UAS INTEGRATION PILOT PROGRAM

U.S. Department of Transportation
Federal Aviation Administration

BEYOND

From IPP to BEYOND

ICAO NACC UASRPAS Workshop

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AGENDA

- **Integration Pilot Program (IPP)**
  - Overview
  - Participants
  - Achievements
- **Transition to BEYOND**
  - Definition and Principles
  - Beyond visual line of sight (BVLOS) Challenge Scope
- **BEYOND Updates**
  - BEYOND Focus
  - Lead Participant Activities
  - Community Engagement
  - Societal and Economic Measures
  - Data Analysis

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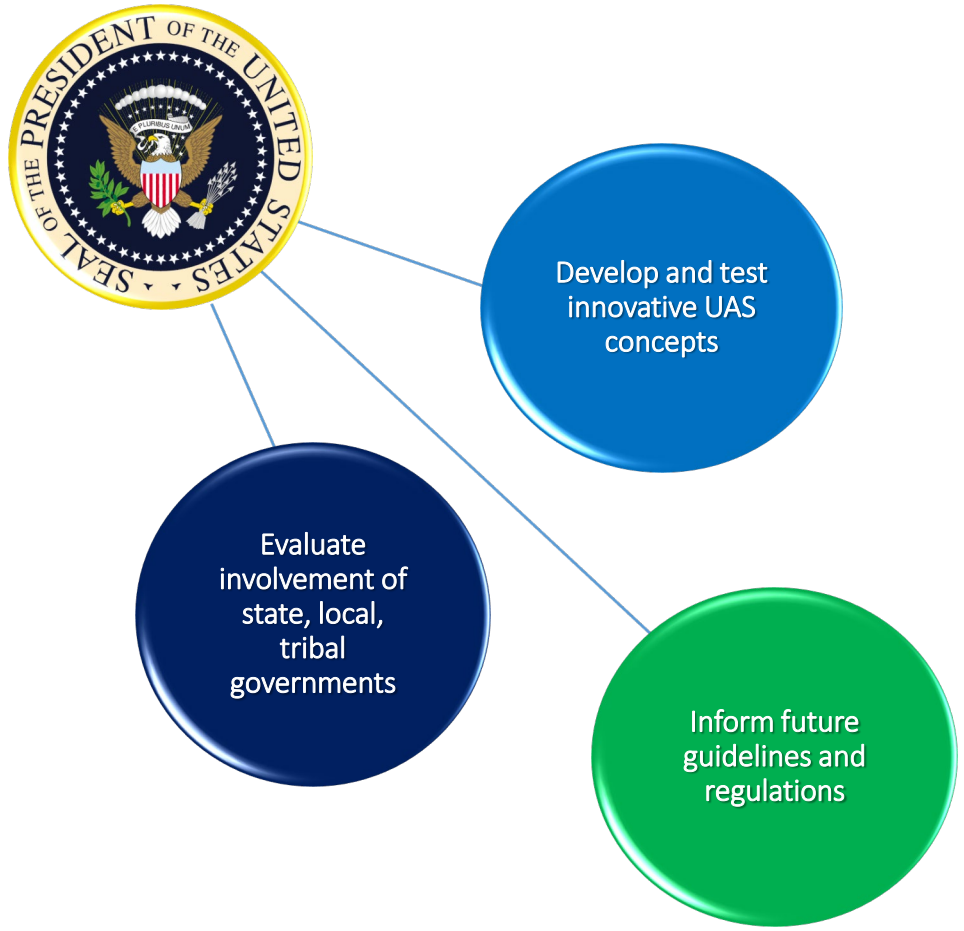
Integration Pilot Program (IPP)

IPP at a Glance



Operational Concepts – Broad Range

- Package delivery (commercial and medical)
- Linear infrastructure inspections
- Event monitoring / Newsgathering
- Disaster - Post-hurricane damage assessments / Flood
- River rescue
- Public safety; law enforcement response
- Airport surveillance; parts delivery

The FAA approved **89 Part 107 Waivers**, and **45 Airspace Authorizations** for the IPP Lead Participants (LPs) enabling more than **21,000 total flights**

LPs also collected **12,800 comments** measuring the public sentiments of UAS operations

Informing new Unmanned Aircraft Systems (UAS) rules, policy and guidance

IPP Lead Participants

Operation Type

* Grey inner shading denotes planned operations

- UAS Type Certificate
- Delivery Operations
- Multi-UAS
- Infrastructure/ Inspection
- BVLOS
- Agriculture
- Ops Over People

Lead Participants

- University of Alaska-Fairbanks
- City of San Diego
- City of Reno
- North Dakota DOT
- Kansas DOT
- Choctaw Nation
- Memphis-Shelby County Airport Authority
- Innovation and Entrepreneurship Investment Authority
- North Carolina DOT

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IPP Success Areas & Achievement Summary

Safely Integrate UAS into the National Airspace System (NAS)

- **Conducted more than 21,000 flights**
- Issued the **first two air carrier certificates for UAS cargo delivery** operators for Part 135 operations (Wing LLC, UPS Flight Forward)
- Advanced beyond visual line of sight (BVLOS) operations

Societal and Community Impacts

- **Improved medical services** and access to medical supplies
- **Expanded access** to goods and services
- Improved support for **disaster response**
- Received more than **12,800 public comments** providing insight into public opinion

Inform FAA Policy and Decision Making

- **Gathered data to inform** policy making pertaining to **Durability & Reliability (D&R) Means of Compliance (MoC) for small UAS Type Certification**
- Established UAS command-and-control (C2) link testing metrics for cellular networks
- Certified **the first tribal government for Public Aircraft Operations** (Choctaw Nation)
- Gathered data to **inform policy and best practices** for engaging communities and garnering support related to UAS operations

Major IPP Lessons Learned

- **Close collaboration and data sharing between UA Manufacturers and ASTM standards development body** has improved safety risk management practices implemented by the UA operators

- With increasing demand for Beyond Visual Line of Sight **(BVLOS) operations**, many in remote areas, **continuing approvals through part 107 may not be scalable**, prompting discussions for alternate solutions

- **Unprecedented access** to various FAA personnel helped IPP Lead Participants conduct operations benefited from a **high level of FAA engagement**, and proved informative and educational for both sides.

- **Data and strategy sharing** between FAA, LPs and Industry were integral to the IPP success.

- Communities that plan to conduct drone operations should **develop methods to quantify societal/economic benefits** to obtain a buy in from a large body of stakeholders

IPP Community Engagement Best Practices

The FAA has identified three successful strategies:

Reaching Different Populations

- Participants are most successful when they **understand the populations** they serve and the ways in which they could reach those individuals.
- **Targeted meetings** play an essential role in communicating with highly impacted stakeholders. Such meetings yield successful dialogue and support across the community.

Storytelling Across Operational Characteristics

- Understanding the **positive impacts** of operations and sharing that with the public has a constructive outcome on public perception.
- **Tailoring engagement approaches** to the unique characteristics of operations, such as urban versus rural, population density, or operation type, helps maximize outreach.

Feedback Facilitation

- Collecting public sentiment towards UAS operations allows operators to **address public concerns** and **garner support** for UAS integration in the community. Feedback collection occurs in a variety of forums including surveys, meetings, websites, public events, etc.
- Local communities tend to be **interested and supportive of UAS operations perceived to provide benefits to their wider community**, such as disaster response and emergency services.

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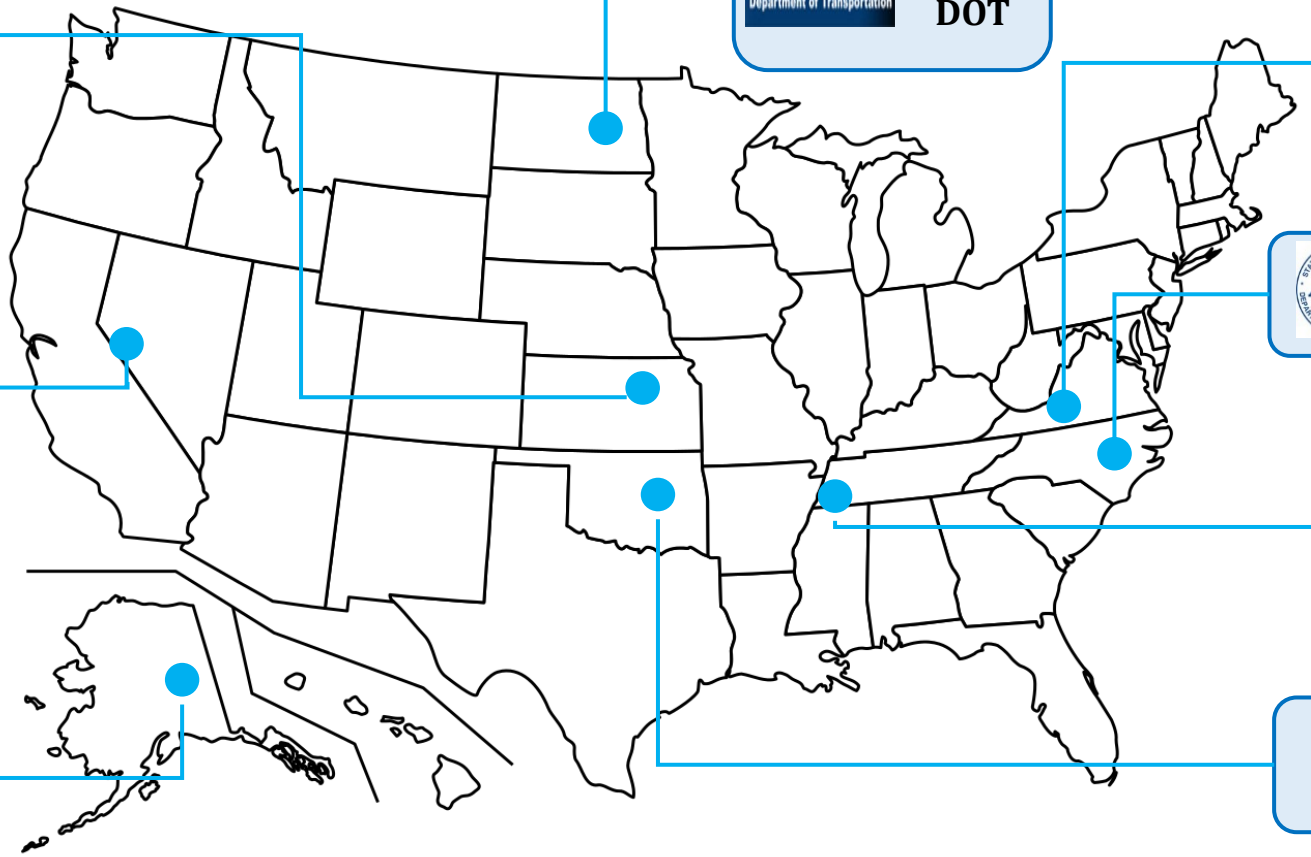
Transition to BEYOND

UAS BEYOND Program - Background

Collaborative effort between <u>state, local and tribal governments</u> and the FAA to:

- **Continue** progress of the IPP
- **Advance** BVLOS Operations
- **Explore** societal and economic benefits and community engagement best practices

BEYOND Lead Participants



- Kansas DOT
- North Dakota DOT
- Center for Innovative Technology
- City of Reno
- North Carolina DOT
- Memphis-Shelby County Airport Authority
- University of Alaska-Fairbanks
- Choctaw Nation of Oklahoma

Planned Operation Types

- UAS Type Certificate
- Delivery Operations
- Multi-UAS
- Infrastructure/ Inspection
- BVLOS
- Agriculture
- Ops Over People

BEYOND – BVLOS Challenge Scope

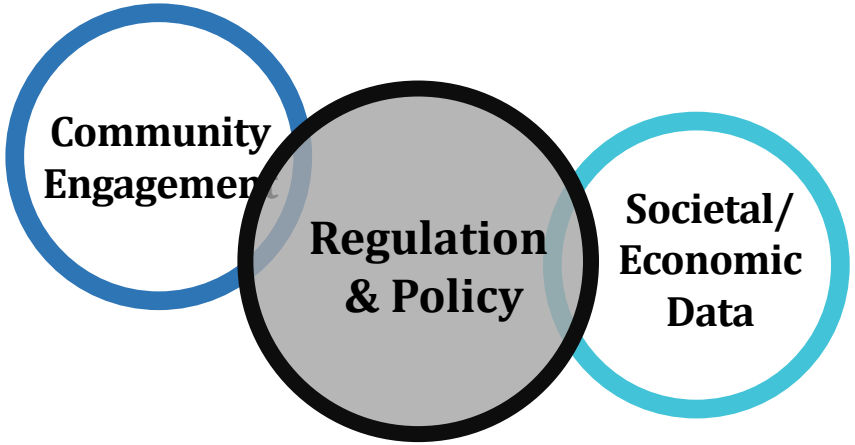
Flexibility to use **Three Mission Types** in **Three Distinct Environments**
Promote overall UAS integration efforts by defining **community engagement best practices** and **quantifying societal/economic benefits**

Mission Types

Infrastructure Inspection
Mission: the use of UAS to determine structural status and support enhanced, more efficient decision making

Public Safety Operations
Mission: the use of UAS to assist State/Local/Tribal law enforcement, wildfire monitoring, search & rescue and other emergency response activities

Package Delivery
Mission: the use of UAS to accomplish routine package delivery while maintaining compliance with parts 91 and/or 135



2020 — *Standardization* — *Normalization* — *Expansion* — *Integration* — *2024*

Environments

RURAL
- Extend BVLOS operational capability in uncontrolled environments
- Determine best solution for C2 requirements in rural environments
- Anticipated automation levels are low

SUBURBAN
- Extend BVLOS operations to meet routine operational requirements based on average UAS endurance and performance capabilities
- Expand the use of complex mitigations like UAS Traffic Management (UTM) and onboard detect and avoid (DAA) solutions
- Determine if UAS can achieve D&R MoC moderate "hour" threshold
- Determine necessary infrastructure for UAS integration
- Anticipated automation levels are moderate.

URBAN
- Extend BVLOS operations to meet routine operational requirements leveraging advanced mitigations to meet challenge of more complex air and ground environments
- Work with standards bodies to develop performance metrics to enable full integration
- Determine if UAS can achieve D&R MOC advanced "hour" threshold
- Local / State Gov't Roles
- Anticipated automation levels are high

Key Enablers

C2 | DAA | Certification

Key Tenets

Repeatable | Scalable | Economically Viable

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BEYOND Updates

BEYOND Focus

Functional Focus Areas

- Detect & Avoid
  - Collision Avoidance
- Communication and Control Links
  - C2 & Spectrum Usage
- UAS Traffic Management
  - UTM Capabilities

ConOps under BEYOND (25+ total) Including:

- Linear & infrastructure inspection
  - Power Lines; Oil & gas Pipelines; Bridges; Rail and Highways; Airport perimeter surveillance; Runway and Taxiway (FOD)
- Perimeter surveillance
- Public safety
  - First responder; wildfire & natural disasters; safety patrol; water rescue
- Small package & cargo delivery
  - Commercial items; Medical supplies; Cargo to remote areas; Aircraft parts payload delivery

Type Certification Efforts (19 total) mostly through the D&R Means of Compliance (MoC); Vehicle size & configuration range from:

- sUAS (fixed wing/ eVTOL)
- Single/multi-rotor,
- Modified Cessna caravan for Optionally Piloted Aircraft

Part 135 Certification Efforts (8 total)

- **3 Prospective new applicants** and expansions to current certificate holders.

Operations Related Highlights

BVLOS Technology

- 2 Lead Participants are evaluating Scientific Applications and Research Associates (SARA) Terrestrial Acoustic Sensor Array (TASA) **acoustic system as ground-based DAA solution** against non-cooperative aircraft. Simulation testing scheduled for the fall of 2021.
- A partner operator is working on an **onboard electro-optical DAA system**.
- A Lead Participant, working on a statewide UAS **BVLOS network**, received state funding as an investment to supply the infrastructure required for command and control of UAS and the surveillance equipment.
- A partner operator has ongoing collaborations with the FAA waiver team on their fixed site BVLOS inspection operation **using a Drone-in-a-Box solution.**
- A state university helped conduct successful flight operations using their own designed weather sensor packages for **weather measurements.**

Operations Related Highlights

Public Safety & Inspections

- A partner operator obtained a BVLOS waiver to successfully conduct a hurricane relief/delivery operations demo. Plans to use lessons learned to submit Phase 2 of BVLOS waiver.
- A partner operator completed a capabilities exercise to demonstrate drone inspection and disaster response to a simulated tornado event.
- A Lead Participant performed inspections via photographic imagery of 11 different Boeing 757 aircraft and improved rate of defect detection from 60% to 90%.
- A partner operator conducted safe and efficient inspections of High Mast Light Towers (HMLT).

Operations Related Highlights

Regulatory

- A Lead Participant was part of an FAA Safety Risk Management (SRM) Panel in June 2021 to seek expansion of their VLOS operations to an entire airport; the final SRM document is in circulation.
- A Lead Participant completed >300 part 107 training flights that will enhance BVLOS ConOps preparation.
- A Lead Participant submitted MoC documents under the new Operations over People (OOP) rule.
- A partner operator entered the Type Certification process through D&R MoC for long-range cargo delivery to unserved/underserved communities.

COVID-19 Operations (IPP and BEYOND)

Part 135 Package Deliveries	• Pharmacy and convenience items • Books • Medical supplies • COVID-19 vaccine

Part 107 Visual line-of-sight Package Deliveries	• Food and essentials
	• Personal Protective Equipment (PPE)
	• Testing Supplies
	• Medication
	• Vaccines
	  • Between facilities
	  • Not COVID-19

Public Service Announcements	• Including to reach homeless individuals in difficult to access areas
Photography	• To inform effectiveness of stay-at-home orders

Quantifying Societal and Economic Data Measures and Methodology

The BEYOND Team developed standard **data measures** across the three mission types: *Package Delivery, Public Safety, and Infrastructure Inspection*

Resource Costs	*Delivery/Response/Inspection times, number of people served, miles traveled, fuel costs, infrastructure/vehicle maintenance costs, equipment costs, staff hours, etc.*
Human Health & Safety	*Workplace injury, victim injury, number of high-risk activities, etc.*
Environment	*CO_2 carbon footprint per flight, noise per flight, etc.*

The basic **methodology** compares **costs and benefits** of traditional, non-UAS methods to UAS operations.

Traditional Methods

UAS Operations

Calculate the Difference

Collecting and monetizing data for end-to-end operations for traditional versus UAS operations enables us to standardize similar activities across different contexts and compare operations across several dimensions.

Community Engagement - Key Themes

Initial findings are based on Lead Participants' data submissions on their Community Engagement activities.

Methods

- Lead Participants (LPs) and industry partners are using **several methods to engage** their communities, including:
  - Effectively **reaching a diverse group** of stakeholders
  - Further **tailoring their activities** to stakeholder interests
  - Educating them about their UAS operations with a goal to **positively influence public perception** towards UAS integration

Challenge: **COVID-19 restrictions** put a significant damper on Lead Participants' ability to do in-person events.

Awareness and Sentiment

- General populations are still **not very familiar with UAS operations and have not quite formed either a positive or negative sentiment** toward UAS operations
- LPs noted that community and industry groups that they engaged with had **increasingly positive sentiment** throughout the pandemic
- During events, several community groups **also expressed significant concern** regarding UAS in their communities

Challenge: Currently there is **not sufficient data** to understand the unexpected combination of positive sentiment and high levels of concern from communities

Surveys

- Two LPs with different mission types deployed surveys during the first reporting period of BEYOND.
- Survey respondents had **overwhelmingly supported LP's UAS operations**.
- One LP found that **half of their survey respondents expressed safety concerns** related to public safety and inspections

Challenge: **Limited number of surveys** have been deployed during the BEYOND program so far

Community Engagement - Key Themes (Continued)

Initial findings are based on Lead Participants' data submissions on their Community Engagement activities.

Media

- LPs showcased their ongoing UAS efforts through **various media outlets** to remain visible to local stakeholders
- Media outlets provided **high visibility** for UAS operations during COVID-19 restrictions, **helping the public understand and support** the real-world benefits that UAS provides

Challenge: Press releases and articles must undergo review by the FAA and BEYOND for **fact checking and approval** prior to release

Elected Officials

- LPs worked with elected officials to **enable more UAS** operations in support of increased demand for contactless deliveries caused by the COVID-19 public health emergency
- Engagement with elected officials and leaders resulted in **additional state and local government support and funding** for planned UAS operations

Challenge: Engaging community leaders early to **stem misinformation and negative sentiment** toward UAS operations

Data Analysis Questions

Achievements

1) What are the achievements of the Partnership for Safety Plan (PSP) and BEYOND program (separately and jointly) in terms of BVLOS flights by rule using strategic and technical mitigations (without visual observers) in each of three environments (rural, suburban, and urban) for each of three operation types (infrastructure inspection, public safety, and package delivery)?

2) Did PSP and BEYOND demonstrate that the utilized BVLOS strategies are repeatable, scalable, and economically viable? To what degree?

Performance

3) What performance levels did the participants demonstrate for DAA technology during operational flights?

4) What performance levels did the participants demonstrate for UAS durability and reliability during operational flights?

Safety

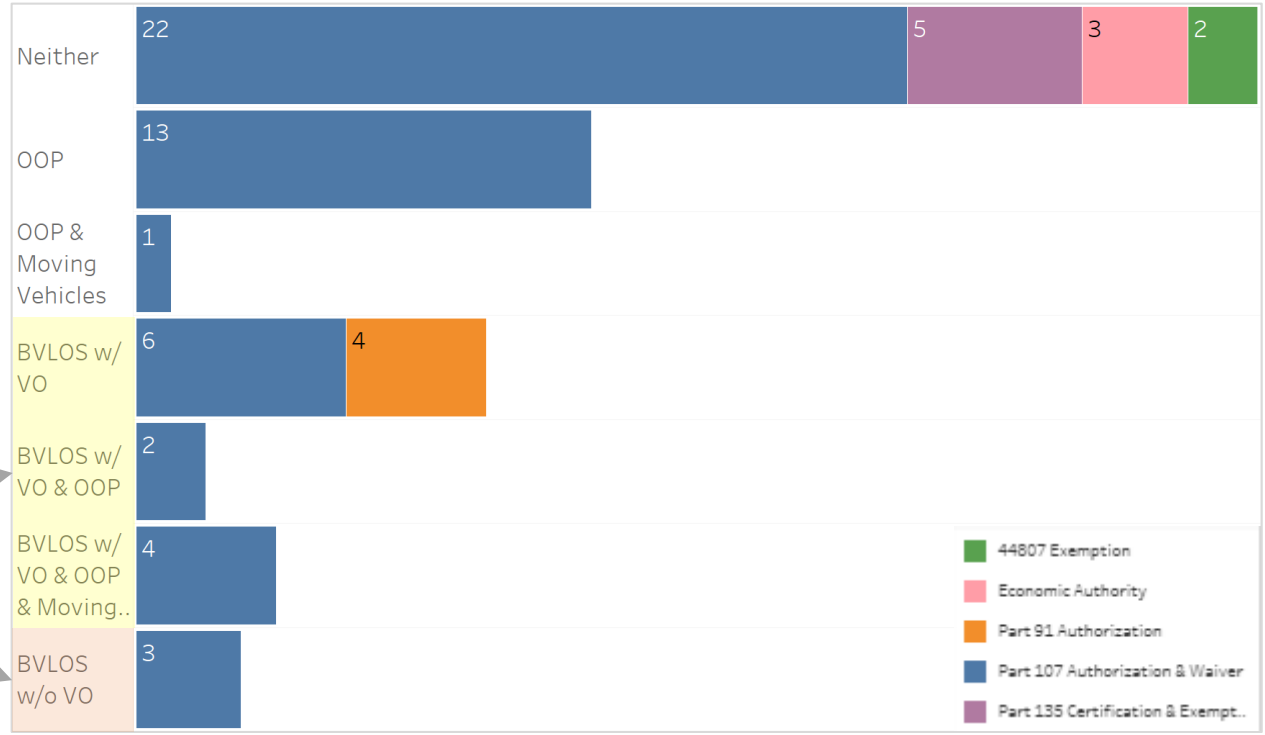
5) What are the safety concerns regarding integration of UAS operations in the NAS?

Transition to BVLOS: Authorizing Documents

% of Active Approved Authorizing Documents	10/26/20	9/2/21
BVLOS with VO	32%	23%
BVLOS without VO	2%	5%

(VO: Visual Observer)

Number of Active Approvals of BVLOS and OOP Operations



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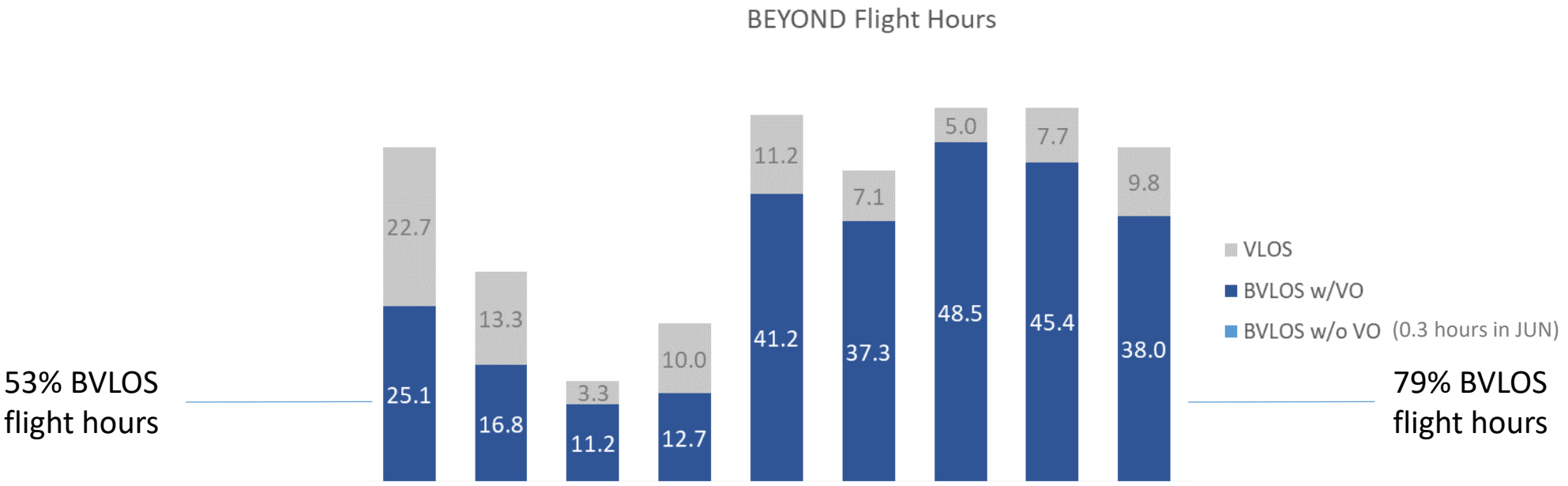
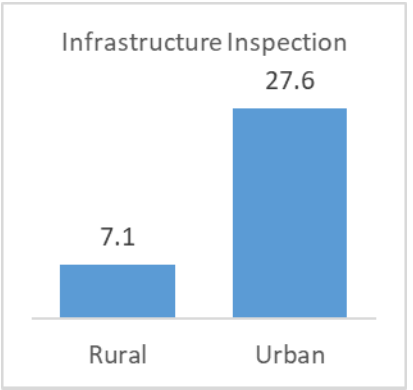
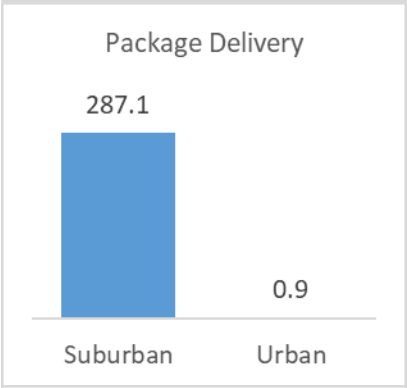
Transition to BVLOS: Flights

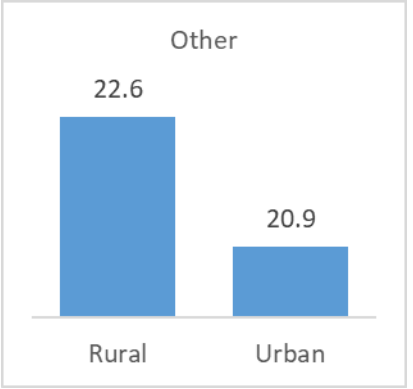
…from approvals to flights…
8 LPs
6 LPs with active BVLOS approvals
4 LPs reported flights
3 LPs reported BVLOS flights



	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	Total
Total Flight Hours	47.8	30.1	14.5	22.6	52.3	44.4	53.4	53.4	47.8	366.3
Total Flights	531	338	209	213	646	589	856	832	787	5,001







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Thank You!