



Exploration of Algorithms for the NextGen Collision Avoidance System

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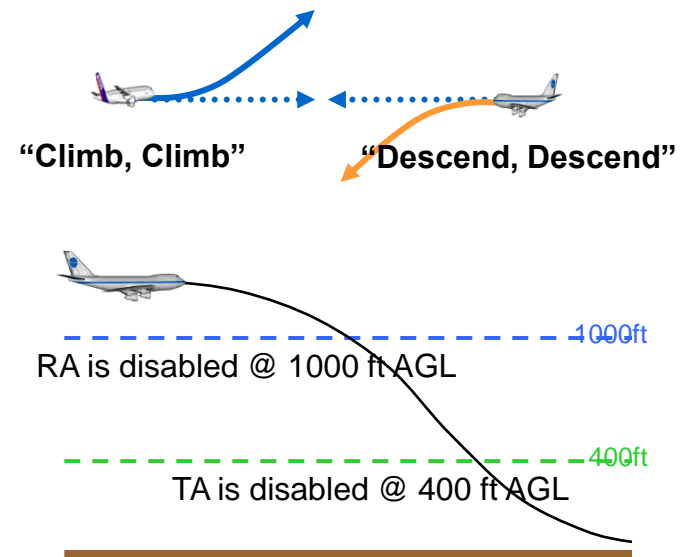
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MSR

Problem

- Future airborne applications and Air Traffic Control (ATC) procedures may interact with Traffic Alert and Collision Avoidance System (TCAS) with the undesired effect of generating nuisance Resolution Advisories (RA)
- TCAS is limited to supporting only vertical RAs
- Below 1,000 ft. AGL these RAs are disabled; furthermore, Traffic Advisories (TA) are disabled below 400 ft. AGL
- The TCAS surveillance function uses 1,090 MHz to actively interrogate other a/c transponders; the 1,090 MHz spectrum is becoming saturated by other systems



Background

- **The Next Generation Air Transportation System (NextGen) is the Federal Aviation Administration (FAA) plan to modernize the National Airspace System (NAS) through 2025**
- **New procedures will reduce spacing and separation requirements, and better manage the overall flows into and out of busy metropolitan airspace to provide maximum use of the highest demand airports**

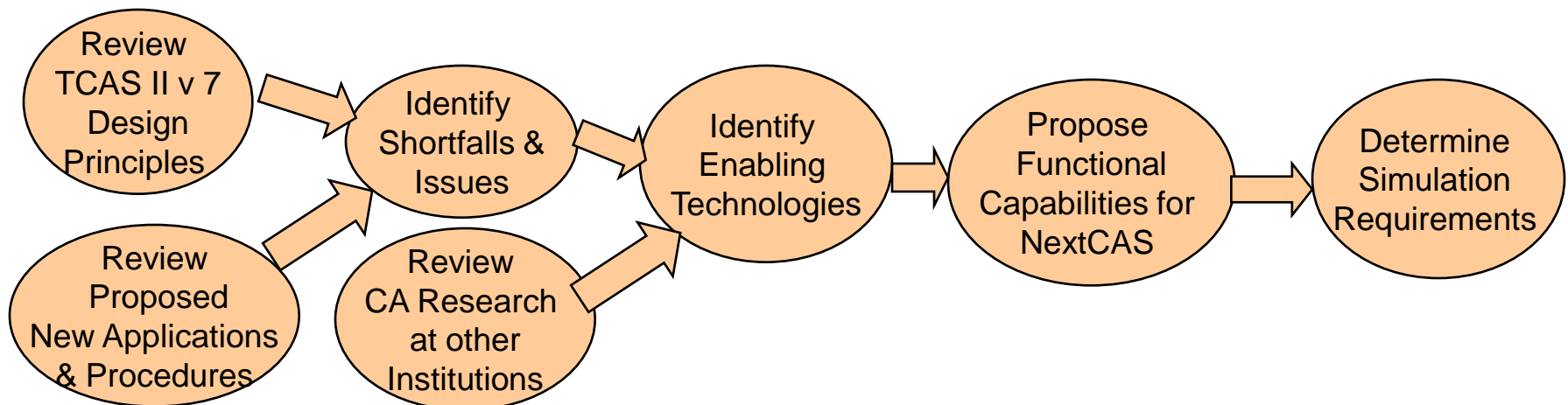
Objective



- **Assess the impact of TCAS limitations on new applications and operational procedures**
- **Establish performance enhancements that can be achieved with new technologies**
- **Propose a set of functional capabilities for an airborne collision alerting and avoidance system**

Activities for Phase I

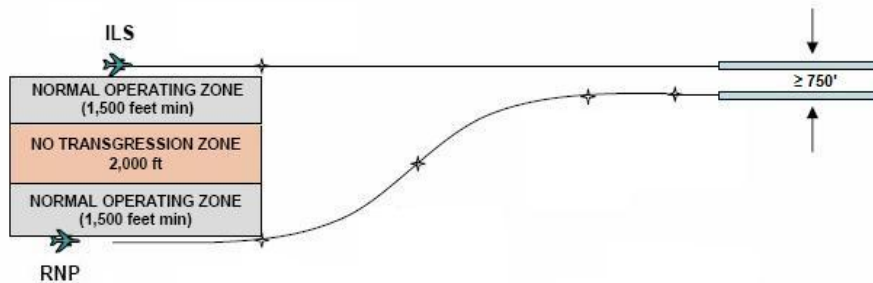
- **Identify limitations of TCAS II version 7 to meet future airborne applications and ATC procedures envisioned for NextGen**
- **Identify technologies that overcome the limitations of TCAS II**
- **Propose functional capabilities for NextGen Collision Avoidance System (“NextCAS”)**
- **Determine high level simulation requirements for NextCAS algorithms**




Highlight: Procedures and Applications Chosen for Initial Examination



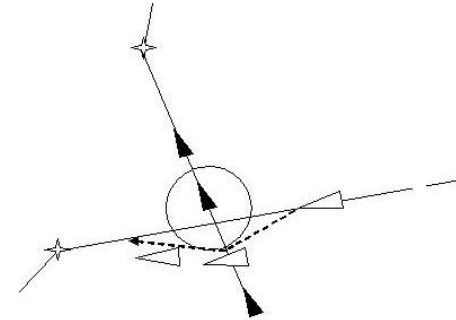
RNP Parallel Approach Transition (RPAT)



- Parallel approach procedure to maintain throughput in marginal Visual Meteorological Conditions (VMC)
- Needs Required Navigational Performance (RNP), visual acquisition near airport
- Initial simulations triggered RAs when the parameter values were near-boundary

Simplified TCAS:  Testbed TCAS: 

Aircraft-based Lateral Crossing

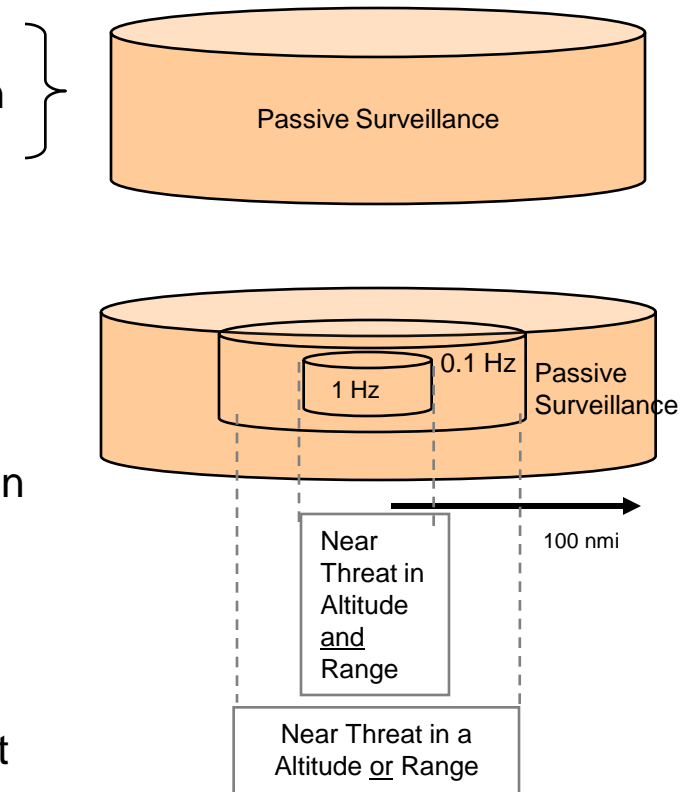


- Equipped aircraft accepts temporary separation responsibility to cross a designated a/c
- Proposed airborne application to minimize diversions en route
- European simulations elicited a unwanted TCAS TAs & a few RAs
- Initial simulations triggered RAs

Simplified TCAS:  Testbed TCAS: 

Highlight: Enabling Technologies with Automatic Dependent Surveillance-Broadcast

- ADS-B (Passive Approach)
 - Collision alerting and avoidance logic is solely based on ADS-B
- Hybrid Surveillance with Desensitization Capability
 - Hybrid Surveillance
 - Combined active TCAS and passive ADS-B surveillance
 - Adapt interrogation rate to intruder location
 - Collision Detection & Avoidance (CD&A) function only uses active interrogations
 - Desensitization
 - Pilot selects participating ADS-B/CDTI target engaged in NextGen application
 - Standard TA/RA are inhibited for selected target
- “Fused” Hybrid Surveillance
 - CD&A fuses ADS-B and active surveillance
 - Provides more accurate tracking and alerting of near-range intruders



Impacts



- The aviation community's existing collision avoidance system (TCAS) can trace its origins to MITRE's Technology Program
- MITRE can make a similar impact on the future of aviation by taking the initiative to explore an integrated airborne collision alerting and avoidance system that accommodates new applications and procedures envisioned for NextGen

Future Plans

- Develop NextCAS algorithms
- Develop encounter scenarios (in collaboration with MIT/Lincoln Laboratory)
- Develop scenarios for future NAS operations
- Build NextCAS model
- Develop the performance metrics
- Evaluate the feasibility and benefits of the NextCAS algorithms in terms of safety, pilot, and ATC acceptance/workload, a/c performance
- Make industry recommendations for NextCAS

