



The Air Parcel Approach to Low Altitude UAS Commerce

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Manned Aviation is Great!





Isn't this so much better





Until it gets too smart.....





I started on UAS in 1998

The big drones were already happening

- ▶ Take pictures of the bad guys!
- ▶ Shoot the bad guys!



Predator UAV (Air Force)



- First Flight: June 1994
- Over 30,000 flight hours
- System includes: 4 air vehicles, 1 ground station, and 1 communications system
- 12 systems planned

- Sensors: Synthetic Aperture Radar, Electro-Optical/Infrared, Video and Laser Designator
- Max Altitude: 25,000 feet
- Payload Weight: 450 lbs
- Endurance: 24+ hours
 - 14 hours at 400 nm
- Main operating base: Indian Springs AF Aux Field, NV
- Contractor: General Atomics Aeronautical Systems





1998: This stuff was already happening....

- ▶ Has flown itself from here to Australia at high altitude
- ▶ GPS navigated
- ▶ Three people fly it when it has to do something
 - Fancy RC running on high tech SATCOM
- ▶ Many millions a piece





But everyone else started dreaming.....



Forest Fire Monitoring



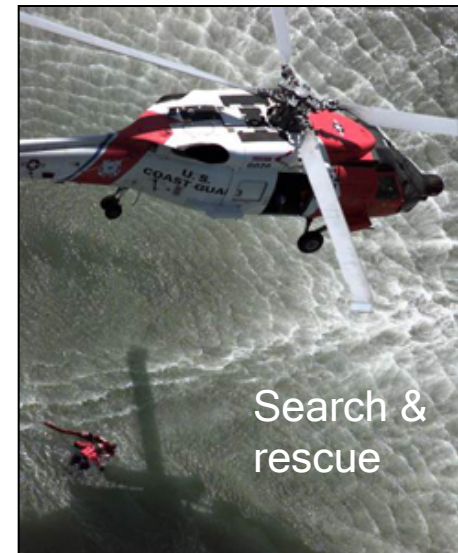
Inter-Office Cargo Delivery



Traffic monitoring



Homeland Defense



Search & rescue



Needs a change of style

- ▶ *Berkeley Fire Department Budget is 34 million in 2013*
- ▶ Change
 - No multi-million dollar UAV → sUAS
 - No three operators per UAV → Intelligence
 - No high bandwidth SATCOM → WiFi, 3G
 - No fancy sensors → GoPro, nanoSAR,...



Rascal \$400 airframe + \$10 K electronics

Just big enough for the computer and cameras



- 12 lbs payload
- 9 foot wingspan
- 22m/s at cruise
- 1.5 hour duration

- Piccolo Autopilot
 - GPS and Pitot Static
 - 900 MHz radio for ground station communication
 - Allows for waypoint and turn rate tracking.

- Computing
 - 1.8 GHz Pentium
 - Onboard sensing, planning and control
 - Vehicles cooperate over an 802.11b ad-hoc network

- Sensors
 - Visual, near infrared, and thermal cameras
 - Left looking single axis sensor gimbal





1 Operator 3 UAS: NASA Crows Landing



Team Monitor

UAV ID	Task	Status	Autopilot Packet Info
BigBlue	Still on (0)	Running	Control Data
Polar	Still on (0)	Running	Payload 9261
Kodiak	Still on (0)	Running	Payload 9200
GroundSt.			

Mission Creation

Step 1: Select mission

Mission List

Cancel	
Cancel	
Cancel	
Cancel	
Cancel	
Cancel	
Cancel	
Cancel	
Cancel	
Cancel	

Abort all Missions

Exit Program

Berkeley Zagi (\$500)

- 6oz sensor payload
- 6 foot wingspan
- 14 m/s at cruise
- 30 min flight duration
- Piccolo Autopilot
 - GPS and Pitot Static
 - 900 MHz radio for ground station communication
 - Allows for waypoint and turn rate tracking.
- Computing
 - 1.6 GHz Pentium
 - Onboard sensing, planning and control
 - Vehicles cooperate over an 802.11b ad-hoc network
- Sensors
 - Visual or near infrared camera





Airborne Intelligence: \$5 million to \$500

UCB/MBARI UAS Flight: Front Detection and Tracking
Monterey Bay 26th September 2012

M B A R I

Berkeley
UNIVERSITY OF CALIFORNIA

The image shows a black rectangular area containing white text and logos. At the top, the text reads 'UCB/MBARI UAS Flight: Front Detection and Tracking' followed by 'Monterey Bay 26th September 2012'. Below this, on the left, is the MBARI logo consisting of the letters 'M B A R I' above a stylized bird-like graphic. On the right, the word 'Berkeley' is written in a large serif font, with 'UNIVERSITY OF CALIFORNIA' in a smaller sans-serif font underneath.

The Geek Force
taking drones from
\$5 million to \$ 500



Consumerization of Robotics!



Its Big and Its Here

- ❑ UAV global lists 400 manufacturers globally with 100 in the USA including storied names like Boeing to small garage shops
 - <http://www.uavglobal.com/list-of-manufacturers/>
- ❑ Daily Beast January 2015
 - Drones flying circles around FAA
 - ...it has been estimated that 200,000 were sold in the U.S. each month of 2014.”
- ❑ Growing at 18% + annually
 - <http://www.technavio.com/blog/commercial-drones-paving-the-way-for-uav-market-growth>



Its Big and Its Here

About 358,000 results (0.34 seconds)

Bay Area Drone Photography | Facebook

<https://www.facebook.com/badphoto.co> ▼

Bay Area Drone Photography, San Francisco, California. 357 likes · 2 talking about this. Aerial perspectives for photo and cinematography purposes on a...

San Francisco Hollywood Grade Aerial Cinematography ...

www.zminteractive.com/ ▼

Developing professional sUAV **Drones** fixed, single to multi-rotor and autopilot driven systems. Interactive Media – Web Design, E commerce, Flash, Motion ...
Aerial Cinematography - Company - SEO - System & Applications

Drones used for aerial real estate videos - SFGate

www.sfgate.com/.../Drones-used-for-aerial-real-e... ▼ San Francisco Chronicle ▼
May 15, 2014 - For aerial **photography**, it charges \$225 for 1 to 10 still **photos**, \$375 for a ... It's especially popular in the **Bay Area**, where water, hills, beaches ...

Aerial Drone Photography | Exposure Elements

www.exposureelements.com/aerial-drone-photography ▼

The Value of HDR **Photography**. Exposure Elements **Bay Area** CA ... Exposure Elements aerial **drone photography** service. In this era of internet exposure ...

Entrepreneurs and hobbyists position Bay Area near the ...

archive.peninsulapress.com/2014/01/16/drones-bay-area/ ▼

Jan 16, 2014 - This is the **Bay Area** face of the **drone** revolution. the technology for journalism and **photography**, opening up interesting avenues in imaging.

Ads ⓘ

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Drone pilots wanted

www.skycatch.com/ ▼

Your own mapping business
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Camera Drones at Amazon

www.amazon.com/Camera+Drones ▼

4.4 ★★★★★ rating for amazon.com
Save Big on New Gear at Amazon!
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Aerial Photography UAV's

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Beginner and Intermediate **Drones**
In stock **UAV's** ship within 1 hour!

The Conversation is now acrimonious



Jan 22, 2015 - Law Enforcement Engagement with Suspected Unauthorized **UAS** ... enforcement actions to **stop** unauthorized or unsafe **UAS** operations.

FAA Fact Sheet – Unmanned Aircraft Systems (UAS)

www.faa.gov › News ▾ Federal Aviation Administration ▾

Jan 6, 2014 - **Unmanned Aircraft Systems (UAS)** come in a variety of shapes and sizes ... The COA allows an operator to use a defined **block** of airspace and ...

Wyden Asks FAA to Stop Foot-Dragging on Drone Regulations

www.golocalpdx.com/.../wyden-asks-faa-to-update-unmanned-aircraft-r... ▾

Nov 25, 2014 - Senator Ron Wyden asked the **FAA** Tuesday Morning to **stop** foot-dragging ... The **FAA** created six test sites across the country to study **UAS** in ...

Illegal Drones Dare FAA to Stop Filming 'Wolf' to Bulls ...

www.bloomberg.com/.../illegal-drones-dare-faa-to-stop-f... ▾ Bloomberg L.P. ▾

Feb 13, 2014 - Drones flown for a business purpose, like the one that left Peskoff and two friends with bruises, are prohibited in the **U.S.** That hasn't **stopped** an ...

FAA Unswayed by Do-Good Drones - WSJ

www.wsj.com/.../SB100014240527023038478045... ▾ The Wall Street Journal ▾

Apr 6, 2014 - In February, the **FAA** in an email ordered the group to **stop** immediately. ... the continental **U.S.**, and has been sending cease-and-desist letters ...

Busting the FAA's "Myth Busting" Document | Drone Law ...

dronelawjournal.com/busting-the-faas-myth-busting-document/ ▾

Feb 27, 2014 - Fact—The **FAA** is responsible for the safety of **U.S.** airspace from the ...
#4: There are too many commercial **UAS** operations for the **FAA** to **stop**.

Listen Up Drone Operators: FAA Has 7 Myths To Bust - Forbes

www.forbes.com/.../listen-up-drone-operators-faa-has-7-myths-to-... ▾ Forbes ▾

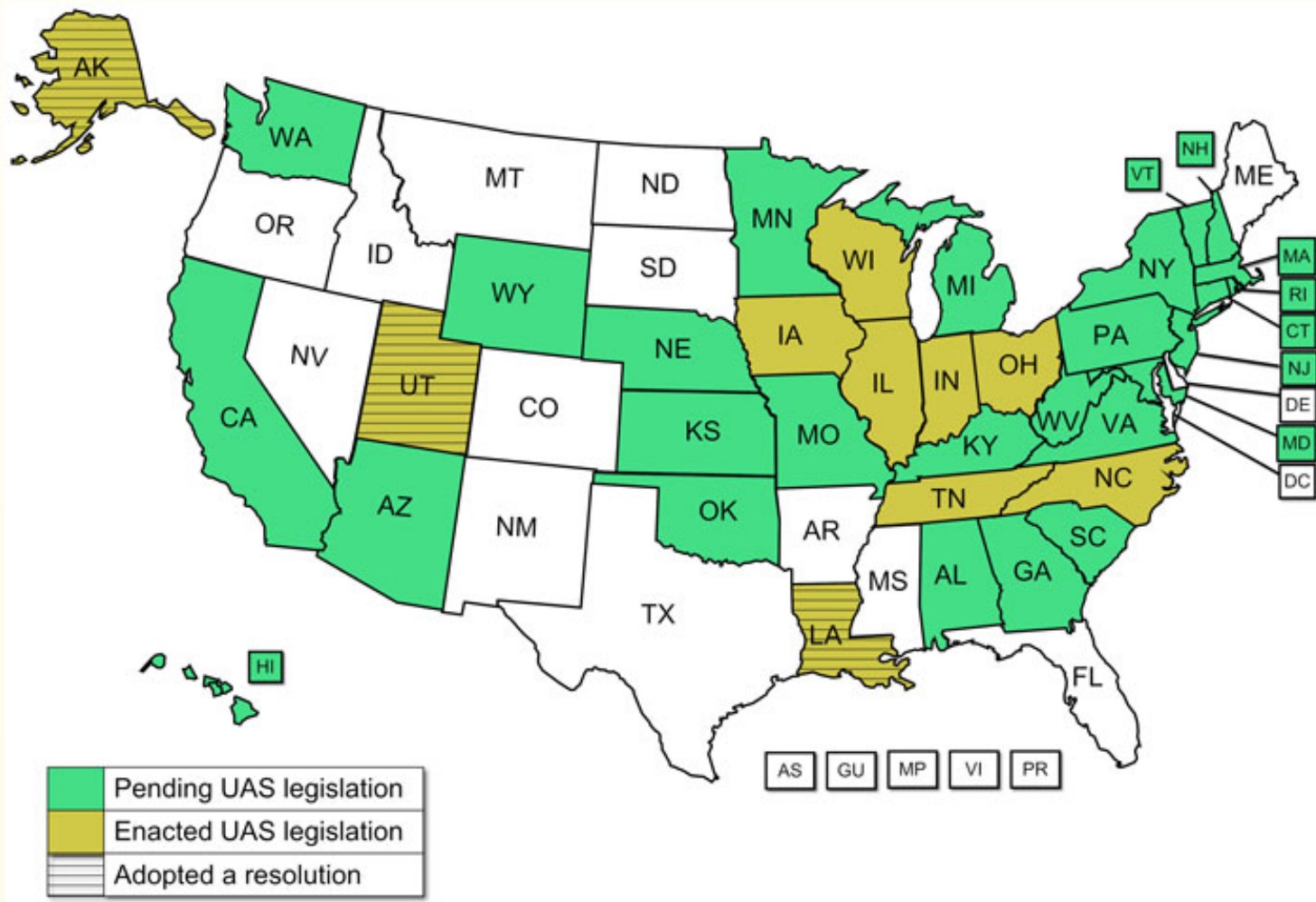
Mar 3, 2014 - Commercial **UAS** flights are not ok over private property even if below 400 ... The **FAA** has a number of enforcement tools to **stop** unauthorized ...

These Are the Companies the FAA Has Harassed for Using ...

motherboard.vice.com/.../these-are-the-companies-the-faa-has-haras... ▾ Vice ▾

Feb 6, 2014 - Some have folded, others soldier on, **FAA** be damned. ... have said they didn't get the notice, others have stopped doing aerial photography, and some ... small

The Anti-droners don't seem reassured





This is what the NAS used to be

- ❑ Sec. 91.119 Minimum safe altitudes: General.

- ❑ Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:
 - ❑ (a)
 - ❑ (b) *Over congested areas.* Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above.....
 - ❑ (c) *Over other than congested areas.* An altitude of 500 feet above the surface....
 - ❑ (1) A helicopter may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section,...

+ Wedding Cake

Below 500 ft. They wanted to be out of the NAS



About 358,000 results (0.34 seconds)

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<https://www.facebook.com/badphoto.co> ▼

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Using our aerial inspection tools

Camera Drones at Amazon

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Aerial Photography UAV's

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The FAA responded by extending the NAS to the ground

- “The FAA is responsible for the safety of U.S. airspace from the ground up.”
- “Obtaining an experimental airworthiness certificate for a particular UAS is currently the only way civil operators of unmanned aircraft are accessing the NAS. Experimental certificate regulations preclude carrying people or property for compensation or hire,.....”
- “By law, the FAA is charged with ensuring the safe and efficient use of U.S. airspace. This authority generally preempts any state or local government from enacting a statute or regulation concerning matters - such as airspace regulation—that are reserved exclusively to the U.S. Government. ”
 - http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153
 - <http://www.faa.gov/news/updates/?newsId=76240>



It is consequently overwhelmed

- ❑ The FAA lists approximately 30 part 333 exemptions to commercial entities up to February 2015
- ❑ FAA lists 545 public COA's as of December 2013
- ❑ 1990 - The FAA's first UAS COA



1994 and waiting.....

There are fundamental reasons for this inertia

Without thought history is against us

Extrude the Land Parcel Map from the County Assessors Office

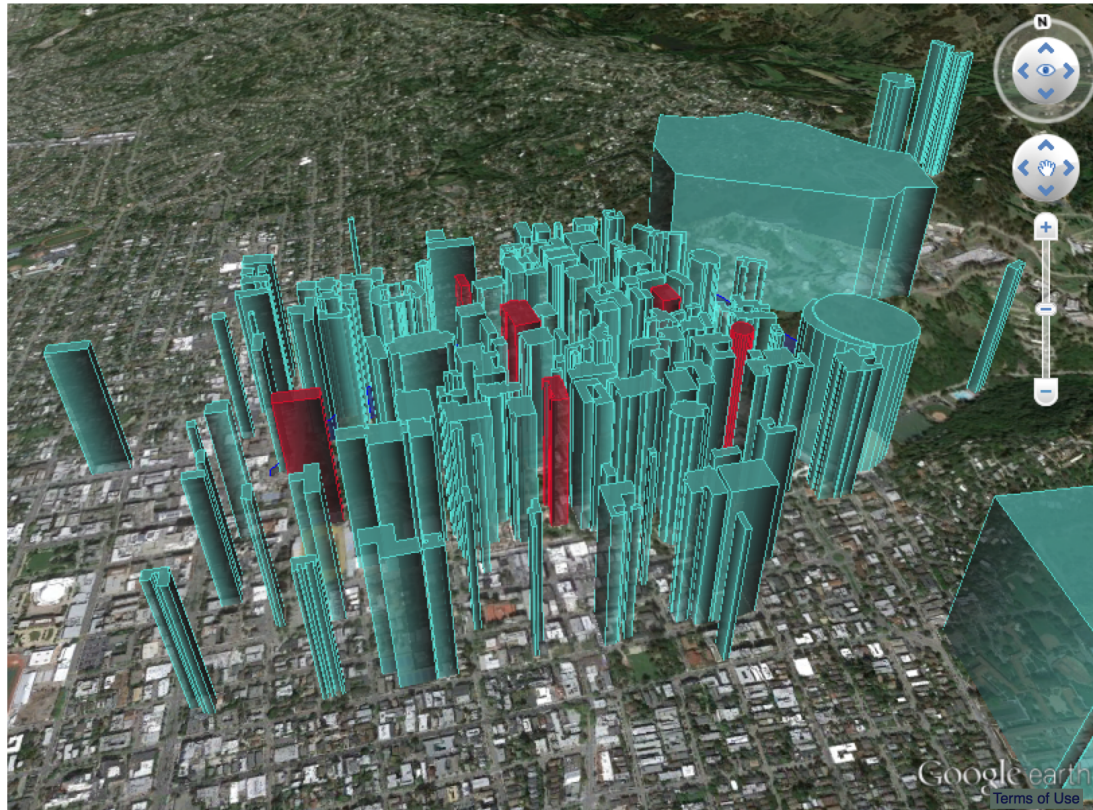


UC Berkeley Community Drones

Home

About Us

Air Parcels



Analyze Flight

hoang_722.kml

Choose Flight

View Mode

- All
- Private Parcels Traversed
- Trespasses

Apply

Console Log

This path passes through:

- Bancroft Library
- Morgan Hall
- Mulford Hall
- Hilgard Hall
- Giannini Hall
- Haviland Hall
- McCone Hall
- Hearst Greek Theatre
- Lewis Hall
- Moses Hall
- Hargrove Music Library
- Hearst Memorial Gymnasium
- Hertz Hall

I'm flying over YOUR land. The FAA has a say.
Do you also want a say?



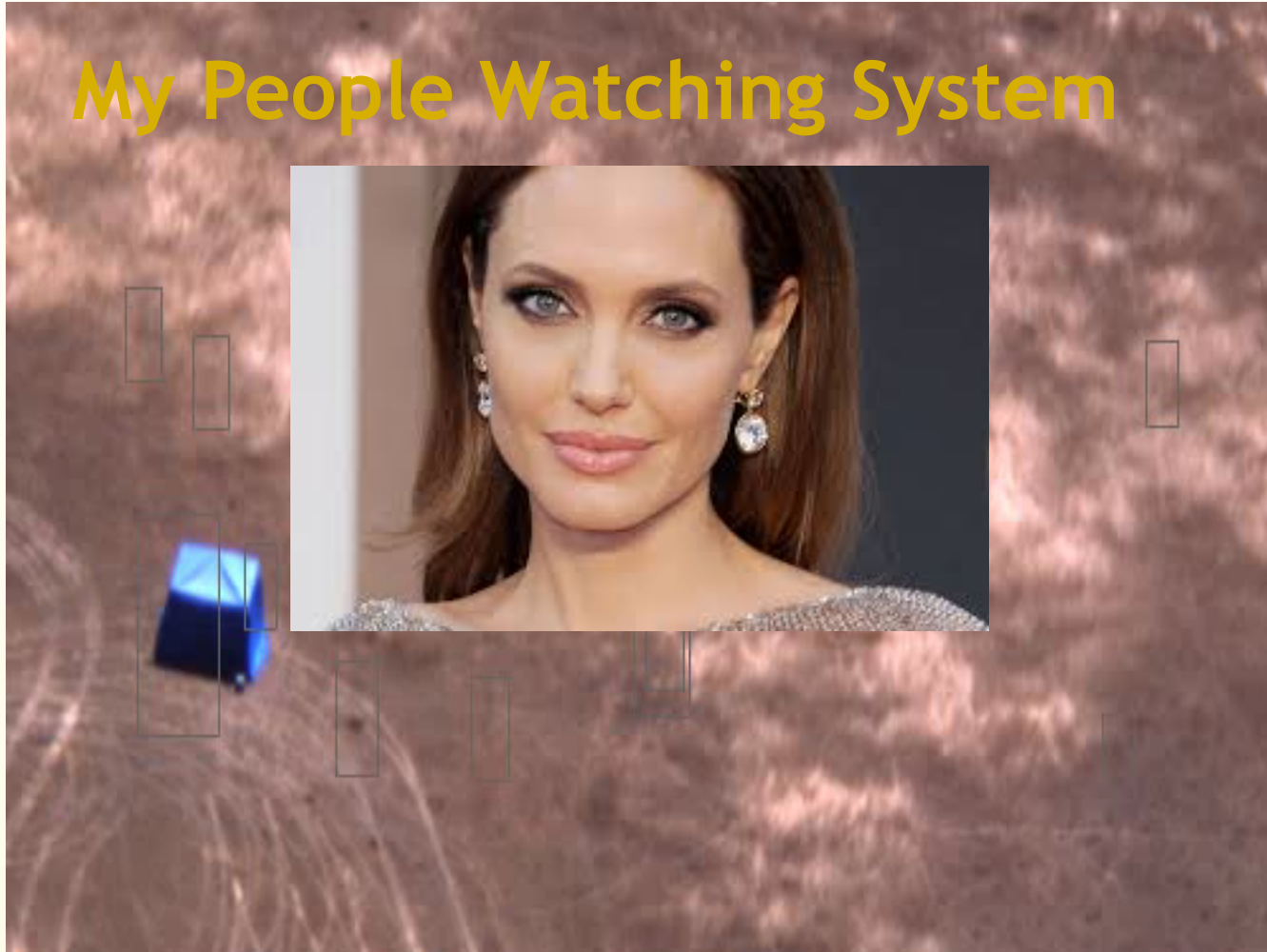
My People Watching System



This is your guest.
Do you also want a say?



My People Watching System



Do you want a say in who flies over your land? Over the streets?



- ❑ If you do are you an ATM/ATC Provider
- ❑ The simplest ATC policy - Keep Out!
- ❑ More complex trespass policy → Keep out unless you're Amazon delivery for me
- ❑ Movie Studio: if you're my cameraman you can fly. If you're paparazzi sneaking pics of my stars you can't.
 - Basic ATC function: Separate the allowed from the not allowed
 - I see a drone - Mine or not mine?
 - Mine → Flying in compliance? Speed limits, weight limits, flight areas only....
 - Not mine → Who is it? Sue!
- ❑ **Have your Say and Pay for it**

The Geek Force
took drones
from \$5 million
to \$ 500



Next: ATM/ATC for Dummies

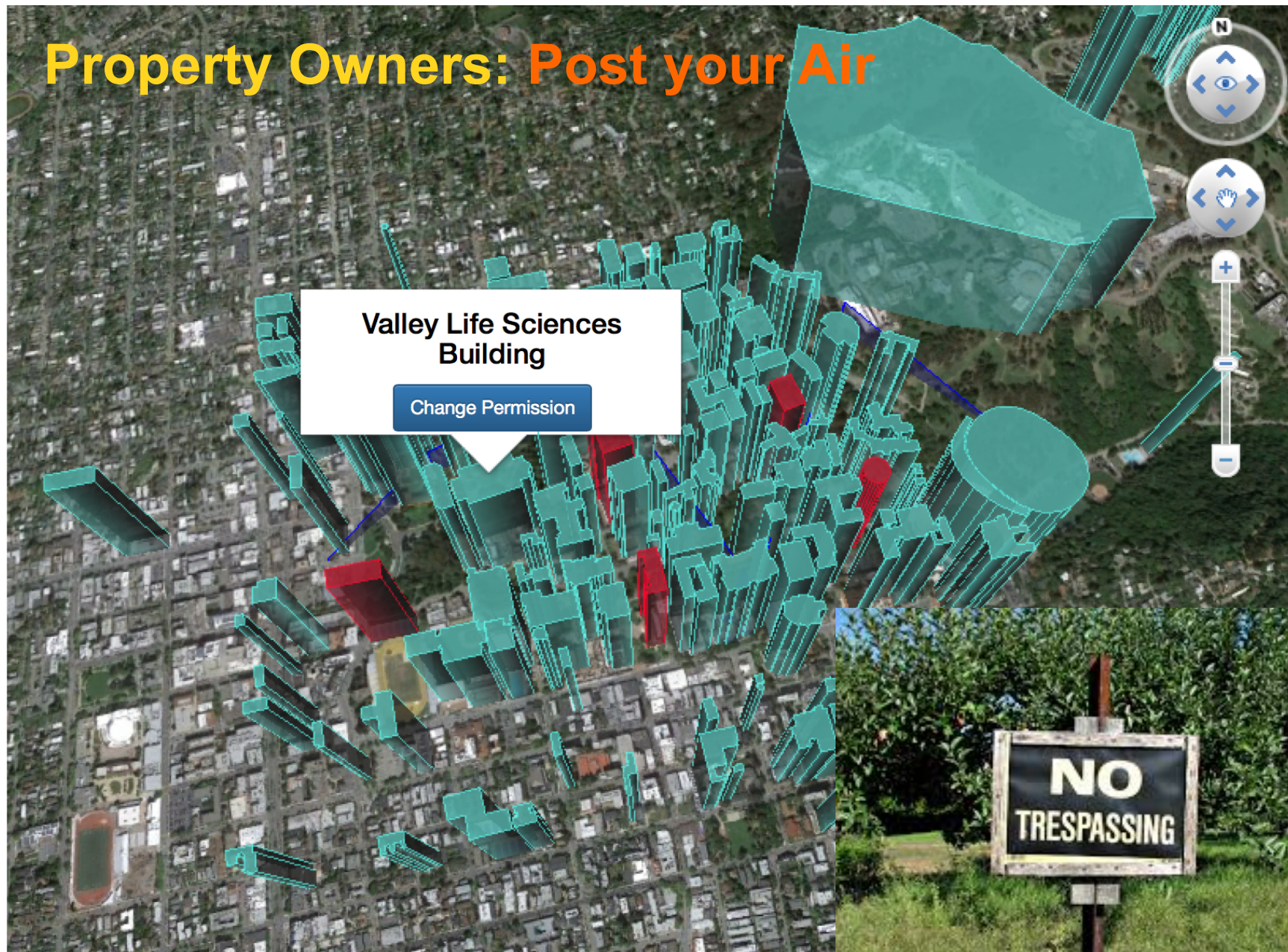
Take ATM/ATC from \$5 billion to \$500

<https://shrouded-river-9813.herokuapp.com/berkeley.html>

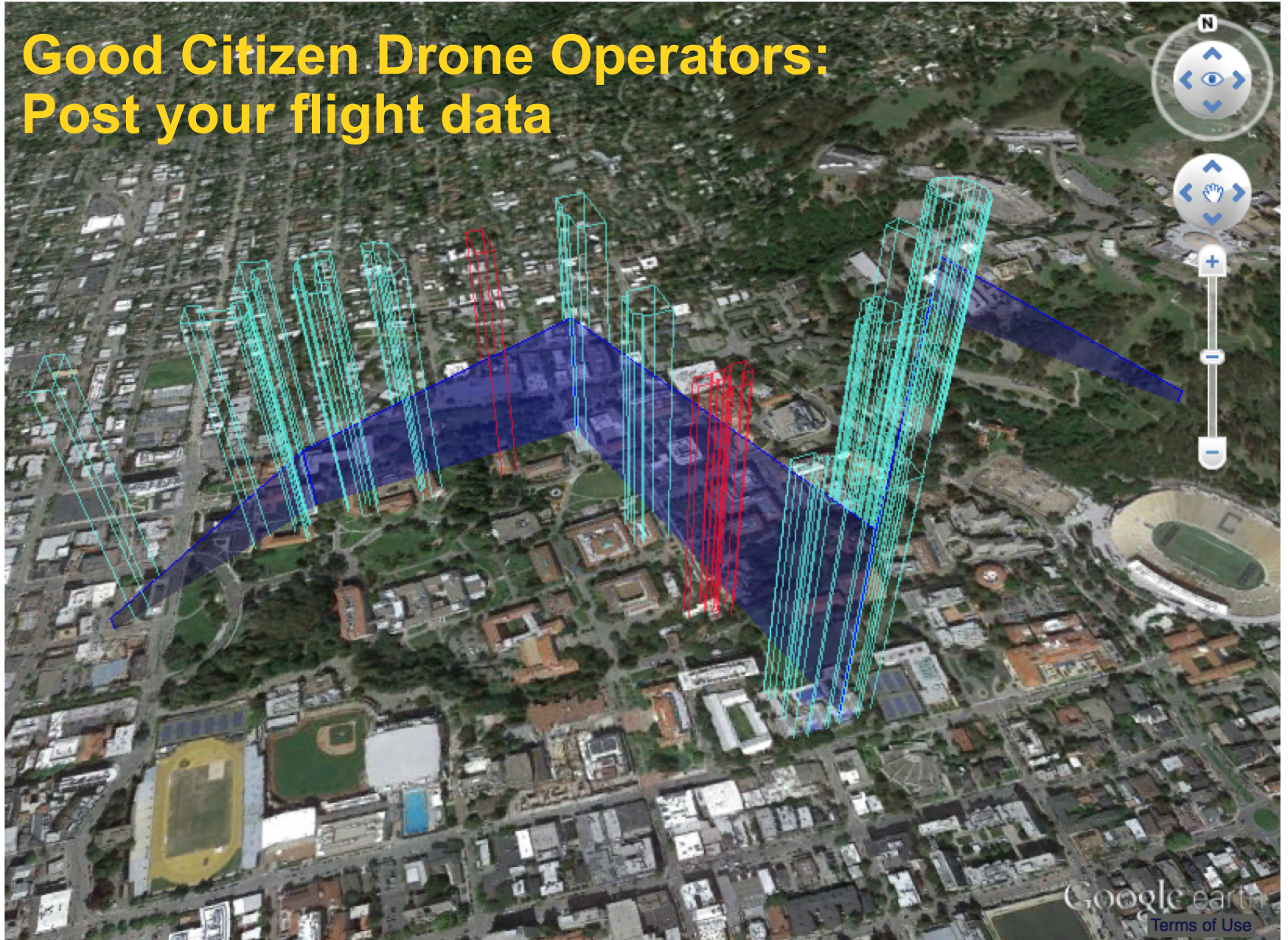
Property Owners: Post your Air

Valley Life Sciences Building

Change Permission



Good Citizen Drone Operators: Post your flight data

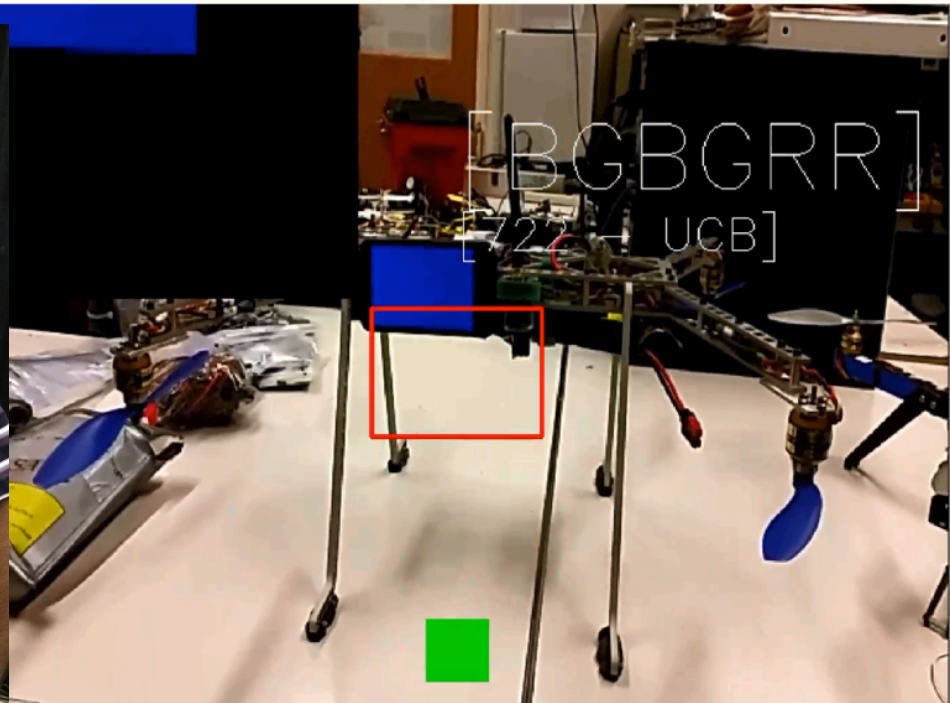
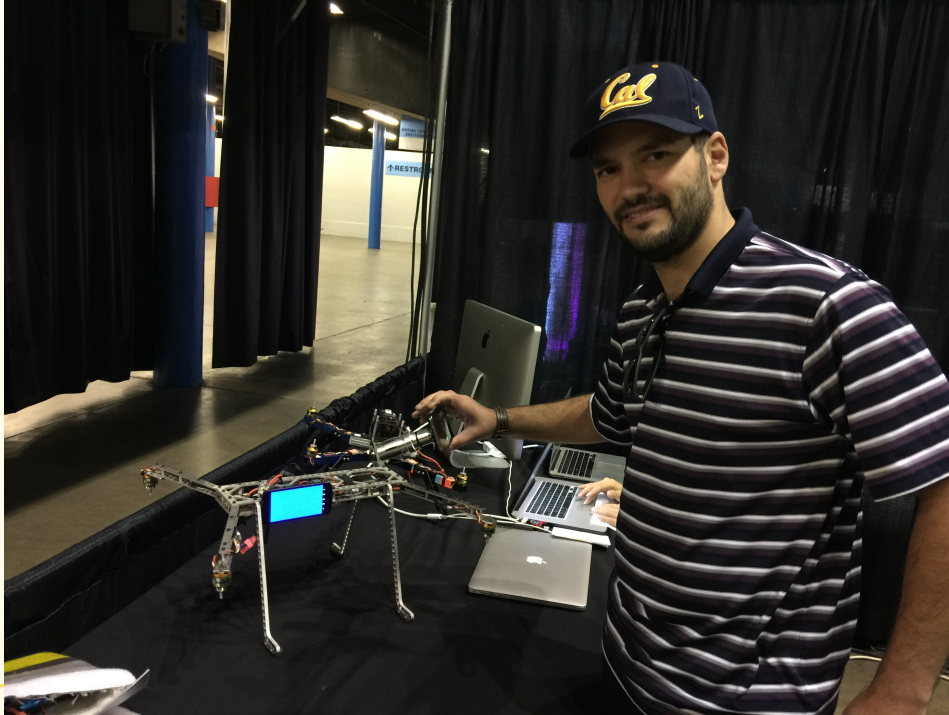



Community Drone Service: Compute the Violations





Devolve enforcement to local authorities





The Air Parcel Approach

ATC ATC Everywhere!

Private ATC, City ATC, County ATC, Park ATC

Technologists: Enable ATC for dummies

Cities or Local Governments: Charge flight fees, create low altitude airways (roads), regulate landowner restrictions (zoning), provide local ATC (traffic lights), and enforcement (city police)

Landowners: Provide ATM/ATC for your own land.

FAA: Operate the high NAS as now including UAS

Low NAS: Make UAS avoidance of helicopters technologically feasible and make the required systems mandatory

Make geo fencing technologically feasible and the required systems mandatory to stay away from general and commercial aviation airspace.

Regulate UAS out of the NAS like NHTSA regulates cars

1994 and waiting.....

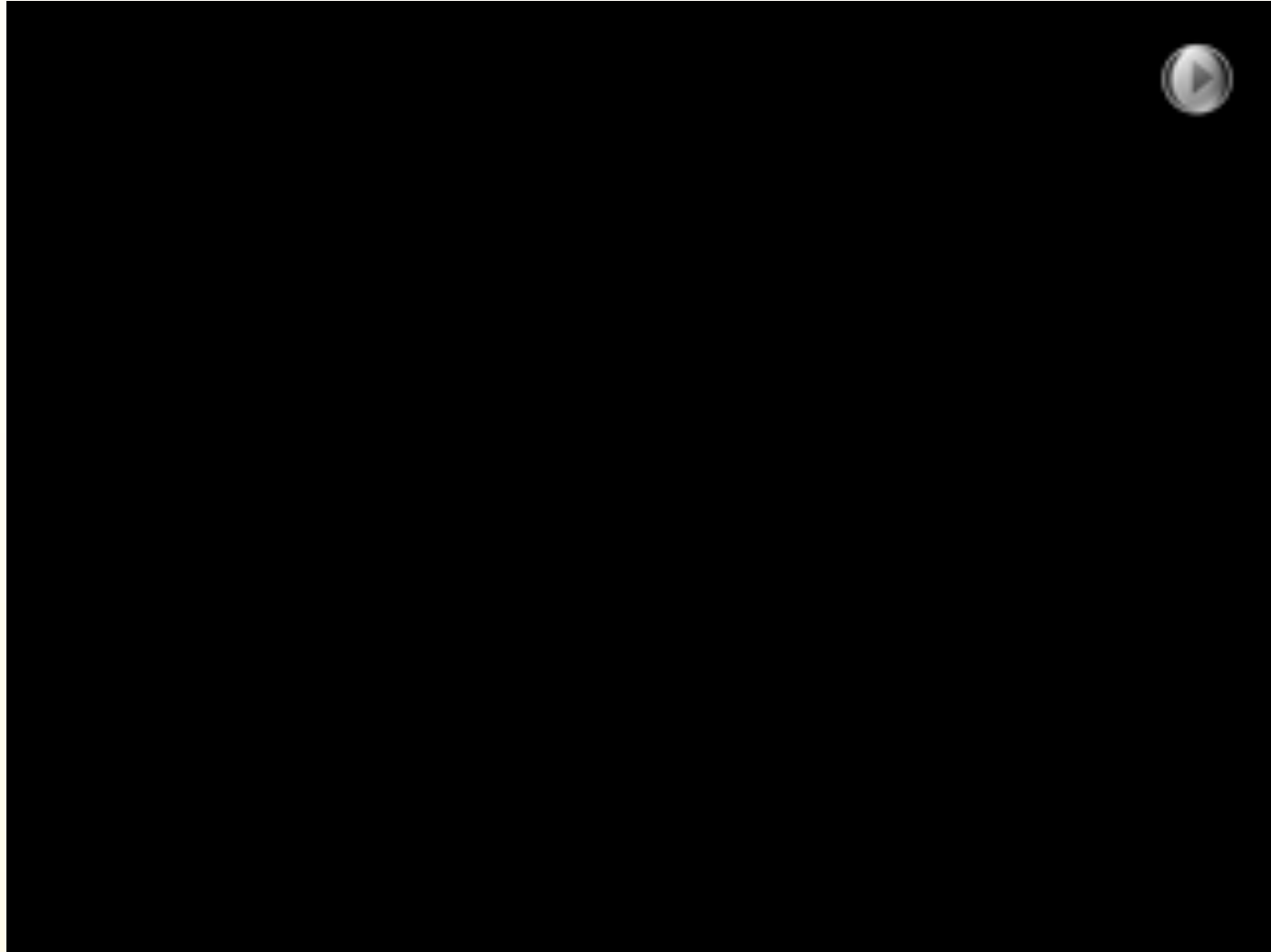
What will work?



- ❑ The devolved model
 - Fracking, driving, education, health care,
- ❑ Strong federal jurisdiction
 - Manned Aviation
 - Railroad
- ❑ Federalism and Subsidiarity
- ❑ “Subsidiarity is the idea that a central authority should only perform those tasks which cannot be performed at a more immediate or local level,” - Governor Brown
- ❑ http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1695008



We can overcome the inertia, NAHSC demo 1997



Automated Driving Today

- ❑ 300,000 autonomous driving miles
 - Not in the Mojave desert
- ❑ Legislation has been passed in four U.S. states and Washington, D.C. allowing driverless cars.....
- ❑ On December 22, 2014, Google unveiled a fully functioning prototype of their driverless car and planned to test it on San Francisco Bay Area roads beginning in 2015.[13]



**Unmanned ATM
Not deadly
serious**





Thank You!