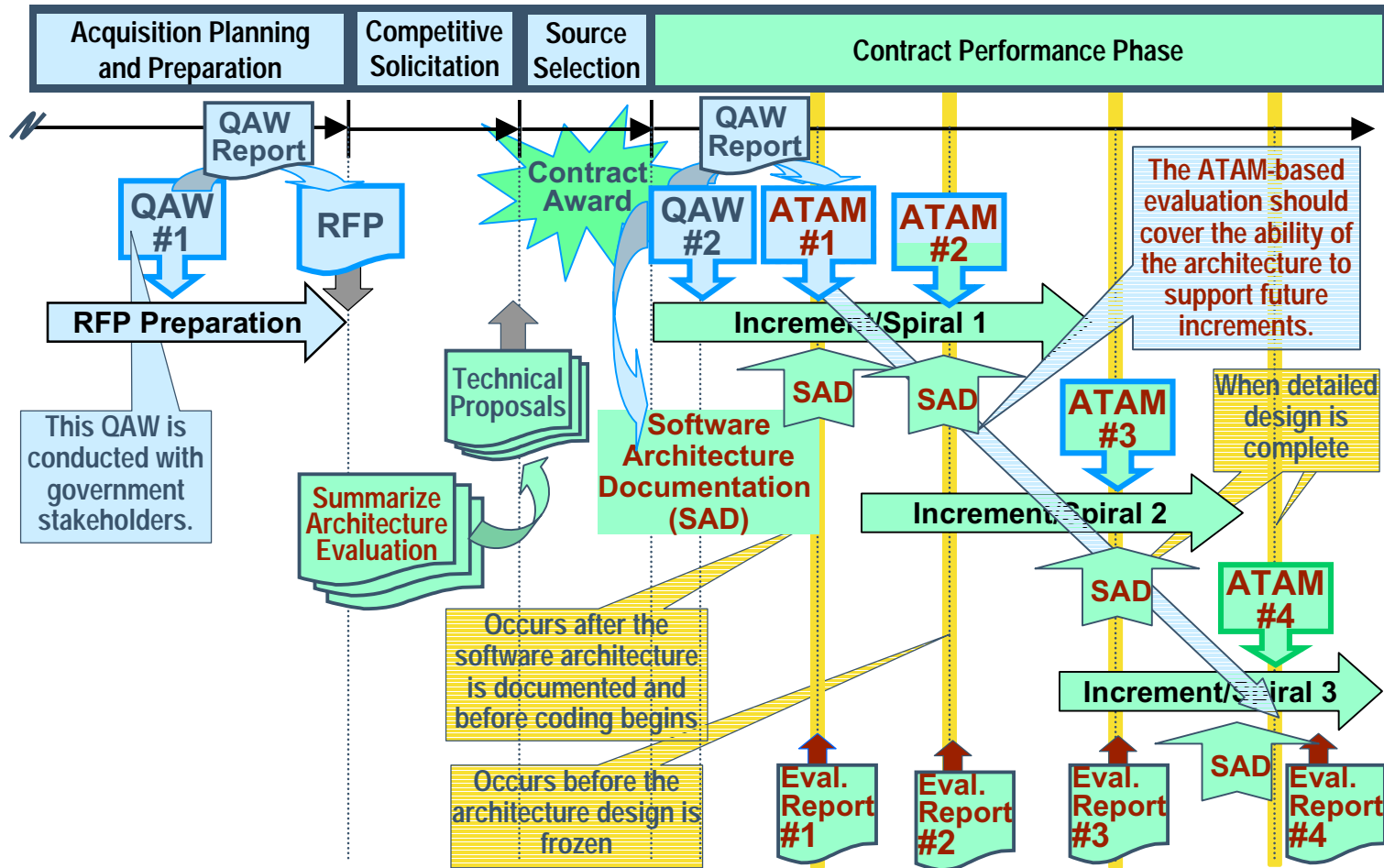
## Example Staging & Transitioning of Responsibilities

Contractor's Software Development Cycle				
ATAM Participants	1st Architecture Evaluation (Increment/Spiral 1)	2nd Architecture Evaluation (Increment/Spiral 1)	3rd Architecture Evaluation (Increment/Spiral 2)	Follow-On Evaluations (Increment/Spiral 3 to N)
ATAM Evaluation Team	SEI conducts full ATAM evaluation. <i>A contractor and program office representative may also attend as observers.</i>	SEI provides ATAM facilitation. Team consists of SEI lead evaluator, an SEI evaluator, and two or more external* ATAM evaluators.	SEI provides ATAM coaching only. Lead evaluator and other team members are all external* ATAM evaluators.	SEI is not involved. An all project team conducts evaluations. Lead evaluator and other team members are all external* ATAM evaluators.
Project Decision Makers	Includes chief architect and other agents of contractor and program office			
Software Architecture Stakeholders (Only participate in Phase 2 of the ATAM)	Includes program office agents, contractor personnel, and representatives from organizations to be supported by Increment/Spiral 1			
	Increment/Spiral 1	Increment/Spiral 1	Increment/Spiral 2	Increment/Spiral 3 to N

Full ATAM Adoption

\* External evaluators can be an agent of the government program office or an agent of the contractor organization; contractor agents, though, must be external to the project whose architecture is being evaluated.

# Coordinated Use of QAW and ATAM



## Impact

A QAW and ATAM-based evaluation have been successfully integrated into an RFP/contract for a major DoD acquisition.

The approach and RFP/contract language were approved by an independent assessment team and the CLIP contracting officer.

Based on the CLIP experience, we have developed “*Guidance for Reducing Software Acquisition Risk through Architecture Evaluation*”.

This guidance is available to DoD programs that want to promote architecture-centric development and proactively perform software architecture evaluation in their system acquisition.

The architecture evaluation approach and corresponding contract language and software deliverables will be described in a set of SEI Technical Notes.