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

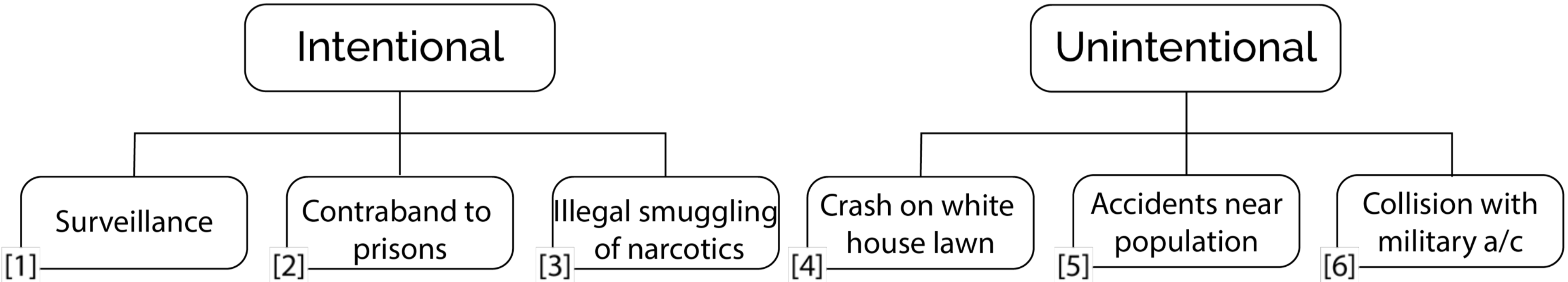
Problem Statement

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."

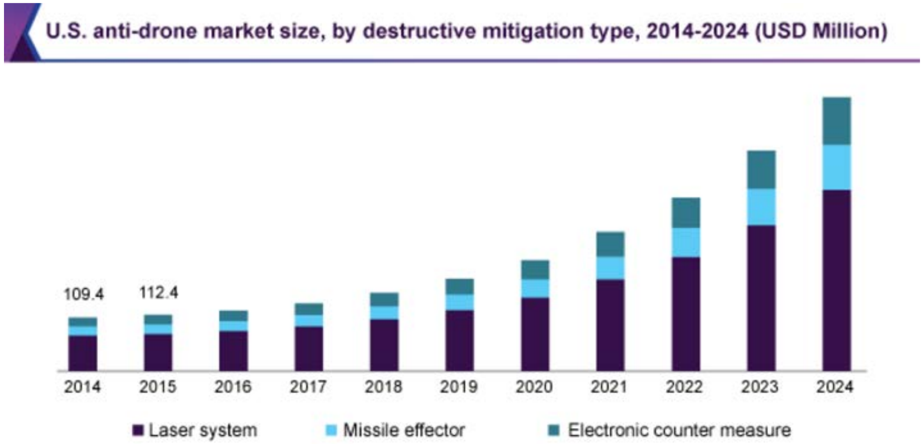
[4] Michael D. Shear and Michael S. Schmidt, "House Drone Crash Described as a U.S. Worker's Drunken Lark," The New York Times, January 27, 2015,

[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

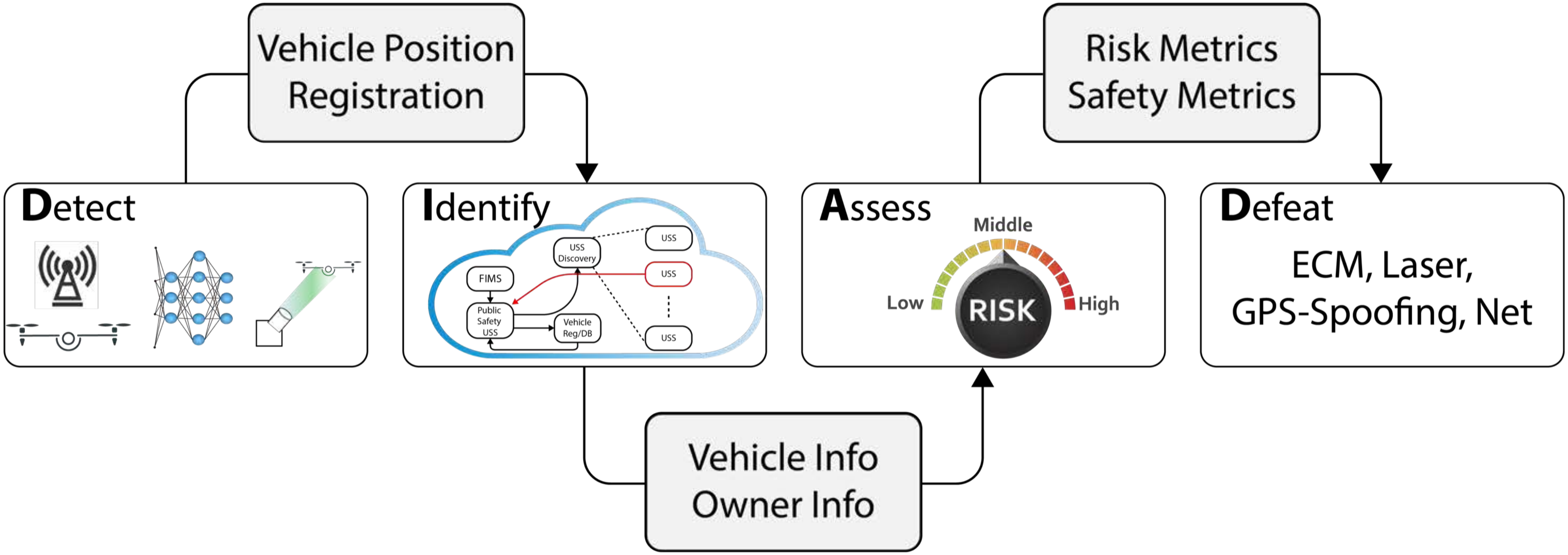
Emergence of Counter UAS

- 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



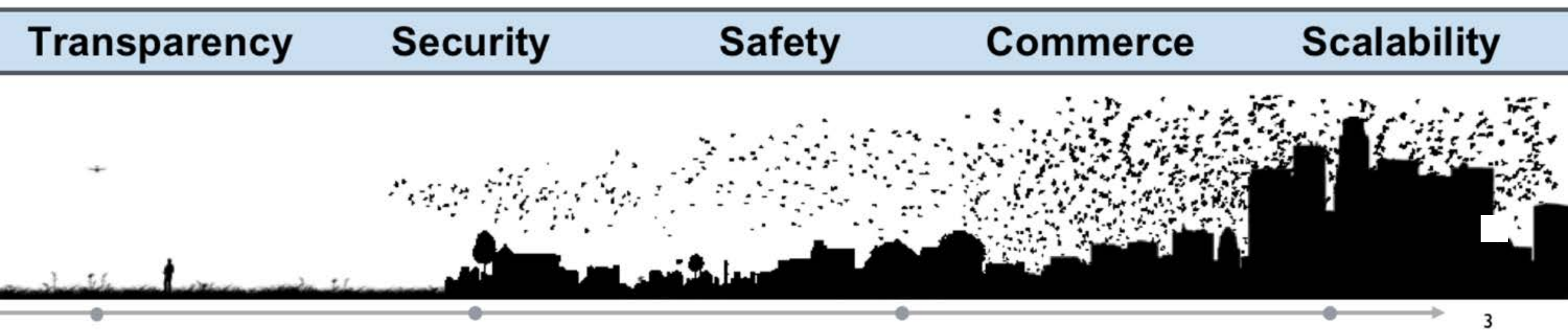
ECM = Electronic Counter Measures

UAS Traffic Management (UTM)

UTM is an "air traffic management" ecosystem for small UAS in low altitude airspace

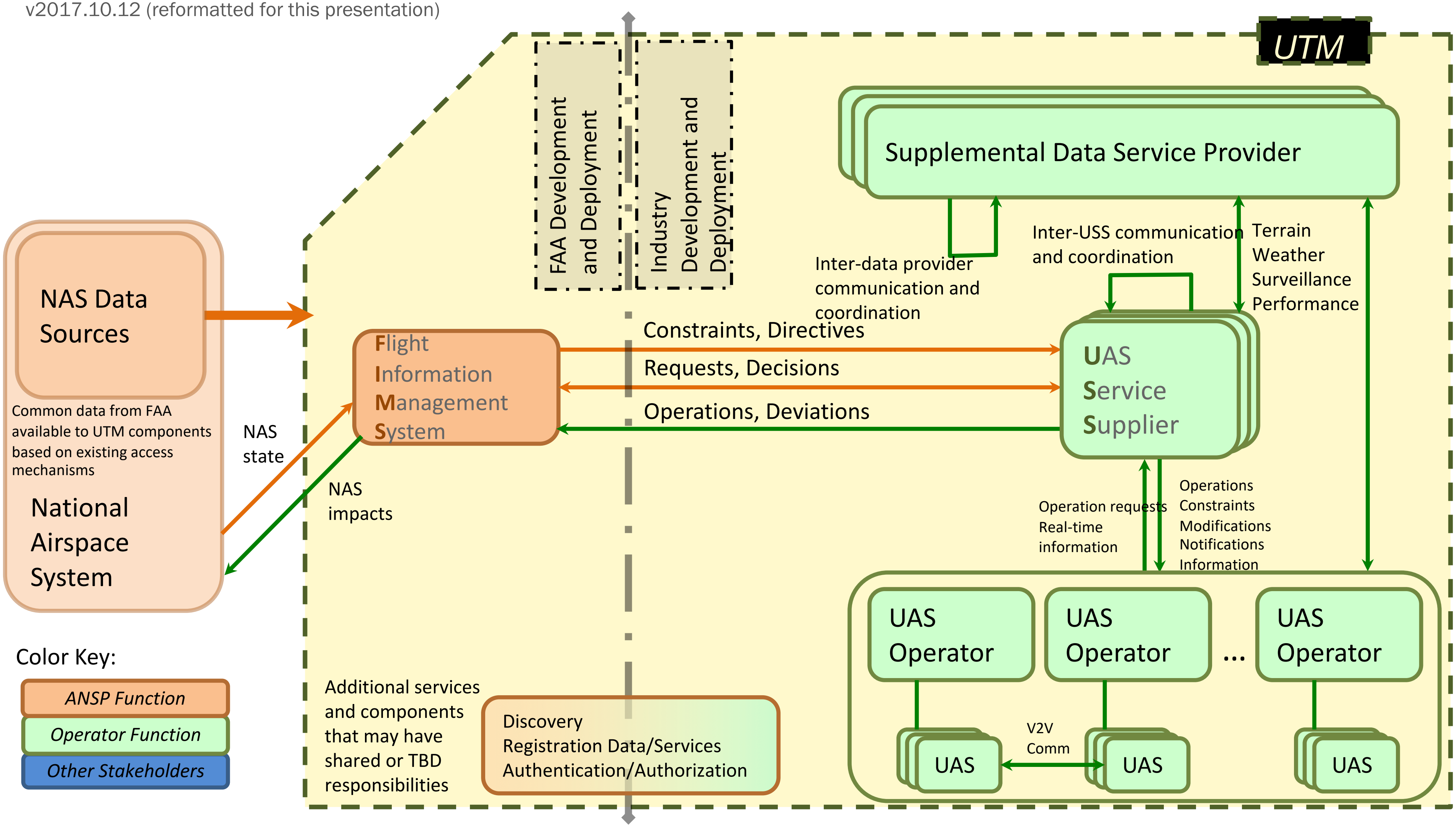
UTM aims to identify

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



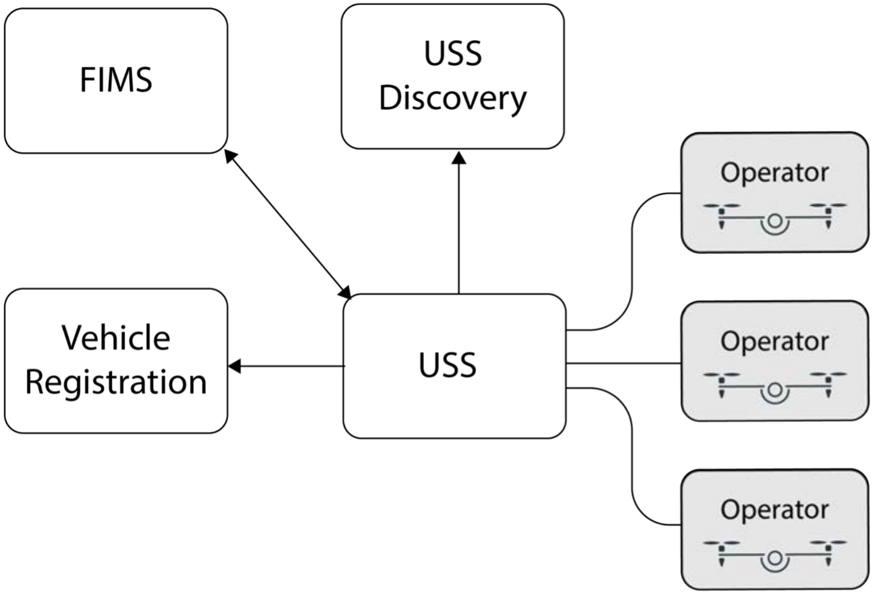
UTM Architecture

v2017.10.12 (reformatted for this presentation)



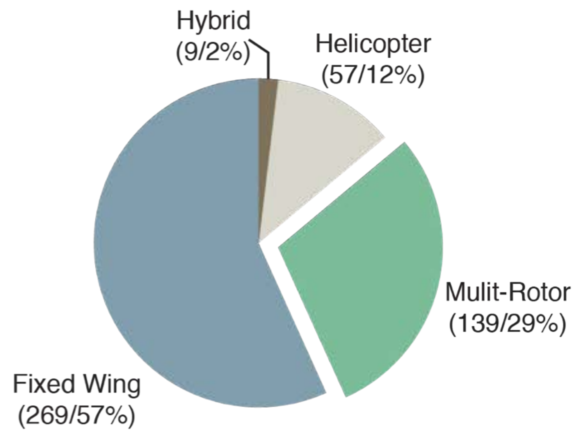
UTM Elements

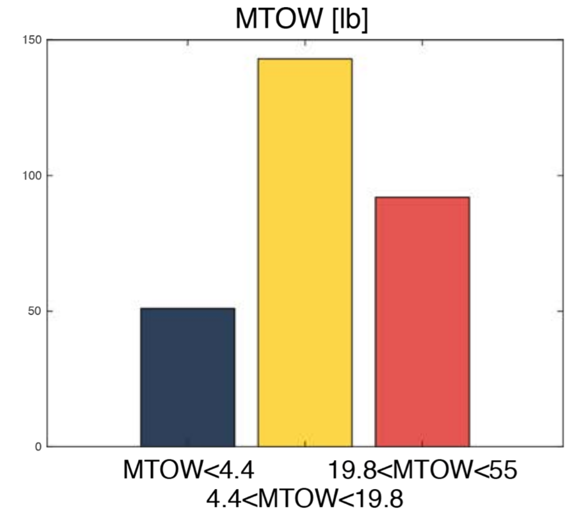
- Flight Information Management System (FIMS)
- UAS Service Supplier (USS)
- Vehicle Registration
- USS Discovery



Vehicle Registration and Model Database

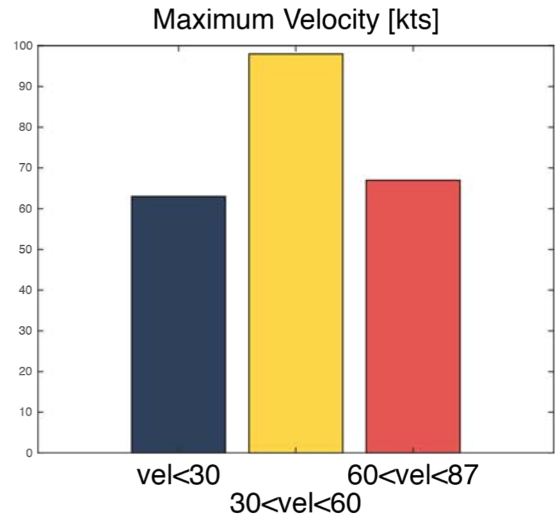
- 474 different vehicle types
- 168 manufacturers
- Organizations select vehicle from list

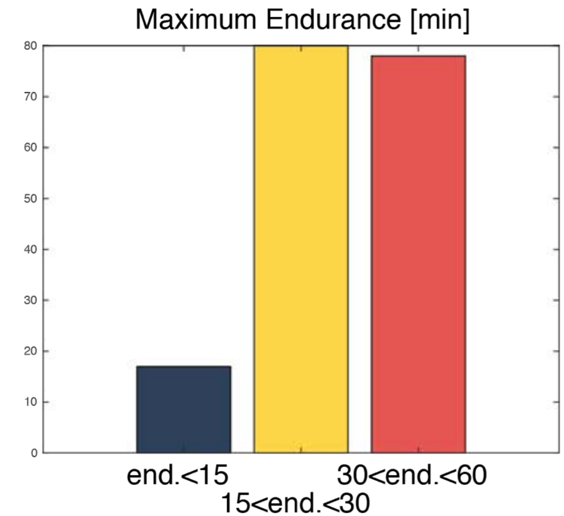


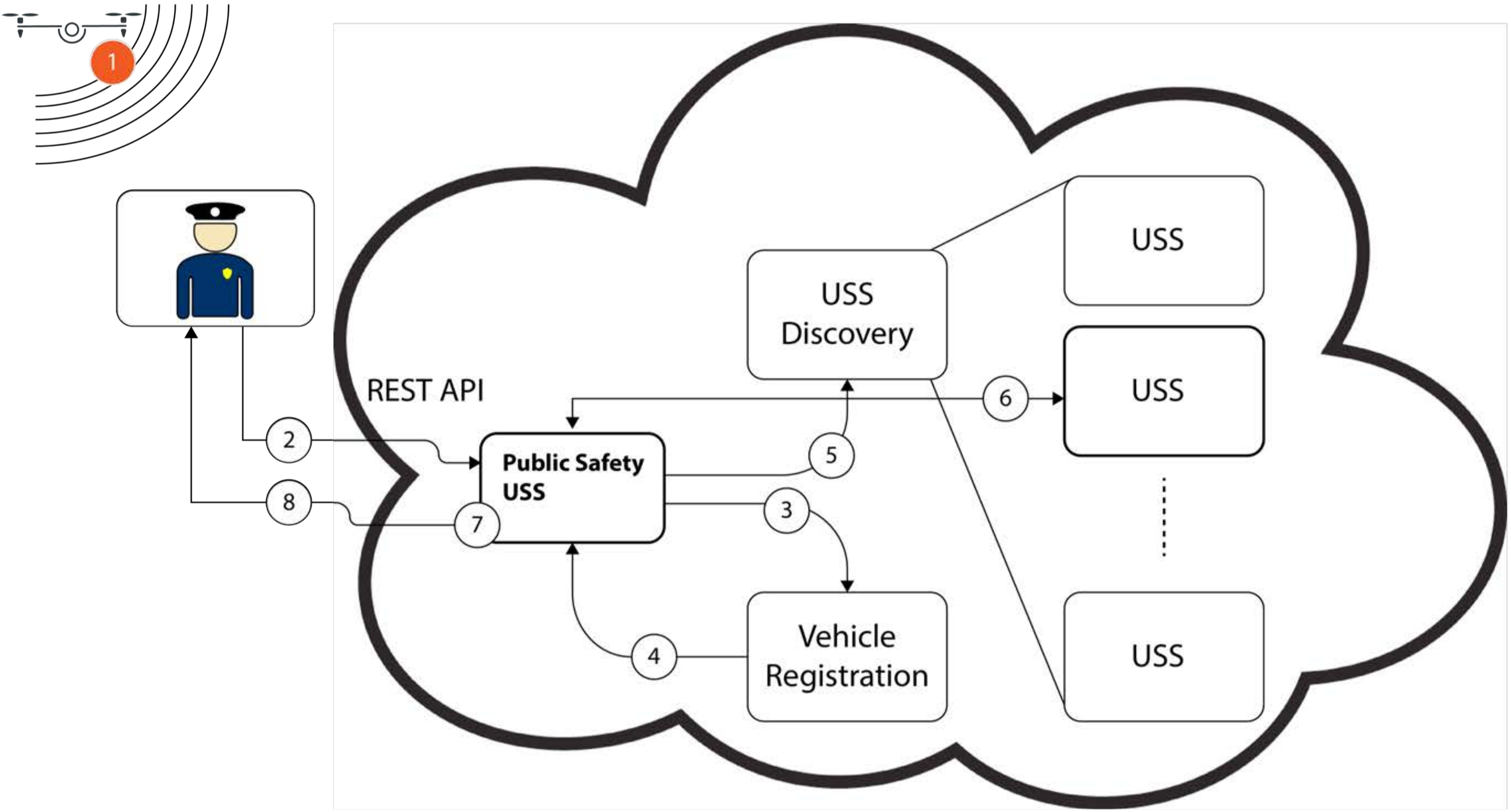


<u>Other properties</u>

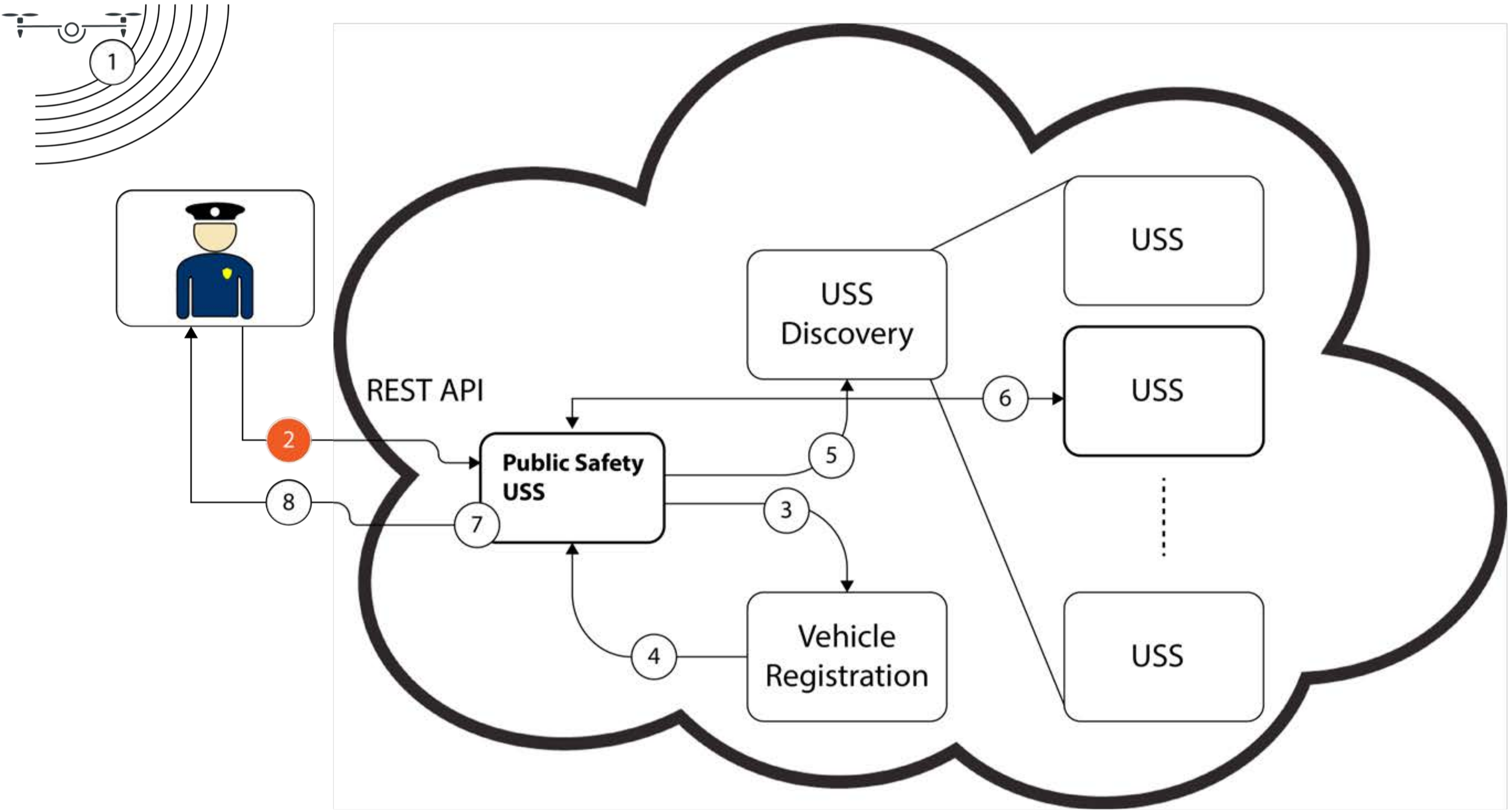
- Dimensions
- Max range
- Max ceiling
- Engine type
- Battery characteristics
- Turn rates
- Max thrust
- Mass/inertial properties
- Rotors/wing specifications



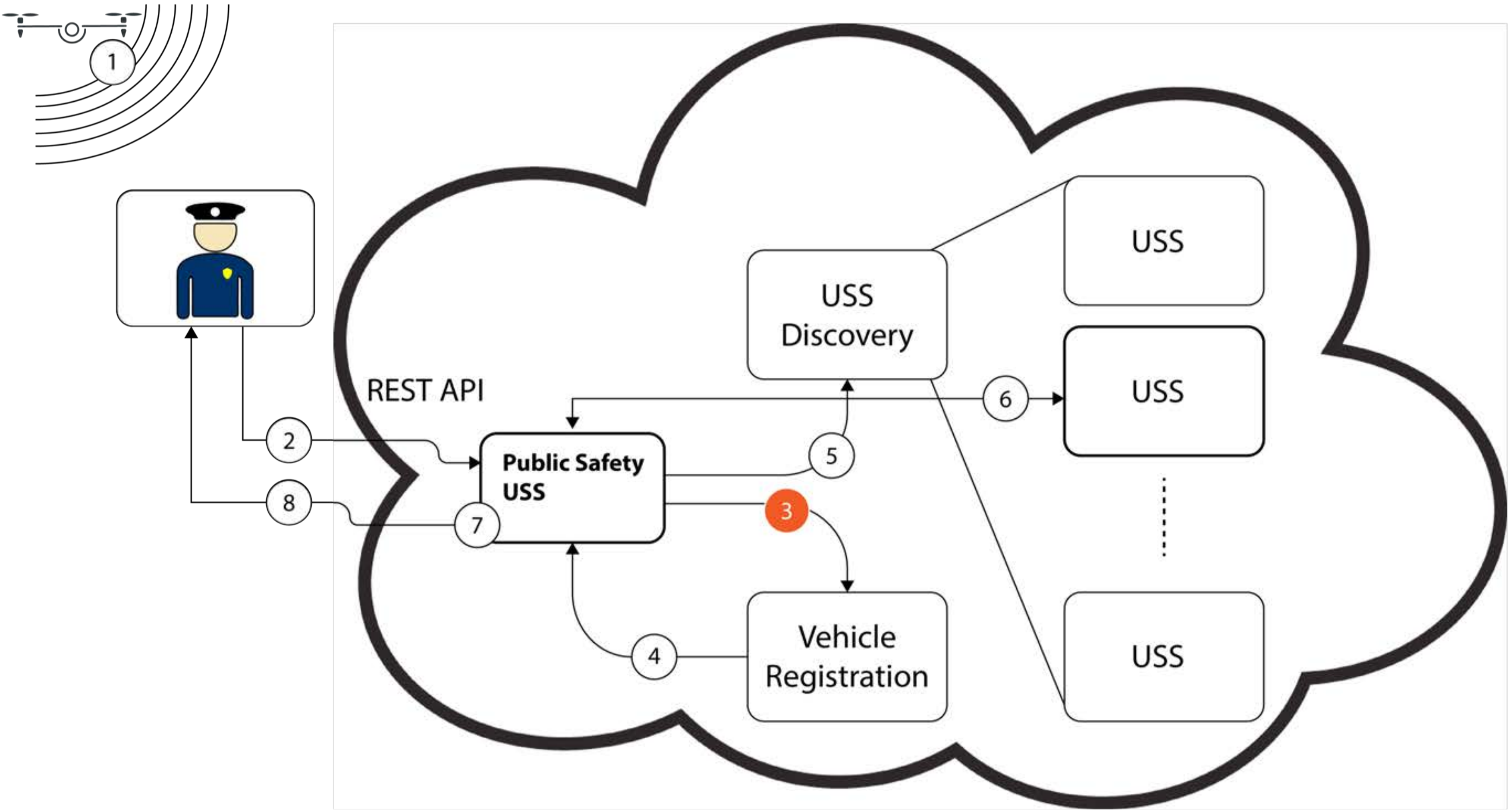




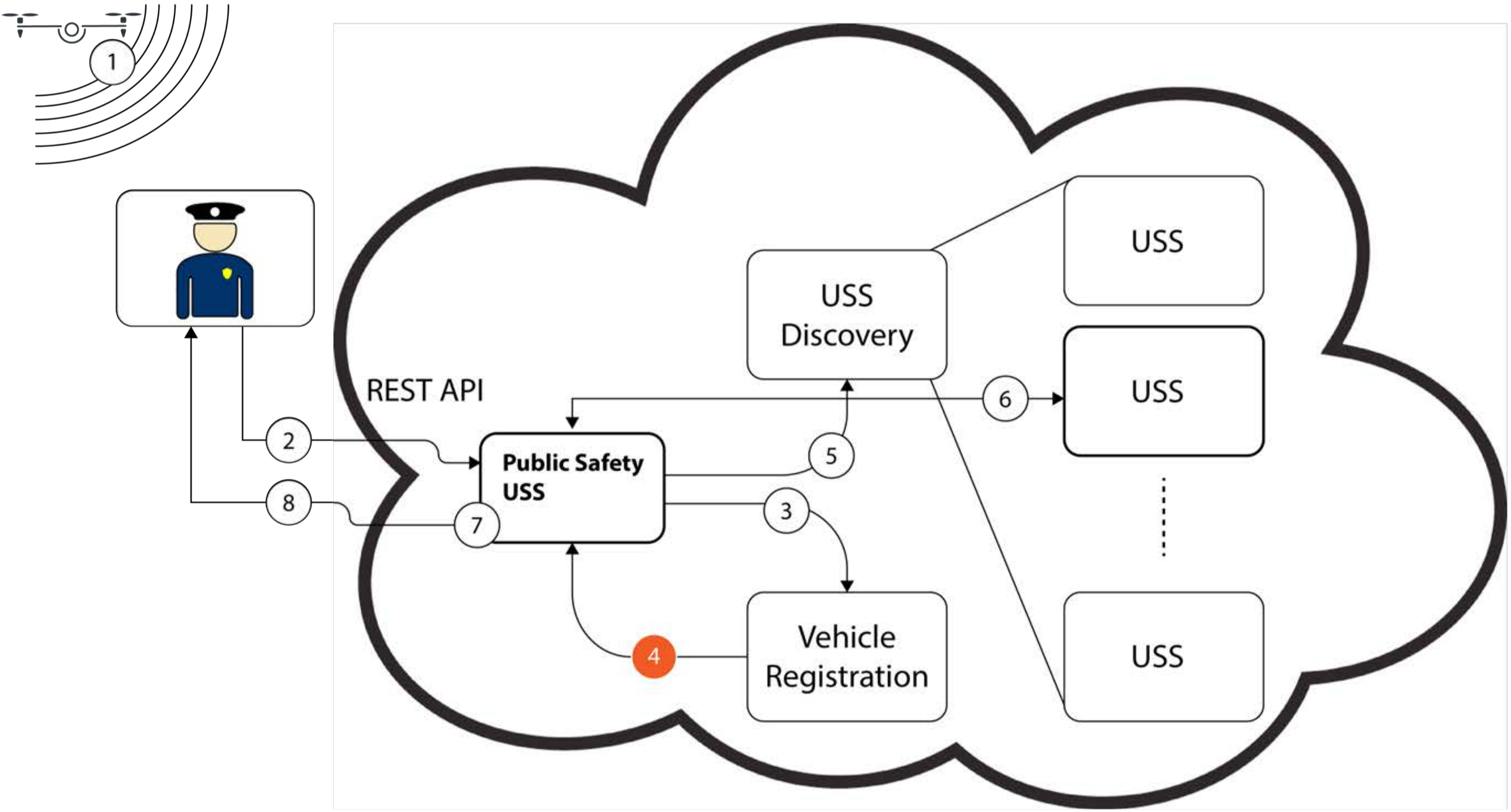
1 Vehicle broadcast uvin and pos. info



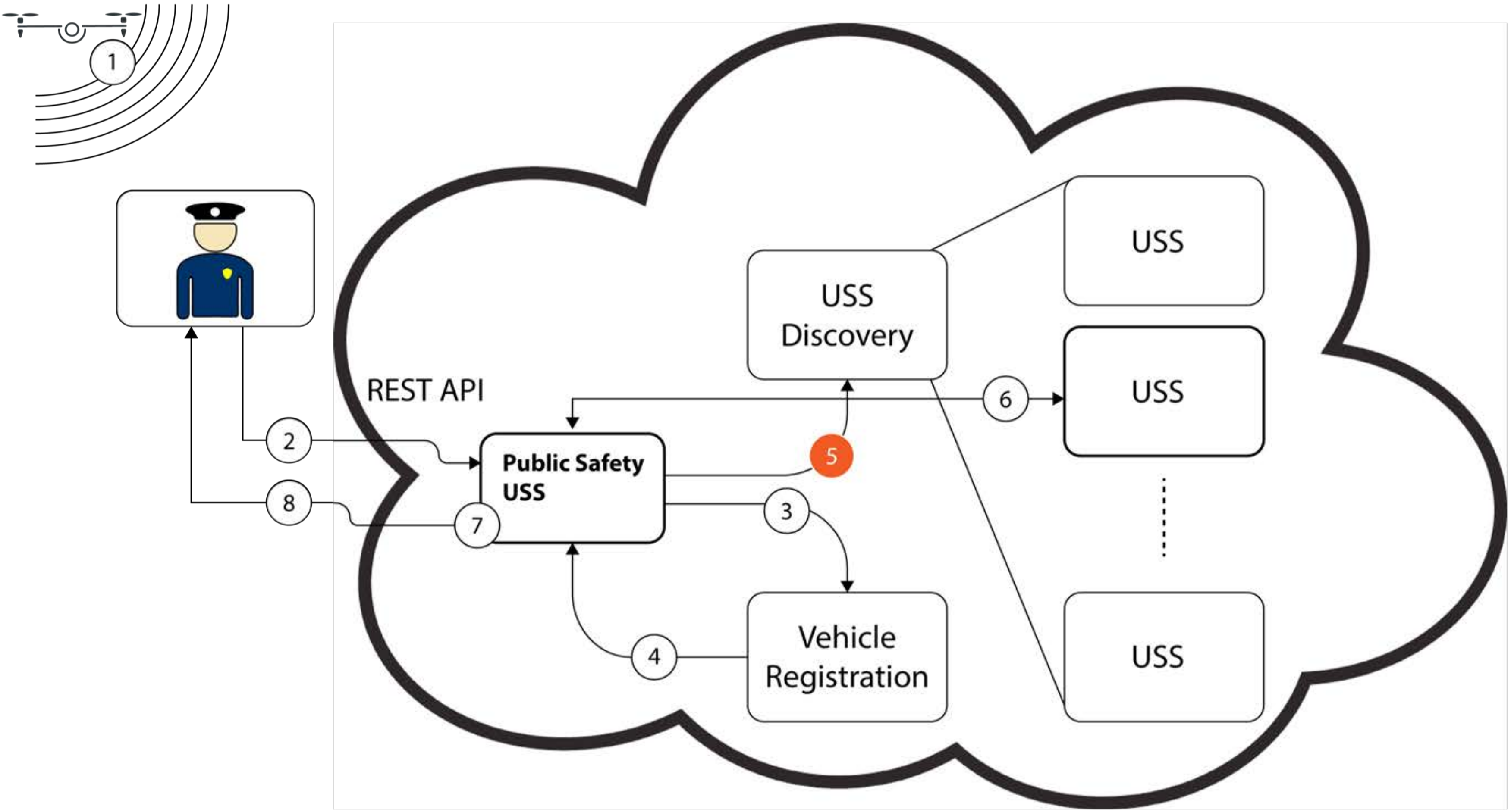
2 VID acquires drone data, authenticates (PUB-SAFE USS), and sends GET request



3 If UVIN exists, retrieve info from Vehicle Reg.



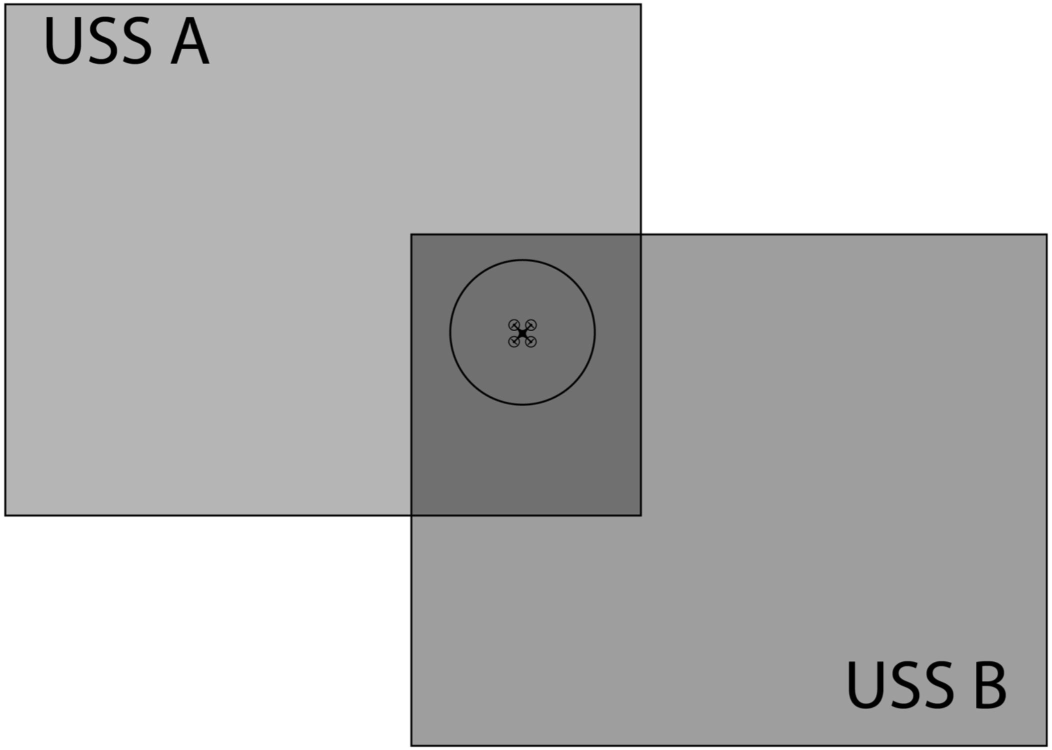
4 Receive response and process/store data

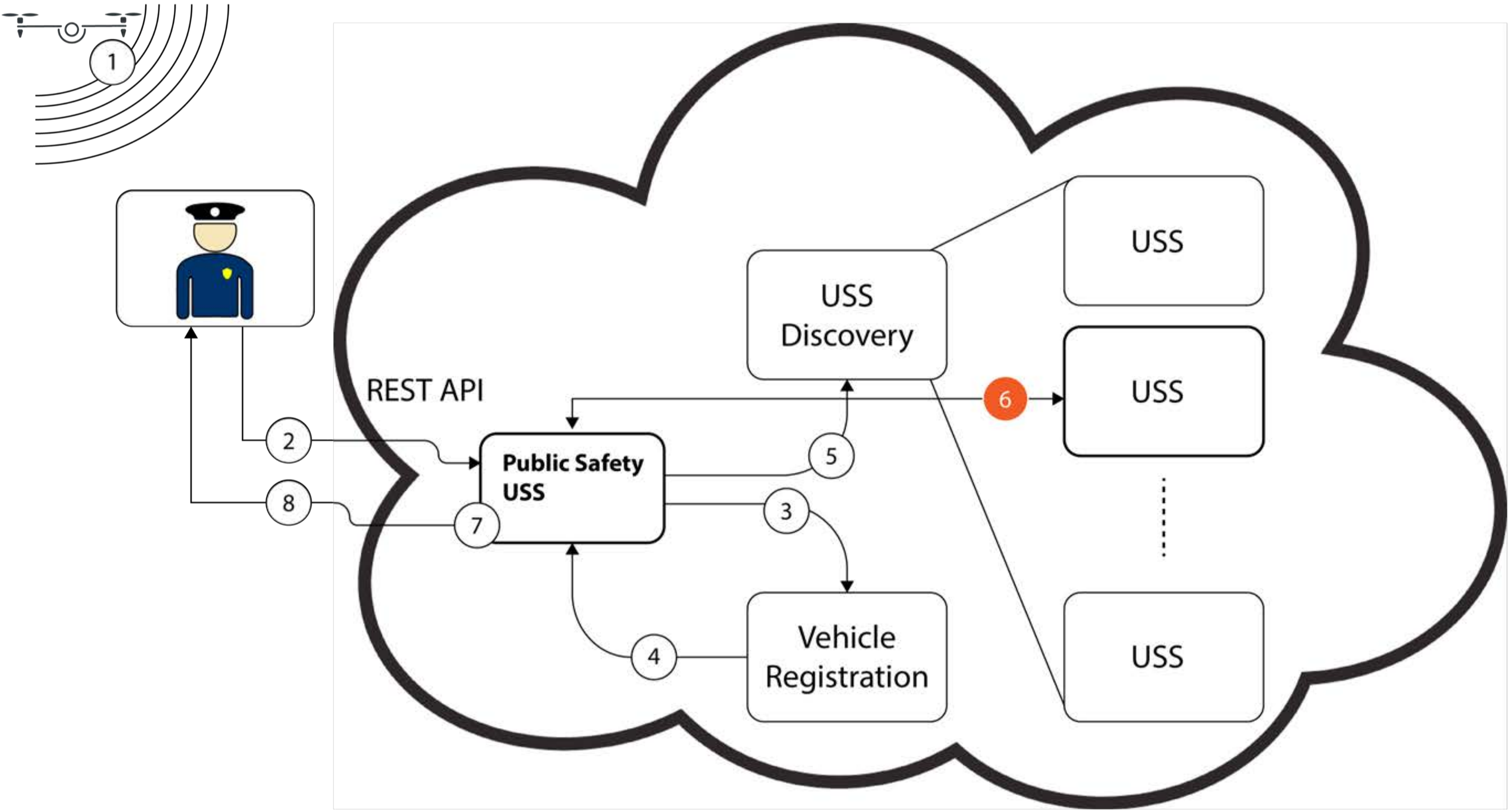


5 Given uvin/pos. info lookup up USS via dis-
covery service and obtain uss_id and url

USS Discovery – find by bounding box

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

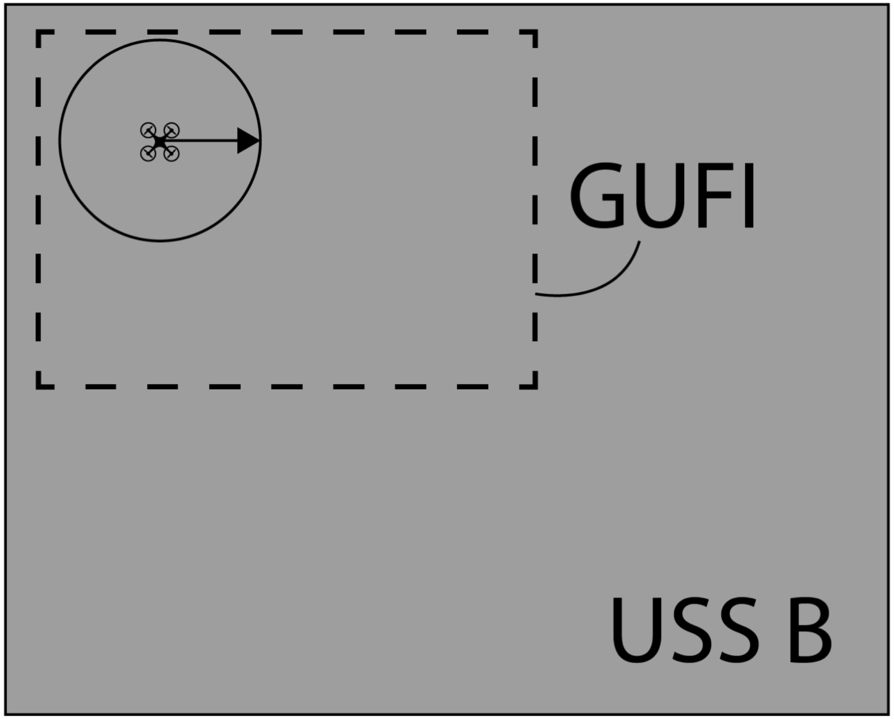




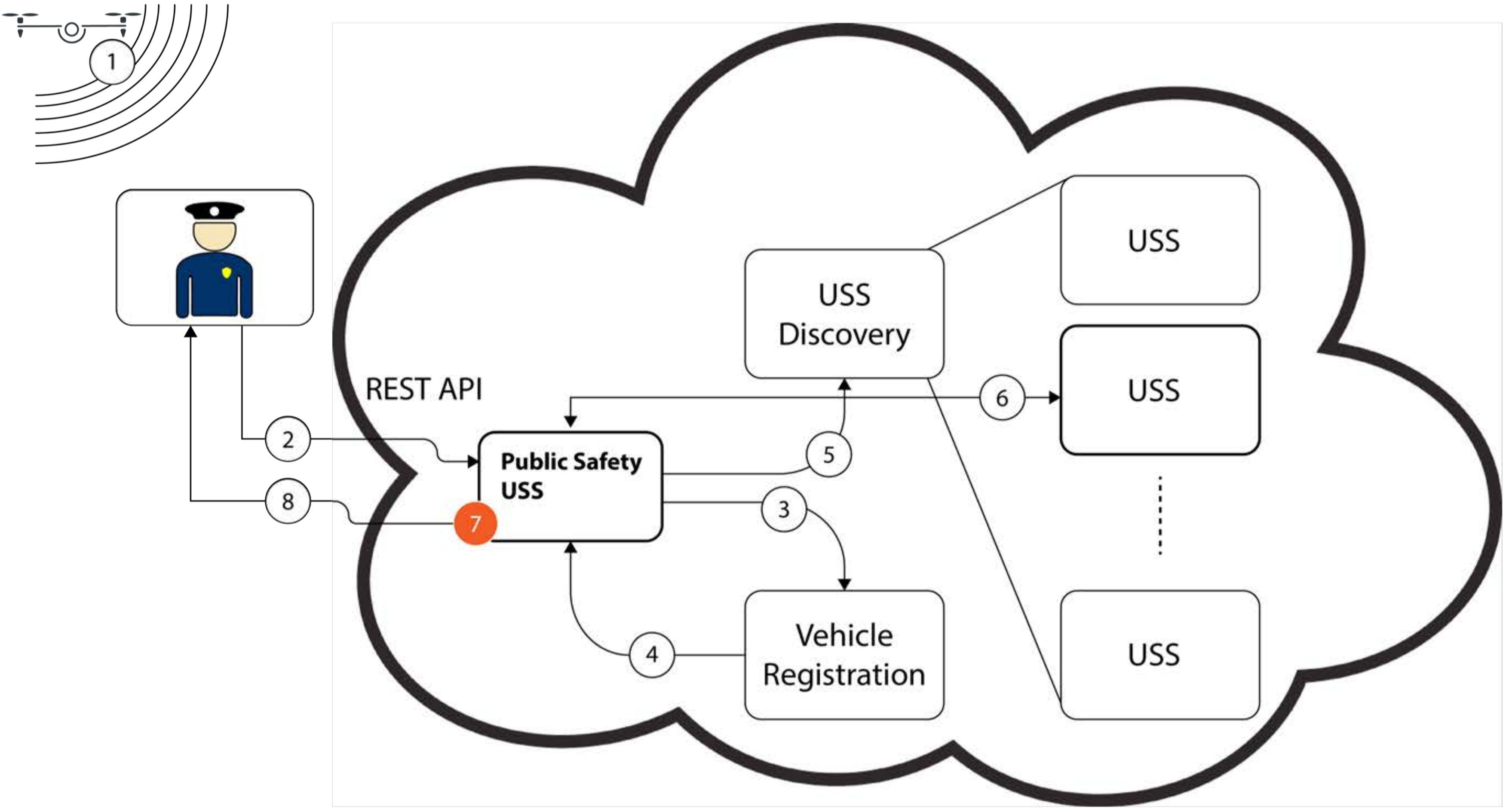
6 Contact USS and request information

Contact USS

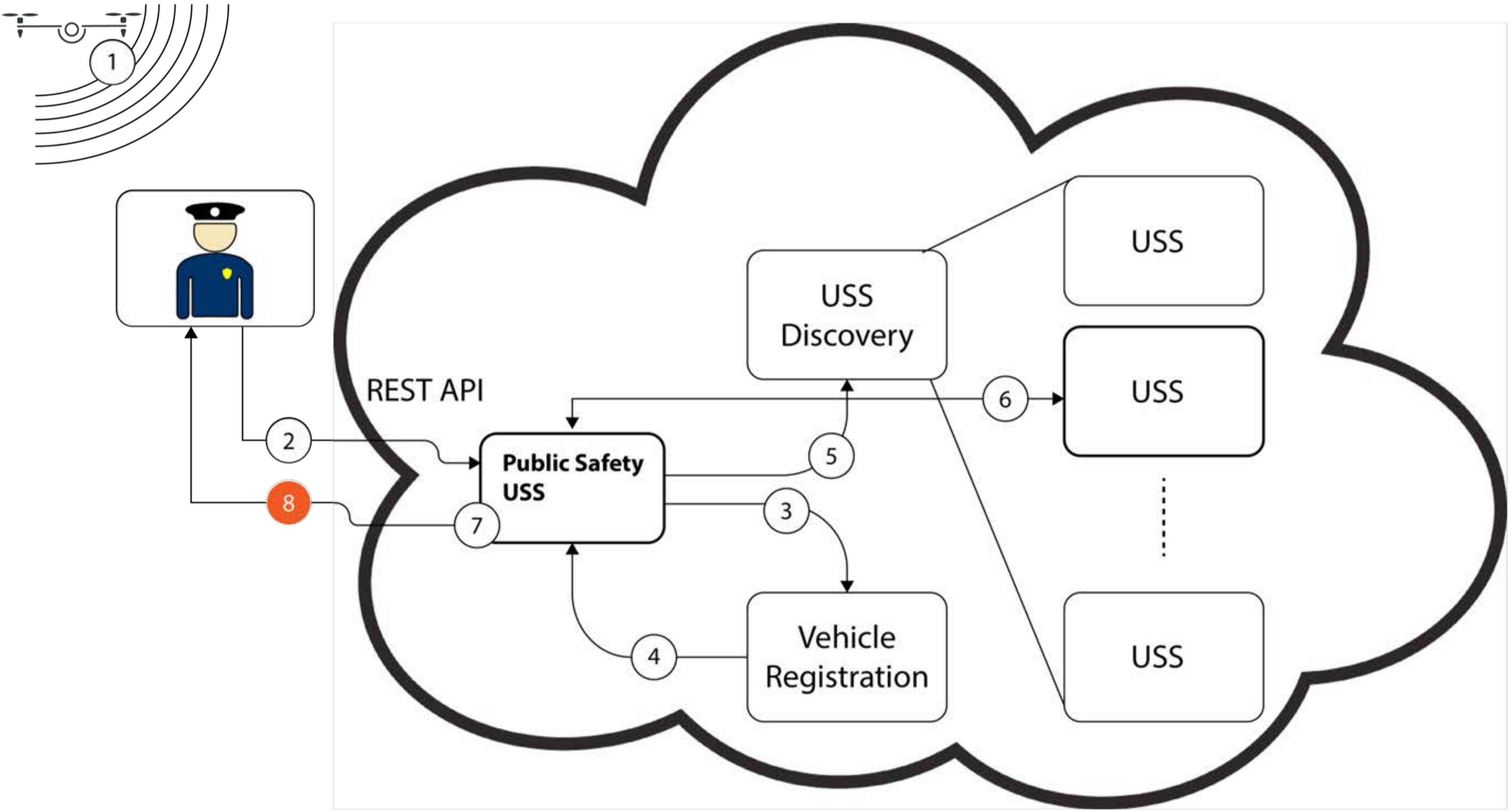
Given USS find operation
by point and radius



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

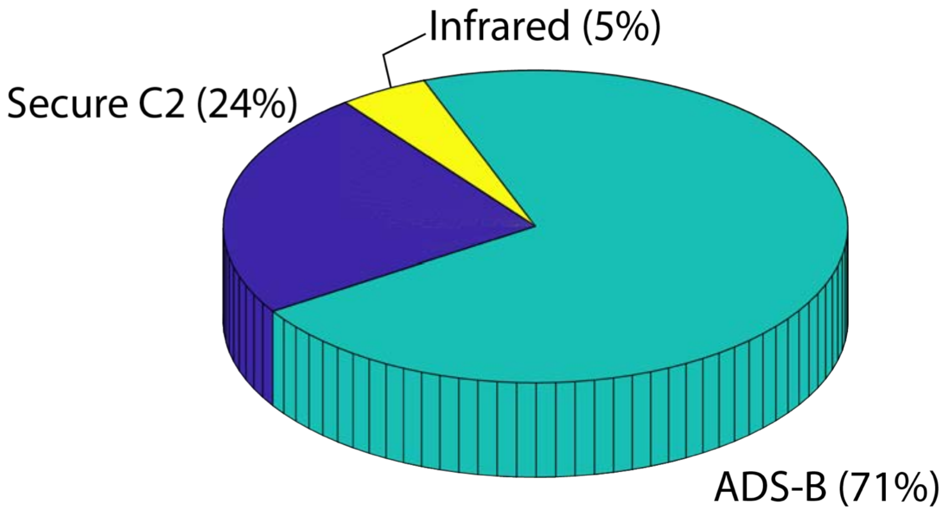
TCL3 Remote ID Testing: Feb-June 2018

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

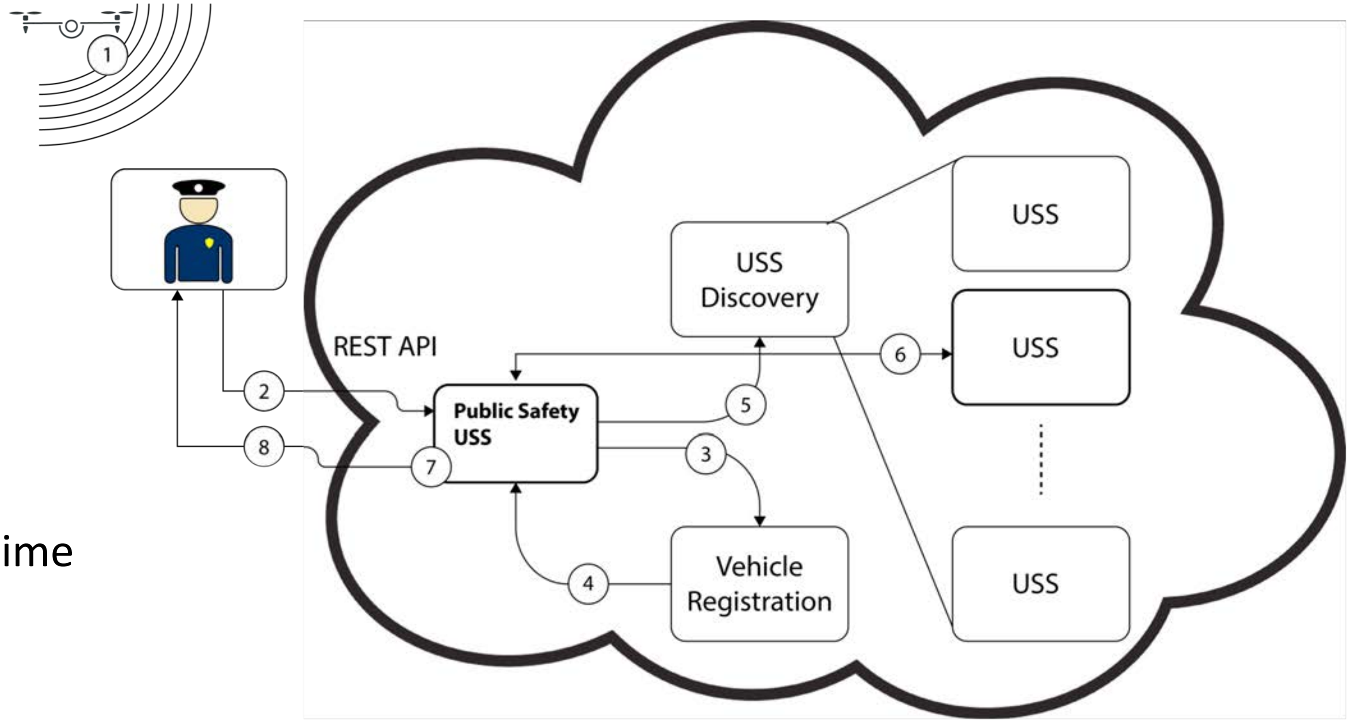


Metrics Computed

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

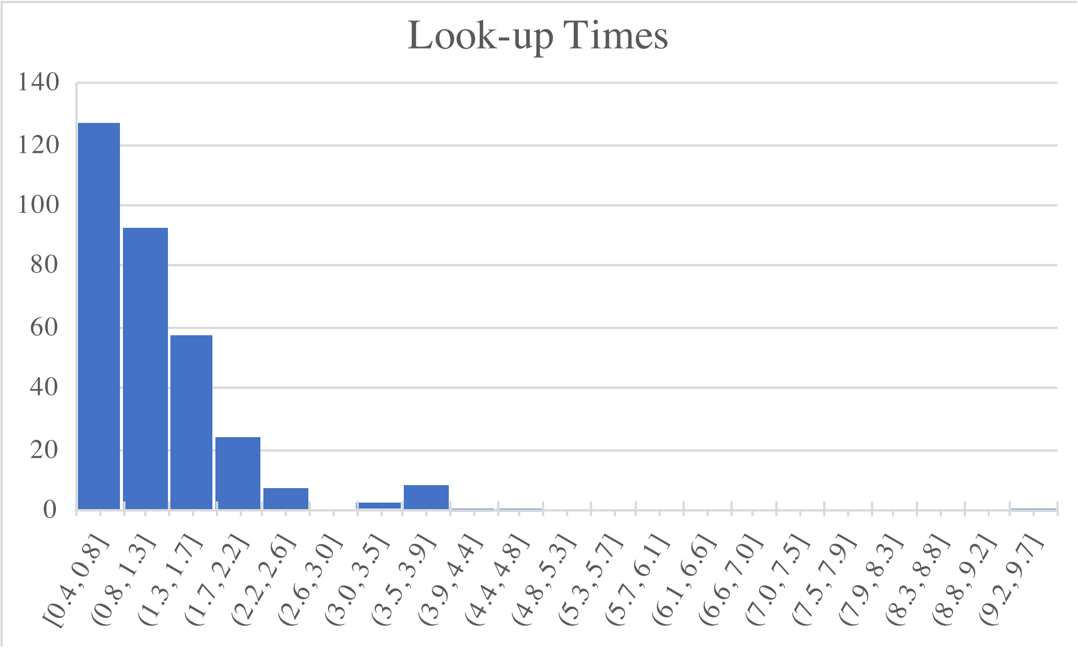
Distances

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