



**KBRwyle**



# Remote ID for Rapid Assessment of Flight and Vehicle Information

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# Lots of Drones

- Commercial drone market to reach 17 billion US\$ by 2024

“Global Market Insights,” <https://www.gminsights.com/industryanalysis/consumer-drone-market>, March 2018.

- Projected 50 million drone deliveries per day

Jenkins, Darryl, et al. *Forecast of the Commercial UAS Package Delivery Market*. Embry-Riddle Aeronautical University, 2017.

# Bad Actors?

# Problem Statement

Who's drone is that?

Owner  
Contact

Drone



What is it doing there?

Current Operation  
UTM State



Public Safety Officer

What kind of drone is it?

Manufacturer  
Model  
Weight  
Velocity

Where is it going next?

Future Operations  
Submitted

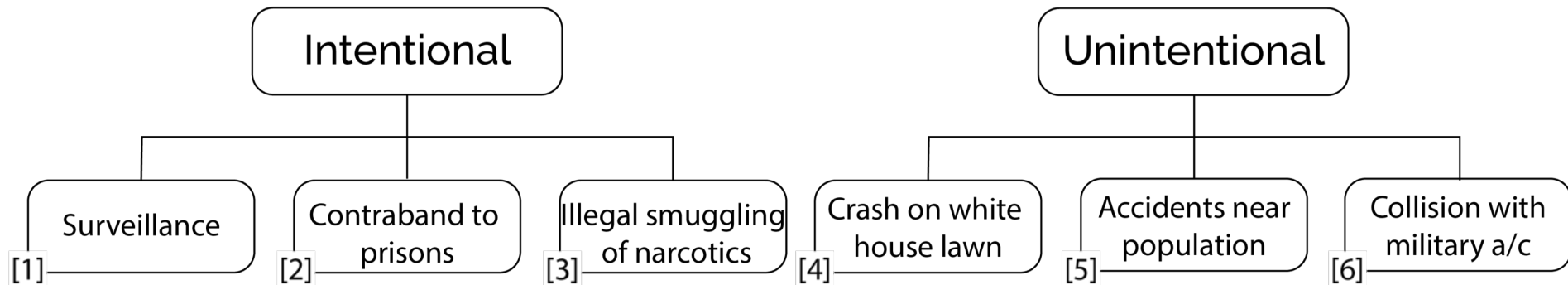
# Problem Statement

Can we develop a system to rapidly deliver flight and vehicle information?

# Outline

- Background and Motivation
- UTM Remote ID Architecture
- Main Results
- Summary

# Intentional and Unintentional Bad Actors



[1] Barrett, D., "Burglars Use Drone Helicopters to Target Homes," <https://www.telegraph.co.uk/news/uknews>,

[2] Craig, T., Russo, J., and Shaffer, J., "Eyes in the skies: the latest threat to correctional institution security," Corrections Today, 2017.

[3] Dinan, S., "Thirteen drones in four days: How drug smugglers are using technology to beat Border Patrol."

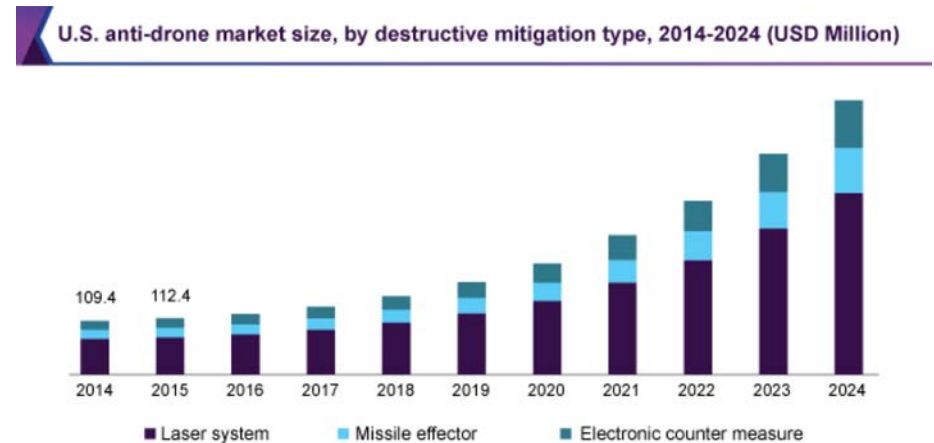
[4] Michael D. Shear and Michael S. Schmidt, "House Drone Crash Described as a U.S. Worker's Drunken Lark," The New York Times, January 27, 2015,

[5] John-Michael Seibler, "Seattle Case Shows Why Drone Regulation Should Be Local, Not Federal," The Daily Signal, March 9, 2017,

[6] National Transportation Safety Board, Aviation Incident Final Report, Incident Number: DCA17IA202A

# Emergence of Counter UAS

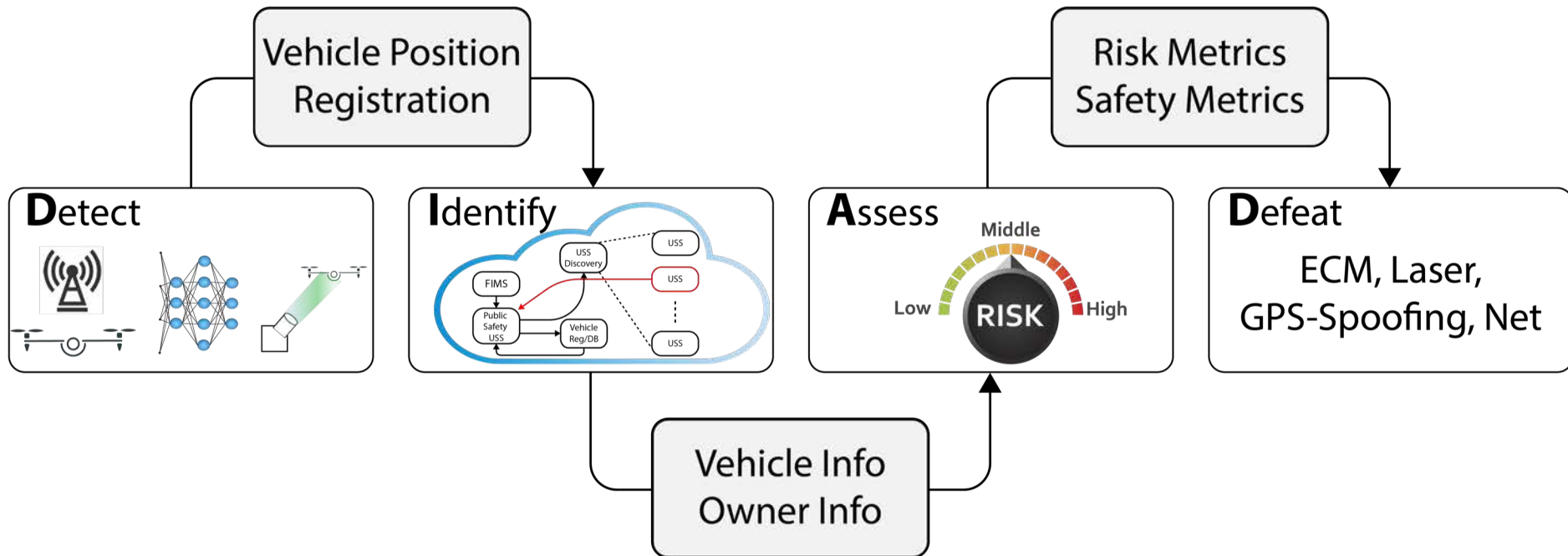
- Over 230 products currently exist or are under development
- Detection technologies include
  - Radar
  - Active, passive optics
  - Acoustics
  - EM emission
- Counter-UAS market to reach reach 1.85 billion by 2024



Anti-Drone Market Size, Grand View Research, Inc., May 2018



# DIAD



ECM = Electronic Counter Measures

# UAS Traffic Management (UTM)

**UTM is an “air traffic management” ecosystem for small UAS in low altitude airspace**

UTM aims to identify

- services
- roles/responsibilities
- information architectures
- data exchange protocols
- software functions and infrastructure
- performance requirements

Transparency

Security

Safety

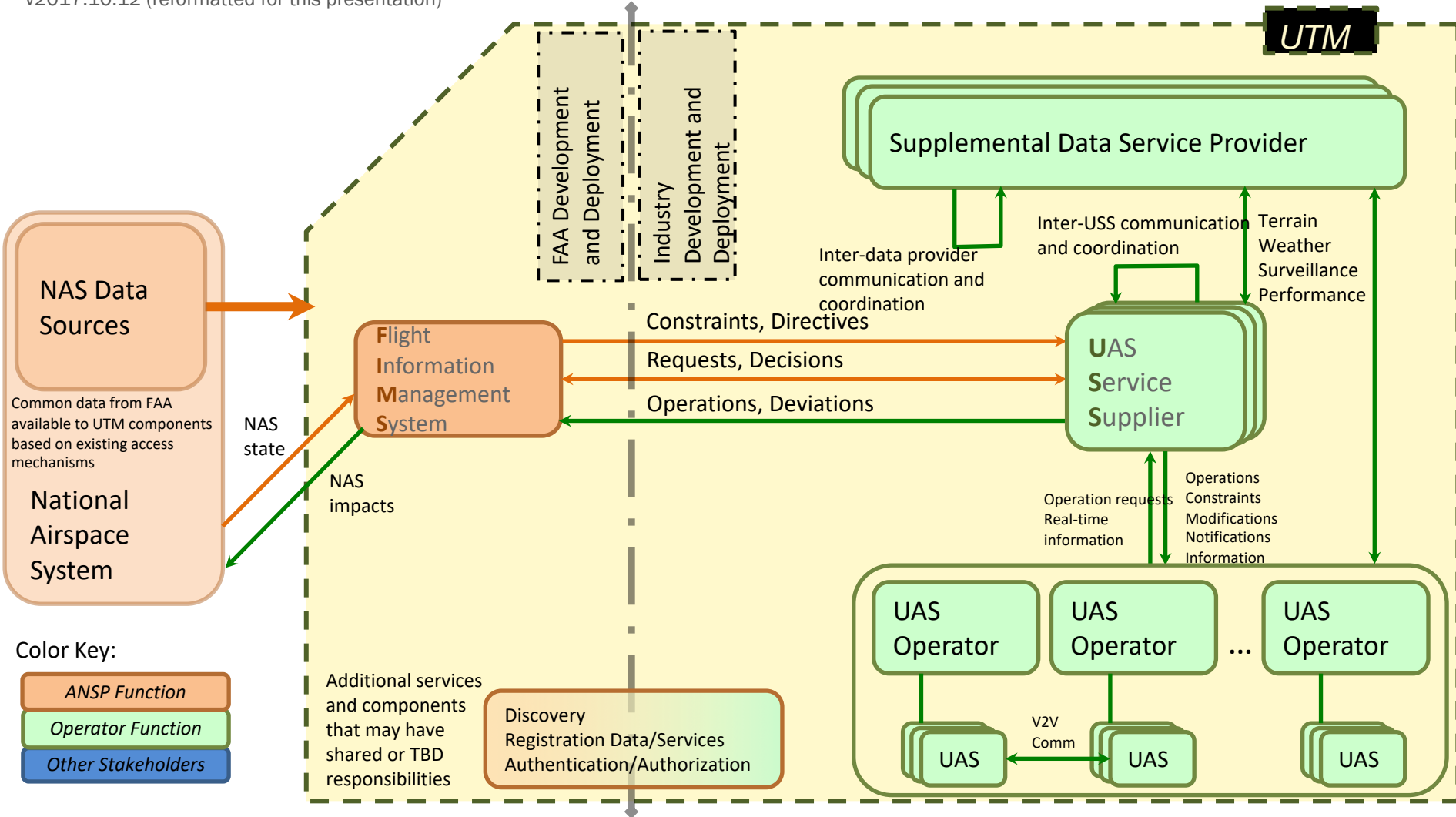
Commerce

Scalability



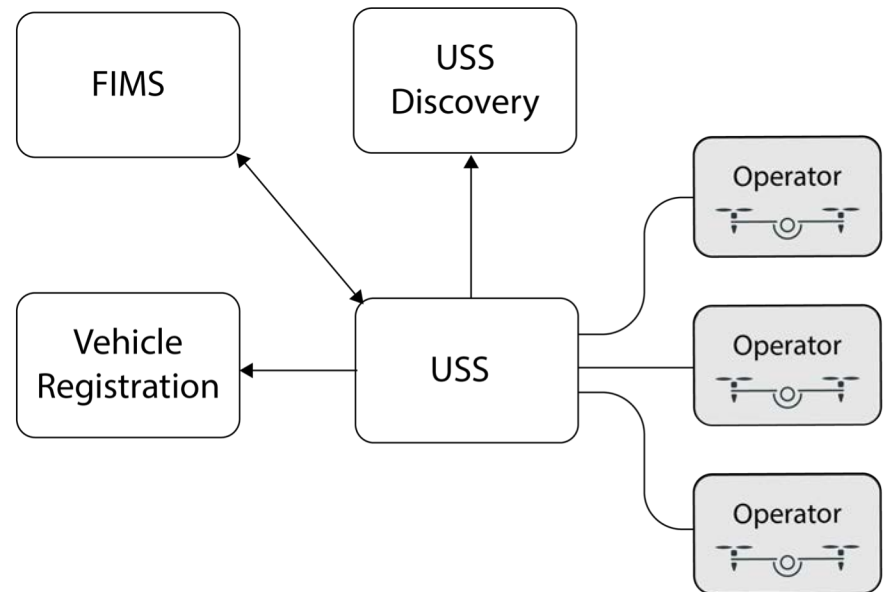
# UTM Architecture

v2017.10.12 (reformatted for this presentation)



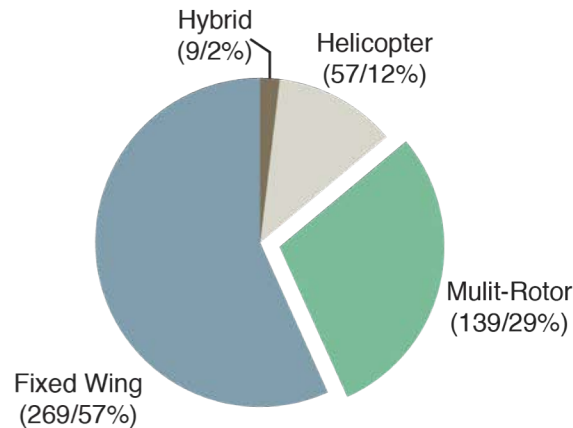
# UTM Elements

- Flight Information Management System (FIMS)
- UAS Service Supplier (USS)
- Vehicle Registration
- USS Discovery



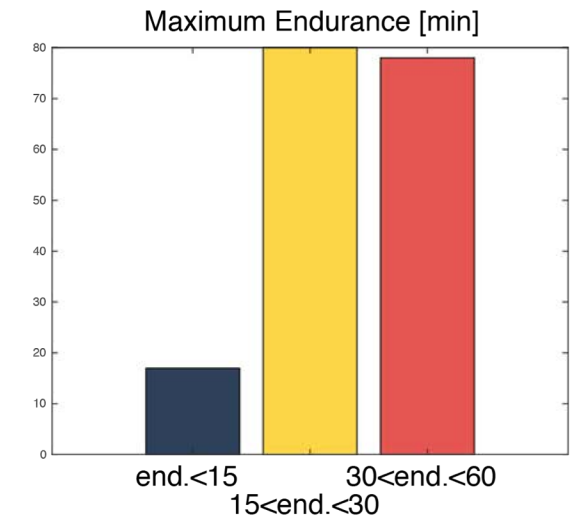
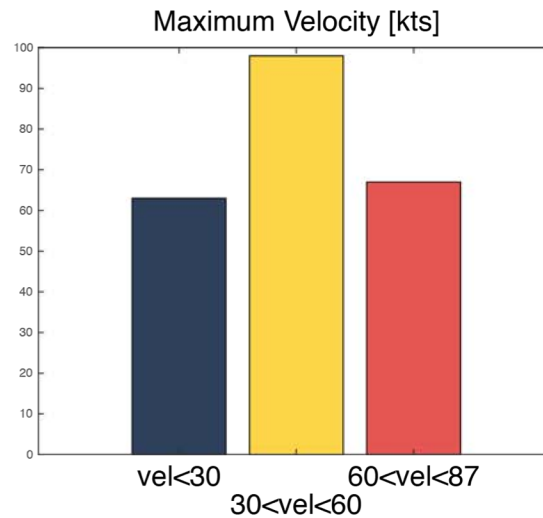
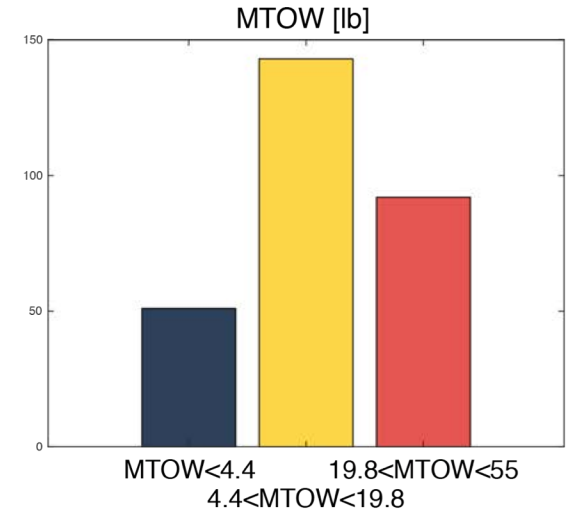
# Vehicle Registration and Model Database

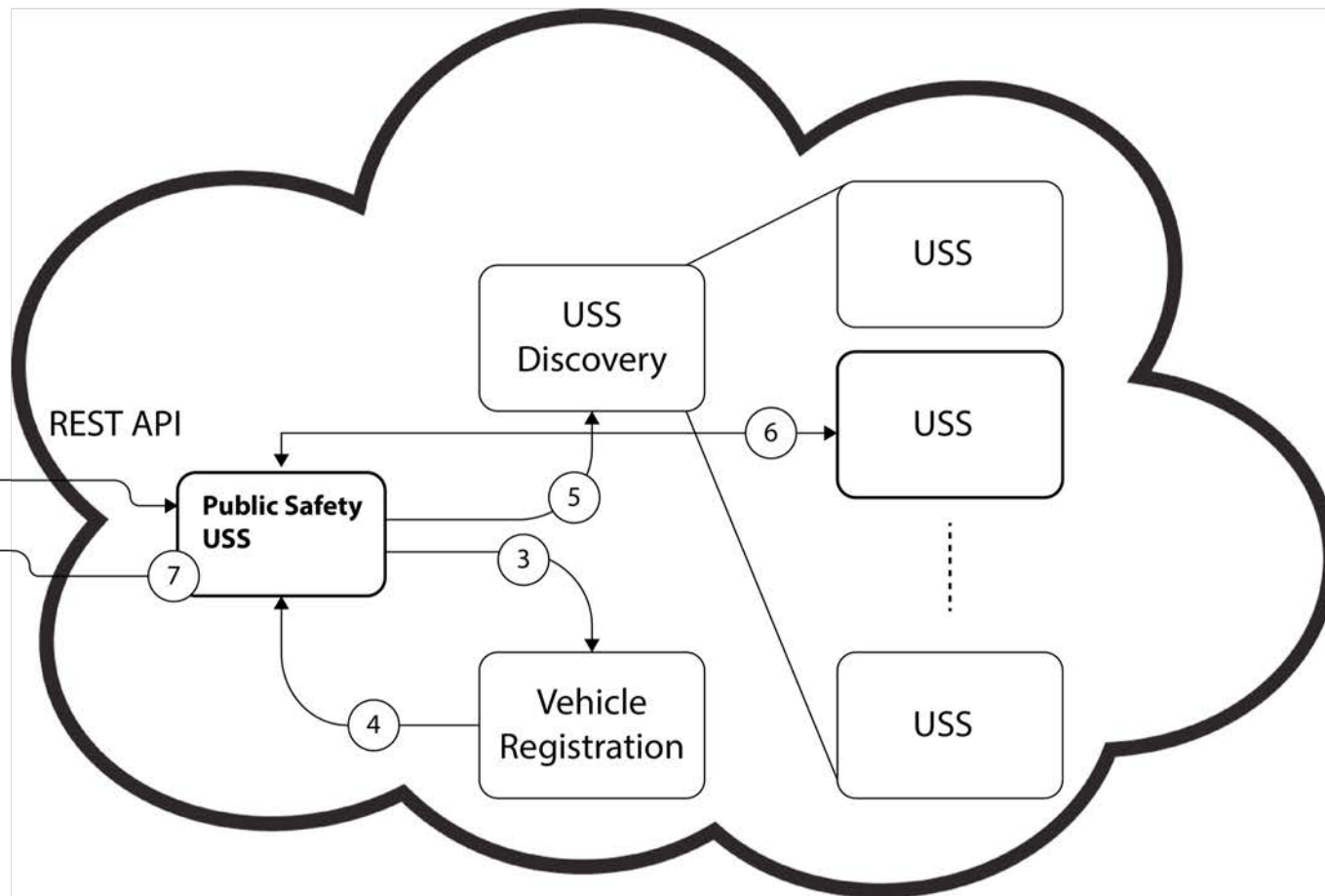
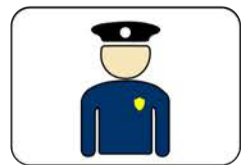
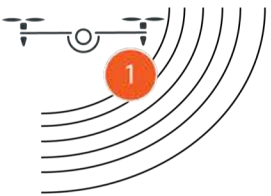
- 474 different vehicle types
- 168 manufacturers
- Organizations select vehicle from list



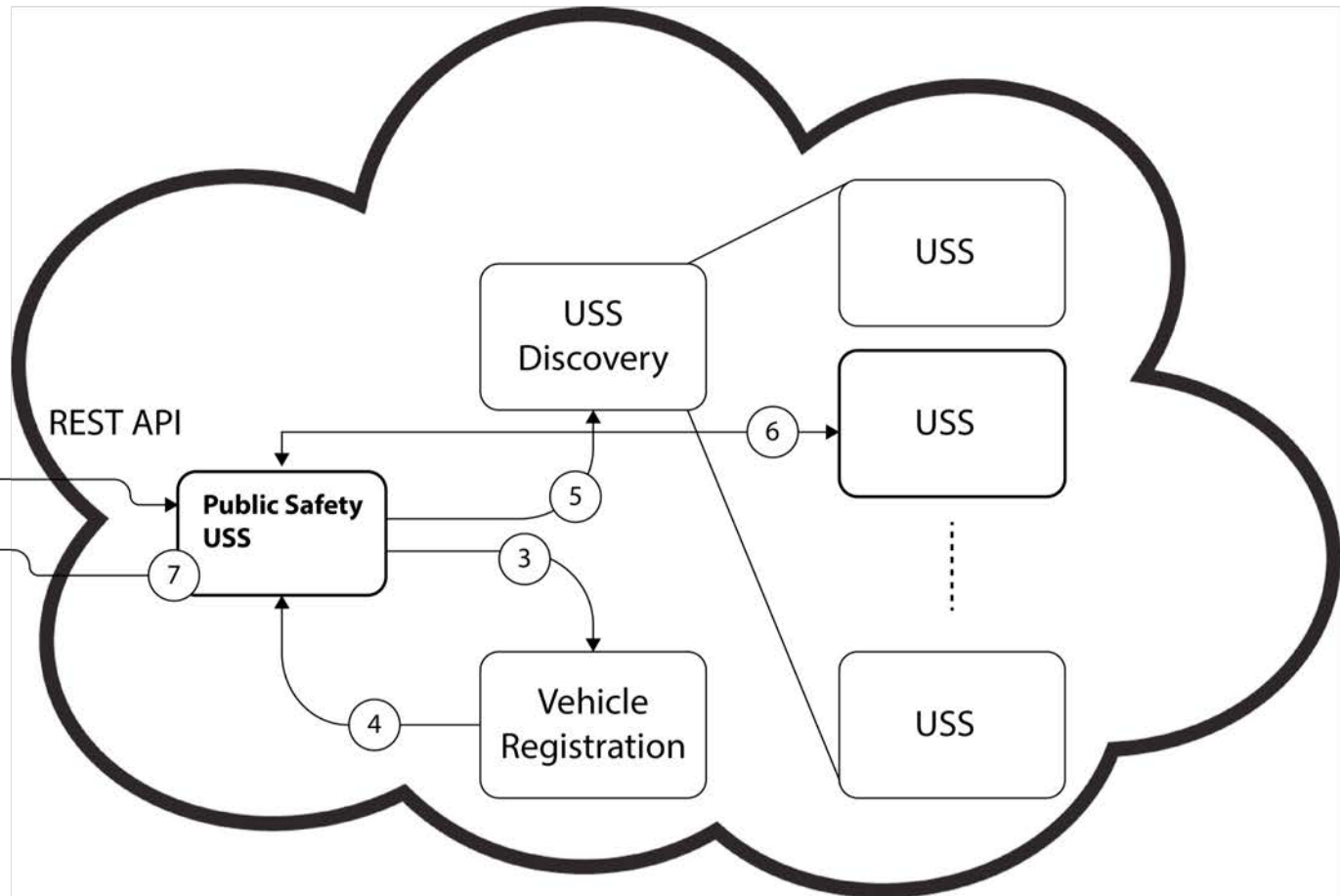
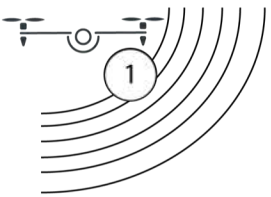
## Other properties

- Dimensions
- Max range
- Max ceiling
- Engine type
- Battery characteristics
- Turn rates
- Max thrust
- Mass/inertial properties
- Rotors/wing specifications

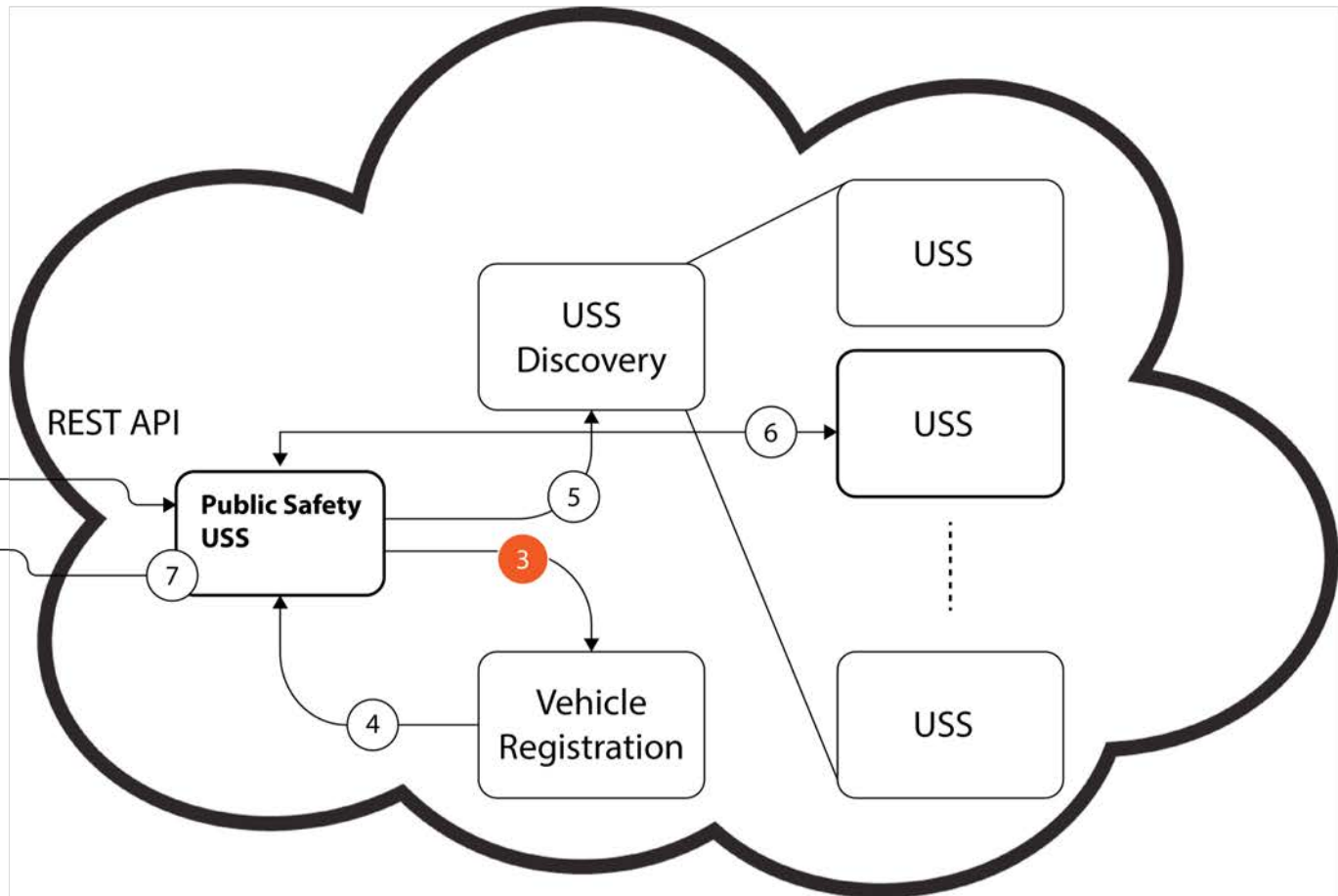
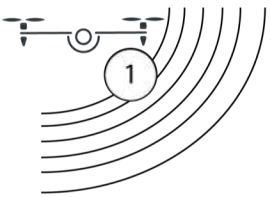




1 Vehicle broadcast uvin and pos. info

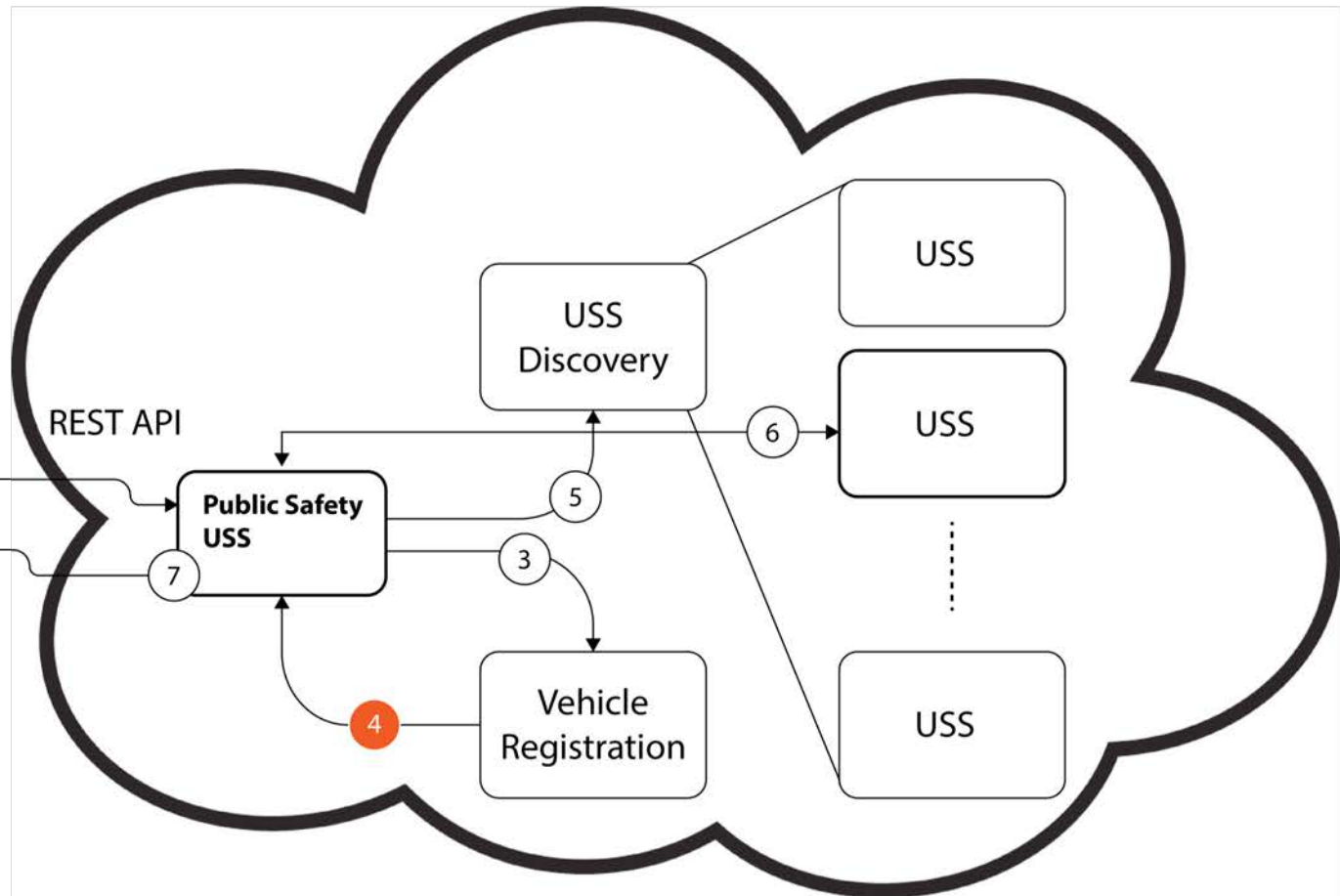
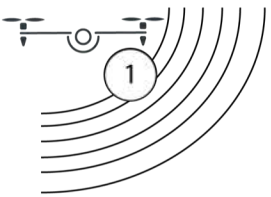


- 2 VID acquires drone data, authenticates (PUB-SAFE USS), and sends GET request

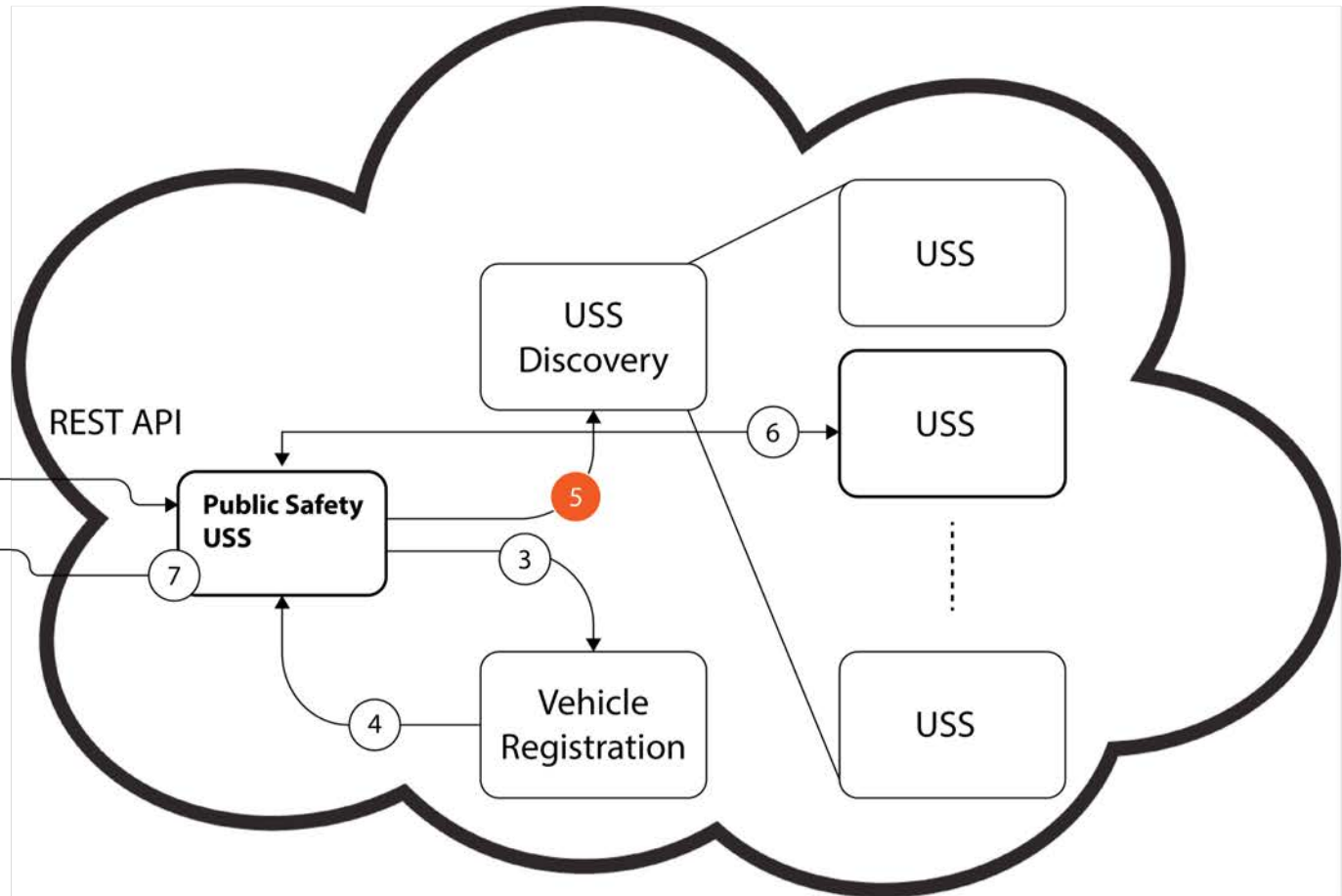
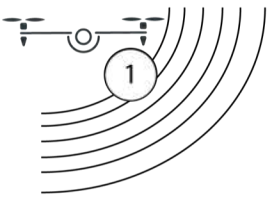


3 If UVIN exists, retrieve info from Vehicle Reg.





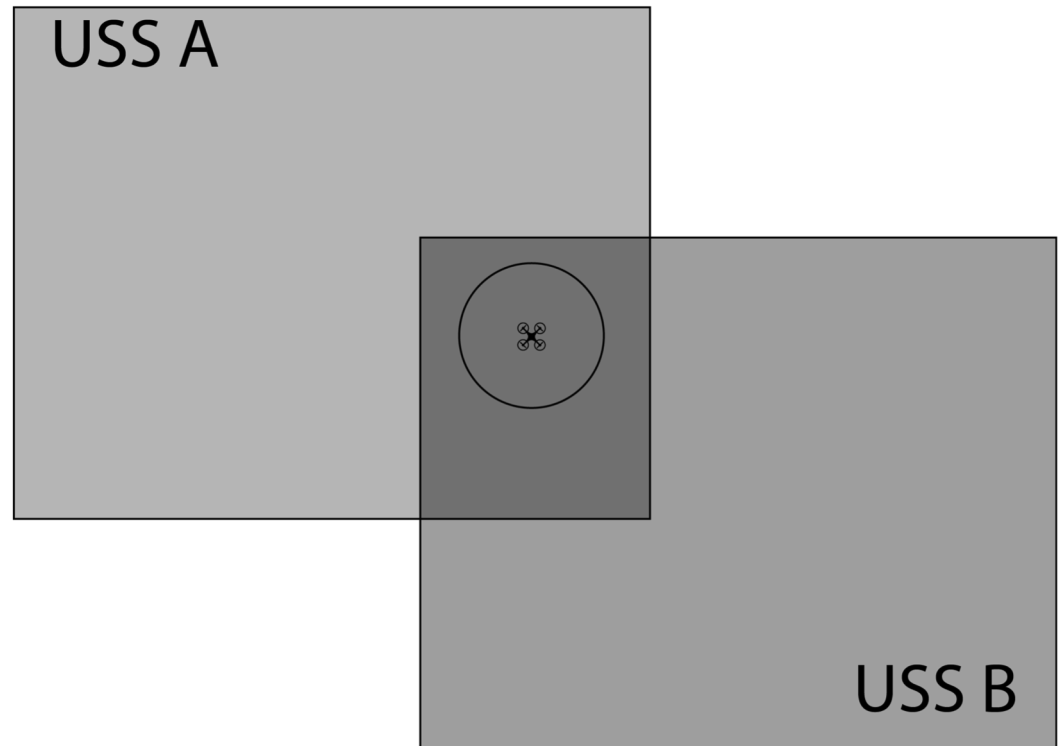
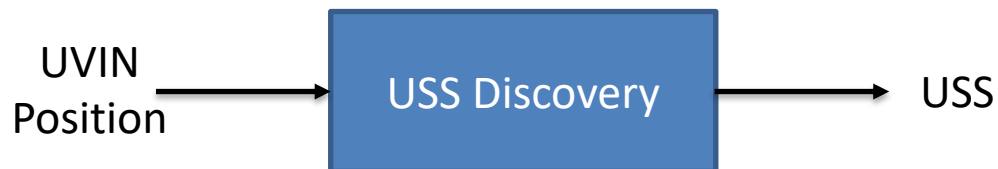
**4** Receive response and process/store data

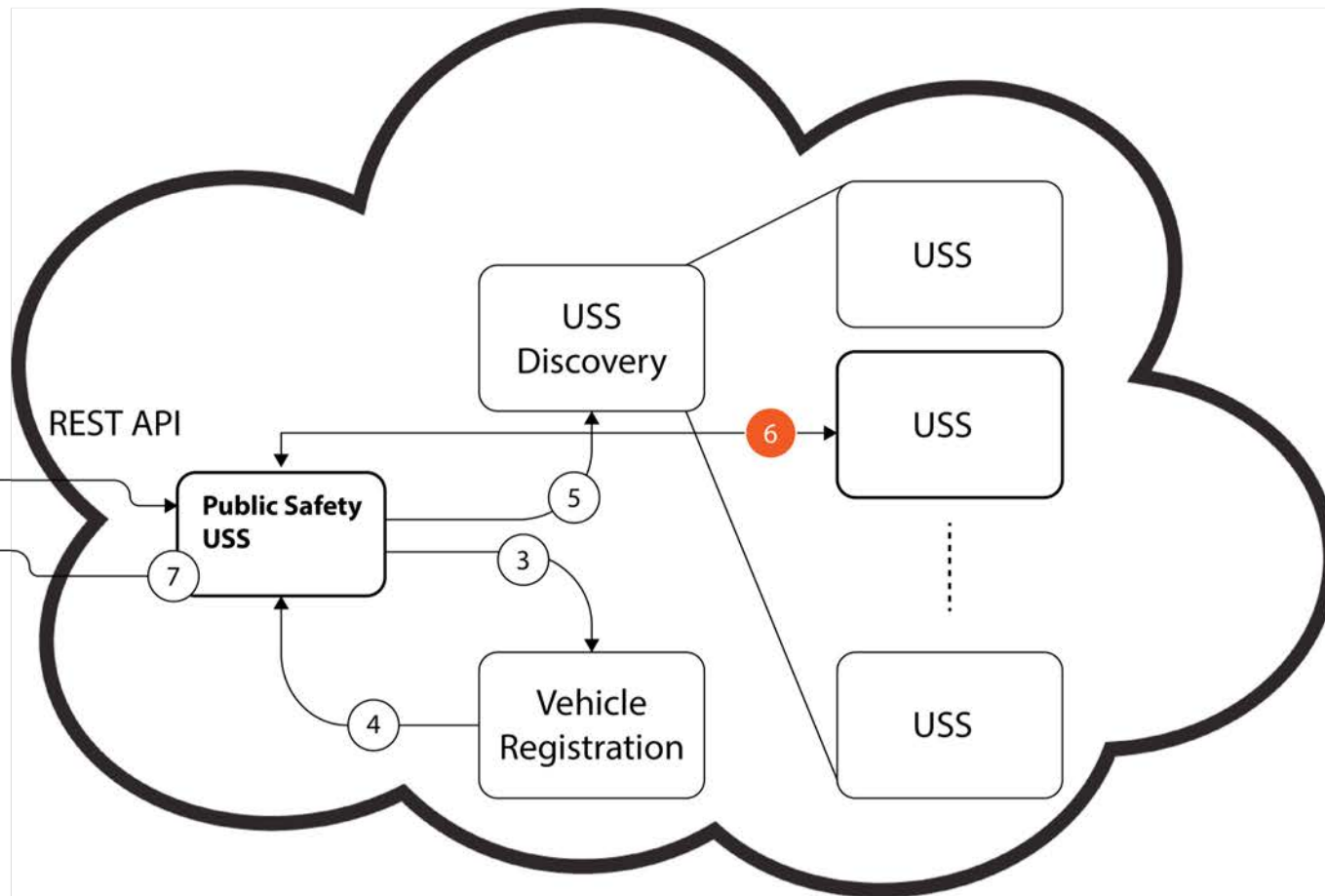
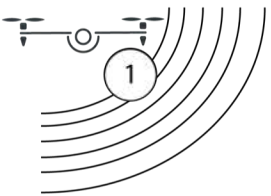


- 5 Given uvin/pos. info lookup up USS via discovery service and obtain `uss_id` and `url`

# USS Discovery – find by bounding box

Public Safety USS uses discovery service to return an array of intersecting USS instances given position and time

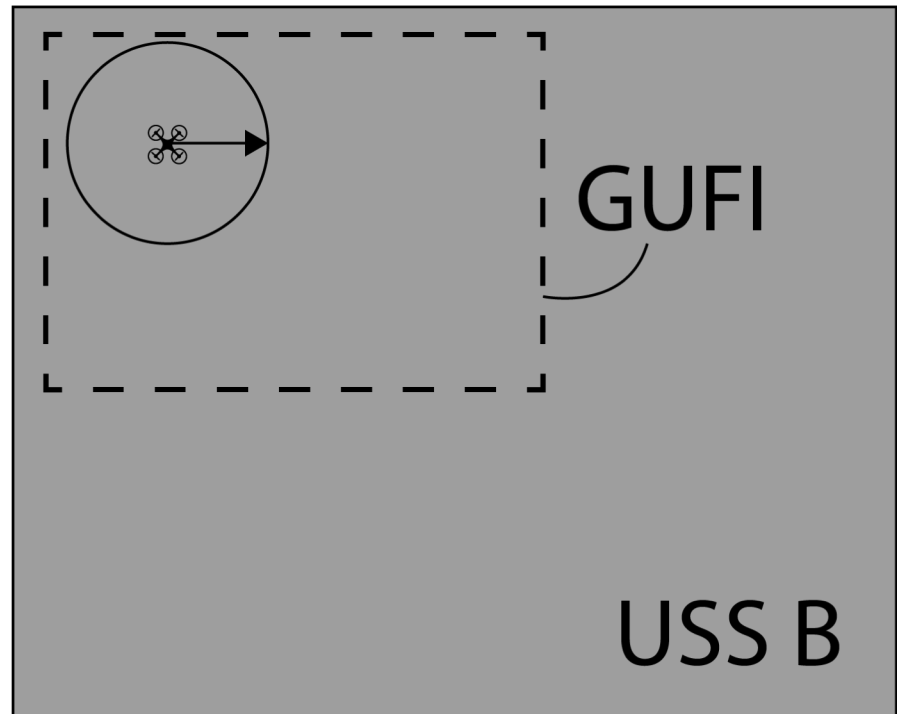




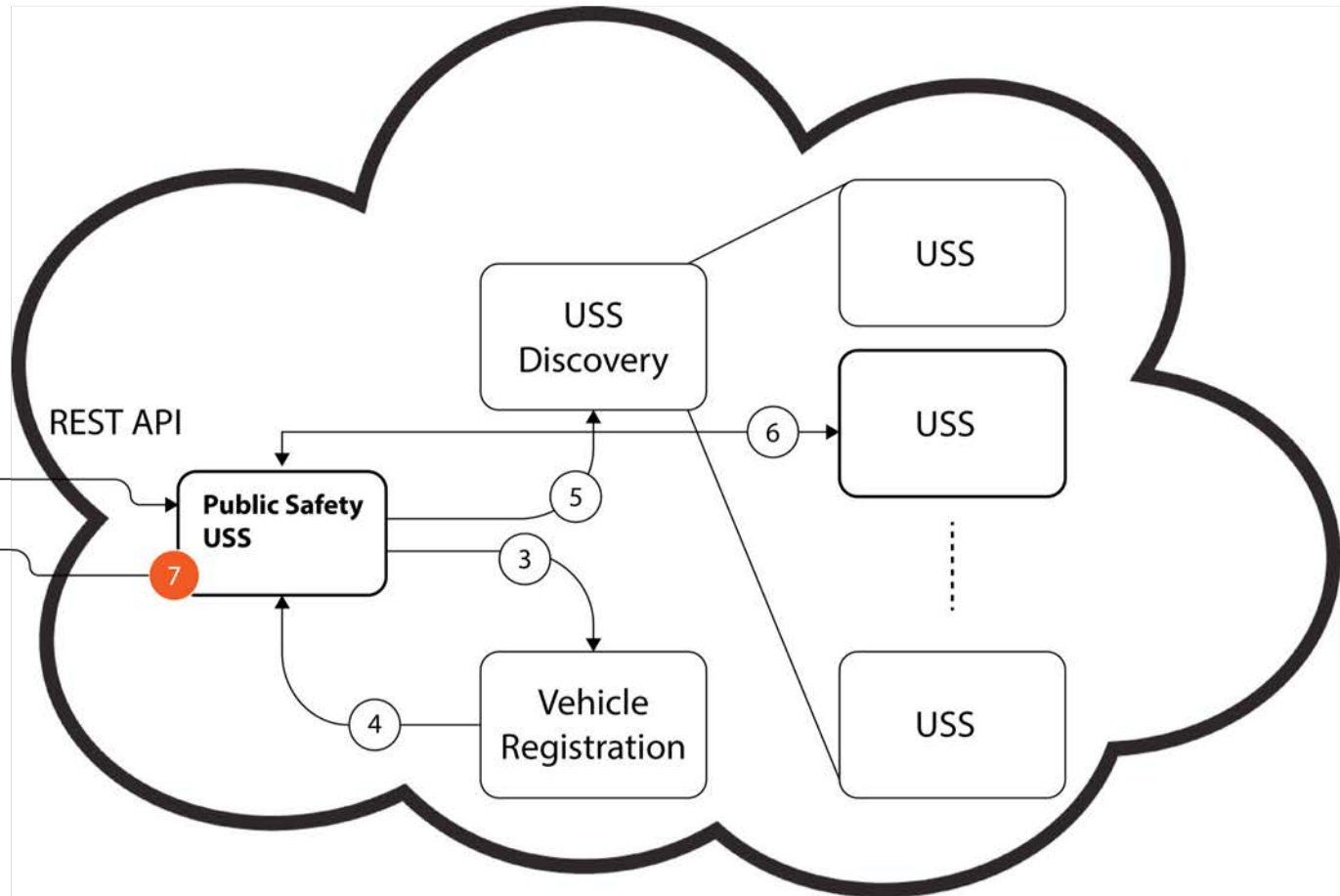
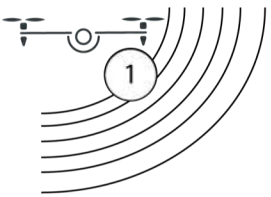
**6** Contact USS and request information

# Contact USS

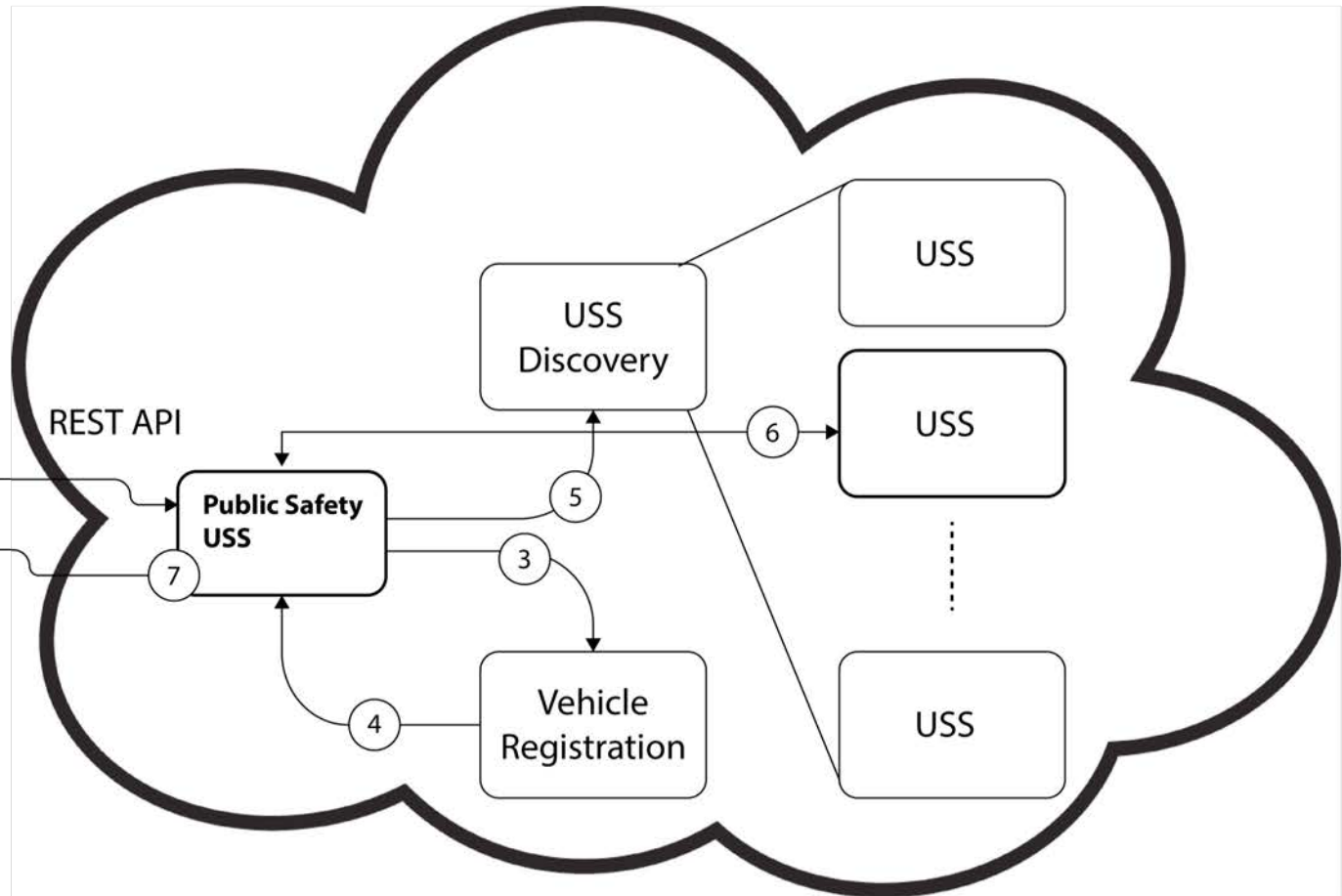
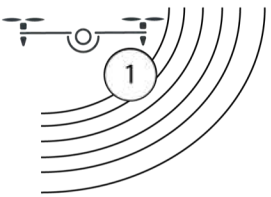
Given USS find operation  
by point and radius



GUFI=Globally Unique Flight Identifier



**7** Perform Drone Observation Resolution (DOR) with acquired data



**8** Package results/information and return to VID

# Technical Capability Levels



## TCL 1

Remote Population  
Low Traffic Density  
Rural Applications  
Multiple VLOS Operations  
Notification-based Operations

## TCL 2

Sparse Population  
Low-Mod Traffic Density  
Rural / Industrial Applications  
Multiple BVLOS Operations  
Tracking and Operational Procedures

## TCL 3






Moderate Population  
Moderate Traffic Density  
Suburban Applications  
Mixed Operations  
Vehicle to Vehicle Communication  
Public Safety Operations

## TCL 4

Dense Population  
High Traffic Density  
Urban Applications  
Dense BVLOS Operations  
Large Scale Contingency Management



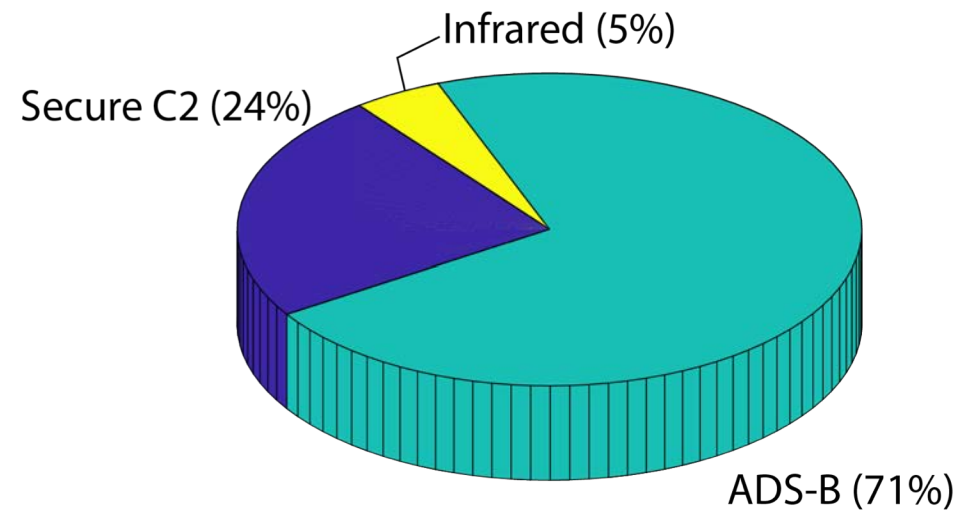
# TCL3 Remote ID Testing: Feb-June 2018

Vehicle	Test-Site	Manufacturer	Model	MTOW
	North Dakota	Altavian	Nova	14.8 [lb]
	North Dakota	Sharper	A6	39.7 [lb]
	North Dakota	Pulse Aerospace	Vapor 55	55 [lb]
	New York	DJI	S1000	24 [lb]
	New York	DJI	M100	7.9 [lb]

Credit to NASA

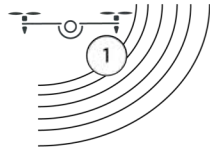
# Technologies Investigated

- ADS-B uAvionix
- Secure C2
- IR Beacon/Receiver

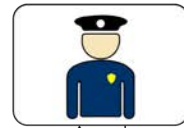


# Metrics Computed

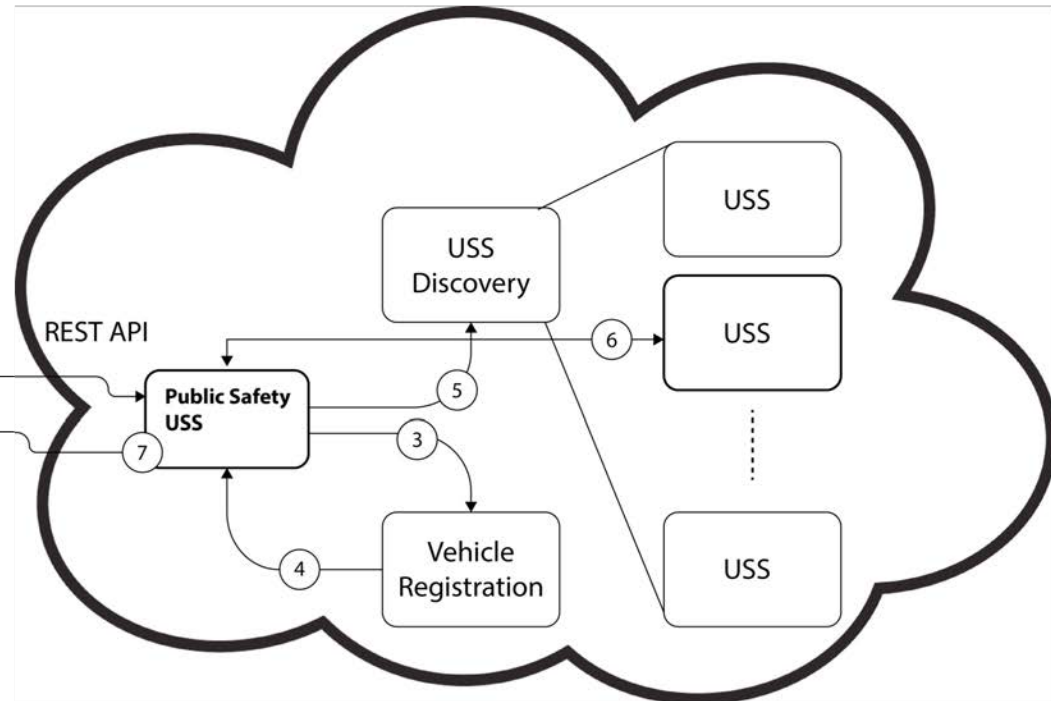
Detection Time



Look-Up Time



Distance from UAS at time of Look-Up



# Results

Detect Latency

Minimum Latency [s]	Average Latency [s]	Maximum Latency [s]	Standard Deviation [s]
0.01	1.54	5.2	1.12

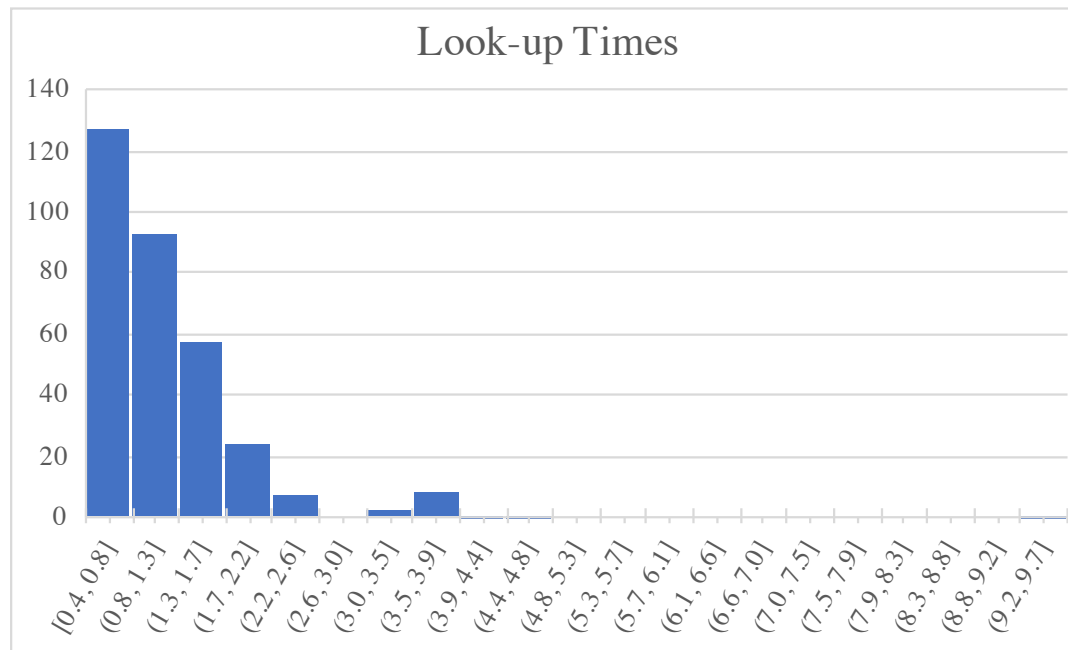
Distances

Tech	Min	Q1	Q2	Q3	Max
ADS-B	45.81	59.47	82.50	141.82	194.73
Secure C2	48.18	57.96	88.78	111.70	163.95
IR	54.52	57.33	66.72	73.18	84.24

IR=Infrared

# Results

Total Look-Ups	Minimum Latency [s]	Average Latency [s]	Maximum Latency [s]	Standard Deviation [s]	Positive Look-Up Percentage
326	0.40	1.20	9.49	0.86	94.0



# Summary

- With the number of drones projected remote ID is a critical component
- We proposed a remote ID architecture that leverages the UTM ecosystem to obtain vehicle and operational information
- Presented UTM Remote ID test results
  - Analyzed 326 look-ups; 94% positive look ups
  - Average look-up time was 1.2 [s]
- Future Work
  - Examine specific latencies in each component
  - Investigate how the information can be used to provide better estimates on lookup regions given vehicle information

# Acknowledgments

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- The UTM Team

# Example: North Dakota Test Site

