

NARI

NASA AERONAUTICS
RESEARCH INSTITUTE



Developing an Adaptable NextGen Interface for the UAS Ground Control Station

Principal Investigator: Jim Murphy

NASA Aeronautics Research Mission Directorate (ARMD)

2015 Seedling Phase II Technical Seminar

November 17 & 19, 2015

Outline



- Innovation
- Development Partners
- Technical Approach
- Impact of the Innovation
- Results
- Distribution/Dissemination
- Next steps



Innovation

- Motivation: NextGen traffic infrastructure is in place to support manned aircraft operations. However, the UAS ground control station (GCS) adds a data interface requirement that is not yet fully accounted for in the NextGen data service architecture
 - Existing NextGen data service is focused on aircraft, not GCS
 - Smaller UAS may not have payload or power capacity to support additional equipment
- Innovation: Provide a mechanism for a UAS—regardless of size, payload, bandwidth, and power capacity—to gain access to NextGen data-sourced traffic information in real-time

Partners



UAS Integration
into the NAS



Sensor Integrated
Environmental Remote
Research Aircraft (SIERRA)

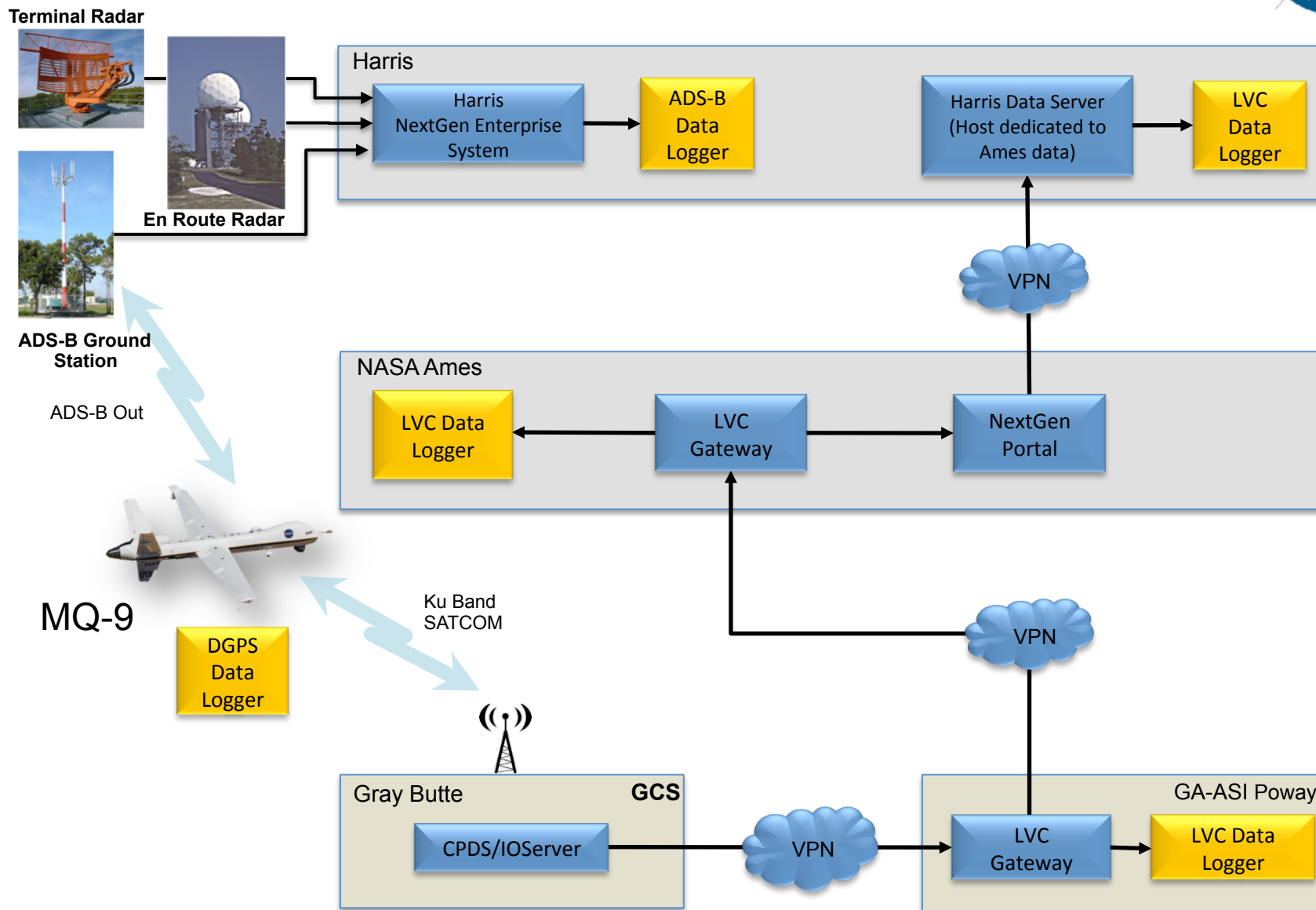


Technical Approach

- Leverage NASA's Live, Virtual, Constructive (LVC) flight test infrastructure to prototype a real-time connection between a UAS and the Harris Commercial NextGen traffic data service and Symphony Suite
 - Provide the location of the UAS to NextGen
 - Provide display of aircraft in the airspace around the UAS to the GCS

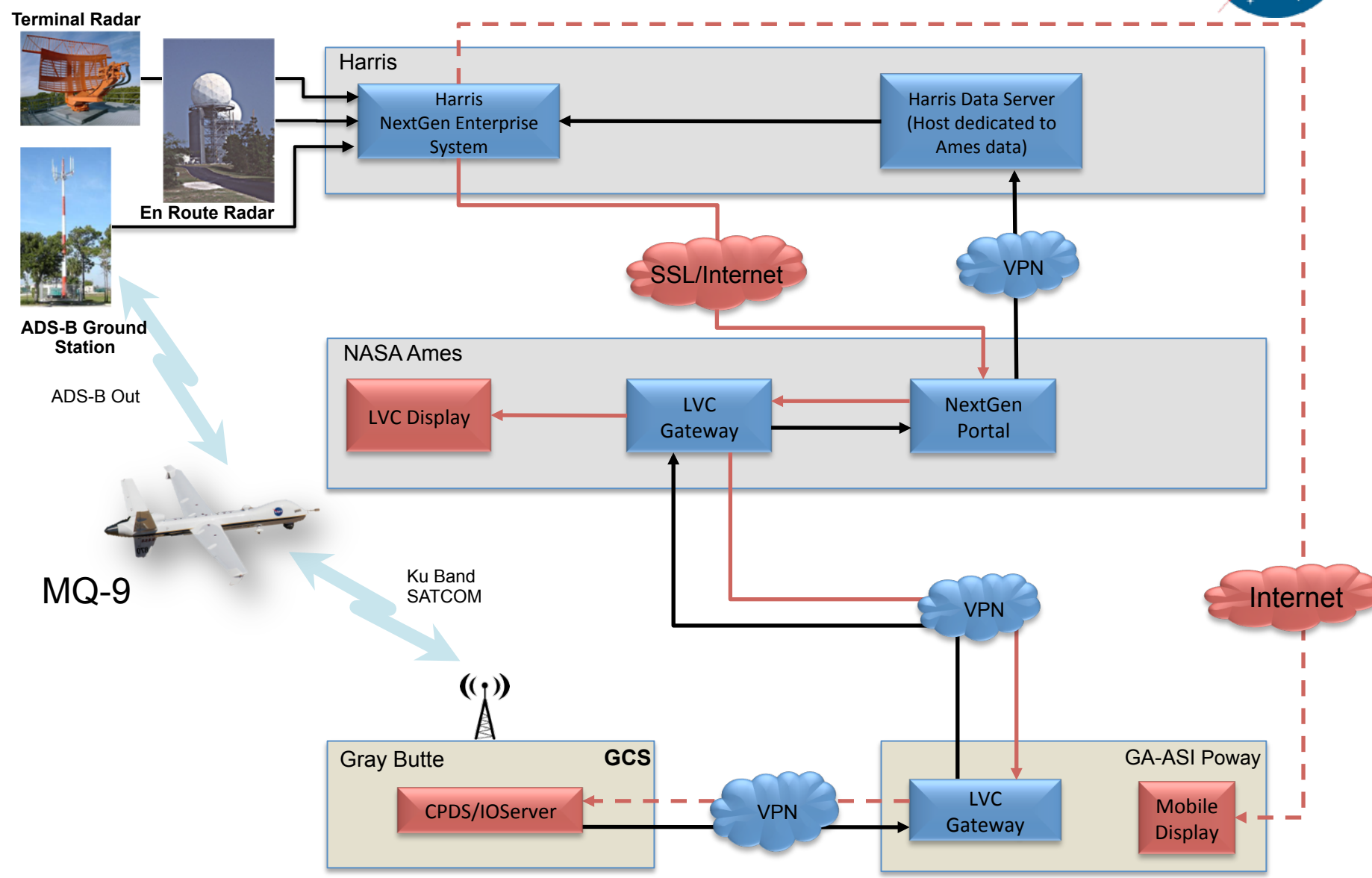


Technical Approach: Data Collection





Technical Approach: Display





Impact of Innovation

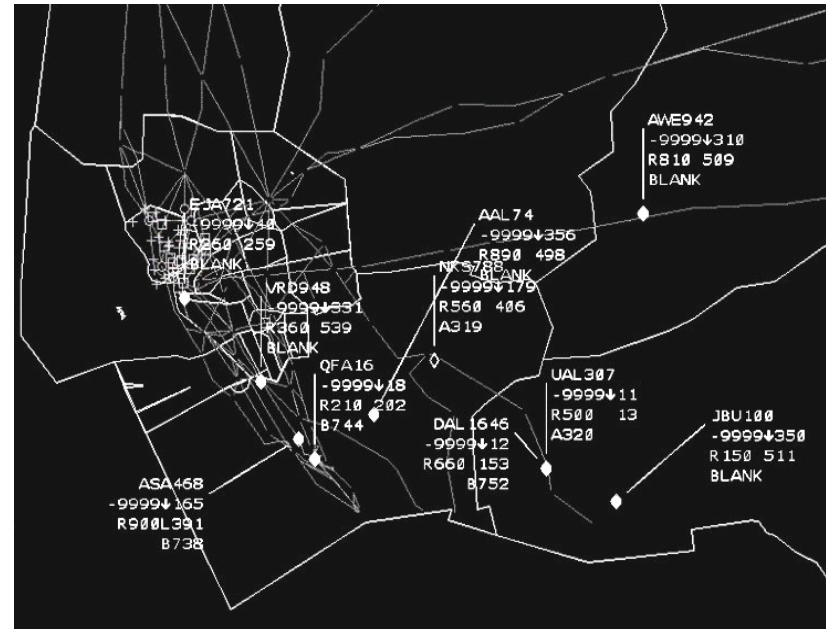
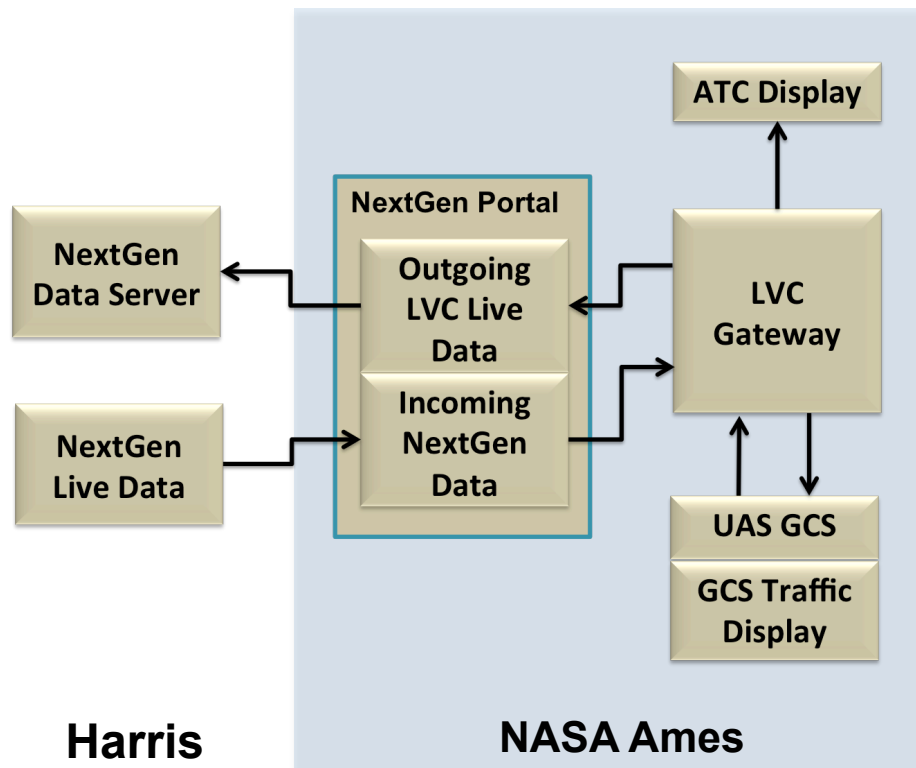
- Provide a low bandwidth, low power, and small form factor option for small and very small UAS such that operators can install surveillance equipment on their aircraft and effectively “participate” in the national airspace system (NAS)
- Add redundancy to existing traffic situation awareness capabilities for larger (well equipped) UAS
- Provide primary or alternate source of surveillance data to the NAS for UAS aircraft
- Enable ingestion of live traffic surveillance data into an LVC test environment

Result: Improved traffic awareness for all equipped aircraft operating in the NAS

Results: Harris-LVC Connection

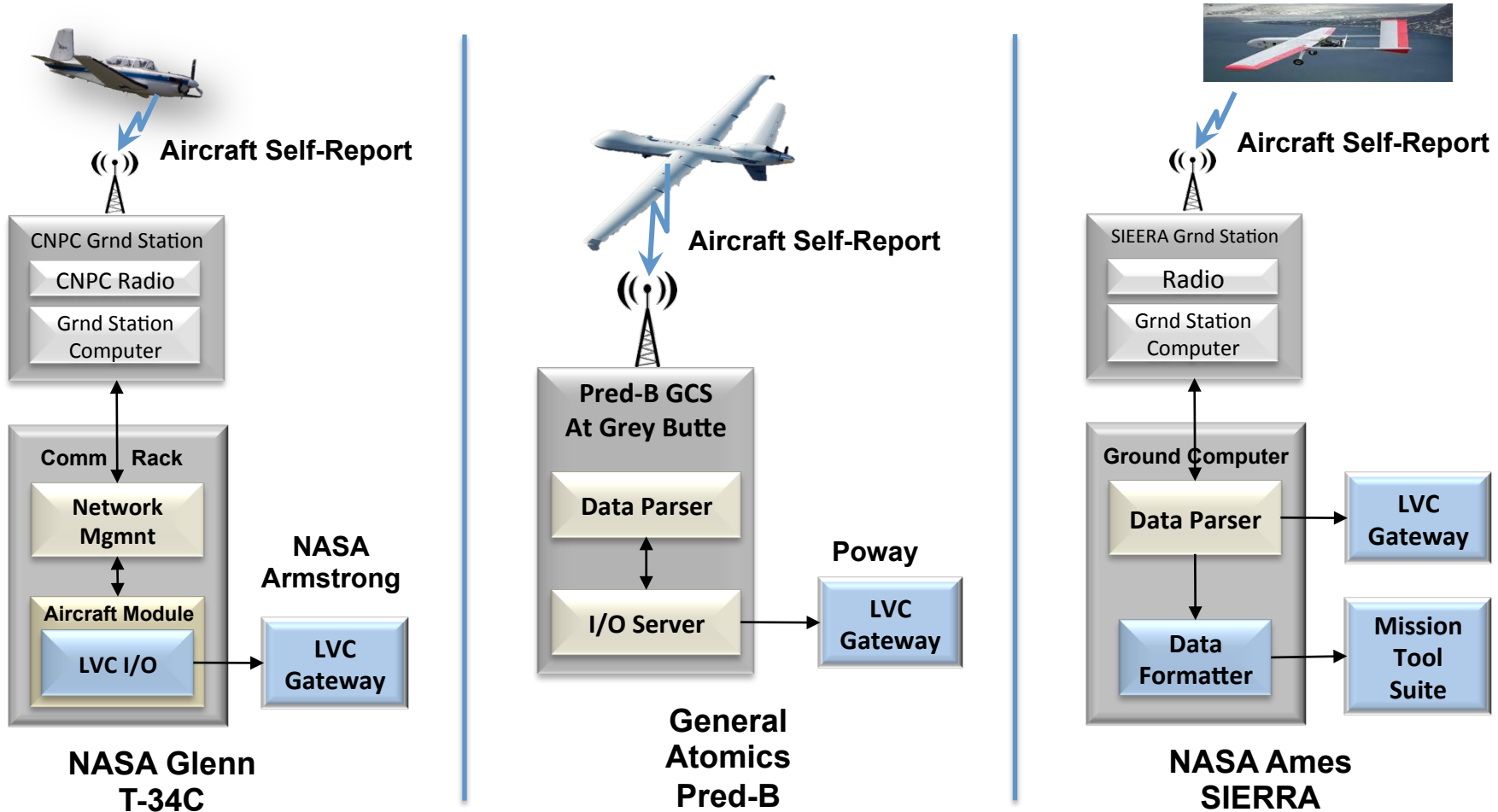


NASA LVC and Harris two-way connection



Display of NextGen data on LVC ATC Screen

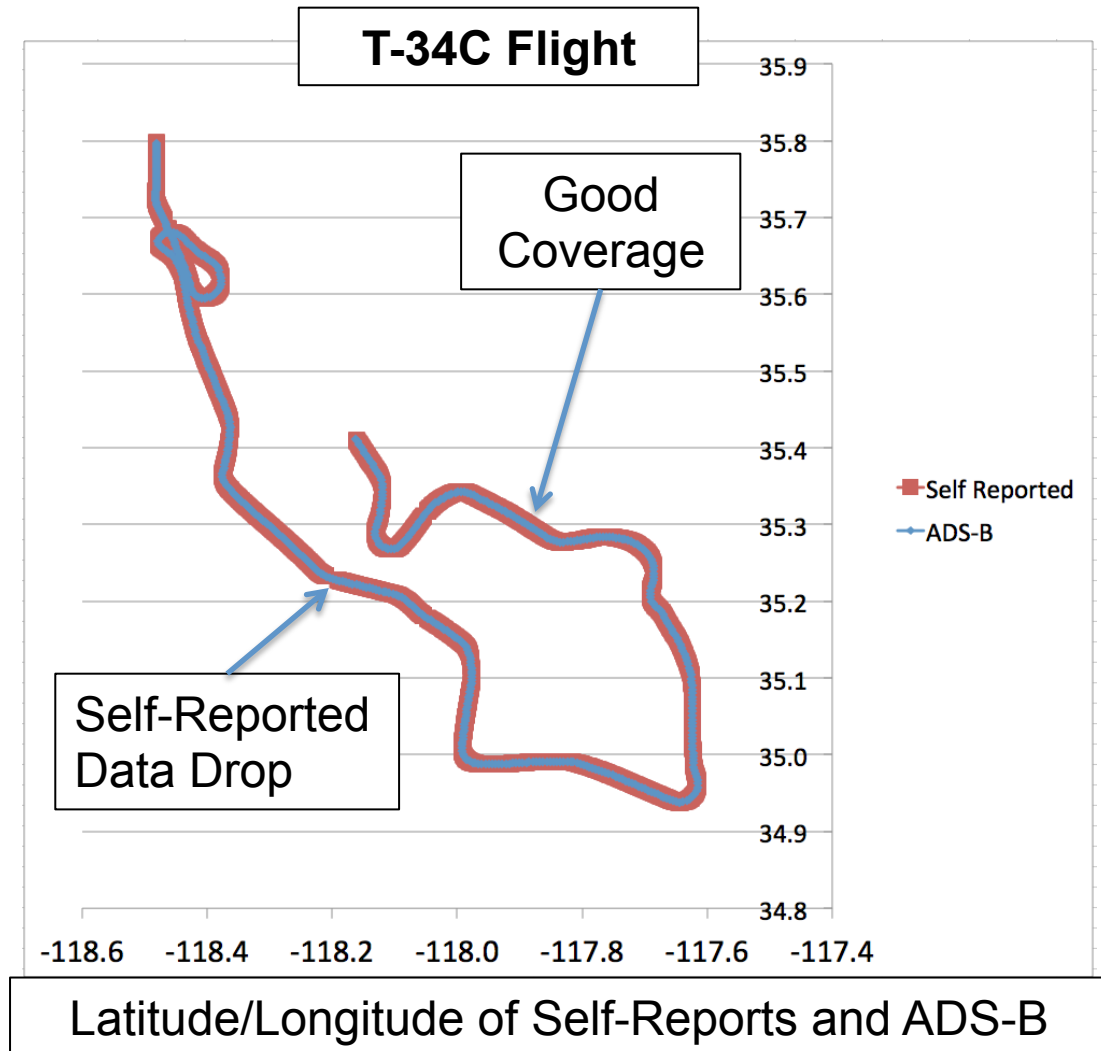
Results: UAS-LVC Connections



Results: Position Reporting



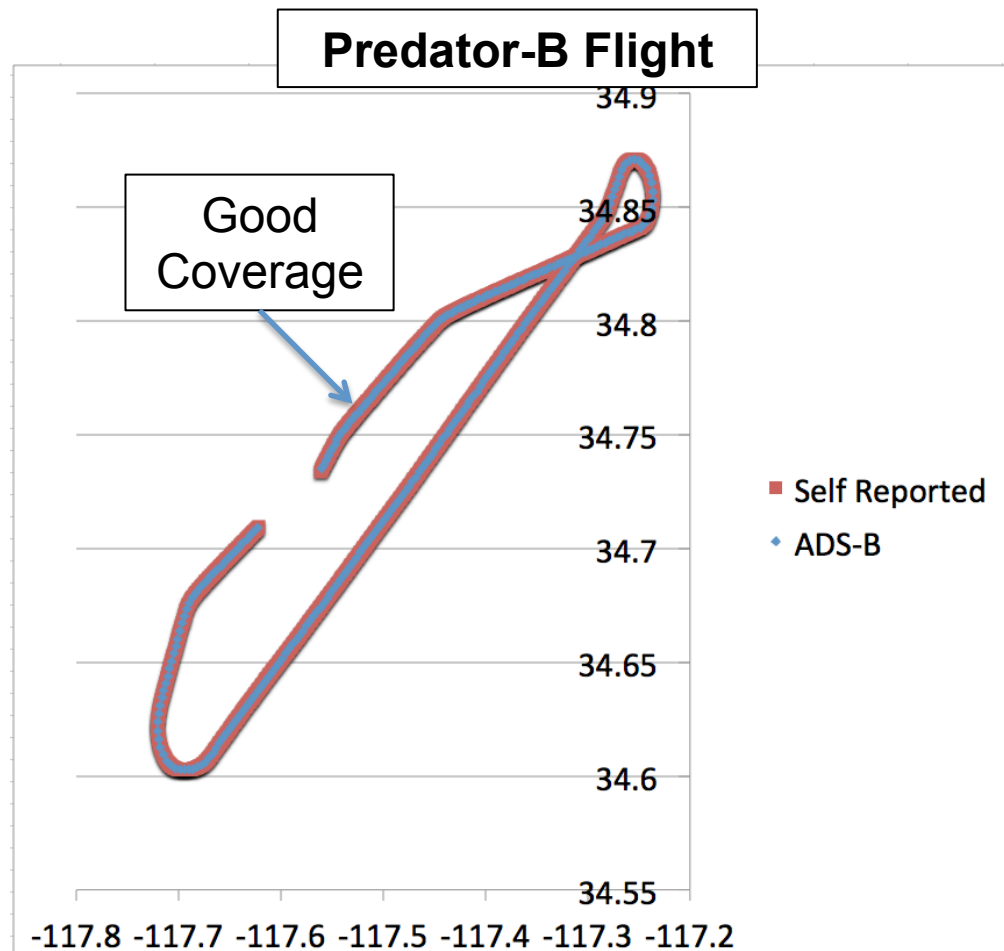
- 50 minute flight
 - Aircraft self-reports sent 2 times per second
 - ADS-B data recorded 1 every 5 seconds from commercial data sources



Results: Position Reporting



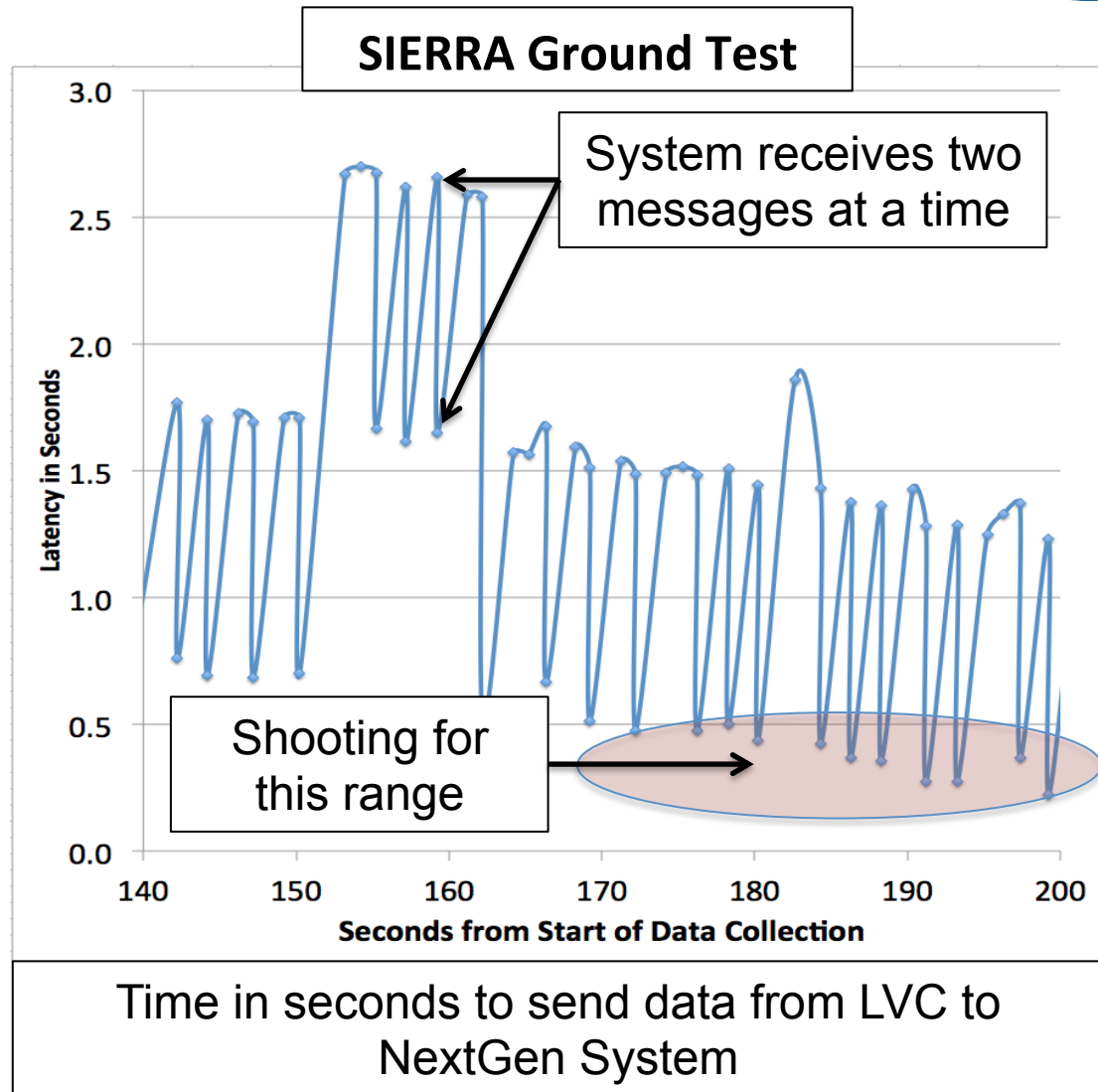
- 25 minute flight
 - Aircraft self-reports sent once per second
 - ADS-B data recorded 1 every 5 seconds from commercial data sources



Results: Transmission Latency

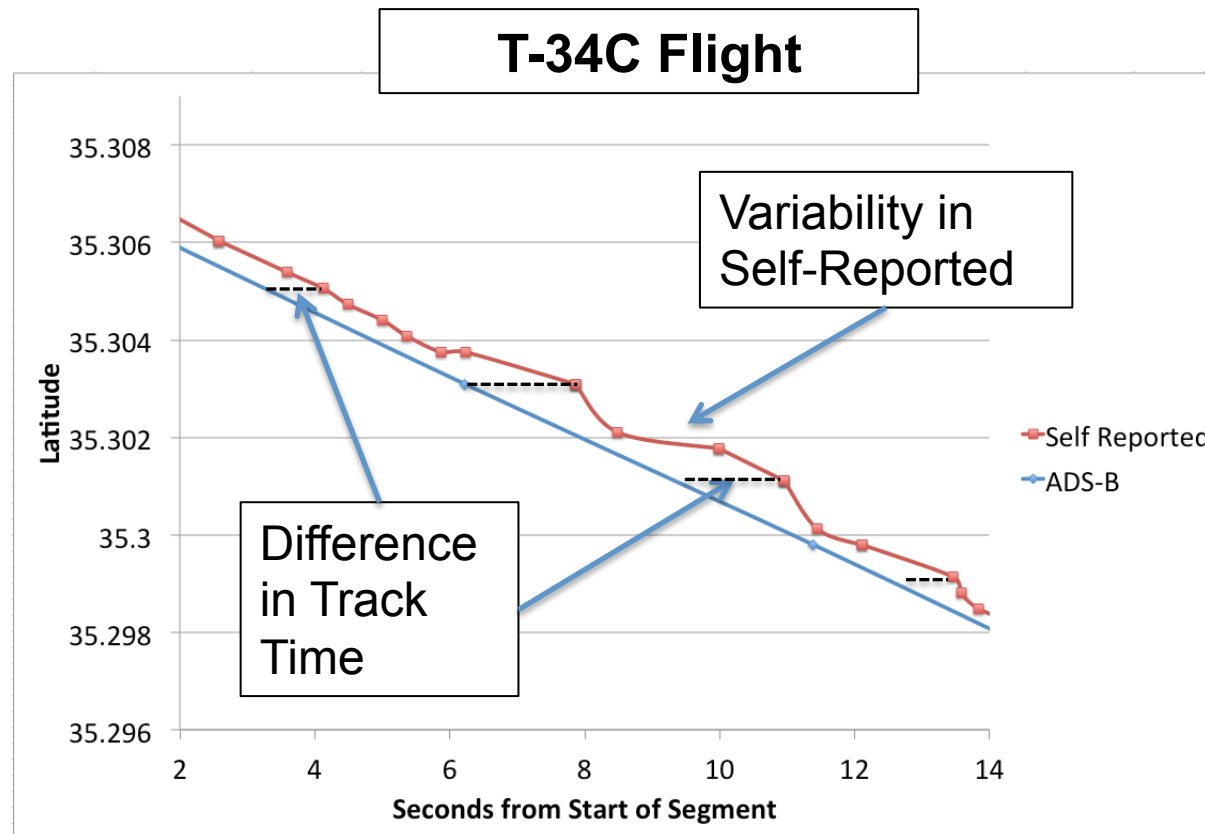


- 3 minute test
 - Aircraft self-reports sent once per second
 - No ADS-B





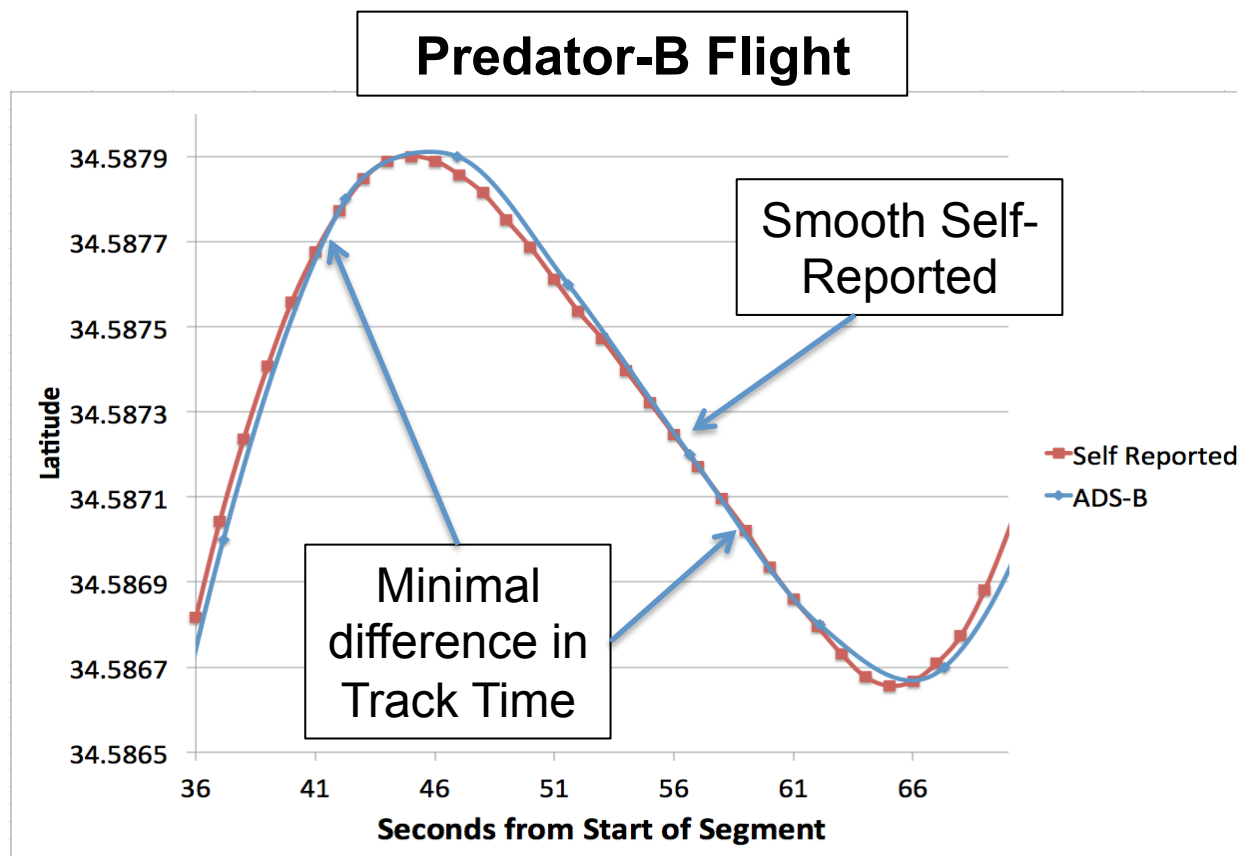
Results: Position Difference



- Self-report position/time recorded on board the aircraft
- ADS-B position/time comes from GPS receiver
- ADS-B appears to be slightly ahead of self-reported time
 - Average 800 ms earlier



Results: Position Difference



- Self-reports position/time recorded on board the aircraft
- ADS-B position/time comes from GPS receiver
- ADS-B appears to be in line with self-reported time



Results: Display to GCS

Mobile display of traffic in Crow's Landing airspace provides situation awareness for pilots at Crow's landing during Unmanned Traffic Management (UTM) testing

The screenshot displays the EXELIS mobile application interface. On the left, a sidebar menu includes 'Logout', 'Options', 'Help', and 'About'. Below this are tabs for 'Details', 'Tools', 'Replay', and 'My Flights'. The 'Details' tab is active, showing flight information for ASA743, including tail number N796AS, flight type 'Overflight', and AC type B734. It also lists airport information (KSLC to KSFO) and current position (395 mph, 26625 ft altitude). A 'Times' section shows an ETA of 08:42:00 and an ETD of 07:12:00 on 05/29/2015.

The main area features a satellite map with several aircraft icons. A pop-up window for ASA743 shows the Alaska Airlines logo and flight details: Flight ID: ASA743, Tail Number: N796AS, Origin: KSLC, Destination: KSFO. A table at the bottom lists tracked flights:

FlightID	Tail Number	Destination	TaxiTime
SWA3302	N298WN	KSFO	
N387CS		KSCK	
CPZ5729	N631CZ	KSEA	

At the bottom, there are 'Clear Filters' and 'Back To Top' buttons, along with a status message: 'Tracking 3 flights and 0 noise monitoring sites.'



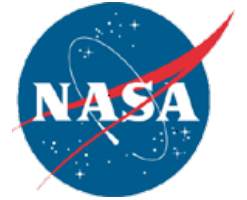
Conclusions

- Equipment used for self-reported location has significant impact on aircraft position accuracy and utility
- Latencies added by system in line with commercial use
 - Need to address message buffering
- Viable to serve “TIS-B level” traffic awareness
 - Traffic Information Services – Broadcast (TIS-B)



Getting the Word Out

- Connection concept and technologies used during UTM flights
 - Display of traffic in test area for situation awareness
- Leveraged the GA/LVC connection in UAS-NAS Project flight testing
- Paper submitted to AIAA Aviation 2016 conference



Next Steps

- Flight Test with SIERRA
 - Scheduled for February
- Analyze self-reported position and time against high fidelity truth data
 - Investigate impact of different aircraft equipment
- Evaluate long-term LVC interface format
 - Address message buffering
- Use NextGen surveillance data in UAS flight test via the LVC connection