Weather needs for UAS

Joe Burns CEO
Sensurion Company Highlights

- Uniquely positioned as a vertically integrated sUAV platform and services provider
  - FAA-certified UAVs, avionics and sensor platforms
  - UAVs as-a-service ("UaaS")
  - UAV-enabled data management solutions
- Seasoned management team from major airlines, aerospace companies and the US military with deep relationships with the FAA and NASA
- Designed and engineered two distinct UAV sensor platforms
  - Magpie: Fixed wing aircraft
  - Sentinel: Commercial grade drone with unlimited persistence capability from tethered operations
- Partnerships with IBM Bluemix and Watson and Amazon Web Services
- History of providing security and safety professional services to commercial and governmental agencies and successfully transitioned to being a provider of products and software/data services
- Extensive weather operational experience
UAS Weather Needs – Our perspective

Sensurion Background:

• Extensive manned aircraft experience
  • Major Airlines, GA, Military
  • Pilots, Operations, Management
  • Technology – Avionics, Airframes, Weather, Security, Communications, etc.
  • Entrepreneurial Businesses
    • Weather Dissemination, Forecasting
    • Weather Observation / Collection
    • Weather Uplink and Downlink, Displays, Communications
  • R&D
    • Weather Radar Systems
    • Weather uplink, downlink, and cockpit displays
    • Turbulence, Icing, Winds, Deicing
    • Data Observations & Collection From Aircraft

We understand how hard it is to operate aircraft safely and reliably – what it takes to do that, and how the manned aviation industry achieved those goals. The UAS industry still has a long way to go in all three of those areas, and can learn a lot from the manned aviation industry – if it will...
SEN TinEL MP-4 / MP-4T

- Sentinel MP-4 / MP-4T
  - Multirotor aerial sensor platform
  - Commercial utility UAV for numerous applications
  - Simple to fly and program
  - Manual or flight planning route
  - GPS/WAAS centimeter precision positioning
  - Tethered up to 100M
  - Tethered unlimited flight time
  - Can launch / recover from small area

SEN TinEL

MP-4/MP-4T Multi-Rotor Specifications

- Model #: MP-4/MP-4T
- Endurance: 27 min/indefinite (MP-4T)
- Weight: 6.5 lbs.
- Payload: 3 lbs.
- Powerplant: Electric/LiPo or tethered power — ground-battery/power
- Body Diameter: 39 inches
- Tether Height: Up to 200 feet
- Datalink: Configurable to operating environment, location, regulations
- GCS: Autoflight programming, graphical flight data, payload status/data, datalink, data storage, networking and weatherproof
FAA Certified UAV: MAGPIE MP-1

- Fixed-wing Commercial utility UAV
  - Configurable Sensor Platform
- FAA Certifications Include:
  - 1st Special Airworthiness Certificate through FAA Test Range
  - 333 waiver for commercial operations
  - Registered (N#)s
  - Numerous COAs – airspace approval
  - FAA approved manuals
    - Operations
    - Maintenance
    - Training
    - Safety Checklist

MAGPIE

MP-1 Fixed-Wing Specifications

- **Model #:** MP-1
- **Endurance:** 1.5 hours
- **Weight:** 10-15 lbs.
- **Payload:** Up to 5 lbs.
- **Powerplant:** Electric/LiPo
- **Wingspan:** 95.76 inches
- **Length:** 62.50 inches
- **Landing Options:** Skid, wheels, skis
- **Datalink:** Configurable to operating environment, location, regulations
- **GCS:** Autoflight programming, graphical flight data, payload status/data, datalink, data storage, networking and weatherproof

Sensurion Proprietary and Confidential
Sensurion Aerospace provides both custom and off-the-shelf sensor payload solutions for a variety of mission profiles:

- Optical
- Survey, Daylight Observation, Electronic News Gathering
- Infrared IR
- Search & Rescue, Wildfire Reconnaissance and Surveillance, Law Enforcement
- Chemical
- Airborne Gasses, Plume Tracking, HAZMAT response
- Radiological
- Infrastructure Protection, Law Enforcement, Disposal, Tracking
- Atmospheric
- Temp, RH, Wind, Pressure
- Data Collection
- Links to ground-based sensors to collect data, store, and relay

Custom/Proprietary Sensor Payloads:
- Sensurion integrates custom sensor payloads for testing, demonstration and deployment
- Civil and Military applications

Magpie sends real-time sensor datalink to handheld displays and feeds Dynamic Plume Modeling decisions. Precision IR imagery helps pinpoint unique thermal signatures.
How is “Weather” Relevant to sUAS Operations?

• Regulatory Requirement for certain operations
• Planning
  • Can I successfully conduct the mission? Safely?
  • Can I stay within required altitude, geofencing, and other limits for entire mission?
  • Can I successfully recover aircraft at the end of the mission period?
  • What impact will weather have on my mission duration capability?
• Direct Operational Impacts
  • Managing challenging or near-limit conditions
  • Reacting to changing conditions
• Contributing Data Back Into the Weather System
  • Alert other operators of changing conditions
  • AMDAR-type observation input to forecast models
Weather Impacts on Practical sUAS Operations

- Scale Factors of sUAS vs Part 23 Aircraft Make Them Much More Susceptible to Turbulence and Wind Shear:
  - Wing loading is much lower
  - Mass is much lower
  - Wing/Rotor Spans are Much Shorter
- Stall and cruise speeds much lower than Part 23 and Part 25 – winds have a dramatically increased impact
  - Cruise speeds top out about where Part 23 begins
- Many lower boundary wind speeds can exceed forward flight speeds – thus creating a no-return scenario
- Many sUAS have Precipitation Restrictions
Weather Impacts on Practical sUAS Operations

- Most UAS are not intended for flight into IMC
  - Icing, precip, loss of Vis/CAVU all potential issues
- Ability to maintain VLOS is key to planning and executing many missions
- How do we characterize ground-to-air “visibility”
- Lower boundary layer atmospherics hard to measure, much less model
- Dramatic wind shifts/shear from surface to 500’ for small UAS
- Effects of weather on ground-based (versus aircraft-based) operator
Weather Impacts on Practical sUAS Operations

- Temperature susceptibility of Li-Ion battery packs
- Effects of turbulence & winds on mission duration
  - Deviation limits can significantly vary impacts on mission duration
- Increasing levels of sUAS autonomy will require reduced weather uncertainty
- Tethered UAS Systems Present Additional Considerations, Including Lightning and Static Buildup
- A briefing is required – but where do the pilots get one?
  - FSS is not yet equipped to handle UAS briefing request
  - Typical sUAS operator will have limited weather training – will need simple, intuitive tools in the field
So... What Weather Information Will Be Needed - Specifically?

- Currently available WX information, tailored for sUAS users
- New products that provide much higher spatial and temporal resolution in the boundary layer area, including:
  - Winds, Turbulence and “Gustiness Factors”
    - We need to look at “Gusts” differently than classical turbulence in low-altitude, sUAS Ops contexts
    - Indexing Gusts/Turbulence to a radically different scale of airframe/limits
  - Visibility – referenced to VLOS-type operations
  - Probability of exceeding specific limit factors:
    - Max Winds versus aircraft return speeds
    - Gusts, Turbulence, Shear – Controllability AND Battery Life
    - Temperature & Density Altitude
    - Visibility variations
    - Precipitation / Icing
    - Variations in altimeter setting during a mission
    - Lightning/Static Buildup
So... What Weather Information Will Be Needed?

- Leverage the UAS platforms themselves as a key part of the solution
  - Real-time observations of boundary layer conditions
    - Nowcasting
    - Research & modeling
    - Calibrate model metrics for individual aircraft types
  - Interaction between turbulence, deviation limits/range, and vehicle performance
  - Terrain and vegetation database updates
The number of connected devices is exploding:

- The Connected Life by 2020
  - 24 Billion Connected Devices in 2020
  - Revenue Opportunity for Mobile Service Operators: $1.2 Trillion

SaaS opens up the market to SMB:

Big Data and advanced analytics:

- Descriptive analytics: What happened?
- Predictive analytics: What will happen?
- Prescriptive analytics: What should I do about it?
UAV-Enabled Data Solutions

Sensurion 4G/LTE IoT data module

Sentinel or Magpie aircraft

The “cloud” - IBM Bluemix and Watson, AWS and Azure

Mobile apps

Security

Asset Management

Sensurion Proprietary and Confidential
UAVs as a Weather-Collection Platform – “Micro” AMDAR/MDCRS

Sensurion MP-1 or MP-4
Thank you!

6300 34th Ave South
Minneapolis, MN 55450
1-877-222-1599

www.sensurion.com