

## NASA UTM (2017) --

Four Working Groups are now established:

- Concepts and Use Cases (2016)
- Data Exchange (2017)
- Sense and Avoid (2017)
- Communications and Navigation (2017)

Subsequent (2018) testing focuses on

- **System-level evaluation**, including contingency management and off-nominal conditions
- **Separation**, including both cooperative and non-cooperative aircraft, and ground obstacles
- Direct and distributed **communication and control**
- **Navigation**, close to people and buildings, both terrestrial and satellite based





## Taking Air Travel to the Streets, or Just Above Them

*Urban Air Mobility (UAM), is a safe and efficient air transportation system where everything from small package delivery drones to passenger-carrying air taxis operate over populated areas, from small towns to the largest cities.*

<https://www.nasa.gov/aero/taking-air-travel-to-the-streets-or-just-above-them>

# Geofencing: A Key part of UTM/UAM

- A geofence is a volume of airspace that a UAS cannot pass through the boundaries of.
  - If the UAS is inside, it must stay inside
  - If the UAS is outside, it must stay outside
- UTM Coordination:
  - Define, negotiate geofencing map
  - Share with UTM/UAM operators
- UAS/UAM Vehicle/Operator:
  - Request access
  - Remain in authorized geofenced volumes
  - Avoid restricted (keep-out) volumes



# Geofencing Illustration



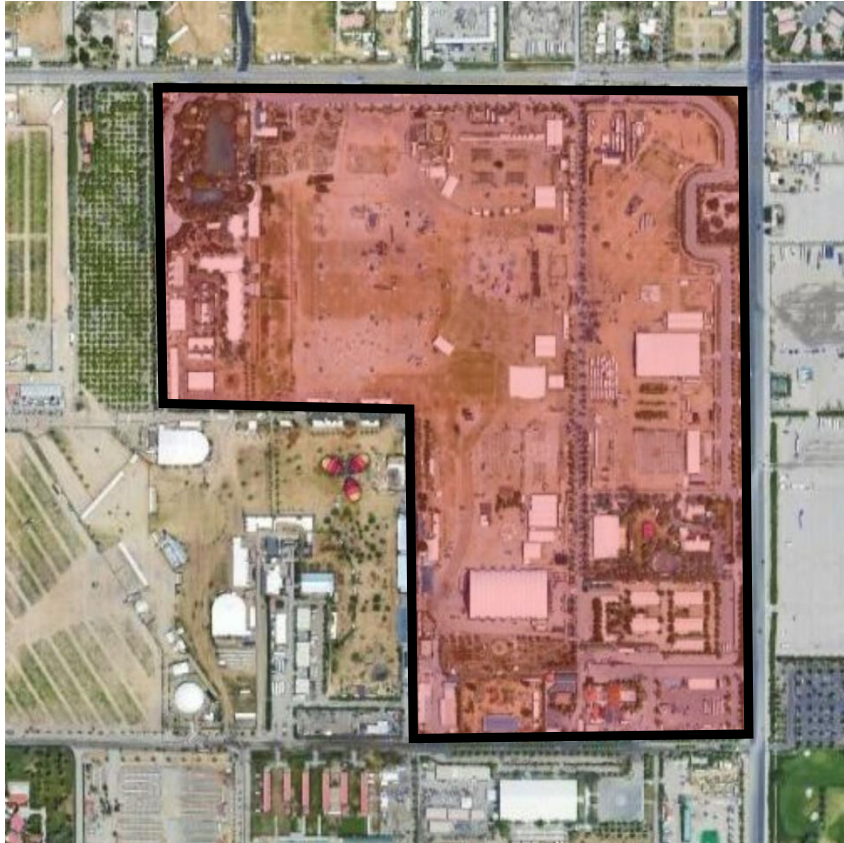
- Consider a music festival
- Want to prevent unauthorized UAS
  - Stop UAS before entering the area
  - Warn UAS operator before control override
- Want to contain authorized UAS
  - Stop UAS before leaving the area
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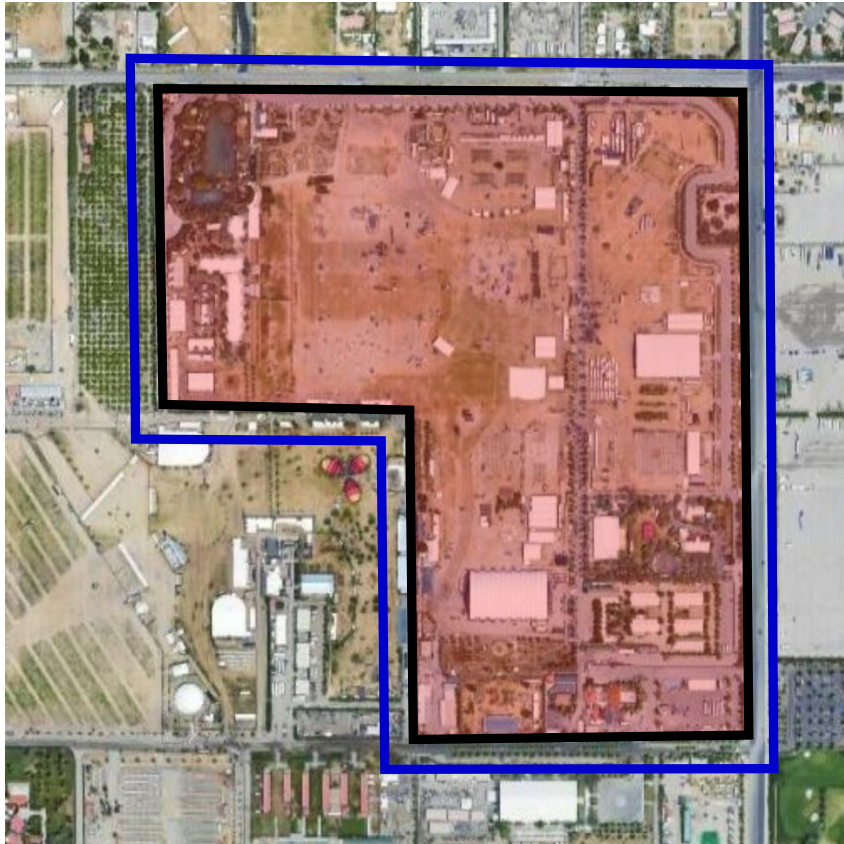
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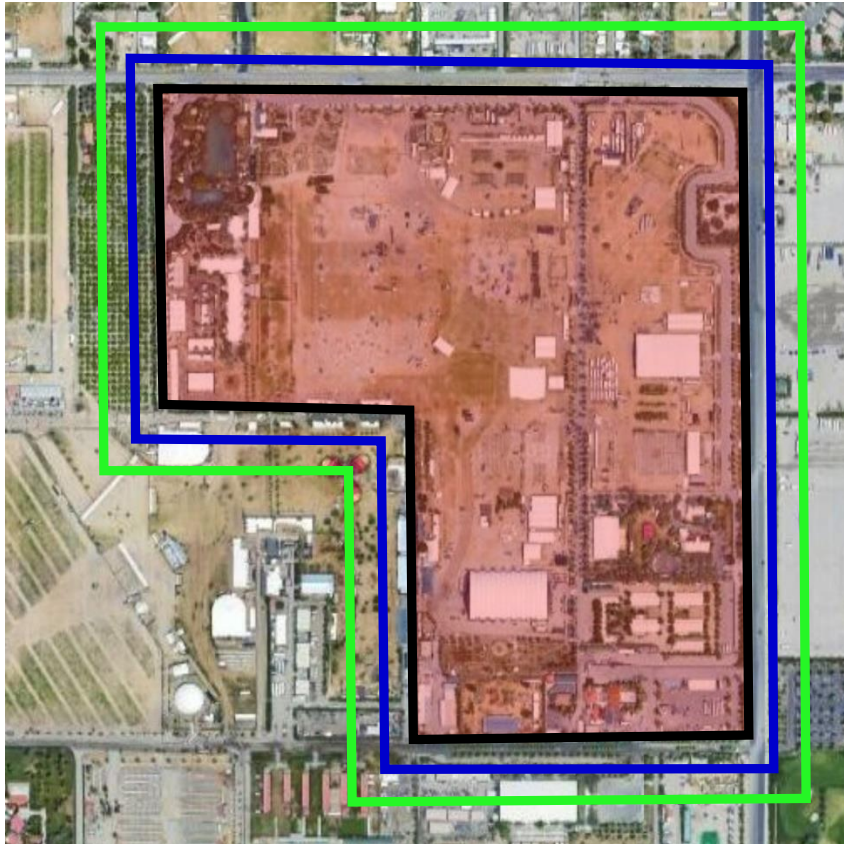
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# Geofencing: How will it work?

- Durational (limited-time), static (cube) v. moving (tube)
- Based on communications (spectrum use, range) as well as separation assurance and permissions
- Research: complex geofence volumes, assured activation, guidance and control
  - Boundary violation detection with layering
  - Response itself can be simple (flight terminate) or more complex as needed (don't flight terminate into a crowd)
- Open question:
  - Who has priority access, and who decides? First in line? Balanced across different operators? Access fees? Prioritized by community / landowner / FAA?



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