NOAA Unmanned Aircraft Systems Engineering & Resources/Capabilities

John “JC” Coffey

River Forecasting Center Workshop

February 2012

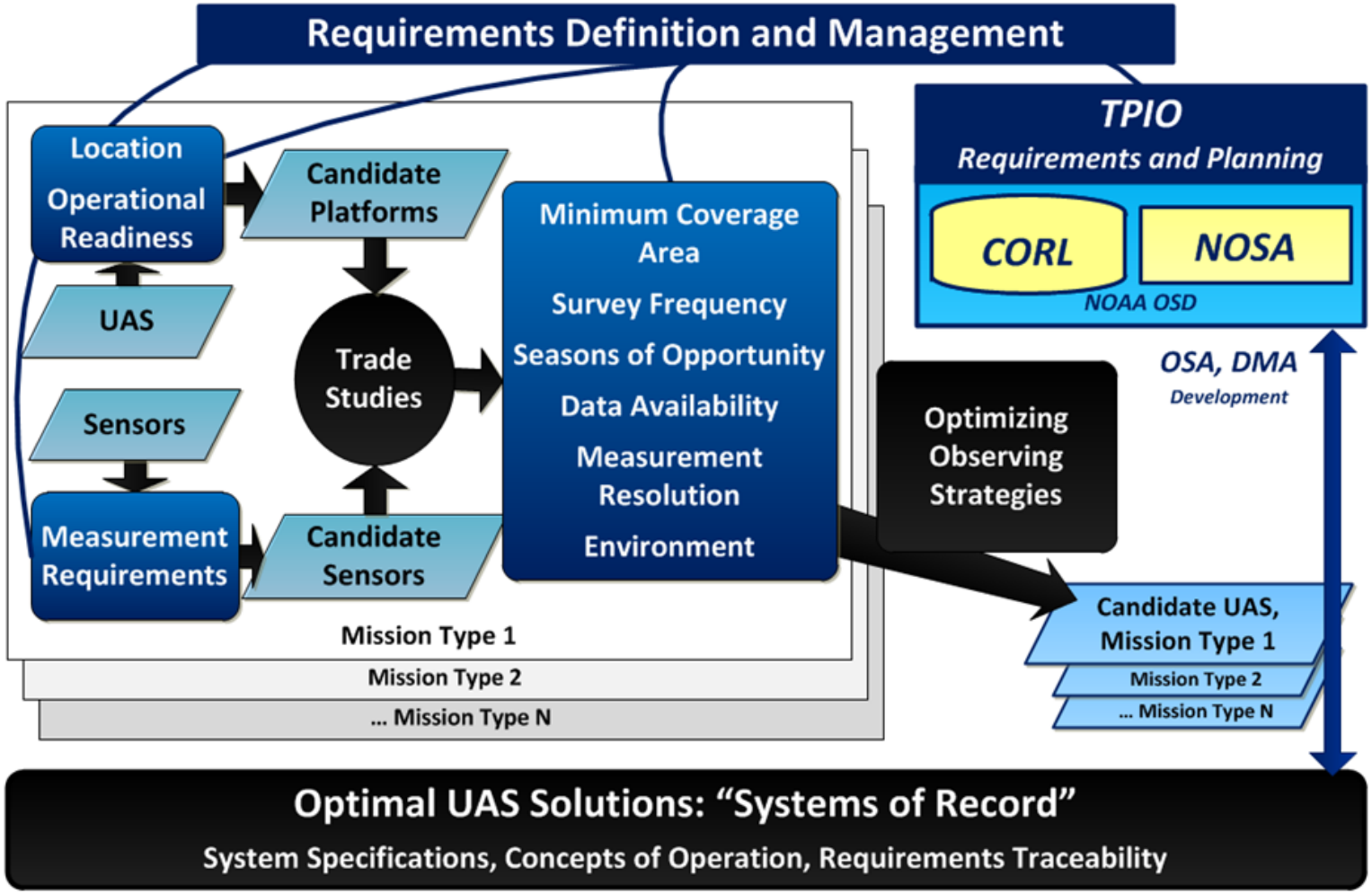
Purpose and Outline

- **Systems Engineering**
- **Requirements Analysis**
- **Provide Overview of Unmanned Aircraft Systems available to NOAA Researchers**
  - Global Hawk (NASA)
  - Ikhana (NASA)
  - Manta
  - Puma AE
  - md4-1000
  - APQ-16
  - SkyWisp
  - Emily

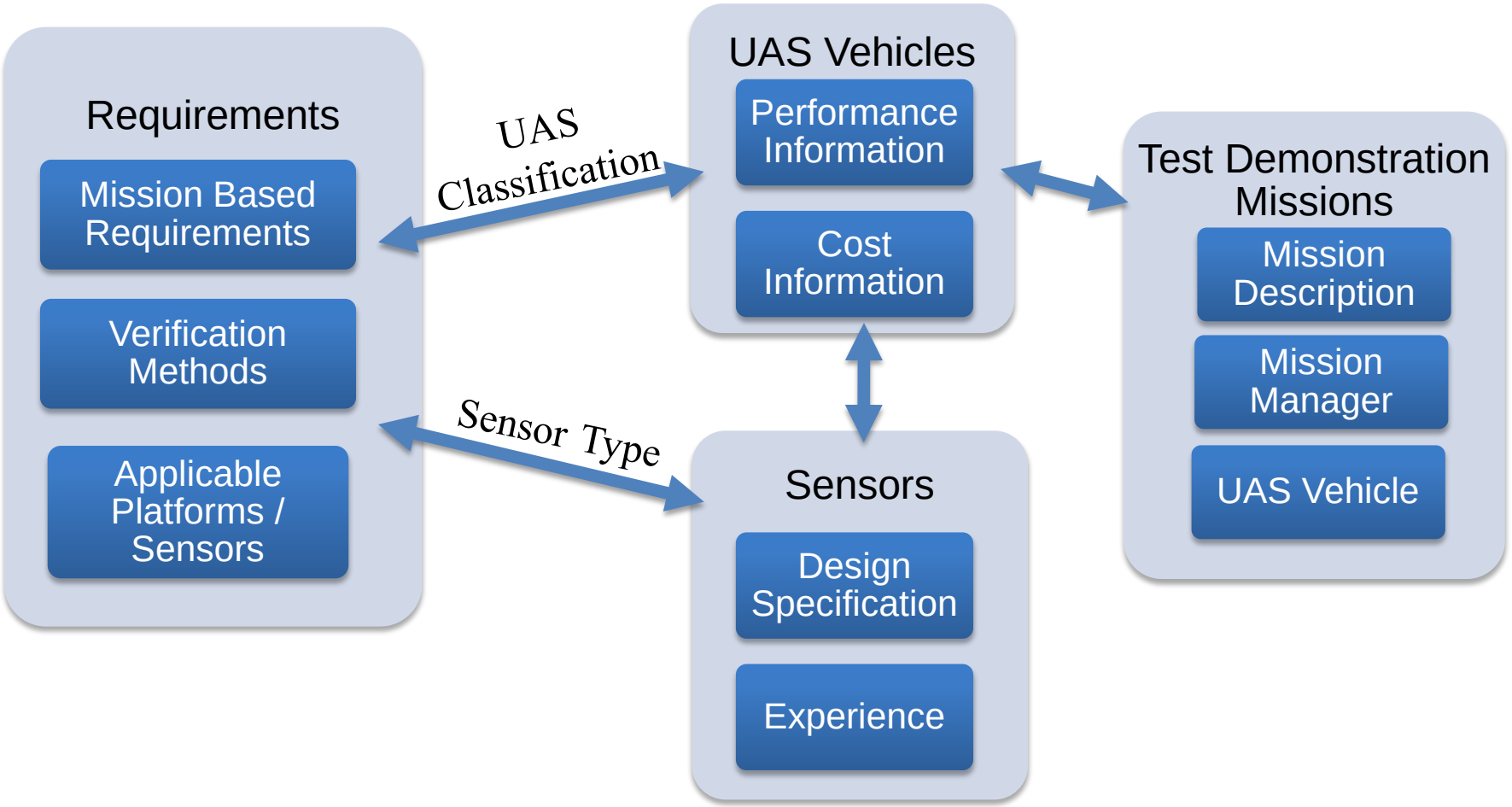
Systems Engineering Process

Technology, Planning, Integration for Observation

Consolidated Observation Requirements List & NOAA Observing System Architecture



UAS System Engineering Database Overview



RFC Identified Requirements

- Ice flows – need to know size, movement, etc. in near realtime
- Ice jams – need to know height in near realtime
- Soil moisture before first freeze
- Rapid response for Lidar after a catastrophic flooding event to track changes in river channel structure and morphology
- Vegetation and soil mapping to insure accurate river model parameter settings especially in response to drought
- Rapid response for photos to document extent of inundation to verify flood inundation maps and enable production of flood maps for more locations
- Thermal imagery and other sensor arrays to attempt to measure depth of inundation to verify flood inundation maps and enable production of flood maps for more locations

Global Hawk

- NOAA has partnered with NASA for joint use of the NASA Global Hawk (GH) UAS.
- The GH is built by Northrop Grumman. The NASA GH are initial production (Block 10) aircraft modified for high altitude long endurance (HALE) research missions.
- Currently, NASA has two operational GH with plans to stand up a third aircraft.
- The NASA GH capabilities are summarized in the Table below:

Parameter	Value
Payload	1,500 lb
Endurance	31 hours
Cruise Speed	335 knots
Range	11,000 nm
Ceiling	65,000 ft
Launch/Recovery	Conventional

Ikhana

• The NOAA /NASA partnership includes joint use of the NASA Ikhana UAS.
• The Ikhana was built by General Atomics and is an early version of the military Predator B. It has been modified for medium altitude long endurance (MALE) research missions.
• Currently, NASA has one operational aircraft.
•The NASA Ikhana capabilities are summarized in the Table below:

Parameter	Value
Payload	2,000 lb
Endurance	24 hours
Cruise Speed	200 knots
Range	4800 nm
Ceiling	40,000 ft
Launch/Recovery	Conventional

Manta

- The NOAA currently owns one Manta UAS that includes two aircraft.
- The Manta is built by BAE Systems.
- Currently has observation and carbon sampling sensors integrated.
- The NOAA Manta capabilities are summarized in the Table below:

Parameter	Value
Payload	15 lb
Endurance	8 hours
Cruise Speed	40 knots
Range	352 nm
Ceiling	16,000 ft
Launch/Recovery	Rail/Conventional

Puma AE

•The NOAA is currently in the process of procuring two Puma AE UAS through the Army PM UAS. Each UAS will include 3 aircraft and 2 GCS.
• The Puma AE is built by AeroVironment.
•The Puma AE is waterproof and can land in water making it compatible with ship launch and recovery.
• Gimbaled payload, 360 degree continuous pan, +10 to -90 degrees tilt, stabilized EO, IR camera, and IR Illuminator all in one modular payload.
•The Puma AE capabilities are summarized in the Table below:

Parameter	Value
Payload	2 lb
Endurance	2 hours
Cruise Speed	20-45 knots
LOS Range	8 nm
Ceiling	500 ft
Launch/Recovery	Hand/Deep Stall

md4-1000

• NOAA currently owns one md4-1000 UAS that consists of one aircraft and one GCS.
• The md4-1000 is built by Microdrones GmbH in Germany.
•The aircraft is a VTOL quadracopter.
•The NOAA md4-1000 capabilities are summarized in the Table below:

Parameter	Value
Payload	1.7 lb
Endurance	1.16 hours
Cruise Speed	29 knots
LOS Range	0.54 nm
Ceiling	3,280 ft
Launch/Recovery	Vertical/Vertical

APQ-16

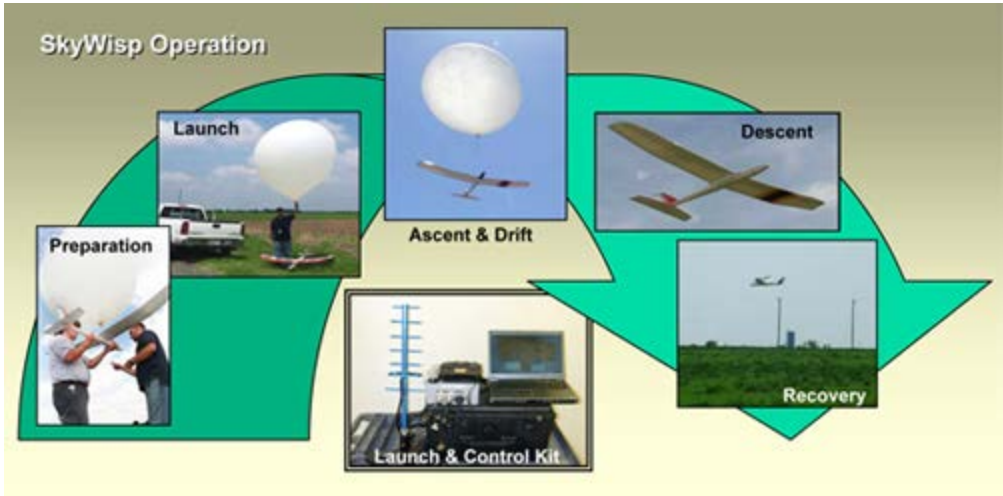
- NOAA currently owns one APQ-16 UAS that includes one aircraft and one GCS.
- The APQ-16 is built by Aerial Imaging Systems.
- The NOAA APQ-16 capabilities are summarized in the Table below:

Parameter	Value
Payload	1.1 lb
Endurance	0.5 hours
Cruise Speed	25 knots
LOS Range	6.3 nm
Ceiling	4,000 ft
Launch/Recovery	Vertical/Vertical

SkyWisp

- NOAA currently owns this system.
- The SkyWisp System was developed and built by Southwest Research Institute (SwRI).
- The NOAA SkyWisp capabilities are summarized as the listed below:

❖Operation to 100,000-feet altitude
❖Very low-cost balloon-assisted glider
❖Autonomous operation and recovery
❖1- or 2-person launch and forget
❖Continuous option for positive human control
❖Quick reaction capability
❖Low observables

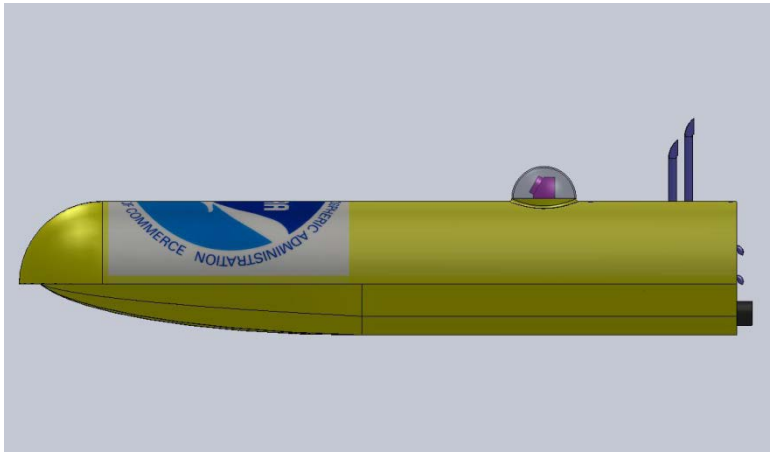


E.M.I.L.Y

• NOAA currently owns TBD Emergency Integrated Lifesaving Lanyard (E.M.I.L.Y) USVs.
• The Emily was developed and built by Hydronalix. Technology sub-systems will be demonstrated through a series of 3 missions:

1. Marine sanctuaries testing - Channel Islands
2. Coral mapping - Florida Keys
3. Tropical cyclone testing -Florida keys region

• Gas engine will increase endurance to 5 days at 2-3 knots.
•The NOAA Emily capabilities are summarized in the Table below:



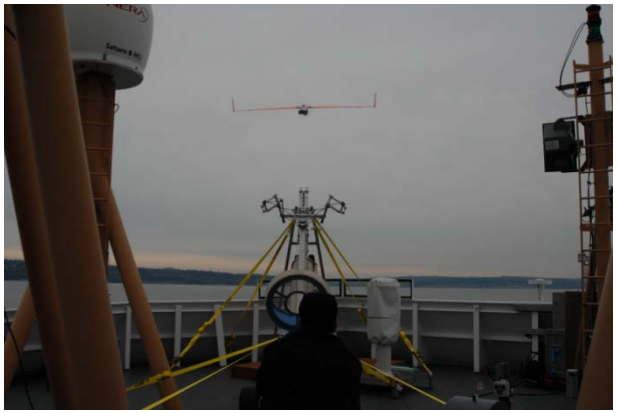
Parameter for 65” hull	Value
Tethered Buoy Sleep Mode	100+ hours
Battery Storage	240 Whrs to 1920Whrs (1 to 8 packs)
5mph patrol	600 minutes
Speed	13 mph with 46 lbs payload (max of 30 mph)
Duration	30 mph - 20 minutes
	13 mph - 39 minutes with 46 lbs
	1-2 mph - approximately 20 hours
Dimensions	65” length, 15” width, 8” height
Payload Capacity	Up to 80 lbs
Buoyancy	80.0 L (4882 inch^3) or 170 lbs

Turning Vision Into Reality

Buckeye unmanned airborne Lidar System

Global Hawk dropsonde release over hurricanes & the Arctic

Resolution UAS NOAA SBIR for debris tagging



Scan Eagle Operational Testing from NOAA's Oscar Dyson

Goals of the Workshop

- Get a better understanding of your observation requirements and areas of interest.
- Get a better understanding of your current capabilities and unmanned missions flown.
- Get a better understanding of current unmanned platforms, sensors and operators including those used by NOAA and other government agencies.
- Construct the foundation for an unmanned systems strategy for the RFC.

White Paper Outline

- RFC Requirements
- Sample Applicable UAS Assets
  - Operators
  - Platforms
  - Sensors
- Past Missions
  - Goals
  - Process
  - Results
- Potential Missions
  - Requirements, including parameters like coverage rate, data availability, environment, location, measurement, measurement resolution, minimum coverage area, operational readiness, season of opportunity, and survey frequency.

Contact Information

John “JC” Coffey
NOAA UAS Program Office
National Oceanic and Atmospheric Administration
Email: John.J.Coffey@noaa.gov
Office Telephone: 301-734-1104
Cell Telephone: 904-923-1709