

Drone Pilot as a Service



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“Drone”



“Flying robots” can benefit...



...human safety

...food production

...shipping efficiency

Possible now. Not ubiquitous. Why?

Why aren't drones ubiquitous?

Problem

1:1 human operator ratio

Not easy for everyone

“Beyond line of sight” is unsafe, illegal

Drone Pilot as a Service

Solution: Economical, easy, safe

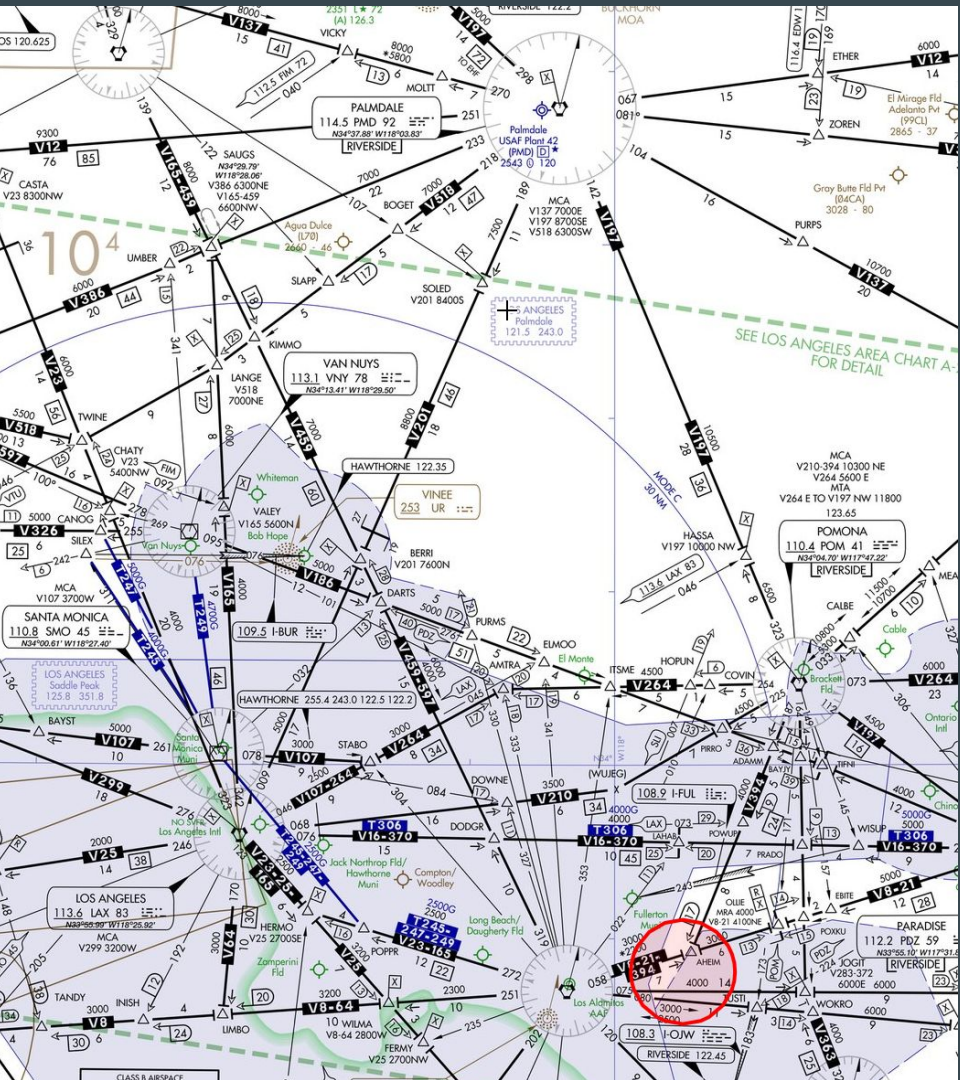
Like software as a service

Abstract human operator into the cloud and scale

Easy for anyone (interface via API)

Constrain to safe routes

Model successful human process...



FAA “instrument flight rules”

Pilots can’t see

Guarantees...

...aircraft safety

...public safety

“Drone world”

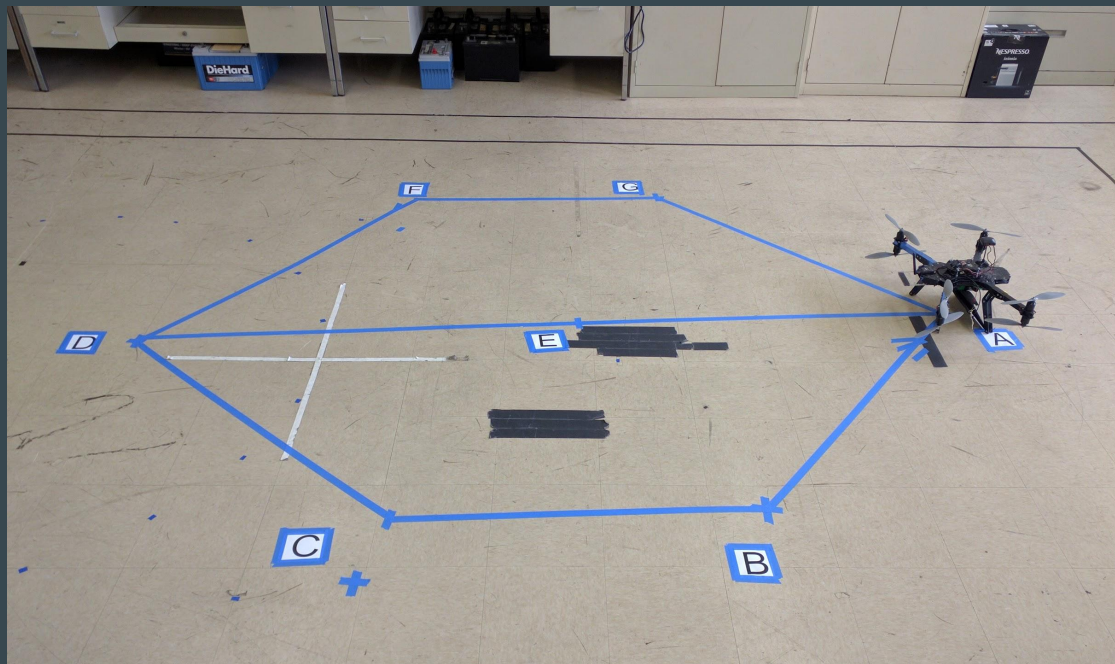
FAA chart abstracted

Nodes: safe to land/turn

Edges: safe/required path

Trusted web service is “air traffic control”

(tape for observers)



Cloud routing algorithm...

Routes:

	A	B	C	D	E	F	G
A	A	AB	ABC	AED	AE	AGF	AG
B	BA	B	BC	BCD	BAE	<u>BAGF</u>	BAG
C	CBA	CB	C	CD	CDE	CDF	<u>CDFG</u>
D	DEA	DCB	DC	D	DE	DF	DFG
E	EA	EAB	EDC	ED	E	EDF	EAG
F	FGA	<u>FGAB</u>	FDC	FD	FDE	F	FG
G	GA	GAB	<u>GFDC</u>	GFD	<u>GFDE</u>	GF	G

Defines fixed, safe routes

Complete: verifiable and reliable

Modular, replace with

--Large graph

--BYO algo (shortest path, salesman)

Cloud-based: Correct, secure

Ex: F to B = FGAB

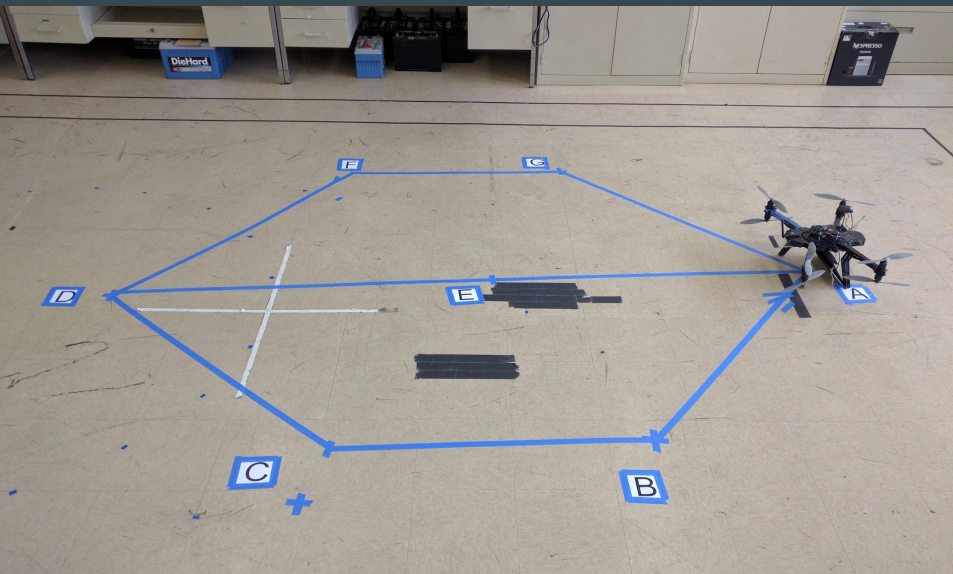
User API

One call: “Go to waypoint ‘B’”

No drone state required

Safe. Can only do one thing.

(JSON over http/websocket)



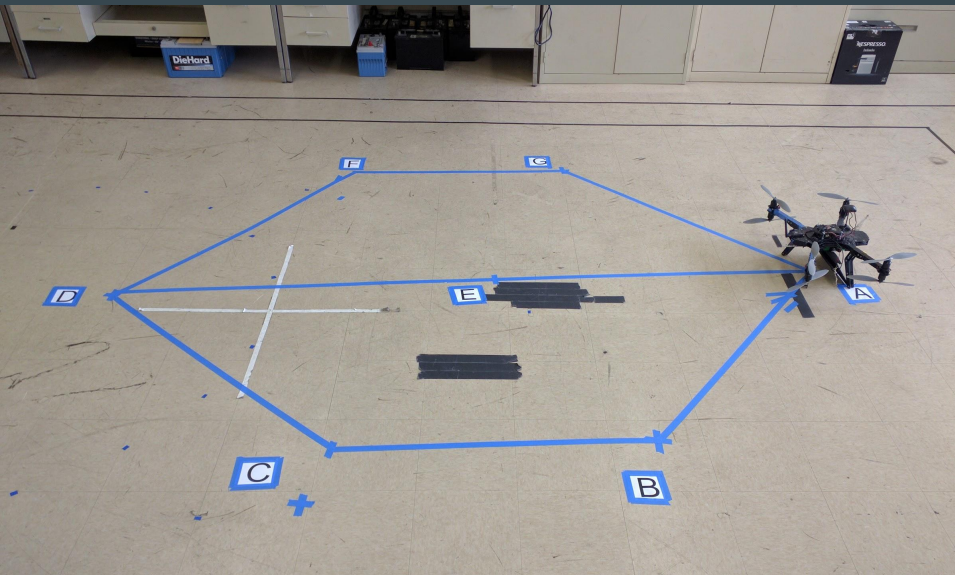
Drone API

Simple:

1. Server: “Go to waypoint B”
2. Drone (at F): “Get route from F to B”
3. Server: “Route is {F, G, A, B}”

Network fail? Safe.

(Drone requests all routes possible from current route)



Security

Application/Network

Web server flying a drone?

Two-way authentication

HTTPS with client certificates

Hardware

Cloud and Drone

Amazon EC2 and UCSB Eucalyptus

Indoor Internet Drone (IID)

Demo



Impact



Economical

Easy

Safe

The Future

Ready as research platform

Test routing algorithms

Deconflict multiple drones

Address drone airworthiness

Deliver a pizza, medicine.....



Drone Pilot as a Service

Questions?

