



TO-1: Cooperative Human-Adaptive Traffic Simulation (CHATS)

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Objectives

- Investigate the feasibility of developing a Cooperative Human-Adaptive Traffic Simulation (CHATS) to
 - Test free flight concepts with stakeholders & conflicting goals
 - Determine appropriate airspace regions & conditions for free flight
- If feasible
 - Develop a functional design for CHATS
 - Provide a development plan



Objectives (cont.)

- CHATS is proposed to
 - Simulate strategic decision-making by air carriers and traffic management
 - within context of different airspace and rules assumptions
 - strategic decisions span time from hours to days to (potentially) years
 - Use human teams to represent these interests and make decisions
 - Use computer simulation to calculate impacts of those decisions



Task Description

- Team
 - Charles Phillips, Ed Koenke, Torai Madjid, SRC
 - Bill Colligan, Alex Suchkov, CSSI
 - Bill Leber, Northwest Airlines
 - John Hansman, Bill Hall, MIT
- Approach
 - Derived functional requirements from desired CHATS capabilities
 - Determined feasible design from examining these requirements
 - Proposed a low-cost, fast-payoff development plan



Results - Overview

- MIT Survey of Models
 - Odoni et al report: “Existing and Required Modeling Capabilities for Evaluating ATM Systems and Concepts”, 1997
 - A conclusion: Little past work on models of strategies and behavior of airlines and other users vis-a-vis ATM, an “important new area of basic research”



Results - Overview (cont.)

- Using CHATS, researchers would
 - Develop a simulation capability which focuses on user and service provider strategic decision-making in the free flight environment
 - Assess new roles and strategies for the service provider (traffic management, rules)
 - Permit users and provider to invent and evaluate new strategies
 - Determine impacts of these strategies upon stakeholders (users and provider)

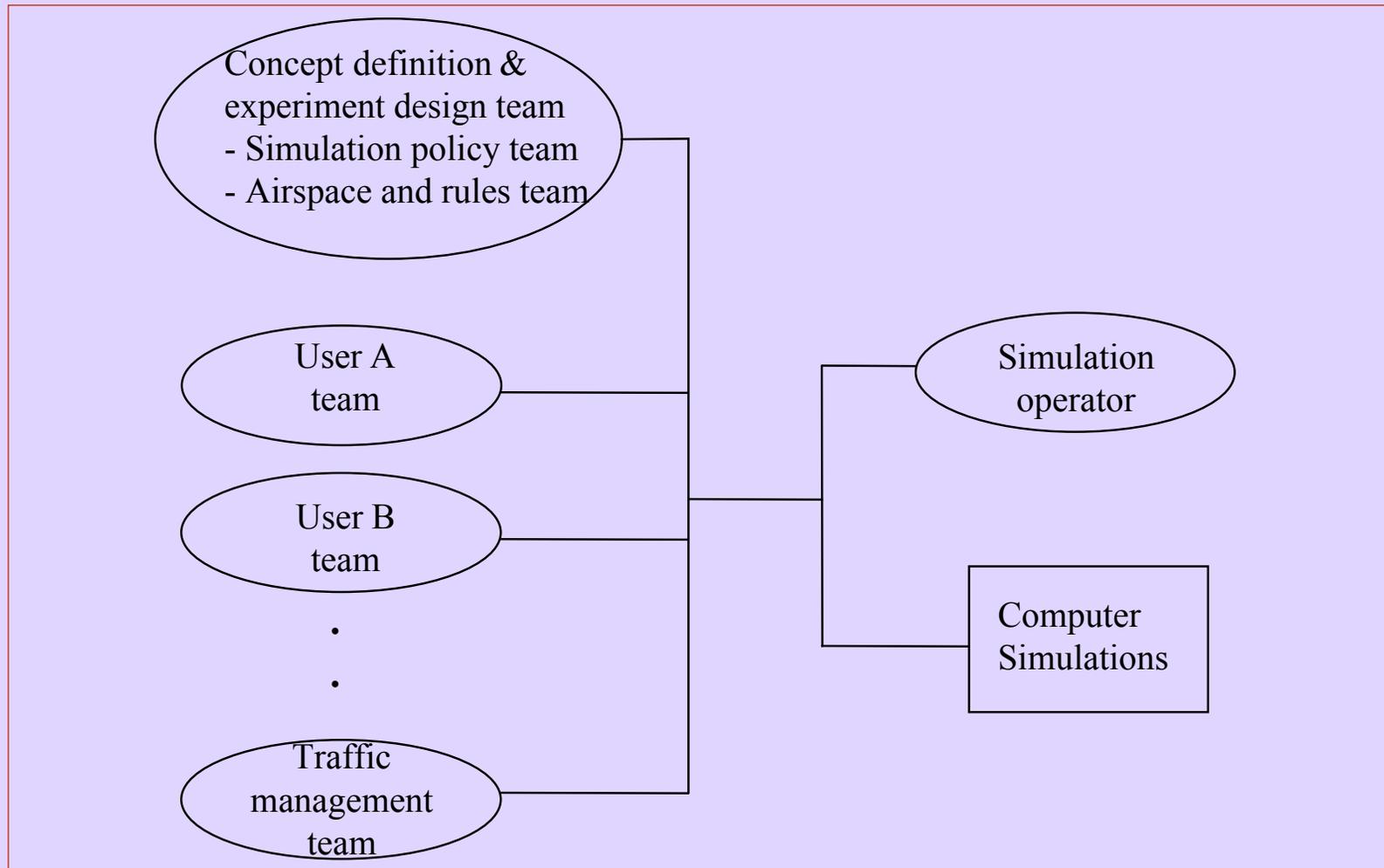


Results - Overview (cont.)

- Example Decisions and Actions for CHATS
 - Service provider allows complete user-preferred routing
 - Airlines submit schedules unconstrained by airport capacities
 - Traffic management negotiates schedule changes with airlines to fit within airport constraints
 - Service provider introduces a new airport, and airlines work this into their schedules



Results - Operational Concept CHATS Players





Results - Operational Concept CHATS Players (cont.)

- Concept definition and experiment design team
 - Simulation policy team
 - define concepts, establish ground rules, create experiment design
 - Airspace and rules team
 - define airspace and rules assumptions
- User teams
 - airline, air cargo, general aviation, military
 - set own objectives and may change them as a result of simulation experience



Results - Operational Concept CHATS Players (cont.)

- User teams (cont.)
 - air carriers
 - set schedules, reschedule in response to problems, negotiate capacity problems with traffic management
 - negotiate with each other if permitted by ground rules
- Traffic management team
 - set objectives and may change them as a result of simulation experience
 - Perform TM role
 - resolve capacity bottlenecks in sectors and airports
 - negotiate with or direct air carriers as necessary



Results - Operational Concept CHATS Operation

- Fast time or real time
 - fast time with pauses for evaluation is usual mode, conserves time for players
 - real time without pauses would force airline players to react to problems with realism
- Metrics measure results from multiple perspectives
 - NAS-wide
 - service provider
 - aircraft operators



Results - Operational Concept Kinds of Scenarios

- Collaborative activities - wider and deeper than in today's CDM
- Competitive activities - win-win, win-lose, lose-lose
- Introduce disruptive external events
 - bad weather, closed runways, equipment failures
- Totally new schedules, city-pair services, aircraft fleet mix
- New or expanded airports



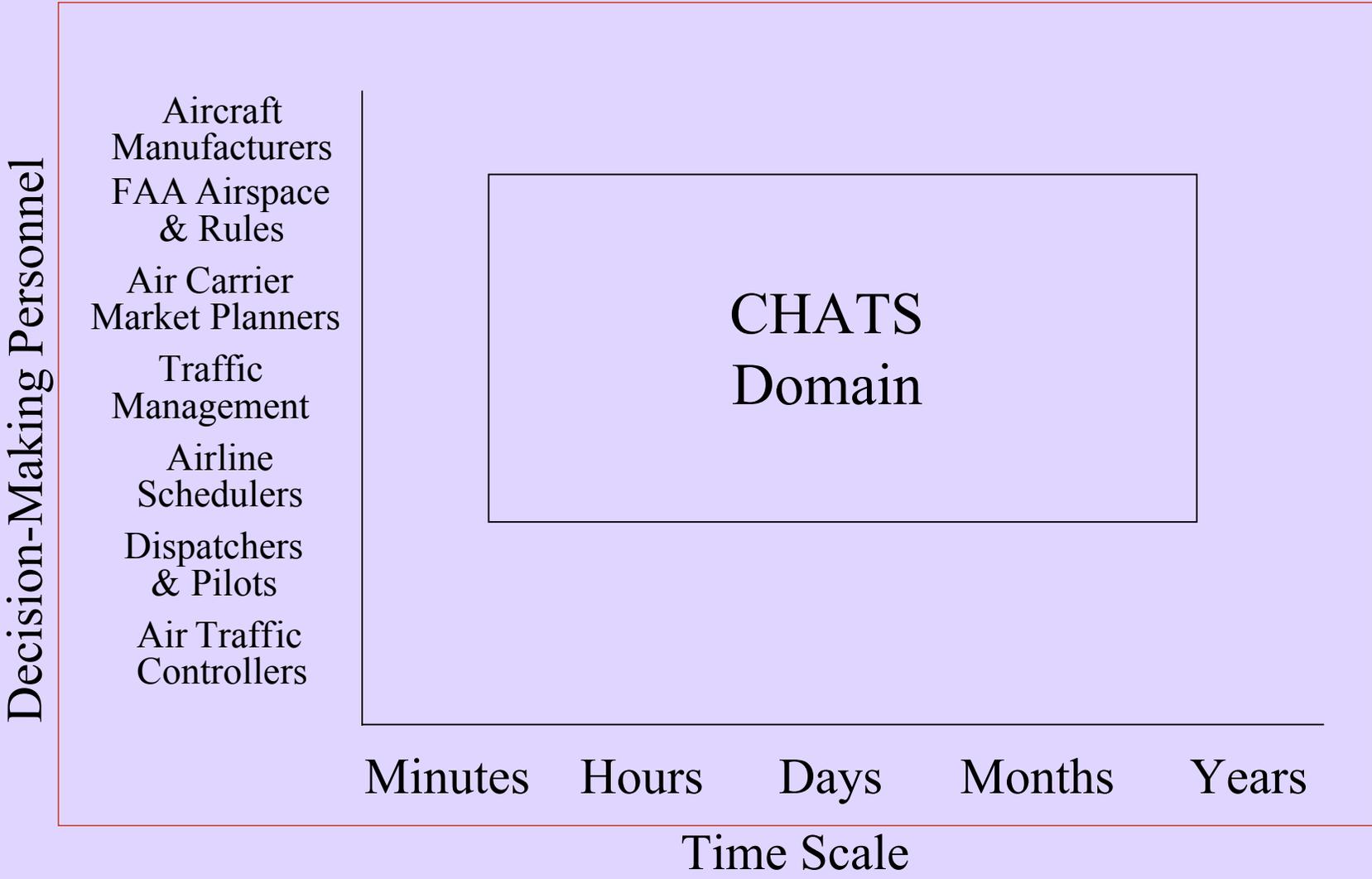
Results - Operational Concept Representative Questions

- How to allocate limited airspace/airport resources with increased future demand
 - satisfactory for stakeholders?
- Is allocation stable, including effects of negotiation, competition and disturbances, or does it break down
- How well do future concepts respond to disruptive events
- Criteria used by different teams in making decisions



Results - CHATS Design

Decision Makers and Time Scale





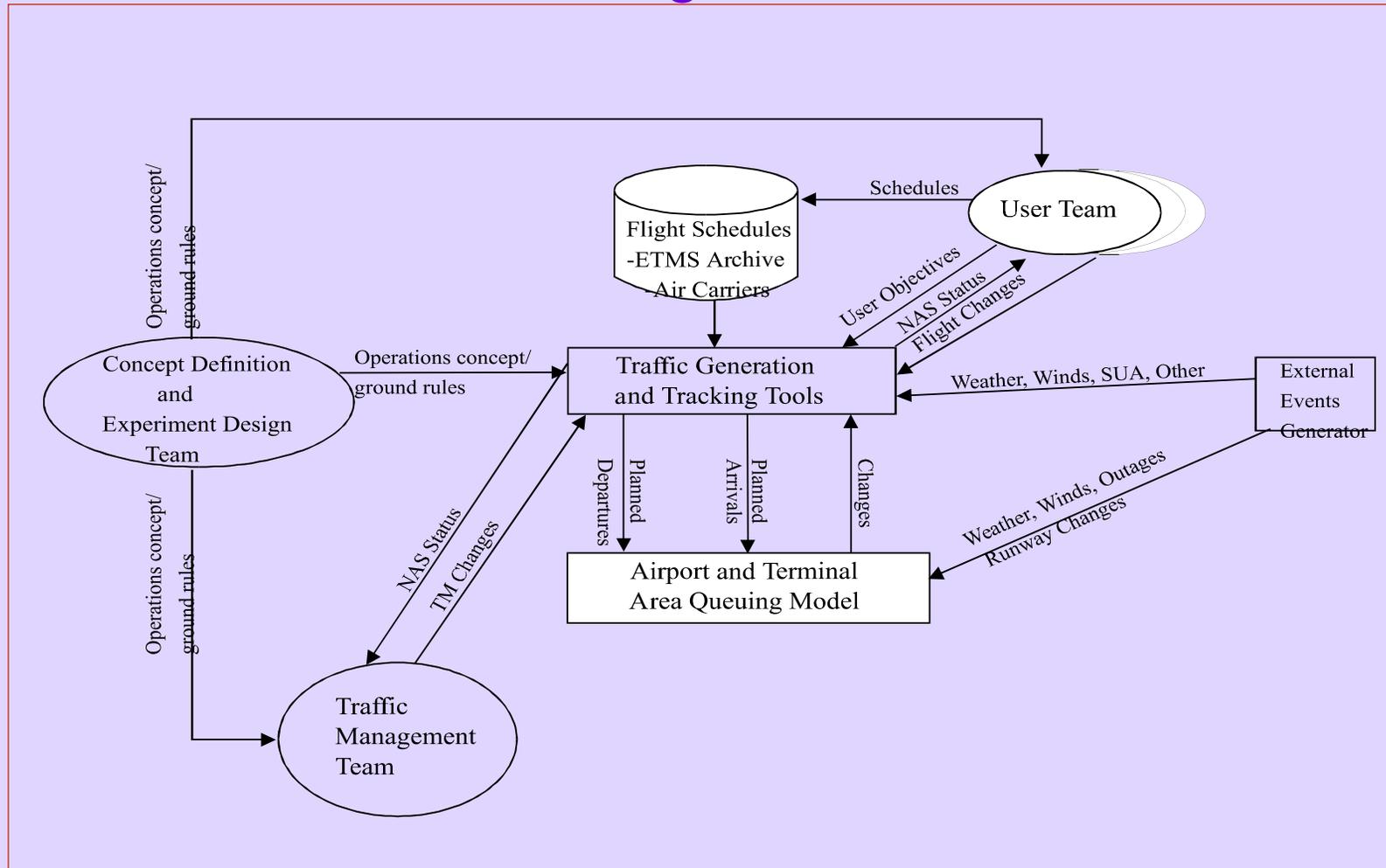
Results - CHATS Design

Potential models for CHATS

	Time Scale					
	Minutes		Hours	Days	Months	Years
Decision-Making Personnel						
Aircraft Manufacturers						Air Carrier Investment Model (ACM)
FAA Airspace & Rules					Sector Design Analysis Tool (SDAT)	ASCENT
Air Carrier Market Planners				Air Carrier Network Cost Model		ACM
Traffic Management			Find Crossings Tool	TAAM NASPAC	TFM Modeling and Analysis Capability (TMAC)	
			Airport Capacity and Delay Model			
			Approximate Network Delays (AND)			
Airline Schedulers		Total Traffic Tool	RAMS	LMINET	SIMMOD	
	OPGEN	Airspace Simulation				
Dispatchers & Pilots	Functional Analysis Model (FAM)		Flight Segment Cost Model			
Air Traffic Controllers	ARC2000/HIPS BancDe Test					



Results - CHATS Design High-Level





Results - Development Plan

- First year:
 - Develop Rapid Prototype
 - colocated workstations, interaction of a single airline team with a traffic management team
 - gain airline and TM support of CHATS concept
- Second year:
 - Conduct Simulations Using Prototype
 - publicize initial results
 - Complete CHATS Development
- Third year:
 - Conduct Full-Scale Simulations

Conclusions

- CHATS is based on existing models
 - risk is reasonable
 - CHATS is feasible
- Will explore air carrier competitive and cooperative behavior in a free-flight environment, not being addressed elsewhere



Conclusions (cont.)

- New strategies and environments can be tested
 - wholly revised schedules
 - free flight rules
 - new airports
- CHATS can be built for a little over \$2 million life-cycle cost over a three year development and operating period