Safely Enabling Low-Altitude Airspace Operations: Unmanned Aerial System Traffic Management (UTM)
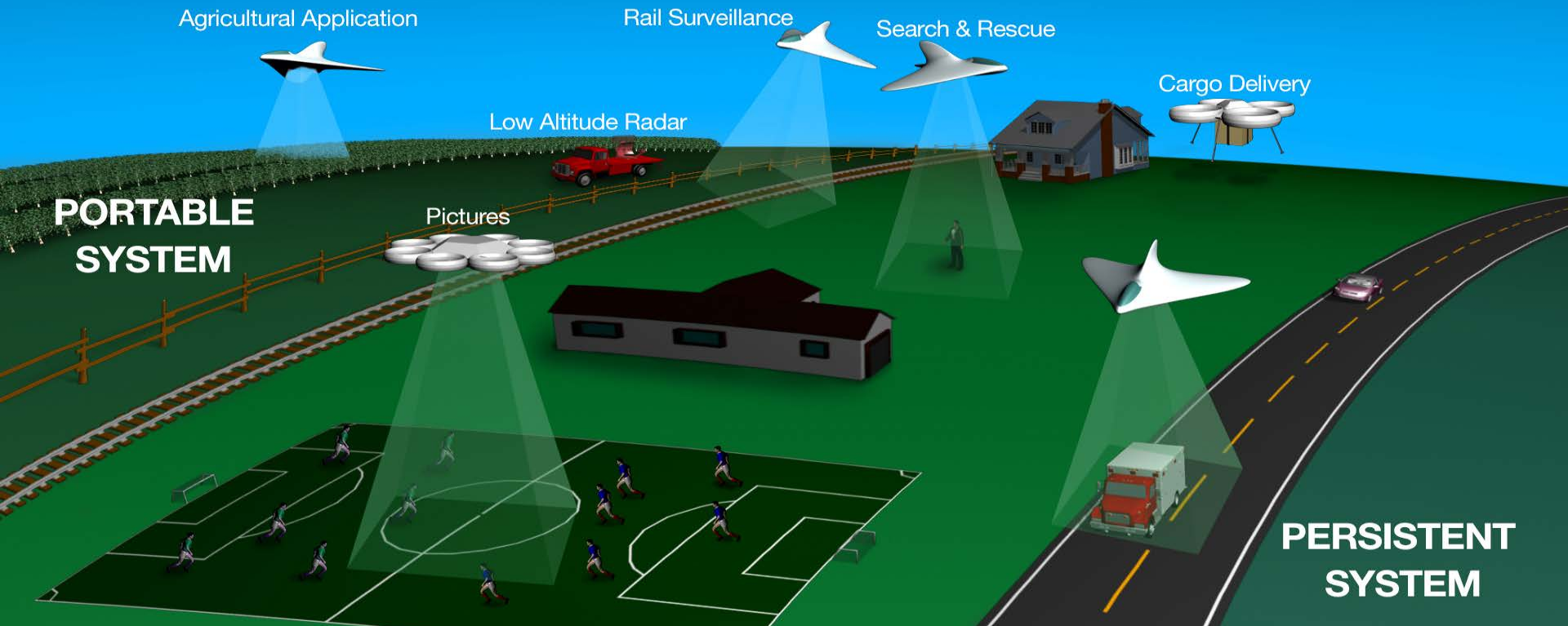
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UTM Applications

NOTIONAL SCENARIO

Agricultural Application

Rail Surveillance

Search & Rescue

Cargo Delivery

Low Altitude Radar

PORTABLE SYSTEM

Pictures

PERSISTENT SYSTEM

- **Near-term Goal** – Enable initial low-altitude airspace and UAS operations with demonstrated safety as early as possible, within 5 years
- **Long-term Goal** – Accommodate increased UAS operations with highest safety, efficiency, and capacity as much autonomously as possible (10-15 years)
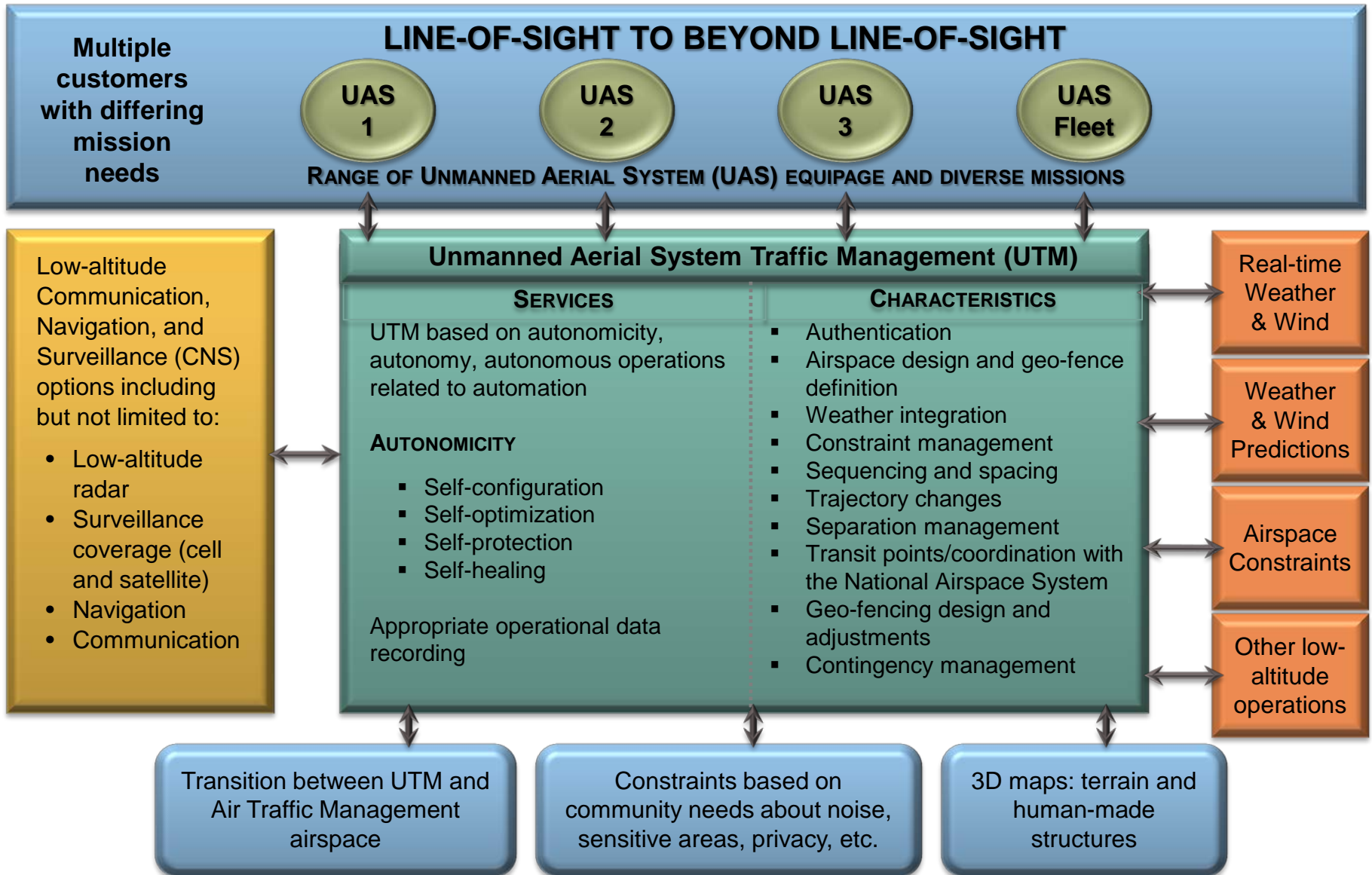
UTM Design Functionality

- Cloud-based architecture

- UAS operations will be safer if a UTM system is available to support the functions associated with

  - Airspace management and geo-fencing

  - Weather and severe wind integration

  - Predict and manage congestion

  - Terrain and man-made objects database and avoidance

  - Maintain safe separation

  - Allow only authenticated operations

- Analogy: Self driving or person driving a car does not eliminate roads, traffic lights, and rules

- Missing: Infrastructure to support operations at lower altitudes

UTM – One Design Option – Towards Autonomy

Multiple customers with differing mission needs

LINE-OF-SIGHT TO BEYOND LINE-OF-SIGHT

UAS 1 **UAS 2** **UAS 3** **UAS Fleet**

RANGE OF UNMANNED AERIAL SYSTEM (UAS) EQUIPAGE AND DIVERSE MISSIONS

Low-altitude Communication, Navigation, and Surveillance (CNS) options including but not limited to:

- Low-altitude radar
- Surveillance coverage (cell and satellite)
- Navigation
- Communication

Unmanned Aerial System Traffic Management (UTM)

SERVICES

UTM based on autonomicity, autonomy, autonomous operations related to automation

AUTONOMICITY

- Self-configuration
- Self-optimization
- Self-protection
- Self-healing

Appropriate operational data recording

CHARACTERISTICS

- Authentication
- Airspace design and geo-fence definition
- Weather integration
- Constraint management
- Sequencing and spacing
- Trajectory changes
- Separation management
- Transit points/coordination with the National Airspace System
- Geo-fencing design and adjustments
- Contingency management

Real-time Weather & Wind

Weather & Wind Predictions

Airspace Constraints

Other low-altitude operations

Transition between UTM and Air Traffic Management airspace

Constraints based on community needs about noise, sensitive areas, privacy, etc.

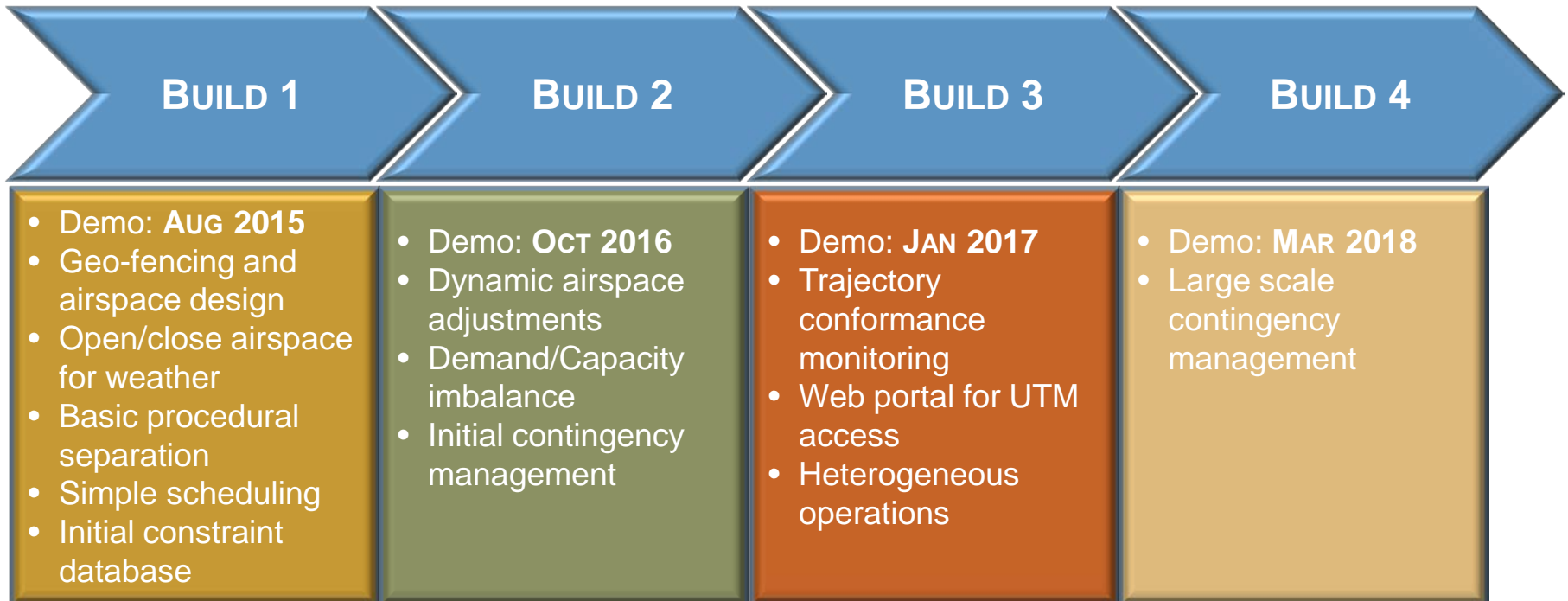3D maps: terrain and human-made structures

UAS User Access to UTM

- Cloud-based: user accesses through internet

- Generates and files a nominal trajectory

- Adjusts trajectory in case of other congestion or pre-occupied airspace

- Verifies for fixed, human-made, or terrain avoidance

- Verifies for usable airspace and any airspace restrictions

- Verifies for wind/weather forecast and associated airspace constraints

- Monitors trajectory progress and adjust trajectory, if needed (contingency could be someone else's)

- Supports contingency – rescue

- Allocated airspace changes dynamically as needs change

Schedule

- UTM research and development driven by various "Builds"
- Each Build adds more services and capabilities

BUILD 1	BUILD 2	BUILD 3	BUILD 4
• Demo: **AUG 2015** • Geo-fencing and airspace design • Open/close airspace for weather • Basic procedural separation • Simple scheduling • Initial constraint database	• Demo: **OCT 2016** • Dynamic airspace adjustments • Demand/Capacity imbalance • Initial contingency management	• Demo: **JAN 2017** • Trajectory conformance monitoring • Web portal for UTM access • Heterogeneous operations	• Demo: **MAR 2018** • Large scale contingency management

Consideration of Business Models

- Single service provider for the entire nation such as a government entity

- Single service provider for the entire nation provided by a non-government entity (for-profit, or not-for-profit entity)

- Multiple service providers by regional areas where UTM service could be provided by state/local government entities

  – Need to be connected and compatible

- Multiple service providers by regional areas where UTM service could be provided by non-government entities

  – Need to be connected and compatible

- Regulator has a key role in certifying UTM system and operations

NuSTAR: Idea under consideration

- National UAS Standardized Testing and Recording (NuSTAR)
- Parallel: Underwriter's Laboratory, Consumer Reports, JD Powers
- Credible test bed and scenarios
  - Urban, rural, atmospheric conditions (e.g., fog, smog, rain)
  - Simulated pets
- Data oriented rating, acceptance, and assurance
- Every UAS vehicle model goes through
- Support UAS manufacturers, consumers, FAA, insurance companies, and public at large through objective assessments
- Initial feedback from industry members has been positive
- Your feedback is requested

Summary

- UTM appears to be a good construct
- Many collaborators
- Field testing and simulations will demonstrate its feasibility
- Safe operations is goal
- Collaboration is welcome