1. Air traffic rules and regulations
2. UTM system
3. Radio operator's cert.

9C: Air traffic management (ATM), UAS traffic management (UTM)

Lecture Presented By: Kevin Kochersberger

In this lecture you will learn:

- Airspace radio and communications requirements
- Air traffic management

ADS-B has become a requirement for manned and unmanned aircraft entry into controlled airspace

1. **Air traffic rules and regulations**
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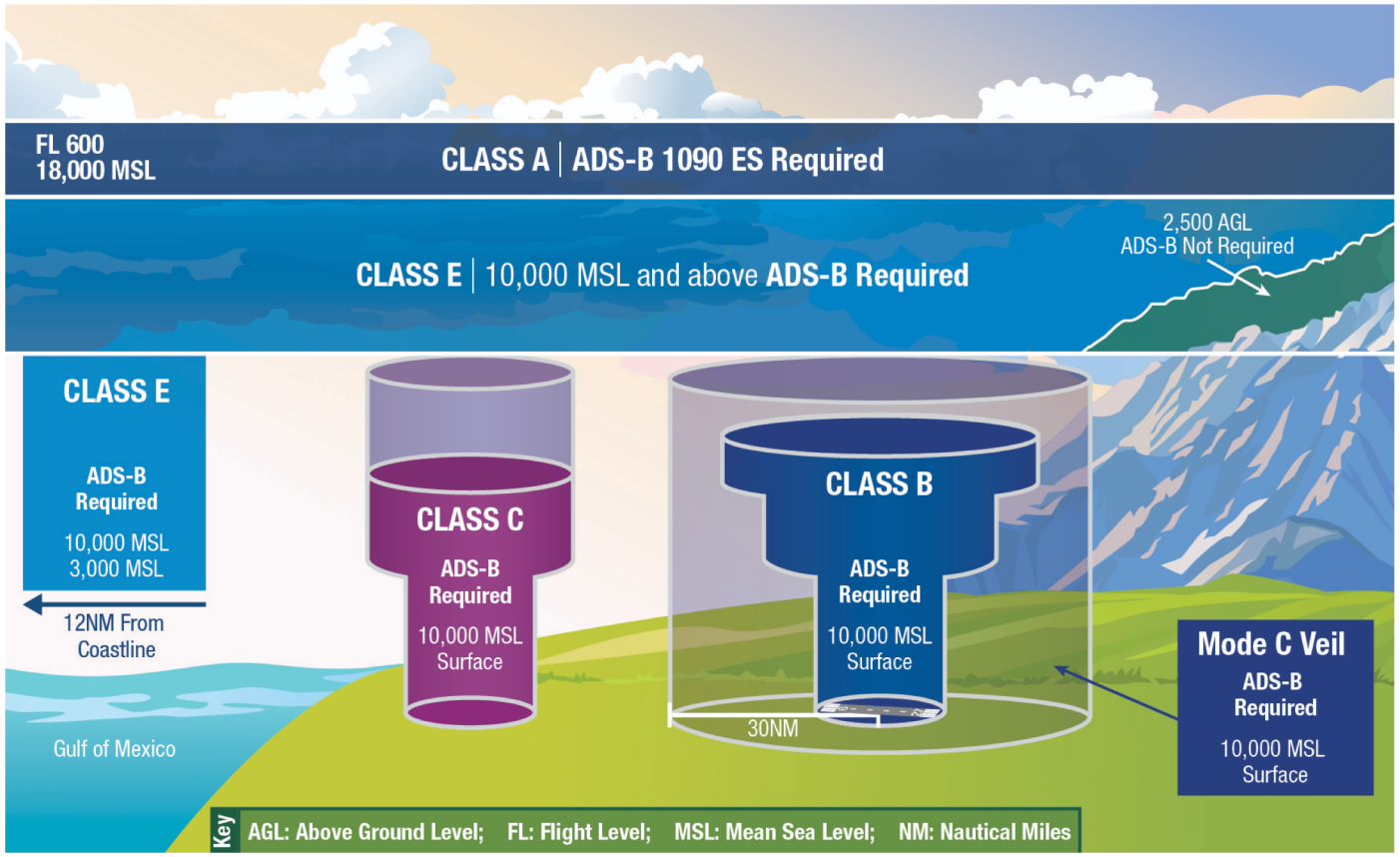
- Radar coverage with an altitude-reporting transponder used to be adequate for flight in controlled airspace
- Now, most flights must have ADS-B reporting
  - For manned aircraft, ADS-B is commonly required in controlled airspace
  - For unmanned aircraft, ADS-B is required for BVLOS flight



Safe flight operations rely on the deconfliction of RPA with other aircraft

1. **Air traffic rules and regulations**
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- A UAS Traffic Management (UTM) system is being developed to international standards that will support the safe introduction of UAS into airspace
- While many experiments are taking place worldwide, the ICAO is supporting a convergence of standards to be used internationally

UTM generated flight volumes for each UAS

Four UAS autonomously flying over Reno managed by UTM

Terminology

1. **Air traffic rules and regulations**
2. UTM system
3. Radio operator's cert.

- ANSP: Air Navigation Service Provider
  - Manages air traffic on behalf of a country
- SWIM: System Wide Information Management is a global air traffic management (ATM) system initiative
  - Allows the exchange of aeronautical, weather and flight information across controlling agencies
  - Net-centric system based on the management of aircraft information
- FIMS: Flight Information Management System provides -
  - Cross-agency / country drone information exchange
  - Accessibility to a common operational picture
  - Enables joint operations / authority collaboration
- USP, USS: UAS Service Provider or UAS Service Supplier

The standards for information exchange in air traffic control are currently being defined

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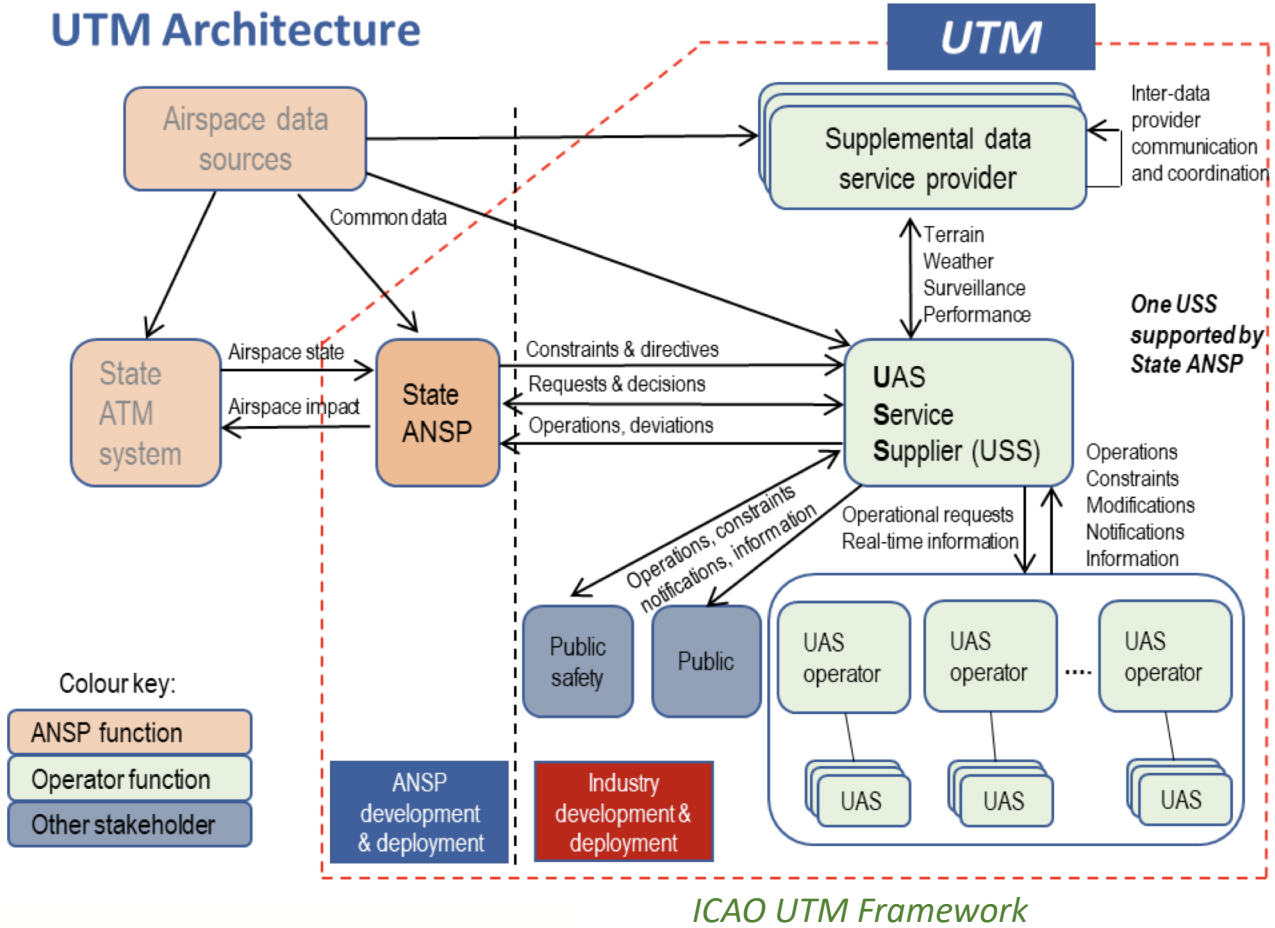
- A UAS Traffic Management (UTM) system is being developed to international standards that will support the safe introduction of RPA into non-segregated airspace
- Layers of airspace management provide safe oversight for all users
  - Gaps exist between the operations of manned and unmanned aircraft, and the system is designed to minimize risk in combined operations



ICAO UTM Framework

The standards for information exchange in air traffic control are currently being defined

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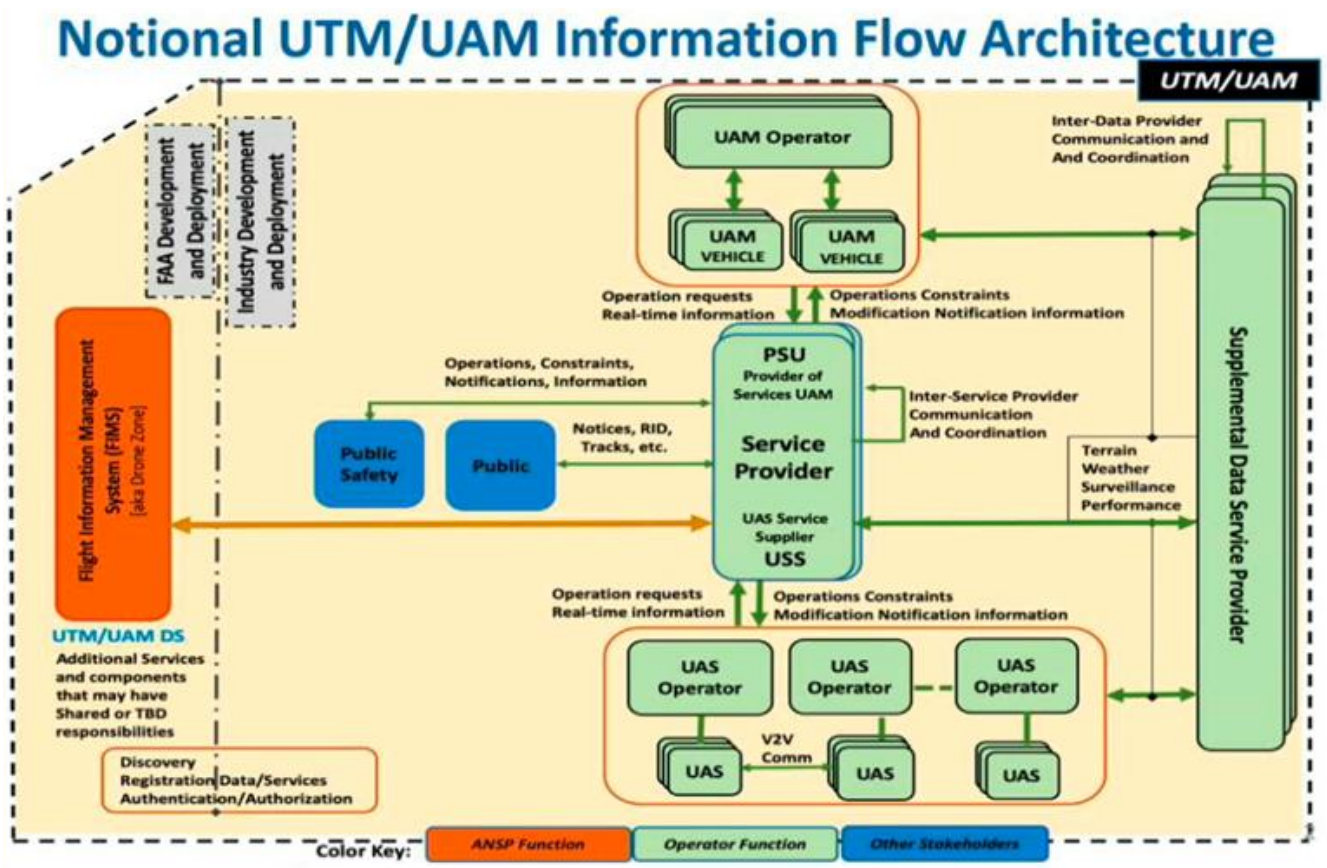
- A similar definition for UTM has been developed by the FAA
  - Security and authentication requirements
  - Phantom controllers and aircraft may spoof activity
  - Information integrity
  - Privacy and identification needs
    - Remote ID will be handled via IP
- In the cooperative community, services are decentralized



FAA UTM Framework

Safe flight operations rely on the deconfliction of RPA with other aircraft

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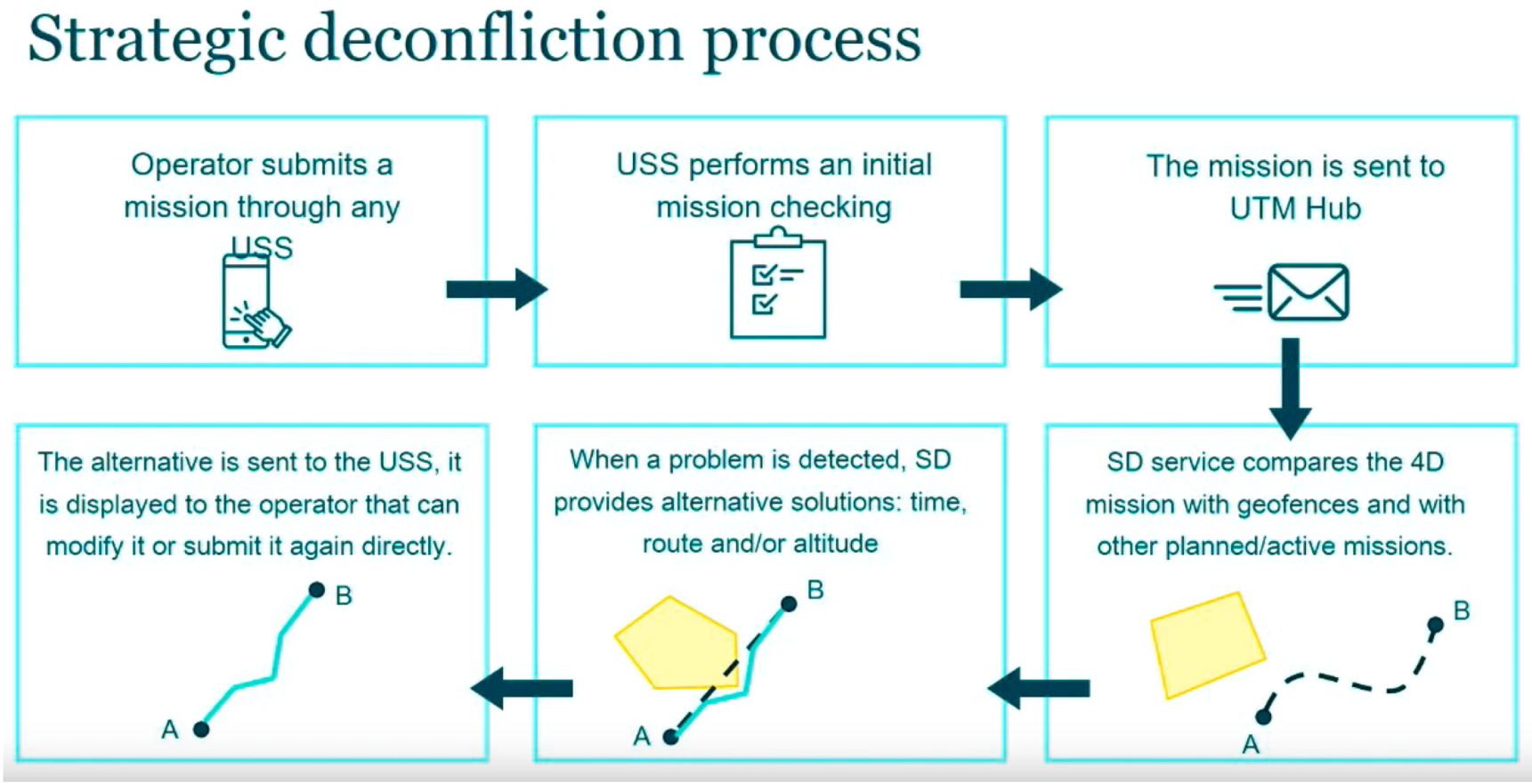
- A process is used to accept a flight request, evaluate it and then issue a final flight approval



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Safe flight operations rely on the deconfliction of RPA with other aircraft

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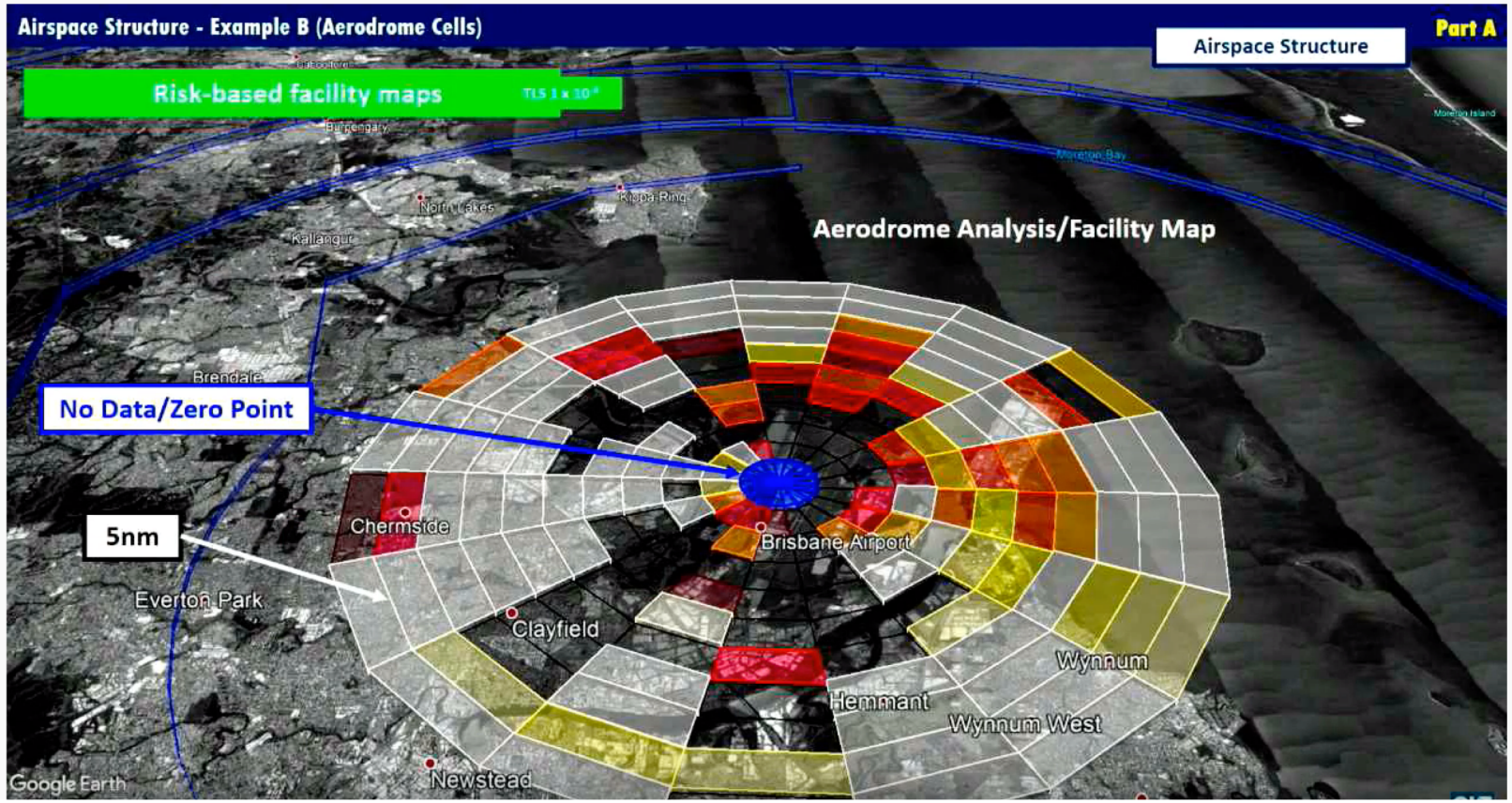
- Risk may be calculated to provide a database that is helpful for defining routes for RPA
- Using existing air traffic activity, the risk map will show 3D risk near an aerodrome
- SORA methods are frequenty used to evaluate BVLOS operational risk



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Safe flight operations rely on the deconfliction of RPA with other aircraft

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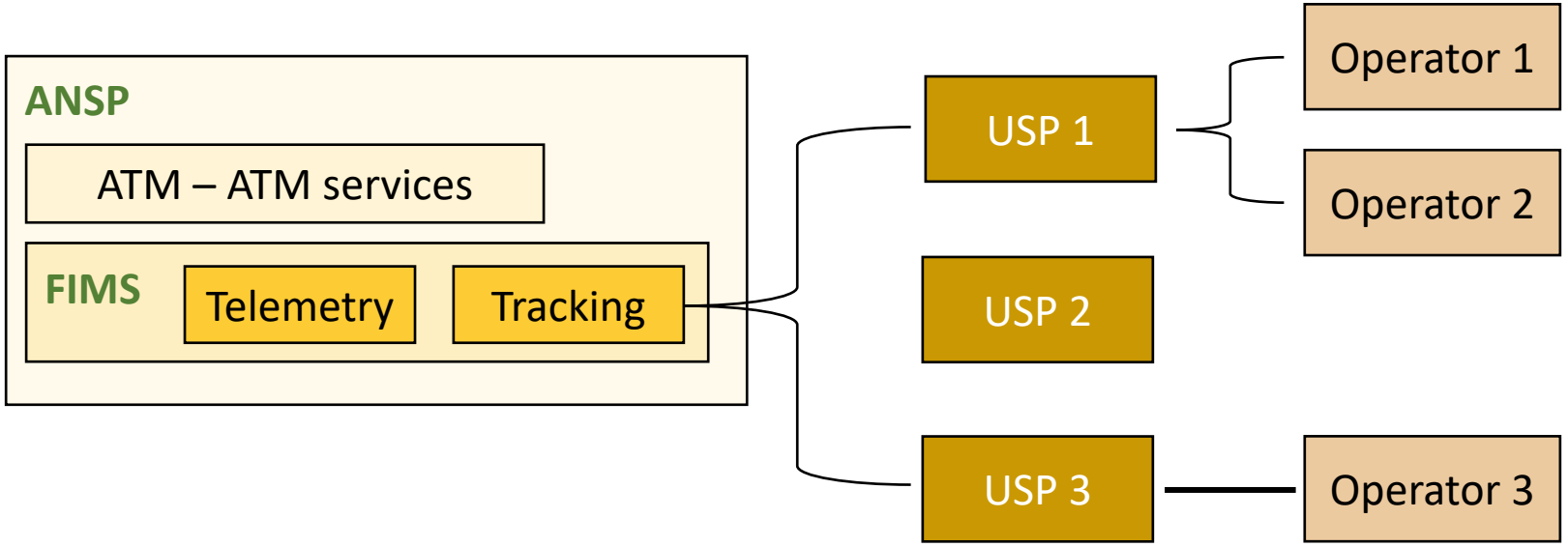
- Deconfliction of traffic between other RPA is handled by the FIMS
  - Serves to integrate multiple service providers
  - Real-time situational awareness for all users

- FIMS enables UTM/ATM integration
- Standardized protocols enable multiple USPs to function under one ANSP



Specialization of services is possible in a FIMS architecture

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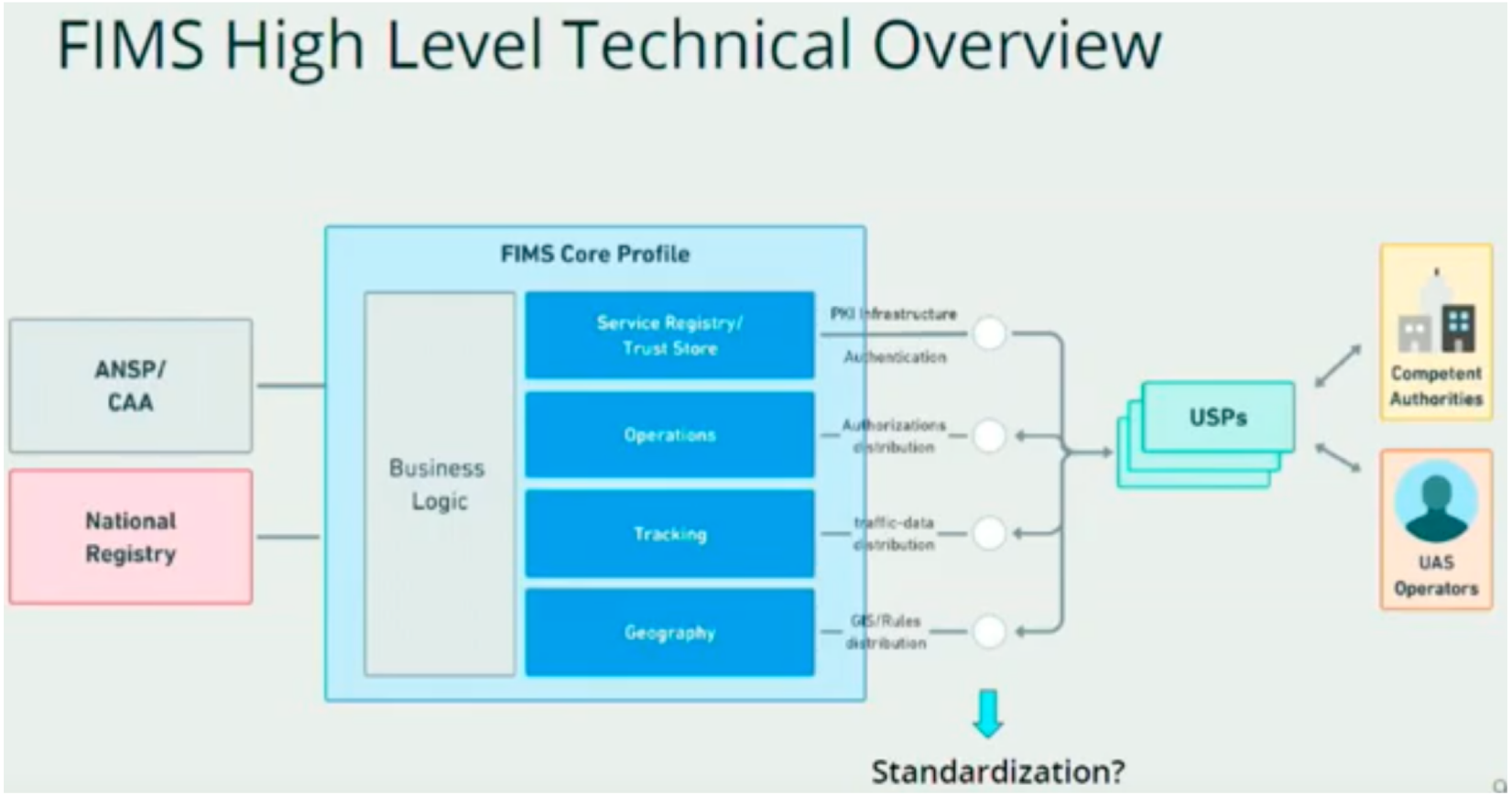

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Safe flight operations rely on the deconfliction of RPA with other aircraft

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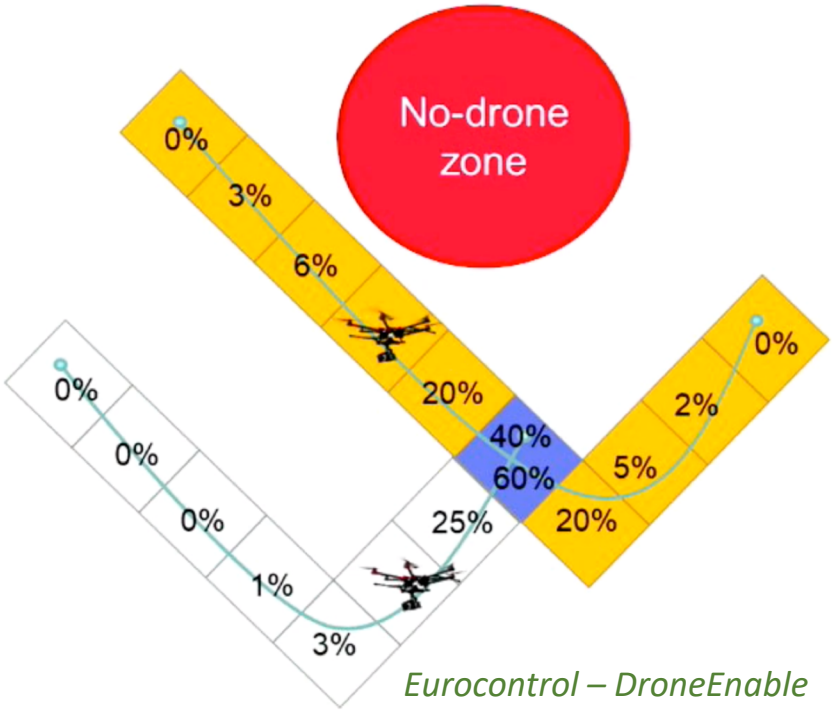
- Typical deconfliction can be addressed using 4-dimensional trajectory models
- Tracking information is provided to the FIMS which computes collision risk
  - When needed, the aircraft is rerouted or delayed to avoid conflict

Pairwise Strategic (pre-flight) conflict resolution with Bubbles

EUROCONTROL

- Conflict Detection is done
  - by the Operation Plan Processing service
  - on receipt of an Operation Plan
- A probabilistic 4D trajectory is extracted from the operation plan
- This is then compared with all others
- When the probability of a bubble intersection exceeds some predefined value
- Then a conflict is declared



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Options in the use of UTM to remotely identify RPA

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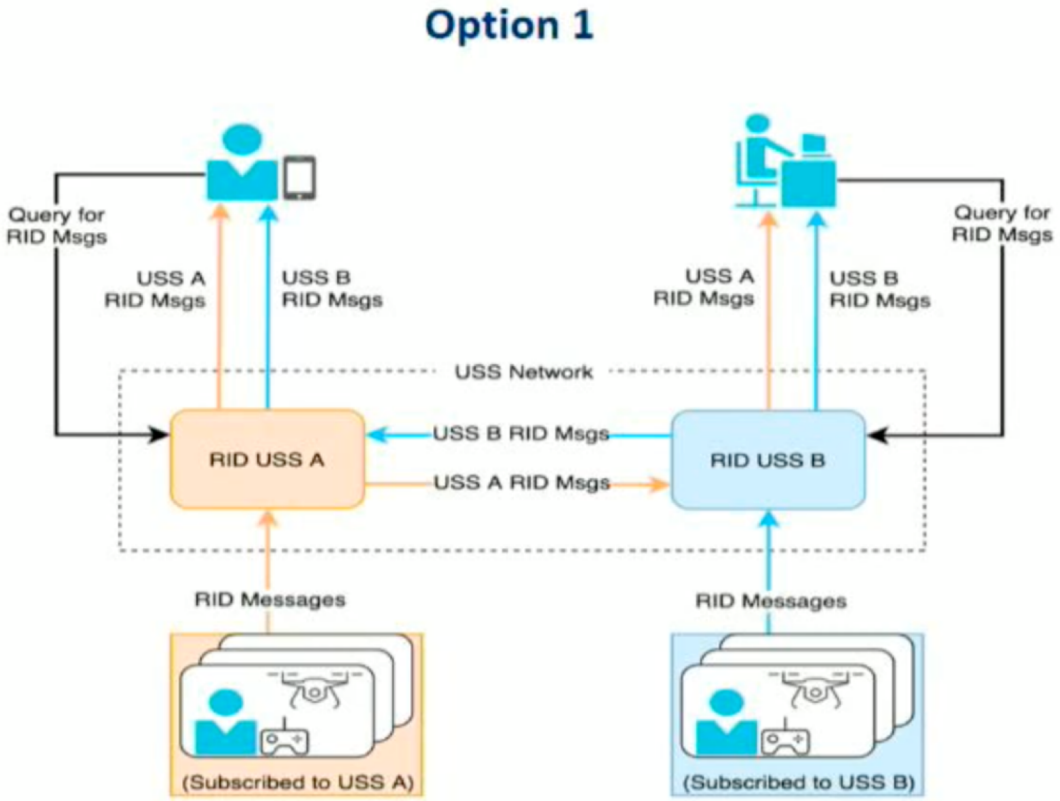
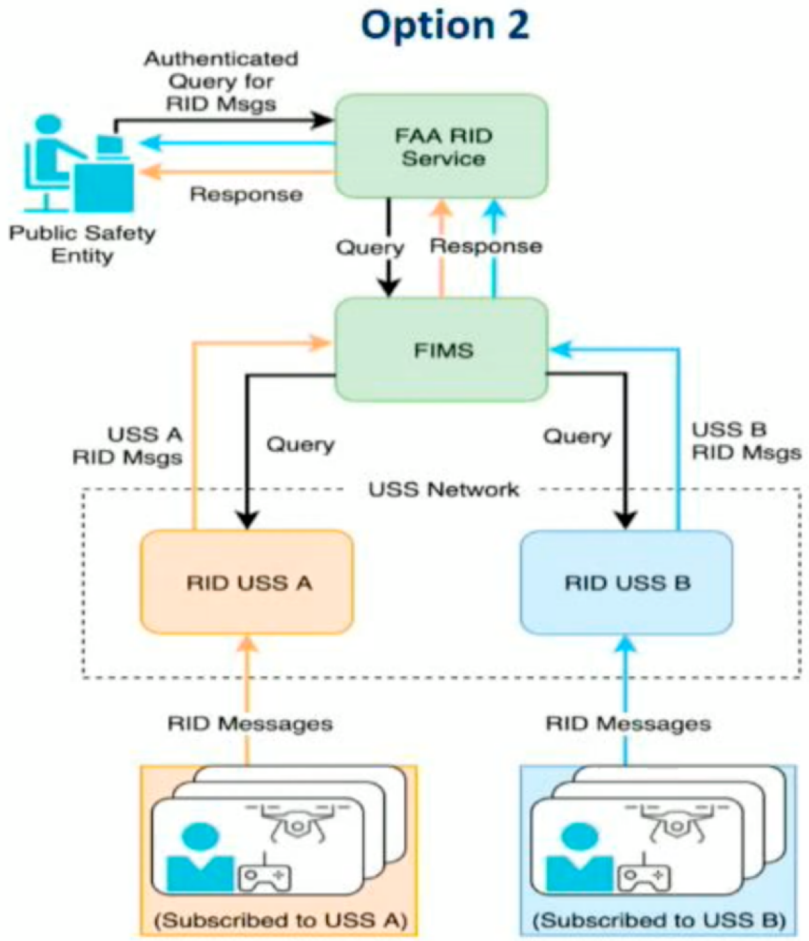


In Option 1, the FAA does not intervene when public safety queries information



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In some States, it is required to possess a radio operator's certificate

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- The aeronautical radiotelephony certificate demonstrates a capability to communicate effectively on a radio
- ICAO Doc 9432 Manual on Radiotelephony specifies transmission techniques including:
  - Before transmitting, *listen* to ensure there will be no interference from your transmission
  - Use a normal conversational tone, speaking clearly and distinctly
  - A slight pause after numbers will make them easier to hear/understand

Aviation radio communications

1. Air traffic rules and regulations
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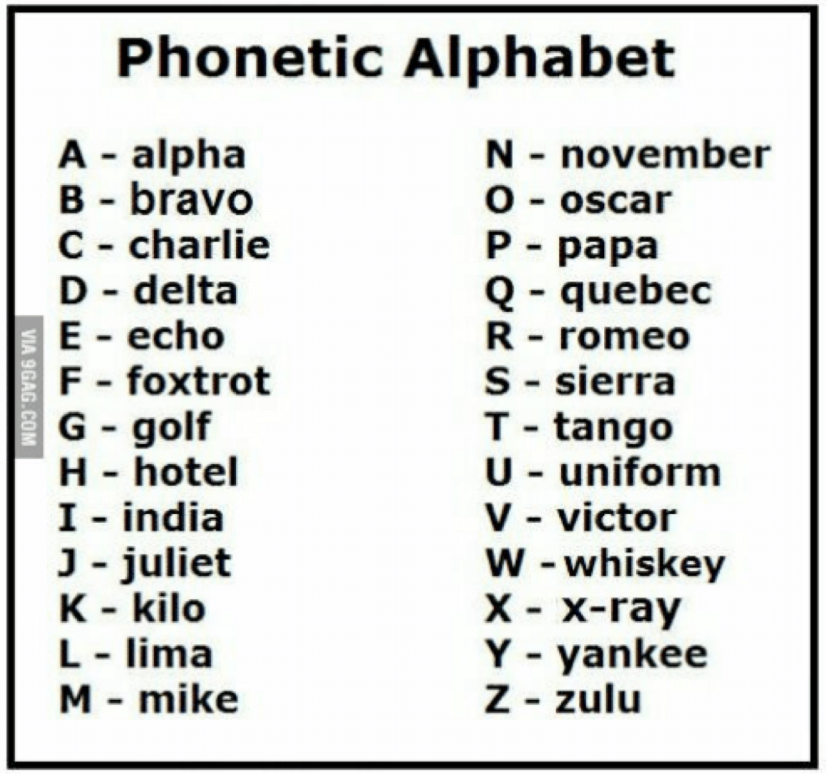
- The Phonetic alphabet is used in radio communications to other aircraft
  - The purpose of the phonetic alphabet is to reduce errors in voice transmissions
- Acknowledging communications:
  - "affirmative" or "roger" = "yes"
  - "negative" = "no"
- Requesting communications
  - State **who you are contacting** followed by **who you are**: "Lilongwe tower this is alpha delta delta alpha, over"



Aviation radio communications

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- Numbers should be communicated in a standard fashion to avoid confusion
- The phonetic pronunciation shown should be referenced
- Other terminology related to dialogue is standardized for efficiency

Channel	*Transmitted as*
118.000	ONE ONE EIGHT DECIMAL ZERO
118.025	ONE ONE EIGHT DECIMAL ZERO TWO
118.050	ONE ONE EIGHT DECIMAL ZERO FIVE

Time	*Statement*
0920 (9:20 A.M.)	TOO ZE-RO *or* ZE-RO NIN-er TOO ZE-RO
1643 (4:43 P.M.)	FOW-er TREE *or* WUN SIX FOW-er TREE

Phrase	*Meaning*
SAY AGAIN	Repeat entire message
SAY AGAIN . . . (item)	Repeat specific item
SAY AGAIN ALL BEFORE . . . (the first word satisfactorily received)	Repeat part of message