Policy-Based Radios for UAS Operations

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What single factor will most limit the expansion of UAS?

**Spectrum**

A. Williams
FAA prebrief  6/08

UAS need spectrum for command, control, and payload

But all spectrum is already allocated

WRC 2015?
Cognitive Radio

Communicate in “whitespaces”
How does a Cognitive Radio Know which Bands it can Access?

Spectrum Policy

- Software rules that permit use of a spectrum band

- A radio can have many policies for many bands
Spectrum Policies – who, what, where, when, and how

Example Policy:
WHO: UAVs for flight operations
WHAT: 960MHz – 970MHz
WHERE: everywhere but red areas
WHEN: 2am – 6am until Jan 1, 2013
HOW: max power 10W
Policy-based radio

A CR that only uses policies to determine available spectrum

- What are the UAS opportunities & challenges?
- Advantages of policy-based radios for UAS?
- How do we adapt policy-based radios to UAS?

Implementation for FAA
UAS opportunities for policy-based radios

- UAS have GPS
- Only a small number of PBR are needed to have large impact (e.g. Border Patrol).
- UAS applications are predictable
UAS challenges for policy-based radios

- Third dimension
- Long-range missions
- Varied radio requirements
  - Depends on phase of flight
  - Flight safety vs. low priority
- Multiple radios must coexist
Policies for UAS

Airport assigned channel during taxi and take-off

Regional Assignment during climb

En-route channels change with interference and location

Emergency gets Priority Channel

Unlicensed channel during pre-flight check
Advantages of Policy Radio for UAS

- Better Manage Existing Spectrum
- Make more Spectrum Available for UAS use
- Simplify Spectrum Management
- Enhance UAS Safety
Simplify Spectrum Management

NTIA

FAA

DEN

Policy Manager

Base Policy

Sub Policy

Sub Policy

Sub Policy

Sub Policy

UAS Operator

Aircraft
Policy Distribution

Secure Policy Chain
Ensures authority to assign spectrum

FCC/NTIA
FAA
DEN
FAA
GCS
DEN
NTIA - FAA
FAA - DEN
FAA
10MHz
CONUS
signed
NTIA
DEN
10MHz
Colorado
signed
FAA
GCS
1MHz
Colorado
signed
DEN
NTIA - FAA
FAA - DEN

UAS Operator
Policy Manager
Ignored Unauthorized Policies

University of Colorado
Boulder
Improve Flight Safety

Flight Planning

- Can identify communication gaps
- Communication gaps can be planned for and dealt with:
  - Request additional policies
  - Change flight plan
  - Scrub flight
Video

- Implementation of policy architecture (for FAA)

http://www.youtube.com/watch?v=Bdd-ykVI0EM
3D Analysis

Primary

$h_p$

$UA$

$h_{UA}$

$d_p$

$d_{UA}$

$h_{UA}$ (feet)

$d$ (miles)

0 10000 20000 30000 40000 50000 60000 70000 80000

Primary $h_p$

$h_{UA}$

$d_p$

$d_{UA}$

$h_{UA}$ (feet)

$d$ (miles)
Availability, Outage

Available

Outage

Policy Exclusion zone
Availability

![Graph showing availability vs. UA height for different numbers of primary users.](image)

- **20 primary users**
- **50 primary users**
- **100 primary users**
- **200 primary users**
Conclusion

Policy-based radios (with changes for UAS) can:

- enhance flight safety
- enhance and simplify spectrum management
- provide useful additional spectrum.