
Hazard Analysis of Teaming Systems

2021 STAMP Workshop Lightning Talk

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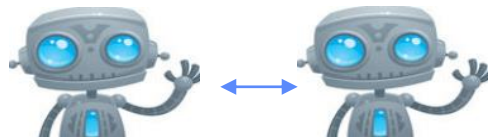


Teaming Overview

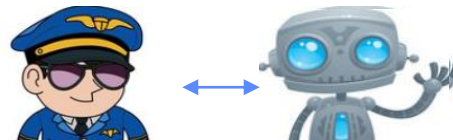
Aviation Teaming System Concepts



Teaming Systems can be:



automation-automation



human-automation



human-human

Definition in Literature - Team: two or more entities who interact **dynamically, interdependently,** and **adaptively** toward a **common** and valued **goal**, with **unique roles and functions** to perform (Salas 1992)

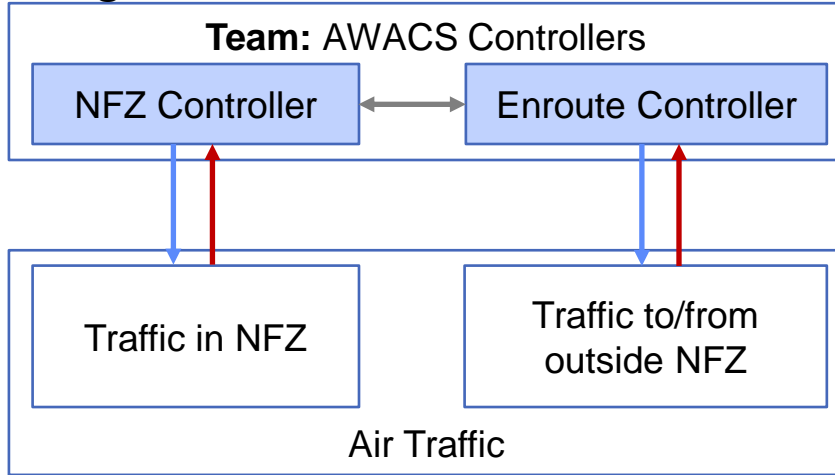
Questions: • What exactly is a “Teaming System”? How is it different than just a “System”?

- How to systematically design / analyze system safety for teaming systems

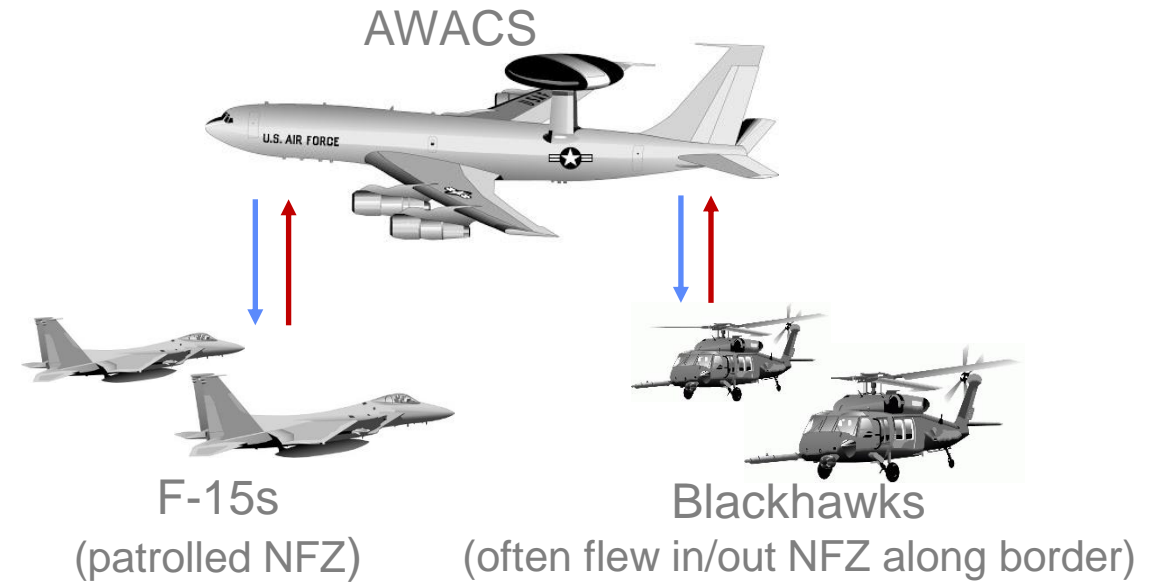
Example Accident Related to Teaming

1994 Friendly Fire of 2 USA Blackhawks by 2 USAF F-15s, all aircraft under AWACS control (Leveson, ESW)

Designed Control Structure



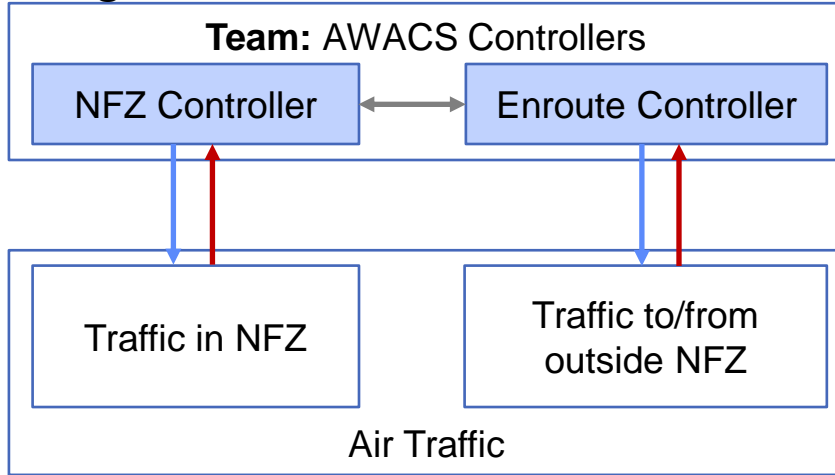
NFZ: No Fly Zone



Example Accident Related to Teaming

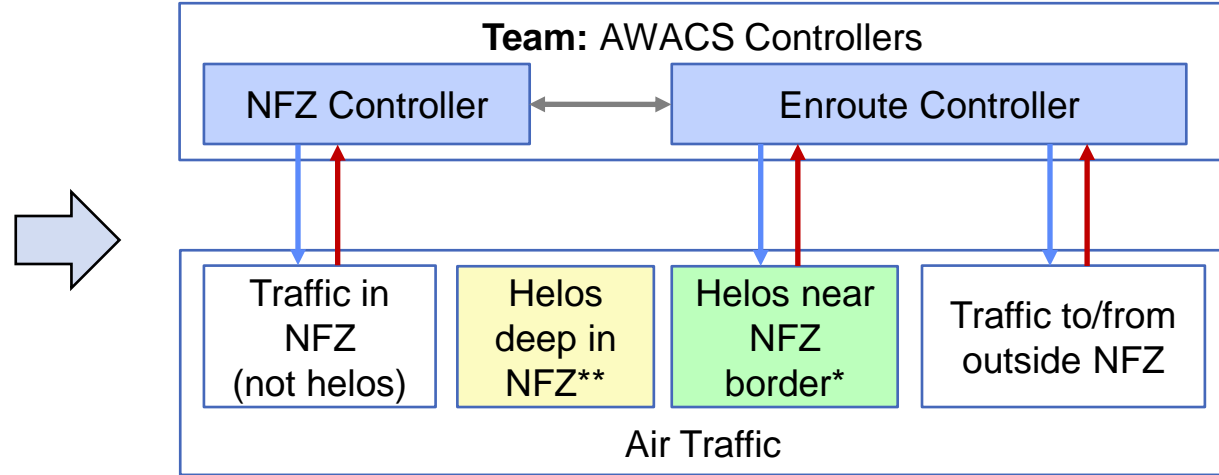
1994 Friendly Fire of 2 USA Blackhawks by 2 USAF F-15s, all aircraft under AWACS control (Leveson, ESW)

Designed Control Structure



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Evolved Control Structure



* Adapted over time

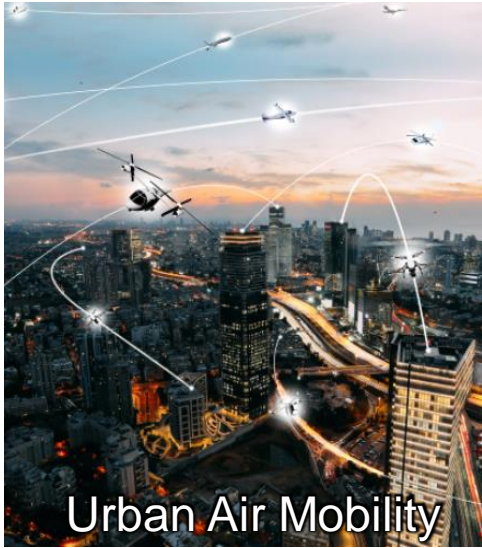
** Unanticipated control process

Considerations encountered in STPA Analysis

- Control structure dynamics: overlap of authority, unclear boundaries, asynchronous evolution
- Interdependent UCAs
- Coordination between controllers (Johnson, PhD '17)

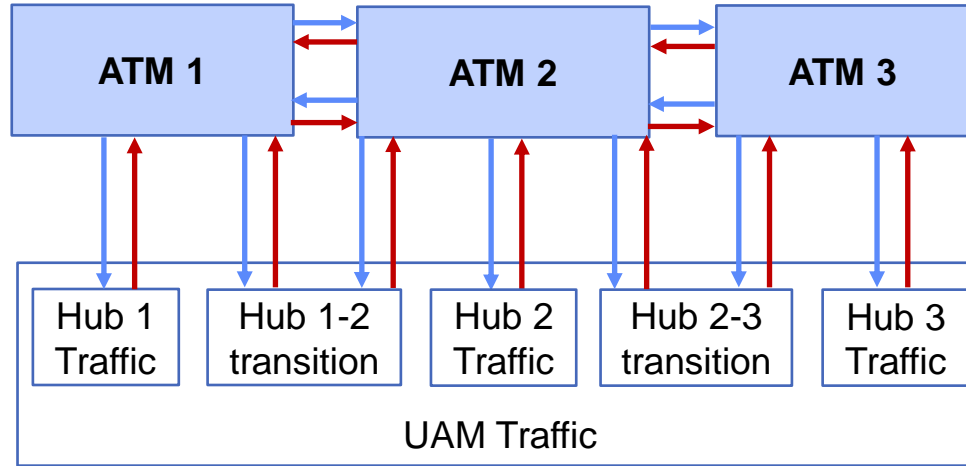


Teaming Control Structures in Aerospace Concepts



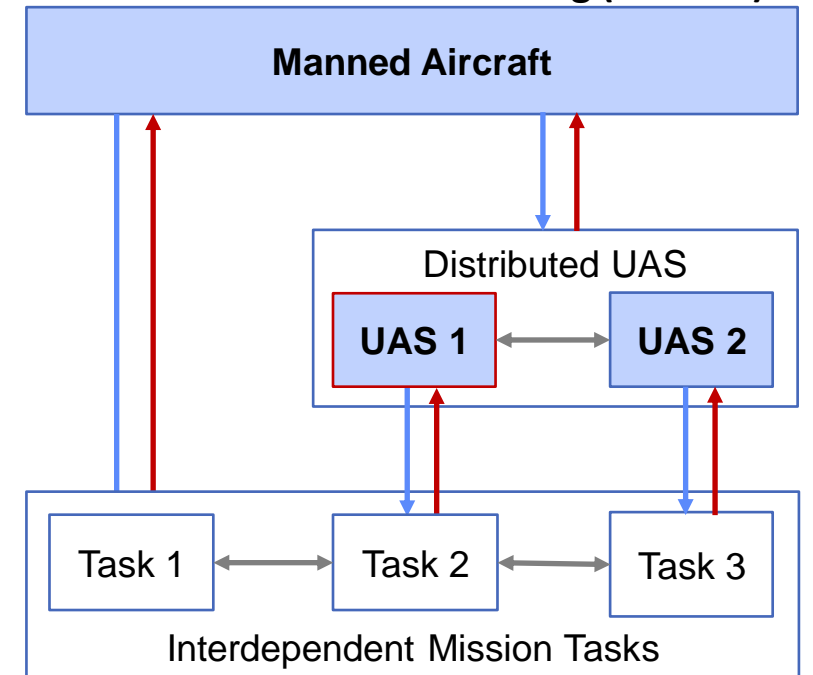
Urban Air Mobility

Air Traffic Mgmt (ATM) Distributed Control

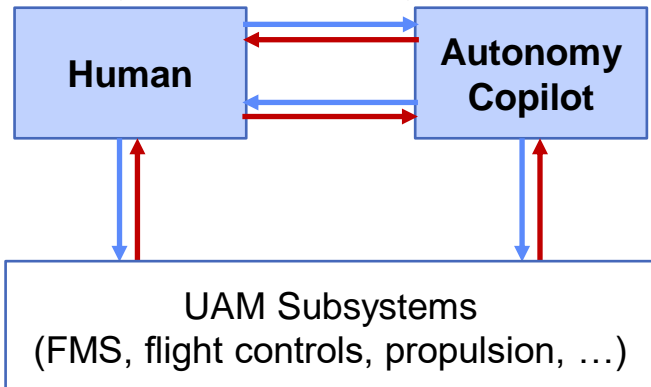


Swarms, Loyal Wingmen, MUM-T

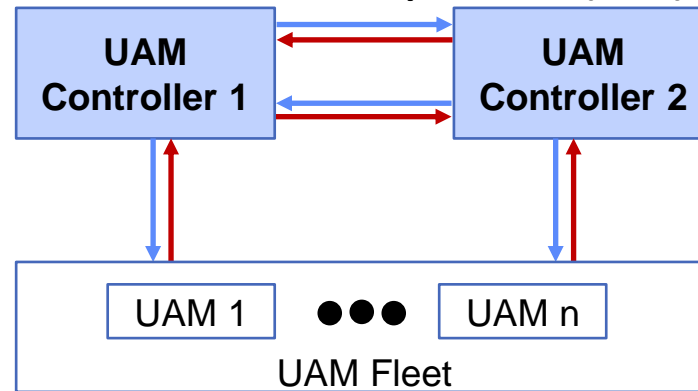
Manned-Unmanned Teaming (MUM-T)



UAM Human Autonomy Team in Simplified Vehicle Operation (SVO)

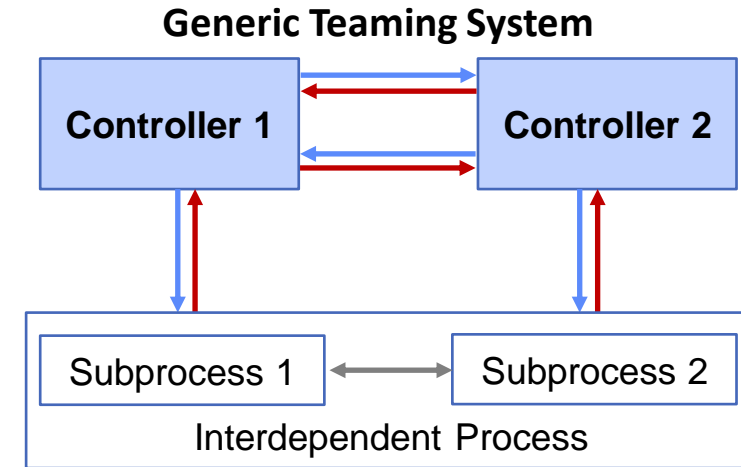


UAM Fleet Operations in Remote Vehicle Operations (RVO)



Properties Observed in Teaming Systems

- Distributed control
- Communications between controllers
- Controllers with bi-directional constraints
- Dynamic allocation of authority
- Asynchronous effects
- Shared responsibility
- Teams within broader teams



How do we enhance hazard analysis guidance to systematically and rigorously identify causal scenarios given teaming system properties?

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- Distributed control
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Interested in following information:

- Examples of teaming vs non-teaming systems
- Properties / attributes distinct to teaming
- Challenges in developing and fielding teaming systems
- Examples of accidents related to teaming
- References, resources on this topic

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- **Research Goal: Develop a rigorous and systematic framework to analyze system safety of multi-controller teaming systems. The framework will:**
 1. Specifically handle teaming system properties
 2. Enable safety-guided design to enhance verification and validation, and certification of these systems