NASA Quesst Mission Update

Aeronautics and Space Engineering Board Fall Meeting

October 8, 2024

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Image credit: Lockheed-Martin

Presentation topics

- Quesst mission background and overview
- Mission elements
  - Phase 1: X-59 Aircraft Design and Fabrication
  - Phase 2: Acoustic Validation
  - Phase 3: Community Response Tests
- Mission timeline
- Concluding remarks


ULTRA-EFFICIENT AIRLINERS

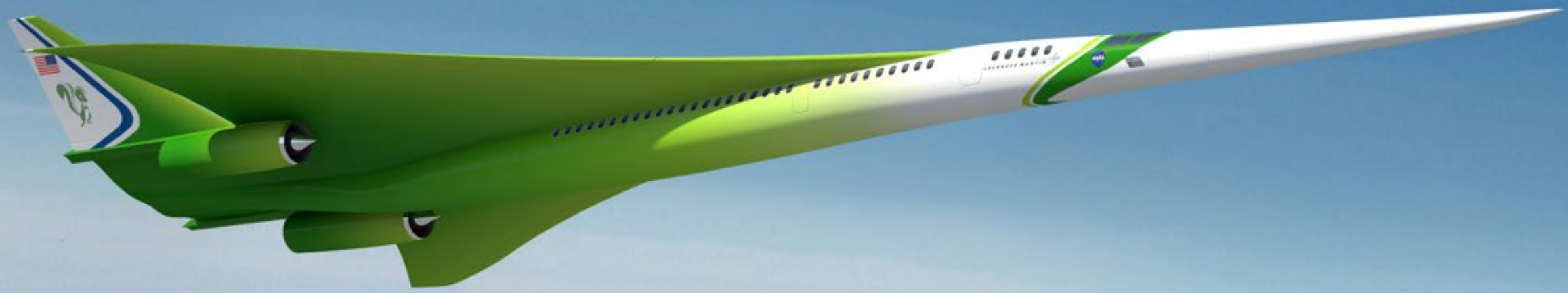

FUTURE AIRSPACE AND SAFETY


HIGH-SPEED COMMERCIAL FLIGHT


ADVANCED AIR MOBILITY

Vision for commercial supersonic flight

- The vision of the supersonics community is a future where sustainable fast air travel is available for a broad spectrum of the traveling public.
- NASA plays a vital role in developing technology and collecting data that will enable a new market for commercial supersonic flight over land.



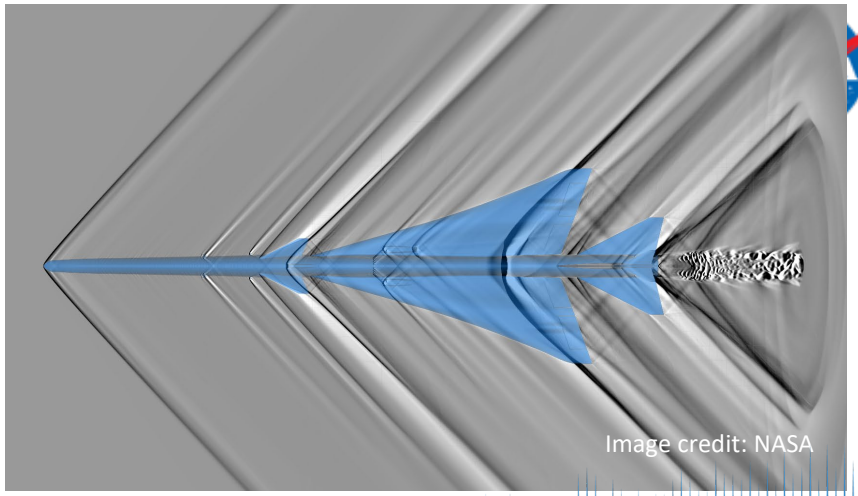
QUESST

Quiet supersonic design

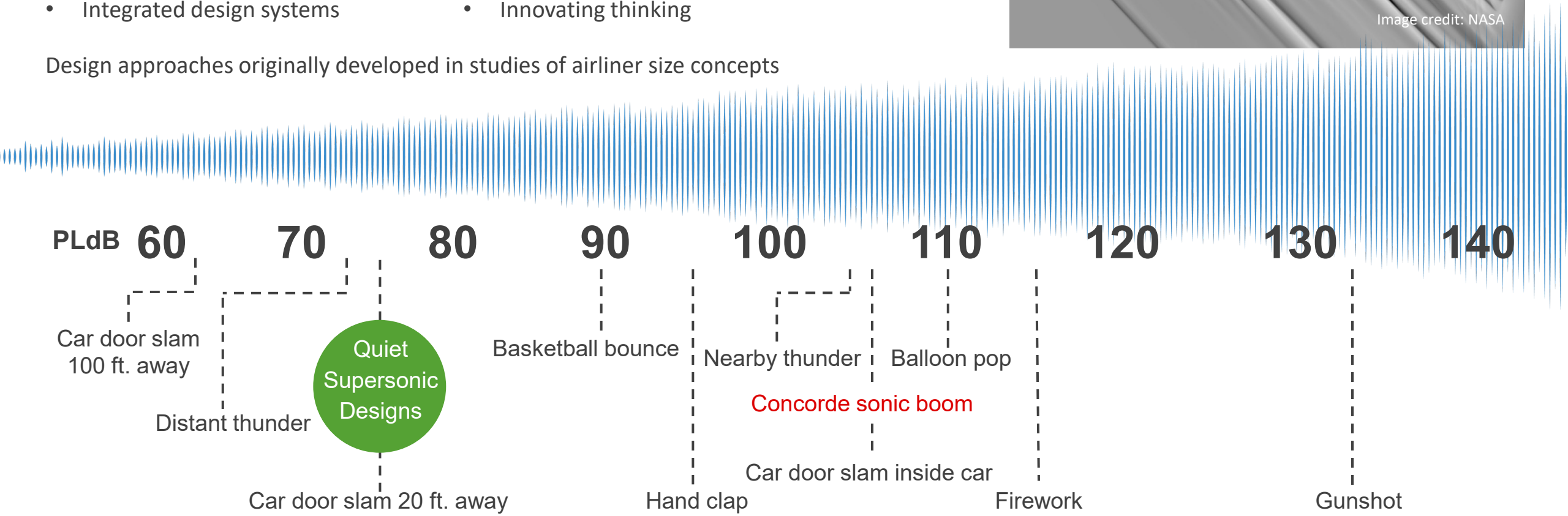
Acoustic pressure wave is “shaped” by controlling the strength and position of shock waves generated by aircraft components

Important advances:

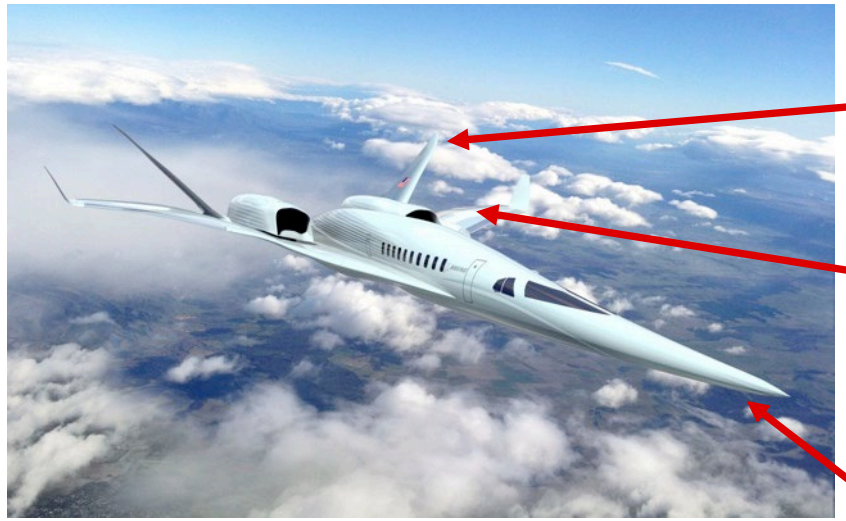
- Higher fidelity analysis
- Integrated design systems
- Faster computers
- Innovating thinking



Design approaches originally developed in studies of airliner size concepts



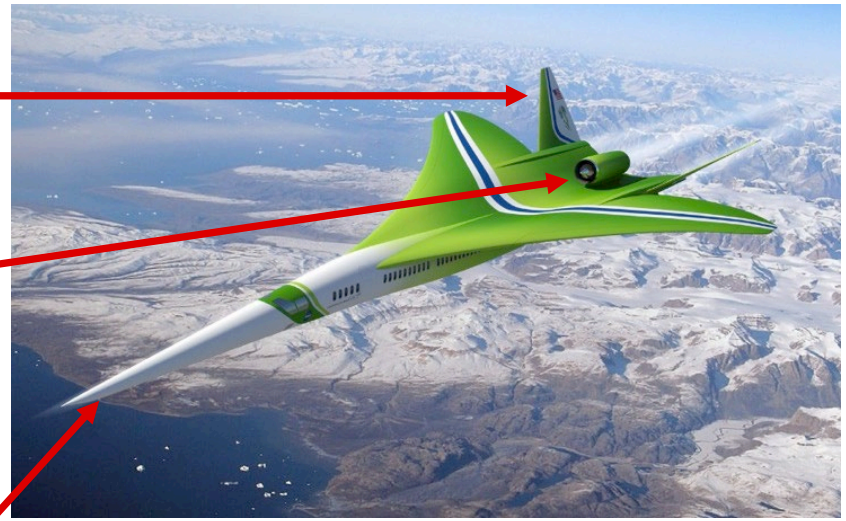
Breakthrough: Quiet, practical supersonic airliner designs

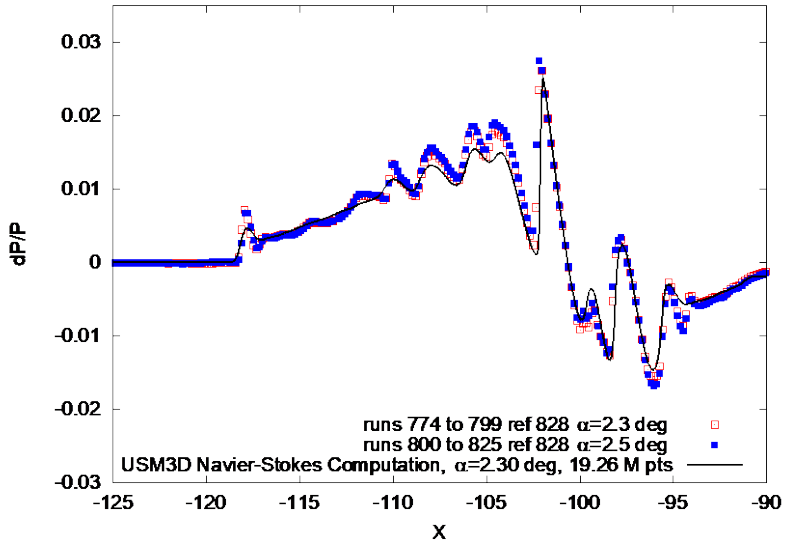


Unique empennage shape to control lift impact on signature

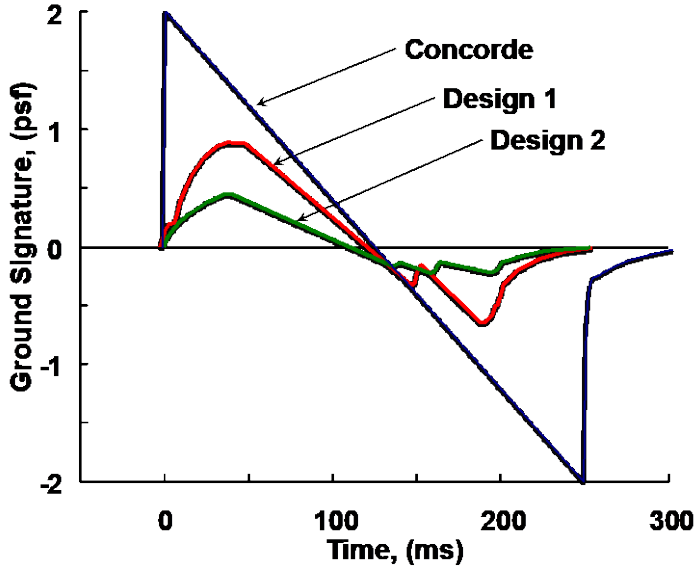
Propulsion installation minimizes contribution to signature

Integrated 3-D design of fuselage shape, wing planform camber & thickness





Wind tunnel/analysis comparison



Ground signature comparison

Overcoming the barrier to overland flight

Quesst Mission Goal:

Collect internationally accepted data to support ICAO-CAEP effort to develop an En Route Noise Standard

- **An En route Noise Standard is required**
  - Replace current prohibitions
  - Create relevant data to define limits
    - Community data from large, diverse population
  - Accepted internationally

Quesst mission overview and the X-59 aircraft

Use the X-59 Research Aircraft to gather data on community response to quiet supersonic flight

Phase 1: Research Aircraft Development

- Design, fabrication, ground test, and envelope expansion

Phase 2: Acoustic Validation

- Detailed ground and flight measurement to prove design

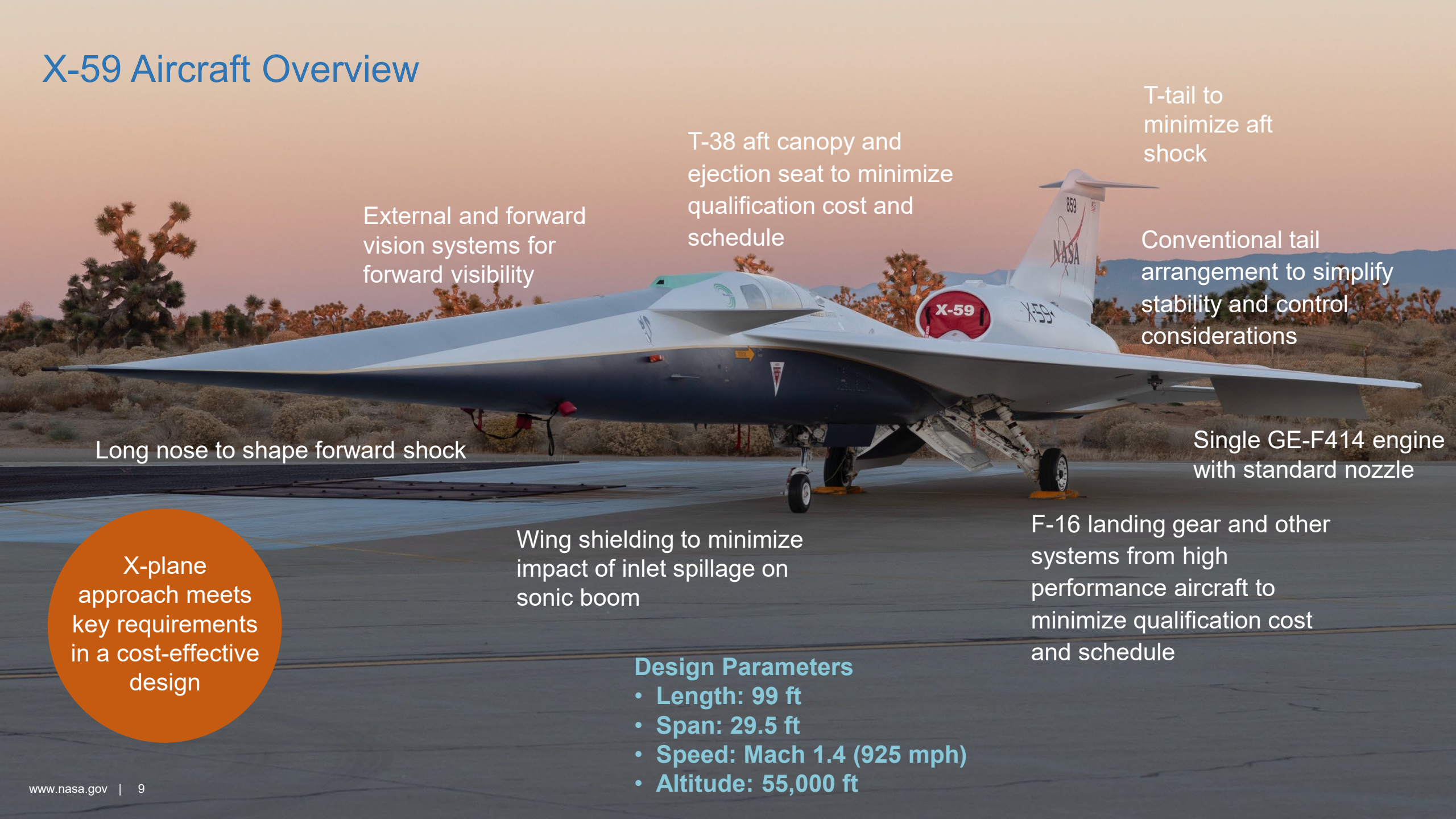
Phase 3: Community Response Testing

- Overflights, sound measurement, surveys

Community test requirements drove the X-59 design

- The acoustic signal must effectively replicate that of future larger supersonic commercial aircraft.
- The X-plane must conduct community overflight tests using normal commercial aircraft flight maneuvers.

X-59 Aircraft Overview



T-tail to minimize aft shock

T-38 aft canopy and ejection seat to minimize qualification cost and schedule

External and forward vision systems for forward visibility

Conventional tail arrangement to simplify stability and control considerations

Long nose to shape forward shock

Single GE-F414 engine with standard nozzle

X-plane approach meets key requirements in a cost-effective design

Wing shielding to minimize impact of inlet spillage on sonic boom

F-16 landing gear and other systems from high performance aircraft to minimize qualification cost and schedule

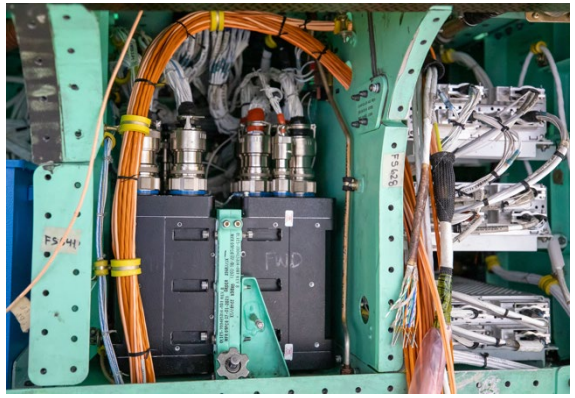
Design Parameters

- **Length: 99 ft**
- **Span: 29.5 ft**
- **Speed: Mach 1.4 (925 mph)**
- **Altitude: 55,000 ft**

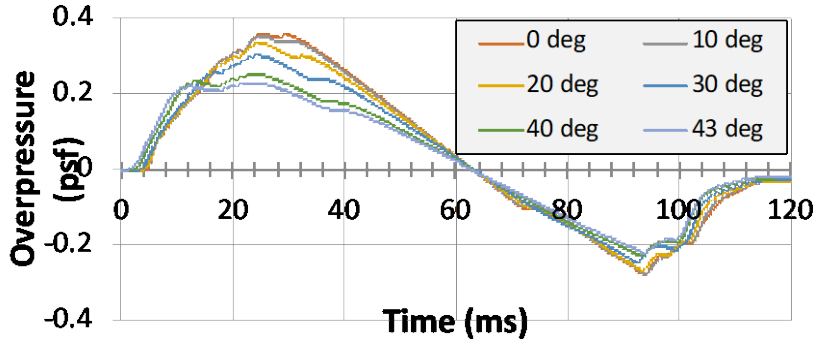
Design and Engineering Challenges

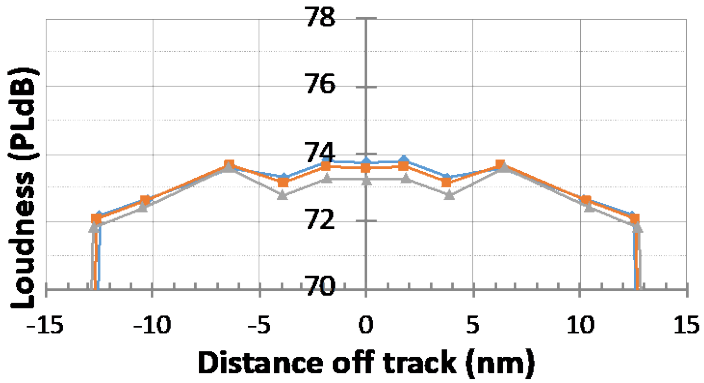
Unprecedented detail in analysis

Electrical complexity



Achieving a quiet signature across the ”carpet”





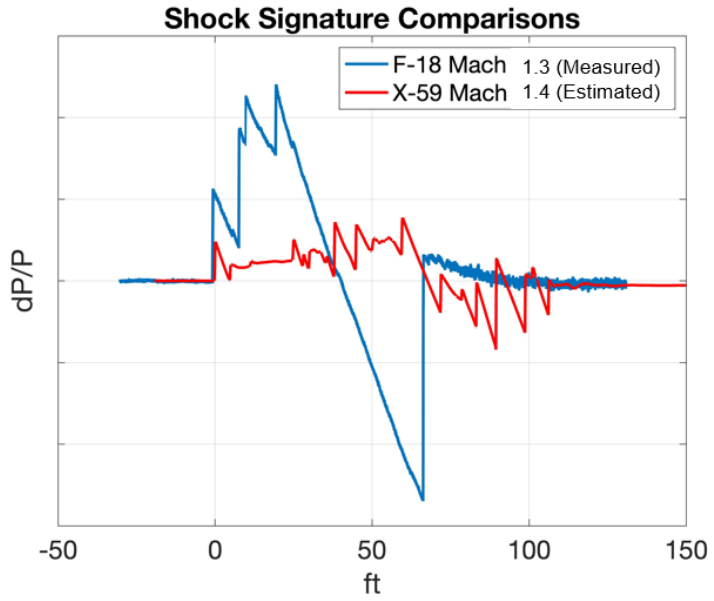
Integration of legacy hardware from multiple aircraft

Aeroservoelasticity and Handling Qualities

X-59 2024 Progress

- Rollout ceremony – Jan
- Flight Readiness Review – Mar
- 30 subsystems checkouts complete
- Structural coupling test complete
- Transition from production team to flight test team
- Integrated testing started
  - First engine motor completed
- Next up: First engine run

Phase 2: In-flight measurement capabilities



Develop and demonstrate capabilities to safely measure X-59 acoustic signature in-flight:

- Near-field acoustic characteristics of the LBFD aircraft
- Atmospheric effects on the far-field sonic boom signatures

Key Deliverables

- F-15D flight research instrumentation system
- Shock Sensing Probe (SSP) for F-15
- System for safe and efficient relative positioning of test and measurement aircraft (ALIGNS)
- Maintain acoustically instrumented TG-14 aircraft
- In-flight schlieren imaging (ASPS) system

2224 Progress

- Phase 2 ready versions of SSP, ASPS and ALIGNS have all been demonstrated in flight
- F-15D corrosion and fatigue repairs completed
- Instrumentation system buildup completed

Next up

- In-flight integrated system checkouts

Phase 2 : Acoustic Validation Test Preparation and Execution

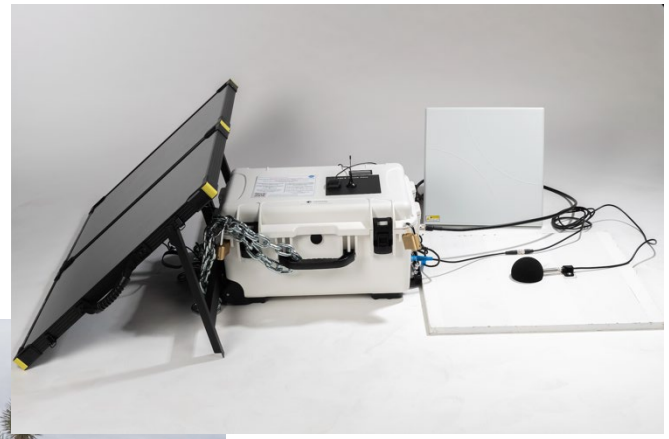
Objective

- Plan and execute a test series to validate ground acoustic signature loudness is acceptable for community response testing and to gather airborne and ground data that will be used to anchor sonic boom propagation and acoustics models in a real atmosphere.
- Coordinate multiple ground and flight assets to efficiently gather multiple data types

Key Deliverables

- Ground Recording System (GRS) development
- Acoustic validation test plans
  - Efficiency and flexibility
- Test Execution
  - Deployment and test logistics
  - Data collection

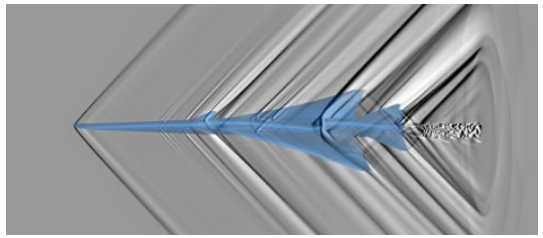
Phase 2: Acoustic Validation preparation progress

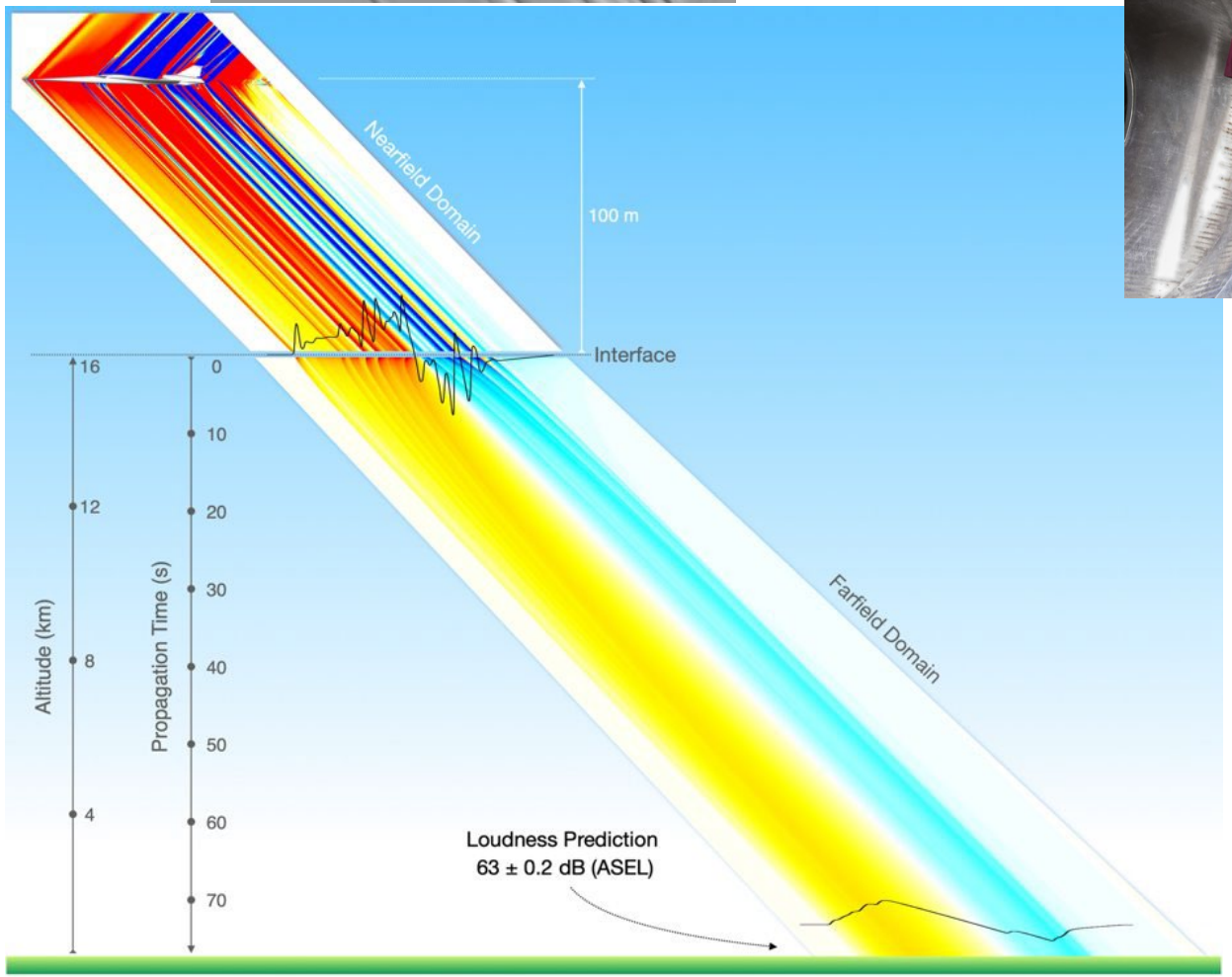


- Completed field test of GRS logistics and operations (Jan)
- Received full complement of 70 GRS units required for phase 2
- Received prototype units with additional features for phase 2
- Completed development of transport/storage/service equipment
- Ongoing tests of hardware security and durability
- Ongoing combined system tests
- Flight test plan developed
- Next up: Dry Run

Phase 2: Acoustic predictions

- Significant improvements in computational tool accuracy implemented and validated in wind tunnel experiments
- Refinements made to acoustic propagation tools and atmospheric turbulence models
- Phase 2 capability review completed
- Continuing ”stress tests” to improve robustness
- Next up:
  - Predictions with “as built’ geometry
  - Dry run

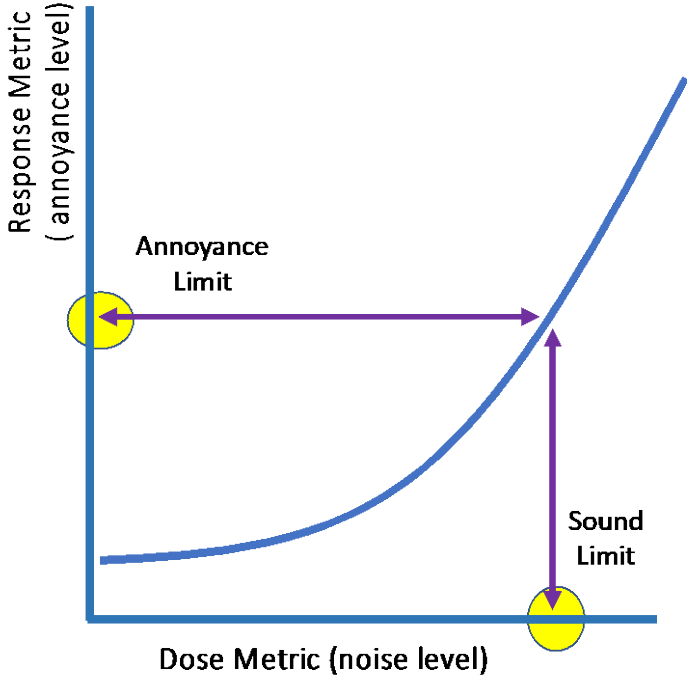




Quesst Goal: Define community response at an international scale

Objective: Create a robust dose – response relationship for community annoyance vs appropriate noise metrics

- Large populations, large number of representative responses
  - 10k to 100k, depending on survey method employed
  - Varied community settings including representative:
    - Geography and climate
    - Home and building construction
    - Community demographics, etc.
- Tests in multiple locations, ideally international
- A range of exposures required, possibly including normal booms
- Up to a maximum of 6-8 daily exposures
- Sufficient test duration to establish effect of repeated exposure
- Engage the international research & regulatory community to ensure data acceptance

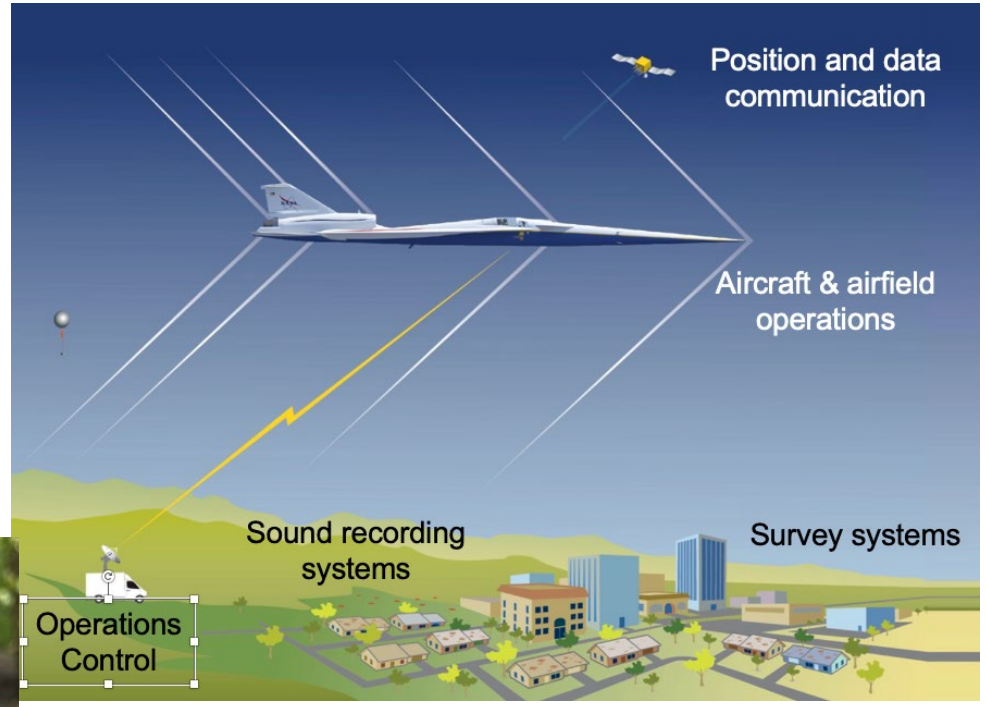


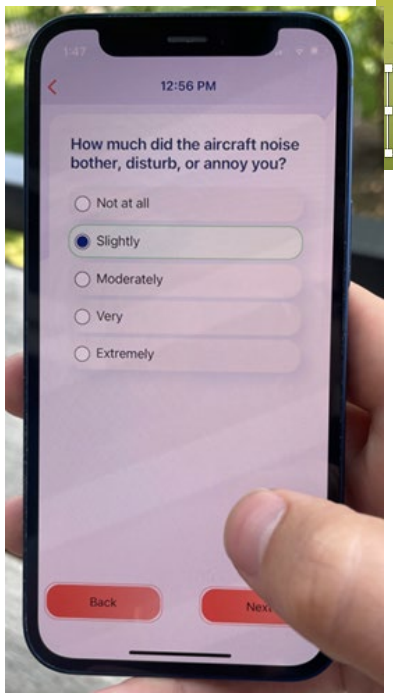
Notional Dose-Response Curve

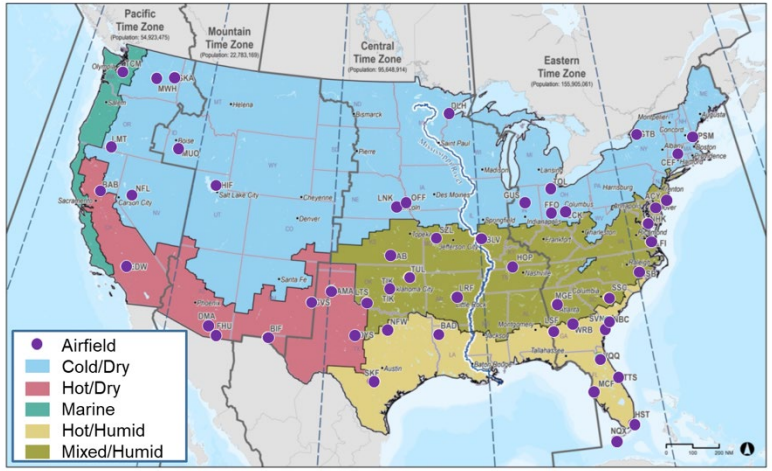
Phase 3 Community testing is the key to delivering on the goal of the Quesst Mission

Phase 3: Community Test preparation

- Community test campaign design continues with government team and industry contractors
- Survey methods test completed in Nashville (Detail report received May 2024)
- Continued engagement with stakeholder community
  - International Civil Aviation Organization-Committee on Aviation Environmental Protection (ICAO-CAEP)
  - FAA
  - International research community
  - External survey methods panel
  - Statistical analysis community
- Airfield and community selection process is ongoing

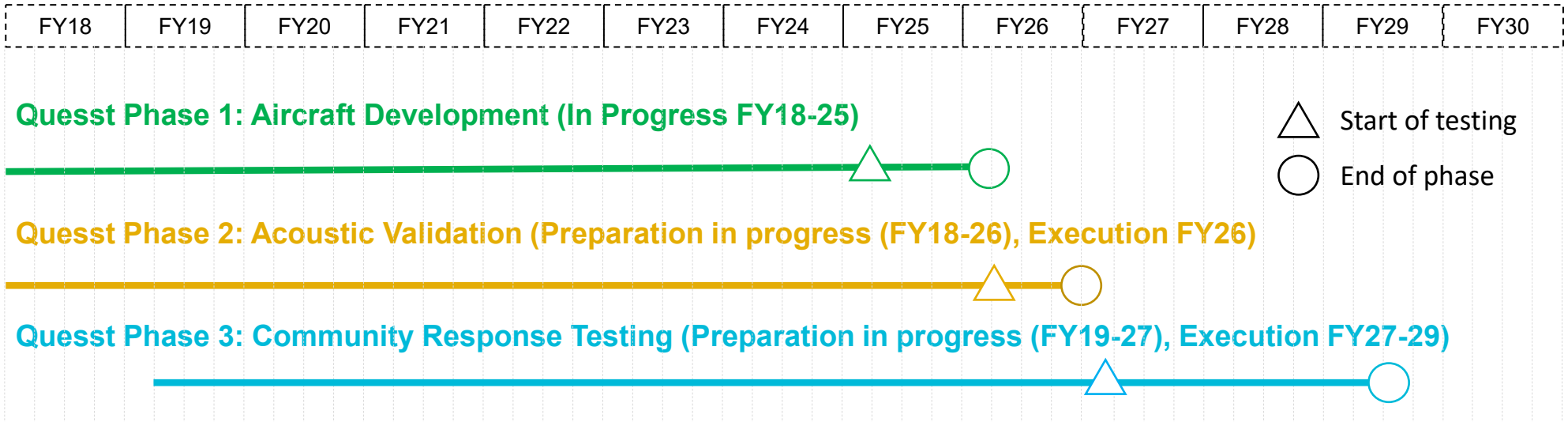






Quesst mission timeline

- Current mission target is to deliver data to ICAO-CAEP in 2029 (supporting the 15th CAEP Meeting
- Original target was deliver in 2027 (supporting the 14th CAEP meeting)
- Delays have been experienced in all elements of the mission
  - COVID, supply chain
  - Aging support aircraft
  - Contract delivery quality
  - Complex integrated testing
- NASA and stakeholders remain committed to completing the mission and delivering on commitments



Concluding remarks

- The Quest mission is focused on overcoming the technical and regulatory barriers to quiet supersonic flight over land
  - Commitment to deliver data to ICAO on community response to quiet overflight sounds
- The development of a new supersonic X-plane is the core of the mission
  - Fantastic team effort on accomplishments to date
  - X-59 aircraft is undergoing integrated powered system check outs prior to first flight
- Preparation for acoustic validation and community overflight tests is also progressing
- Near term focus is on completing an X-59 aircraft that is safe to fly in the National Airspace System and meets the mission performance goals
- NASA is engaged with the FAA and ICAO in the development of an international standard for sound levels for supersonic overland flight
- NASA seeks the broadest possible engagement with the international research and regulatory community to support acceptance of Quesst results
- Quesst mission team continues to make progress, but at a slower pace than planned
- NASA is remains committed to the mission and delivering the data to support CAEP efforts

Quesstions?

For more information on the Quesst mission, visit www.nasa.gov/quesst