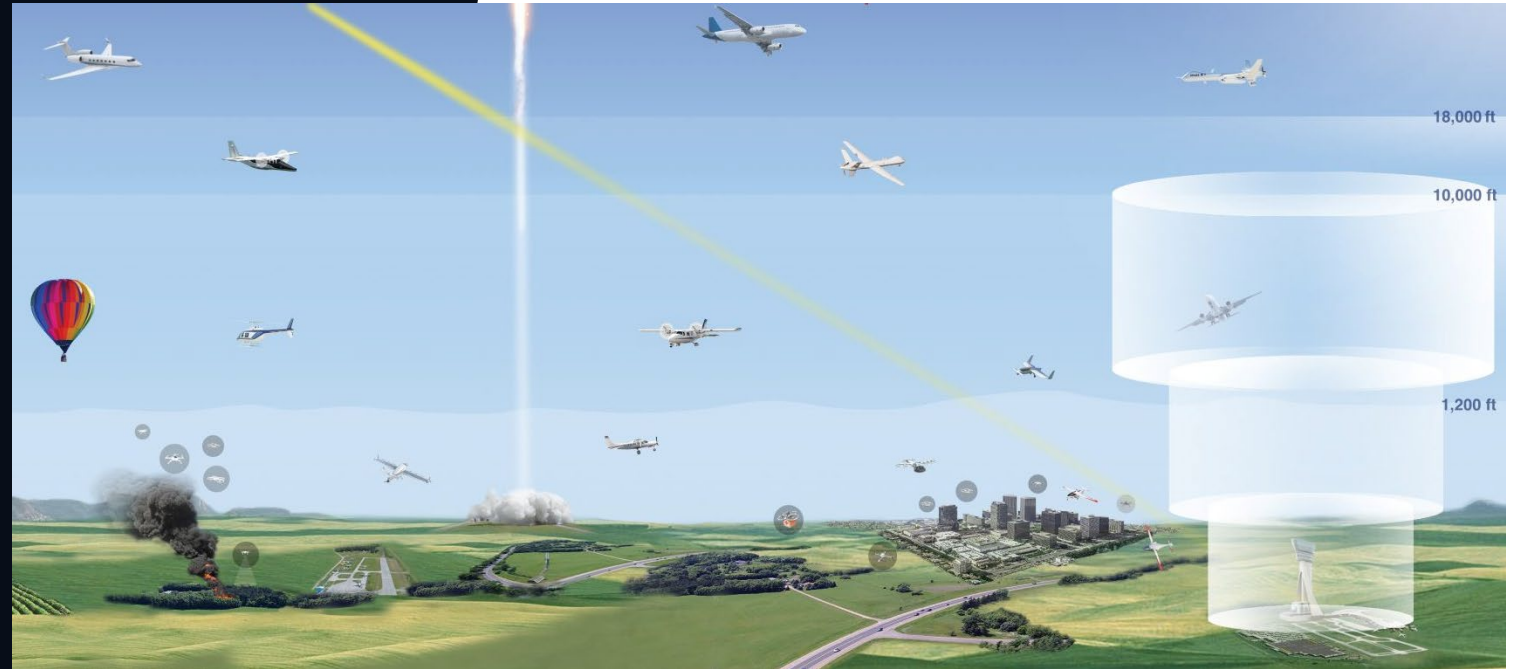
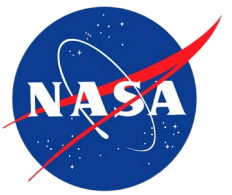
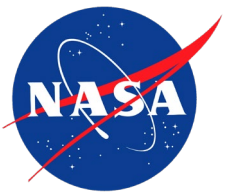


Responsible AI Framework for Air Traffic Management



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ICAO Air Navigation World 2023



Outline

- Evolution Airspace Operations
- Key Proposal
- Responsible AI Framework
- Collaboration and Harmonization



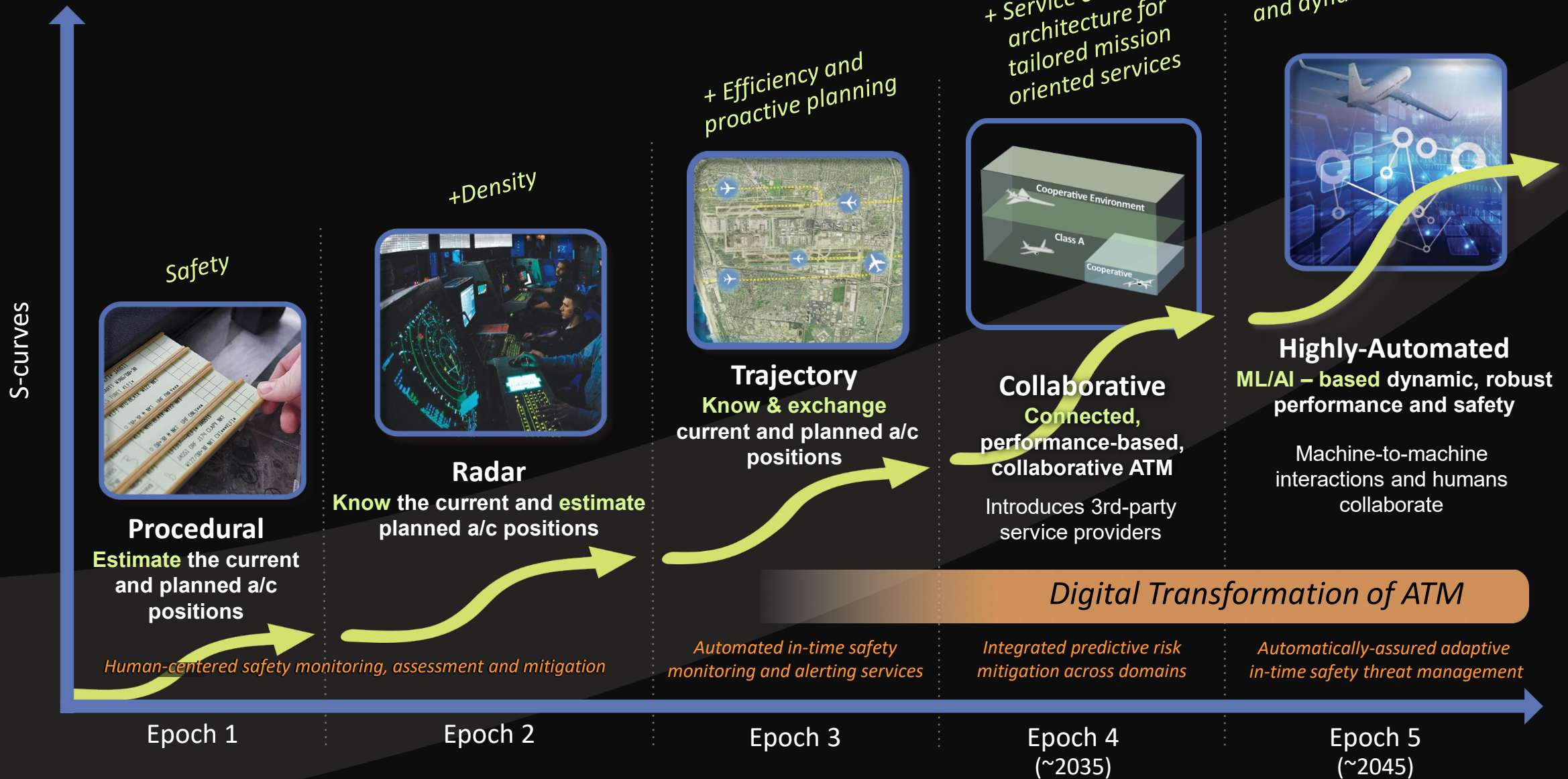


Evolution of Airspace Operations

Hypothesis: Role of Automation

- Future system will require increased levels of automation to address increased diversity, density, environmental considerations resulting in higher complexity
- Historical basis for this hypothesis

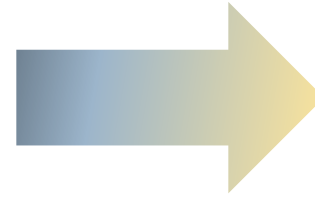
Evolution of Airspace Operations and Safety



Transition to UTM-inspired Airspace Traffic Management



Current ATM



UTM-inspired-ATM

All services are provided by FAA



Services are provided by FAA and third-parties

Humans address off-nominal situations and contingencies to ensure safety



Automation addresses off-nominal situations and contingencies to ensure scalability while maintaining safety

Very little interaction among users and third parties



Users collaborate/cooperate for efficiency, preferences for flights into constraints resources

- Human at the epi-center of information integration
- Every data for every vehicle moves through FAA systems
- Management by clearances
- Each change is focused on domain-specific FAA system



- Automation at the epi-center of information integration
- New paradigm: digital, connected ecosystems, outside applications
- Movement towards management by exceptions
- Each change is focused on trajectory optimization



NASA Unique Role: Architecture, data exchanges, service allocation/roles/responsibilities, rules of engagement, performance requirements for aircraft and airspace system technologies, automation for contingency management and disruption handling, machine learning environment and algorithms for continuous improvement, safety assurance/certification/acceptance approaches, and technology transfers.



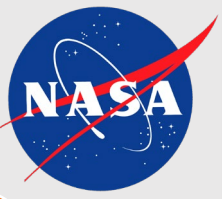
Key Question

- Will automation be able to manage off-nominal, non-normal, unexpected, contingency situations?



Proposal

Proposal



Type 1: Decisions that are reversible, strategic, or impact only efficiency, capacity, sustainability but do NOT impact safety of operation directly

Type 2: Decisions that are irreversible, tactical, and COULD impact safety of operation directly including other measures of performance

Responsible AI Framework: Factors

Particularly for Type 2 Decisions

Explainability

Transparency

Visibility in Learning – external validation before implementation

Security

Safety

Trustworthiness

Stay within the rules of behavior



Behavior Rules

- Every system or subsystem must have clear “system behavior” rules to ensure compatibility and harmonization with rest of the universe
- Example, Asimov’s Rules
 - First law is that a robot shall not harm a human, or by inaction allow a human to come to harm.
 - Second law is that a robot shall obey any instruction given to it by a human, and
 - Third law is that a robot shall avoid actions or situations that could cause it to come to harm itself.
- Challenge with Asimov’s rules were not easily testable

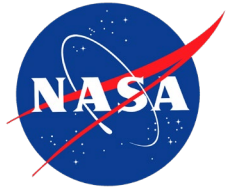


Example Behavior Rules

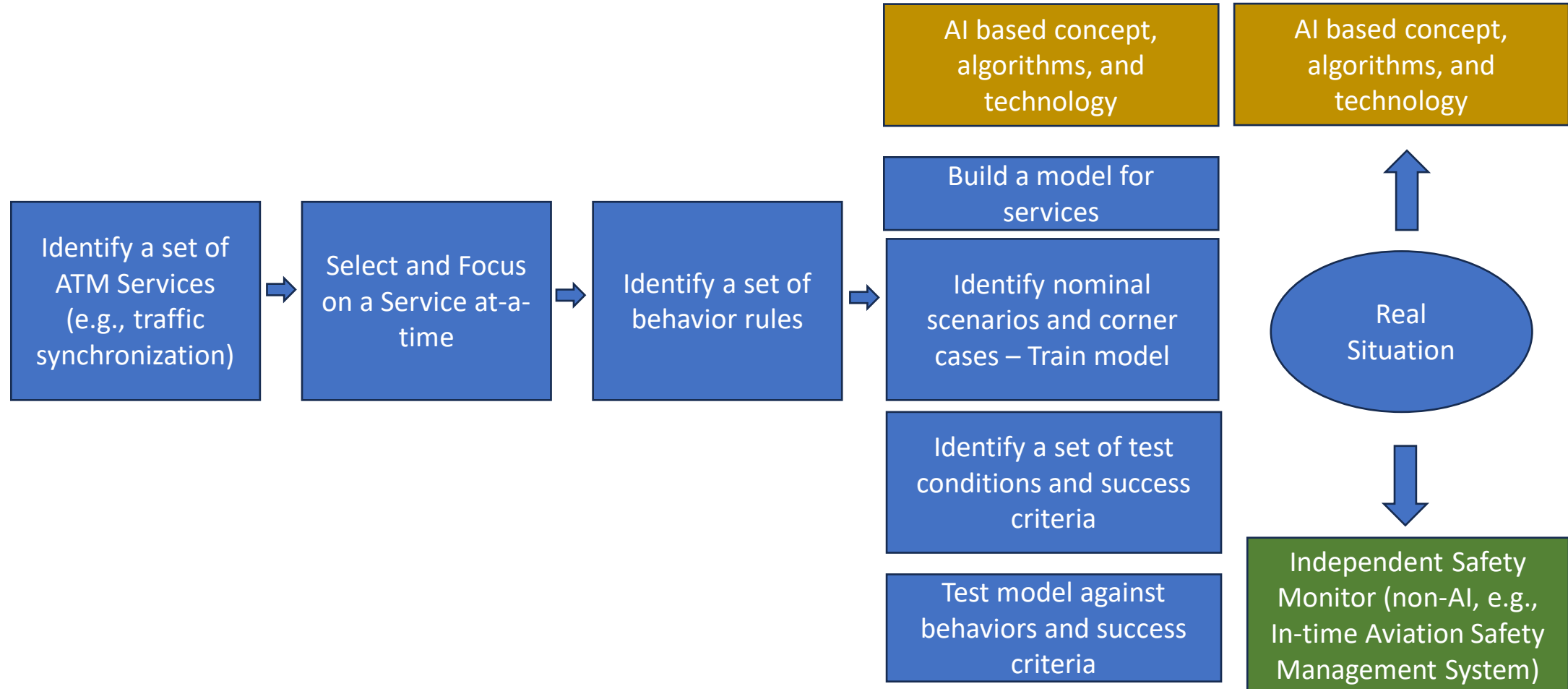
- Flow management System
 - Demand should not exceed capacity in any given time
- Conflict management system
 - No two aircraft should ever come closer than minimum separation
- Surface management system
 - Two aircraft should not occupy the same runway at the same time

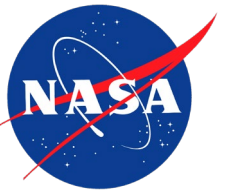


Responsible AI Framework



Responsible AI Framework: A Process





Safety Monitor - Proposal

- Not human
- Layer of deterministic automation
- Not intended to duplicate same capabilities such as AI-based approaches for total system performance
- Safety monitor – manages for safety! One function.
 - Like humans do today – safe, expeditious, and orderly flow in that sequence
 - We have precedence – Traffic Collision Avoidance System (TCAS)
- Architecting a new system is key
- System-level “digital twin” running in the background



Collaboration and Harmonization

Collaboration and Harmonization

- Factors for Responsible AI
- Behavioral rules for ATM enterprise
- Basic architecture – safety monitor construct
- AI-based technology will be secret sauce but set of test conditions and success criteria does not have to be



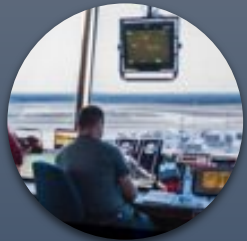
Embracing Innovation in Aviation while Respecting its Safety Tradition

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ATCSCC Webinar transcription

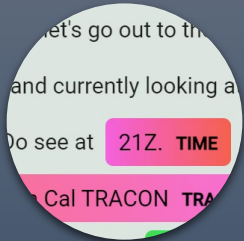
Goal: Utilize recent trends in AI/ML to provide automated transcriptions of ATCSCC webinar audio and extract relevant information from the transcript to help specialists.

Challenges: Unstructured audio data, highly domain-specific. Creating manual transcriptions takes time.



ATCSCC Webinar Speech2Text

- Collect and preprocess
- Automatically create text-based transcriptions



Digital Information

- Provide downstream information extraction and text processing
- Digital TMIs



Outcomes

- More efficient review
- Computable analytics



ML Models:

- **Speaker Diarization:** Split speaker segments from long audio
- **Speech2Text:** Convert audio into text transcriptions.
- **Audio-Lexical Inverse Text Normalization:** Add text formatting, punctuation, and capitalization to raw text.
- **Named Entity Recognition:** Used to extract key words and phrases from text transcriptions.



Transcription

currently on the OIS we have to boston newark laguardia and seattle ground delay programs in place

Text Formatting (ITN)

Currently **on the OIS** we have **to** Boston. Newark, LaGuardia and Seattle **GDPs** in place.

Microsoft Baseline

Currently **only OS** we have **the** Boston, Newark, LaGuardia, and Seattle **Ground lay programs** in place.

Analytics

Currently on the OIS we have to **Boston AERODROME** . **Newark AERODROME** , **Laguardia AERODROME** and **Seattle ARTCC** GDPs in place.