
# Industry Inputs into Future NASA Project Planning

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# Motivation & Objective

Motivation

- ATD will complete in FY2020
  - ATD-1 completed in FY2018
  - ATD-3 completes in FY2019 (less than 30 days from now)
  - ATD-2 will complete in FY2020 (~ 12 months from now!)
  - ATM-X is planning for work for FY21 – FY25

- NASA seeks to maintain ATD-2 industry collaborations while transitioning ATD expertise to other NASA projects, including the ATM-X Project

Objective

- This breakout session is an opportunity for NASA to hear from industry to guide NASA AOSP planning

# Planning Parameters

- Effort to begin executing in FY21 under the ATM-X Project
  - Requires NASA approval to execute, scheduled in summer 2020

- NASA envisions executing a series of joint NASA/Industry partnership evaluations from FY21 to FY25
  - Targets applications that industry (airline operators, airport operations, new entrants and vendors) expects to provide benefits
  - Complements current (TBFM, TFMS) and future (TFDM) FAA automation platforms as well as yet-to-be developed future systems
  - Service oriented technology to be validated through operational use to support commercialization potential by others in the aviation industry – expected deliverables include reference prototype, requirements, and associated documents

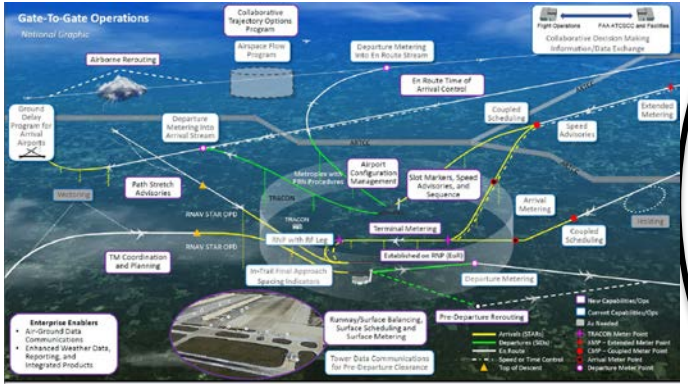
- Leverage the NASA/FAA/Industry partnership developed under ATD
  - Jointly develop future system requirements

# Scope of Today's Discussion

Future

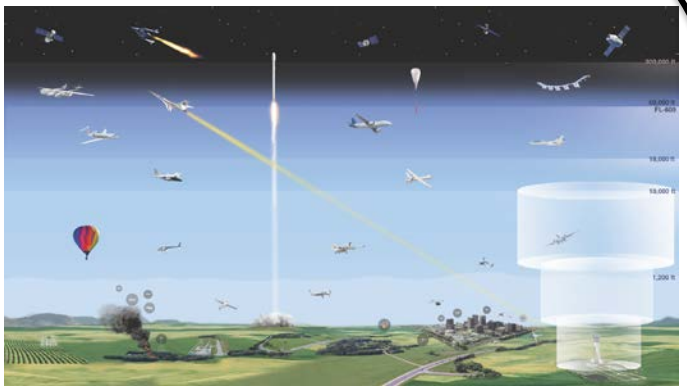
Current & Emerging NAS Needs

Longer Term NAS-Wide Goals




*Trajectory Based Operations in 3T with SWIM*

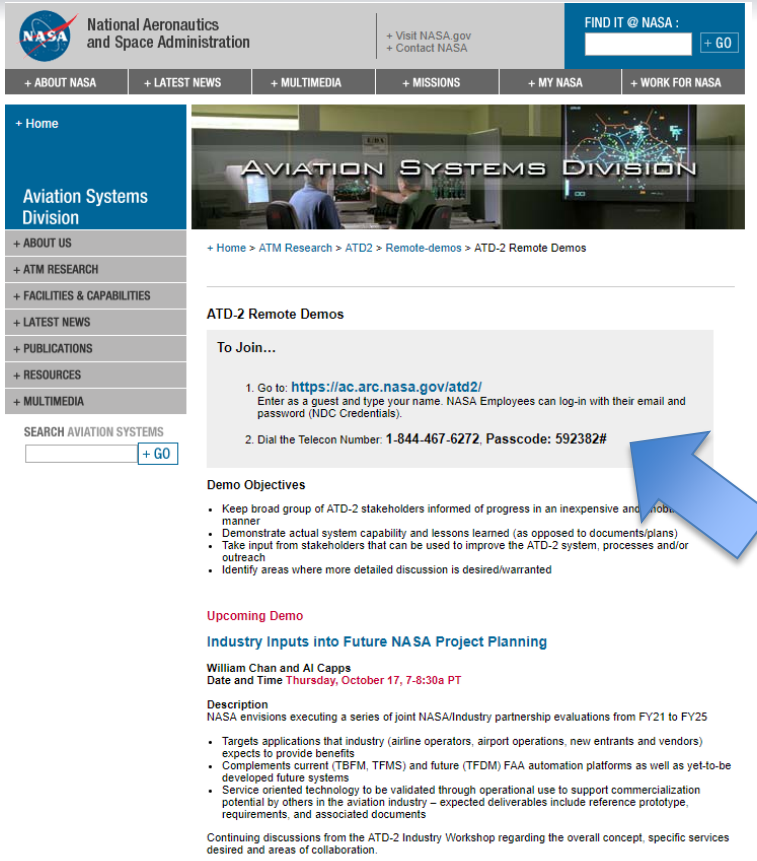
**Both**



*2045 Airspace Vision Including New Entrants*

Today's discussion is to ***begin*** the conversation on current & emerging needs that are likely to benefit the entire future aviation community.

# Follow up Webinar- Continuing the Dialog

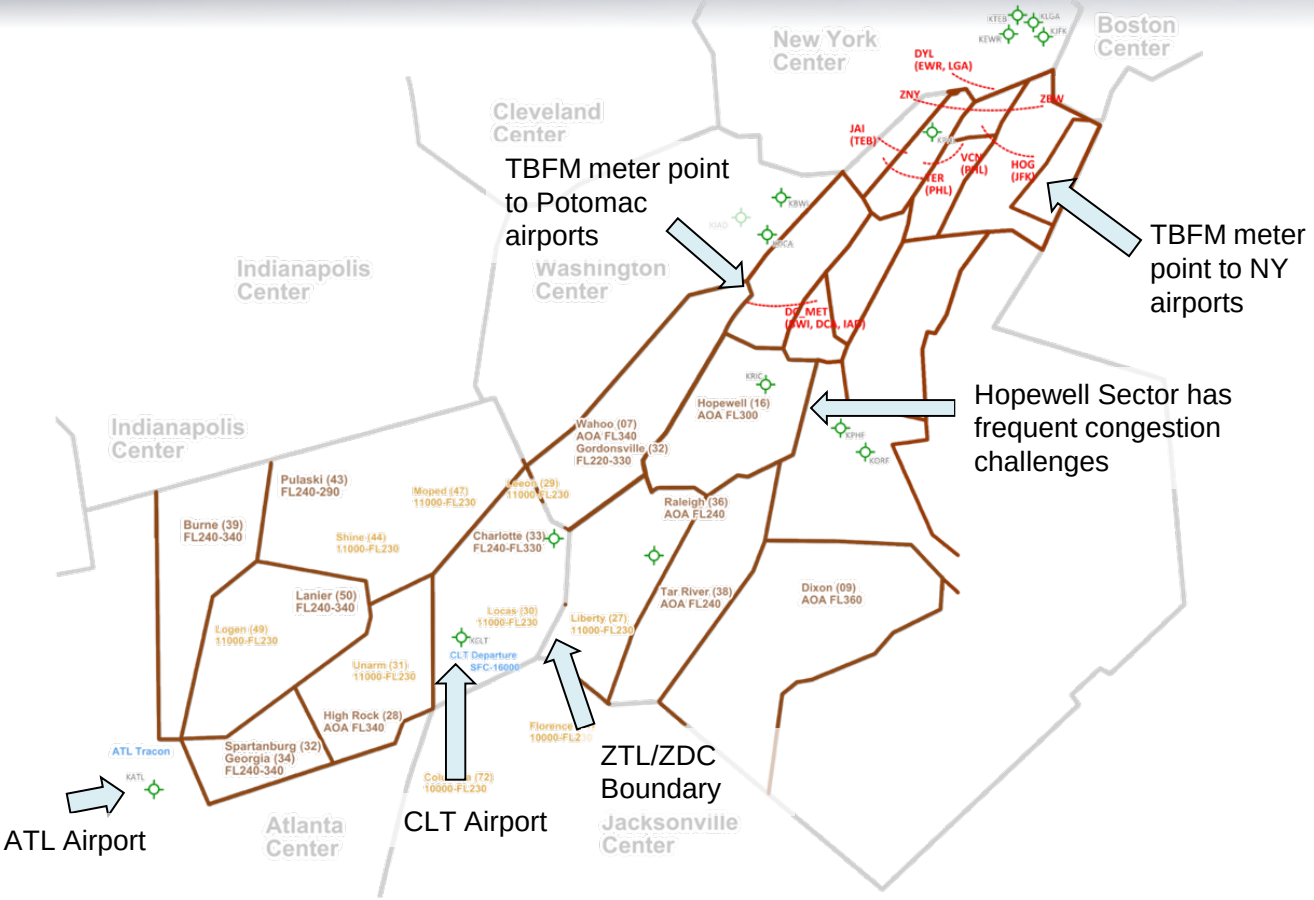



- A considerable amount of content will be presented today that benefits careful consideration
- In addition to today, follow up opportunities to provide input are welcome and available
- Feel free to join the currently scheduled follow-up Webinar on Oct 17th, 10-11:30 Eastern
  - https://www.aviationsystemsdivision.arc.nasa.gov/research/atd2/remote-demos/index.shtml

# Applying End State Design Maxims to the Current Day System

- The community represented at this venue is very familiar with current and emerging needs
  - The information on this slide provides some additional necessary future system background
- The Unmanned Aircraft System (UAS) Traffic Management (UTM) system design paradigms are now commonly used worldwide in the new entrant field
  - The following slides walk through initial nearer-term examples of what applying paradigms from UTM might look like when projecting this onto the current day Air Traffic Management (ATM) system
  - The process of applying UTM paradigms to the current NAS has been called “UTM Inspired ATM” (see criteria below)
  - While these slides focus on nearer-term notional examples only, the larger objectives extend beyond NextGen timelines
- Criteria and design maxims applicable to the current day NAS that are being used in formulation
  - Maximize collaborative planning (the right user- taking the right action - at the right time)
  - Strong focus on early input from users to mitigate problems before they become a disruptive system event
  - Address known needs in the national airspace system (‘move the needle’)
  - Foster a streamlined development process (‘ecosystem for rapid innovation’)
- Drive toward a common set of aviation-wide services using greater data digital exchange in a Service Oriented Architecture (SOA) cloud environment

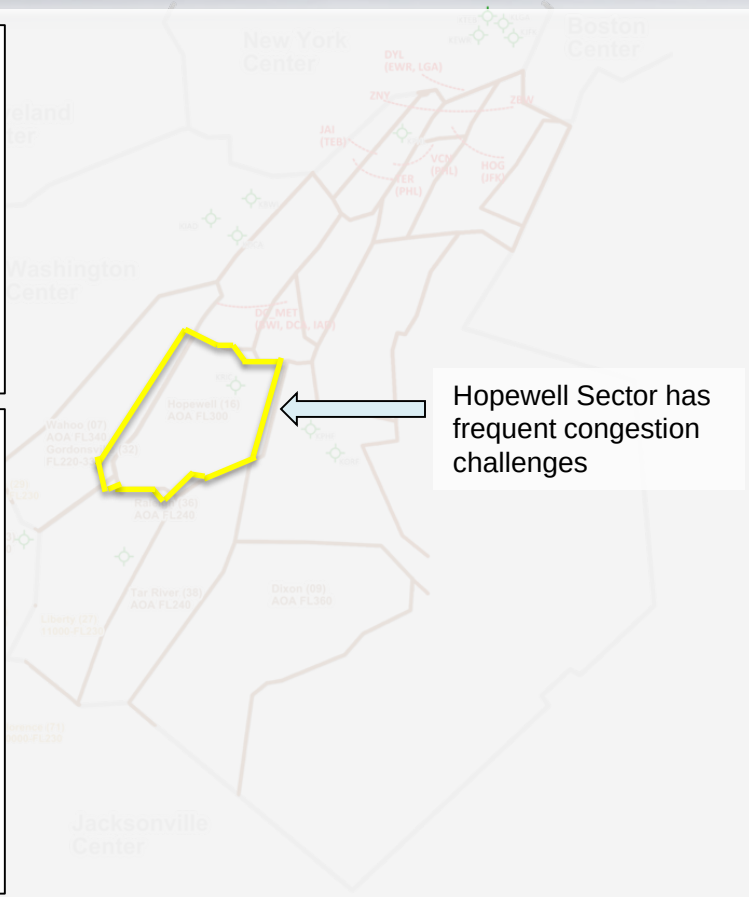
# Operational Example- Maximizing Collaboration & Mitigating a Disruptive Event



# Operational Example- Maximizing Collaboration & Mitigating a Disruptive Event

The current day response to this sector demand/capacity imbalance (i.e.- congestion) is for the ATC to add a Miles in Trail (MIT) to flights that fly through this airspace

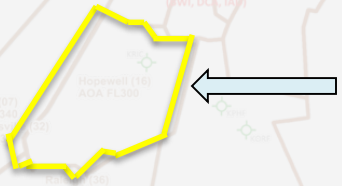
Implementing this ATC restriction may create substantial complexity. It may utilize a combination of TFMS, TBFM and/or procedural pass back delay to other Centers which impacts the airport surface.



# Operational Example- Maximizing Collaboration & Mitigating a Disruptive Event

In the current day system, is the right user, taking the right action, at the right time?

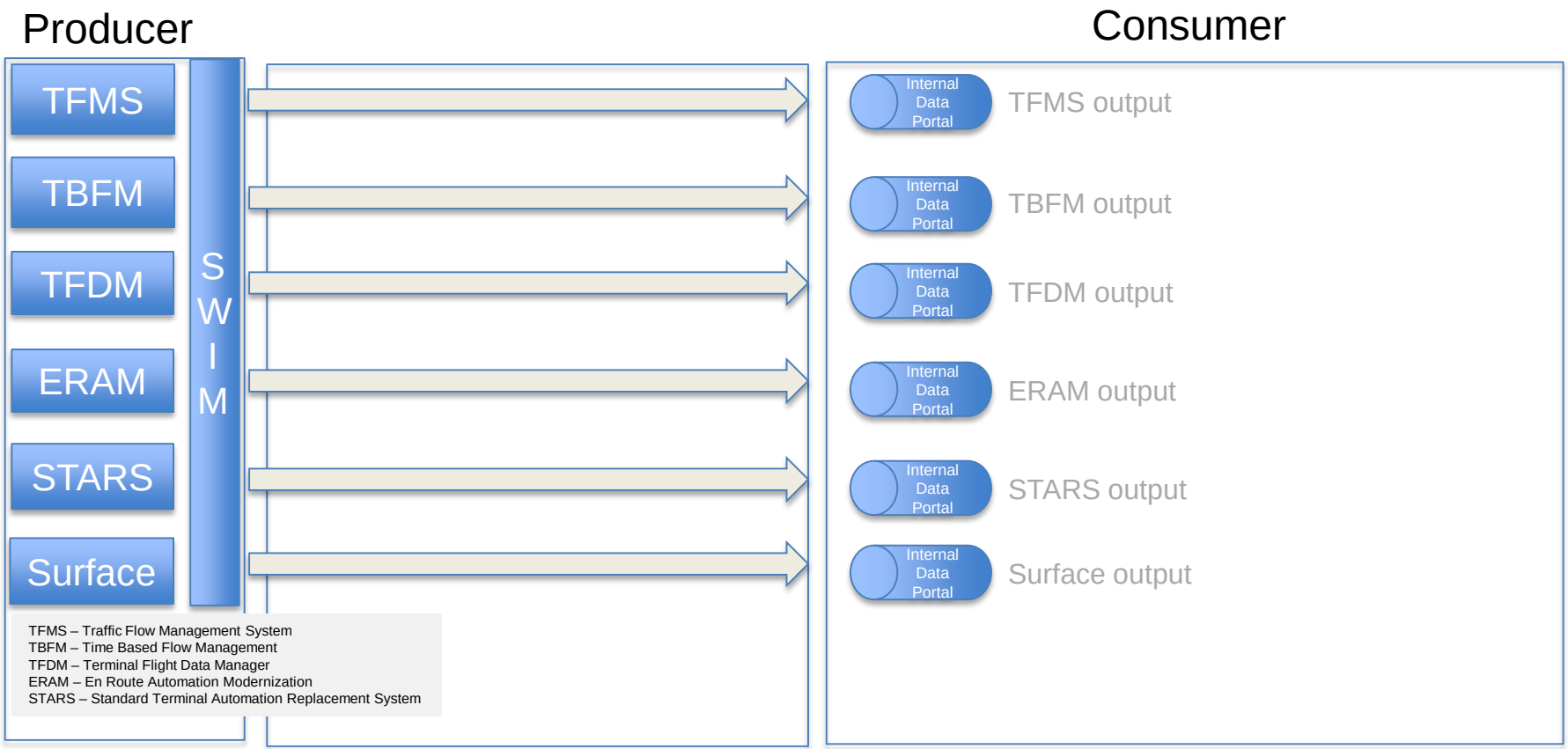
In the future, might we be able to mitigate this disruptive congestion problem before it becomes an issue in the first place? If yes, what new services and procedures would allow for this?



Hopewell Sector has frequent congestion challenges

***Note***: This type of service is likely beneficial to both current day and new entrant airspace users.

# How? Let's Start with Current Day SWIM Data Consumption



# NAS Services in the Cloud- NASA Pathfinder

## Producer

- TFMS
- TBFM
- TFDM
- ERAM
- STARS
- Surface

SWIM

## Services

*Fuser Service*

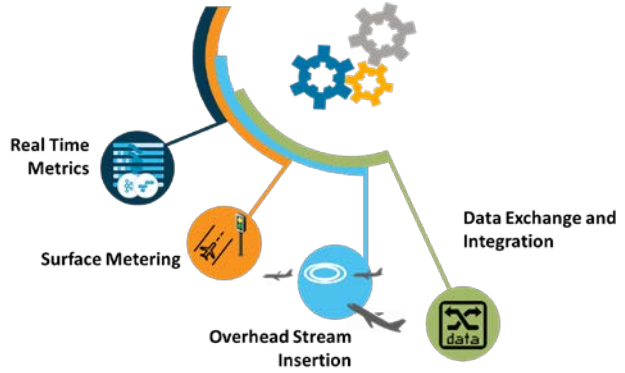
- Merge
- Validate
- Mediate
- Derive

Fuser was developed on ATD-2 to merge real-time SWIM inputs into a logically consistent data stream

## Consumer

Internal Data Portal

Fuser output




The output of Fuser was used internally on Java Message Set (JMS) topics to provide real-time capability to operational field personnel on NASA displays.

# Building on the Pathfinder - NAS Services in the Cloud Examples

## Producer

- TFMS
- TBFM
- TFDM
- ERAM
- STARS
- Surface

SWIM

## Services

*Fuser Service*

*Congestion Prediction*

*Options Identification*

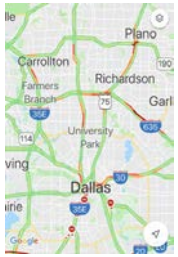
The same Fused data that drives ATD-2 is used to build new services **without additional needs on the FAA systems**. Examples are described on the following slides.

## Consumer

Cloud

Cloud

Cloud




Fuser in the Cloud

Real-time trajectory synchronization data to help construct ***your New* Service**

In this concept, the 'Fuser in the cloud' is published to cloud data stream. This allows others to innovate (and validate) with the same data NASA is using to build new community services.

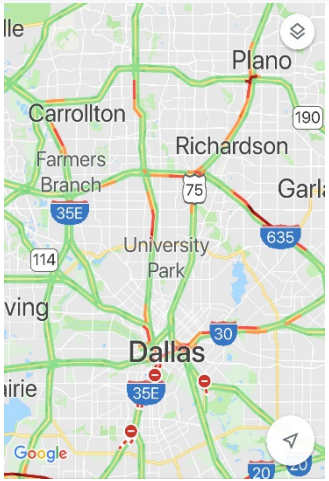
# Example - Congestion Prediction Services

## Problem

- Traffic congestion forecasting has become commonplace in our modern lifestyle. However, congestion forecasting (and monitoring) is not widely available in the U.S. aviation system.
- To predict congestion accurately, good estimates are required of both the capacity and the demand for the specific NAS resource (e.g. gate, runway, fix, etc.). Until recently, actual capacity or local demand was not accessible outside of traffic manager's visibility.

## How Data-Driven Services Will Help

- In recent years, new data sources and analytical methodologies have emerged that enable this capability. In this example, the NAS congestion prediction service would be a suite of foundational services that will provide real-time indications of congestion for NAS planning purposes and measure their accuracy.




**Workshop Traffic Prediction**

## Research Challenge

- Sector congestion. Can predictive analytics yield greater accuracy than purely deterministic algorithms?
- Surface runway congestion. Can new TFDM data help localized (e.g. flow dependent) predictions?
- Can TBFM metering delay pass back from the Center boundaries and airports be accurately predicted?
- Can new sensor data, not currently available to aviation, be used to improve capacity predictions?
- Note: The best algorithms for NAS resources ***may*** vary by domain and location. Can services be used to consolidate estimates of flight congestion by disparate domains into one useful representation?

# Example - Flight Operator Options Identification Services

## Problem

- A flight may be subject to multiple traffic restrictions and delay conditions which span ATC domains, Operators domains and mitigation strategies (e.g. substitute, re-route, fuel-efficient hold).
- From the perspective of flight operators, substantial experience exists with strategic restrictions (i.e. – substituting TFMS EDCTs). However, other flight alternatives are either new (surface substitution), invisible to operators (re-route alternative) or too complicated to work through quickly in operations.

FLT234 has 5 options (est. savings)

- TOS departure fix (12)
- TOS arrival fix (4)
- TOS low sector (8)
- Surface substitution (4)
- Strategic substitution (30)

## How Data-Driven Services Will Help

- In this example, the flight operator options identification service would be in the unique position of being cognizant of all the delay producing conditions that exist in the NAS. This ‘birds eye’ view of the NAS has only recently become available with SWIM and other emerging initiatives.

## Research Challenge

- What is the complete list of options available for a specific flight and the time window for decisions?
- Which options are mutually exclusive? (i.e.- can’t take options A&B, options B&C can be together)
- TBFM. Can we route around high TBFM delay to improve predictability without unexpected impacts?
- TFDM. Which flights are exempt (unavailable) for surface substitution? Which have multiple delays?
- Would consistent, automated options recommendations lead to greater predictably/reliability?

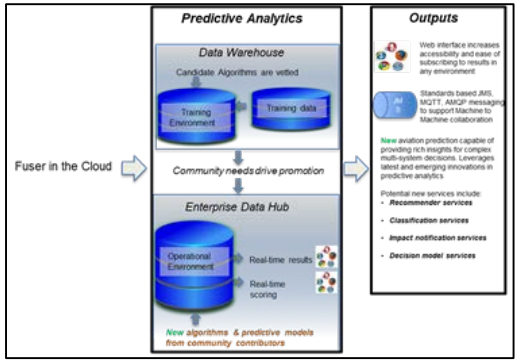
# Many Other Examples!!!

- Many other possibilities exist within this solution framework
  - Other examples are provided below (dozens exist). Solid progress is a key to success.
  - Ideas brought forward will be vetted with the aviation community in a collaborative fashion
  - We do not have time to discuss all the potentials today

- Input is desired on both the methodology and potential specific data-driven services

## *Leveraging Data Science*

Platform for Predictive Analytics

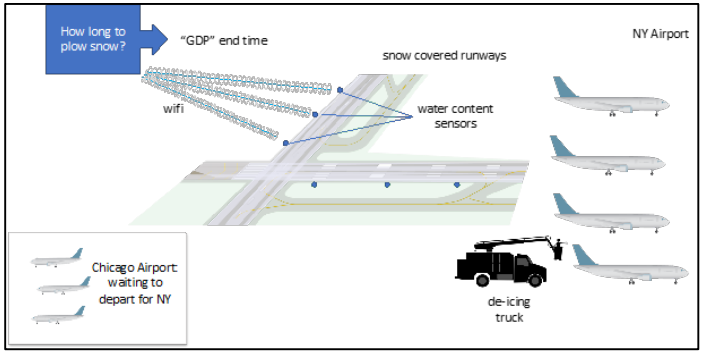



## *Innovative Pilot Tools*

Pilot Communication Services

## *New sensors to improve planning data*

Improving Capacity Estimation for Snow Affected Airports



# Formulation Input and Feedback During the Workshop

- Overall concept
- Specific services you would like to see
- Willingness to collaborate and good venues to do so
- Future discussion topics

# Next Steps

- Collect formulative input from you during or after this conference
  - Please speak to any of the presenters here today after this breakout
  - If desired, we can schedule a follow up with your team
  - NASA will collect this formulative input, consolidate it, and provide a status of the formulation in the Webinar scheduled below

- Additional input can be sent to Al.Capps@nasa.gov

- NASA is hosting a follow up Webinar to continue the dialog
  - The information collected above will be discussed with the community
  - Oct 17th, 10-11:30 Eastern
  - https://www.aviationsystemsdivision.arc.nasa.gov/research/atd2/remote-demos/index.shtml

# Thank You

Thank you for your input!

We are listening!