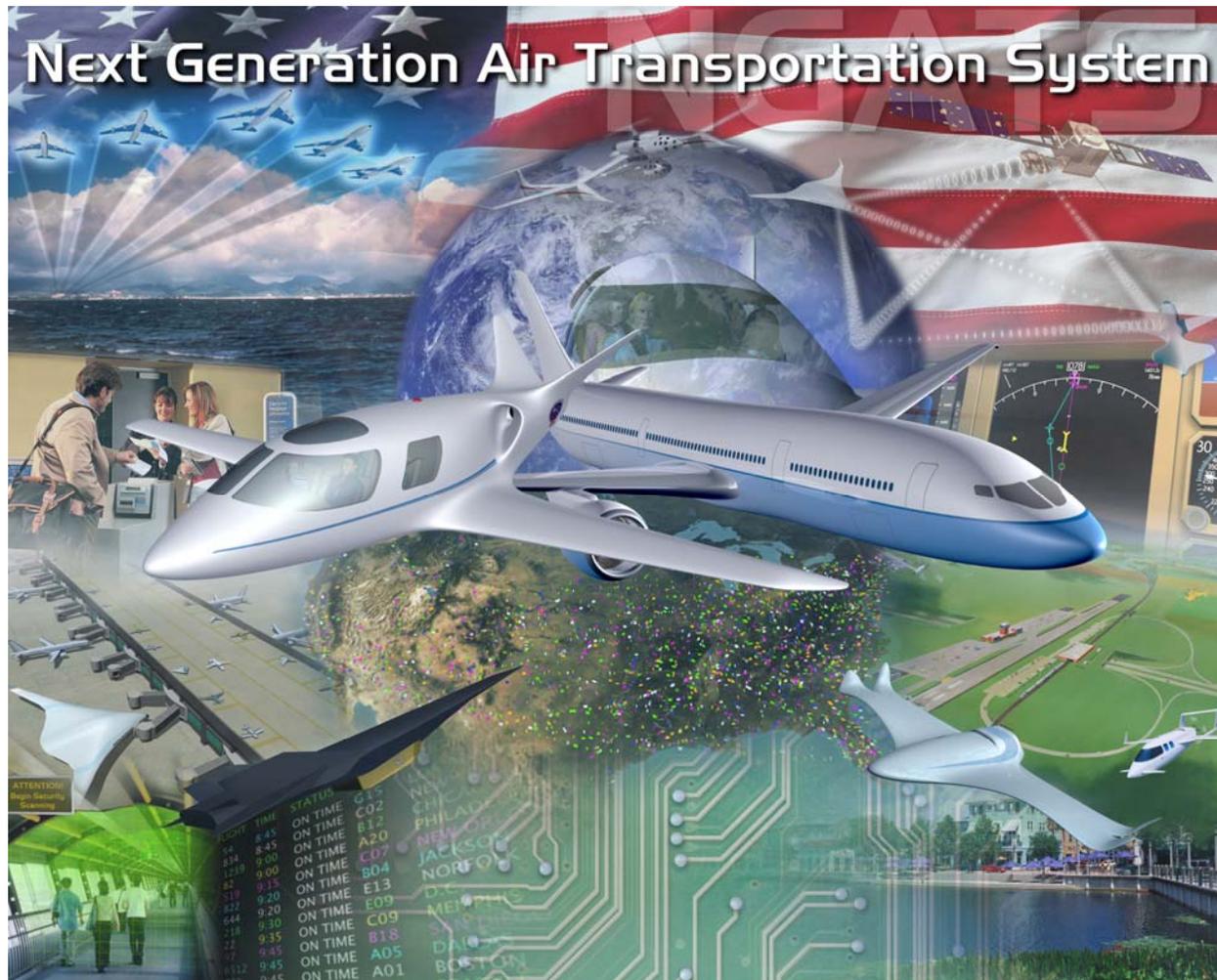


NGATS Dynamic Architecture



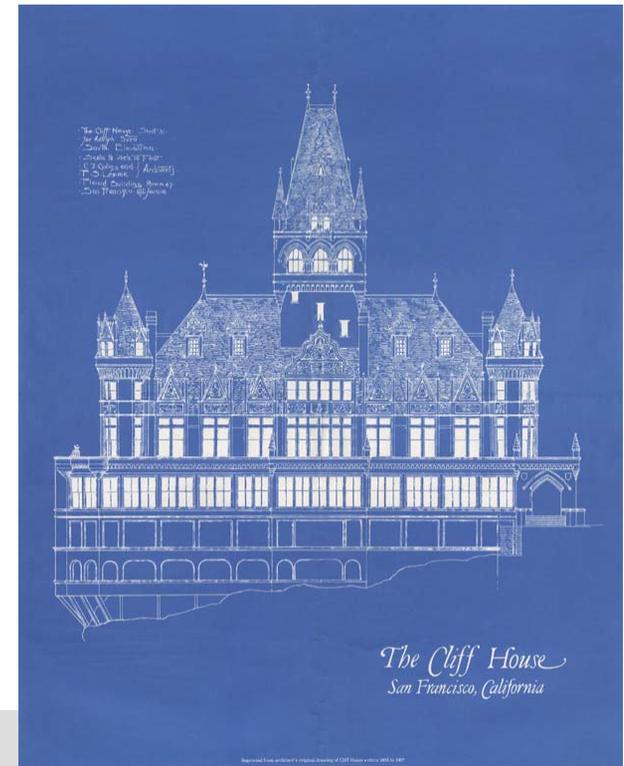
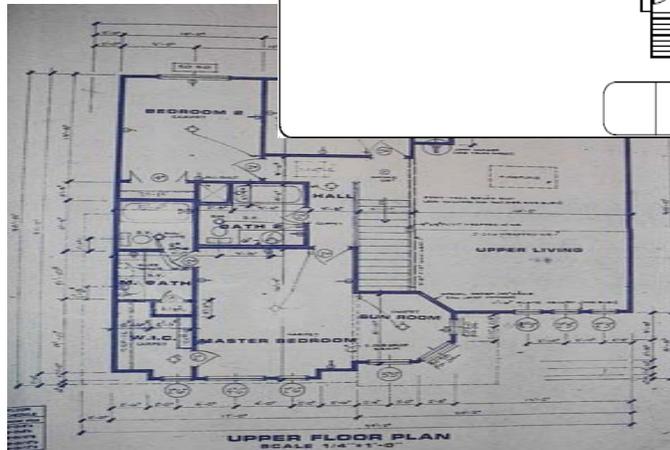
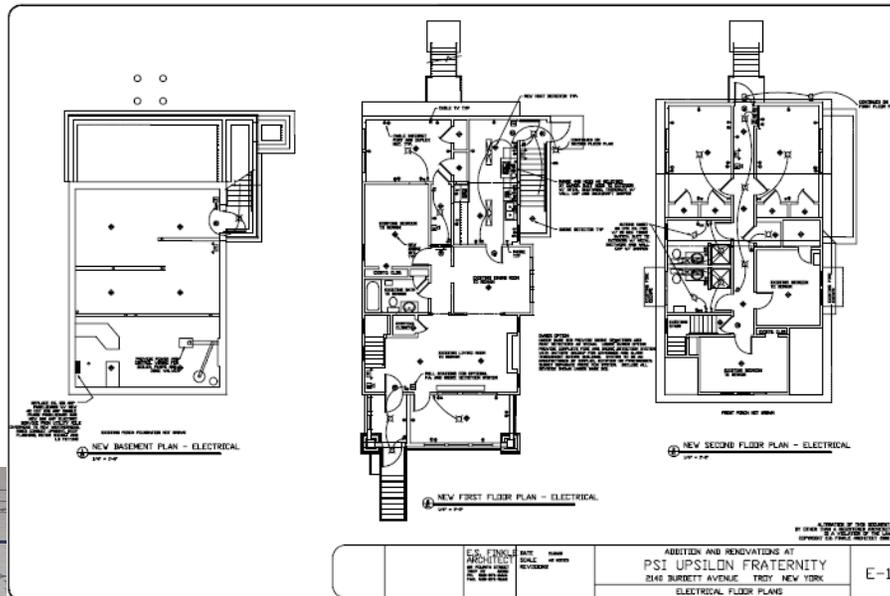
Kenneth Arkind
Raytheon Company
Marlborough, MA
508 490 3787

Dynamic Architecture

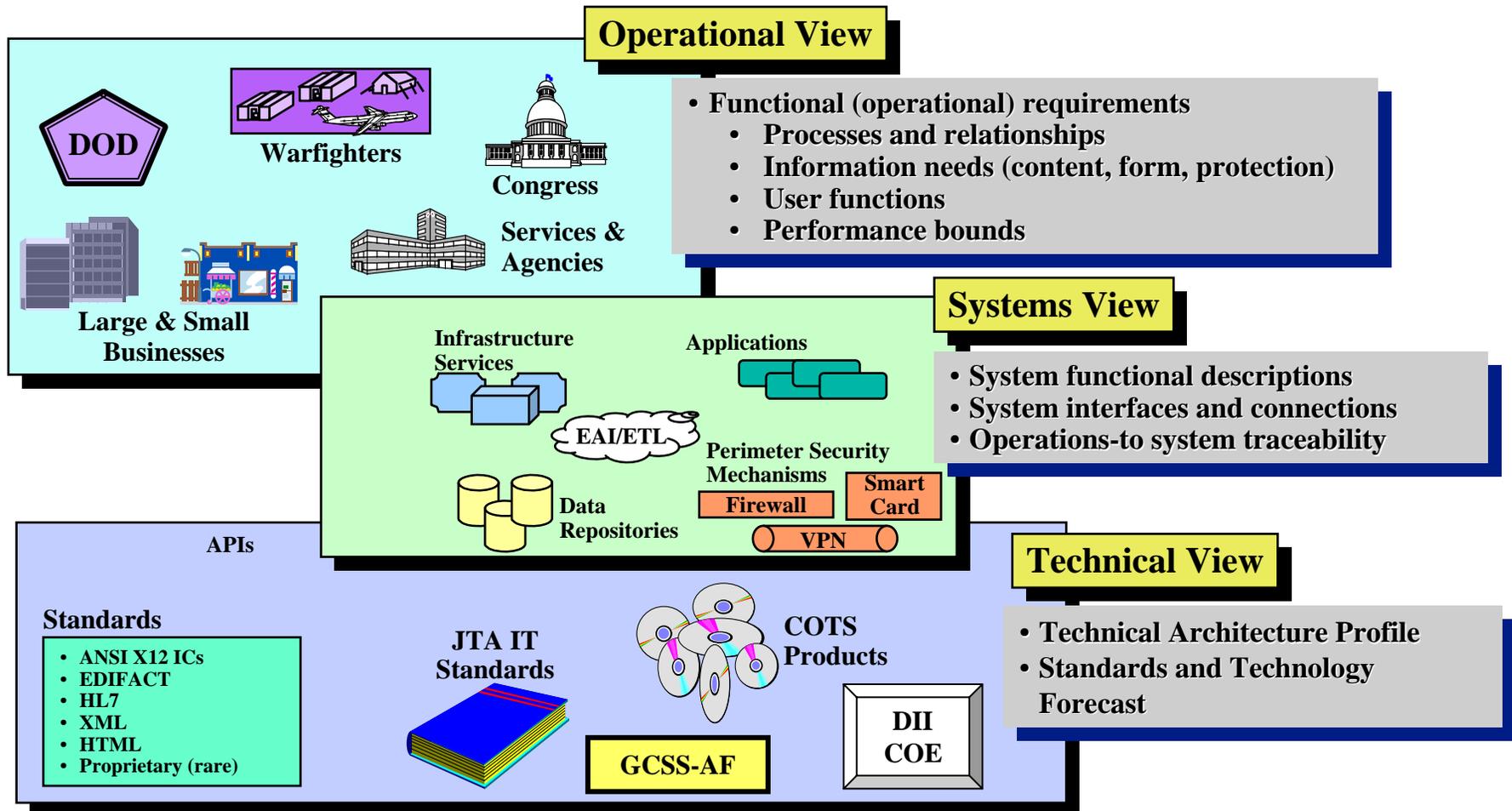
- **Architectures expressed in a well-defined framework are a cornerstone to understanding what models are necessary for enterprise-scale evaluations.**
- **The evaluation of alternative architectures can be organized around a set of models by imposing a series of interactions between models dictated by the architecture and organized into a framework defined by the architecture.**
- **A formal underpinning for describing the architecture (Operational Views from DoDAF) can result in a set of activities that can be modeled as behavioral agents, integrated by a standardized “backbone”, such as CybelPro® to evaluate the performance of the enterprise.**
- **Standardizing the architecture representation, the integration backbone, and the modeling interfaces will allow a “plug and play” capability that can allow contributions from many sources.**

Architecture Provides Blue Prints, or “Views” to Communicate with the Builder.....

- Floor Plans, Elevations, wiring diagrams, plumbing, plans, etc



Enterprise Architecture also provides "Views"



Per the DoD Architecture Framework

Utilizing DoDAF Products



  Department of Defense Architecture Framework Version 1.0 <i>Volume II Table 2-1. List of Products</i>			
Applicable View	Framework Product	Framework Product Name	General Description
All Views	AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings
All Views	AV-2	Integrated Dictionary	Architecture data repository with definitions of all terms used in all products
Operational	OV-1	High-Level Operational Concept Graphic	High-level graphical/textual description of operational concept
Operational	OV-2	Operational Node Connectivity Description	Operational nodes, connectivity and information exchange needlines between nodes
Operational	OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relevant attributes of that exchange
Operational	OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations
Operational	OV-5	Operational Activity Model	Capabilities, Operational Activities, relationships among activities, inputs and outputs. Overlays can show cost, performing nodes, or other pertinent information
Operational	OV-6a	Operational Rules Model	One of the three products used to describe operational activity—identifies business rules that constrain operation
Operational	OV-6b	Operational State Transition Description	One of three products used to describe operational activity—identifies business process responses to events
Operational	OV-6c	Operational Event-Trace Description	One of three products used to describe operational activity—traces actions in a scenario or sequence of events
Operational	OV-7	Logical Data Model	Documentation of the system data requirements and structural business process rules of the Operational View
Systems	SV-1	Systems Interface Description	Identification of systems nodes, systems, and system items and their interconnections, within and between nodes
Systems	SV-2	Systems Communications Description	Systems nodes, systems, and system items, and their related communications lay-downs
Systems	SV-3	Systems-Systems Matrix	Relationships among systems in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc.
Systems	SV-4	Systems Functionality Description	Functions performed by systems and the system data flows among system functions
Systems	SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to capabilities or of system functions back to operational activities
Systems	SV-6	Systems Data Exchange Matrix	Provides details of system data elements being exchanged between systems and the attributes of that exchange
Systems	SV-7	Systems Performance Parameters Matrix	Performance characteristics of Systems View elements, for the appropriate timeframe(s)
Systems	SV-8	Systems Evolution Description	Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation
Systems	SV-9	Systems Technology Forecast	Emerging technologies and software/hardware products that are expected to be available in a given set of time frames, and that will affect future development of the architecture
Systems	SV-10a	Systems Rules Model	One of three products used to describe systems functionality—identifies constraints that are imposed on systems functionality due to some aspect of systems design or implementation
Systems	SV-10b	Systems State Transition Description	One of three products used to describe systems functionality—identifies responses of a system to events
Systems	SV-10c	Systems Event-Trace Description	One of three products used to describe systems functionality—identifies system-specific refinements of critical sequences of events described in the Operational View
Systems	SV-11	Physical Schema	Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schemas
Technical	TV-1	Technical Standards Profile	Listing of standards that apply to Systems View elements in a given architecture
Technical	TV-2	Technical Standards Forecast	Description of emerging standards and potential impact on current Systems View elements, within a set of time frames

To...

- Create
- Communicate
- & Validate

...the architecture

• All Views

• Operational View
Usage/Users

• Systems Views
Capabilities/Interfaces

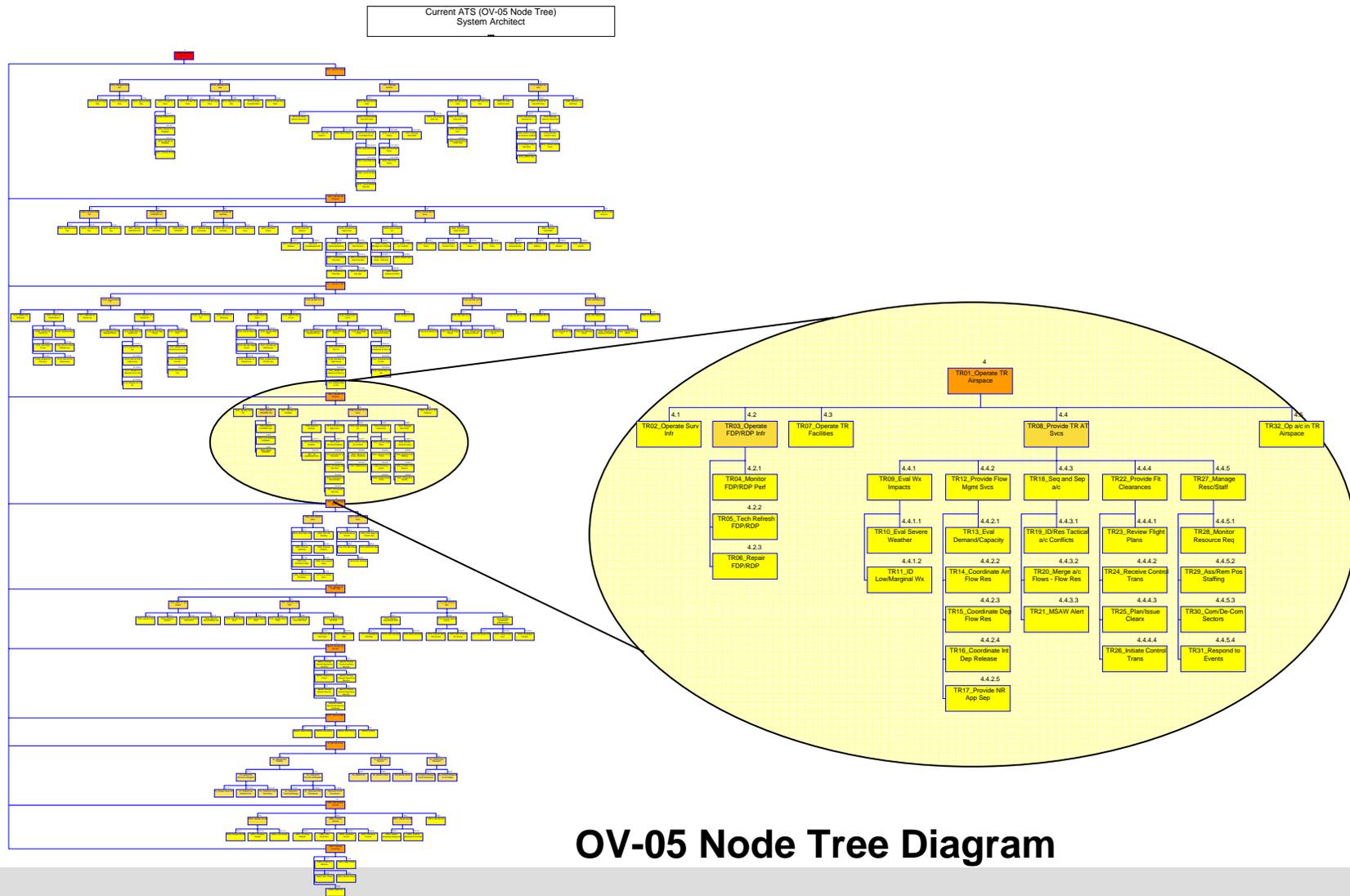
• Technical Views
Codes/Specs

Today's Air Transportation System Top Level Operational Activities



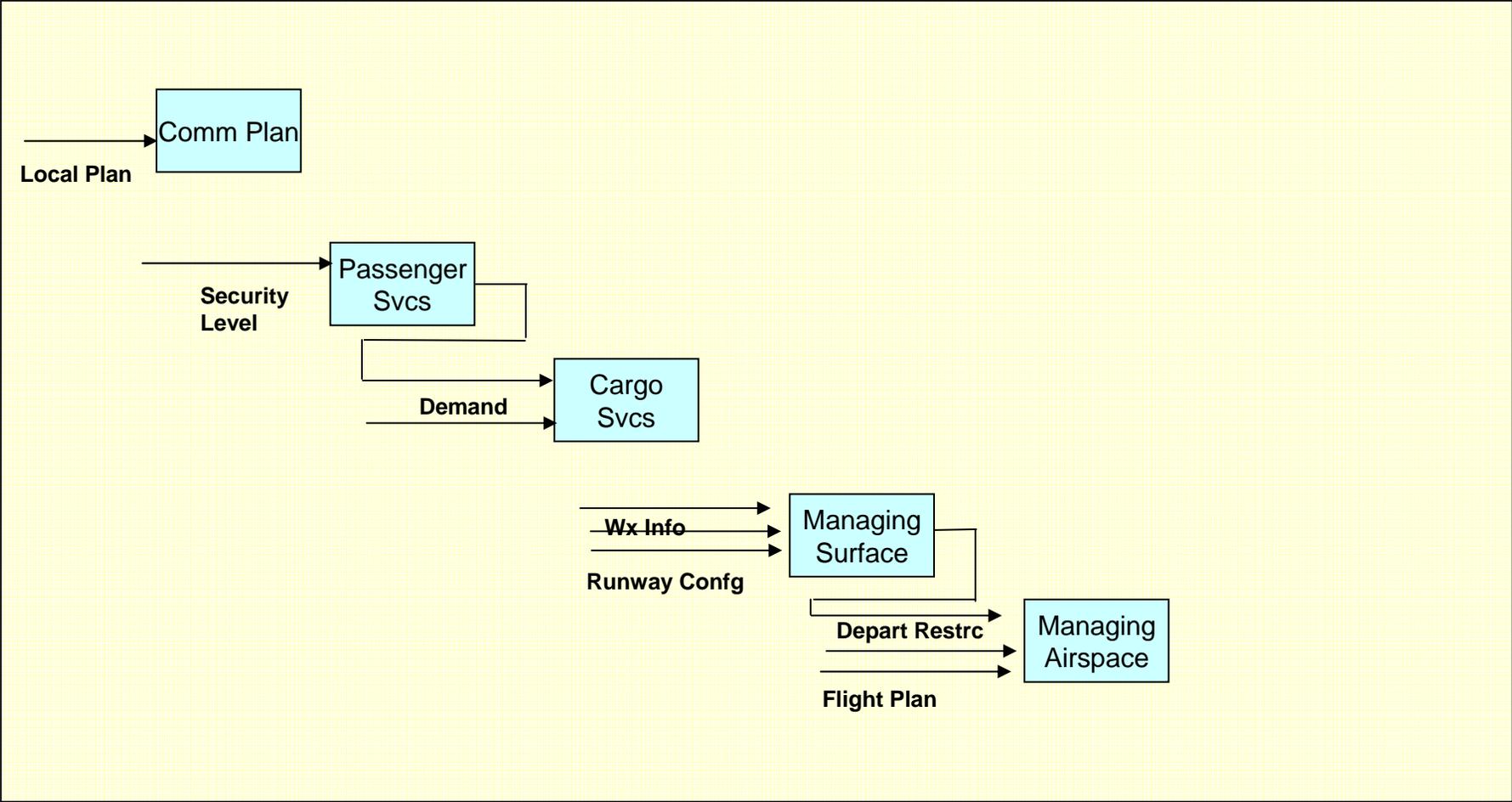
ATS.0..Air_Transportation_System_Operations	Air Transportation System Operations	All activities, tasks, and services performed in ATS.
AP.1..Operate_Airpt	Operate Airport	This activity includes activities to enable passenger, flight and cargo operations to be conducted within an airport with consideration of safety, efficiency, resource limitations and local environmental issues.
AA.2..Allocate_Airsp	Allocate Airspace	This activity includes all efforts associated with designing airspace, providing strategic airspace management, providing surface and airborne sequencing for aircraft, providing air traffic separation services, and managing the operational infrastructure.
FL.3..Operate_Flights	Operate Flights	This activity includes all activities associated with the planning, coordination, dispatch and operation of air carrier, business aviation, general aviation and military flights.
SAF.4..Enforce_Safety_Comp	Enforce Safety Compliance	This activity involves the establishment of safety policy, setting of policy and oversight of the conduct of analyses, education, outreach, Quality Assurance programs, and conduct of Certification.
AR.5..Establish_Av_Regs/Standards	Establish Aviation Regulation and Standards	This activity identifies all the local, state, federal and international regulations and standards used to govern the Air Transportation System. The regulations and standards address aviation, homeland security, trade and environment issues.
SEC.6..Provide_Opl_Sec	Provide Opl Security	This activity involves the planning and handling of ATS crises that are not limited to an airport.
FS.7..Provide_Flt_Svcs	Provide Flight Services	These services are support services to the general aviation and business aviation communities to provide flight briefing information prior to, during and after flights.
AM.8..Manufacture_A/C	Manufacture Aircraft	This activity includes all efforts associated with developing, producing, marketing, and selling aircraft.

OV-5 Hierarchy - ATS Activities



OV-05 Node Tree Diagram

Information Used by each Operational Activity



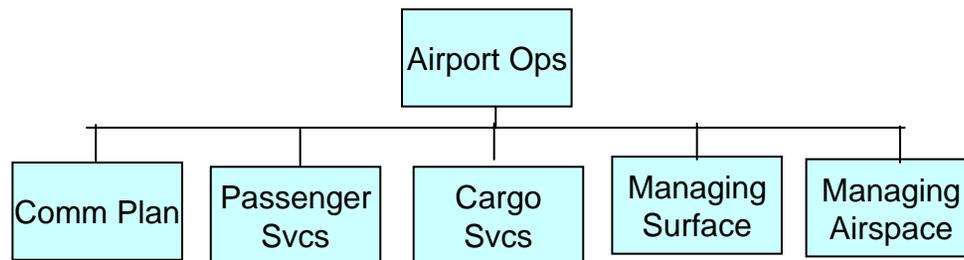
Information Exchange – OV-3

- **Elaborates on the needlines by expanding each needline into one or many information exchanges.**

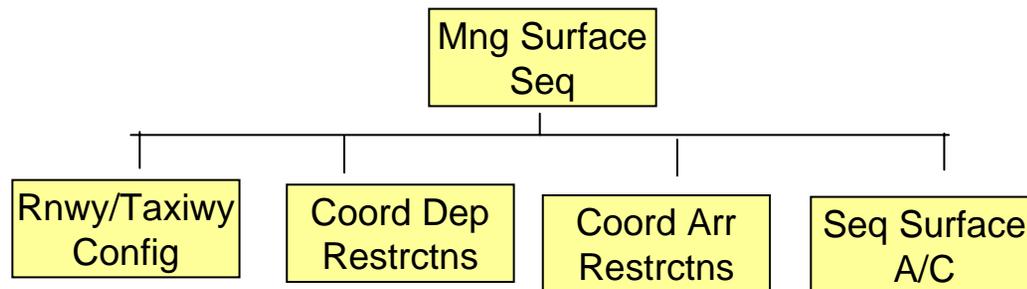
<i>Need Line</i>	<i>IER</i>	<i>Description</i>	<i>From Activity</i>	<i>From Node</i>	<i>To Activity</i>	<i>To Node</i>	<i>Transaction Type</i>	<i>Triggering Event</i>	<i>Communication Medium</i>	<i>Criticality/Priority</i>	<i>Frequency</i>
Tower.Air Carrier	Clearx to Pilot	The Clearance to Pilot object represents any of the types of clearances given by air traffic controllers to the flight crew including initial flight route clearance, take-off clearance, landing clearance, taxi clearance and other clearances.	AA.2-3-1-1..Seq_Arrs/Deps	Tower	FL.3-4-1-4..Landing	Air Carrier	Verbal ATC Instruction	Ready to Taxi, Ready to Take-Off, Exiting Runway	Aircraft-Ground Radio Transmission	Critical	approx. 8 events per flight
			AA.2-3-1-1..Seq_Arrs/Deps	Tower	FL.3-4-1-6..Docking	Air Carrier					
			AA.2-3-1-1..Seq_Arrs/Deps	Tower	FL.3-4-1-5..Taxi_In	Air Carrier					
			AA.2-3-1-1..Seq_Arrs/Deps	Tower	FL.3-4-3-2..Dtrmn_Desired_Course	Air Carrier					
			AA.2-3-1-1..Seq_Arrs/Deps	Tower	FL.3-4-2-5..Approach	Air Carrier					
			AA.2-3-1-1..Seq_Arrs/Deps	Tower	FL.3-4-4-4..Comms_W/_Cntrlr	Air Carrier					
TRACON.ARTCC	Airport Demand	The Airport Demand object represents the flight demand for arrivals and departures at NAS airports.	AA.2-3-2-2-1..Eval_Dmnd/Capacs	TRACON	AA.2-3-2-2-5..Coord_Arr_Flow_Rstrs	ARTCC	Verbal ATC Coordination	Upcoming Arrival or Departure Push, Change in Arrival or Departure Demand	Land Line Communication	Essential	per Push Period
	Arr Flow Res	The Arrival Flow Restriction object represents a maximum airport flow rate and/or arrival miles-in-trail restrictions imposed to regulate the flow of arrival aircraft into the TRACON airspace and airport area.	AA.2-3-2-2-5..Coord_Arr_Flow_Rstrs	TRACON	AA.2-3-1-2..Merge_A/C_Flows	ARTCC	Verbal ATC Coordination	Upcoming Arrival Push, Change in Arrival Demand	Land Line Communication	Essential	per Push Period

Analysis "scale"

- Activity hierarchy provides opportunity for tailoring analysis

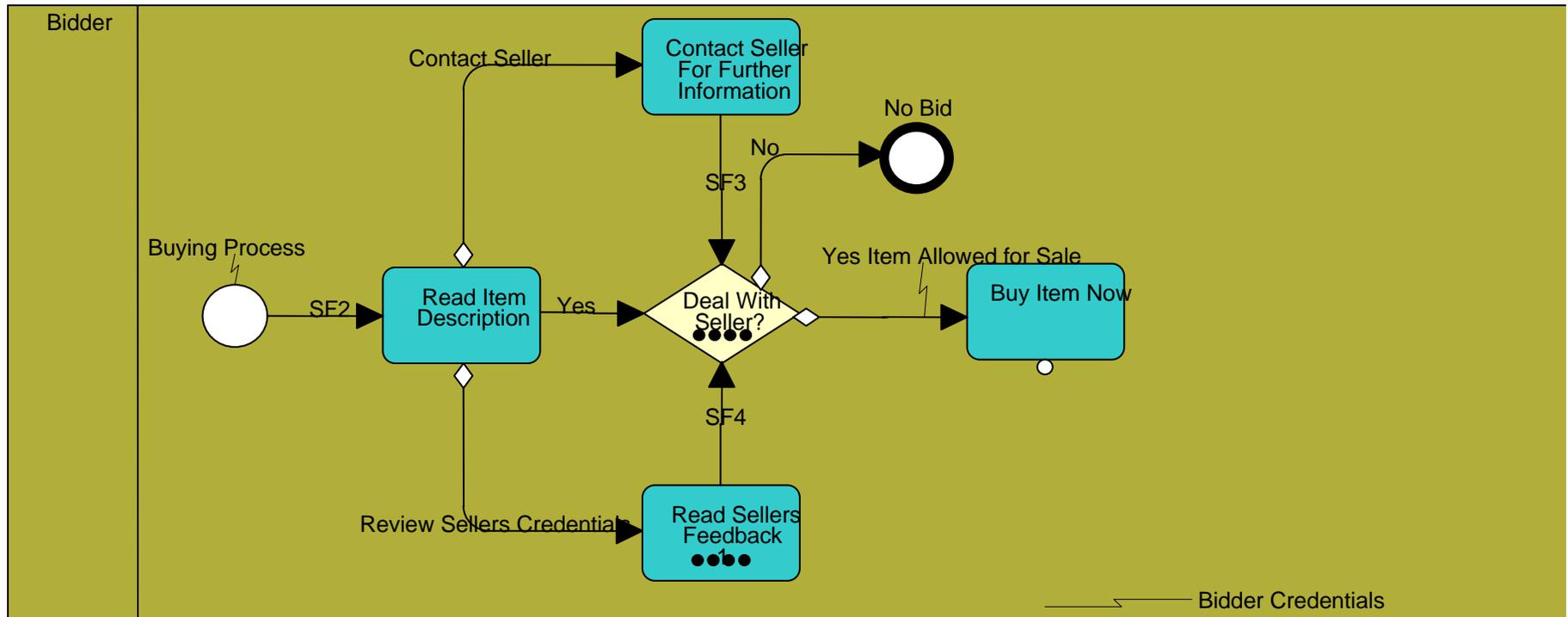


- NAS Wide impact of Airport Ops
- ARR/DPR impact of NAS Wide change



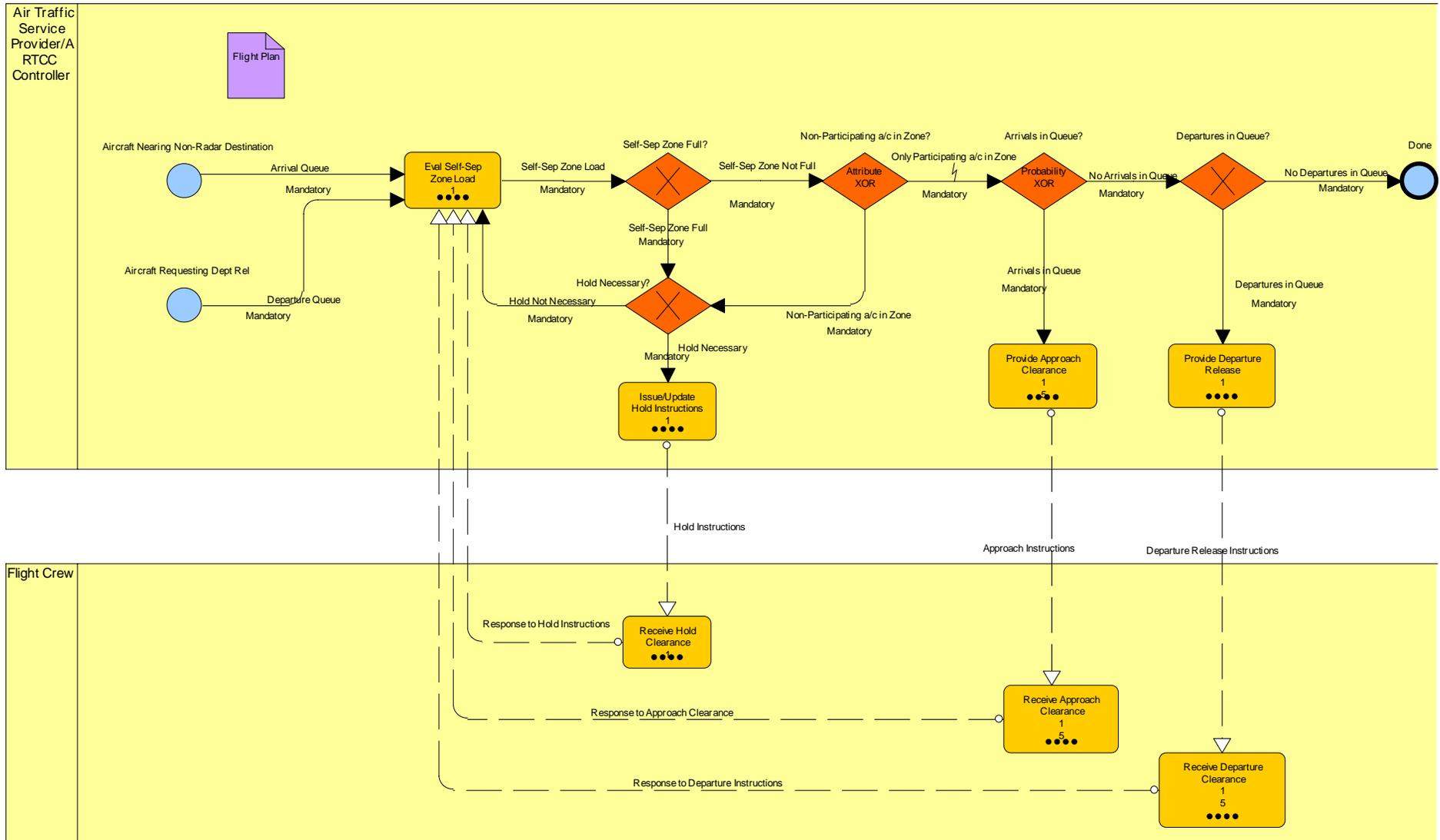
- Evaluate taxi time for alternate runways
- Impact of APREQs on surface movement

High Fidelity - Business Process Modeling (BPM)

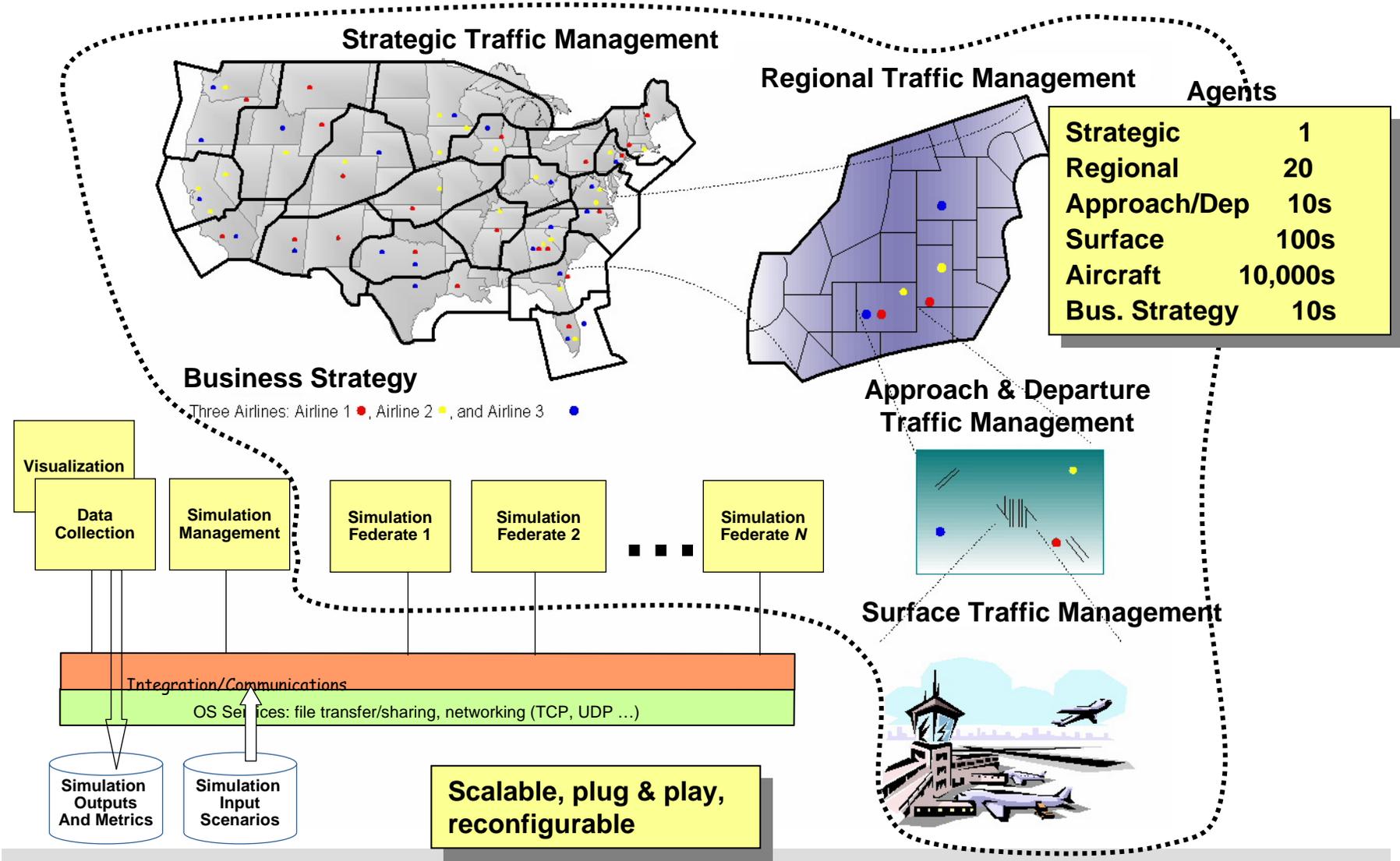


- Detailed analysis of step by step process
- Trade-off analysis of system/subsystem alternatives

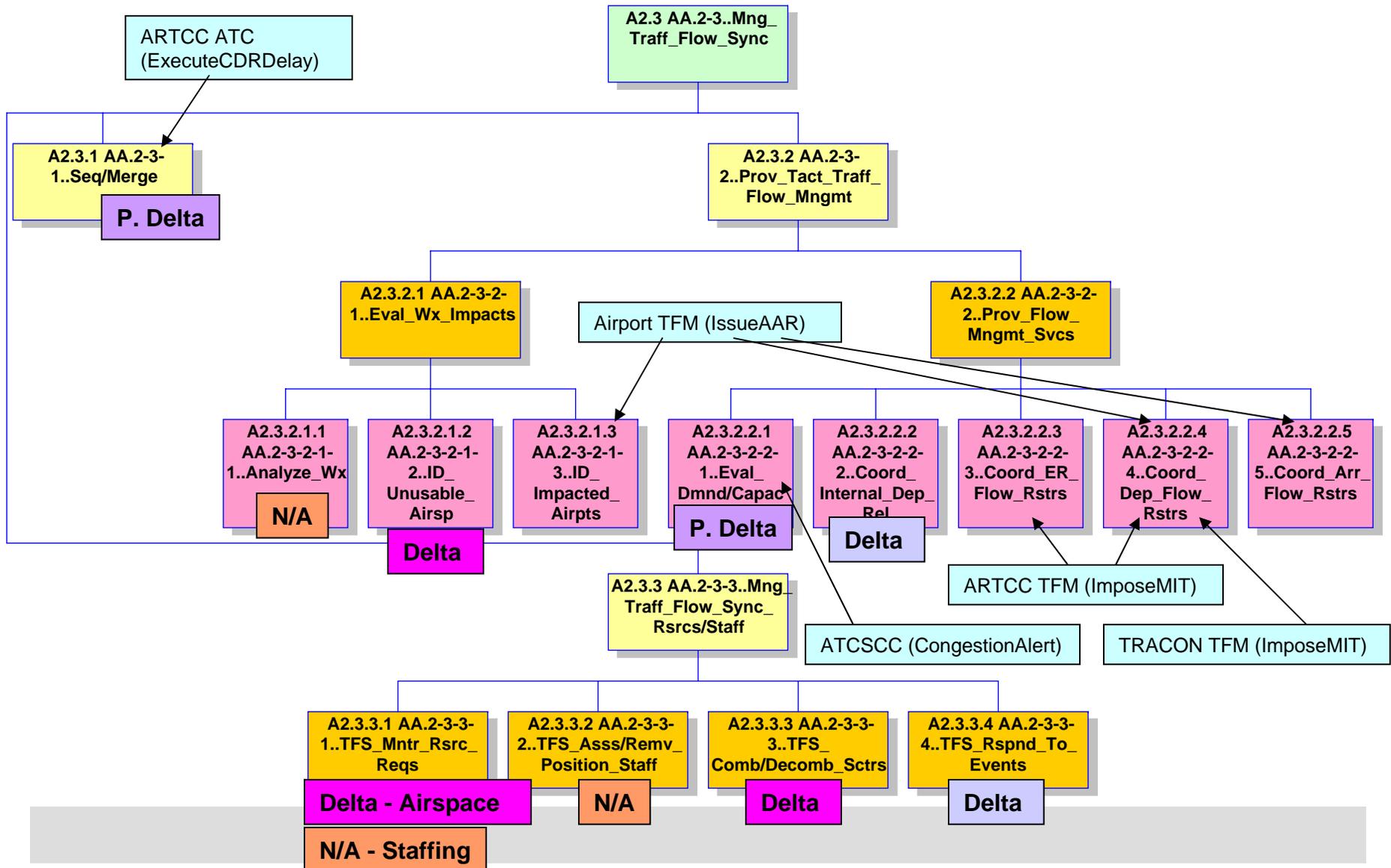
Provide Non-Radar Approach Separation - Outcome



Airspace Concepts Evaluation System



Mapping ACES to EA



Updating ACES

Identified prioritized alignment analysis for Today's ATS Architecture

Name	Description	ACES Comment	Needed to Model Current NAS?	Needed to Model Future NAS?	Needed for Metrics?	Delta Priority	Realistically Within Scope?	Initial ACES Update?
AA.2-3-2-1-2..ID_Unusable_Airsp	This activity is conducted by the Meteorologist and the TMC to identify airspace areas that will be unusable for flight because of severe weather impacts.	ACES delta for ER airspace	3	3	3	(9) high priority - enroute weather modeling needed for both current and future assessments	1	No - link to SCR 218
AA.2-3-2-2-1..Eval_Dmnd/Capac	This activity is conducted by the TMC to determine airspace areas, sectors, routes, fixes, and/or airports that may have flight demand that exceeds the capacity of the element.	Partial delta: In current ACES, ATCSCC identifies projected sector overlads and advises ARTCCs of these sectors. ARTCC agents then conduct overlod assessments and reslutions only for these sectors. ACES ARTCC agents can be enhanced to conduct independent overlod search and resolution for all their sectors. ATCSCC (CongestionAlert) Airport TFM (IssueAar) - evaluates airport traffic demand in relation to capacity to meet spacing requirements at the airport.	3	2	2	(7) med priority - ARTCCs should evaluate their own sectors	2	Possible - link to SCR 53
AA.2-3-2-2-2..Coord_Internal_Dep_Rel	This activity is conducted by the TMC and Tower to coordinate the departure release of individual departure flights destined for high-volume airports or routes to ensure that departure flights have a slot in the overhead stream.	ACES delta for ER airspace	2	1	1	(4) low priority - release into overhead slots	1	No
		ACES delta for TR airspace - no special TFM for flights destined for high-volume airports or routes	1	1	1	(3) low priority - overhead streams	1	No

2025 NGATS Concept

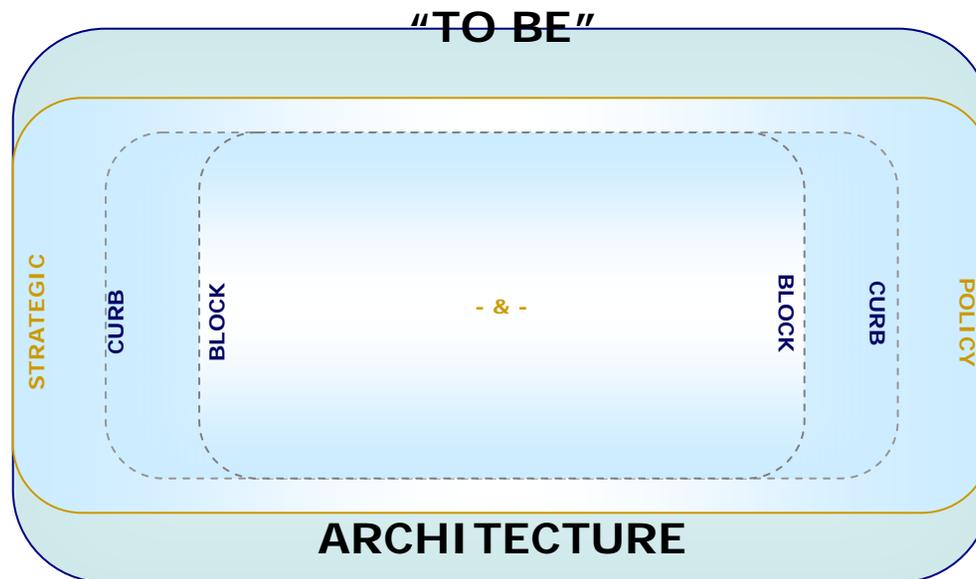
Key Capabilities

- Net-Enabled Information Access
- Performance-Based Services
- Weather-Assimilated Decision Making
- Layered, Adaptive Security
- Broad-Area Precision Navigation
- Trajectory-Based Aircraft Operations
- “Equivalent Visual” Operations
- “Super Density” Operations



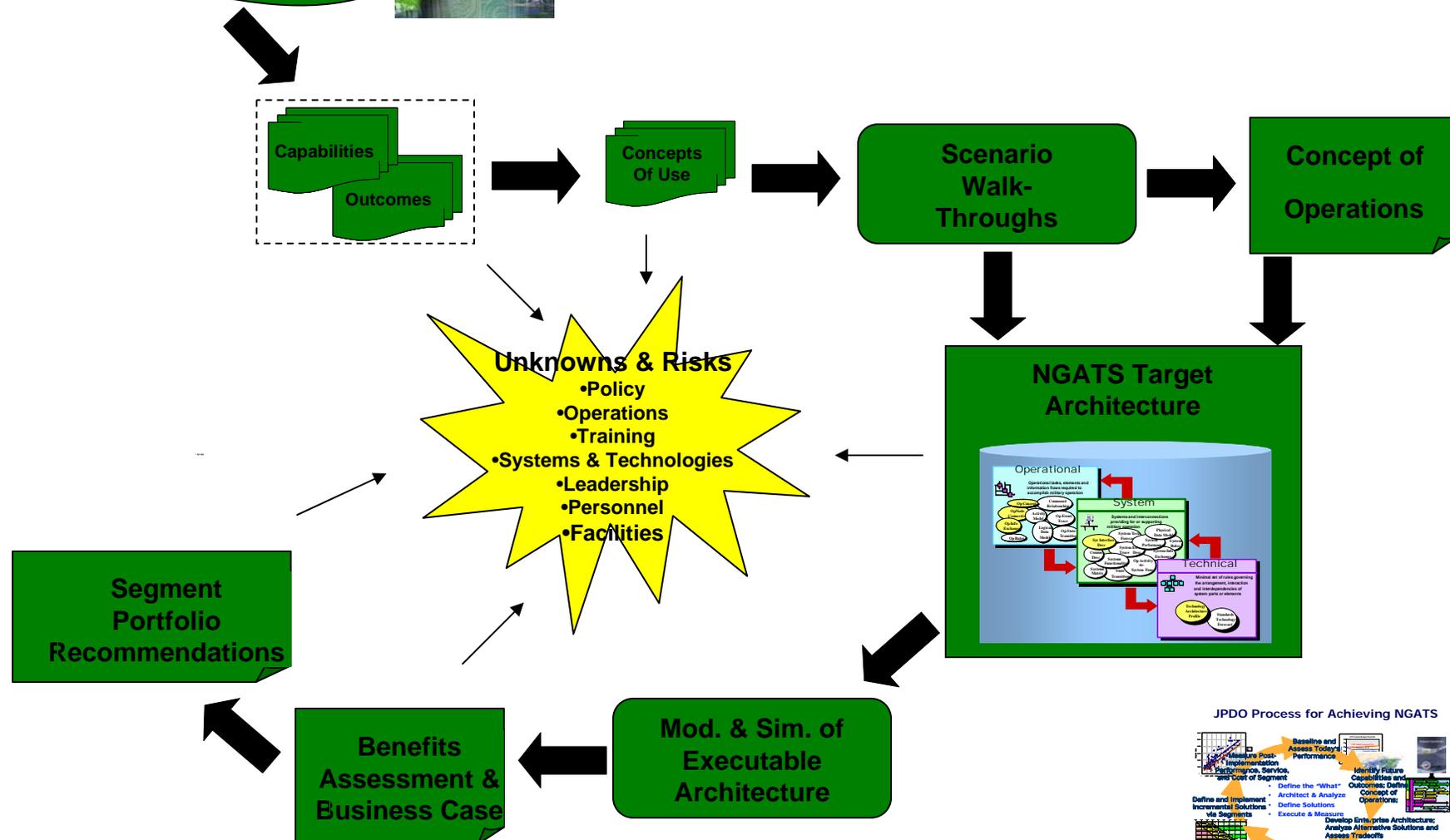
JPDO's Architecture Development

- **Step-wise development process**
- **Includes peer (IPT) and community vetting at each step**
- **Focused on Operational Activities**

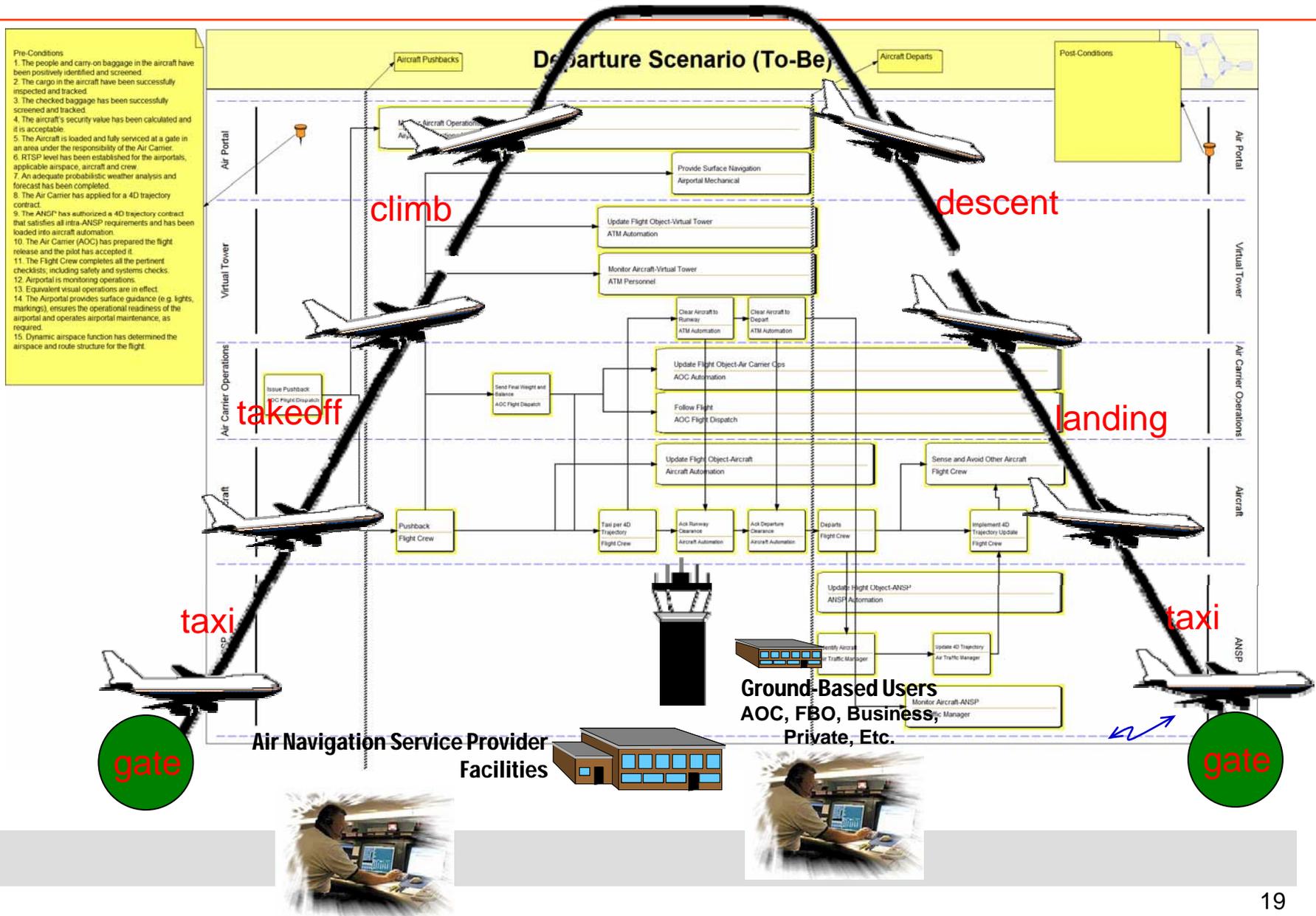


Architecture Based Process

NGATS 2025 Vision



Scenario Walkthrough's



Block to Block Capabilities

Broad-Area Precision Navigation

Weather Assimilation into Decision Loops

“Equivalent Visual” Operations

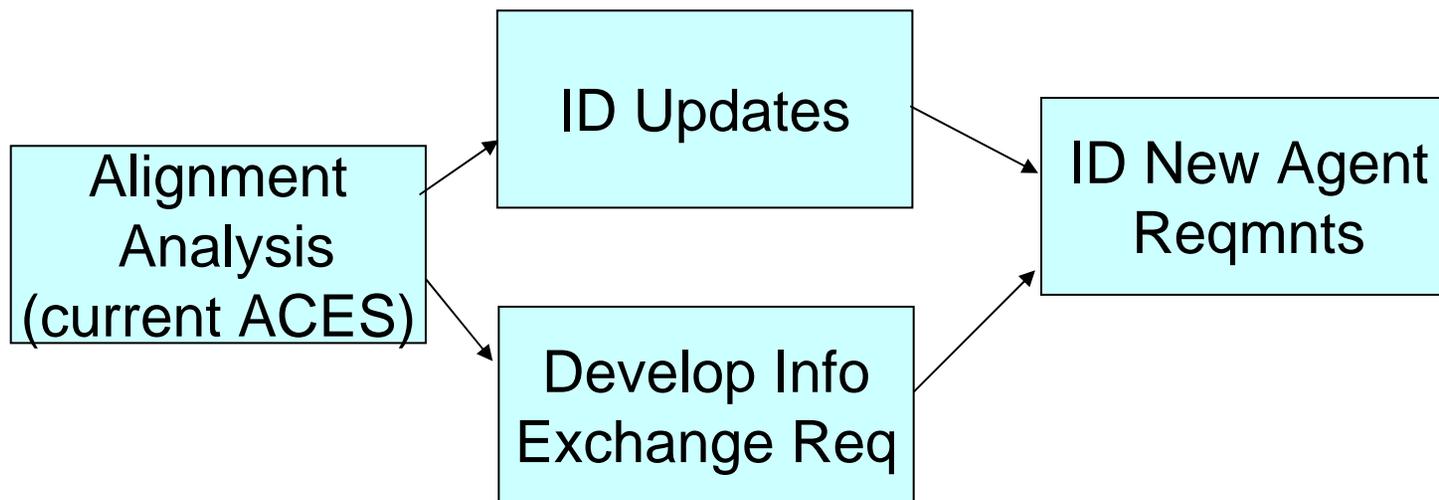
“Super Density” Operations

Aircraft Trajectory-Based Operations

Net-Enabled Information Access



Mapping NGATS Architecture to ACES



NGATS Enterprise – a Global solution



Meeting the future challenges

- Retain U.S. leadership in global aviation
- Expand capacity
- Ensure safety
- Protect the environment
- Ensure our national defense
- Secure the nation