

ATM-X

Air Traffic Management – eXploration
ATM-X and Urban Air Mobility Overview

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Integrated Future Airspace Operations

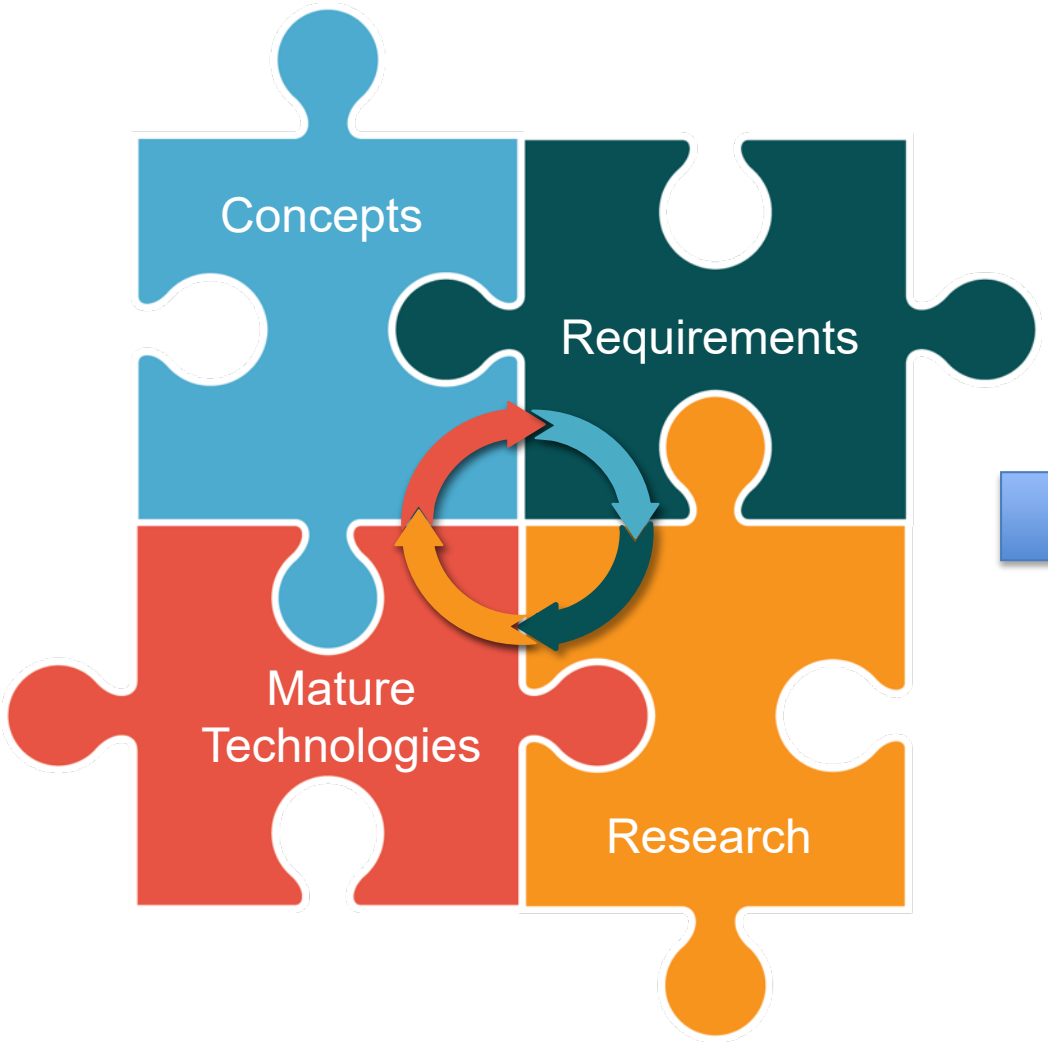


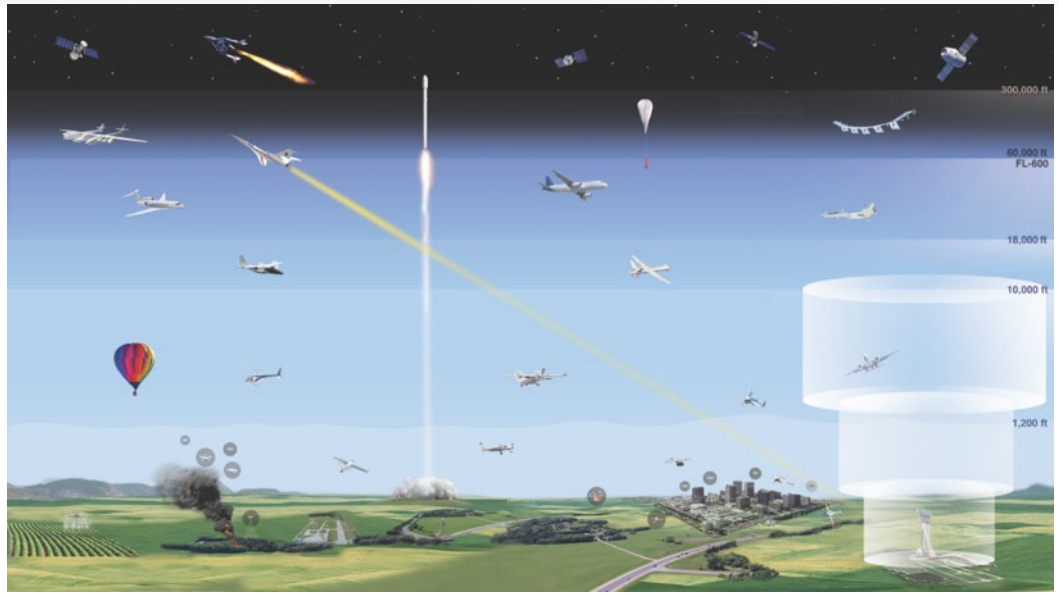
Traditional operations will be interacting with new entrants requiring operational and technological improvements for safe and efficient operations for all users

Airspace system needs to support more coordinated decisions for efficient management

ATM-X is exploring new concepts and airspace management technologies leveraging UTM attributes to enable safe and efficient operations for all users

ATM-X Project Goal

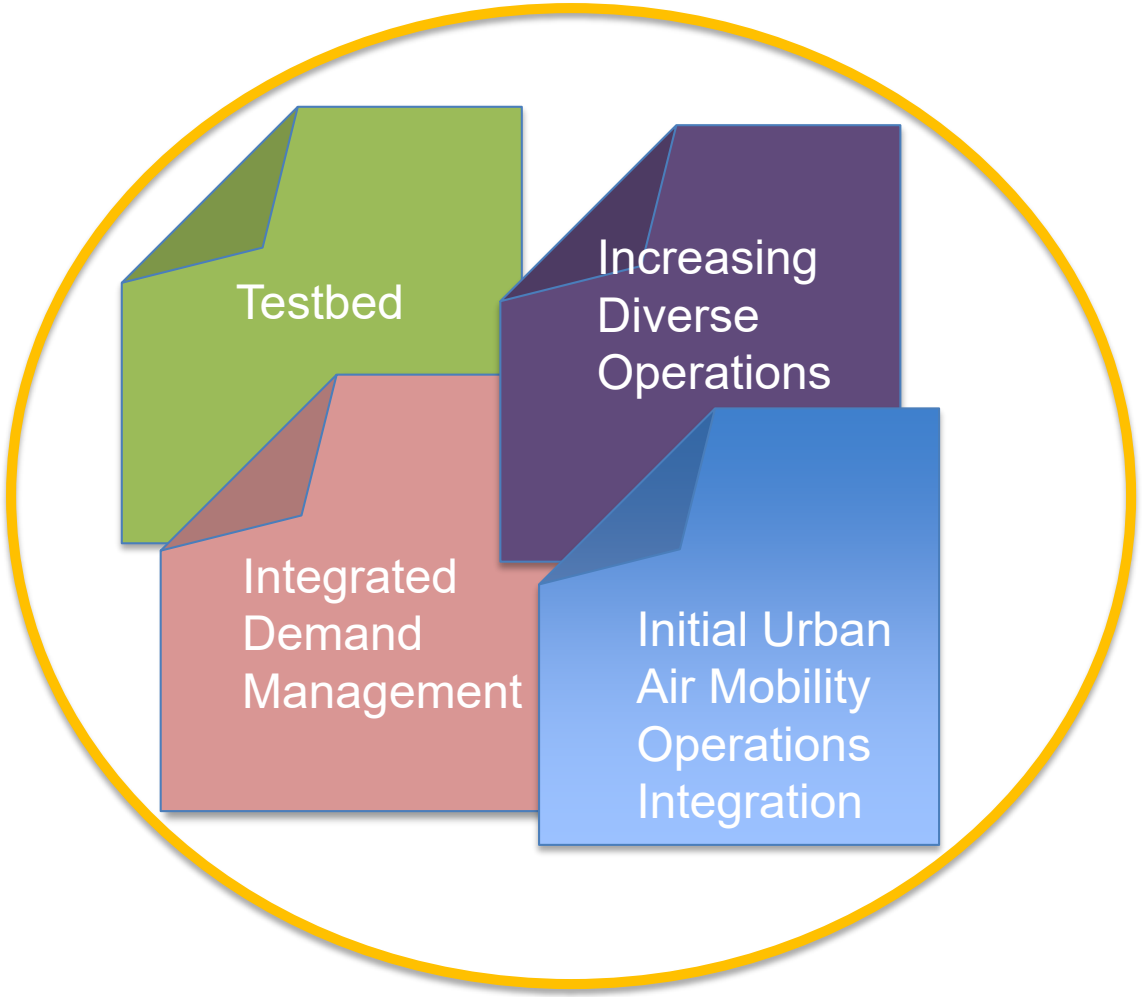


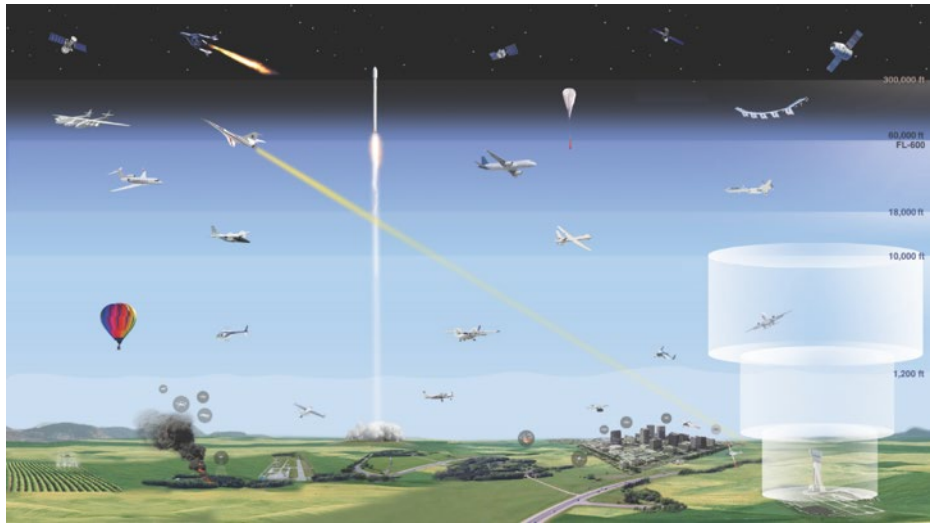


ATM-X Goal: Explore concepts, define requirements, and build technologies towards an integrated transformed air traffic system to enable safe and efficient airspace access across all users, vehicles, and missions

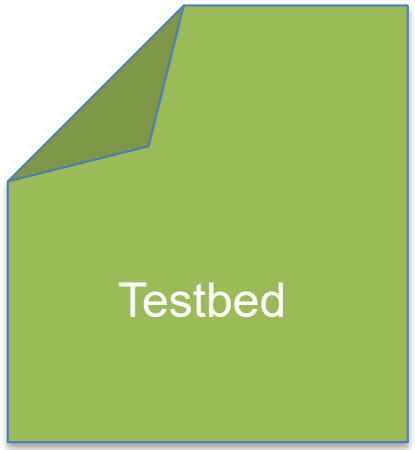
ATM-X Portfolio

ATM-X has a portfolio of four sub-projects where each area contributes to achieving the ATM-X goal by exploring new concepts with targeted areas of research





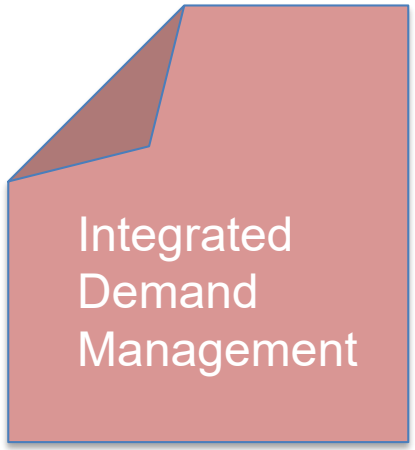
ATM-X Sub-Projects



Accelerates evaluation of ATM-X *concepts, technology development*, and research in a service-oriented environment



Develops a *concept for airspace integration of UAM operations* and conducts research for *developing the UAM airspace system by extending UTM architecture*



Quantifies the benefit of coordinating digital data for strategic and tactical traffic management



Initiates the *concept for future airspace* and *explores UTM-inspired ATM services* for traditional commercial transport operations

Initial Urban Air Mobility Operations

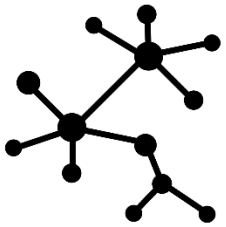


Motivation: Burgeoning UAM market estimated to be in the billions of dollars and will need a system to manage high-tempo airspace access and high-density operations

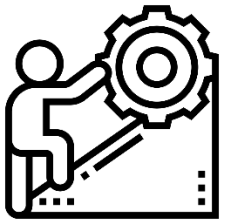
Approach: Develop UAM airspace concept, build and test a UAM airspace system (extended from UTM TCL4) and UAM services to define requirements to enable mature UAM operations

UAM Research

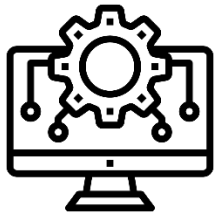
UAM Research



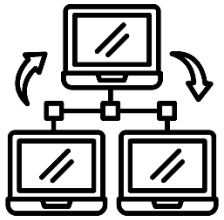
Develop concept of operations for UAM in collaboration with other NASA projects, the FAA, and the UAM community



Identify and characterize technical challenges for UAM airspace operations that the UAM community must tackle

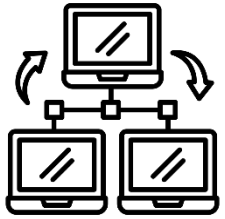


Develop and utilize airspace algorithms for research to define requirements; leveraging, adapting, extending existing algorithms whenever possible

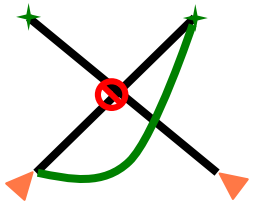


Defining information exchange requirements for interoperability across UAM airspace technologies

UAM Research Questions



What are the information exchange requirements and protocols needed for independently-developed airspace management services to interoperate?



What are the UAM separation minima requirements?



What are effective management strategies for UAM operations under uncertainties?



What are effective management strategies and procedures for minimizing noise generated by UAM operations?

National Campaign

- Challenge the industry to execute ecosystem-wide safety and integration scenarios
- Build knowledge base for requirements and standards
- No purse or prize money



NC-Developmental Test (2020) and NC-1 (2022) flight activities with simulation activities to prepare before each

ATM-X in National Campaign

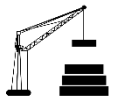
- Developing and preparing the core UAM airspace system for NC simulation and flight activities



  - Enables NASA and NC partners to collaborate



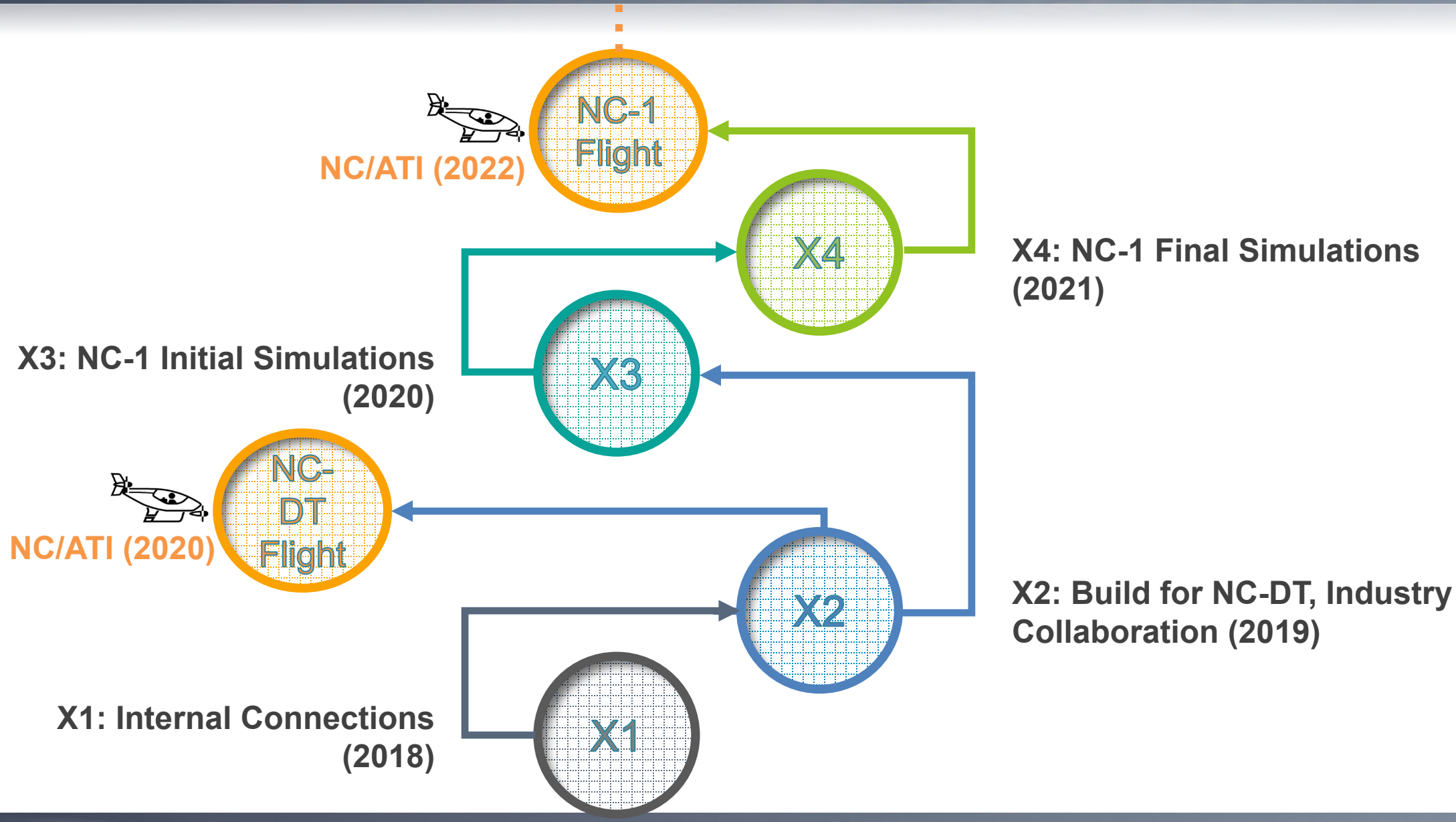
  - Supports data sharing and integration to ‘plug and play’ technologies through interfaces



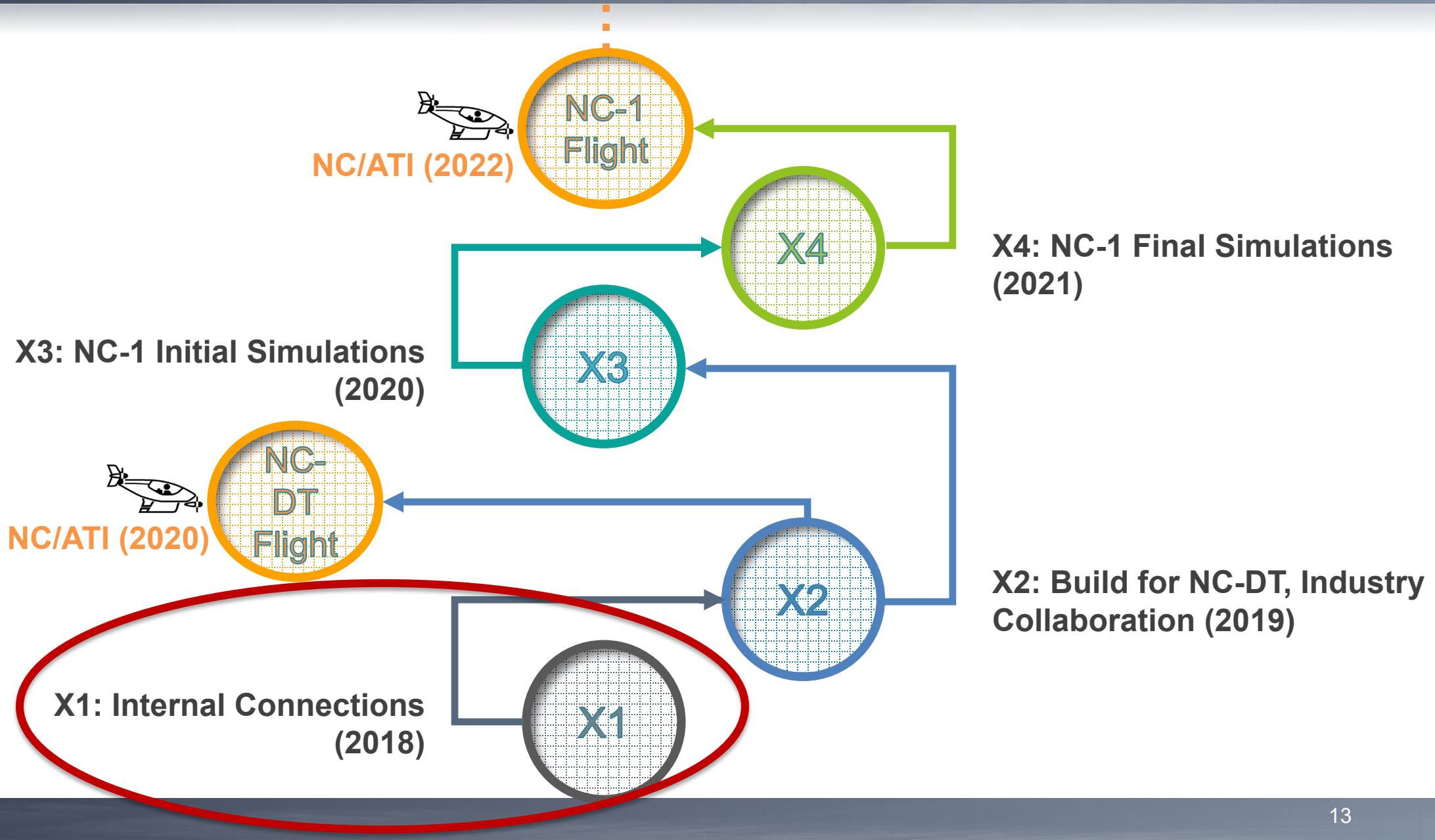
  - Builds upon UTM software and adds access to data and services needed for NC

- Conducting simulations of NC scenarios with NC airspace partners in preparation for NC flight tests

ATM-X UAM in NC



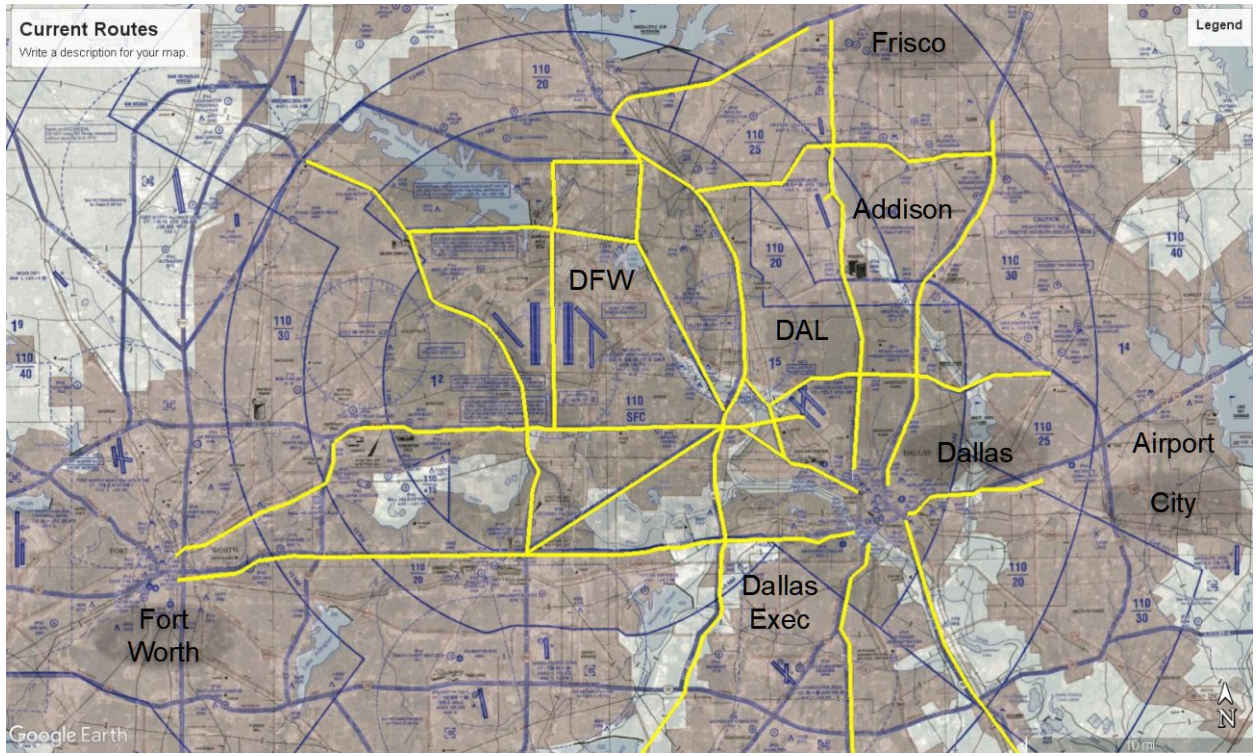
ATM-X UAM in NC



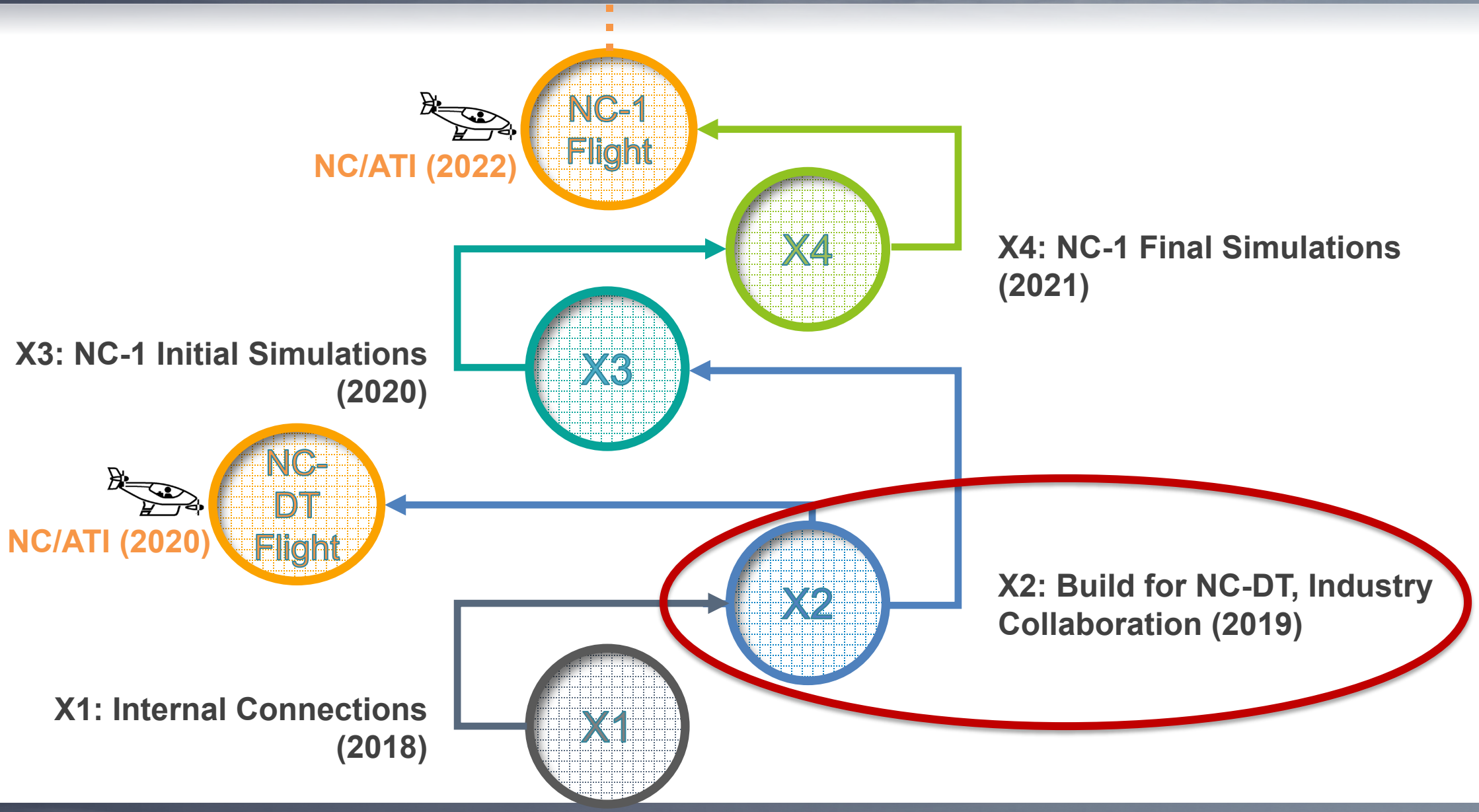
X1

Goal: Build up capabilities to evaluate UAM concept and technologies and to better understand UAM operations

Approach: Assess scalability of simulation capability by evaluating low to high tempo UAM flights managed with near-term procedures in DFW area



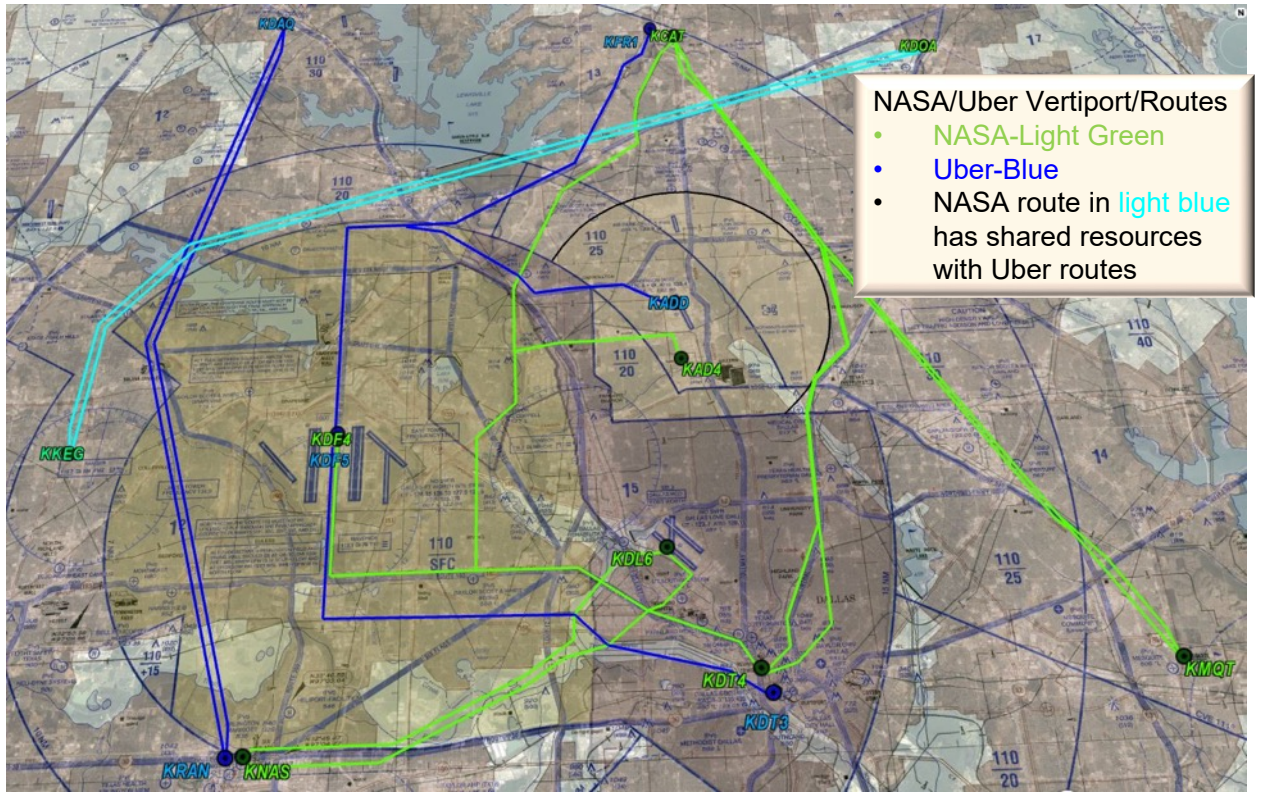
ATM-X UAM in NC



X2

Goal: Determine if the UAM airspace system can enable the high-tempo information exchange required between simultaneous high-tempo UAM operations by multiple operators in shared airspace

Approach: Conduct lab evaluation with industry partner Uber using the UAM airspace system



X2 Accomplishments

Expanded performance limits of UTM implementation in collaboration with NASA UTM team to meet UAM X2 simulation requirements

- Modifications made to enable simulation of mature UAM operations (up from about 40 concurrent operations with the UTM implementation as is)
- Incorporated design insights gained during UTM activities

Conducted simulations that showed UTM architecture is scalable for mature UAM operations

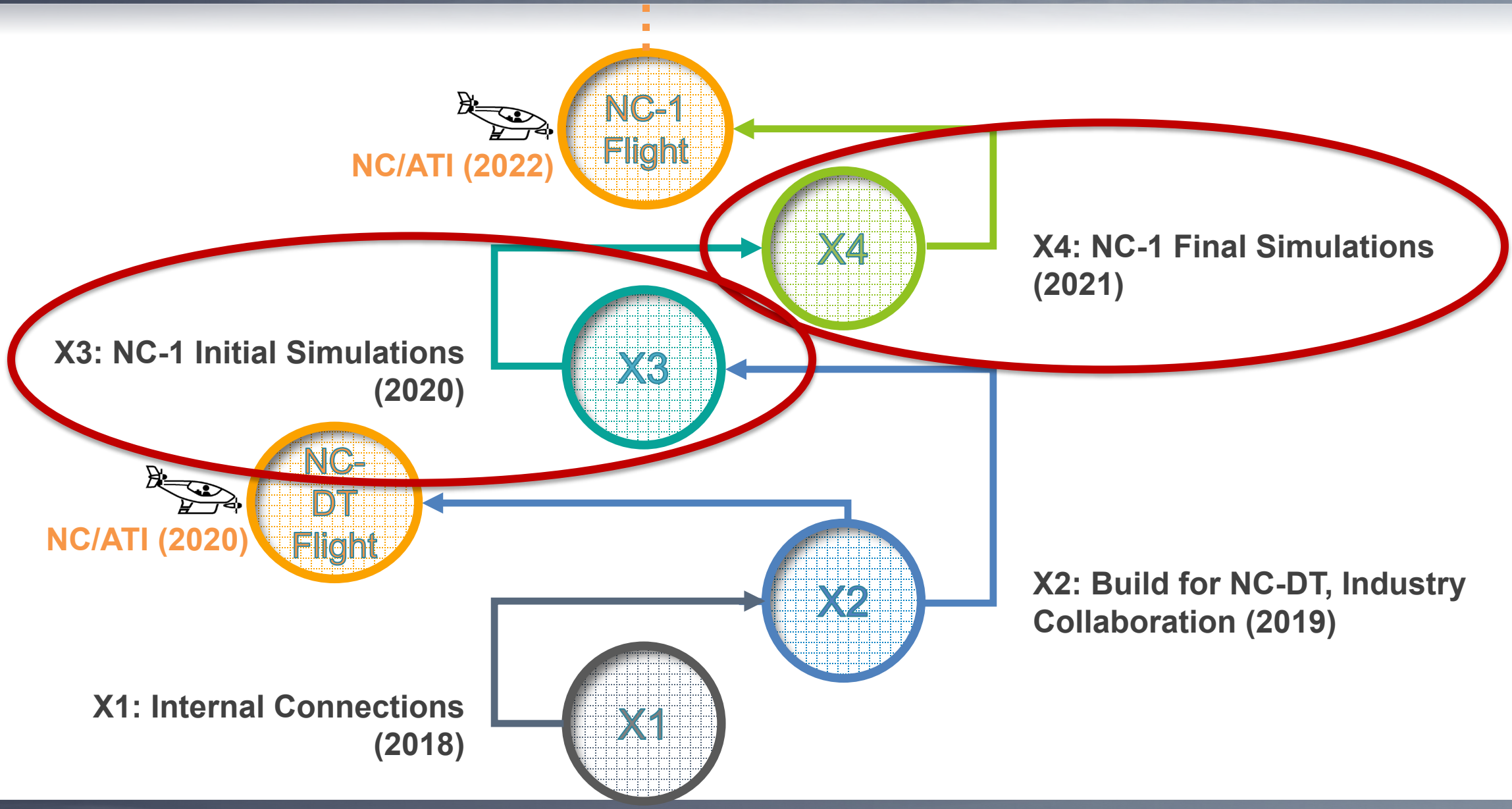
- 100+ UAM operations simulated concurrently by NASA and Uber

Identified additional system performance enhancements for mature UAM operations

- Different information exchange protocol needed for high-tempo data in mature UAM operations (e.g., 1 Hz position updates); alternative streaming protocol being explored
- Need to transition to latest implementations of system components provided by industry; currently underway

X2 Demonstrated that the UTM Architecture is Scalable for mature UAM operations

ATM-X UAM in NC

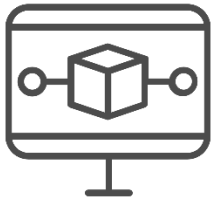


X3 and X4

X3



Develop sandbox for NC airspace partners to connect their technologies

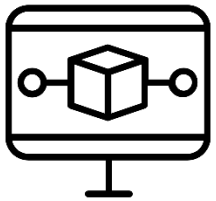


Conduct simulations on a subset of NC-1 scenarios with NC airspace partners

X4



Modify information exchange interfaces for testing in NC, in collaboration with the FAA and NC airspace partners



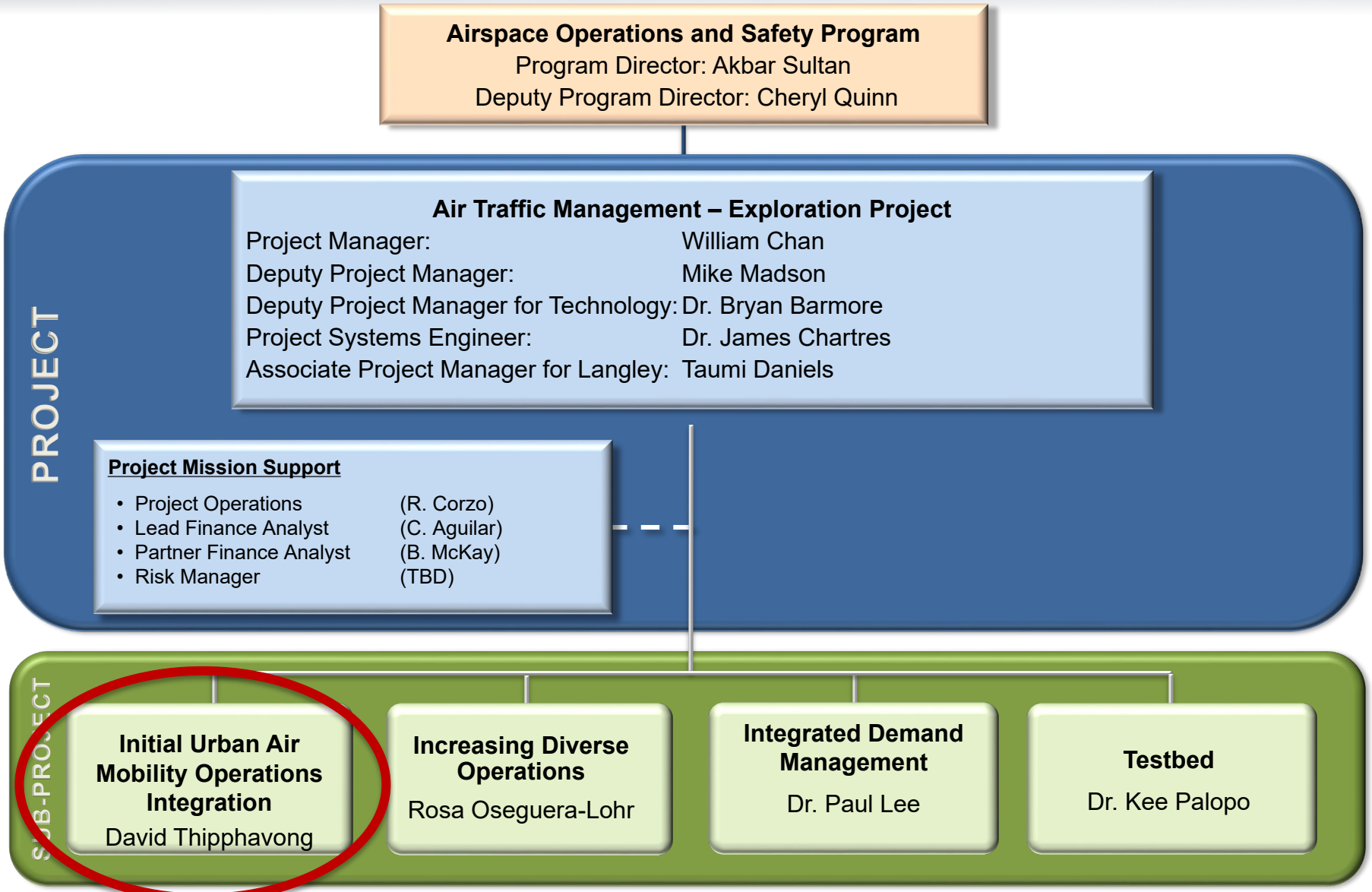
Conduct simulations on the full set of NC-1 scenarios with NC airspace partners to prepare for NC-1 flight tests

Concluding Remarks

ATM-X UAM is focused on the airspace aspects of UAM

- Developing UAM concept of operations in collaboration with the FAA, other NASA projects, and the UAM community
- Conducting research towards defining airspace requirements for mature UAM operations
- Developing and preparing the core UAM airspace system for simulation and flight activities in National Campaign and conducting NC simulations with NC partners in preparation for NC flight tests

ATM-X Organizational Chart



UAM Organizational Chart

Initial Urban Air Mobility (UAM) Operations Integration Sub-Project

Sub-Project Manager:	David Thipphavong
Deputy Sub-Project Manager:	Lindsay Stevens
Sub-Project Systems Engineer:	Annie Cheng
Sub-Project Project Control Analyst:	Charlene Cayabyab

Grand Challenge
Lead: Spencer Monheim

UAM Concept
Lead: Joey Rios

UAM Research
Lead: Heather Arneson