

Terminal Sequencing and Spacing (TSS)

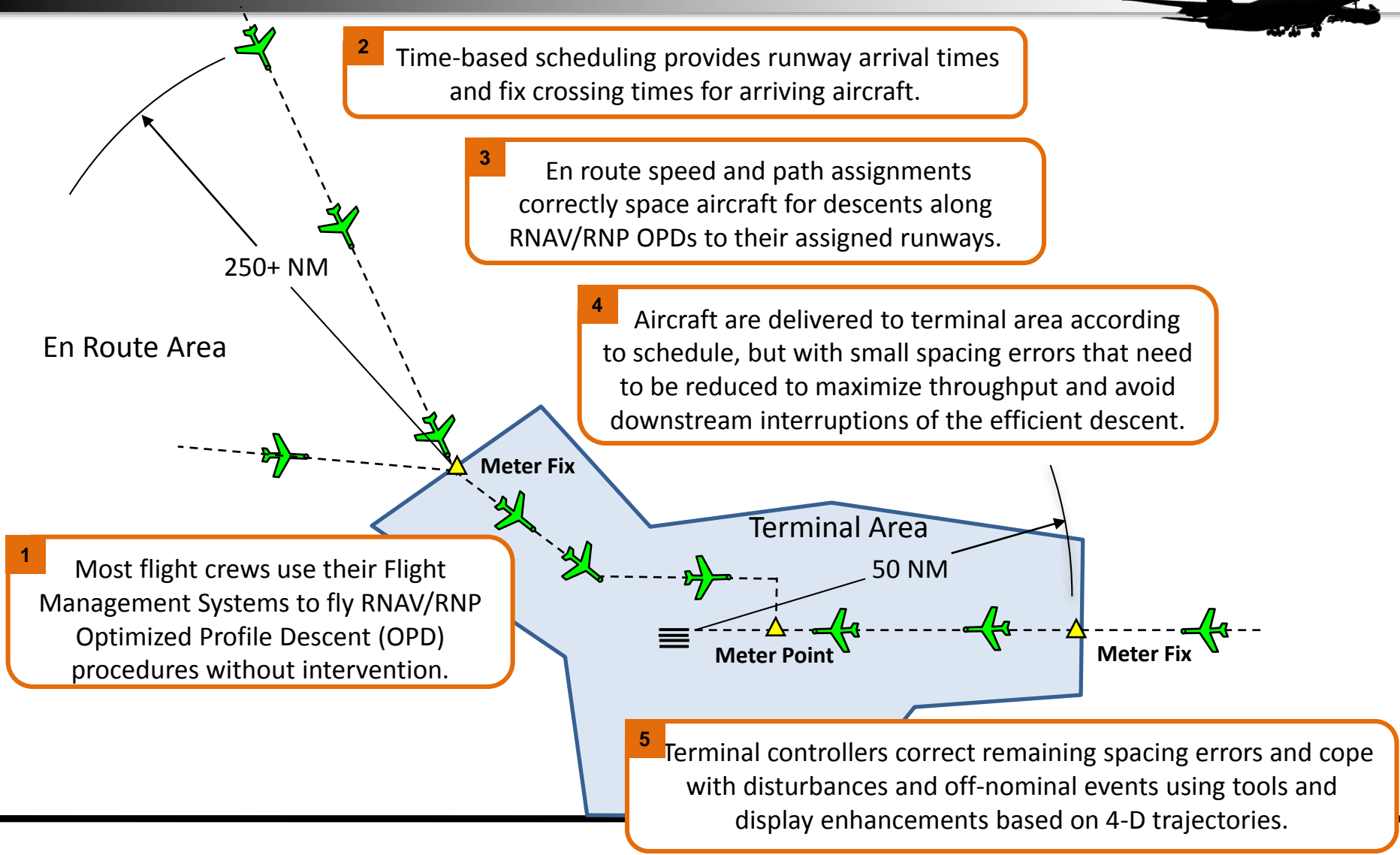
John E. Robinson III
National Aeronautics and Space Administration
Ames Research Center

ICAO Block Upgrade Showcase and Symposium (BUDSS)
Demo 11: Improved Airport Operations through Departure, Surface and Arrival Management
May 19, 2015





Operational Scenario



2 Time-based scheduling provides runway arrival times and fix crossing times for arriving aircraft.

3 En route speed and path assignments correctly space aircraft for descents along RNAV/RNP OPDs to their assigned runways.

4 Aircraft are delivered to terminal area according to schedule, but with small spacing errors that need to be reduced to maximize throughput and avoid downstream interruptions of the efficient descent.

1 Most flight crews use their Flight Management Systems to fly RNAV/RNP Optimized Profile Descent (OPD) procedures without intervention.

5 Terminal controllers correct remaining spacing errors and cope with disturbances and off-nominal events using tools and display enhancements based on 4-D trajectories.



ATM Technology Demonstration #1 (ATD-1)



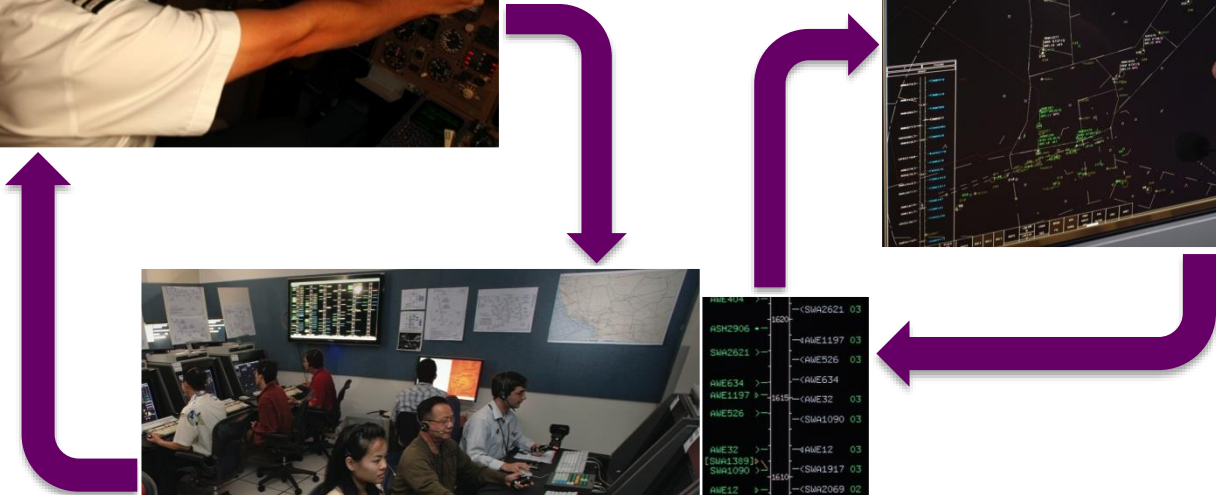
FIM Flight Deck Interval Management for Arrival Operations



CMS Controller-Managed Spacing in Terminal Airspace



TMA-TM Traffic Management Advisor (TMA) with Terminal Metering





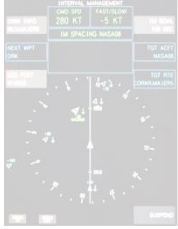
Terminal Sequencing and Spacing (TSS)



FIM

Flight Deck Interval Management for Arrival Operations

TSS



CMS

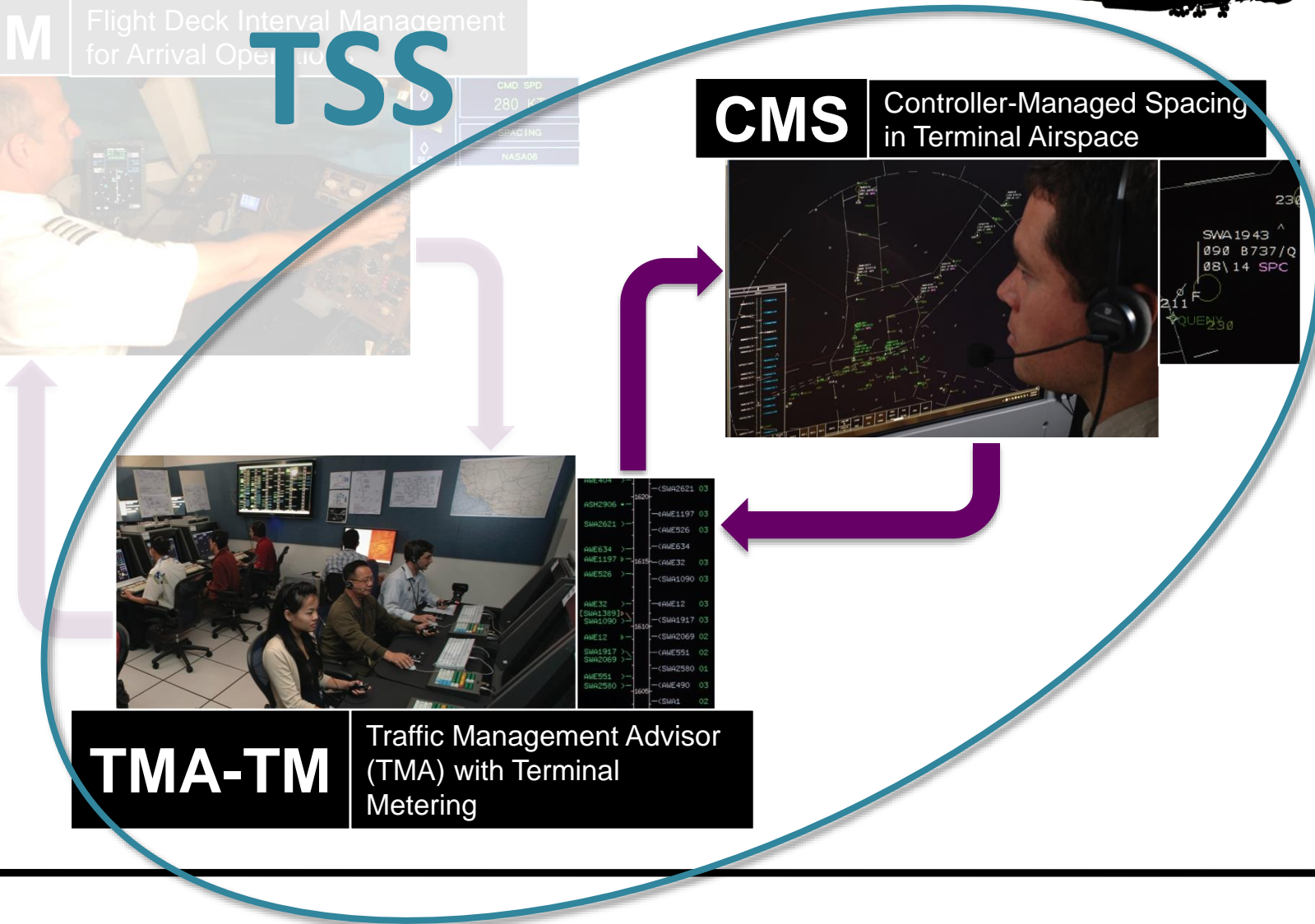
Controller-Managed Spacing in Terminal Airspace



AWK501	-CSW2621 03
AWK2906	-AWK1197 03
SWA2621	-AWK526 03
AWK634	-AWK634
AWK1197	-AWK32 03
AWK526	-CSW1090 03
AWK32	-AWK12 03
[SWA1389]	-CSW1917 03
SWA1090	-CSW2069 02
AWK12	-AWK551 02
SWA1917	-CSW2580 01
SWA2069	-AWK490 03
AWK551	-CSW1 02
SWA2580	

TMA-TM

Traffic Management Advisor (TMA) with Terminal Metering





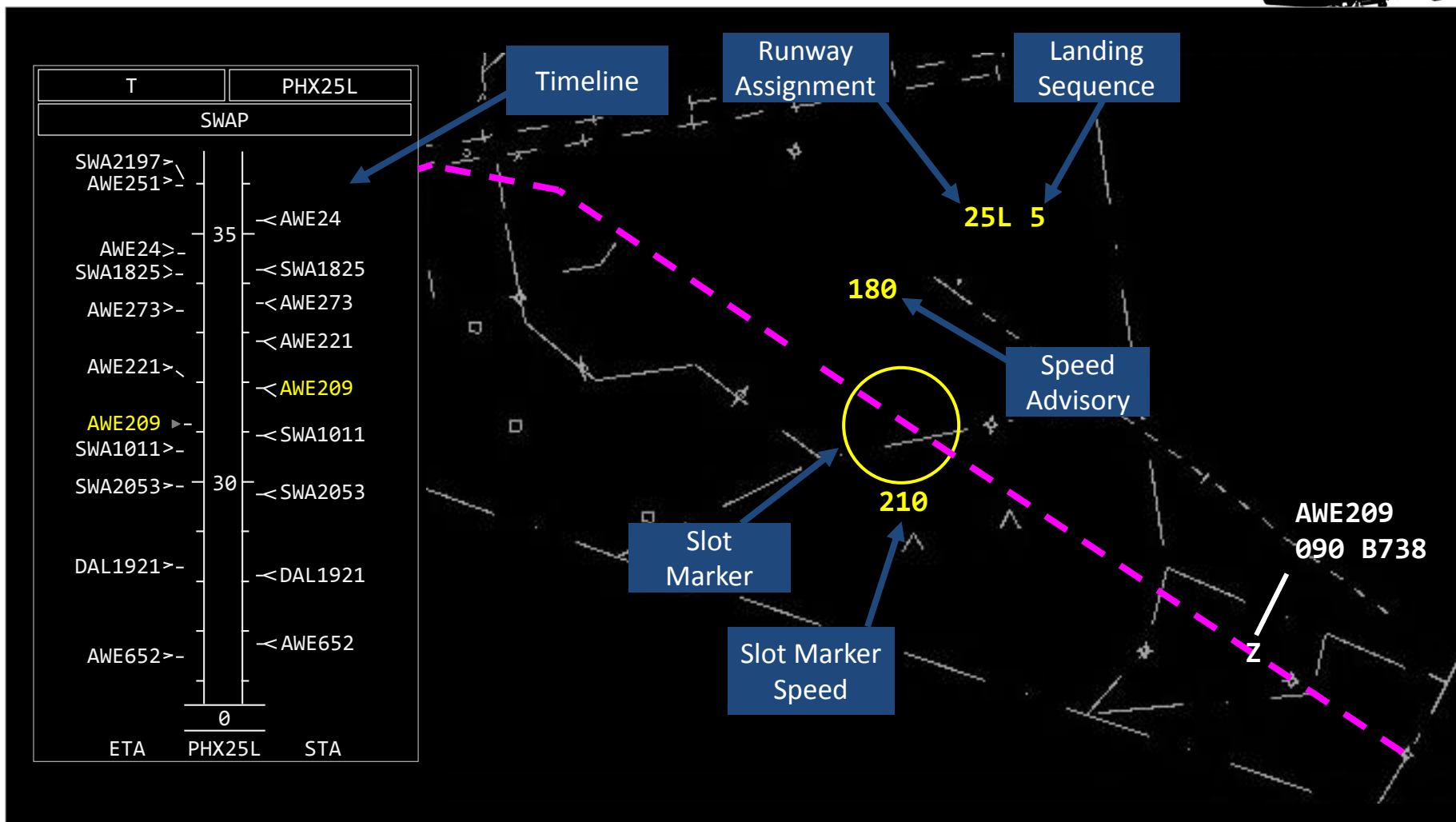
ATD-1 Overview



Movie segment from 0:00 to 1:32



TSS Prototype Capabilities



NOTE: TSS Prototype look-and-feel is shown. The FAA will finalize the operational look-and-feel prior to deployment.



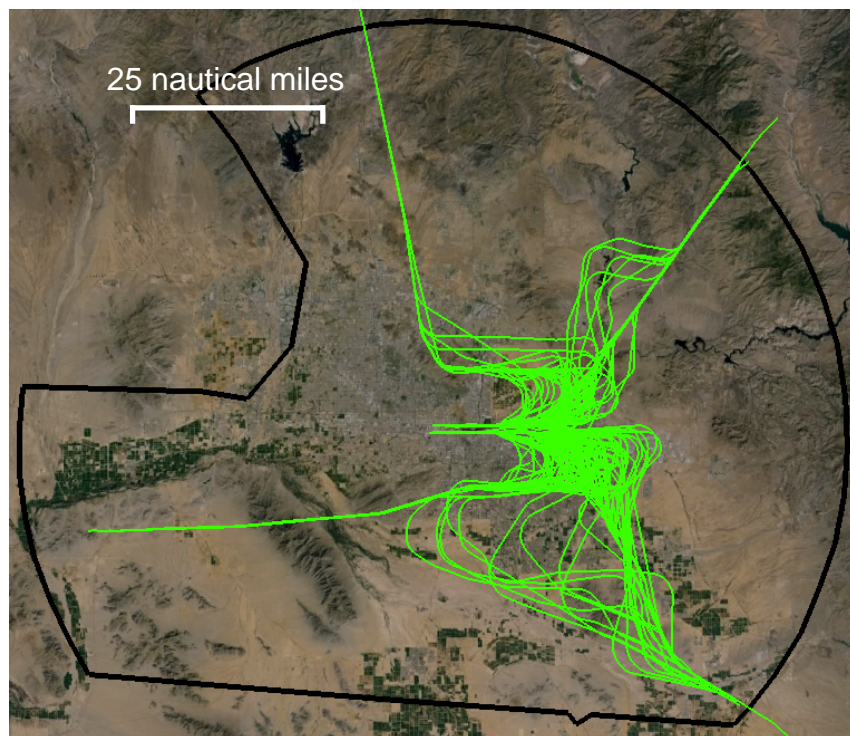
TSS Description



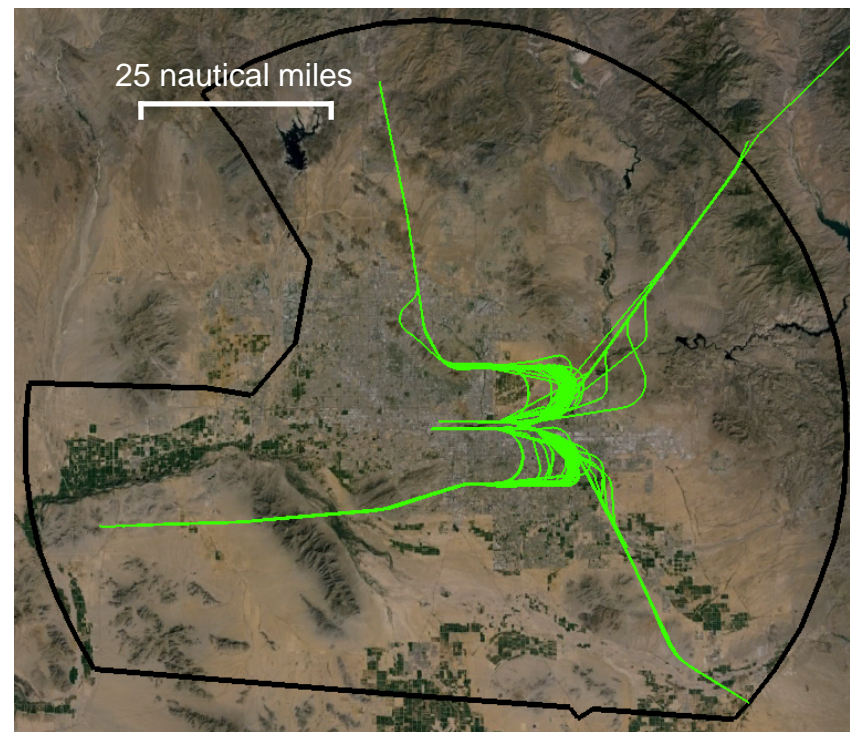
Movie segment from 1:45 to 5:08



Illustration of PBN Conformance



Operations without TSS



Operations with TSS



Status of TSS Development



- NASA developed TSS prototypes from FAA systems:
 - Time-Based Flow Management (TBFM)
 - Standard Terminal Automation Replacement System (STARS)
- NASA transferred the Terminal Sequencing and Spacing (TSS) technologies to the FAA in July 2013
- NASA and the FAA evaluated TSS in twenty-four high-fidelity simulations
- NASA and the FAA are currently conducting another joint TSS simulation to mitigate operational deployment risks
- FAA is planning for an initial capability in the NAS in 2018



Concluding Remarks



- NASA transferred Terminal Sequencing and Spacing (TSS) technologies to the FAA
- As part of NextGen, TSS will enable routine use of fuel-efficient PBN procedures during all traffic conditions
- FAA is planning an initial capability in the NAS in 2018
- FAA booth will include full-length movie presentation, pamphlets, and playback of human-in-the-loop simulation recordings



Points Of Contact



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Alternative Slides

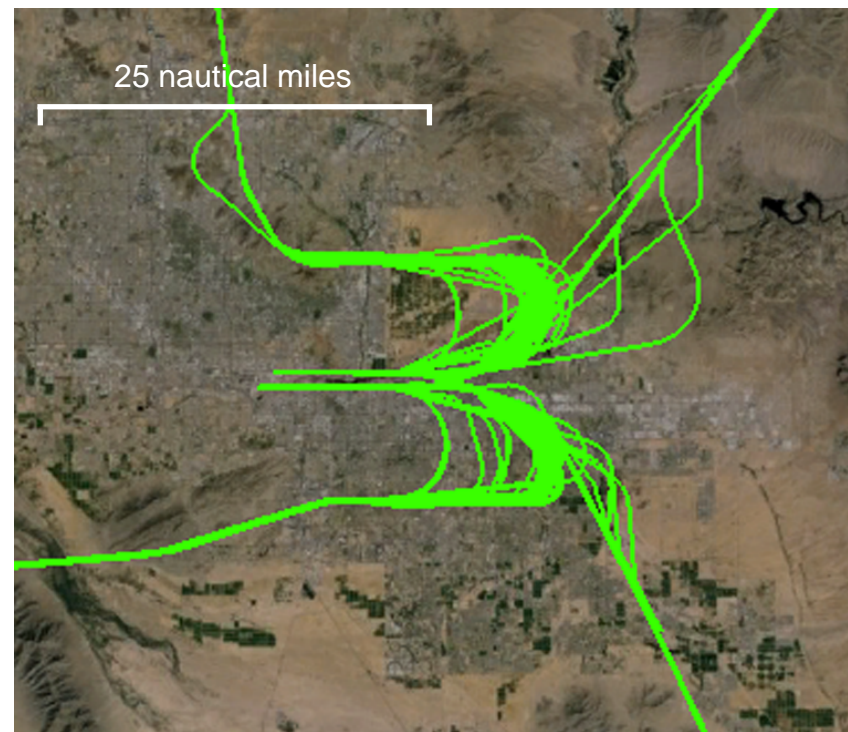




Illustration of PBN Conformance



Operations without TSS



Operations with TSS