System of Systems Architecture and TSPR Contractor Model

Conference on the Acquisition of Software-Intensive Systems

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Jonathan D. Addelston
(mailto:JDAddelston@alum.mit.edu)

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Presentation Goal

- Base discussion a recent 10-month study for a key intelligence agency (without attribution)
- Identify acquisition issues driving the agency PMOs for mission critical IT systems
- Show relationship between System-of-Systems Architecture and TSPR Acquisition Model
- How well does the TSPR approach respond to the software-intensive acquisition issues?

Agenda

- Acquisition Organization Pressures
- Very Quick View of System-of-Systems and its Architecture(s)
- TSPR – Total System Performance Responsibility Contracting
  - Overarching Systems Integrator
- Acquisition Process Changes

Acquisition Issues "Nightmare"

Client Organization

Client Core Competencies

Client Mission and Strategy

Roadmap

Governance and IPTs

Client eBusiness Transition

Client R&D Investments

Trusted Agents

IV&V Contractor

Checks and Balances

Industrial Base

Process Improvement (Maturity, Capability)

Of Client

Of Contractors

CMM-SW
CMMI
SA-CMM
FAA-iCMM
Other Models

Other

Incentives

Transition

System of Systems

Architecture
As a Goal or Standard?

System Safety and Security

Technology Adoption

(S)COTS Products

Life Cycle

Project Definition

System Delivery

System Operations
and Maintenance

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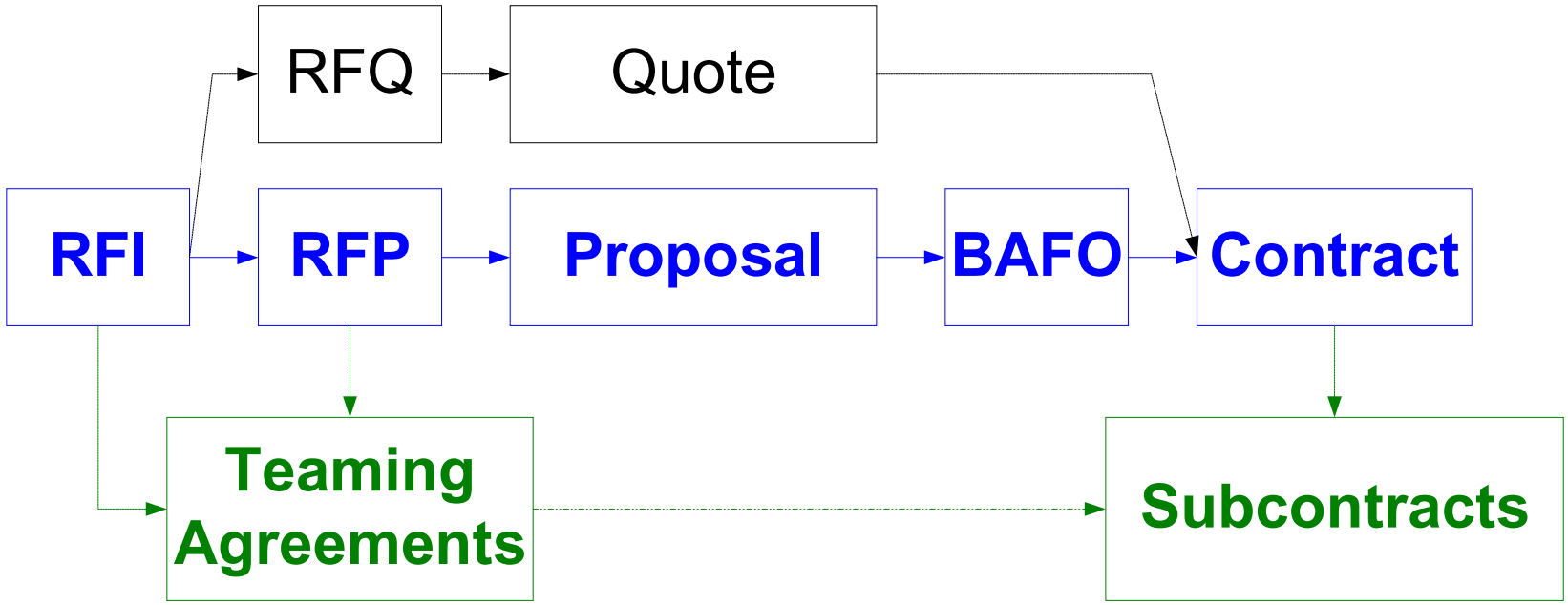
Acquisition PMO Issues

- Limited trained, skilled acquisition management team struggling with multiple systems contracts
- Attempting process improvement without key core competencies
- Hoping to gain control while outsourcing critical functions and decisions
- Unanticipated impacts on acquisition processes and controls
- Massive management and technical control changes

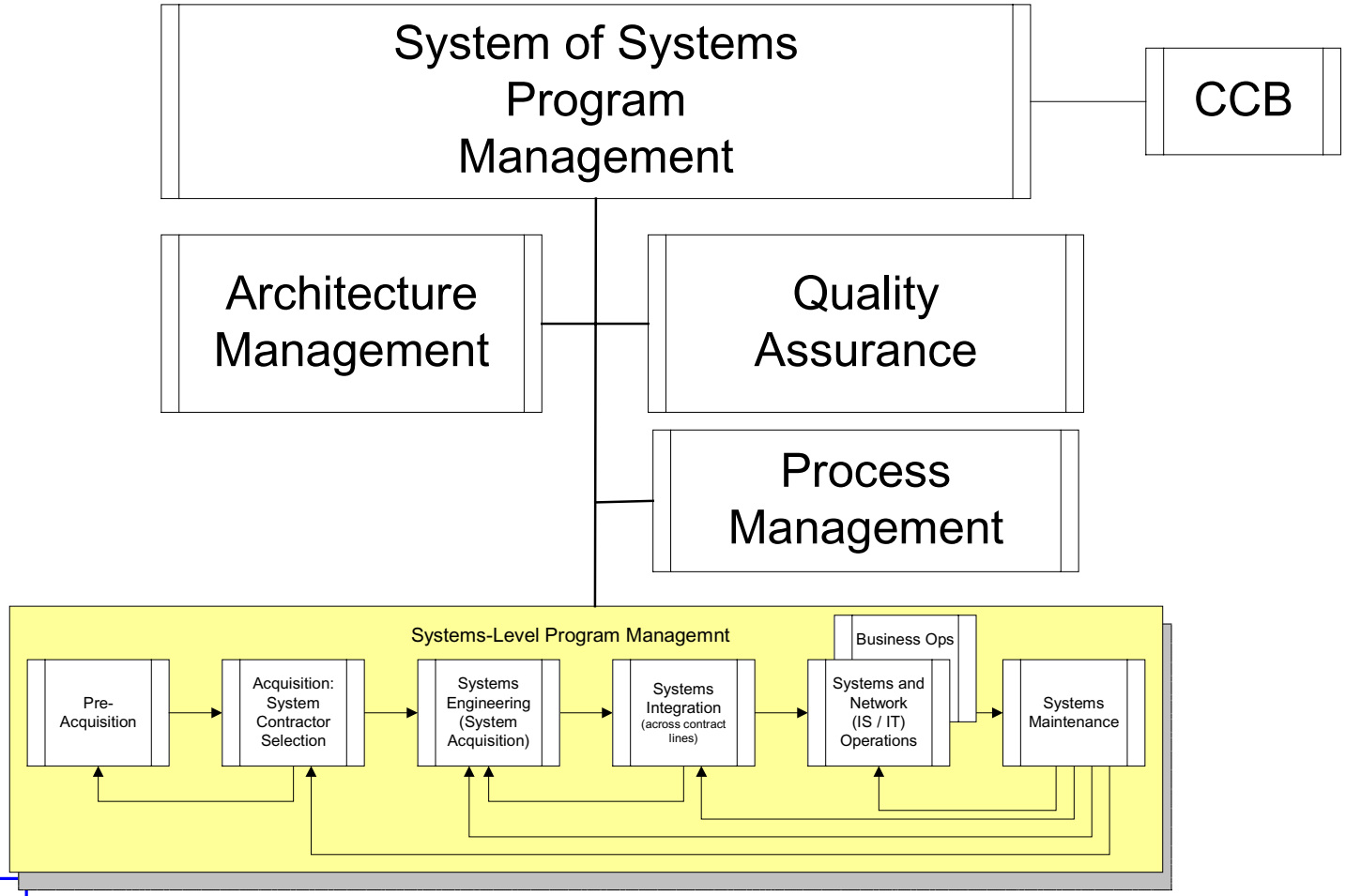
Traditional Acquisition Documents

- Statement of Objectives (SOO)
- Operational Requirements Document (ORD)
- Statement of Requirements (SOR)
- Systems Operations Concept (SOC)
- Statement of Work (SOW)
- Concept of Operations (CONCOPS)
- System Requirements Document (SRD)
- System Architecture ("as is" and "to be")

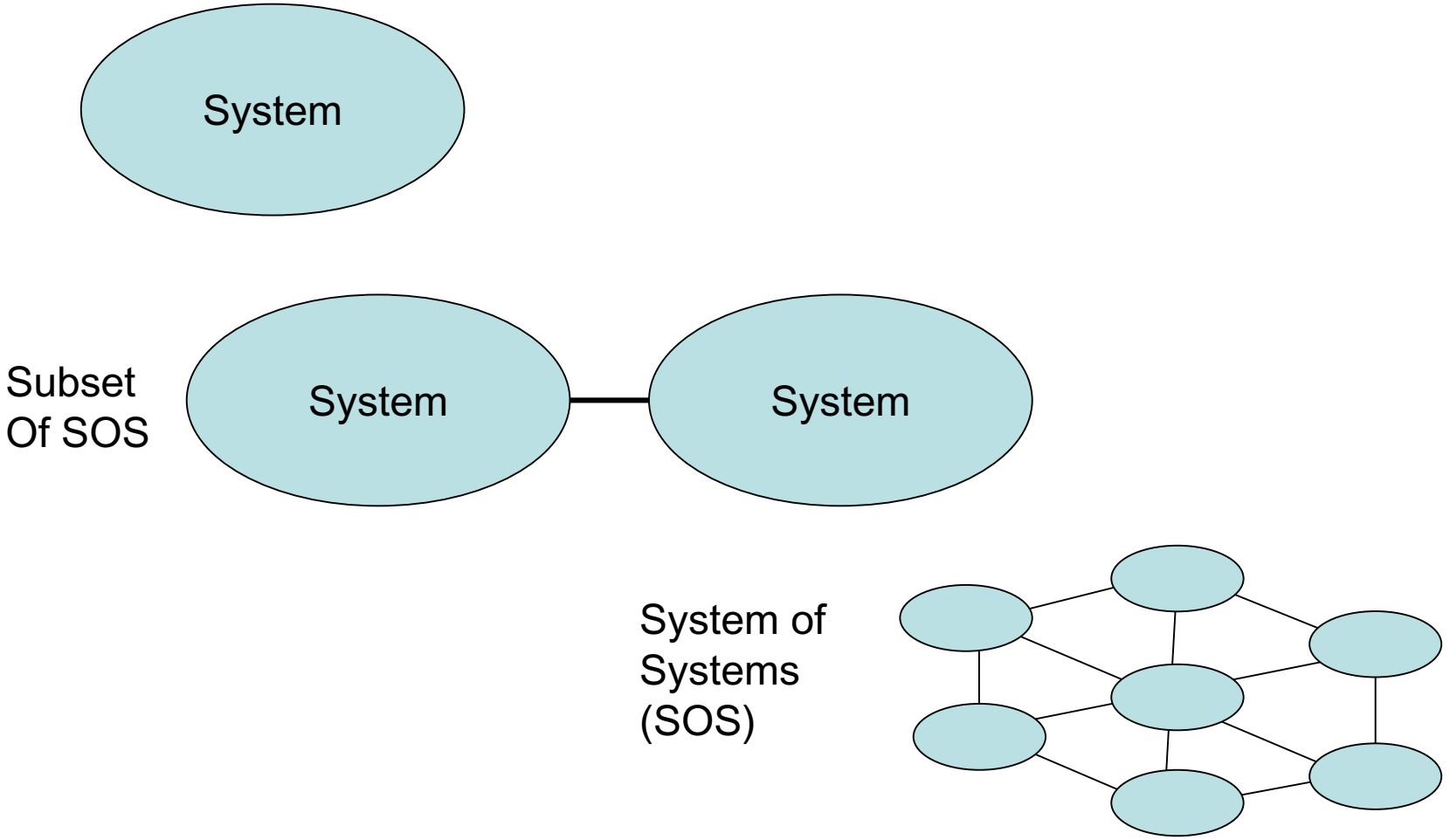
Acquisition Overview



Agency Program Management



System of Systems Architecture



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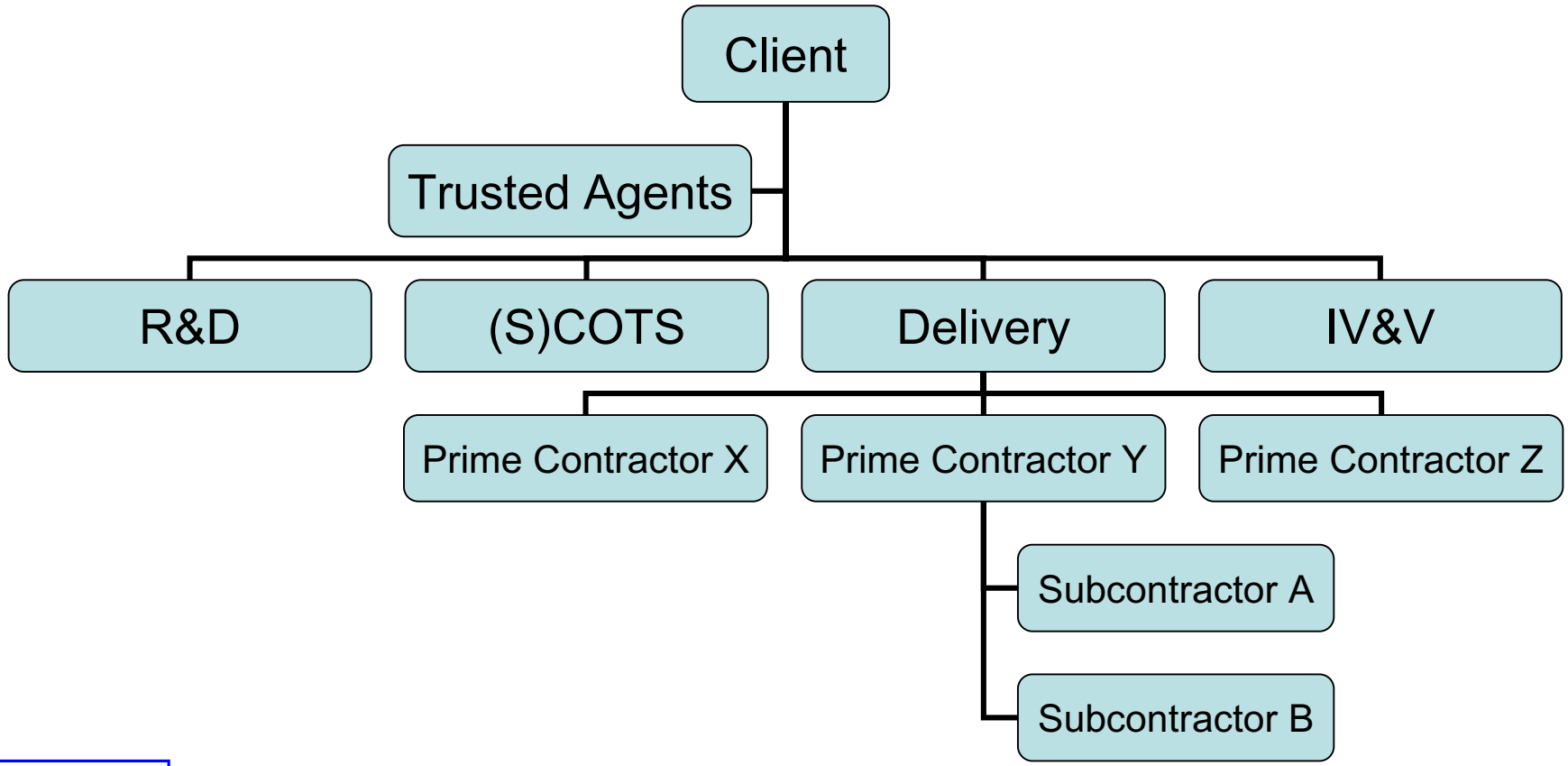
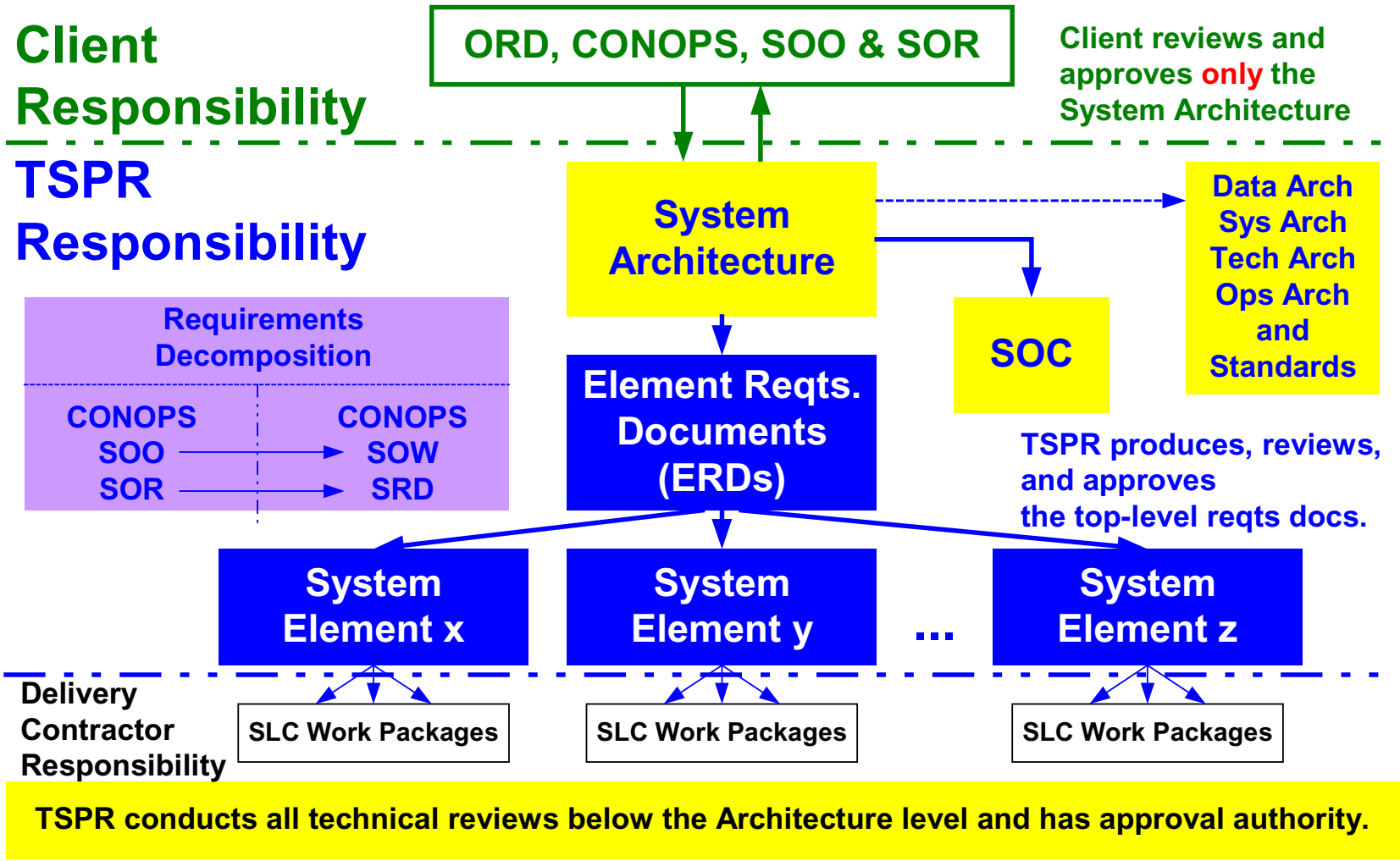
After Behind the Wizard's Curtain, Figure 2-1

Client Organization



TSPR and Requirements



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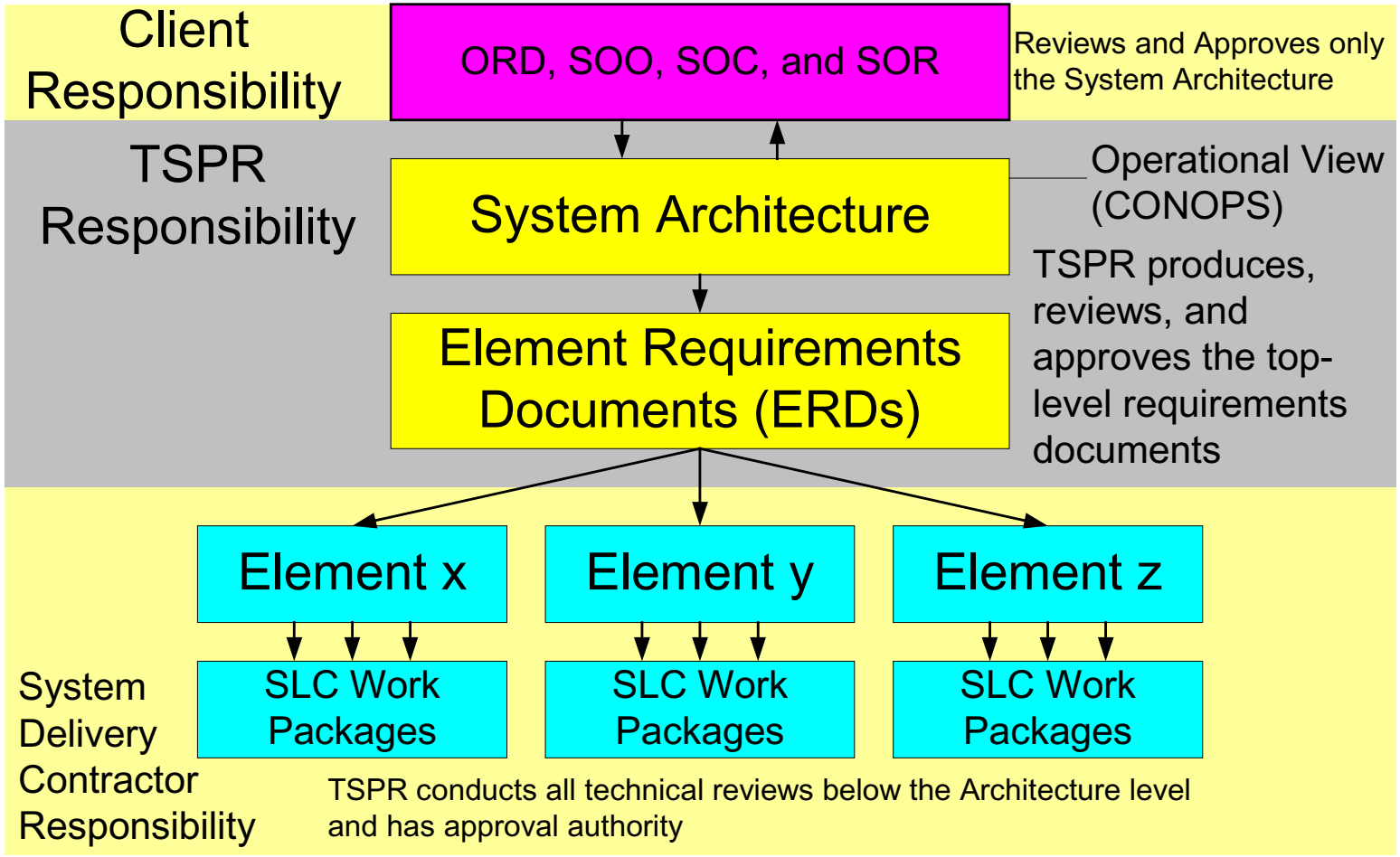
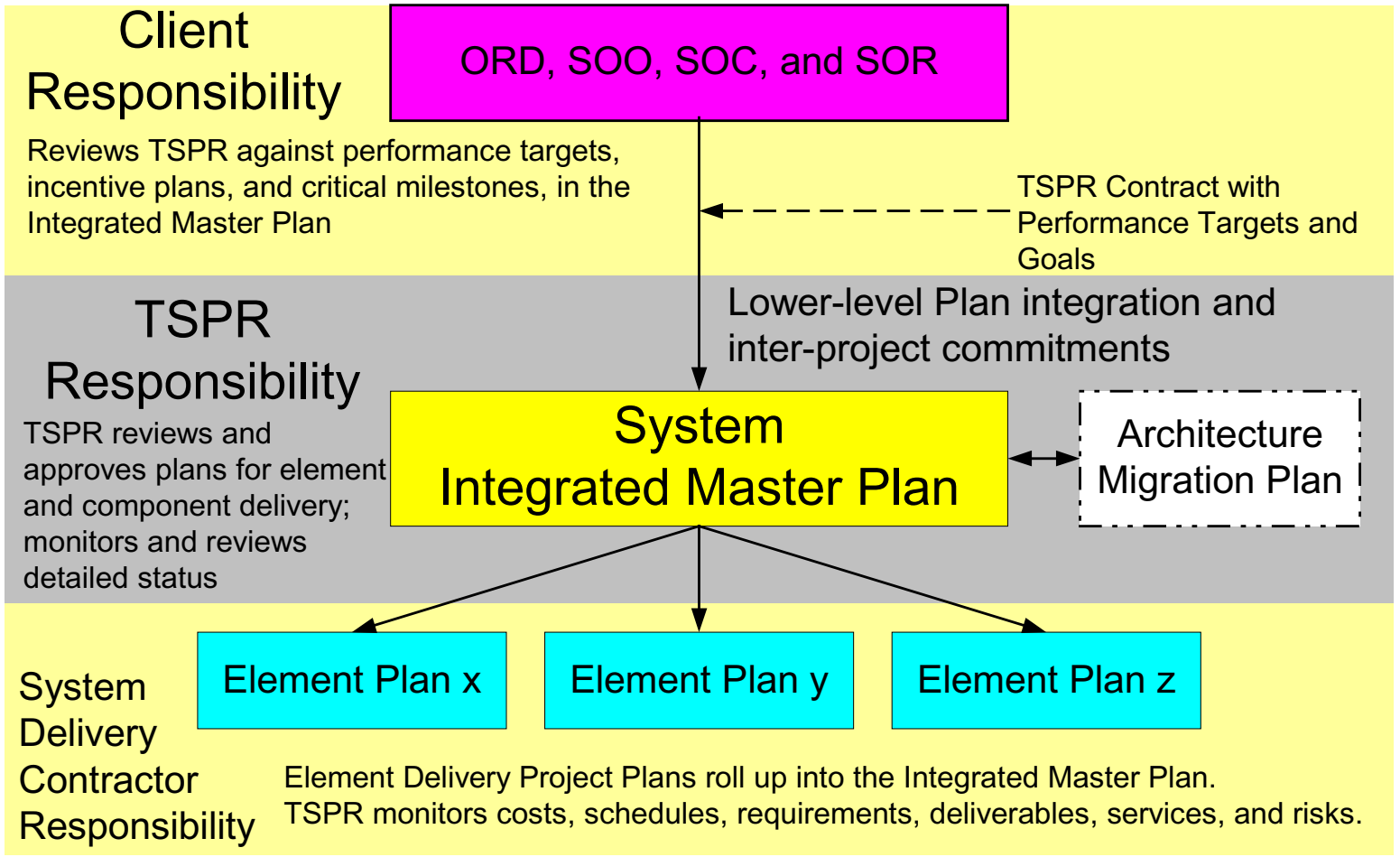
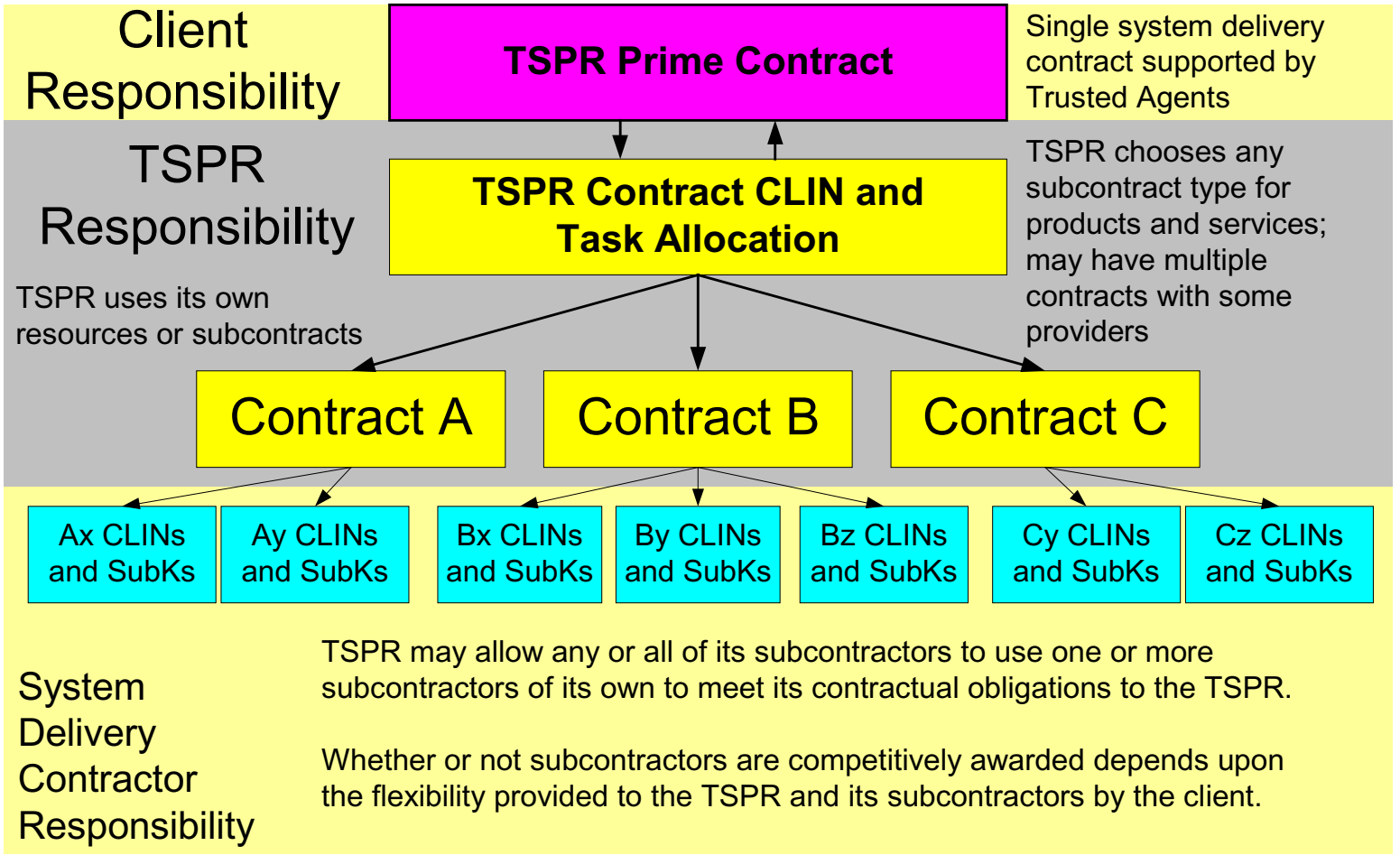
TSPR and Architecture



TSPR Integrated Master Plan



TSPR Subcontracts



TSPR "End-to-End"

- End-to-end responsibility means:
  - Control of all of the system components from the beginning to the end of any system interaction or transaction
  - Control of the system engineering life cycle
    - From the elicitation of detailed requirements through the operation of the deployed system through system retirement
    - ***With certain key exceptions, especially at key control points during the integration phase that are not even under client's control***

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Acquisition Changes

- Long term partnership with dominant prime
- Less of technology control
- Less of contractor community control
- Fewer contract deliverables reviews and approvals (open loop implementation?)
- Dependency on TSPR incentives for influence in lieu of control
- Complex commitment process for integration with external systems
- Non-traditional acquisition, program, and technical management skills still required

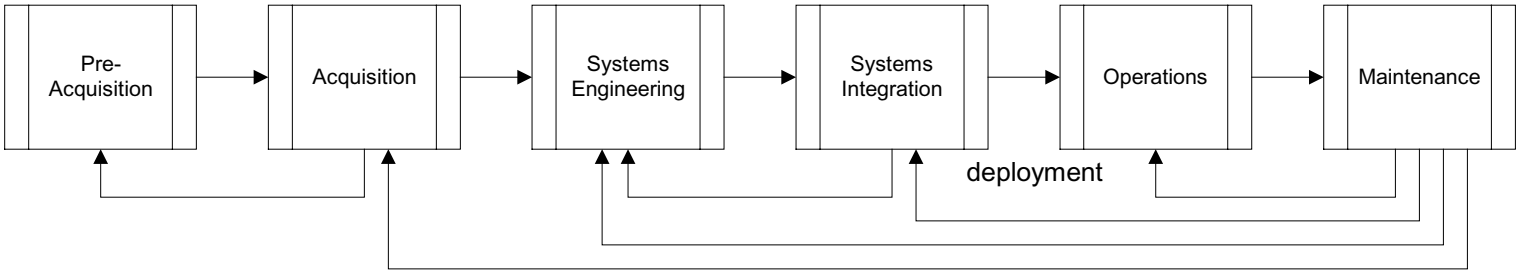
Backup Slides

Acronyms (reference)

- ASCON Associate Contractor
- CLIN Contract Line Item Number (item itself)
- CMM Capability Maturity Model
- CMMI Capability Maturity Model Integrated
- CMM-SW Capability Maturity Model for Software
- CONOPS Concept of Operations
- COTS Commercial Off-the-Shelf (product)
- FAA Federal Aviation Administration
- iCMM Integrated CMM from FAA (see CMMI)
- IEC International Electrotechnical Commission
- IPPD Integrated Product and Process Development
- IPT Integrated Product Teams
- ISO International Standards Organization
- IV&V Independent Verification and Validation
- O&M Operations and Maintenance
- ORD Operational Requirement Document
- OSSP Organizational Standard Software Process
- R&D Research and Development
- RFI Request for Information
- RFP Request for Proposal
- RFQ Request for Quote
- S&S Safety and Security
- (S)COTS Standard Commercial Off-the-Shelf (product)
- SA Software / System Acquisition
- SE System Engineering
- SI System Integration
- SOO Statement of Objectives
- SOC System Operating Capability
- SOR Statement of Requirements
- SOW Statement of Work
- SRD System Requirement Document
- SubK Subcontract
- SW Software
- TSIR Total System Integration Responsibility
- TSPR Total System Performance Responsibility

Systems Life Cycle Eye Test

Systems-Level
Program Managemnt



Unplanned iterations slow the pipeline

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Four Acquisition Models

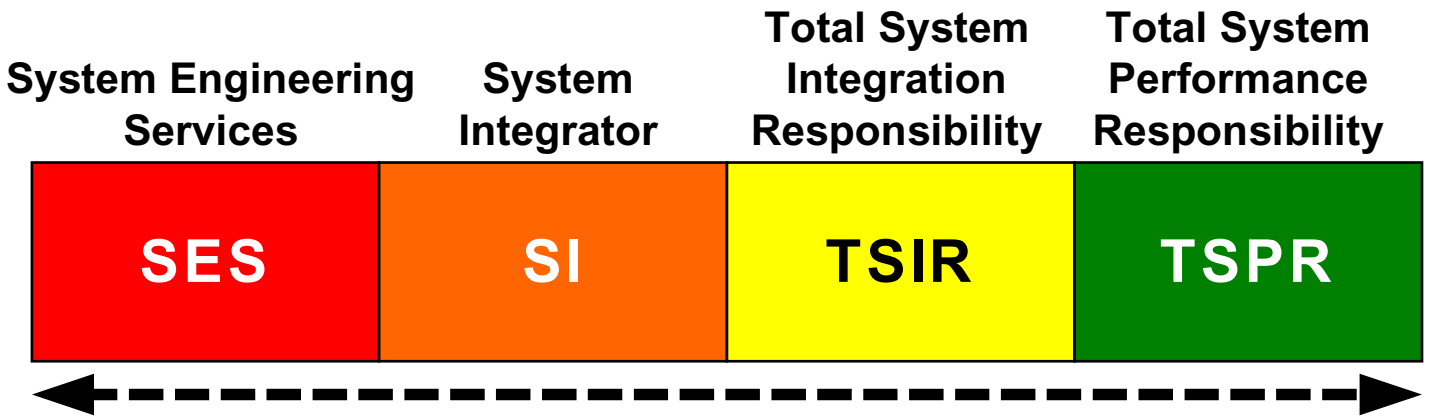
- The "Four Horsemen"
  - System Engineering (SE)
  - System Integration (SI)
  - Total System Integration Responsibility (TSIR)
  - Total System Performance Responsibility (TSPR)
- To transition *smoothly* from Systems Engineering to TSPR, use the other two

TSPR, TSIR, and SI Intent (Theory)

- Total System Performance Responsibility (TSPR)
  - A contract team is responsible for performance of end-to-end system capabilities, from the development of detailed requirements, through deployment and operations
- Total System Integration Responsibility (TSIR)
  - A contract team is responsible for delivery of an end-to-end system that has pieces already developed and available (constraining the approach) from Associate Contractors (ASCONS), (S)COTS vendors, or the Government, from the end of system test (beginning of system integration) through deployment
- System Integration (SI) including System Engineering (SE)
  - A contract team is responsible to prepare for system integration through deployment and to recommend to the government effective and efficient standards, plans, decisions, and actions to ensure successful system integration

Note: TSPR and TSIR introductory phrases are based heavily on TSPR presentation by Al Hoheb, Systems Planning and Engineering, The Aerospace Corporation, 20 March 1998.

Control Spectrum



At the left end, more control is retained by client.
At the right end, more control is allocated to the Prime Contractor.

In each case, the Prime develops the Architecture, maintains a comprehensive Integrated Master Plan, and manages IT Infrastructure, in response to the Problem Statements. The Client retains an appropriate level of SA, SE, and SI support from independent trusted agents.

TSPR Definition

- A ***systematic and tailored management*** strategy that is implemented by a contractor team which is responsible for the performance of end-to-end system capabilities.
- A ***strategic partnership*** between a government agency or major program and its exclusive (total) systems development prime contractor:
  - Exploiting the core competencies of each organization
  - Including System Acquisition (through subcontractors), System Engineering (including System Architecture), and System Integration (including final testing, exercises, deployment, operations, and maintenance)
  - Based on (1) operation concepts, general objectives, and top-level requirements ***including system performance*** and (2) allocation of ***authority*** and substantial ***control*** to the TSPR Prime Contractor for detailed requirements and implementation within ***broad*** schedule and cost constraints and ***detailed*** quality objectives

TSPR Roles

- Develops, uses, improves, and enforces the ***architecture,*** **as approved by client,** as the systems blueprint for all contractors, including relationship of requirements to (S)COTS products (with SCOTS-specific roles) and to approved technologies
- ***Delivers*** (S)COTS-based and mission-specific ***solutions*** in system life cycle from requirements allocation through O&M
- ***Develops and manages*** to the ***integrated master plan*** across the system life cycle from after research investment through retirement
- ***Manages*** system acquisition, engineering, and integration, including process improvement, through itself and subcontractors, including IT infrastructure provisioning and management, ***except*** for functions allocated to research, SCOTS-specific, (I)V&V S&S, and "trusted agent" (advisors) contracts ***which it monitors***
- ***Manages*** from top-level requirements and prioritization provided by client (ORD-level) and runs the requirements elicitation, requirements management, and prioritization processes (SRD-level) for individual systems projects

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TSPR Roles for Client

- Develops, uses, improves, and enforces the ***architecture,*** **as approved by Client,** as the systems blueprint for all contractors, including relationship of requirements to (S)COTS products (with SCOTS-specific roles)
- ***Delivers*** (S)COTS-based and mission-specific ***solutions*** in system life cycle from requirements allocation through O&M
- Develops and manages to the ***integrated master plan*** across the System life cycle from after research investment through retirement
- ***Manages*** system acquisition, engineering, and integration through itself and subcontractors, including IT infrastructure provisioning and management, ***except*** for functions allocated to research, SCOTS-specific, (I)V&V S&S, and "trusted agents" (advisory contractors)
- ***Manages*** from top-level requirements and prioritization provided by Client (ORD-level) and runs the requirements elicitation, requirements management, and prioritization processes (SRD-level) for individual systems projects

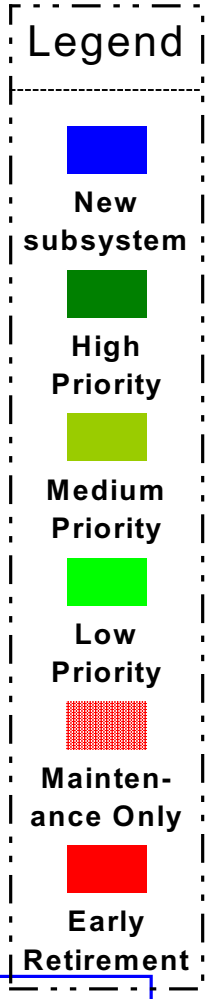
TSPR Transition

- TSPR cannot be introduced immediately with full TSPR responsibility and accountability because its risks with respect to the current system implementation and ongoing projects would be too great.
- In the simple model, TSPR shadows the SE contractor and takes over the responsibilities as a SES (System Engineering Support) Contractor.
- Then it transitions to take over SI responsibilities for incremental parts of the system, overlapping with some SES functions.
- Then it transitions to take over TSIR responsibilities for incremental parts of the system, overlapping with some SES and SI functions.
- Then it transitions to take over TSPR responsibilities for incremental parts of the system, overlapping with some SES, SI, and TSIR functions.

Architectural Transition

- A more realistic model for the TSPR transition takes advantage of prioritization within the System Architecture, as in the Architecture Migration Strategy, starting at the time the TSPR contract starts:
  - New parts that have to be delivered with or without (S)COTS components
  - High priority parts due to high priority requirements to be met or existing high risk conditions with impact on high priority parts
  - Medium priority parts due to priority and risk, including heritage systems that will continue in the Architecture
  - Low priority parts due to priority and risk, including legacy systems that will continue in the Architecture
  - Parts in maintenance or “unattended” mode that need little attention, based on failure and maintenance records; this includes (S)COTS products and infrastructure components
  - Parts (typically legacy or heritage) that are scheduled for rapid replacement and low-level maintenance (rapid retirement) that may never become the TSPR’s responsibility

Architectural Migration



- New, funded systems have highest priority, otherwise resources and funding would address enhancement or maintenance of other systems
- Enhancement of existing systems meets new and emerging customer requirements with new and improved technologies, (S)COTS products, and special development
- Maintenance of existing systems addresses repairs and achieving existing commitments for requirements implementation and deployment
- Near-retirement systems can be addressed through existing contractors without System Prime involvement
- IT Infrastructure Operations support configuration and operation of existing and improving System Infrastructure Elements for prototyping, testing, and operations

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