“Enabling America’s Next Generation of Aviation Vehicles “

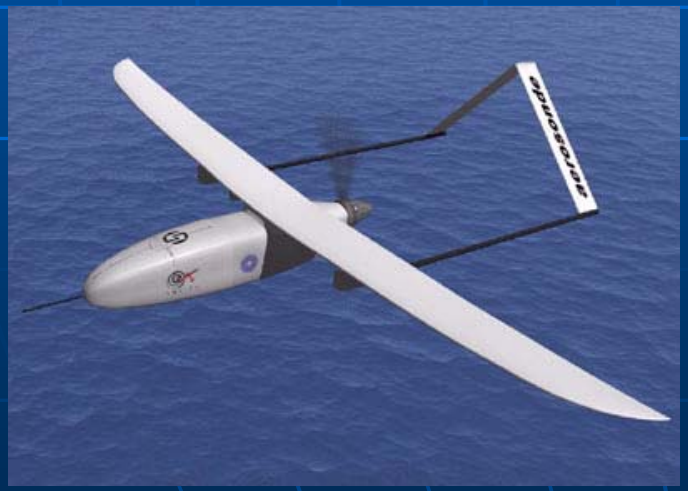
Unmanned Air Vehicles – UAV’s

2004 NASA ICNS Conference
& Workshop
April 26-30, 2004

“The trouble with the future is that it usually arrives before we’re ready for it.”

Arnold H. Glasow

Glimpse of the Future



Where will UAV's Fly?

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UAV's - Unlimited Applications

Security

Civil
- Defense
- Natural Disasters
- Humanitarian Relief

Science
- Environment
- Weather and Storm Tracking

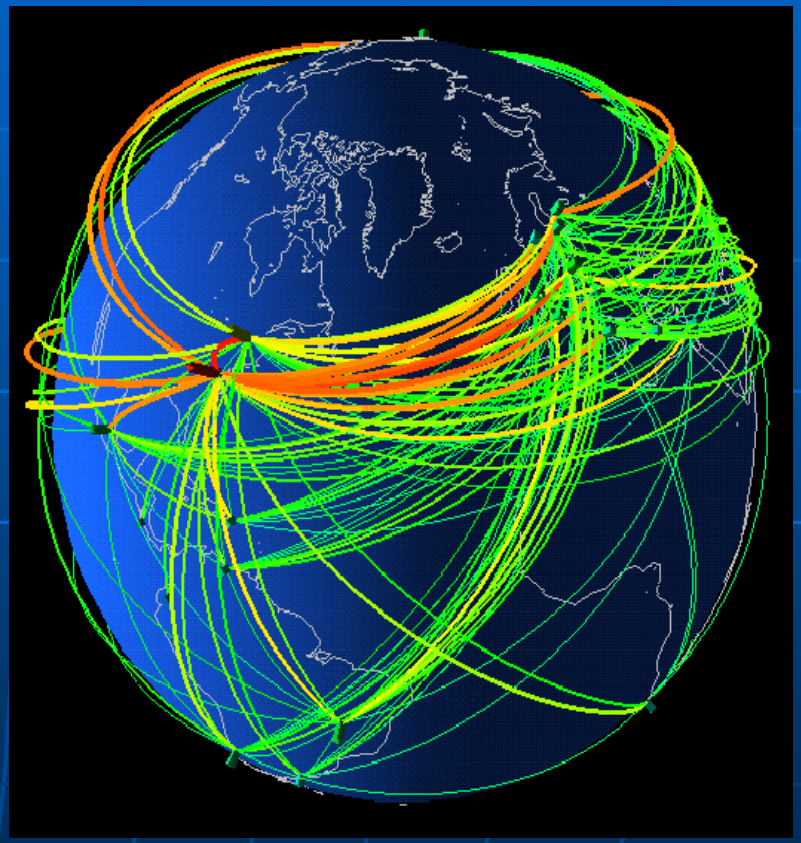
Commercial
- Wireless Communications
- Precision Agriculture
- Cargo Transport

Today's UAV operations in the NAS
are via a "Certificate of Authorization – COA"
Issued by the FAA – ATO/AVR

Dull, Dirty, Dangerous

Global Challenges

- Managing Expectations
  - Domestic
  - International
- Creating an Environment of Trust
  - Making Positive Progress
- Making Communications and Collaborations Effective
  - Outreach to Stakeholders
    - Harmonization



UAV/CNS Overview

- Unmanned Air Vehicles (UAV) will need to rely heavily on Communication, Navigation, and Surveillance (CNS) technologies to operate Safely and Efficiently in civil managed airspace.

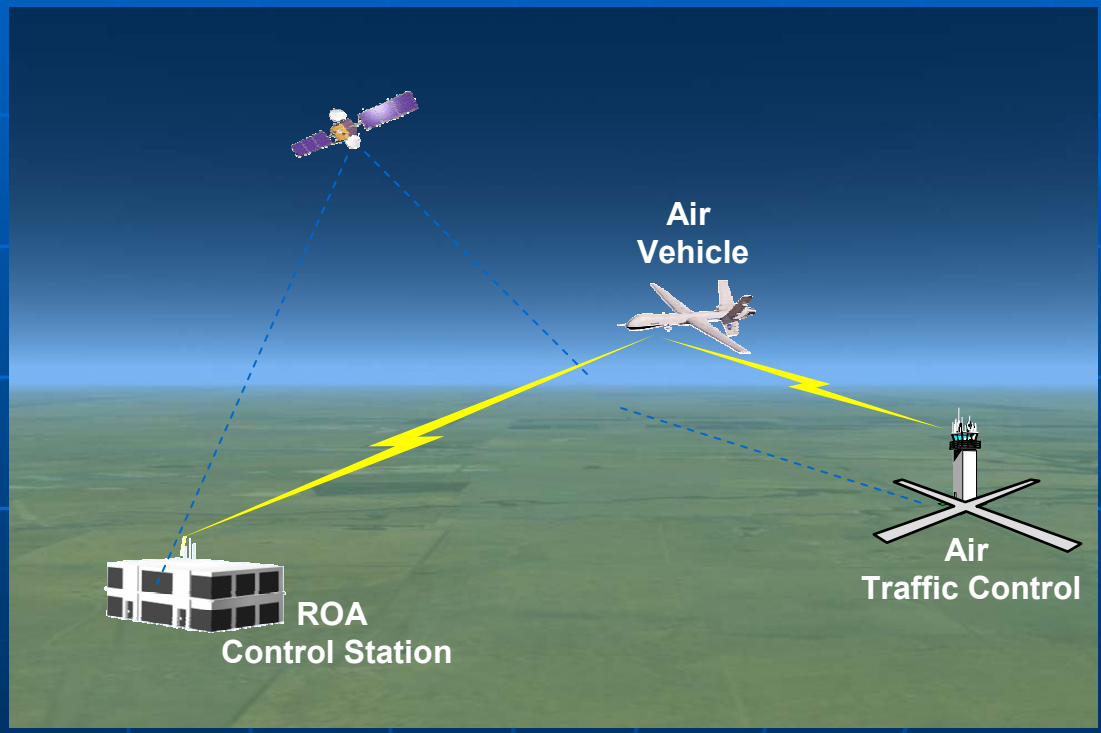
- Utilization of CNS technologies will be essential for the safe, secure, and reliable integration of UAV into the NAS

- UAV community must design UAV systems to operate within the current and future NAS architecture in Partnership with current NAS users
  - Cannot disrupt efficiency of the NAS
  - Will enable a faster introduction and acceptance by other NAS users

Communications

- Two communication links required for UAV operations:

1. Interface between UAV pilot and Air Traffic Control
2. Interface between UAV pilot and aerial vehicle



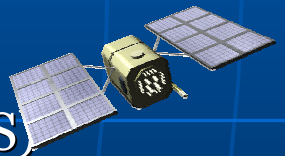
- Need for both Line Of Sight (LOS) and Beyond Line of Sight (LOS) capability

Communication (cont.)

- Specific Challenges:
  - Latency …how much delay is acceptable?
    - Command & Control and ATC Comm requirements may be different
  - Security
    - Prevent any unauthorized seizure of aircraft
    - Ensure protection from jamming / spoofing / sabotage
  - Availability / reliability (lost link problem)
    - Need to incorporate redundancy into UAV system
    - Landline link to the ATC Centers will be considered
  - Link quality
    - Provide sufficient voice quality and limited data degradation
  - Sufficient Bandwidth
    - Potential for large numbers of Civil/DoD/Public use UAV's to saturate available bandwidth within a given geographical area

Navigation

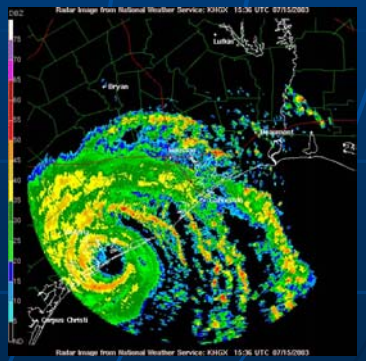
- Very reliable and accurate navigation systems will be essential for UAV operations throughout the NAS.
  - UAV pilot does not have the ability to use dead reckoning or geographical features to help navigate
  - UAV system will need to rely entirely upon onboard equipment as well as direction provided by Air Traffic Control System
- Specific technologies under consideration:
  - Inertial Navigation Systems (INS)
  - Global Positioning System (GPS)
    - Wide Area Augmentation System (WAAS)
    - Local Area Augmentation System (LAAS)
  - Existing ground navigation aids



Navigation (cont.)

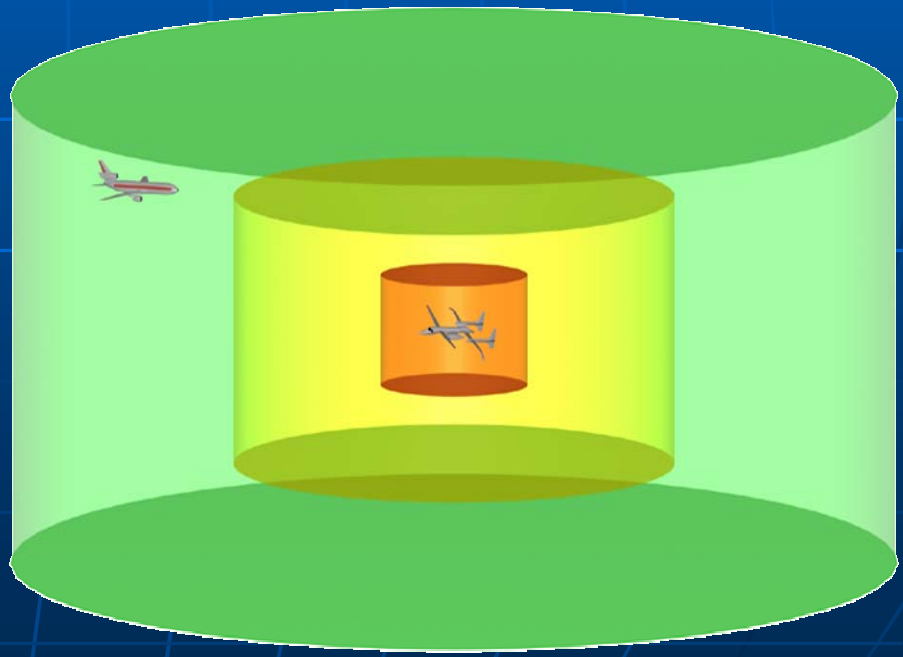
- Other navigational considerations:
  - Ability to recognize aeronautical lighting and other visual aids
    - Critical information such as active taxiways, glide slopes, and terminal lights
    - Potential need to recognize runway markings and respond accordingly

  - Near real time weather avoidance considerations
    - Internet service into UAV ground control station
    - On board weather detection system



Surveillance

- UAV operations will be expected to file and fly an IFR flight plan as a manned flight
  - Allows Air Traffic Control to monitor, direct, and anticipate UAV flight paths
  - Permits de-confliction between UAV and other aircraft
- UAVs intend to take advantage of existing and future transponder-based systems
  - Mode A, C or S compatible
  - Ensures other equipped aircraft can detect the UAV

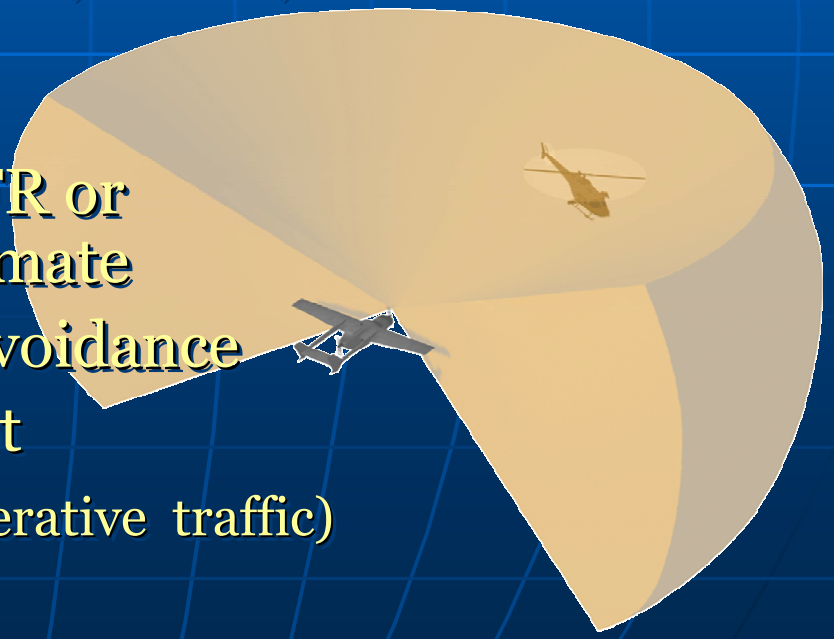


Surveillance (cont.)

- Specific technologies under consideration:
  - Traffic Alert & Collision Avoidance System (TCAS)
  - Automatic Dependent Surveillance-Broadcast (ADS-B)
  - Traffic Information Service (TIS)
  - Non-cooperative sensors (i.e. RADAR, LADAR, EO, IR)

- Whether flying under IFR or VFR conditions, the ultimate responsibility for collision avoidance will be the UAV pilot

(for both Cooperative and Non-Cooperative traffic)



Closing Remarks

- UAV flight operations must demonstrate that they can achieve an "***equivalent level of safety***", comparable with manned aircraft; so they do not pose a hazard to persons & property, both in the air and on the surface.

- The NASA/FAA/DoD Access 5 Project is dedicated to addressing each of these technological issues as they apply to UAVs, as well as developing recommended policies and procedures that will be necessary for UAV operations within the NAS.

Creating the Future

When asked, *"To what point do you think airplanes will be developed?"*

"There is no way of telling. Things are moving too fast. No one can predict where it will end."

-

Orville Wright, January 1938 – Celebration in his honor on the 34th anniversary of the first flight.

UAVs are Experiencing Similar Growth as Early Aviation