VAST Requirements

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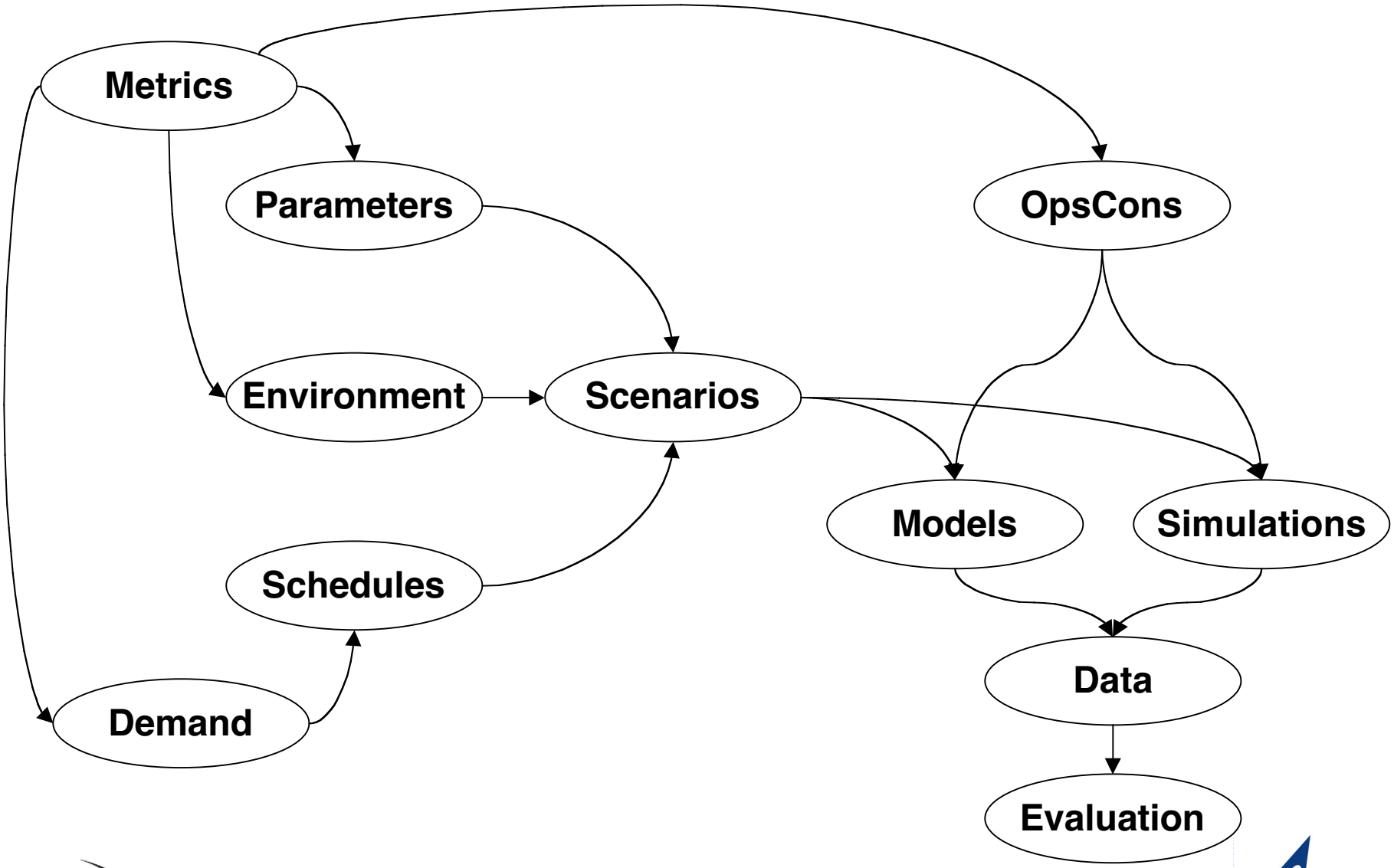
Outline

- Requirements Definition Process
- Requirements Approach
- Deliverables
- Challenges in VAST requirements
- Questions
- Overview of tomorrow's sessions

Requirements Definition Process

- **Establish Metrics (SEA)**
  - Parameters and required data sets
- **Define Scenarios (SEA)**
  - Common Scenario Set
- **Define Operational Concepts (SLIC)**
  - Concept functionality
- **Map Concepts to Concept Functional Model (SLIC)**
  - Concept integration and models
- **Define VAST architecture and functionality (VAST)**
  - Functionality resulting from scope of effort

Simplified Requirements Flow



Requirements Approach

- **Issues contrary to "perfect world" process**
  - Project Phasing
  - The "chicken or egg" syndrome
  - Many unknowns
  - Many approaches
  - Many undefined elements
- **Parallel Artifact Development**
  - Establishing metrics and scenarios
  - Defining and maturing concepts
  - Developing modeling and simulation systems
- **Consequences**
  - Many assumptions are made
  - Will never have everything as wanted when needed
  - Integration is minimal at first but improves with time

VAST Requirements Approach - 1

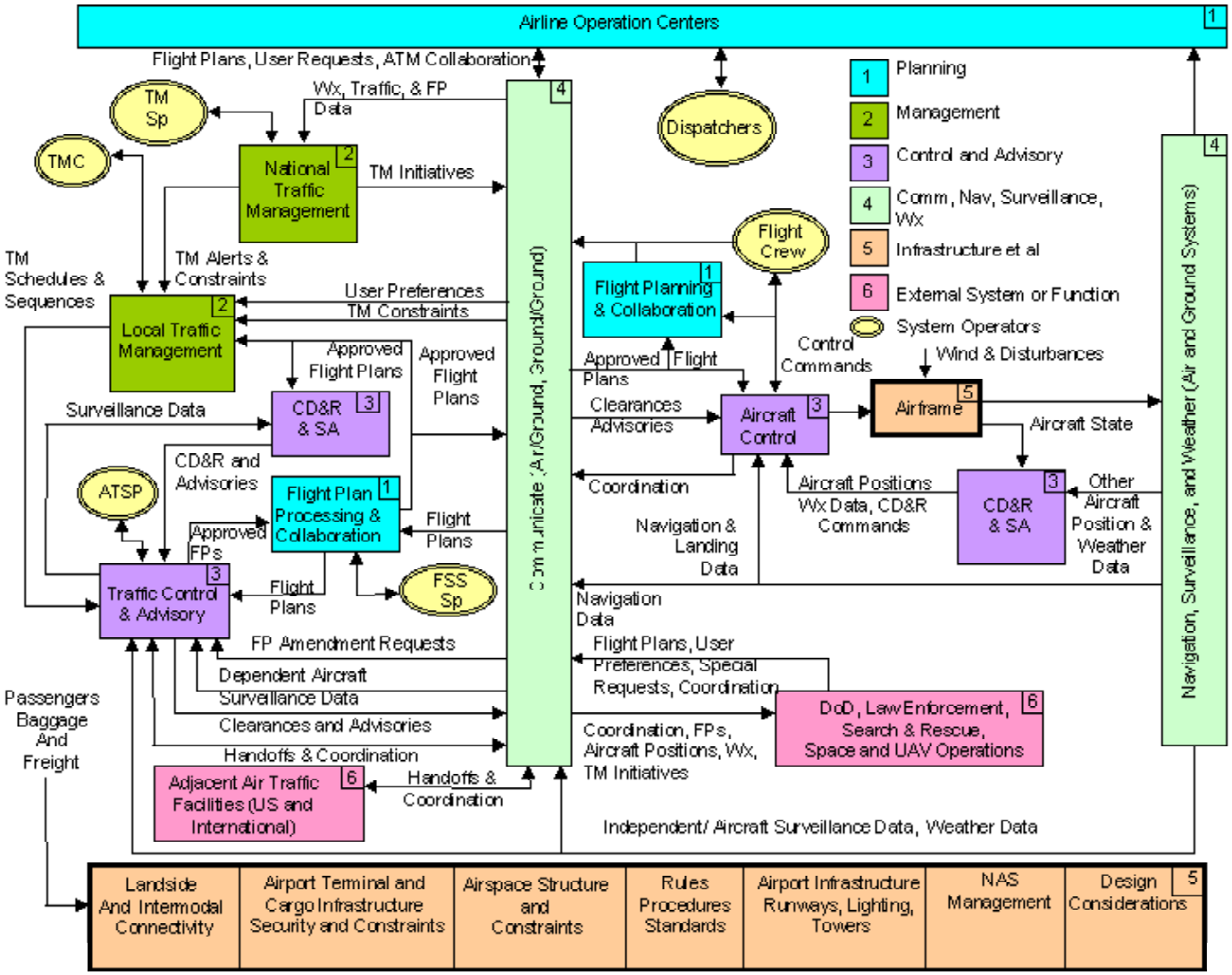
- **Establish initial requirements**
  - Scope Efforts (fast-time, real-time)
  - Survey other modeling and simulation systems
  - Understand deficiencies in current/past capabilities
- **Define what is needed**
  - Flexible, extendable, reconfigurable systems
  - Distributed environments
  - Stepped functionality improvements
- **Know what is missing**
  - Described future concepts
  - Full set of metrics
- **Early Decisions Made**
  - Use current NAS (2002) to define initial development
  - Create independent scenarios and validation plan

VAST Requirements Approach - 2

- **Next Steps (short-term)**
  - Begin integrating additional requirements from growing knowledge base
    - **Maturing VAMS Concepts**
    - **Refining Metrics and Scenarios**

- **VAMS Concepts help define future requirements**
  - Review current information on concepts to establish modeling requirements (VAST/SLIC)
  - Interview concept developers for guidance and feedback (VAST/SLIC)
  - Gather information through mechanisms like TIMs (VAMS)
  - Map concepts to Concept Functional Model (SLIC)
  - Extract VAST requirements from Concept Functional Model (VAST)
  - Prioritize VAST development efforts (VAMS)
  - Integrate prioritized requirements as required (VAST)

Concept Functional Model



Concept Mapping

	NRA GFI Model	VAMS Required Functionality (for planning purposes only)	Initial Requirements	Model Developer or Coder for ACES and/or RTHITL	VAST ICD/FOM required (Yes/No)	Real-Time Functionality	Non-Real-Time Functionality	Comment Number	Potential Simulation object type (model = called function, algorithm = logic tree, adaptation = a unique representation of the model)	CONCEPTS														Other					VAST					SCENARIOS								
										VAMS Blending Concept	Boeing	Metron - Weather	Seagull	AMES - Sridhar	Metron - Surface	Optimal Synthesis	Northrup-Grumman	Raytheon	Langley - Rutishauser	AMES - Erzberger	University	"x" count	DAG	FAA's OEP functionality	NAS Conops (RTCA 4.1)	Eurocontrol Conops	ICAO DRAFT Conops	Prototype	Build 1	Build 2	Build 3	Build 4	National Good Wx day 1	National Good Wx day 2	National Bad Wx day 1	National Bad Wx day 2	High Alt Facility Down	Terminal Facility down	Runway Down	Regional Comm Down	Security Contingency
	Nat Traffic Mgmt	"5400 Airport" System Model	Seagull										x									1																				
	7	Full Trajectory Conflict Avoidance									x		x	x							x	4																				
		High/Low Density Regions									x										x	2																				
		On-Demand Operations	Seagull										x									1																				
		Sector and Sectorless Operations										x	x	x						x	x	5																				
		Sequential Trajectory Planning	Ames											x								1																				
		Weather Avoidance Algorithms										x	x	x								3																				
	Local Traff Mgmt	4D Terminal Path Alg - groundbased											x				x	x		x	x	5																				
	20	ATSP/Weather Displays	Metron									x										1																				
		Blunder Reconginition Time	Metron												x							1																				
		Curvilinear final flight paths	Raytheon															x				1																				
		New Decision Support Tools										x	x			x	x			x		5																				
		Surface Automation										x			x			x				3																				
		Surface Automation via Controllers	Metron												x							1																				
		Surface Automation via FMS													x	x						2																				
		Surface Automation via lights	Metron												x							1																				
		Surface Automation via Pilots													x	x						2																				
		Surface Automation via timed routes	OS													x						1																				
		Surface Deceleration Control Algorithm	OS													x						1																				
		TCAS										x								x		2																				
		Terminal FP Alg. Monitored by Specialist	NG														x					1																				
		Tower Monitors/Surface Displays													x	x						2																				
		TSAFE	Ames																	x		1																				
		Wake Vortex Avoidance Alg.	Langley																x			1																				
		Weather Avoidance Algorithms										x	x									2																				
		Wind Optimal Routing										x		x								2																				
		Workload - Controller														x	x			x		3																				
	CD&R & SA	Full Trajectory Conflict Avoidance									x		x	x			x	x		x	x	7																				
	2	Surface CD&R & Separation Assurance	OS													x						1																				
	Flight Plan/Collab	Collaborative Flight Planning											x			x		x		x	x	5																				
	2	Collaborative Arrival/Departure	NG														x					1																				
	Traff Cont & Adv	Conflict Avoidance Advisories															x			x		2																				
	3	Override to FlightPath by ATC	NG														x					1																				
		Separation Assurance Advisories															x			x		2																				
	Adj Air Traff Fac																					0																				
	0																																									
	CNS/Weather	ADS-B										x	x		x	x		x		x	x	7																				
	15	ASDE-X													x	x		x				3																				
		Datalink										x	x				x	x		x	x	6																				
		GPS										x			x			x		x		4																				
		ILS	Metron									x				x						2																				
		Increased VHF Safety	Univ																		x	1																				
		Integrated Terminal Area Network																x				1																				
		LAAS										x	x			x		x				4																				
		Mode-S										x								x		3																				
		Multi-sensor Surface Surveillance fusion													x			x				2																				
		NASWIS	Seagull										x									1																				
		NEXCOM Digital Radio	Metron									x										1																				
		Position/Velocity Uncertainty										x	x		x							3																				
		Redundant Ground Nav System	Seagull										x									1																				
		Stochastic Weather	Ames											x								1																				

VAST Requirements Approach - 3

- **Metrics & Scenarios help define future requirements**
  - Review concept developers' scenarios and metrics (SLIC/SEA/VAST)
  - Extract information from metrics list and description of common scenario set and evaluation criteria (VAST/SEA)
  - Review real-time system validation experiment requirements (VAST/SEA)

ACES Deliverables

- **Build 1**
  - Capabilities: Overall emphasis on architecture and run-time capability, establishing core architectural foundation and initial set of models for toolkit. Integrate and develop basic simulation control, data collection and visualization. Target ability to assess economic impact of new technology and NAS operational performance, and the ability to model the dynamic effects of interactive agents.
  - Delivery Date: December 2002
  - Requirements Defined by: May 2002 (completed)
  - Concept modeled: Current NAS (2002)
  - Scenario: Simulate a good-weather day-in-the-NAS. NAS-wide, gate-to-gate simulation. Emphasize TFM interactions (ATCSCC/ATSPs/AOCs). En route ATC. Simple terminal/airport ATC models. Mixed fidelity AC.
  - Metrics: Flight time delay. Departure delay. Fuel costs. Controller workload measures (# of vectors given, speed changes...).

ACES Deliverables

- **Build 2**
  - Capabilities: Emphasis on performance and expanded modeling. Enhance the core architectural foundation. Expand set of models for model toolkit (fidelity for current NAS models/VAMS new concepts?). Enhance simulation control, data collection and visualization. Target ability to model and assess uncertainty within the system and within models, to model infrastructure and transitory constraints and assess their impact on the system.
  - Delivery Date: December 2003
  - Requirements Defined by: September 2002
  - Concept modeled: Defined when requirements are available
  - Scenario: Defined when requirements are available
  - Metrics: Defined when requirements are available

ACES Deliverables

- **Build 3**
  - Capabilities: Emphasis on usability and expanded modeling. Expand on set of models for model toolkit (fidelity for current NAS models/VAMS new concepts, cognitive human performance, CNS). Enhance simulation control, data collection and visualization. Target expanding models to higher resolution levels.
  - Delivery Date: August 2004
  - Requirements Defined by: September 2003
  - Concept modeled: Defined when requirements are available
  - Scenario: Defined when requirements are available
  - Metrics: Defined when requirements are available

ACES Deliverables

- **Build 4**
  - Capabilities: Target ability to support trade studies of VAMS operational concepts.
  - Delivery Date: September 2005
  - Requirements Defined by: June 2004
  - Concept modeled: VAMS operational concepts
  - Scenario: Common Scenario Set
  - Metrics: VAMS defined metrics

Real-Time Deliverables

- **Preliminary Design**
  - Capabilities: Define initial requirements, preliminary design and development plan. Define major elements of the simulation environment. Describe preliminary interface specifications. Define initial gaps in current real-time simulation capabilities.
  - Delivery Date: September 2002
  - Requirements Defined by: June 2002 (completed)
  - Concept modeled: NA
  - Scenario: NA
  - Metrics: NA

Real-Time Deliverables

- **Complete Design**
  - Capabilities: Refine and complete requirements from the preliminary design. Prioritize requirements to meet the needs of the baseline validation experiment. Initialize development of system through prototyping.
  - Delivery Date: June 2003
  - Requirements Defined by: December 2002
  - Concept modeled: Current NAS (2002)
  - Scenario: Pilots and controllers fly and control aircraft in the terminal area with some self-spacing tasks using CDTI and self-spacing algorithms. Crews will land the aircraft and both flight deck and ATC will use surface management tools.
  - Metrics: Defined when needs are stated

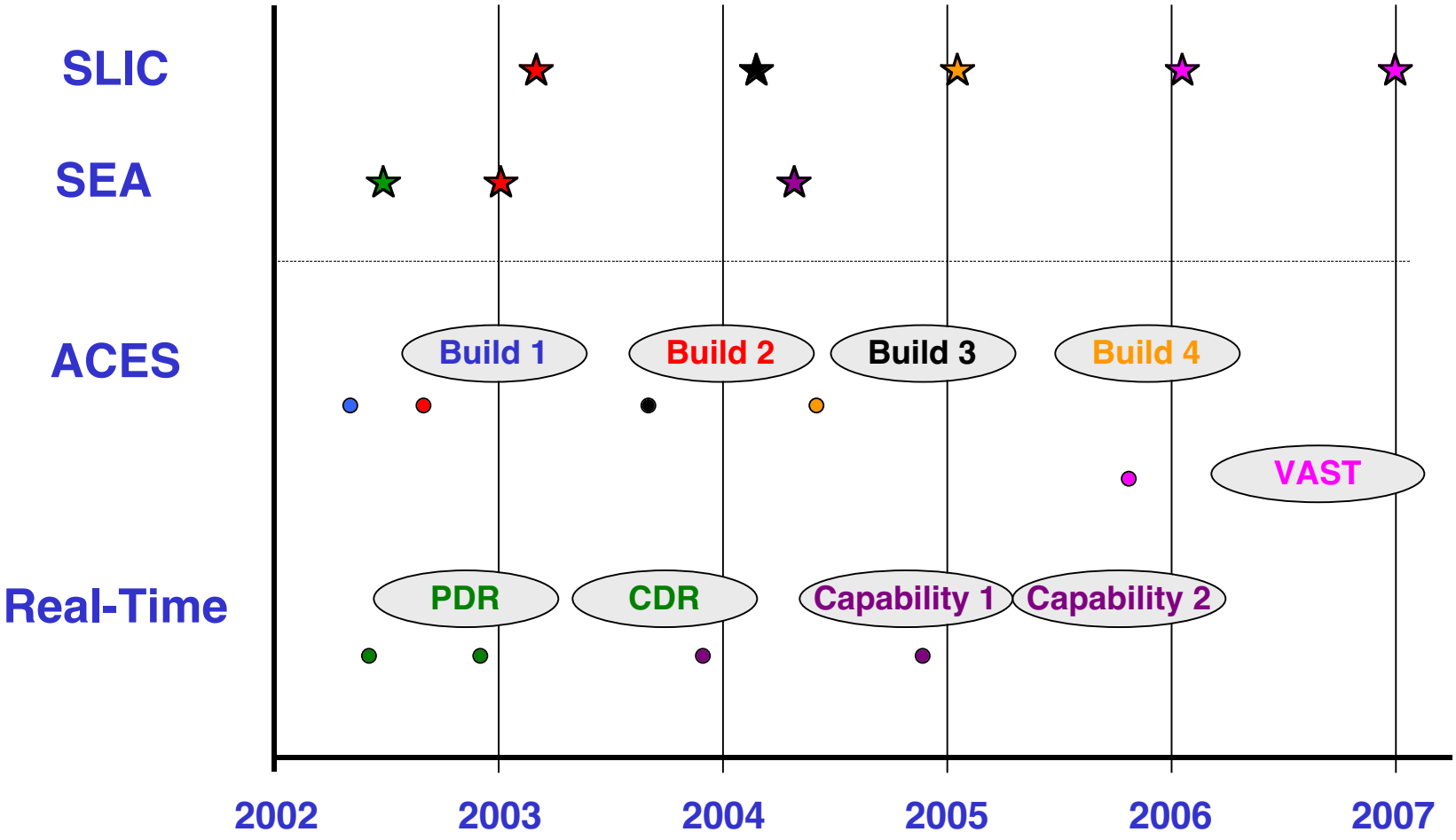
Real-Time Deliverables

- **Capability 1**
  - Capabilities: Overall emphasis on developing architecture and integrating initial real-time models, simulator labs and facilities into the run-time capability. Execute a defined human-in-the-loop experiment for system design validation.
  - Delivery Date: September 2004
  - Requirements Defined by: December 2003
  - Concept modeled: Current NAS (2002)
  - Scenario: Pilots and controllers fly and control aircraft in the terminal area with some self-spacing tasks using CDTI and self-spacing algorithms. Crews will land the aircraft and both flight deck and ATC will use surface management tools.
  - Metrics: Defined when needs are stated

Real-Time Deliverables

- **Capability 2**
  - Capabilities: Enhance architecture and expand network capability to support multi-facility experiments. Expand set of real-time models. Expand facility interfaces. Execute a defined human-in-the-loop experiment for system design validation.
  - Delivery Date: June 2005
  - Requirements Defined by: September 2004
  - Concept modeled: Defined when requirements are available
  - Scenario: Defined when requirements are available
  - Metrics: Defined when requirements are available

VAMS Deliverables



Challenges in VAST Requirements

- Synchronizing VAST requirements needs with VAST development timeline.
- Ensuring appropriate VAST capabilities are available to concept developers and evaluators when needed.
- Providing and integrating all models necessary for the evaluation of all concepts.
- Leveraging modeling and simulation capabilities from other efforts (When to develop ourselves? When to acquire?).
- Selecting appropriate time scale (fast-time or real-time) for acquiring given metrics.
- Understanding the use of real-time simulation as part of the concept design phase.

Questions - 1

- **Questions for VAST to answer**
  - What capabilities will VAST have?
  - When will these capabilities be available?
  - How will the necessary models be developed and integrated?
  - What development support will be available?
  - What operational support will be provided?
  - When would fast-time or real-time simulation be applied?
  - Will some models and capabilities be reusable in both fast-time and real-time domains?

Questions - 2

- **Questions for SLIC to answer**
  - Who defines the elements of the concept functional model not addressed by domain specific concepts?
  - Will concept developers be able to specify, develop and validate concept specific models for integration into VAST?
  - Will concept developers/evaluators have resources to learn and use VAST capabilities?
  - Will interim information be available from concept developers between specific contract deliverables?

Questions - 3

- **Questions for SEA to answer**
  - Will concept evaluators have resources to learn and use VAST capabilities?
  - Will concept specific scenarios and metrics beyond the common scenario set and metrics be considered for evaluation?
  - Will these additional items be applied to all other concepts?

Overview of Task Sessions

- **ACES**
  - Overview envisioned non-real-time capabilities
    - Modeling details, data flow, validation plan
- **Real-Time**
  - Overview of preliminary design
- **Human/Team Performance Modeling**
  - Envisioned cognitive modeling
- **CNS Modeling**
  - Envisioned CNS modeling