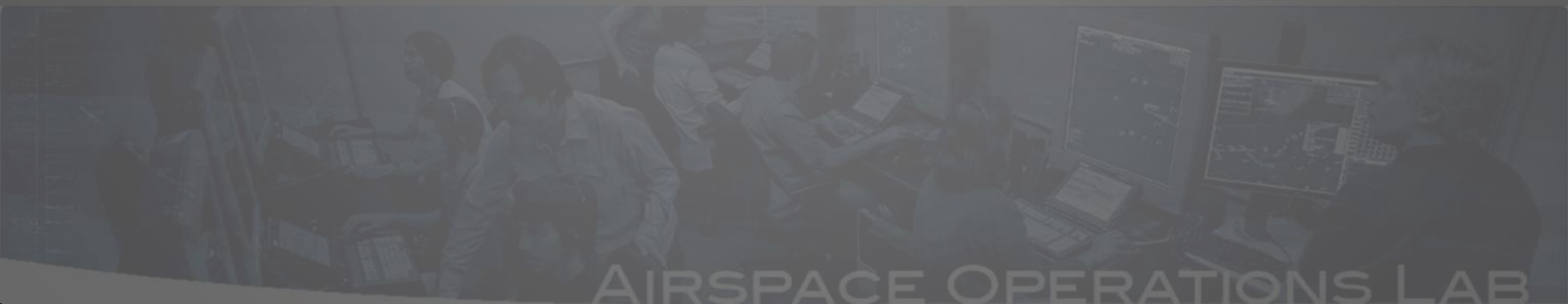
Tuesday (01/10/2012)
Briefings

08:30	Intro and MACS Overview
09:40	Break
10:00	MACS/ADRS simulation architecture and integration with ATOS and TMA
11:00	Using MACS to simulate aircraft operations *Simulation Manager and Flight Deck Stations*
12:00	Lunch
1:00	Basic Air Traffic Control Operations.
1:30	Using MACS to simulate near-term air traffic control operations. *Focus ATD-1, Center/TRACON workstations, Scheduling, CMS*
2:45	Break
3:00	Using MACS to simulate far-term automated air traffic control operations. *Focus on Separation Assurance*
3:45	Developing MACS Software
4:30	End of day

MACS/ADRS simulation architecture and integration with ATOS and TMA

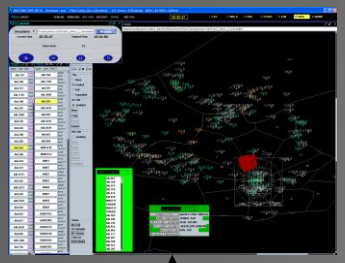
Tom Prevot

NASA Ames Research Center

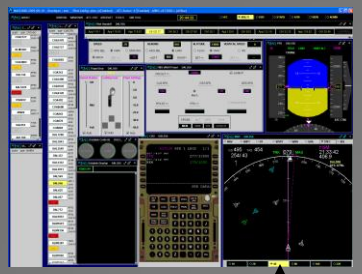


MACS Capabilities

Air traffic simulator /target generator



Multi aircraft autonomous agent



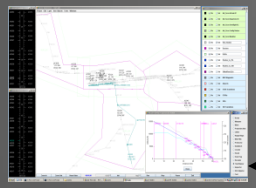
Multi aircraft control flight deck

Single aircraft flight deck (B777 style)

Experiment control

Traffic and weather generation

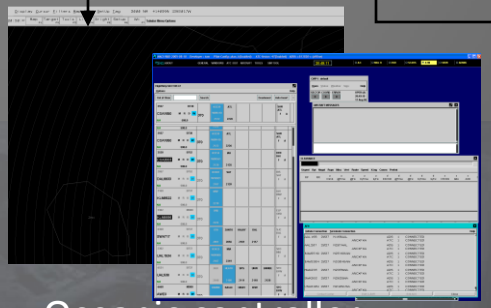
Aeronautical Datalink and Radar Simulator (ADRS) comm. network



Data collection Analysis

Center controller workstation (DSR)

TRACON controller workstation (STARS)



Oceanic controller workstation (ATOP/Ocean21)

Traffic flow and airspace management workstations

MACS Operator Modes

- Each MACS station runs the same software
- The Operator-Mode decides which functions (threads) and windows are enabled
- Only one operator mode can be selected for each station
- MACS stations running different operator modes are networked for a distributed simulation

MACS Operator Modes

- **Real-time distributed simulation**
  - Pilots
    - Single Aircraft Pilot
    - **Multi Aircraft Pilot**
  - Controllers
    - **Center-Controller**
    - **TRACON-Controller**
    - Oceanic Controller
  - Traffic Management and Area Supervisors
    - Planning Controller
    - Traffic Manager
  - Experiment Control
    - **Simulation Manager**
  - Data Collection
    - Observer
    - Analyst

- **Standalone simulation for software and scenario development**
  - Developer
    - ALL capabilities
  - **Developer-Lite**
    - All capabilities except for Oceanic Controller

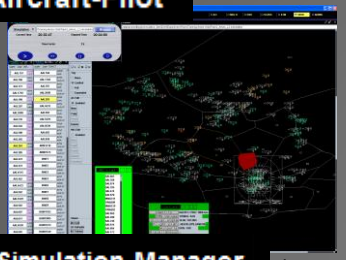
- **Special mode for MACS acting as FMS for CDTI (don't use!)**
  - cfms

Operator Modes/Simulation

Air traffic simulator /target generator

Single-Aircraft-Pilot

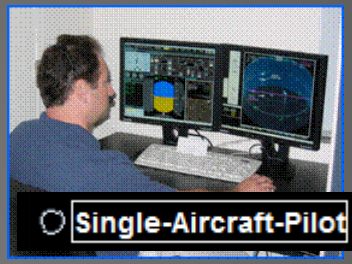
Multi-Aircraft-Pilot



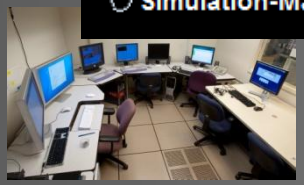
Multi aircraft autonomous agent

Multi aircraft control flight deck

Single aircraft flight deck (B777 style)



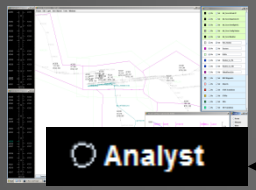
Simulation-Manager



Experiment control

Traffic and weather generation

Aeronautical Datalink and Radar Simulator (ADRS) comm. network



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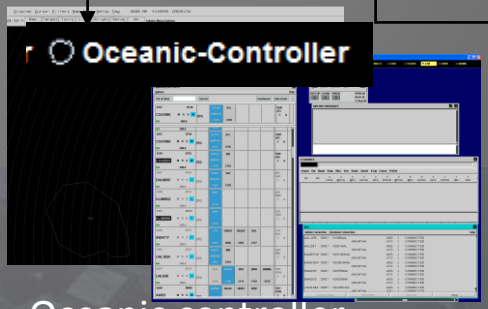


Oceanic controller workstation (ATOP/Ocean21)

Traffic flow and airspace management workstations

MACS Operator Modes

- A typical Center/TRACON simulation (ATD-1) uses
  - Simulation-Manager
  - Multi-Aircraft Pilot
  - Center-Controller
  - TRACON Controller

Typical Operator Modes (e.g. ATD-1)

Experiment control/target generator

Multi aircraft control flight deck and autonomous agent/Target generator

Aeronautical Datalink and Radar Simulator (ADRS) comm. network

Center controller workstation (DSR)

TRACON controller workstation (STARS)

PILOT

Simulation Manager

Multi-Aircraft Pilot

ADRS

ATC

Center-Controller

TRACON-Controller

AIRSPACE OPERATIONS LAB

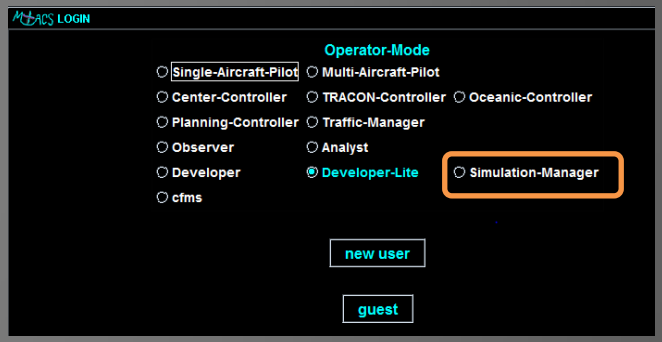
PILOT

Simulation Manager

Multi-Aircraft Pilot

- Specifies the scenario
- Launches the simulation
- Initializes all aircraft
- Simulates all aircraft that are not simulated anywhere else

ADRS



ATC

Center-Controller

TRACON-Controller

PILOT

Simulation Manager

Multi-Aircraft Pilot

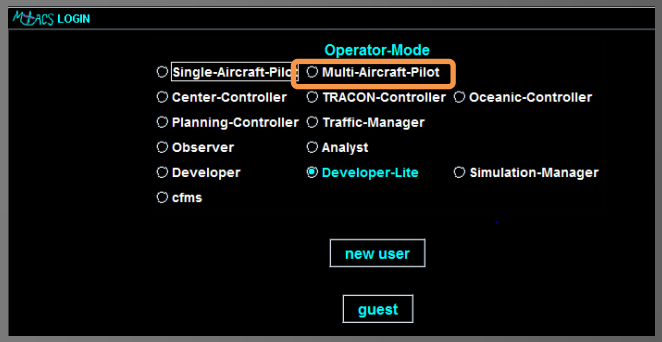
ADRS

ATC

Center-Controller

TRACON-Controller

- Simulates all aircraft according to its config file
- Provides quick entry mechanisms for pseudo pilot
- Provides only flight deck displays and setup panels



PILOT

Simulation Manager

Multi-Aircraft Pilot

ADRS

ATC

Center-Controller

TRACON-Controller

- Provides only Center controller(DSR) ATC displays and setup panels
- Provides flight data entry mechanisms for Center - Controllers

PILOT

Simulation Manager

Multi-Aircraft Pilot

ADRS

ATC

Center-Controller

TRACON-Controller

- Provides only TRACON controller(STARS) ATC displays and setup panels
- Provides flight data entry mechanisms for TRACON -Controllers

PILOT

Simulation Manager

Multi-Aircraft Pilot

- Specifies the scenario
- Launches the simulation
- Initializes all aircraft
- Simulates all aircraft that are not simulated anywhere else

ADRS

Simulates all aircraft according to its config file
Provides quick entry mechanisms for pseudo pilot entries

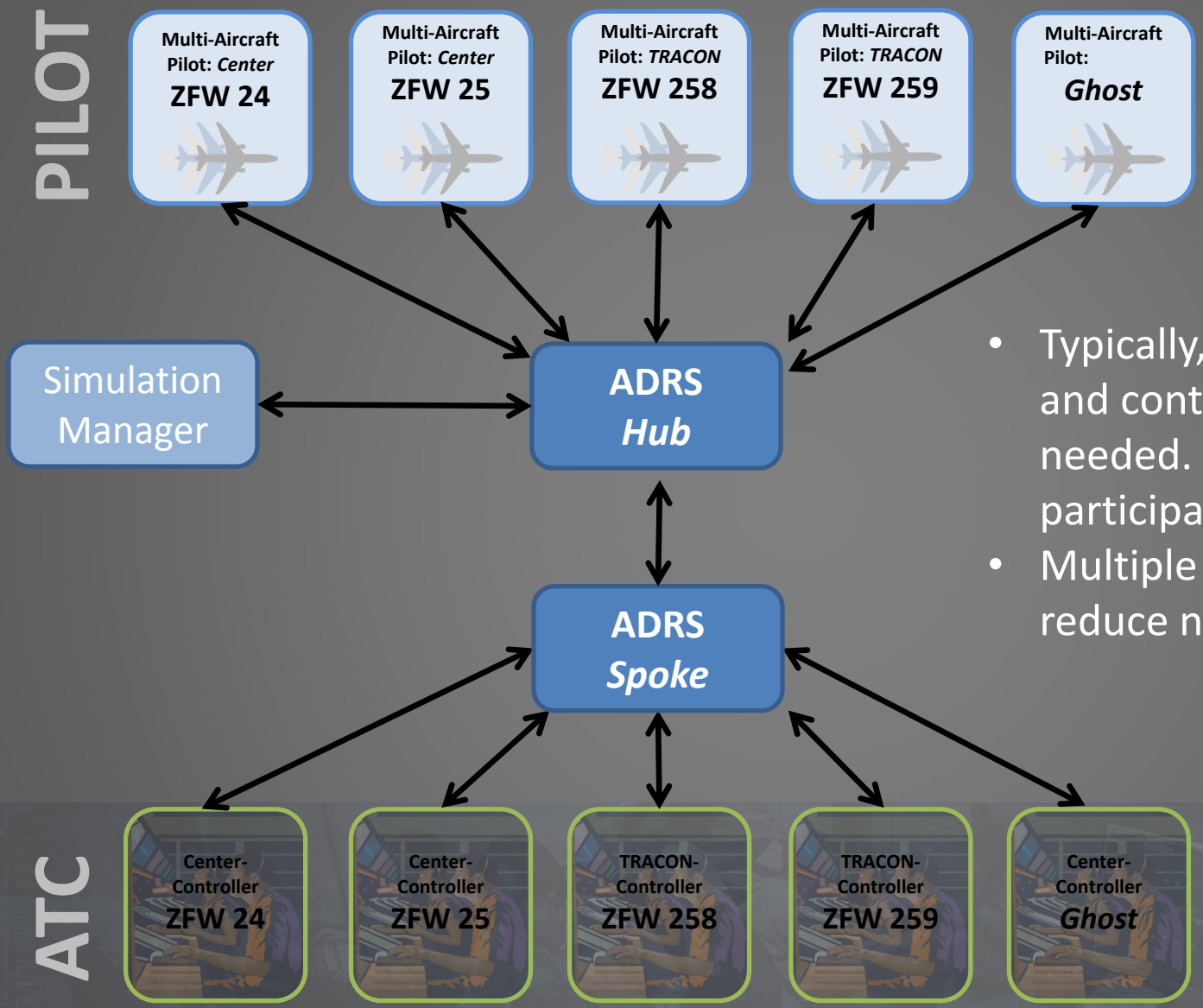
- Provides only flight deck displays and setup panels

ATC

- Provides only Center controller(DSR) ATC displays and setup panels
- Provides flight data entry mechanisms for Center -Controllers

- Provides only TRACON controller(STARS) ATC displays and setup panels
- Provides flight data entry mechanisms for TRACON -Controllers

Configuration with MACS/ADRS (e.g. CMS research*)



- Typically, multiple pilot and controller stations are needed. 1 pilot station per participant controller
- Multiple ADRS are used to reduce network load

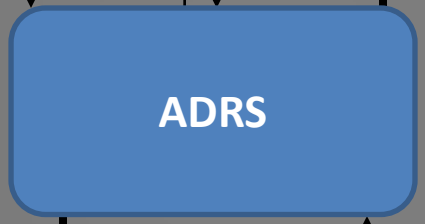
*actual number of pilot and controller stations : usually 8+ pilot, 3 center, 4-5 TRACON, 1 Tower

Standard Information Flow

Initial filed flight plan
Flight State
Active trajectory
ADS-B data (state and autopilot targets)
CPDLC Requests

STANDARD

Traffic ADS-B data (state and autopilot targets)
Traffic trajectories (ADS-A, B, C)
CPDLC Clearances/Trajectories/Frequency Changes/Responses/Free text /…



SURVEILLANCE
Radar Tracks
ADS-B state data

FLIGHT OBJECTS

Filed and amended flight plan
Flight data inputs: *altitude, heading, speed, text, RTA, STA, spacing, track control, handoff, point out, TOC, CPDLC eligibility, equipage…*
Reported trajectory
ADS-B flight control system targets

TRANSACTIONS
CPDLC Requests/Responses

STANDARD

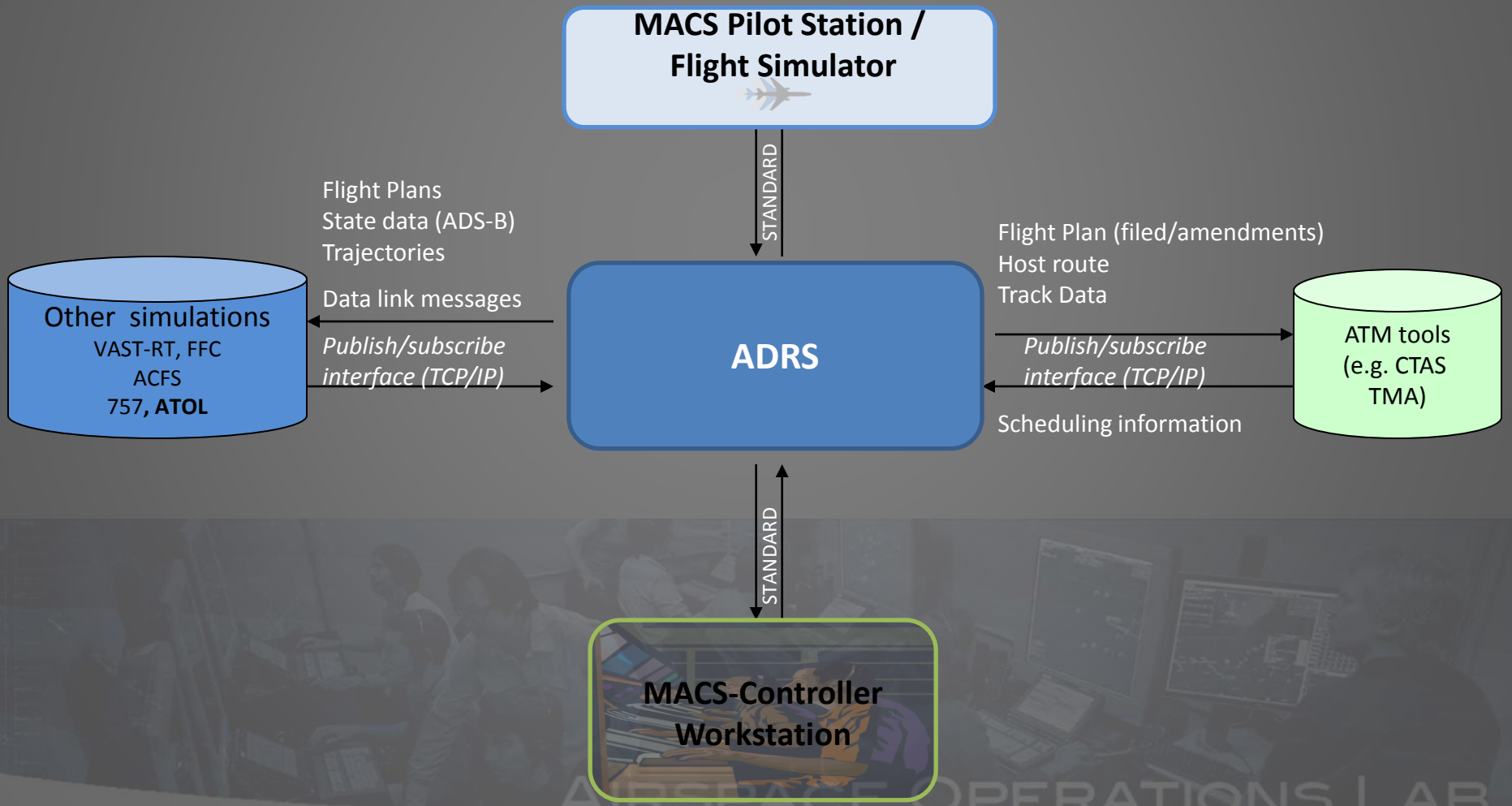
TRANSACTIONS

Controller and/or automation amendments: *routing, altitude, heading, speed, text, RTA, STA, spacing, track control, handoff, point out, TOC, CPDLC eligibility, equipage…*
CPDLC Clearances/Trajectories/Frequency Changes/Responses/Free text/…

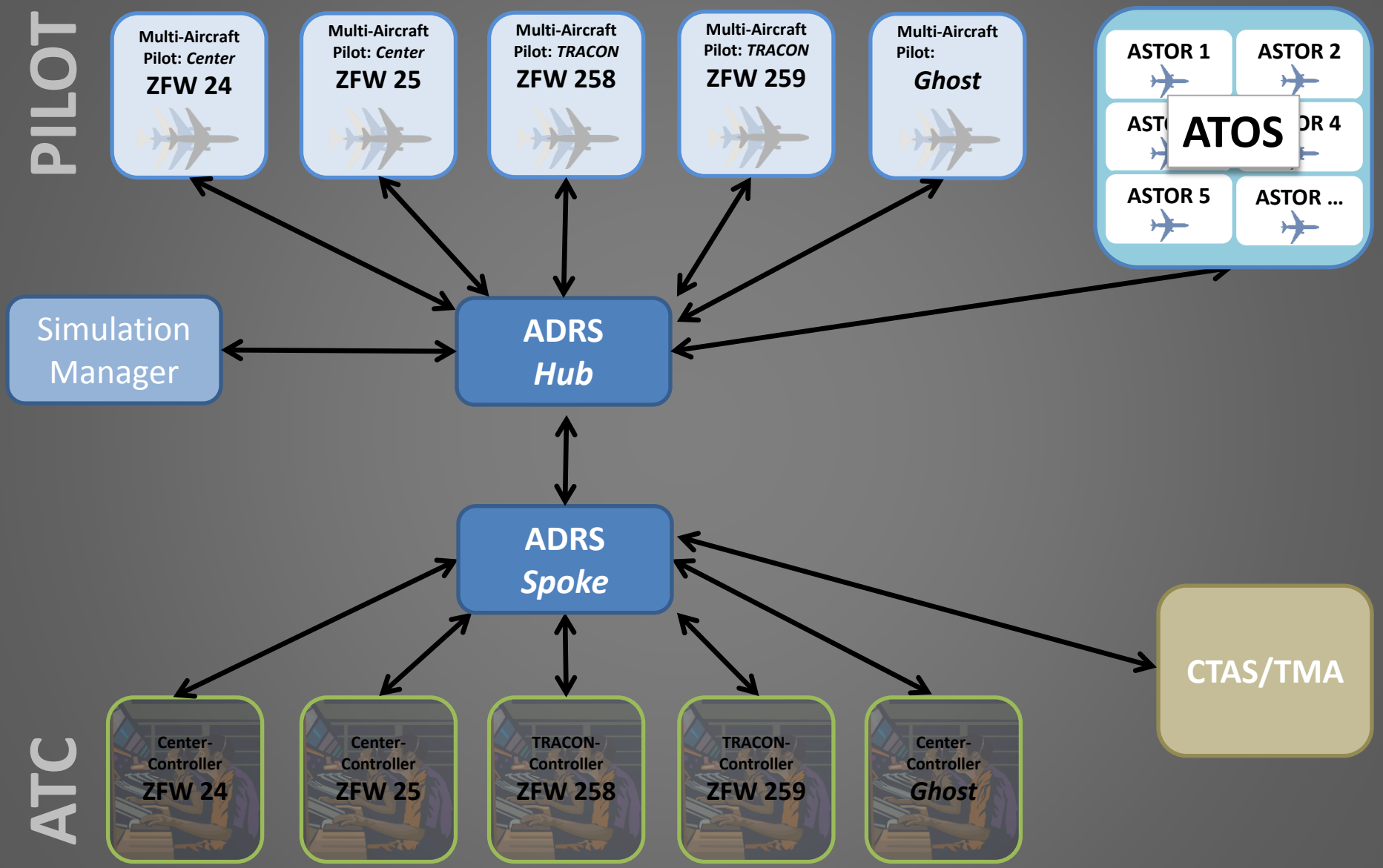
MACS Interface with Other Systems

All communication is handled by one or more networked ADRS processes

The ADRS provides publish/subscribe interfaces for MACS, other simulators and tools and maintains the entire state of the simulation



Integrated Configuration with MACS/ADRS/ATOS/TMA (ATD-1)



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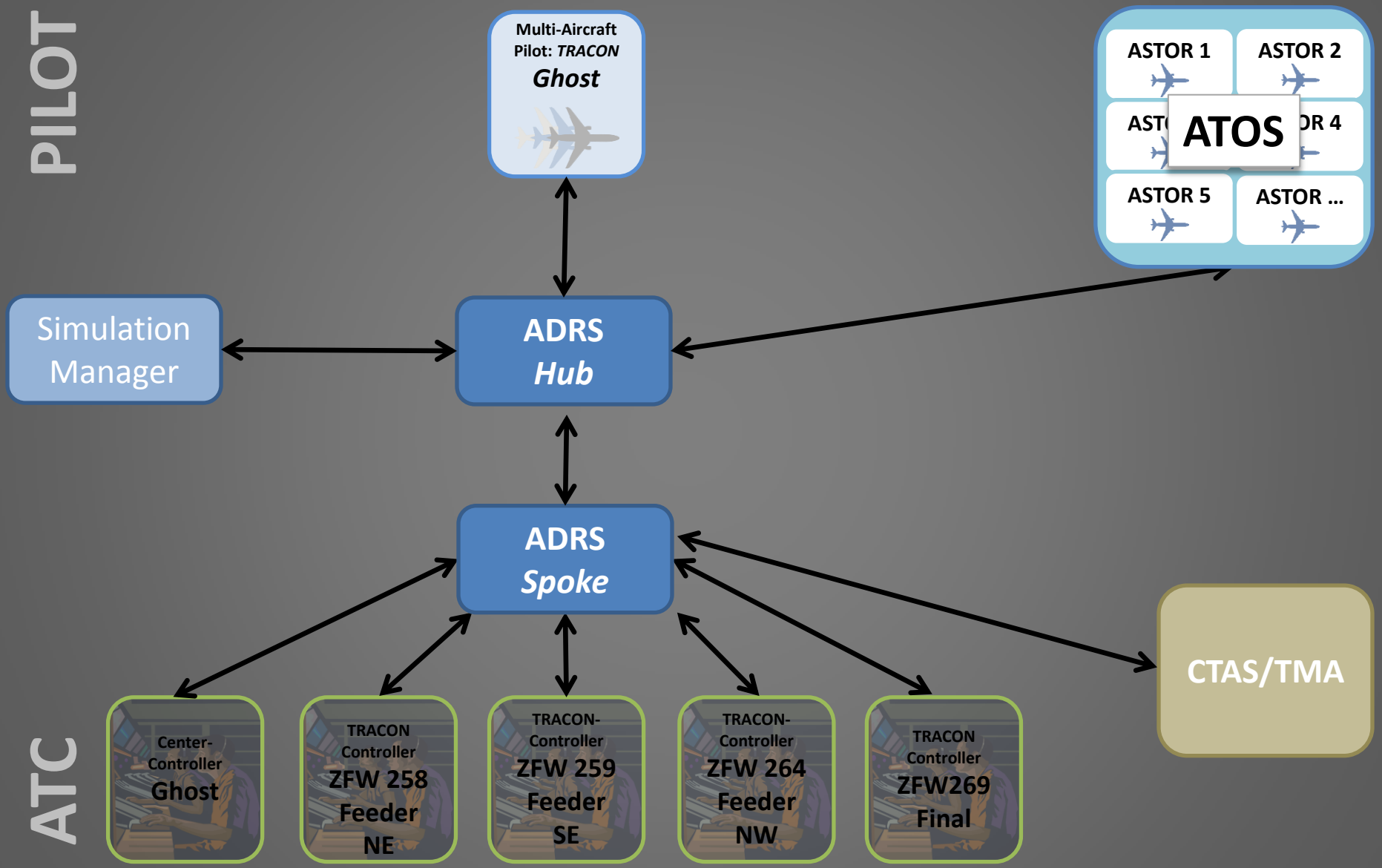
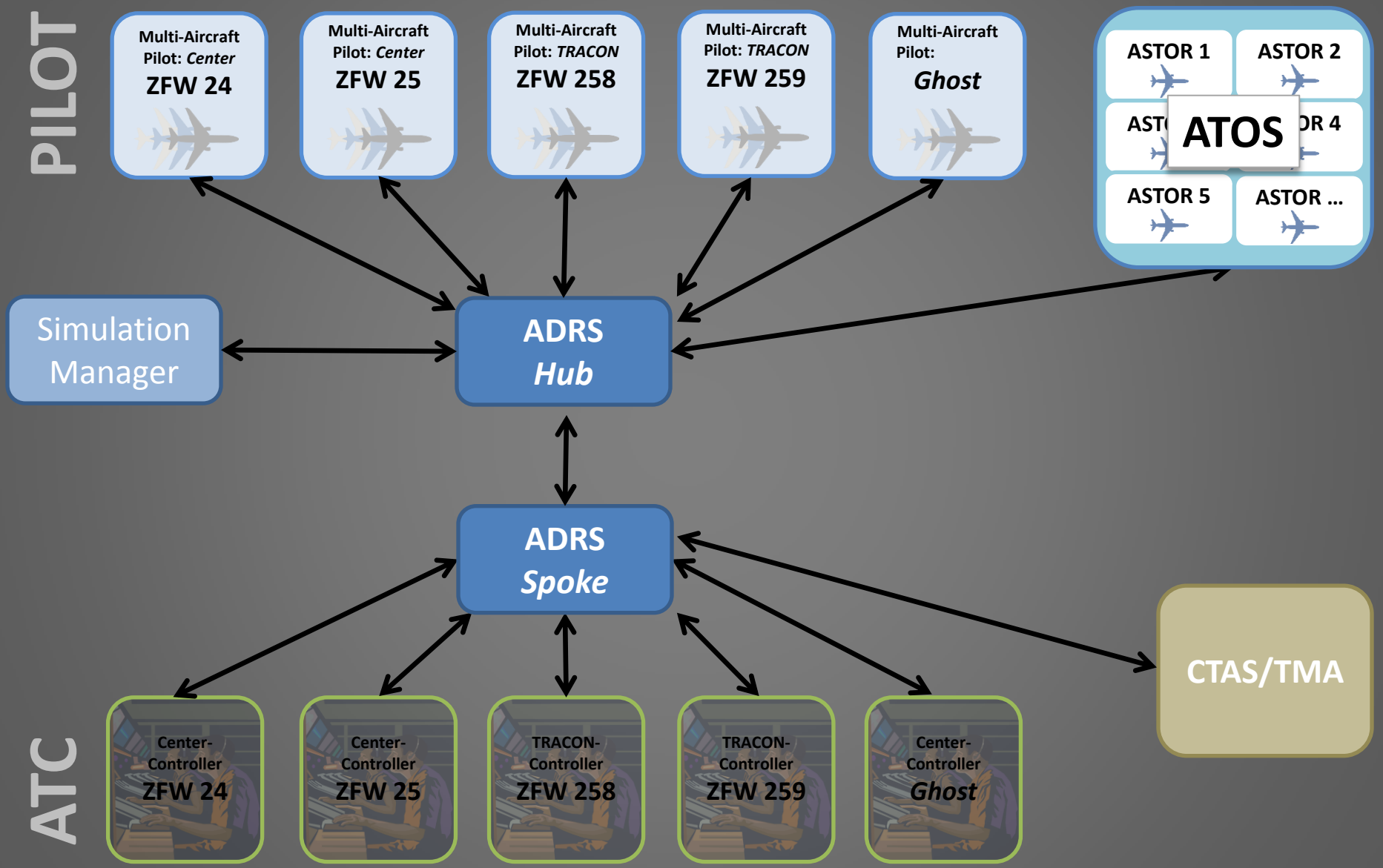
Possible Initial ATOL Configuration for ATD1



Integrated Configuration with MACS/ADRS/ATOS/TMA (ATD-1)



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Questions?