Technology Development & Prototyping Division ANG-C5

Federal Aviation Administration

RIRP Portfolio Update

Presented to: REDAC

Date: August 13, 2015

Runway Incursion Reduction Program (RIRP)

Why do we do what we do?

- FAA Strategic Priority 1 – Make Aviation Safer and Smarter
- FAA Performance Metric 4 – Reduce Category A & B (most serious) runway incursions to a rate of no more than 0.395 per million operations, and maintain or improve through FY 2018.

- FAA Mission Needs Statement 323 (circa 1998):
  - Runway Incursions (RIs) are a major problem affecting the safe operations of the nation's airports.

- Destination 2025 (2011)
  - 2018 Performance Metrics: Maintain the rate of serious runway incursions at or below 20 per 1000 events.

- NTSB Recommendation A-91-30
  - Calls for the FAA to implement equipment aimed at reducing runway incursions

Runway Incursion Reduction Program (RIRP)

Why do we do what we do?

March 27, 1977: Fatal collision between two Boeing 747 passenger aircraft ***on the runway*** of Los Rodeos Airport on Tenerife, one of the Canary Islands. This crash killed 583 people, making it the deadliest accident in aviation history.

August 27, 2006: Comair Flight 5191 Lexington, KY, to Atlanta, GA, crashed on takeoff, just past the end of the runway, killing all 47 passengers and two of the three crew. The aircraft was ***assigned Runway 22 for the takeoff, but used Runway 26*** instead.

Runway Incursion Reduction Program (RIRP)

Why do we do what we do?

April 24, 2014: Two planes nearly collided at Newark Liberty International Airport. United Express Flight 4100 was cleared to take off on runway 4R at the same time United Airlines Flight 1243 was landing on the intersecting Runway 29. The two aircraft passed within yards of each other.

July 6, 2014: A passenger jetliner preparing to leave Barcelona's El Prat airport taxied across a runway where another was about to land, forcing the arriving plane to abort its landing and climb sharply to avoid a possible disaster.

Runway Incursion Reduction Program (RIRP) Projects

- Low Cost Ground Surveillance (LCGS) - Cancelled by JRC
- Enhanced FAROS (eFAROS) – Successful June 2014 Flight Check at BOS; pending approval for OpEval test from AFS.
- Runway Safety Assessment (RSA) – conducting RI Prevention Shortfall Analysis; conducting on-site technical assessments for technologies selected from FY14 Market Survey.
- Small Airport Surveillance Sensor (SASS) – evaluating technical performance of phased array surveillance sensor developed by MIT Lincoln Lab for real-time movement area coverage.

Low Cost Ground Surveillance (LCGS)

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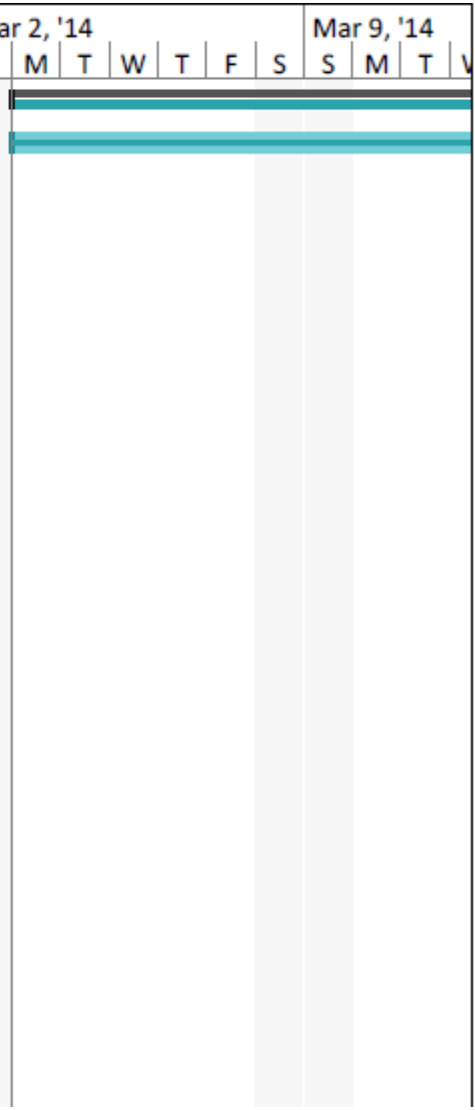
LCGS Pilot Program History and Status

- In August 2007, Runway Safety Call to Action identified LCGS as potential technical solution to increase in Runway Incursions
- Runway Incursion Reduction Program Office requested LCGS Investment Analysis Readiness Decision (IARD) from the Executive Council on May 26, 2009.
- ATO EC delayed making a final decision; EC met again on July 7, 2009, and made the following decision:
  - *Directed team to continue with contract awards for the prototype systems*
  - *Directed team to operate the prototype systems for two years*
  - *Directed team to return to the EC with results of the operational evaluation*
- **JRC meeting 6/19/2013 determined that LCGS not viable as a program**
- All 5 sites were powered down by 09/01/2013
- All LCGS displays were removed from ATCT cabs as of 9/30/2013
- All LCGS cameras were removed from ATCT and radar towers as of 2/28/2014
- Final equipment and infrastructure inventory and bar coding was completed as of 11/01/2014

Notional Removal Schedule

ID	Task Name	Duration	Start	Finish	Predecessors	% Complete
1	**LCGS Asset Disposition Project**	**.21 days?**	**Mon 3/3/14**	**Mon 8/18/14**		**54%**
2	✓ Complete Asset Inventory at all site:	60 days	Mon 3/3/14	Fri 5/23/14		100%
3	Enter assets into AITS	90 days	Mon 5/26/14	Fri 9/26/14	2	90%
4	**Site Disposition**	**60 days**	**Tue 4/14/15**	**Mon 7/6/15**		**44%**
5	**San Jose (SJC)**	**180 days**	**Mon 9/29/14**	**Fri 6/5/15**		**51%**
6	SJC Asset Disposition	65 days	Mon 9/29/14	Fri 12/26/14	3	75%
7	SJC Site Demolition	15 days	Mon 4/27/15	Fri 5/15/15	6,22FS+20 da	0%
8	SJC Site Restoration	15 days	Mon 5/18/15	Fri 6/5/15	7	0%
9	SJC Site Complete	0 days	Fri 6/5/15	Fri 6/5/15	8	0%
10	**Long Beach (LGB)**	**280 days**	**Mon 9/29/14**	**Fri 10/23/15**		**40%**
11	LGB Asset Disposition	65 days	Mon 9/29/14	Fri 12/26/14	3	65%
12	LGB Site Demolition	20 days	Mon 8/31/15	Fri 9/25/15	17FS+30 days	0%
13	LGB Site Restoration	20 days	Mon 9/28/15	Fri 10/23/15	12	0%
14	LGB Site Complete	0 days	Fri 10/23/15	Fri 10/23/15	13	0%
15	**Reno (RNO)**	**230 days**	**Mon 9/29/14**	**Fri 8/14/15**		**33%**
16	RNO Asset Disposition	65 days	Mon 9/29/14	Fri 12/26/14	3	50%
17	RNO Site Demolition	15 days	Mon 6/29/15	Fri 7/17/15	7FS+30 days	0%
18	RNO Site Restoration	20 days	Mon 7/20/15	Fri 8/14/15	17	0%
19	RNO Site Complete	0 days	Fri 8/14/15	Fri 8/14/15	18	0%
20	**Spokane (GEG)**	**205 days**	**Mon 9/29/14**	**Fri 7/10/15**		**25%**
21	GEG Asset Disposition	65 days	Mon 9/29/14	Fri 12/26/14	3	50%
22	GEG Site Demolition	5 days	Mon 3/23/15	Fri 3/27/15	21	75%
23	GEG Site Restoration	75 days	Mon 3/30/15	Fri 7/10/15	22	0%
24	GEG Site Complete	0 days	Fri 7/10/15	Fri 7/10/15	23	0%
25	**Manchester (MHT)**	**93.5 days**	**Mon 9/8/14**	**Thu 6/4/15**		**70%**
26	MHT Asset Disposition	65 days	Mon 9/29/14	Fri 12/26/14	3	90%
27	✓ MHT Site Demolition	5 days	Mon 9/8/14	Fri 9/12/14	26SF-10 days	100%
28	MHT Site Restoration	75 days	Mon 12/8/14	Thu 6/4/15	26FS-15 days	50%
29	MHT Site Complete	0 days	Thu 6/4/15	Thu 6/4/15	28	0%
30	All Assets Dispositioned	0 days	Fri 12/26/14	Fri 12/26/14	6,11,16,21,26	0%
31	All Sites Complete	0 days	Fri 10/23/15	Fri 10/23/15	9,14,19,24,29	0%



Enhanced Final Approach Runway Occupancy Signal (eFAROS)

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Enhanced Final Approach Runway Occupancy Signal (eFAROS)

Enhanced-Final Approach Runway Occupancy Signal (eFAROS) uses surface surveillance with augmented safety logic to provide a visual warning to pilots on final approach that the runway is occupied and unsafe for landing. It does this by flashing the Precision Approach Path Indicator (PAPI) lights.

AJW-143 is providing design and engineering support for the development and implementation of eFAROS at RWSL test locations

Partners / Stakeholders

- Air Traffic Controllers
- AJW-14
- Airport Authorities (DFW, BOS)
- Local Tech-Ops personnel

Milestone Schedule

FY 14 Milestones	Q1	Q2	Q3	Q4
Develop quicklook report on shadow operations testing of the prototype eFAROS system at BOS.		**Complete**		
Complete installation of the FPAPI units at BOS.		**Complete**	**Complete**	
Conduct flight check of the FPAPI units installed at BOS, and commence 90-day Operational Evaluation of the prototype eFAROS system at BOS			**Flight check Completed 06/22/2014**	

Milestone Schedule

FY 15 Milestones	Q1	Q2	Q3	Q4
Commence operational evaluation at BOS (pending final AFS consultation/decision).				
Complete report on 90-day prototype Operational Evaluation test of eFAROS at BOS.				
Develop preliminary requirements document, final benefit/cost analysis report (BCAR) and IARD documents for JRC readiness decision.				

FY14/15 eFAROS Accomplishments & Activities

- Conducted successful Flight Check of eFAROS at BOS – Jun 2014
- Completed eFAROS systems engineering check at BOS – Sep 2014
- **AFS-400 leadership expressed concerns about eFAROS testing at BOS; and more significantly, the eFAROS ConOps that dates back to 2001 – they no longer concur with the use of Flashing PAPI's as annunciators – Mar 2015**
- **In a meeting with ANG-C5 leadership on 3/3/15, the RIRP sponsor, AJI-14 indicated that they will no longer support the eFAROS program or contest AFS-400 concerns – Mar 2015**
- **Awaiting final decision from ATO senior management on project – Jul/Aug 2015**

Runway Safety Assessment (RSA)

Federal Aviation Administration

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Runway Safety Assessment (RSA)

- RSA is intended to address the NTSB recommendation A-00-66 that states: “Require, at all airports with scheduled passenger service, a ground movement safety system that will prevent runway incursions; the system should provide a direct warning capability to flight crews. In addition, demonstrate through computer simulations or other means that the system will, in fact, prevent incursions.”

ANG-C Market Survey - Overview

- ANG-C5 issued a Market Survey on July 23, 2013 for Runway Incursion Reduction Technologies (Contract Opportunity ID: 14673).
- The Market Survey solicits input on feasible technologies from industry partners and interested vendors. This survey is not a formal contract solicitation and is not intended to result in a contract award.
- The intended outcome of the Market Survey is to evaluate one or more technologies which may be applied, or enhanced through additional research, to prevent runway incursions.
- Market Survey closed on Aug 23, 2013; a total of 30 qualifying responses were received.

ANG-C Market Survey - Assessment

- Evaluation of the responses was conducted from 10/31/13 to 12/6/13.
- The responses received were evaluated by a team of 8 FAA employees and contractors from ANG-C and AJI, consisting of SME's in:
  - ATC
  - Engineering & Technology
  - Program Management
  - Runway Safety
- The outcome of the evaluation process is focused on categorizing the responses by:
  - the technical maturity of the proposal
  - research viability within a 3-year timeframe

Milestone Schedule

FY 15 Milestones	Q1	Q2	Q3	Q4	Q1
Perform technical evaluation of feasible technologies identified in Market Survey responses.			Complete		
Develop Runway Incursion Prevention Shortfall Analysis report.					
Develop report on proposed solution set for new Runway Incursion reduction technologies.					

RSA Accomplishments / Activities

- Conducted Technical Feasibility Assessment of Candidate RI prevention technologies identified during market survey evaluation process. Q2-Q3FY15

- Undertake data-driven analysis of coded historical Runway Incursion incidents to categorize RIs by causal factors. Q2-Q4FY15

- Develop Runway Incursion Prevention Shortfall Analysis (RIPSA) report. Q4FY15

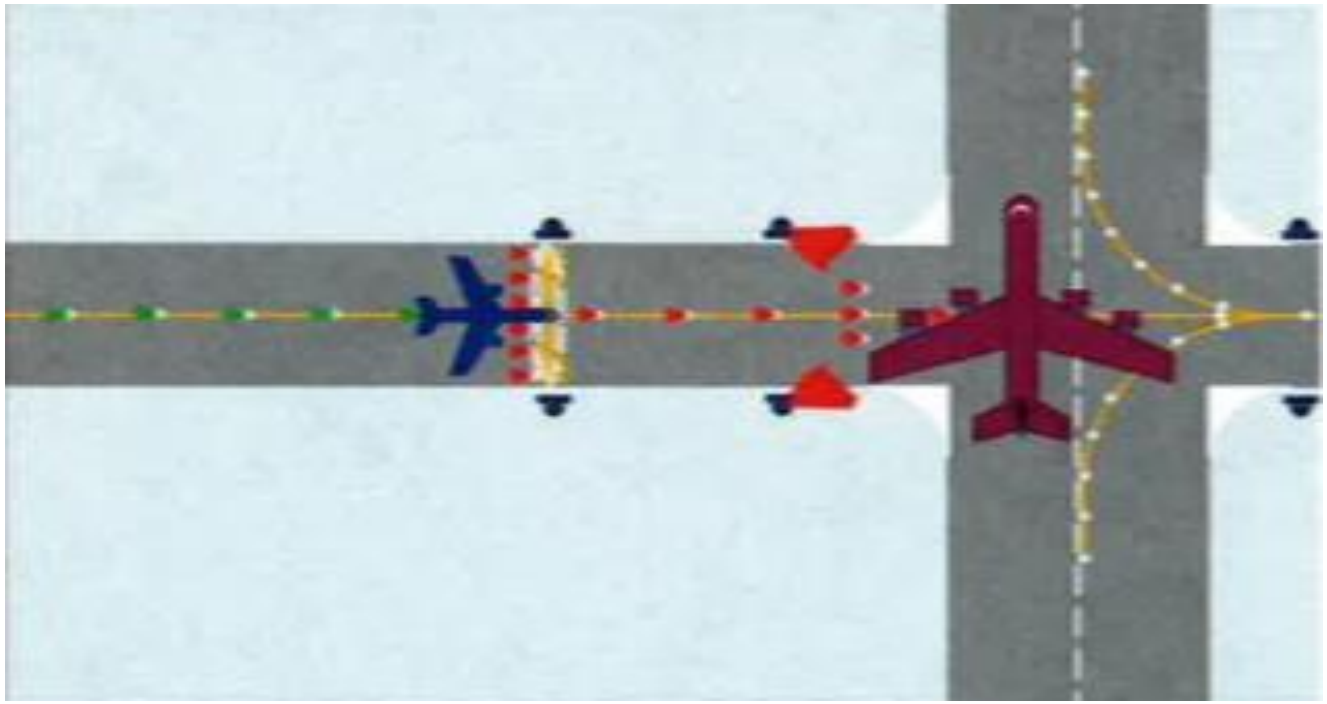
- Develop **“right-site-right-size”** report on proposed solution set for new Runway Incursion reduction technologies based on RIPSA report and candidate technologies deemed feasible for evaluation. Q1FY16

Candidate RI prevention technologies for Technical Evaluation

ADB Airfield Solutions

Proposed Technology

Microwave Barrier Detector (MBD) - ADB proposes using a combination of MDB and infrared sensors (IR) placed for localized surveillance at taxiway/runway intersections.



Local sensor detects holding position overrun

Aeropath Technologies

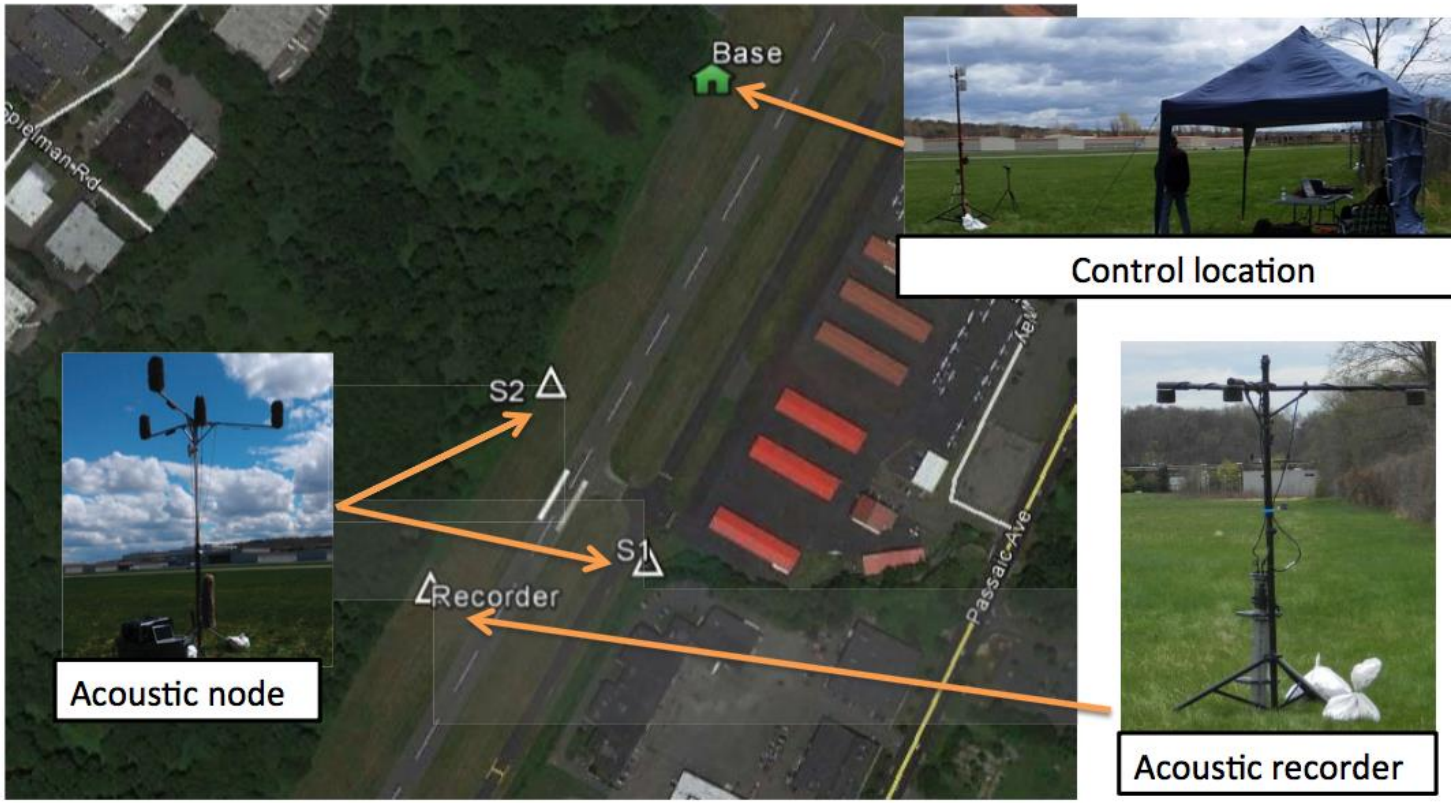
Proposed Technology

Modified TCAS Mode S/C Interrogator- Aeropath proposes using its Airport Real Time Information (ARTI) system for ground surveillance at small to medium-sized airports.

BridgeNet International

Proposed Technology

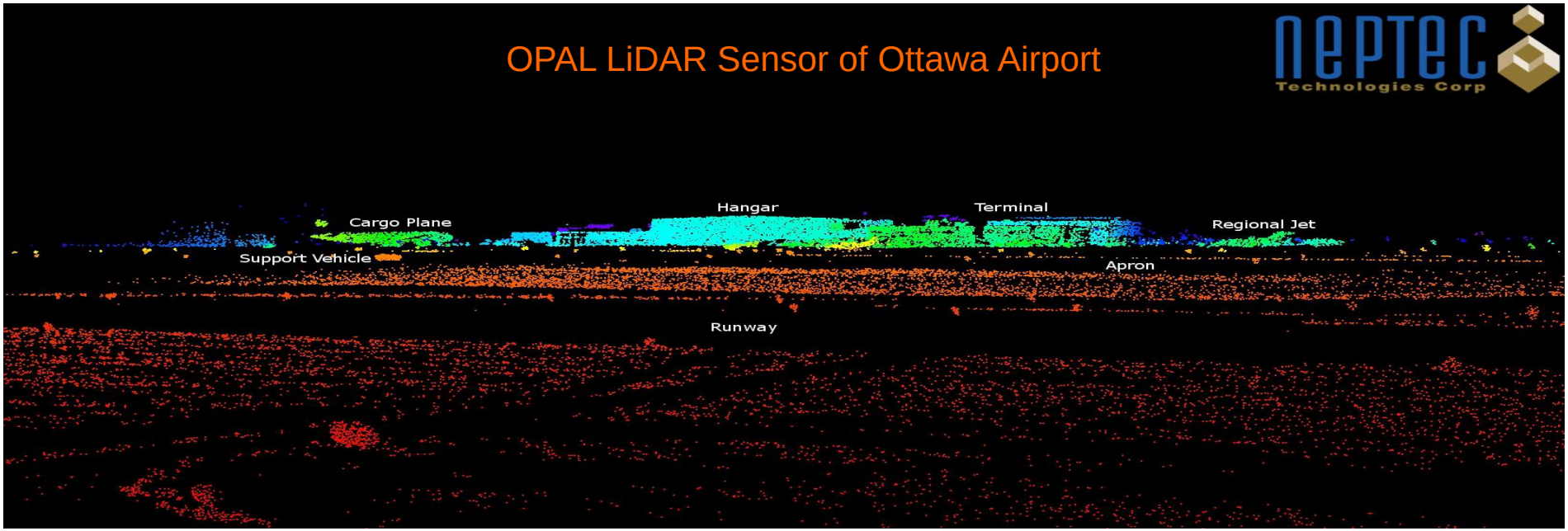
Passive Acoustic Sensor Technology (PAST) - BridgeNet International in partnership with Stevens University, proposes PAST for using for surface and airborne surveillance.



Neptec Technologies

Proposed Technology

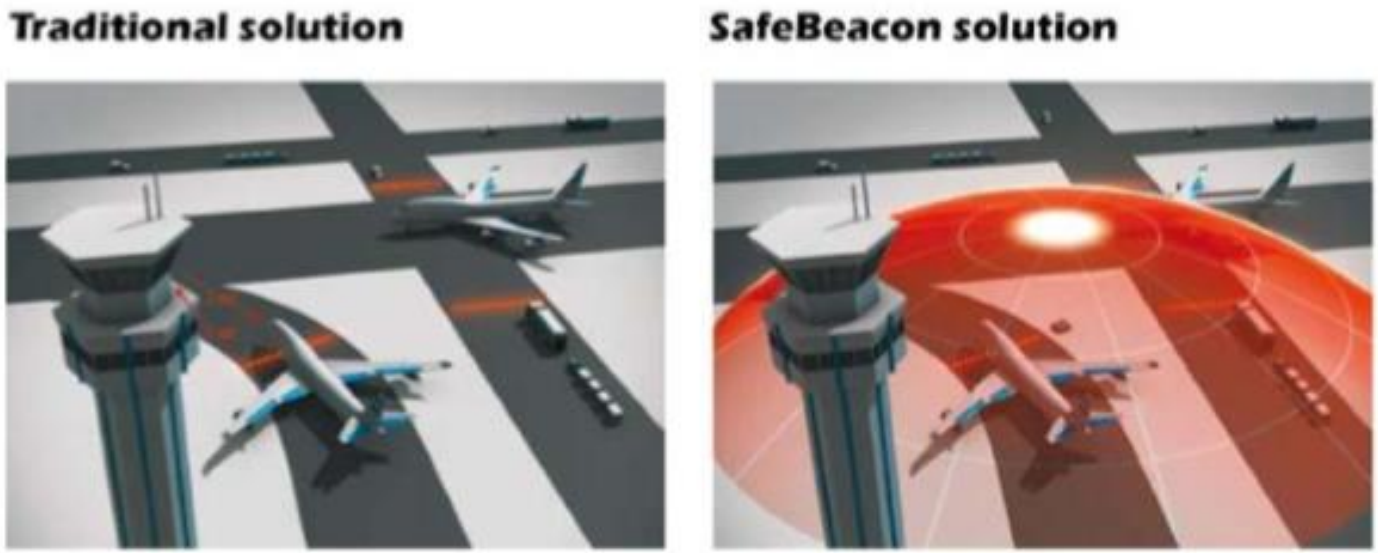
Light Detection and Ranging (LiDAR) - Neptec proposes using its OPAL (Obscurant Penetrating Autosynchronous LiDAR) family of sensors in conjunction with its 3D change-detection software as a sensor system for surface surveillance.



Safegate Airport Systems

Proposed Technology

Microwave Barrier Detector (MDB) - Safegate proposes using MDB sensors, part of their SafeBeacon system for localized surveillance at taxiway/runway intersections.



Searidge Technologies

Proposed Technology

Searidge proposes using its IntelliDAR system, based on real-time video capture and processing for movement area surveillance.

Thales

Proposed Technology

Millimeter Wave Sensors MWS - Thales in partnership with Xsight Systems, proposes using Foreign Object Debris Detection (FODetect) technology that utilizes Surface Detection Units (SDUs) installed along both sides of the airport runway for surface surveillance.

Small Airport Surveillance System (SASS)

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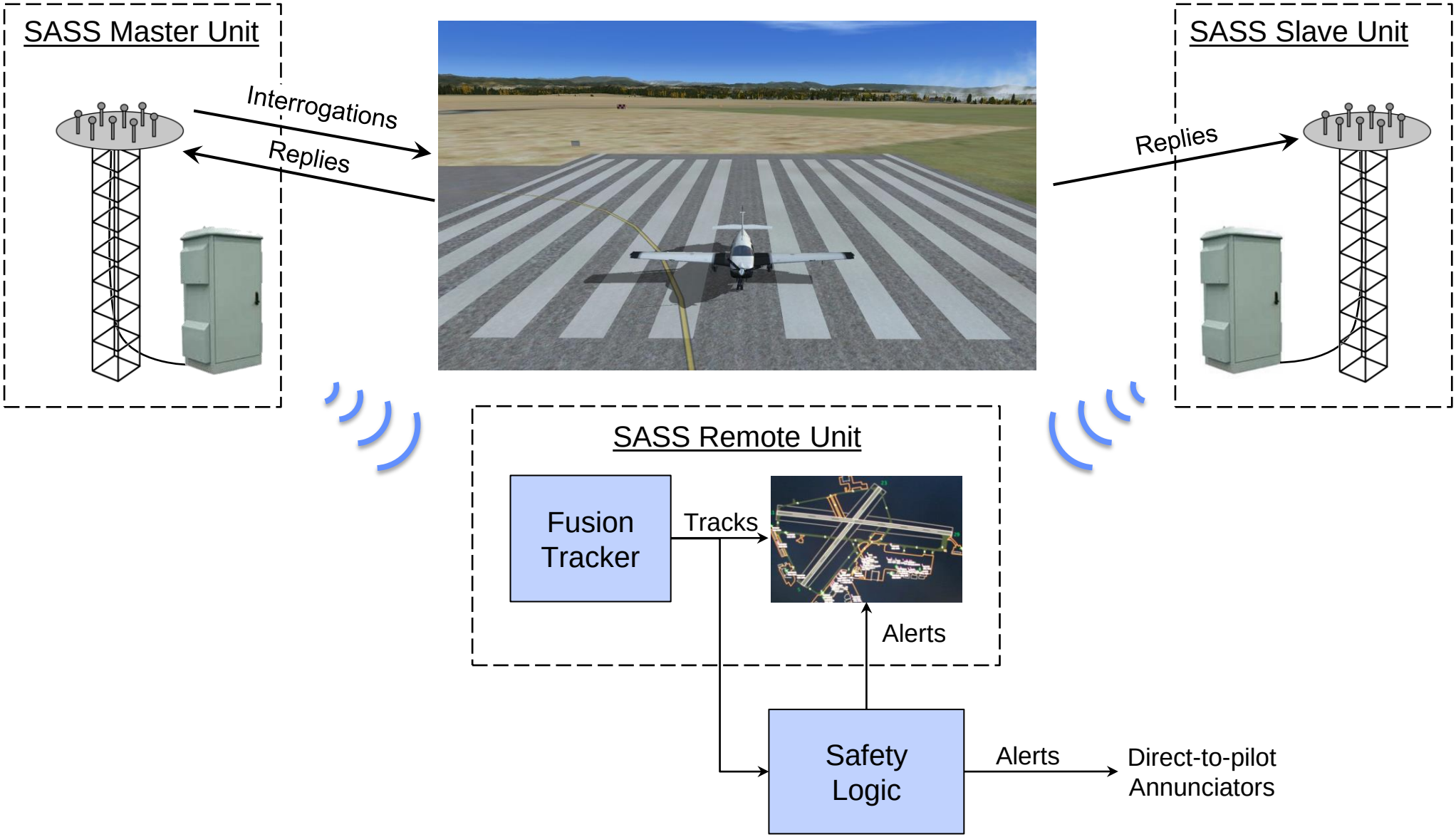
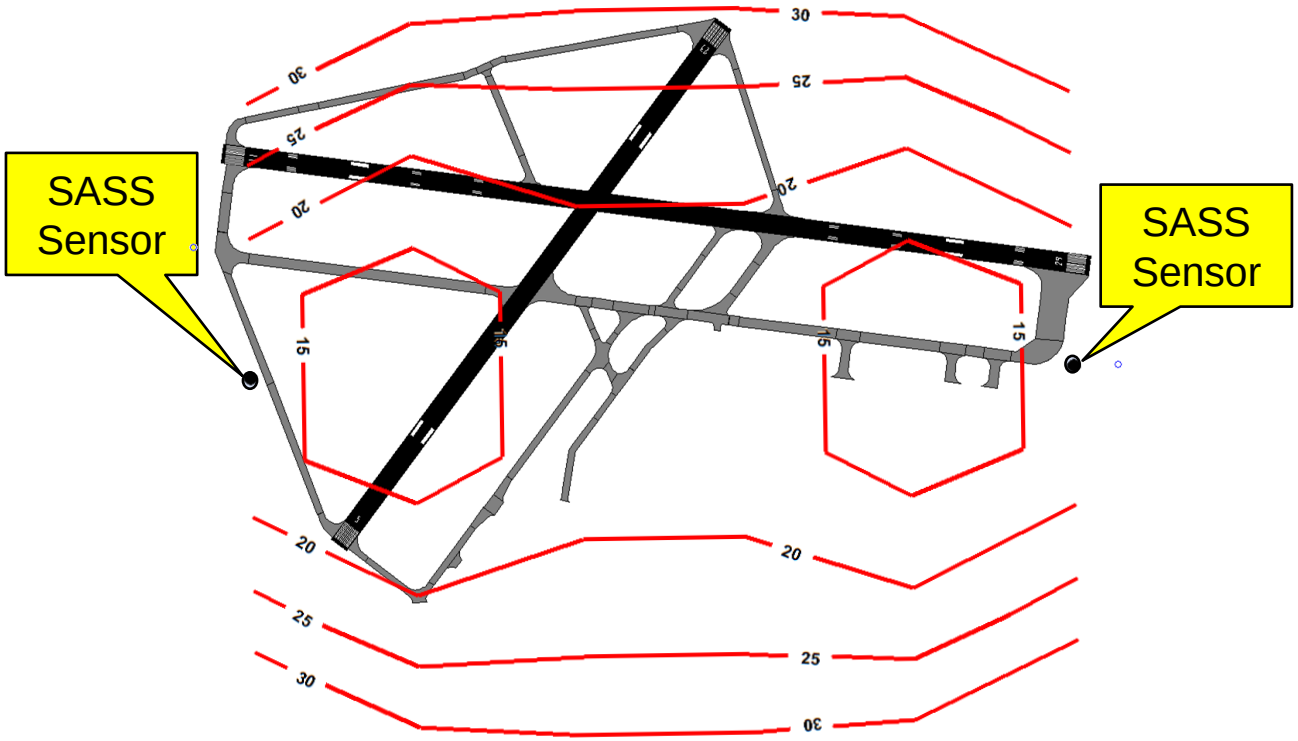
Small Airport Surveillance Sensor (SASS)

- **SASS is a low-cost secondary surveillance solution**
  - Provides surface & airborne surveillance in airport vicinity
  - Expected Surface accuracy ~30', airborne targets ~20 nm out
- **Potential benefits**
  - Provides improved controller traffic situation awareness
  - Improved safety & efficiency at towered airports
  - Portability for disaster response (Haiti) & special events (Oshkosh)
- **Key design features**
  - High accuracy phased array antenna design
  - COTS equipment use - Software Defined Radio (SDR) modules
  - State-of-the-art digital signal processing leveraged from DoD work
  - Requires only two sensors installed on airport property
- **Target airports**
  - GA airports with Class D airspace towers
  - High traffic non-towered airports

SASS System Diagram



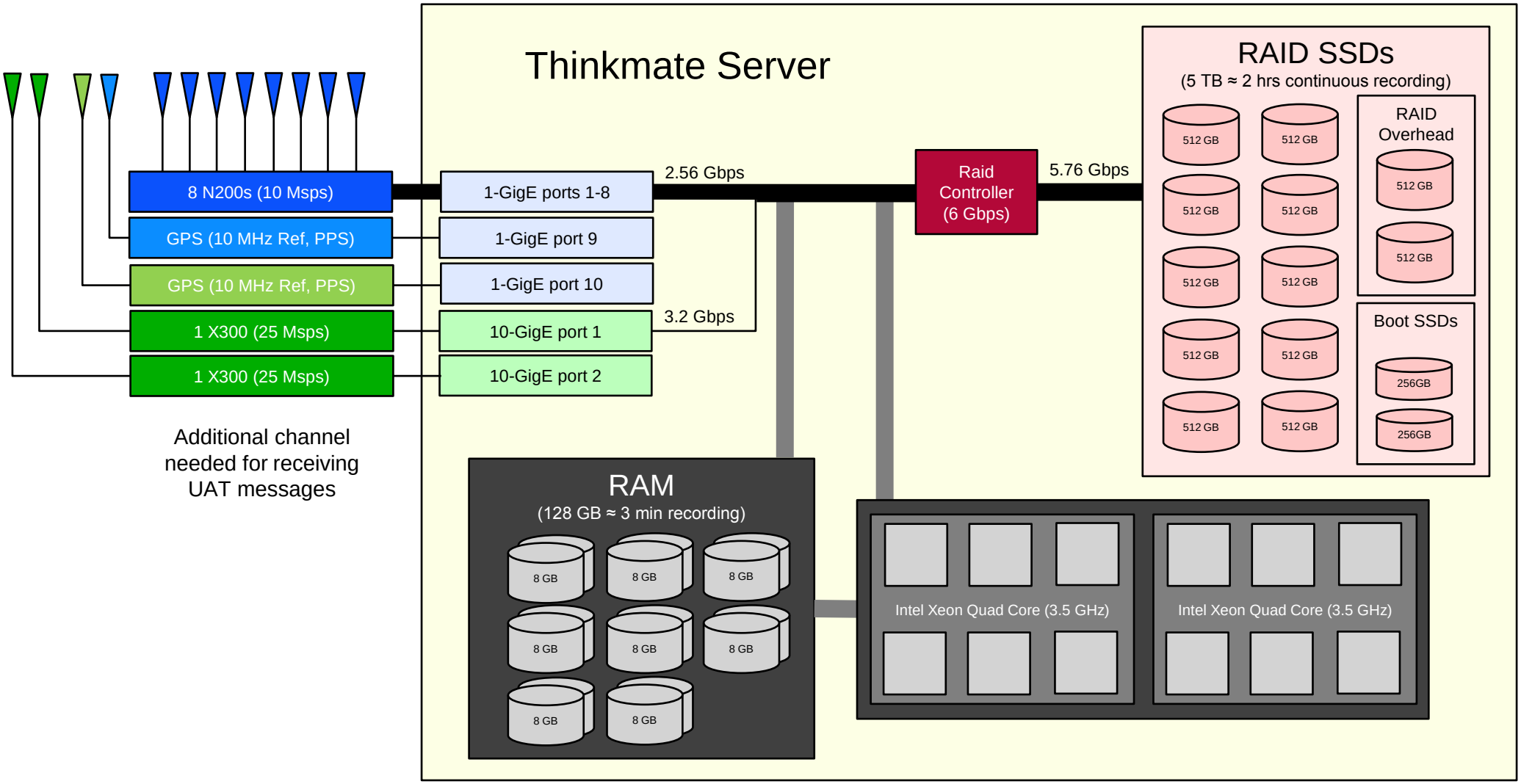
Modeled Surface Surveillance Error (ft)
(Hanscom Field in Bedford, MA)



Model Assumptions
Range error: 10’ (1 σ)
Azimuth error: 0.4° (1 σ)

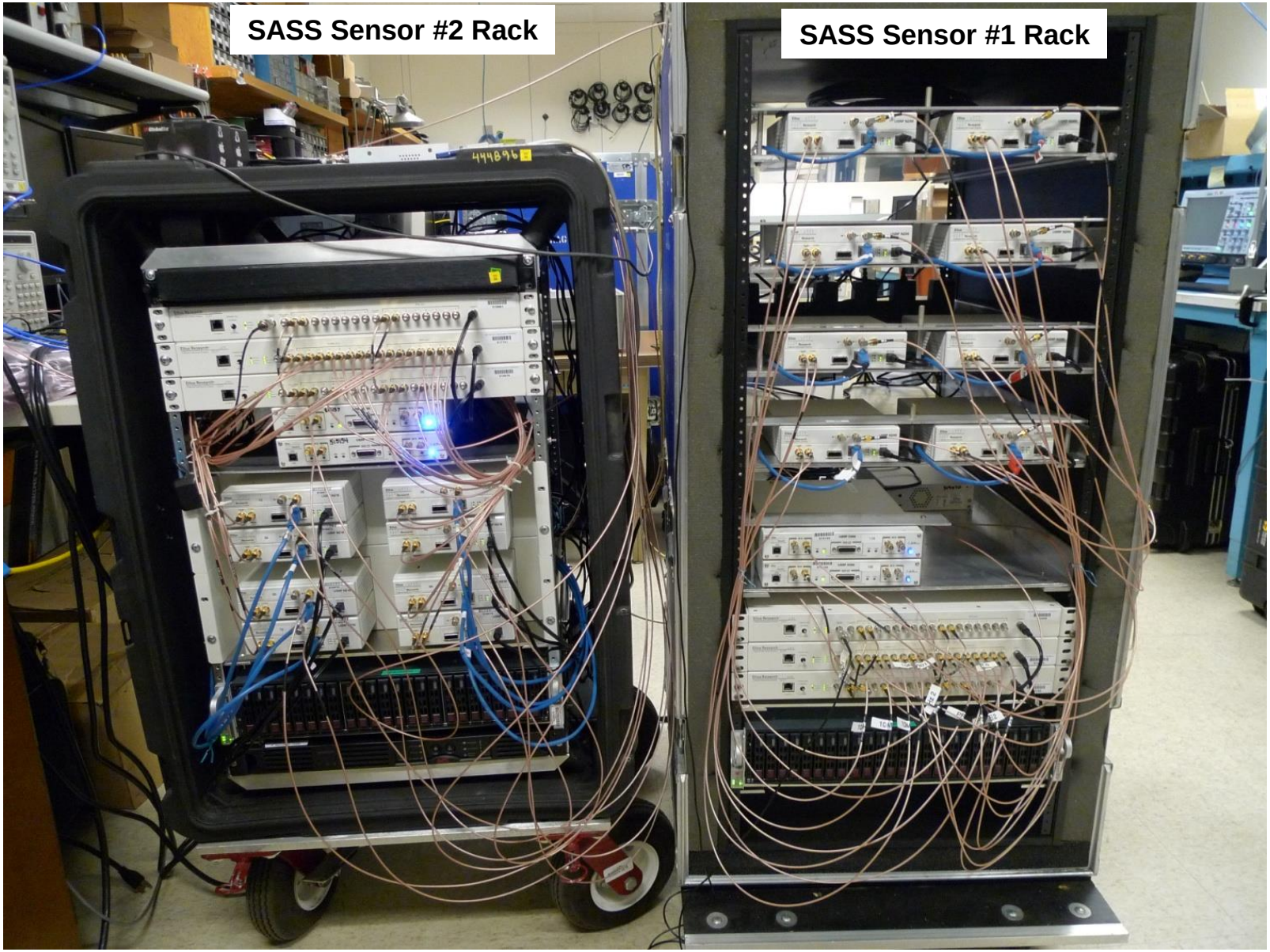
30’ position error or less over entire surface movement area

SASS Sensor System



All hardware now on hand for both SASS sensors

SASS Sensor Racks



FY15 Hanscom Data Collection

ADS-B equipped aircraft

MODSEF (1.3 nm away)

- Installing sensors in vehicles with generators for FY15 data collection pending semi-permanent site installations
- Truth sources: DGPS, Lincoln Mode S radar (MODSEF), ADS-B equipped targets of opportunity & video cameras

Milestone Schedule

FY 15 Milestones	Q1	Q2	Q3	Q4
Develop SOW and create new TASK for SASS project under current MIT LL contract	Completed			
Build and test SASS hardware platform		Completed		
Develop real-time signal processing software			Completed	
Perform surveillance data collection at BED				
Demo real-time surface surveillance at BED using SASS.				

FY15 SASS Accomplishments / Activities

- Built and tested SASS Master and Slave mobile units. Q2FY15
- Developed and tested real-time signal processing software. Q2-Q3FY15
- Conduct field tests at Hanscom Field (BED) using SASS Master & Slave mobile units. Q4FY15
- Perform analysis to evaluate the performance of the SASS system against truth data. Q4FY15
- Develop report on the performance of the SASS system against truth data. Q1FY16

FY16 RIRP Proposed Activities

- Complete annual technical and operational evaluation report of existing RIRP prototype systems.

- Complete annual report documenting results of human-in-the-loop (HITL) testing Human Factors (HF), safety logic, aircraft performance, or any uncertainty or deficiency pertaining to surface based RI indications.

- Complete annual report on Runway Incursion (RI) prevention shortfall analysis.

- Complete annual report on testing of safety logic enhancements to Runway Incursion (RI) detection and prevention products.

- Publish the Project Plan and Resource Management Plan (RMP) for the utilization of a Small Airport Surveillance Sensor (SASS) as a sensor to drive the activation of direct to pilot alerting safety logic.

FY17 RIRP Proposed Activities

- Complete annual technical and operational evaluation report of existing RIRP prototype systems.
- Complete annual report documenting results of human-in-the-loop (HITL) testing HF, safety logic, aircraft performance, or any uncertainty or deficiency pertaining to surface based RI indications.
- Complete annual report on testing of safety logic enhancements to Runway Incursion (RI) detection and prevention products.
- Complete report documenting candidate site selection for a system to test the utilization of a Small Airport Surveillance Sensor (SASS) as a sensor to drive the activation of direct to pilot alerting safety logic.
- Complete report on integration of a system to test the utilization of a Small Airport Surveillance Sensor (SASS) as a sensor to drive the activation of direct to pilot alerting safety logic.
- Publish the initial Project Plan and Resource Management Plan (RMP) for the utilization of an advanced ground surveillance sensor to drive the activation of direct to pilot alerting safety logic

BACKUP SLIDES

LCGS - Steps For Site Breakdown

1) Removal/Relocation of existing equipment racks located in shelter

2) Removal / crating of existing radar equipment located in shelter, including the disconnection of radar waveguide/transceiver/motor controller

3) Removal of electrical conduits between LCGS radar tower and shelter

4) Removal of copper ground leads to ground counterpoise

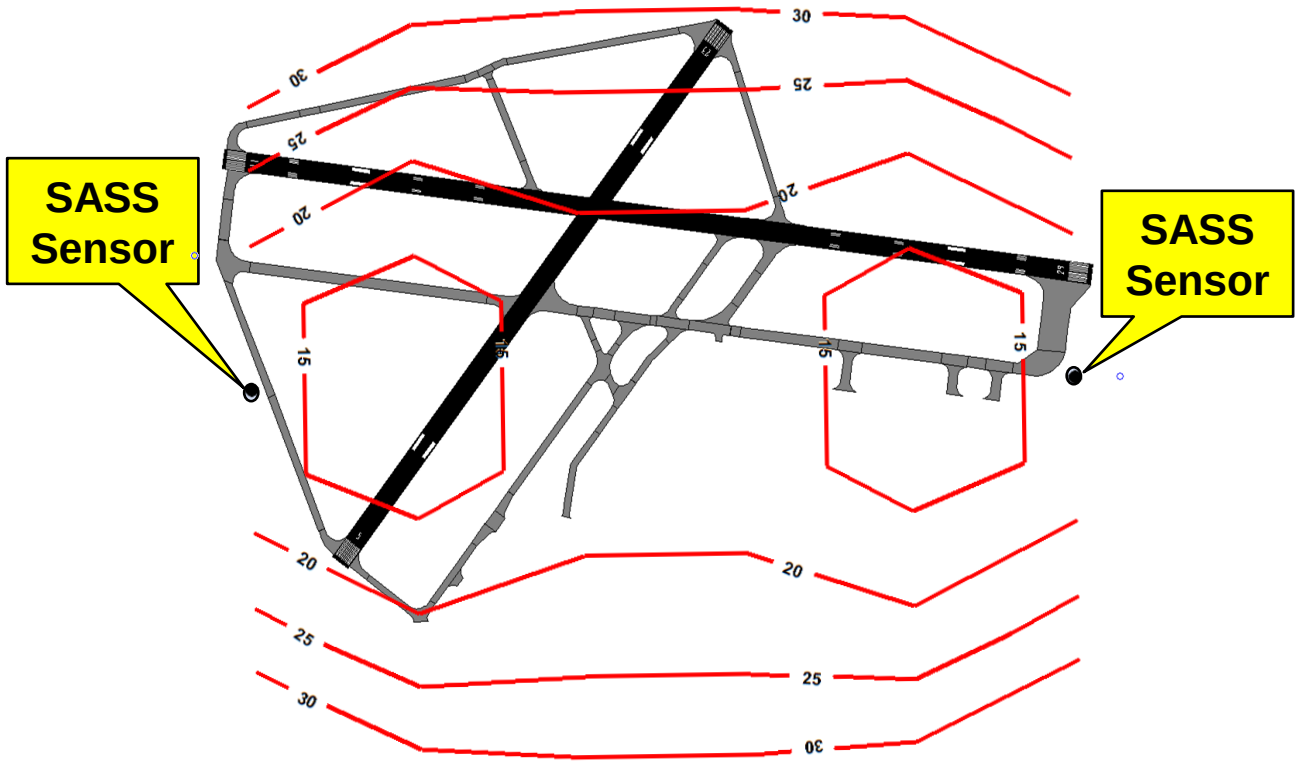
5) Removal of Ice Bridge connecting LCGS tower to shelter

6) Pull back of FAA single mode fiber from the shelter back to nearest pull box

7) Termination of existing power feed to FAA ATCT location (This will require support from the local Service Area)

8) Installation of Battery Operated Obstruction lights on LCGS radar tower until tower can be removed

Modeled Surface Surveillance Error (ft)
(Hanscom Field in Bedford, MA)



Model Assumptions
Range error: 10’ (1 σ)
Azimuth error: 0.4° (1 σ)

30’ position error or less over entire surface movement area

Siting Options with Obstruction Surfaces

Site #1: Pine Hill T-Hangars

Telescoping tower with trailer

- **50’ extended height**
- **15’ retracted height**

Box truck obtained for second SASS unit

- **Allows identical tall rack to be installed**
- **Towed generator for power**

Site #2: Salt Shed

- **Antenna attached to truck**
  - 50’ extended, 20’ retracted
  - Set up at SE corner of salt shed
  - May attach antenna to shed (MassPort suggestion)

- **Truck**
  - Contains data recording system
  - Towed generator for power

Flight Facility Tower Cab

View of airfield to North from Flight Facility tower cab

- **Will be used to mimic BED tower**
  - Good view of runways & taxiways (85’ tall)
  - Near actual tower (550’)