SAM 3.0 Workshop Alliance SV Lab

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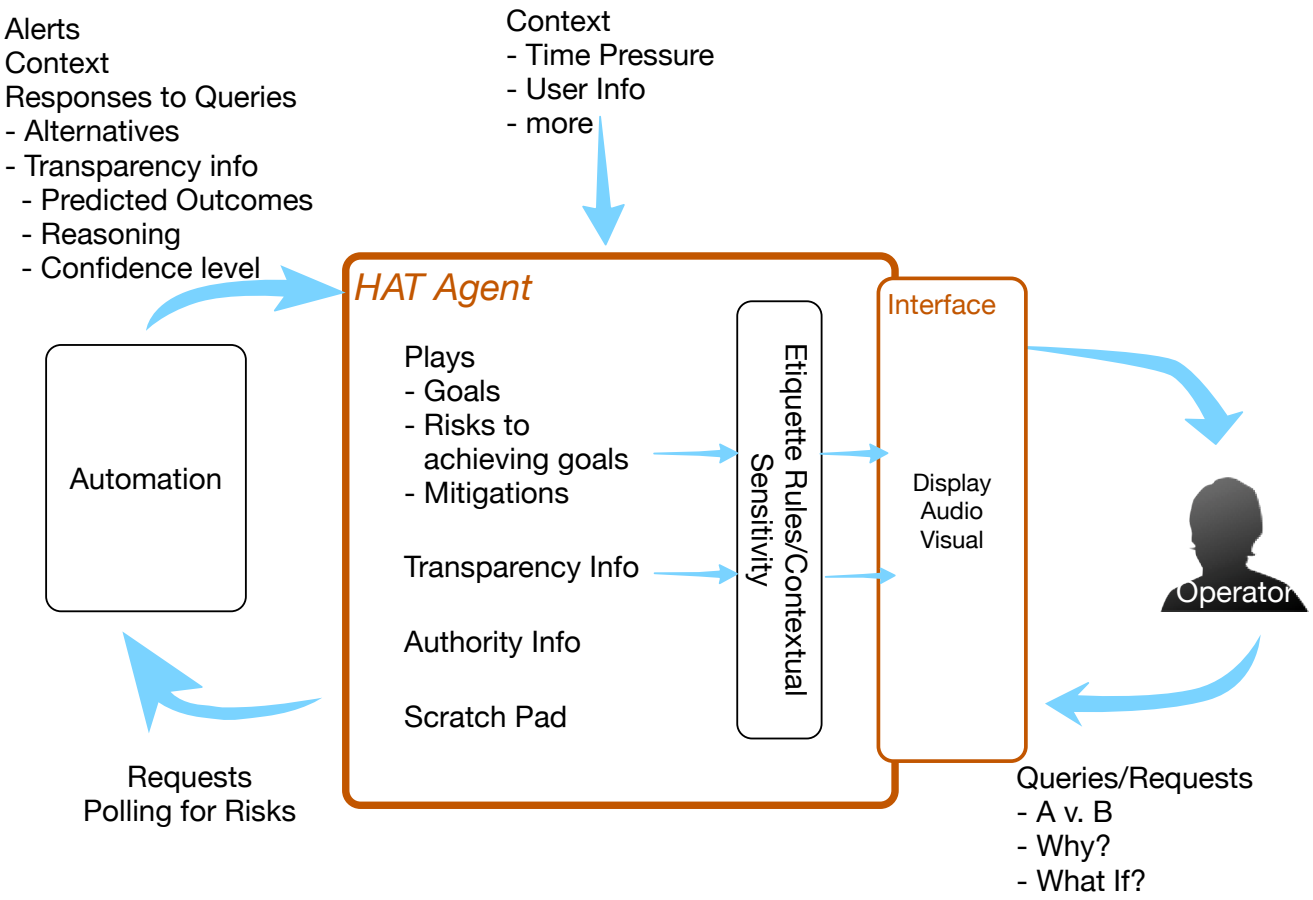
Problems with Automation

- Brittle
  - Automation often operates well for a range of situations but requires human intervention to handle boundary conditions (Woods & Cook, 2006)
- Opaque
  - Automation interfaces often do not facilitate understanding or tracking of the system (Lyons, 2013)
- Miscalibrated Trust
  - Disuse and misuse of automation have lead to real-world mishaps and tragedies (Lee & See, 2004; Lyons & Stokes, 2012)
- Out–of-the-Loop Loss of Situation Awareness
  - Trade-off: automation helps manual performance and workload but recovering from automation failure is often worse (Endsley, 2016; Onnasch, Wickens, Li, Manzey, 2014)

HAT Model


Alerts
Context
Responses to Queries
- Alternatives
- Transparency info
- Predicted Outcomes
- Reasoning
- Confidence level
Context
- Time Pressure
- User Info
- more
HAT Agent
Plays
- Goals
- Risks to achieving goals
- Mitigations
Transparency Info
Authority Info
Scratch Pad
Etiquette Rules/Contextual Sensitivity
Interface
Display
Audio
Visual
Operator
Automation
Requests
Polling for Risks
Queries/Requests
- A v. B
- Why?
- What If?

HAT Solutions to Problems with Automation

- Brittle
  - **Negotiated decisions** puts a layer of human flexibility into system behavior
- Opaque
  - Requires that systems be designed to be **transparent**, present **rationale** and **confidence**
  - Communication should be in terms the operator can easily understand (**shared language**)
- Miscalibrated Trust
  - Automation **display of rationale** helps human operator know when to trust it
- Out-of-the-Loop Loss of Situation Awareness
  - **User directed interface**; adaptable, not adaptive automation
  - Greater interaction (e.g., **negotiation**) with automation reduces likelihood of being out of the loop

HAT Agent

- Mediates human interaction with autonomy
    - Transparent
    - Pilot Directed
    - Comm Channel
- Working agreements
    - Transition to automation
- Applied to single pilot ops/Dispatch

Delegation Control: Playbook®

- Delegation: one way humans manage supervisory control with heterogeneous, intelligent assets
- Playbook®: ones means of delegation
- Plays: analogous to football
  - Quick commands – complex actions
- A Play provides a framework
  - References an acceptable range of plan/behavior alternatives
  - Requires shared knowledge of domain Goals, Tasks and Actions
  - Supervisor can further constrain/stipulate
- Potentially facilitates intuitive cooperative control of Unmanned Systems

A page from Alonzo Stagg's 1927 Playbook

Potential Concepts

- Playbook
- Bi-directional communication
- Transparency
- Operator directed interface

Use Case Questions

- What is the human's task?
- What information is required?
  - Temporal component
- What is (is there) the optimal solution?
- How do humans solve this problem?
- What are the metrics?
  - Time
  - Risk
- How best to display?

HAT and Contingency Management in a Flight Following Context

Initial Reduced Crew Operations (RCO) Research Efforts

- Motivation
  - Enable commercial transports to fly with only one pilot to **save money** and **address a potential pilot shortage**

- Possible Approaches to RCO
  - Support from flight deck automation
  - **Remote support from a human operated ground station**
  - Remote support from a human operated ground station and flight deck automation

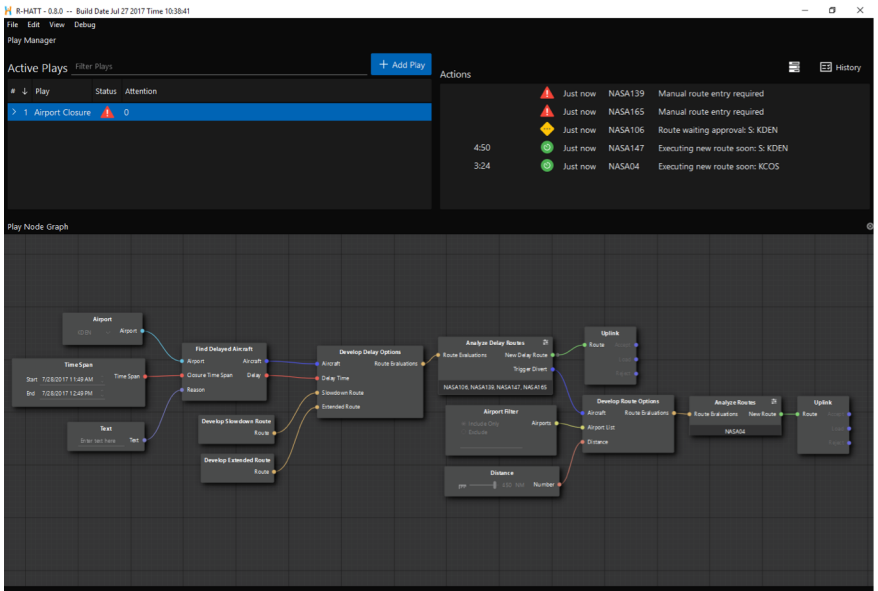
- Goals and Objectives
  - Develop and evaluate advanced flight deck- and ground-based technologies and concepts utilizing
    - Unmanned Aircraft Systems (UAS) technologies
    - New air-ground datalink capabilities
    - Intelligent agents located on flight decks and at ground stations

RCO CM Flight Following Context

- Ground support of pilots under reduced crew operations
  - Looking primarily at flight following/re-routing
  - ConOps: automation does more flight planning; dispatchers aided by automation and real time information do more tactical decision-making
- Alerted when
  - They go off path or fail to comply with clearances
  - Significant weather events affect their trajectory
  - They fail to act on EICAS alerts
- Rerouted aircraft when
  - Weather impacts their route
  - System failures or medical events force diversions

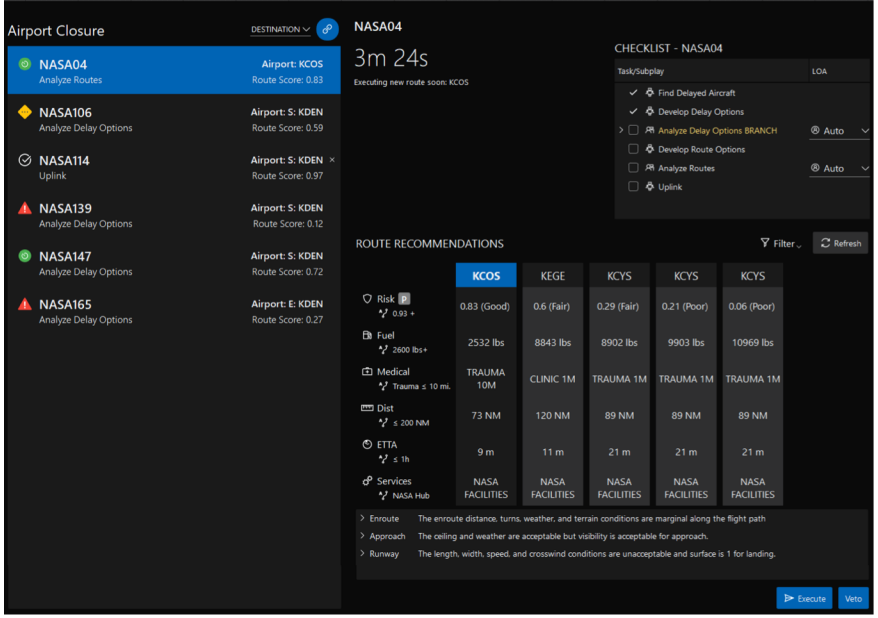
Ground Station Layout

Plays/Working Agreements



Play Manager

- See all active plays
- View actions requiring operator input
- View actions that have been performed
- Invoke Play Selector to configure and launch new play



Play Node Graph

- Visual representation of a play's structure
- Modify ALTA and override LOAs
- Displays progress of play

Recommendation Panel

- Lists ac involved in play and status
- Provides recommendation table with transparency information
- Shows selected ac's working agreement with dynamic checklist
- Used to execute recommendations
- Can be used to constrain LOA determinations

Working Agreements: Automation Level-Based Task Allocation (ALTA)

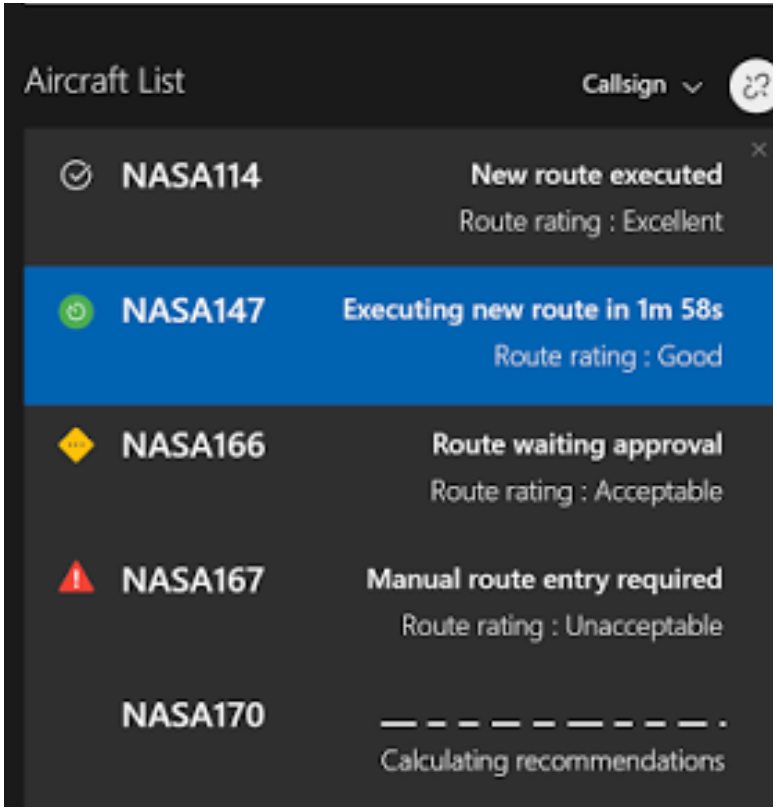
- A model to achieve contextually aware dynamic LOA determinations

- After a problem has been detected or handed to the agent, the agent will conduct an Evaluation Phase
  - Agent requests potential solutions from automated recommender
    - Evaluates on multiple dimensions (e.g., risk, flight delay, fuel)
    - Takes into account user-defined thresholds for each dimension's LOA
    - Sorts solutions by highest LOA first, then user-identified primary criterion

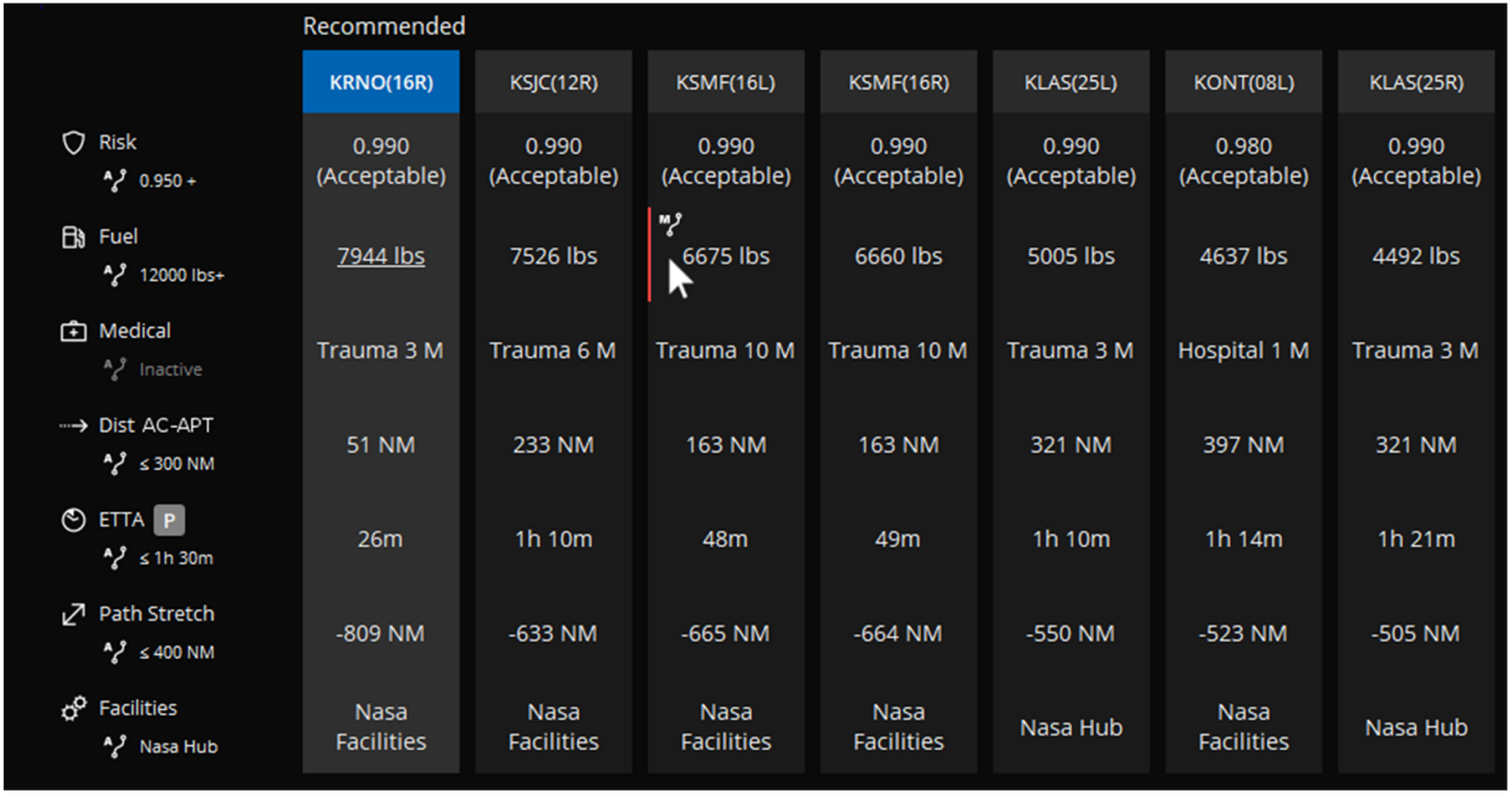
ALTA Action Phase

Working agreements specify, based on predetermined factors, which of the following the automation will do:

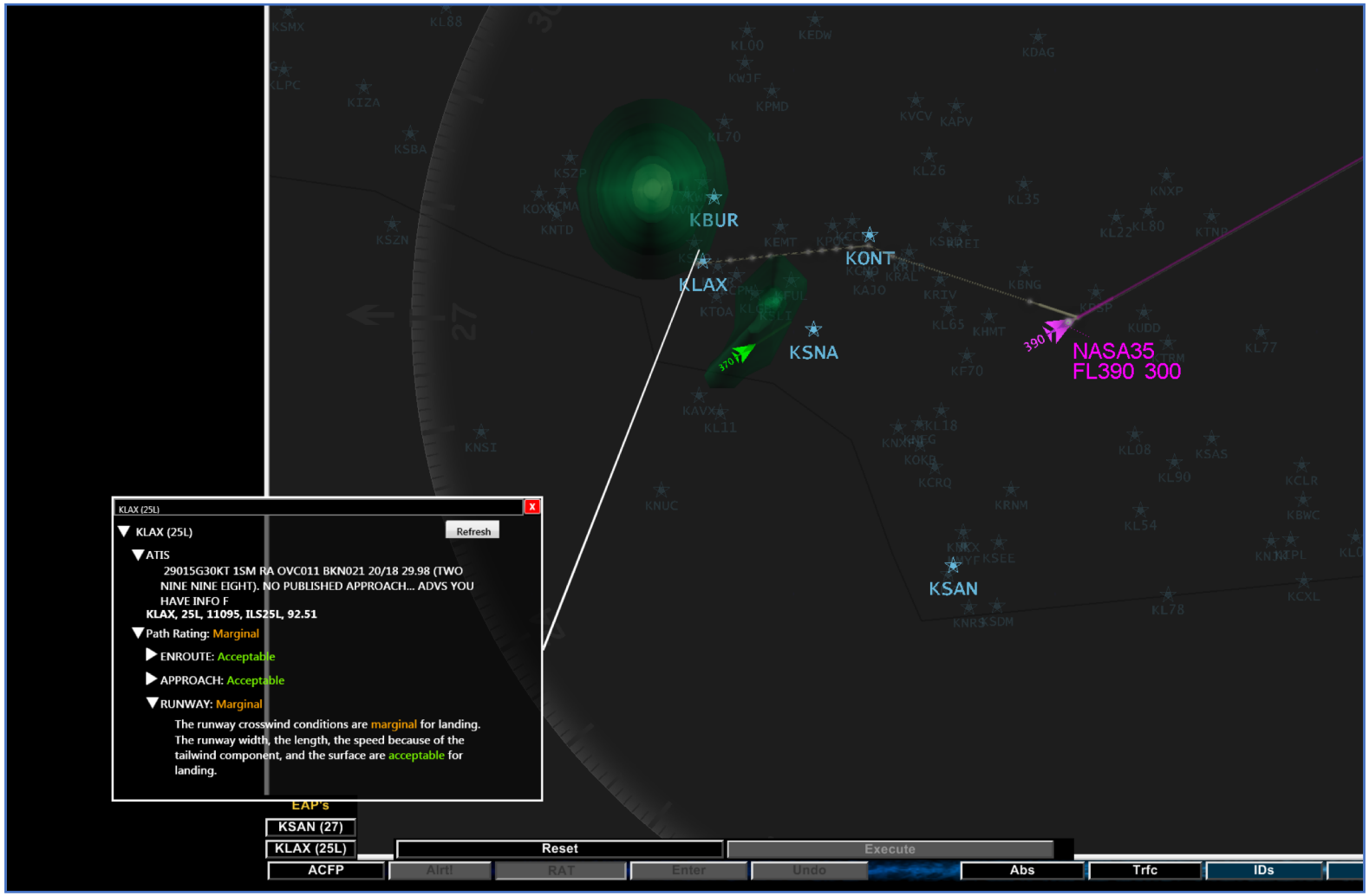
- Auto: autonomously executes and informs operator
- Veto: presents solutions one of which will be autonomously executed unless the operator intervenes
- Select: presents multiple options for operator selection
- Manual: task to be performed by operator



Route Recommendations



Graphical Display of Recommended Route



Concepts for other applications

- Status display for situation awareness
- Flexible, pre-scripted Plays
- Working Agreements
- Emphasis on Teaming
- Transparency to increase both situation awareness and trust and reliance on the system
- Contextually-aware levels of automation to reduce workload in safe and efficient manner
- Bi-directional communication