



BISHOP FOX

Game of Drones

PUTTING THE EMERGING 'DRONE DEFENSE' MARKET TO THE TEST

Updated: 18 March 2019

December 14, 2017

THE DRONES ARE
COMING



Presented by:

- Francis 'tastic' Brown

Bishop Fox, LLC

www.bishopfox.com

Agenda

OVERVIEW

1. The **Danger Drone** by Bishop Fox
2. Crazy State of **Drone Defense Market**
3. Drone **Legal** Landscape
4. **Future** Is Gonna Be Awesome



No Such Thing as Drone Defense 'Best Practices'

MOTIVATIONS BEHIND THIS TALK

- Companies are beginning to implement **1st generation drone defense** solutions / products
 - Previous proof of concepts have already demonstrated that the threat is real
- There **are no 'best practices'** or proven methods for defense against drones
- **Practical pentesting tools** are needed to test the effectiveness of these new 'drone defense' deployments
 - Separating real countermeasures from **snake oil**
 - Must be cheap, easy to build, and easy to learn how to use **for security professionals**

Why?

DANGER DRONE

FOR PENETRATION TESTERS





Welcome to the Danger Drone

FREE PENTESTING DRONE FROM BISHOP FOX



- <https://www.bishopfox.com/resources/tools/drones-penetration-testers/>



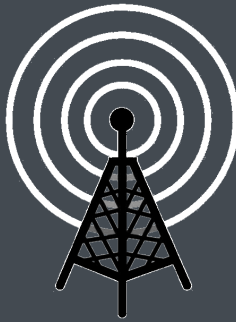
The Hacking Drone for Penetration Testers



Raffle: <http://tiny.cc/dangerdrone>

Parts – Hacking ‘Over the Air’

HACKING PERIPHERALS – ADD-ON USB EXAMPLES



- Custom 3D printed “3rd shelf” is convenient for attaching hacking USB peripherals:



WiFi Pineapple



3D Printed 3rd Shelf



TP-Link TL-WN722N

Parts – Hacking ‘Over the Air’

HACKING PERIPHERALS – **ADD-ON USB EXAMPLES**



- Wi-Fi
- Bluetooth
- RFID / NFC
- ZigBee
- Software Defined Radio
- Wireless Keyboard Sniffers
- ...



SENA UD100 Bluetooth USB



Bluetooth 4.0 USB Micro Adapter (CSR 8510 Chipset)



Wi-Spy DBx Pro – USB Spectrum Analyzer



WiFi Pineapple Nano



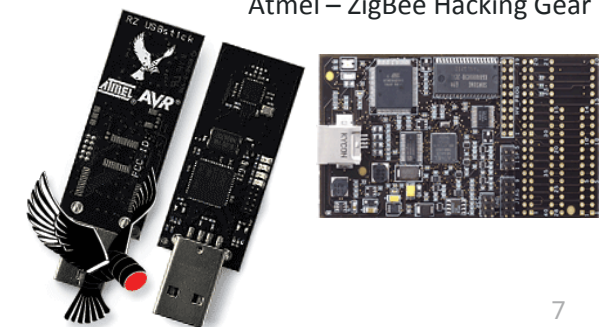
TP-Link TL-WN722N



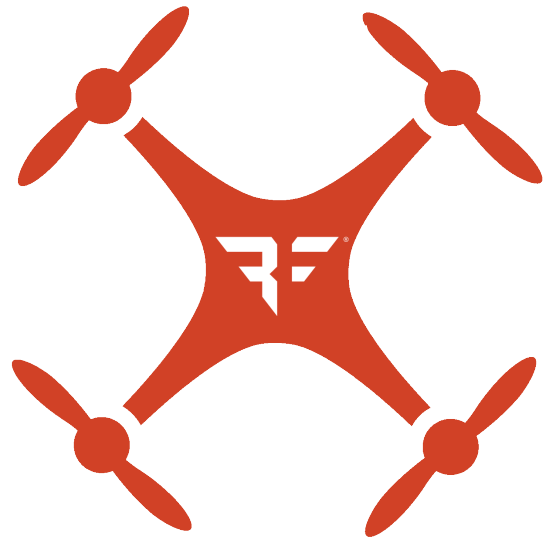
Asus USB-N53 (dual band)



HackRF One: Software Defined Radio

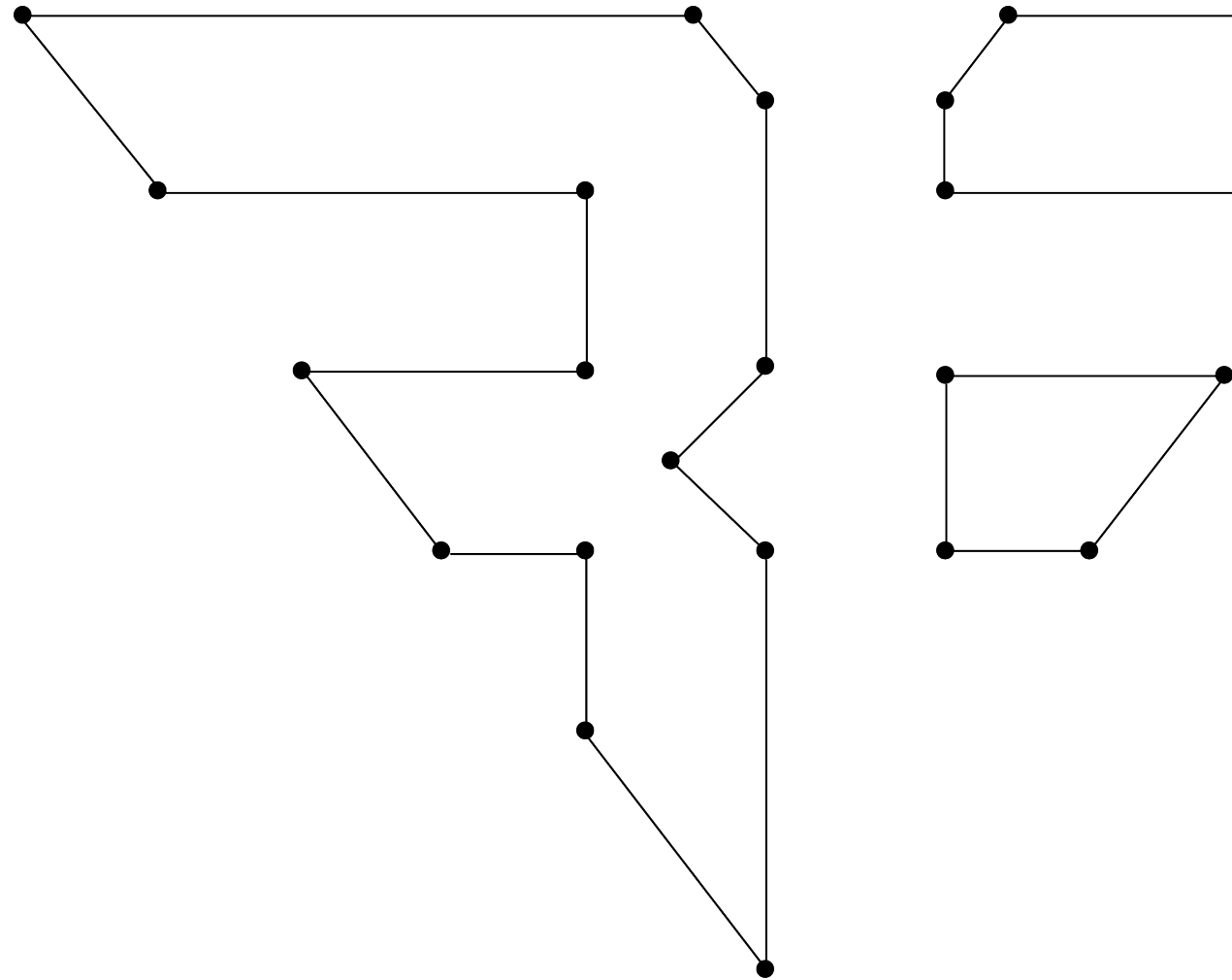


Atmel – ZigBee Hacking Gear



Danger Drone

DEMO



DEMO: Exploiting Wireless Mouse via Drone

FLY-BY DRONE EXPLOITATION, HIT AND RUN HACKING

- <http://dangerdrone.io/>

DANGER DRONE

The Hacking Drone for Penetration Testers



+



<https://github.com/insecurityofthings/jackit>

DEMO: Exploiting Wireless Mouse via Drone

FLY-BY DRONE EXPLOITATION, HIT AND RUN HACKING

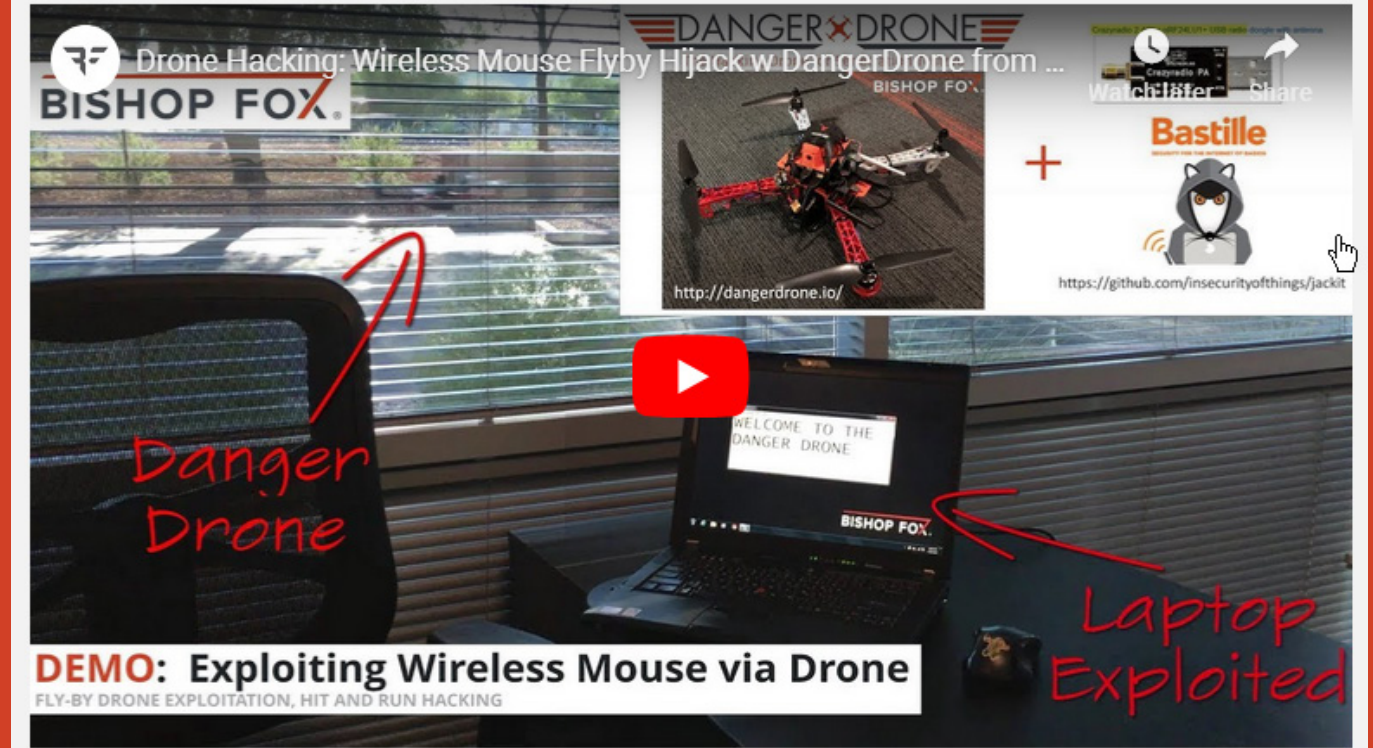
- <http://dangerdrone.io/>



The Hacking Drone for Penetration Testers

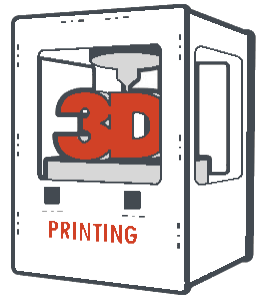


Drone defensive products / solutions were put to the test by our team, with the help of the **DangerDrone**, our penetration testing quadcopter by Bishop Fox. This Raspberry Pi based copter was designed specifically for performing pentests, see video for one such example:

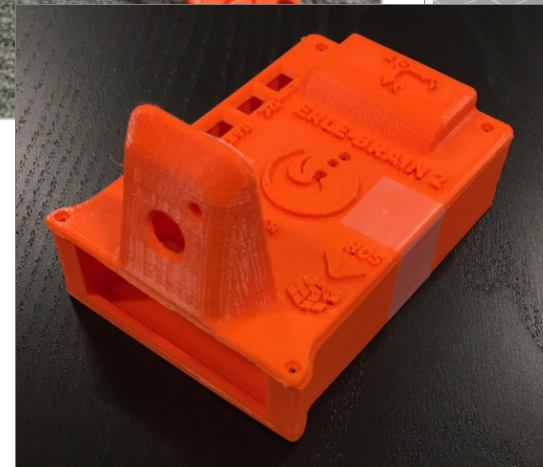
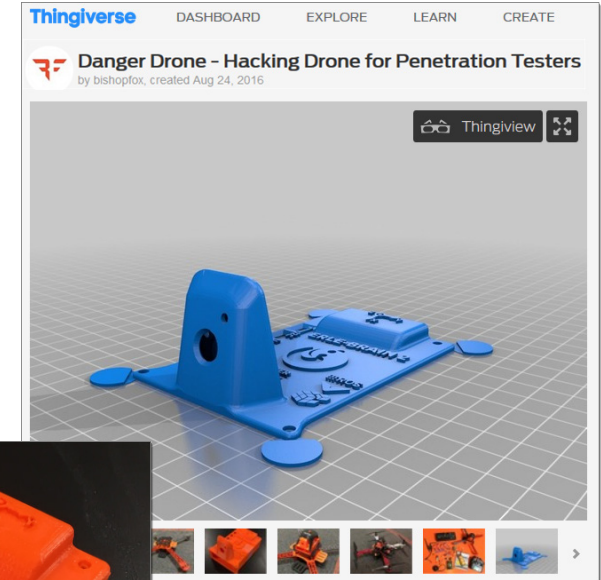
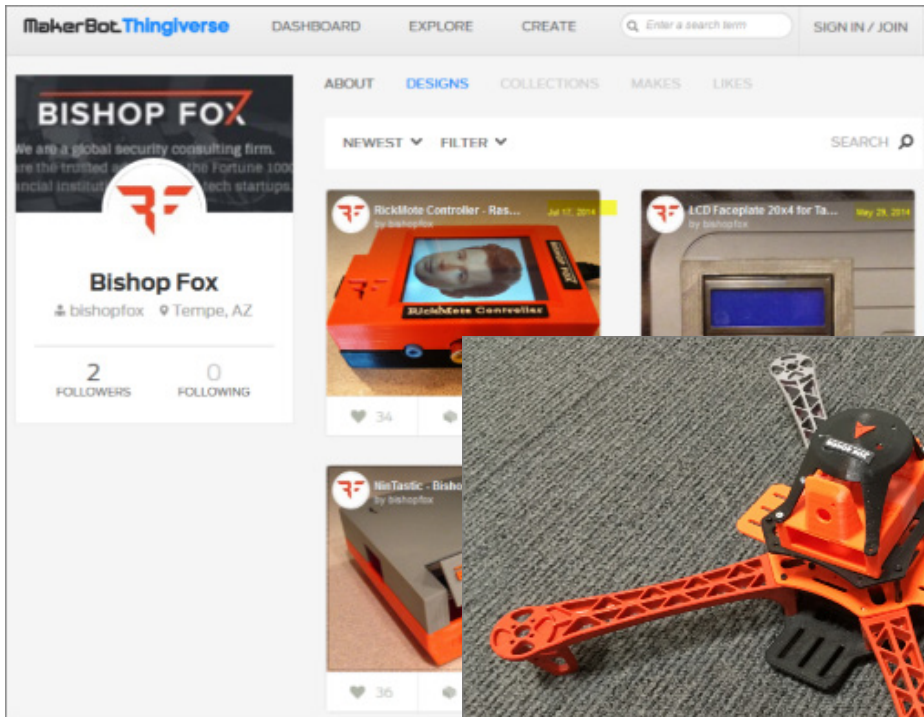


3D Designs

CHEAPER, LIGHTER, AND CUSTOMIZABLE (EXTRA SHELVES / SPACE)

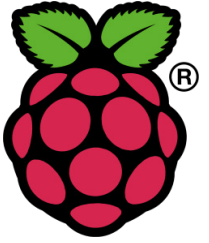


- <http://www.thingiverse.com/bishopfox/designs>
- [3D Print Parts - Danger Drone - Hacking Drone for Penetration Testers by bishopfox - Thingiverse](#)

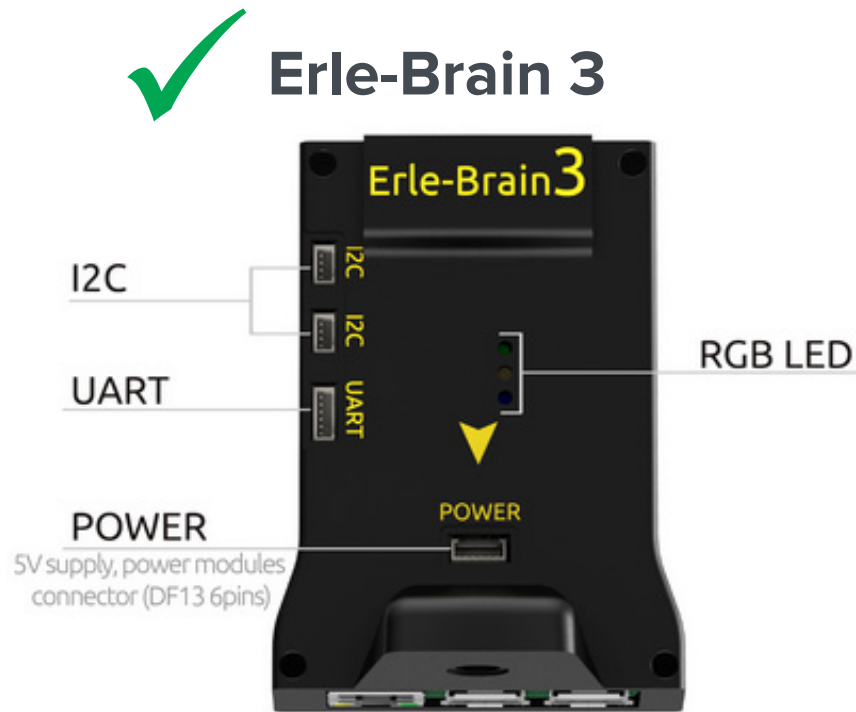


Drone Brain = Raspberry Pi

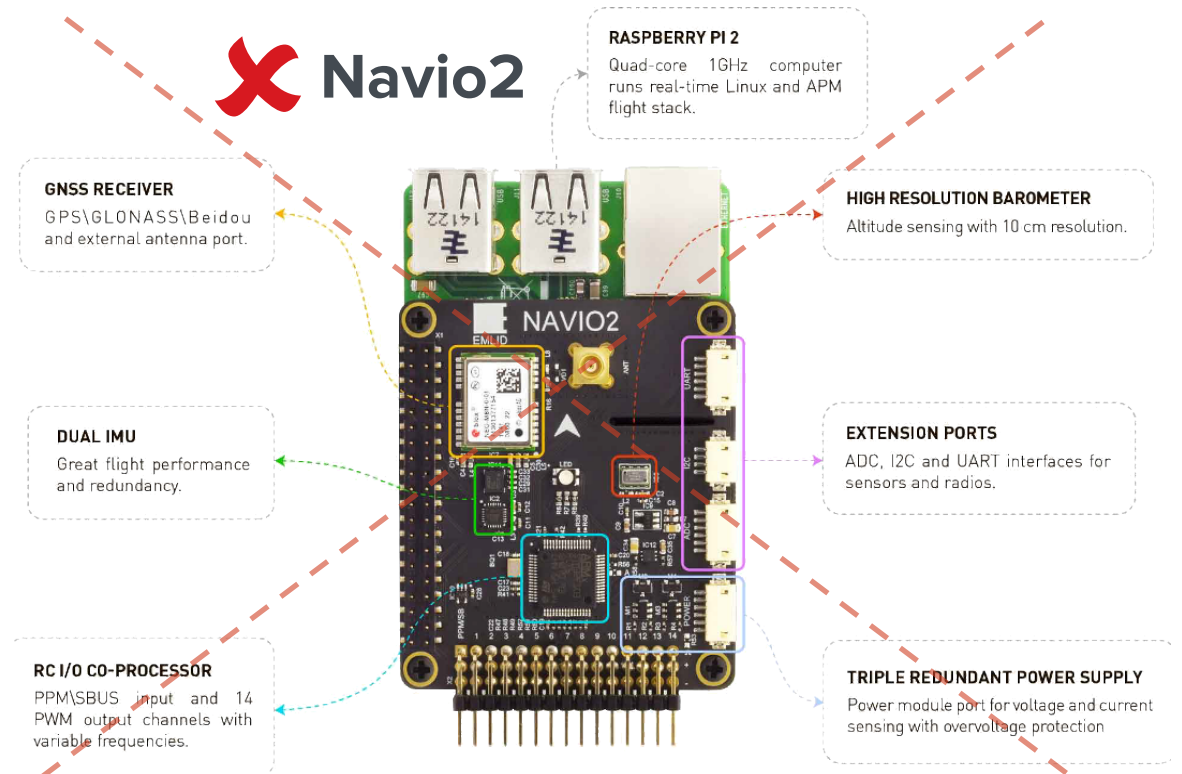
HEAVILY SUPPORTED IN **DRONE** AND **HACKER** COMMUNITIES



- Raspberry Pi based copters have the obvious appeal of being heavily developed and supported by both the drone and hacker communities.
- The 2 most popular Raspberry Pi based flight controllers are the **Erle-Brain 3** and the **Navio 2**:



<http://erlerobotics.com/blog/product/erle-brain-3/>



Parts and Pieces – Piecemeal

CHEAPER TO BUILD YOURSELF - SLIGHTLY



\$490.53

- Essentially starting with **working / flying Erle-Copter** and then **adding hacking** capability (without breaking flying ability):
 - Adding Hardware – e.g. USB peripherals to Raspberry Pi, shelves
 - Adding Software – e.g. drivers, config changes, installs, etc.



Danger Drone - Individual Parts Costs			
#	Description	Cost	Product Link
1	Flight Controller	\$199.00	Erle Brain 2, a Linux brain for robots and drones
2	GPS	\$50.68	Ublox Neo-M8N GPS with Compass
3	RC Controller and Receiver	\$49.00	Turnigy TGY-i6 AFHDS Transmitter and 6CH Receiver (Mode 2)
4	Motors x4	\$45.99	Tiger Motors 6th Anniversary Limited Edition 4x MN2213 Motors + 2 p
5	Telemetry	\$40.88	HobbyKing - HKPilot Transceiver Telemetry Radio Set V2 (915Mhz)
6	Battery (4 cell)	\$39.99	FLOUREON 4S 35C 14.8V 5500mAh Li-Polymer RC Battery Pack (5.98*
7	ESCs x4	\$23.57	Amazon - Andoer 4Pcs Simonk 30AMP 30A SimonK Firmware Brushles
8	Frame (F450)	\$19.99	Amazon.com - RipaFire F450 4-Axis Multi-Rotor Quadcopter Flame Air
9	Power Module	\$14.29	Amazon - Ericoco Power Supply Module w/BEC APM2 2.5 APM Flight Controller
10	PPM Encoder	\$7.14	HobbyKing - PPM Encoder Module HKPilot 32
	Total:	\$490.53	



Bishop Fox – Danger Drone Research – Parts Lists, Assembly, and Config Guidance see:

- <https://www.bishopfox.com/resources/tools/drones-penetration-testers/>



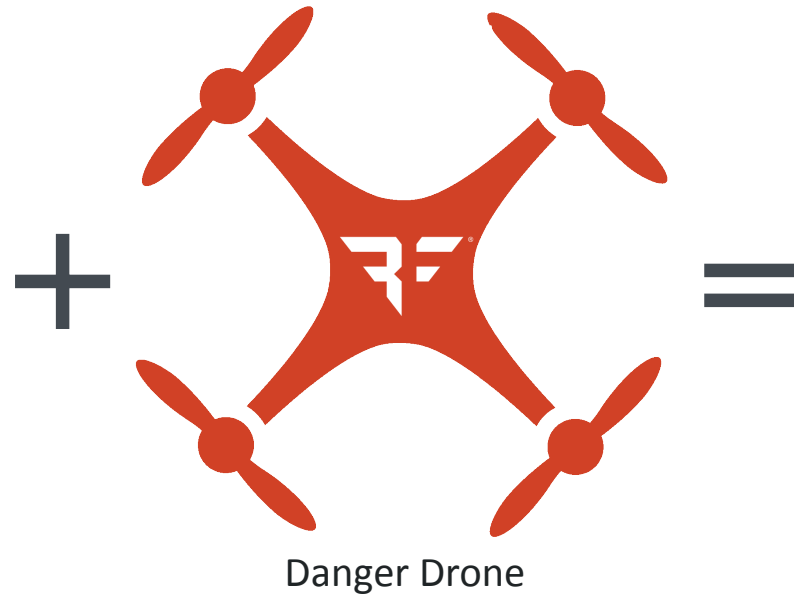
IoT = Target Rich Environment

LOTS OF NEW TARGETS FOR 'OVER THE AIR' ATTACKS

- Ideal platform to launch 'over the air' attacks against new IoT products popping up in both the home & office
- Drone hacking threats need to be considered by consumers, security pros, and IoT product manufacturers



Internet of Things (IoT)



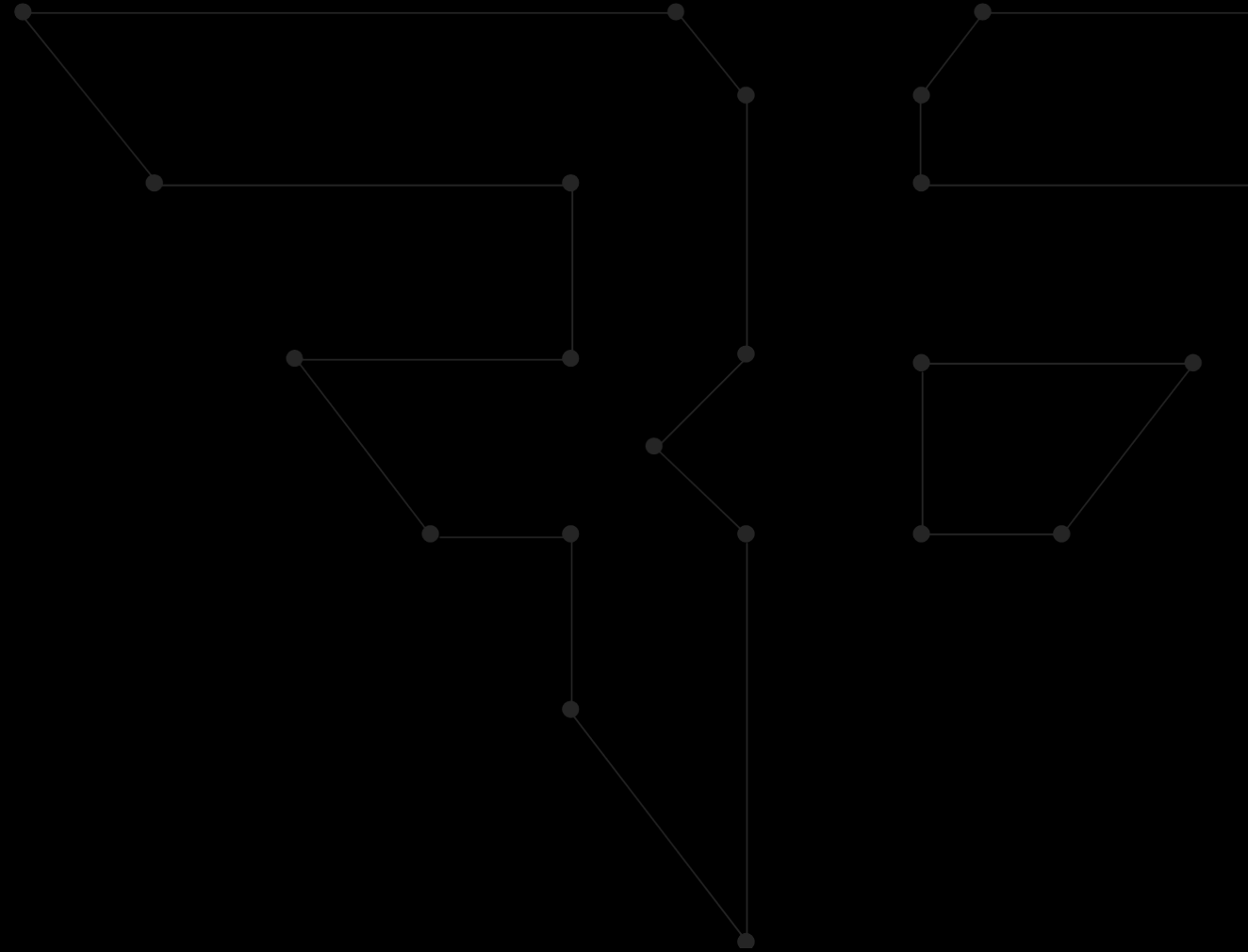
Danger Drone



Target Rich Environment

IN THE NEWS

DRONE-STRAVAGANZA



Data Exfiltration Via Drones and Lights

THREATS EVOLVING, NOW DEFENSES NEED TO AS WELL



Feb 2017

Researchers exfiltrate data by blinking the LEDs on the hard drives

February 23, 2017 By Pierluigi Paganini

A team of Israeli researchers has devised a new technique to exfiltrate data from a machine by using a malware that controls hard drive LEDs.

Across the years, numerous studies demonstrated that it is possible to exfiltrate data from **air-gapped networks** in **various ways** and security experts warned to cover our webcam to avoid being spied by sophisticated malware.

Now a group of researchers from Ben-Gurion University of the Negev's Cyber Security Research Center has devised a new technique to exfiltrate data from a machine by using a malware that controls hard drive LEDs.

"We show that a malware can indirectly control the HDD LED, turning it on and off rapidly (up to 5800 blinks per second) – a rate that exceeds the visual perception capabilities of humans. Sensitive information can be encoded and leaked over the LED signals, which can then be received remotely by different kinds of cameras and light sensors." reads the [paper](https://arxiv.org/abs/1702.06715) published by the researchers. "Compared to other LED methods, our method is unique, because it is also covert – the HDD activity LED routinely flickers frequently, and therefore the user may not be suspicious to changes in its activity."

paper: <https://arxiv.org/abs/1702.06715>

A drone is navigated to a line-of-sight with the infected computer

LED-it-GO. Jumping the Air-Gap with a small HardDrive LED

Cyber Security Labs @ Ben Gurion University

200,950 views

Published on Feb 22, 2017
By Mordechai Guri, Boris Zadov, Yuval Elovici
paper: <https://arxiv.org/abs/1702.06715>

The video player shows a night scene in a parking garage. A drone is visible in the air, positioned between a camera and a computer. The video title is "LED-it-GO. Jumping the Air-Gap with a small HardDrive LED" and it has 200,950 views. The video is published on Feb 22, 2017, by Mordechai Guri, Boris Zadov, and Yuval Elovici. The paper reference is <https://arxiv.org/abs/1702.06715>.

SecurityAffairs.co - Researchers exfiltrate data with drone by blinking the LEDs on the hard drives - 23Feb2017

- <http://securityaffairs.co/wordpress/56583/breaking-news/data-exfiltration-hdd-leds.html>



Military and Drones

THREATS EVOLVING, NOW DEFENSES NEED TO AS WELL



Mar 2017

[The Verge - A US ally shot down a \\$200 drone with a \\$3 million Patriot missile - 16Mar2017](#)

A US ally shot down a \$200 drone with a \$3 million Patriot missile

This will be a bigger problem as more drones show up on the battlefield

by Andrew Liptak | @AndrewLiptak | Mar 16, 2017, 10:13am EDT



MISSILE

USING A \$3.4 MILLION MISSILE TO DESTROY A CIVILIAN DRONE IS OVERKILL

Earlier this week, General David Perkins, the commander of the US Army Training and Doctrine Command (TRADOC) [spoke at the Association of the US Army's Global Force symposium](#), where he discussed the threats that the US military would begin to face in the coming years. One notable example is how a US ally recently shot down a \$200 consumer drone with a Patriot Missile.

Perkins' talk during the symposium focused on the complexity of a military organization in the field, and how the interconnected nature of air, ground, and sea forces can lead to a fragmented response to a threat between the commanders who are in charge of specific areas. He specifically spoke about the necessity for commanders to address threats holistically. He used one specific example of how this occurs on the battlefield: hostile, civilian Unmanned Aerial Systems (UAS). "The gut instinct was," he explains, "that's an air defense problem, because they're in the air."



This drone was used by Iraqi government forces against ISIS in Mosul. It shows the the weapon carriage and arming method, using two attachments. The weapons are maintained safe and could be armed just before takeoff.

"Flying IED's"

Prison Break Thanks to Drone

DRONE-SHANK REDEMPTION



July 2017

[USA Today - Jimmy Causey, escaped inmate, likely used wire cutters dropped by drone - 07July2017](#)

USA TODAY Search

Prison officials say escaped inmate likely used wire cutters dropped by drone

Doug Stanglin, USA TODAY Published 2:38 p.m. ET July 7, 2017 | Updated 3:05 p.m. ET July 7, 2017



A fugitive South Carolina inmate recaptured in Texas this week had chopped his way through a prison fence using wire cutters apparently dropped by a drone, prison officials said Friday.

Jimmy Causey, 46, fled the Lieber Correctional Institution in Ridgeville, S.C., on the evening of July 4th after leaving a paper mache doll in his bed to fool guards into thinking he was asleep. He was not discovered missing until Wednesday afternoon.


Causey was captured early Friday 1,200 miles away in a motel in Austin by Texas Rangers acting on a tip, [WLTX-TV reported](#).

Officers found a semi-automatic handgun, shotgun, ammo, four cell phones and \$47,000 in cash on Causey, who also carried a South Carolina ID.

"We believe a drone was used to fly in the tools that allow(ed) him to escape," South Carolina Corrections Director



"Prison Break via Drone"



The Battle Against **Drones Smuggling Drugs Into Prison** (HBO)

VICE News Published on Sep 29, 2018

The drones come in the night. Flown from adjacent farmers' fields, they fly high up over the floodlit yards of the prison, float momentarily to ensure they've not been spotted, and then descend, dropping illicit cargo in plastic bags attached by s-hook —meth, marijuana, tobacco, cell phones.

VICE News Tonight | HBO 3:36





Fire Crews Forced to 'Let It Burn' in Arizona

FIRST RESPONDERS AND EMERGENCY SERVICES NEED DRONE DEFENSES



July 2017

AZCentral.com - Arrest made in drone flights over Goodwin Fire - 01July2017


The face of the new threat of rogue drones.



azcentral.
PART OF THE USA TODAY NETWORK

Arrest made in drone flights over Goodwin Fire

BrieAnna J Frank, The Republic | azcentral.com Published 3:04 p.m. MT July 1, 2017



(Photo: Yavapai County Sheriff's Office)

A 54-year-old Prescott Valley man suspected of flying a drone that grounded Goodwin Fire firefighting efforts last week has been arrested.

The Yavapai County Sheriff's Office reported Saturday that Gene Alan Carpenter was arrested on charges of endangerment and unlawful operation of an unmanned aircraft.

Carpenter is accused of endangering 14 aircraft and air crews as well as ground fire crews with "substantial risk of imminent death or physical injury" by flying a drone in the fire's airspace.

RELATED: Drone forces firefighting aircraft at Goodwin Fire to land

The Arizona Legislature and Gov. Doug Ducey last year passed a law making it illegal for a drone to interfere with emergency or law-enforcement efforts. There are also federal laws regulating drone flights.



AZ - SB 1449 - Drone Law - May2016 - Crime for drones to interfere with law enforcement or emergency operations

- <https://apps.azleg.gov/BillStatus/BillOverview?billnumber=1449&Sessionid=115>

Planes / Helicopters in Danger from Drones

DON'T DRONE SO CLOSE TO ME ... SERIOUSLY, YOU CAN KILL SOMEONE ...



Feb 2018

[Mashable - FAA investigates video of drones close call with an airplane - 02Feb2018](#)

TECH INDUSTRY


Drone hovers right above jet landing at Las Vegas airport

No, it's not legal, but that didn't stop someone from taking a remote joyride on McCarran International Airport's flight path.

BY **STEPHEN SHANKLAND** / FEBRUARY 2, 2018 5:15 PM PST

The Federal Aviation Administration is investigating an incident in which someone apparently piloted a drone right above a jet landing at McCarran International Airport in Las Vegas.

The [KLAS TV station's LasVegasNow.com](#) website published video Thursday taken at an unknown time from a drone hovering over the city as a jet approaches and then passes underneath. The FAA said Friday it's "aware of the incident and is investigating" but declined further comment.



ONLY ON 8
DRONE FLIES NEAR PLANE
HEADLINES Under Man's stabbing case to 40 years... Las Vegas Now... 5:11:00

This video apparently was shot from a drone immediately above a jet landing at Las Vegas's airport.

Video from KLAS TV/LasVegasNow.com; Screenshot by Stephen Shankland/CNET



“Planes in Serious Danger from Drones Flying Too Close”



Gatwick Airport Shutdown Due To Drones

AIRPORTS NEED DRONE DEFENSES



Dec 2018

[Mashable - Police still hunting for drones that caused mayhem at Gatwick Airport - 23Dec2018](#)

[Hackaday - London Gatwick Airport Shuts Its Doors Due To Drone Sighting - 20Dec2018](#)

POPULAR MECHANICS TECHNOLOGY CARS TOOLS DEFENSE STAY WARM!

We Still Know So Alarmingly Little About How a Drone Shut Down an Airport for Two Days

As the military leaves London's Gatwick airport after a drone scare, it's still not clear exactly what happened.

By Sam Blum Jan 3, 2019



The Royal Air Force (RAF) has left Gatwick Airport in London over a week after a mysterious drone sighting canceled about 100 flights and disrupted holiday travel for an estimated 140,000 travelers, according to the BBC.

The incident prompted international attention, and rabid speculation, as to who was controlling the rogue UAV. The military was called in, equipped with signal-jamming instruments meant to corral the aircraft if the chance presented itself.

It never did. Authorities opted not to shoot down the drone, but rather to wait it out, in large part due to the lack of rules dictating how to deal with such a conundrum. As business slowly resumed its course at Gatwick, it's become clear how ill-equipped we are to deal with drones intruding on commercial airspace, but the story of Gatwick is even more absurd than that

Apparently it's not such a great time for airports, though. On Thursday morning, London's Gatwick Airport — one of the busiest in the UK — announced that all inbound and outbound flights are suspended following reports of two drones flying near the airport on Wednesday night.

As of 08:15am, everything was still in lockdown.



Gatwick Airport LGW
@Gatwick_Airport



Thursday 07:40: Flights to and from Gatwick remain suspended, due to drone activity. Please do not travel to the airport without checking with your airline first. We're sorry for the inconvenience today, but the safety of our passengers and staff is our no.1 priority.

307 12:45 AM - Dec 20, 2018

400 people are talking about this

Gatwick's online statement confirms that the airport is investigating the sightings with the help of Sussex police. In the meantime, staff are working to find alternative travel and accommodation options for passengers who have been affected.

"We apologise to any affected passengers for this inconvenience but the safety of our passengers and all staff is our number one priority," reads the statement.



NO-FLY ZONES



Criminals Using Drone Swarms Against FBI

BAD BOYS... WHATCHA GONNA DO... OH WAIT, DON'T DO THAT...



May 2018

[CNET - Criminals' drone swarm used to obstruct FBI hostage raid - 03May2018](#)

THE VERGE TECH REVIEWS SCIENCE ENTERTAINMENT VIDEO FEATURES MORE

Criminals used a swarm of drones to surveil and disrupt an FBI hostage operation

Criminals are increasingly using drones in illegal activity and to spy on authority

By Thuy Ong | @ThuyOng | May 4, 2018, 7:18am EDT



Criminals are increasingly using drones in illegal activity and as a way to counter surveil and disrupt the FBI and other law enforcement agents, [according to a report by Defense One.](#)

The publication cites one instance where an FBI hostage rescue team set up a raised observation post to monitor a situation. A so-called "swarm" of small drones appeared and assailed the FBI in a series of "high-speed low passes at the agents in the observation post

Mashable VIDEO ENTERTAINMENT CULTURE TECH SCIENCE SOCIAL GOOD SHOP MORE

Suspects deploy swarm of drones to monitor and flush out FBI agents

MAY 03, 2018



A swarm of drones helped criminal suspects ward off FBI agents.

IMAGE: GETTY IMAGES/ISTOCKPHOTO

It's the kind of thing that's surely only cooked up in Hollywood.

A gang of suspects hiding out in the outskirts of a U.S. city used a **swarm of drones to flush out FBI agents** during a hostage rescue, as reported by [Defense One.](#)



Assassination Drones

FOR REAL 'DANGER DRONE'



Aug 2018


[BBC - Venezuela President Maduro survives 'drone assassination attempt' - 05Aug2018](#)

BBC Sign in News Sport Weather Shop Reel Travel More

NEWS

Venezuela President Maduro survives 'drone assassination attempt'

5 August 2018



Footage showed dozens of soldiers running away before the transmission was cut off

Venezuelan President Nicolás Maduro says he has survived an assassination attempt involving explosive drones.

Mr Maduro was speaking at a military event in Caracas when the alleged attack occurred.

Live footage of his speech shows the president suddenly looking upwards - startled - and dozens of soldiers running away.

Mr Maduro has blamed Colombia for the attack - something denied by Bogota as a "baseless" accusation.

Seven soldiers were injured, and several people were later arrested, the Venezuelan authorities said.



DRONE DEFENSE MARKET

EMERGING MARKET OVERVIEW



Drone Defenses - Categories

BY PRODUCT TYPE - EMERGING LEADERS IN 'ROGUE DRONE' DEFENSE



PREDATOR BIRD



DRONE NETTING



DRONE SHOOTING



DRONE SHOOTING



JAMMING



EMP



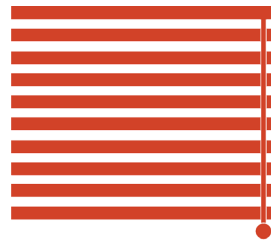
CYBER



GEOFENCING



NO-FLY ZONES



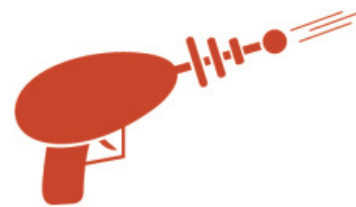
SHUTTERS



CONFETTI GUN



MISSILE



LASER



Examples: Common Drone Defenses

INSIDE LOOK AT WHO ARE CONSIDERED EMERGING LEADERS IN 'ROGUE DRONE' DEFENSE



Eagles Trained to Hunt Drones



Net Cannons



Hunter Drones Shooting Nets



Drones Swooping with Big Nets



Jammer Cannons



Hunter Drones Shooting Nets





Examples: UnCommon Drone Defenses

INSIDE LOOK AT WHO ARE CONSIDERED EMERGING LEADERS IN 'ROGUE DRONE' DEFENSE



Hatchet Defenses



Toilet Paper Defenses






Exclusive Video: Drone Defenses Testing


BISHOP FOX WENT TO THE DESERT TO TEST DRONE DEFENSE PRODUCTS




<https://www.wired.com/story/watch-anti-drone-weapons-test/>

<https://www.youtube.com/watch?v=jlGdPrhRvBA>


WIRED

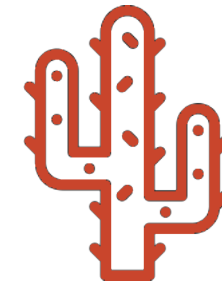
SUBSCRIBE 



JULY 26, 2017

Watch a Test of Anti-Drone Weapons, From Shotguns to Superdrones

From anti-drone shotgun shells to a drone-snagging megadrone, security researchers put the drone defense arsenal to the test.



+



WIRED



Drone and Defenses Markets Growing

EVERYONE WANTS A PIECE OF THAT FUTURE ANTI-DRONE DEFENSE MARKET \$\$\$



[Fortune.com - Drone Sales Are about To Go Crazy - FAA Projects](#)

[Drone Sales To Soar By 2020 - 25Mar2016](#)

- “The FAA believes that 2017 will be the big turning point in drone adoption by businesses, which use them for everything from scanning power lines to inspecting rooftops for insurance companies. Commercial sales are expected to reach 2.5 million, after which sales will increase only slightly for the next few years.” -- Forbes

https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/Unmanned_Aircraft_Systems.pdf

- “Drone sales are expected to grow from 2.5 million this year to 7 million in 2020, according to report released this week by the Federal Aviation Administration... Hobbyist sales will more than double from 1.9 million drones in 2016 to 4.3 million in 2020, the agency said. Meanwhile, business sales will triple over the period from 600,000 to 2.7 million.”

<http://blog.executivebiz.com/2016/03/reportlinker-global-anti-drone-market-to-reach-1-14b-by-2022/>

ReportLinker: Global Anti-Drone Market to Reach \$1.14B by 2022

Posted By: Ramona Adams on: March 17, 2016 In: Industry News, News Print Email



MarketsandMarkets' new report on the global counter-drone systems market states that the anti-drone industry is projected to reach \$1.14 billion by 2022 and achieve a 23.89 percent compound annual growth rate from 2017 to 2022.

Exhibit 7: Recent Anti-Drone Funding

https://www.droneshield.com/sites/default/files/JAW_Drop_V27_04-25-17.pdf

Date	Company	Type	Amount	Total Raised
2/1/16	Advanced Protection Systems	Grant	\$750k	\$1.0m
4/20/16	SkySafe	Seed	\$3m	\$3.0m
5/17/16	Dedrone	Series A	\$10m	\$12.9m
6/22/16	DroneShield	Venture	~\$5.3M USD	~\$6.3M USD
8/22/16	Quanergy Systems	Series B	\$90M	\$135.3m
8/24/16	ApolloShield	Seed	\$500k	\$120k
11/18/16	Airspace Systems	Seed	\$5m	\$5.0m
1/15/17	Advanced Protection Systems	Grant	\$500k	\$1.5m
2/2/17	SRC, Inc.	US Army Contract	\$65M	-
2/13/17	Dedrone	Series B	\$15m	\$27.9m

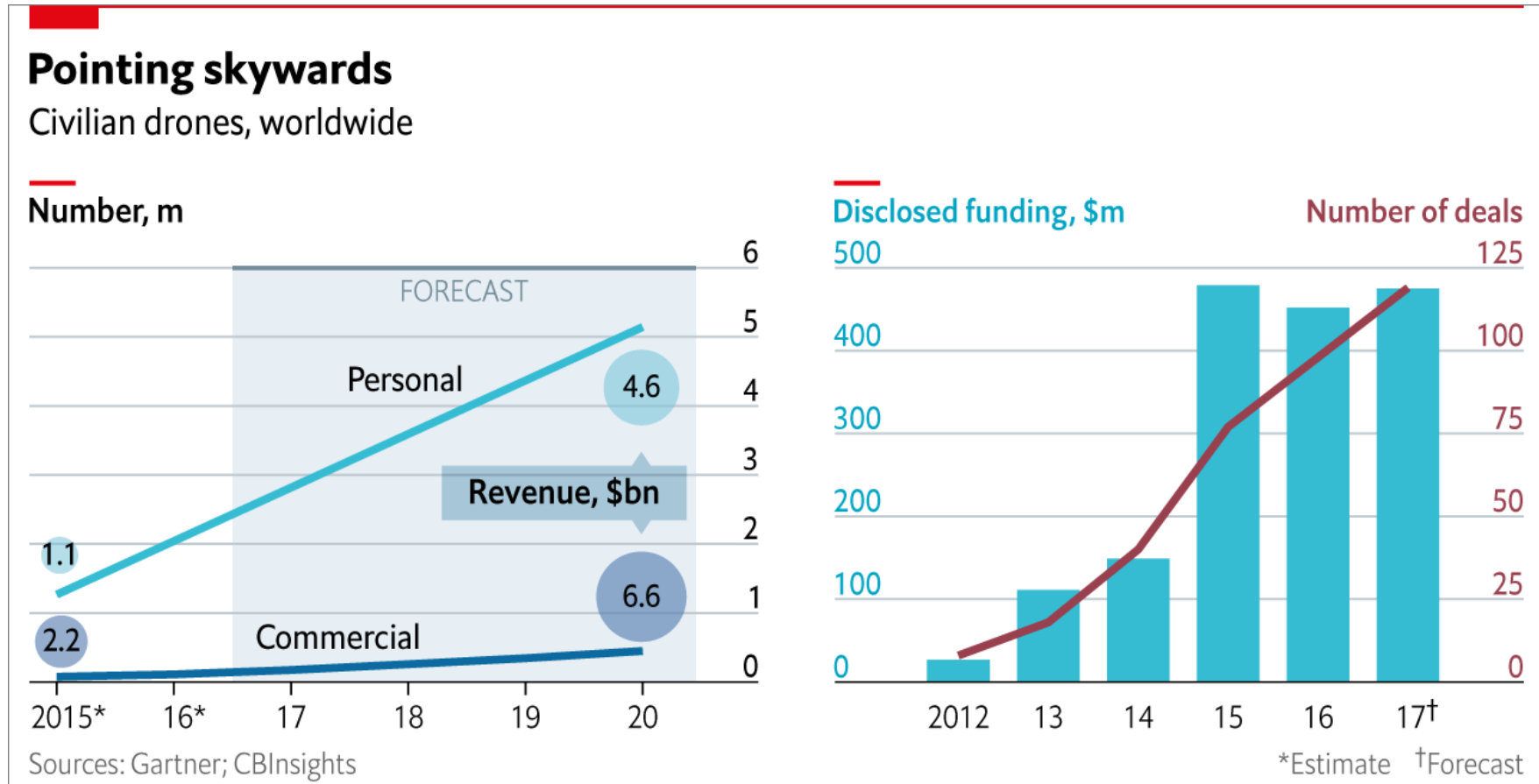
Source: Crunchbase.com; Angelist.com; Company reports; Oppenheimer & Co. Inc.

Drone and Defenses Markets Growing

EVERYONE WANTS A PIECE OF THAT FUTURE ANTI-DRONE DEFENSE MARKET \$\$\$



[The Economist - Taking flight - Civilian Drones - 08Jun2017](#)



Drones Officially Go 'Mainstream' in 2017

GRAB DISPLAY AT THE END OF THE 'PADS' AISLE AT WALGREENS - 29 AUG 2017



You know they've gone mainstream when '*stunt drones*' are at the end of the Walgreen's aisle ...



Walgreens
DRUG STORES

Drone Defenses Gone Wild

INSIDE LOOK AT WHO ARE CONSIDERED EMERGING LEADERS IN 'ROGUE DRONE' DEFENSE



1. Drone Detection & Alerting Systems	2. Air-to-Air: Fighter Drones That Hunt & Shoot Nets at Drones	7. Jamming Cannons Shooting Signals or EMPs
3DEO - LIDAR Detection	Airspace Systems - One-Touch Interceptor	Advanced Protection Systems (DetectDrones.com) - SafeSky
Aaronia - Drone Detector	DelftDynamics.nl - DroneCatcher	Battelle - DroneDefender
Adsys Controls Inc - Sat32	Fortem - DroneHunter - (Formerly Excipio - theissuav.com)	Blighter - AUDES (Anti-UAV Defence System)
Anti-Drone.eu – GROK	Michigan Tech - Robotic Falconry	China's \$19k Drone-Jamming Gun
Aveillant - Gamekeeper 16U - Holographic Radar	Search Systems - SparrowHawk Phase One C-UAV	CTS Technology - Drone Jammer Gun
Black Sage - BST-UAVX (built with SpotterRF)	3. Air-to-Air: Drones with Large Nets That Swoop in & Snag	Digital RF - Cell-block
C Speed LLC - LightWave Radar	Malou Tech - Drone Interceptor MP200	Drone Defense UK - Dynopis E1000MP
CACI - SkyTracker	Search Systems - SparrowHawk v2 C-UAV (2017)	DroneShield - DroneGun
CerbAir - DroneWatch	Tokyo Police - Drone Interceptor	H.P. Wüst - T-Series - RCIEDD Jammers
Chess Dynamics Ltd - AUDES	4. Surface-to-Air Projectiles: Shooting Nets from the Ground	Hensoldt.net (formerly Airbus) - Xpeller C-UAV
DDC LLC - Domestic Drone Countermeasures	BigUrb - Tactical Net Gun	HiGH + MiGHTY (Anti-Drones.net) - SKYNET Rifle
DeDrone.com - DroneTracker	CODA Enterprises - Net Gun	Liteye Systems - AUDES C-UAV
DeTect - DroneWatcher	DIY - Drone Net Gun	MAKE - Build a Raspberry Pi Drone Gun
Digital Global Systems (DGS) - SigBASE	Drone Defense UK - Net Gun X1	MC2 Technologies - Scrambler 300 Rifle
Dronatec - D-FENCE	OpenWorks Engineering - SkyWall 100 Launcher	MCTECH - MC-HORIZON
Drone Labs, LLC - DroneDetector.com	SkyNet - 12 Gauge Shotgun Shell Nets for Drones	Radio Hill - Block 3 Dronebuster and Dronebuster-LE
DroneShield - FarAlert/WideAlert Sensors	Snake River Shooting Products - Drone Munition - 12 Gauge	SESP Group - Drone Defeater
Gryphon Sensors - Skylight	The Net Gun (thenetgunstore.com)	8. Laser Guns – “Directed Energy” Weapons
Kelvin Hughes Limited - SharpEye SxV Radar	X Products - Can Cannon (w Net Gun Ammo)	Boeing - Compact Laser Weapons System
Microflow AVISA - Skysentry AMMS	5. Remotely Hacking Command & Control Signal to Hijack	Lockheed Martin - ALADIN/ATHENA/ICARUS
Mistral Solutions - Sky Archer	AeroTargets International - Gnat C-UAS	MBDA - Laser Effector
ORELIA - Drone-Detector	ApolloShield - CyberBox and Command Center	Poly Technologies - Silent Hunter
Quanergy Systems - Q-Guard - LiDAR X-Drone	Department 13 - Mesmer	Rafael - Iron Beam
Rinicom - SKY PATRIOT	Drone Go Home (DGH)	Raytheon - Phalanx CIWS
Rinicom and METIS Aerospace - SKYPERION	Elbit Systems - ReDrone	Rheinmetall - Oerlikon Skyshield
ROBIN Radar Systems - ELVIRA	Israel Aerospace Industries (IAI) - ELTA Systems - Drone Guard	U.S. Navy - XN-1 LaWS - AN/SEQ-3 Laser Weapon System
Rohde & Schwarz - R&S ARDRONIS-I	Leonardo-Finmeccanica - Selex ES - Falcon Shield	9. Other
SAAB Group - Giraffee AMB Radar - ELSS	Maldrone - First Backdoor for Drones	Confetti Guns
Sensofusion - AIRFENCE	SkyJack - Samy.pl	Patriot Missiles - \$3 million
SpotterRF - A2000 Radar UAVX	SkySafe	
Squarehead Technology - DiscovAir	SRC, Inc. - Silent Archer	
TCI International - Blackbird	6. Falcons & Eagles That Hunt Drones	
Thales - SQUIRE	Guard From Above - Drone Hunting Eagles	

Drone Defenses:

- ~89 products researched

89



More Pricing and Comparisons

PUBLIC EVALUATIONS OF ANTI-DRONE DEFENSIVE PRODUCTS



[DronesX.com - The Anti-Drone Revolution - 22 Companies Building Killer Drone Tech Today - 07Jan2017](http://www.marketsandmarkets.com/Market-Reports/anti-drone-market-177013645.html)

[MarketsandMarkets.com - Anti-Drone Market by Technology - 2022 - Feb2016](http://www.marketsandmarkets.com/Market-Reports/anti-drone-market-177013645.html)

TABLE 65 ANTI-DRONE MARKET- COMPETITIVE ANALYSIS, 2014-2015
<http://www.marketsandmarkets.com/Market-Reports/anti-drone-market-177013645.html>

Company Name	Launch Date	Unit Price (USD)	Technology
The Boeing Company (U.S.)	October 2015	11,000,000	Laser System
Lockheed Martin Corporation (U.S.)	October 2015	NA	Electronic System
Israel Aerospace Industries (Israel)	October 2015	NA	Electronic System
Raytheon Company (U.S.)	October 2014	6,360,000	Laser Systems
Dedrone GMBH (Germany)	October 2015	NA	Electronic System
Orelia (France)	October 2015	36,000	Electronic System
Rafael Advanced Defense Systems Ltd. (Israel)	October 2015	NA	Laser System
Airbus Group SE (Netherlands)	September 2015	500,000	Electronic System
Saab AB (Sweden)	September 2015	NA	Electronic System
Thales Group (France)	September 2015	NA	Electronic System
Rheinmetall Defense Electronics GmbH (Germany)	September 2015	NA	Laser System
Selex ES SPA (Italy)	September 2015	311,000	Electronic System
SRC Inc. (U.S.)	August 2015	NA	Electronic System
DDC-LLC (U.S.)	June 2014	40,000	Sensors/Acoustic
Droneshield (U.S.)	May 2015	5000	Sensor Systems
Blighter Surveillance Systems (U.K.)	May 2015	1,200,000	Electronic System
Search Systems Ltd. (U.K.)	May 2015	NA	Electronic System
China Jiuyuan Hi-Tech Equipment Corporation (China)	November 2014	NA	Laser System
Pwnie Express (U.S.)	NA	1,500	Anti-hacking solutions and software
Detect, Inc. (U.S.)	NA	NA	Electronic System

Source: Annual Reports, Press Releases, and MarketsandMarkets Analysis

Table 35: Detection and tracking systems evaluation results

	Weighted Performance Score	Minimum Durability Standards	Initial Cost (\$ k)	Operational Cost (\$ k)	Recommendation Notes
DeTect, DroneWatcher	83.8*	Meets Standards*	400	22	Strong
Gryphon Sensors, Skylight	80.0	Meets Standards	<1000	50	Strong
Adsys Controls, SATS2	74.5	Meets Standards	200	20	Strong
Drone Go Home	71.9	Meets Standards*	0	54	Acceptable
Gryphon Sensors, Hawk	68.9	Meets Standards	235	15	Acceptable
Robin Radar Systems, ELVIRA	67.7	Meets Standards	190	28	Acceptable
C Speed, LightWave Radar	64.7*	Meets Standards	<1000	20	Acceptable

Table 36: Interdiction systems evaluation results

	Weighted Performance Score	Minimum Durability Standards	Initial Cost (\$ k)	Operational Cost (\$ k)	Recommendation Notes
HiGH + MIGHTY, SKYNET	70.2*	No	35	unknown	Unacceptable*
Battelle, DroneDefender	59.6	Meets Standards	unknown	unknown	Acceptable*
Theiss, EXCIPIO	54.7	No	12	unknown	Unacceptable*
OpenWorks, SkyWall	46.0*	No*	unknown	unknown	Unacceptable

Table 37: Detection and interdiction hybrid systems evaluation results

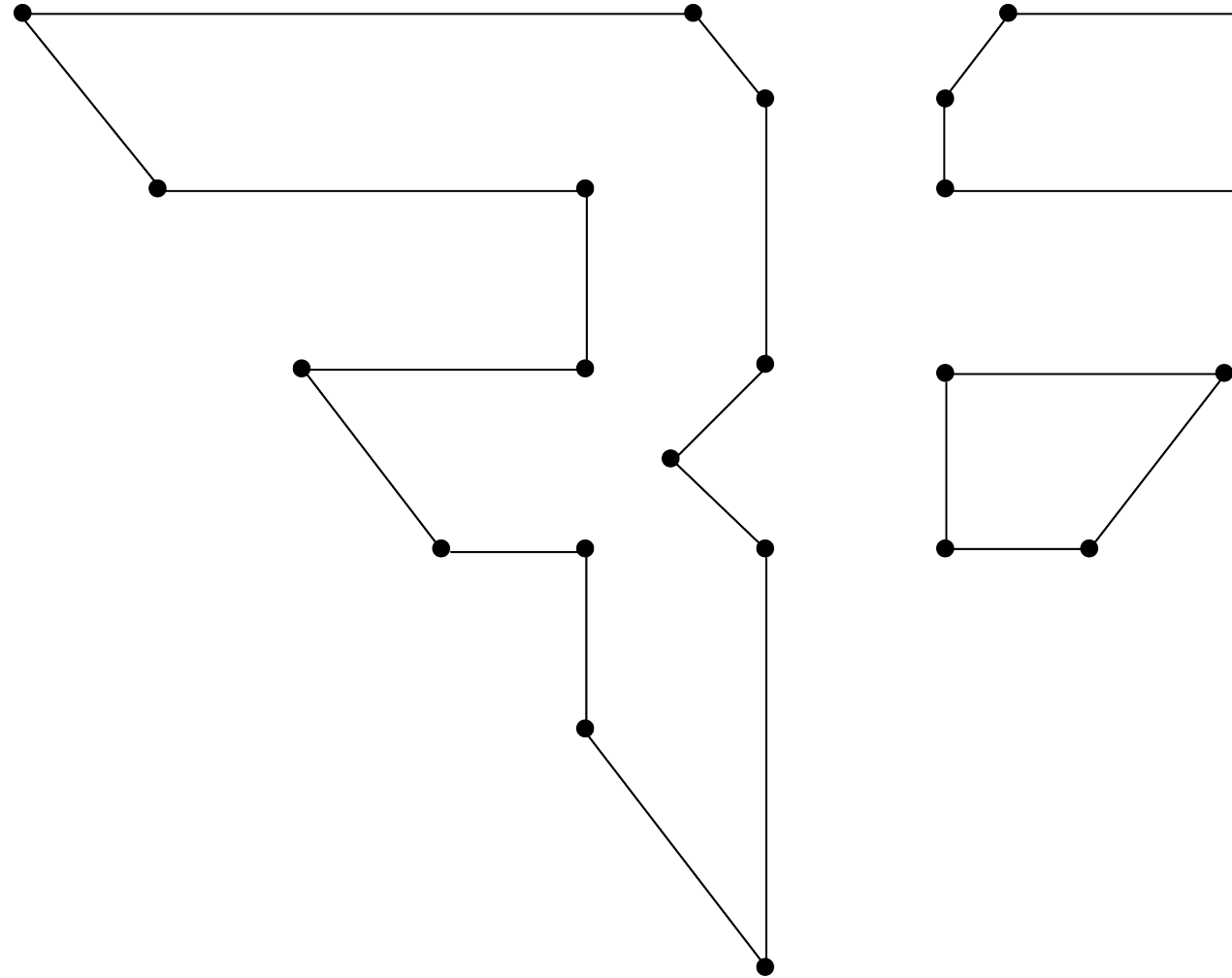
	Weighted Performance Score	Minimum Durability Standards	Initial Cost (\$ k)	Operational Cost (\$ k)	Recommendation Notes
Liteye, AUDES	82.5*	Unknown*	unknown	unknown	Strong
Airbus, Counter UAV System	77.5*	Meets Standards	unknown	unknown	Strong
R&S, ARDRONIS-1	72.6*	Meets Standards*	700	unknown	Strong
DeDrone, DroneTracker	72.4*	Meets Standards*	unknown	unknown	Acceptable
Department 13, MESMER	72.2*	Meets Standards	200	400	Acceptable





MESMER
COUNTER DRONE
DEPARTMENT 13

**EXAMPLE HIGHLIGHT:
MARKETING GETTING A
LITTLE AHEAD OF ITSELF**



Example: Marketing a Little Ahead of Itself

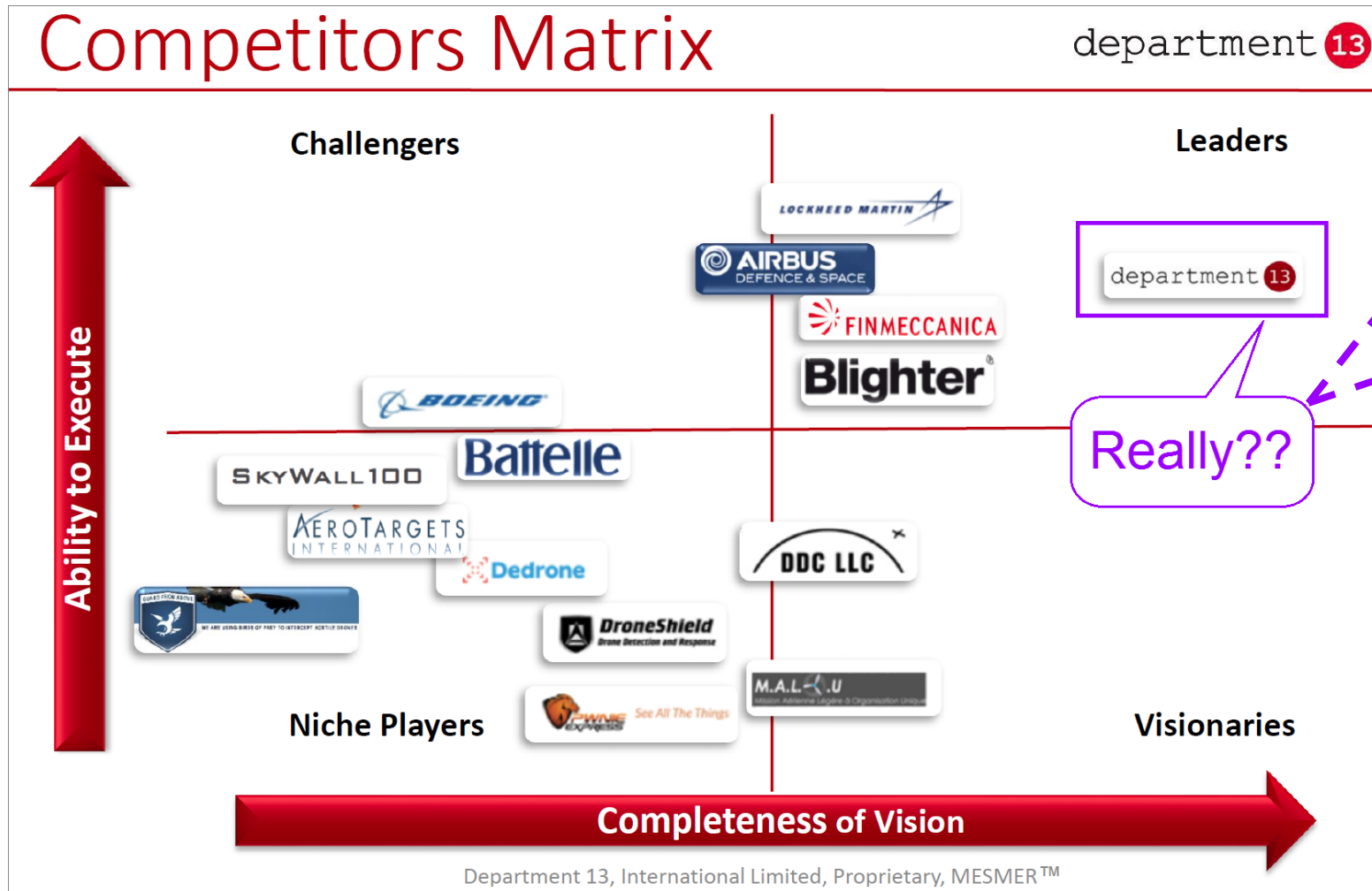
SIGNS OF AN IMMATURE 'DRONE DEFENSE' INDUSTRY - MARKETING MATERIALS VS. REALITY



MESMER
COUNTER DRONE
DEPARTMENT 13

Competitors Matrix

department 13



Date of PDF:

- 04 July 2016

Date of v1.0 Product Released:

- 23 Jan 2017

*Apparently, they considered themselves ahead of Boeing, Lockheed, etc. -- even though they were **still 6 months away** from their **v1.0 release**.*

Example: Marketing a Little Ahead of Itself

SIGNS OF AN IMMATURE 'DRONE DEFENSE' INDUSTRY - MARKETING MATERIALS VS. REALITY



~\$200k

Hijacking command and control signal, or "*mesmerizing*" the drone (as they say)

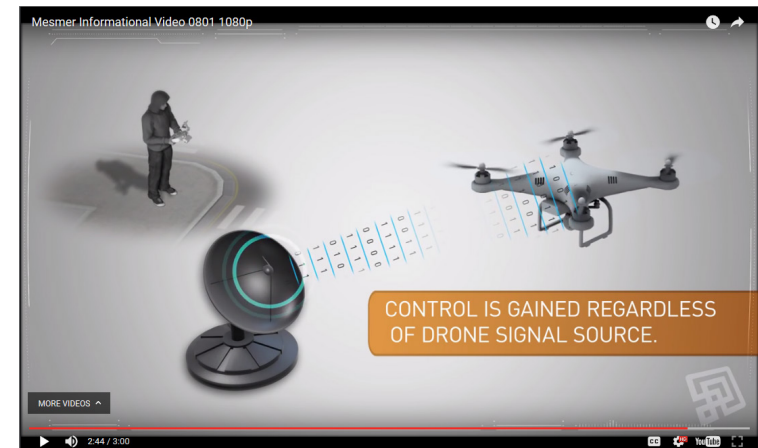
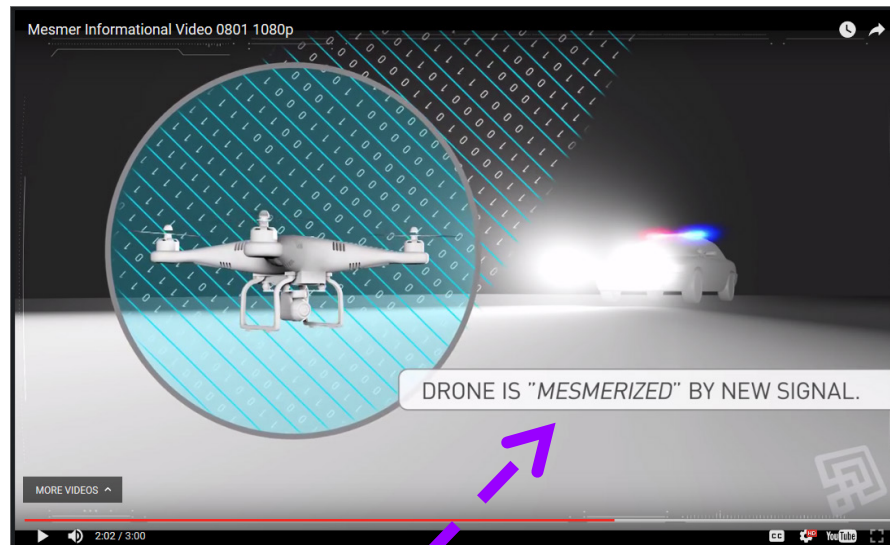


Figure 1 Mesmer V1

"Mesmerized"???



Mesmer - Department 13 - Counter Drone System - Hijack Command and Control Signal

• <https://department13.com/mesmer/>

Example: Marketing a Little Ahead of Itself

SIGNS OF AN IMMATURE 'DRONE DEFENSE' INDUSTRY – MARKETING MATERIALS VS. REALITY



[Popular Science - No one knows the best way to stop a drone - 09Feb2017](#)



A new system competing in this space is MESMER, by Virginia-based Department13. MESMER debuted last month in a segment on [drone countermeasures on the Today Show](#). According to Department13 CEO Jonathan Hunter, it's "a non-kinetic means of taking commercial drones and controlling, truly controlling the airspace." Which is to say: if it works as designed and tested, MESMER can stop drones without crashing them or shooting them.

To block those radio signals, the U.S. Army spent \$17 billion on jammers, with mixed results. Department 13's approach, which led them to MESMER, wasn't to jam the radio signals, but instead find out everything about the radio sending the signals and then send a more sophisticated signal to override it instead.

"What we're doing is we're essentially communicating the same language of the drone," says Hunter. "So when we do our transmission to take over the drone, essentially we're talking the same language, we're not beating it with power. I don't have to yell louder, I just have to speak the same language. Once we're speaking the same language, it will only listen to me."

What if the drone signal is encrypted?

Yeah, good question!!

"Most people don't implement encryption well," says Hunter, after noting that MESMER doesn't decrypt encryption. It can do a password search if need be, but mostly the software is looking to find pathways into the drone's controls that don't require breaking through any secure channels.

I should note, at this point, that *Popular Science* hasn't witnessed MESMER in demonstration yet. There is footage of it on the today show and in an explainer video at Department13's site, and Hunter says they've demonstrated the technology for a long list of potential customers, including the Department of Defense and the Australian Defense Forces. And, perhaps most confusingly, MESMER is both a system-in-a-box and a kind of software than customers will ultimately work into their existing networks of sensors and jammers.

"We also like to think of it as software, but in order to sell software you have to have hardware, so what we do is build a reference platform," says Hunter. "We've found most people have a hard time wrapping their heads around it. People want to buy a black box, so here's a black box."

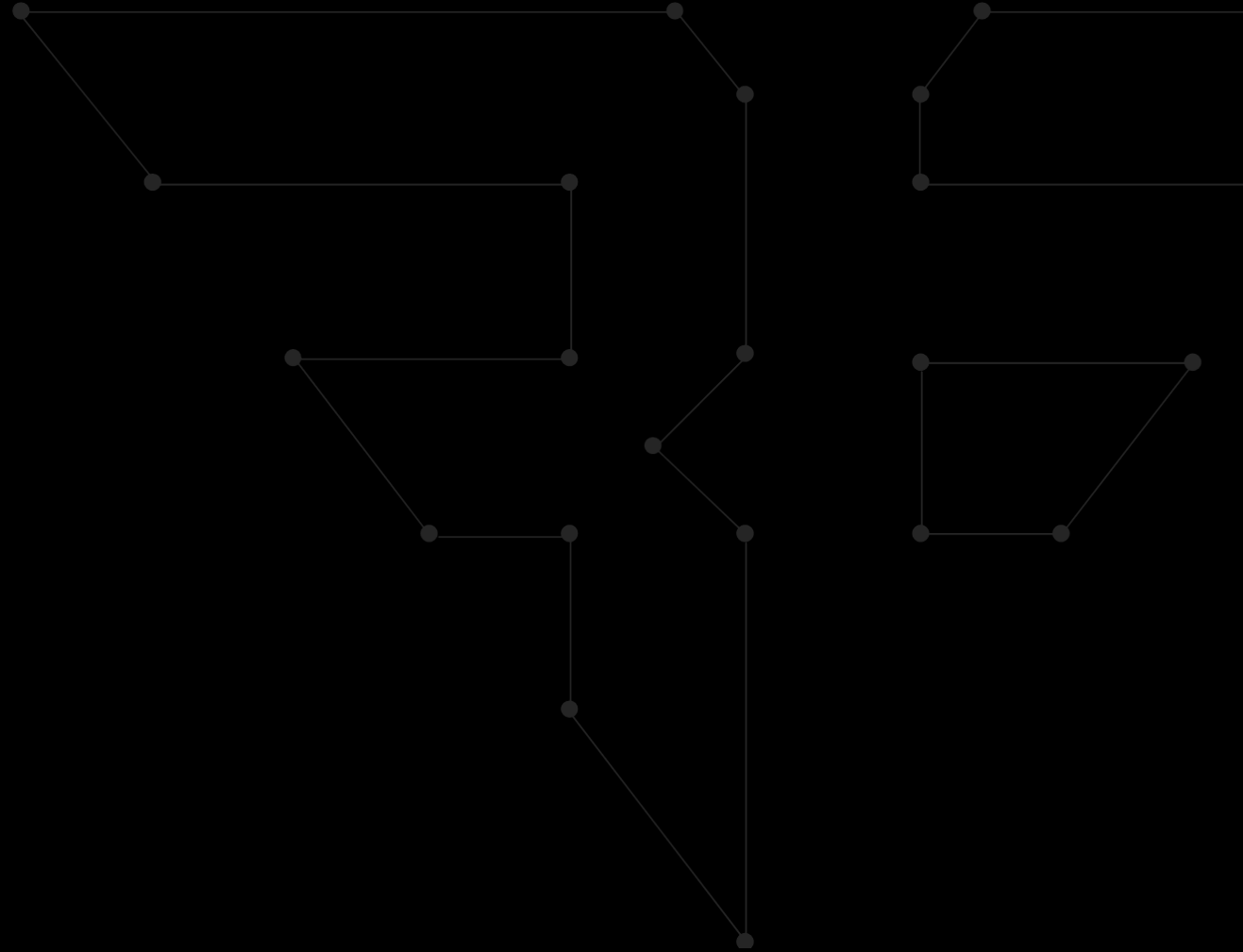
"Here is to hoping the bad guys didn't actually take any time to secure their drone's command and control signal..."

Not surprising, it seems that most drone defense companies just don't want to actually show or sell you their product. It's always a prototype that is 'about to come out'.

Yeah, sure! Who would really want to know how your product works before buying it???

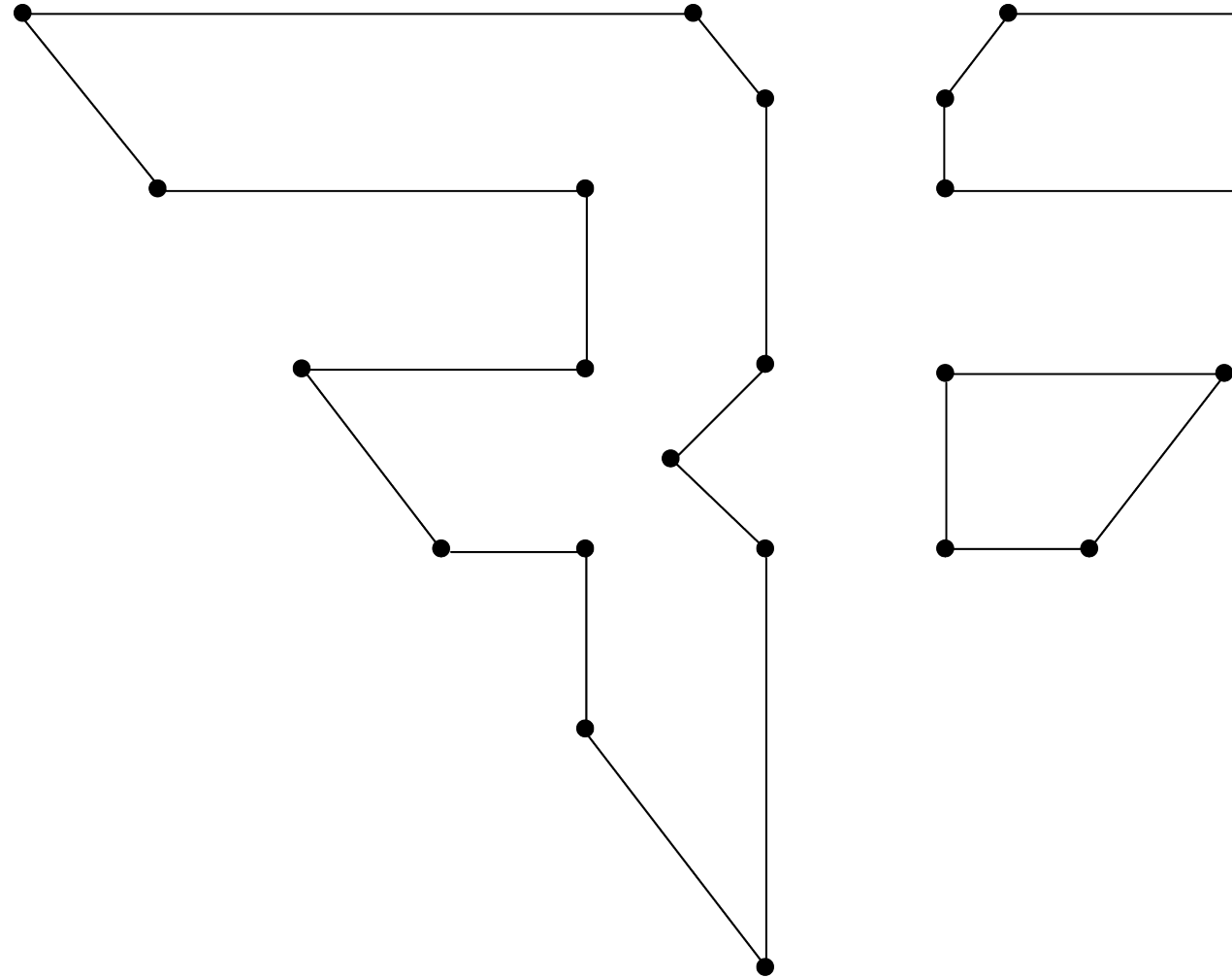
DRONE DEFENSES

THERE ARE NO BEST PRACTICES ... YET





DRONE DETECTION & ALERTING SYSTEMS



Drone Detection and Alerting Systems

LOTS OF WAYS TO FIND / TRACK 'ROGUE DRONES'

- Acoustic
- Sonic/Ultrasonic
- LIDAR
- Radar
- RF
- Visual/Optical/Video
- Infrared (IR)
- Lasers
- Thermal
- WiFi
- ADS-B (Automatic Dependent Surveillance-Broadcast)
- Holographic Radar
- ...



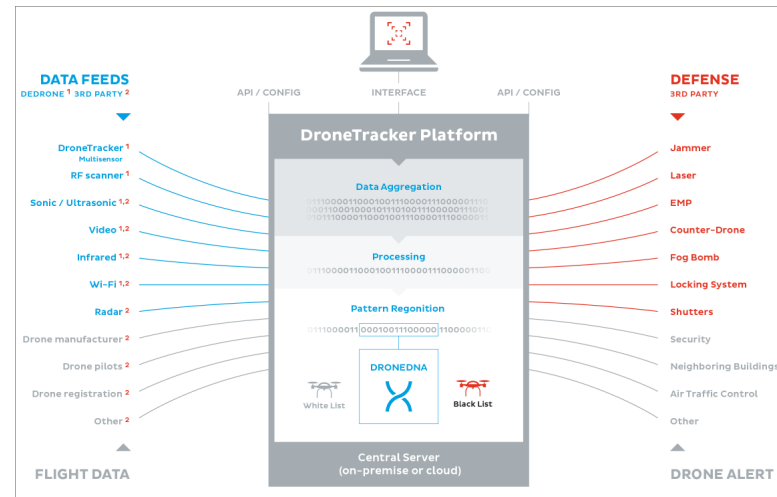
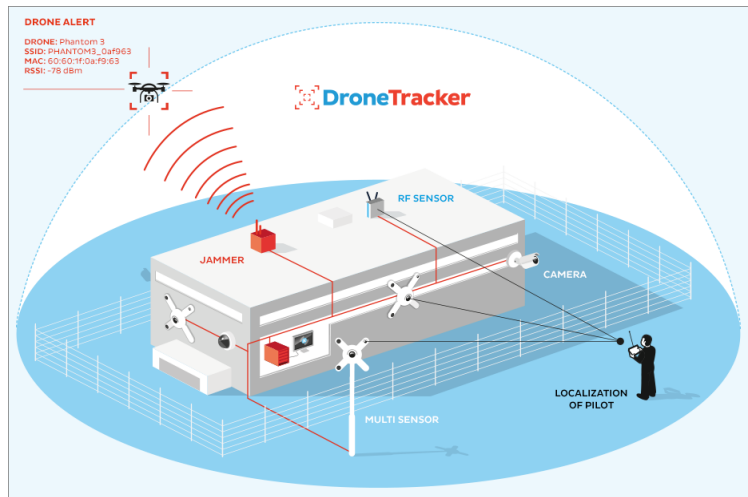
Drone Defenses Gone Wild

NO BEST PRACTICES, SO PENTEST TOOLS NEEDED TO VALIDATE THESE ARE WORKING











[ZDNet- Cisco chairman backs drone security startup \(Dedrone\) in \\$15m Series B round - 14Feb2017](#)

[The Register - Airbus doesn't just make aircraft - now it designs drone killers - 27July2016](#)



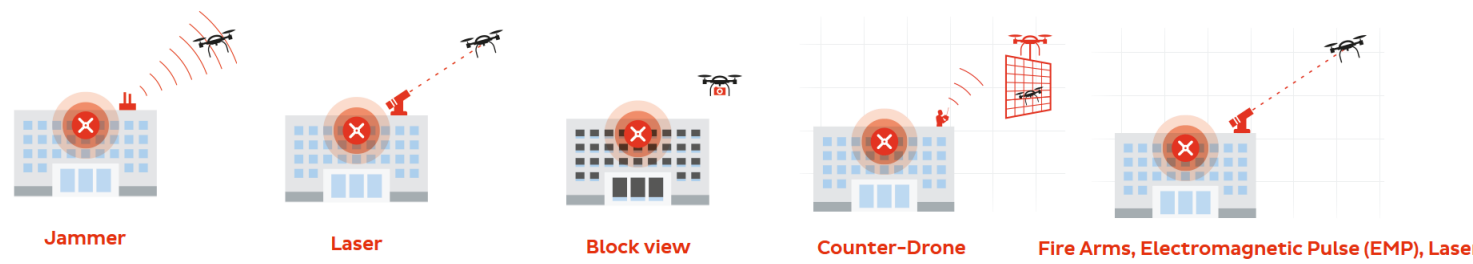
One Software – Many Devices

Scale it to your needs! [Learn more >](#)

 Multi Sensor	 RF Sensor	 Explosion-Protected Camera	 Panorama Camera
 Pan-Tilt-Zoom Camera	 Surveillance Camera	 Jammer System	 Radar System

Automatic countermeasures

Depending on your individual security needs and legal preconditions, you can easily integrate third-party countermeasures into the DroneTracker platform and trigger them automatically via API.



<http://www.dedrone.com>





Drone Defenses Gone Wild

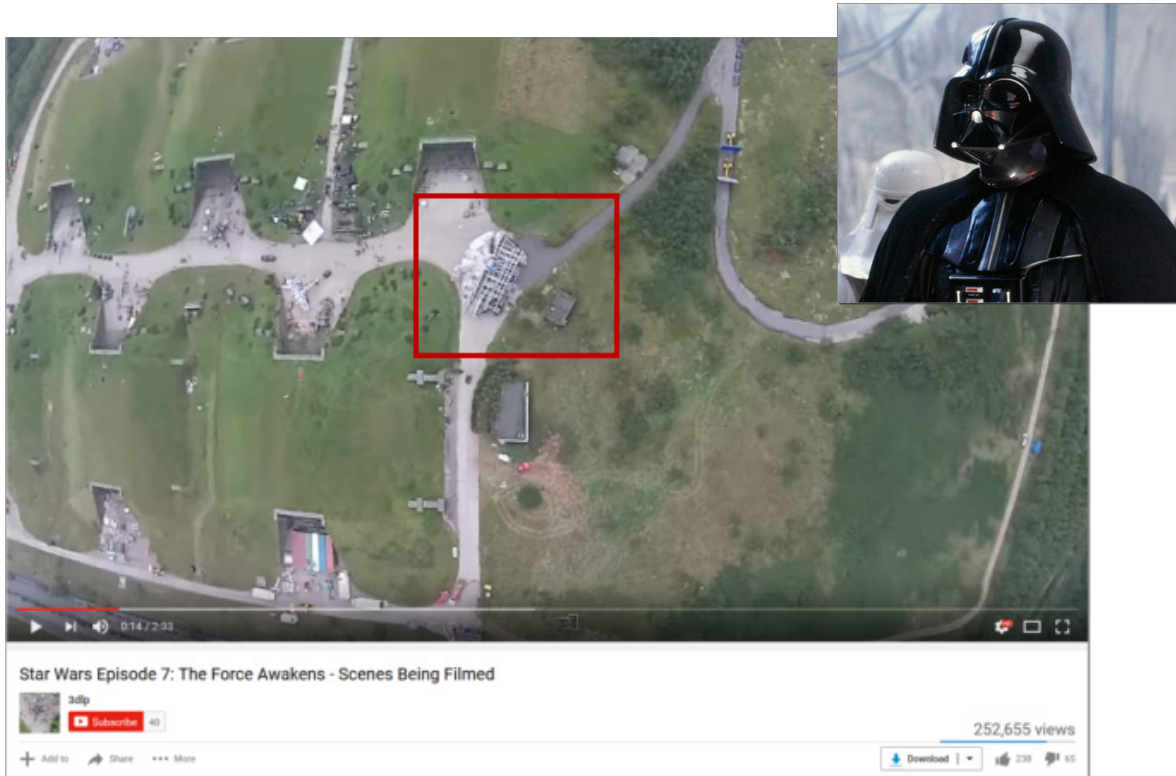
NO BEST PRACTICES, SO PENTEST TOOLS NEEDED TO VALIDATE THESE ARE WORKING



[Gizmodo - The Next Star Wars Movie Has Recruited a Team of Drones to Protect Its Secrets - 22Feb2016](#)

[Motherboard - Star Wars Ordered a 'DroneShield' to Prevent Leaks On Set - 10Sept2014](#)

- *Why monitor a problem if you don't do anything about it, though?*



PRODUCTS

<p>WIDEALERT SENSOR Broad, Full-Range Drone Detection</p>	<p>FARALERT SENSOR Far-Reaching Drone Detection</p>	<p>DRONEGUN Highly effective drone countermeasure</p>
<p>DRONESHIELD BASEPROCESSOR Drone Detection Without Internet Connection Requirement</p>	<p>DRONESHIELD USER INTERFACE Continuous, Online Monitoring of Local Drone Activity</p>	<p>DRONESENTRY Autonomous Detection & Countermeasure</p>



DroneShield – Drone Detection and Response Products

- <https://www.droneshield.com/products>

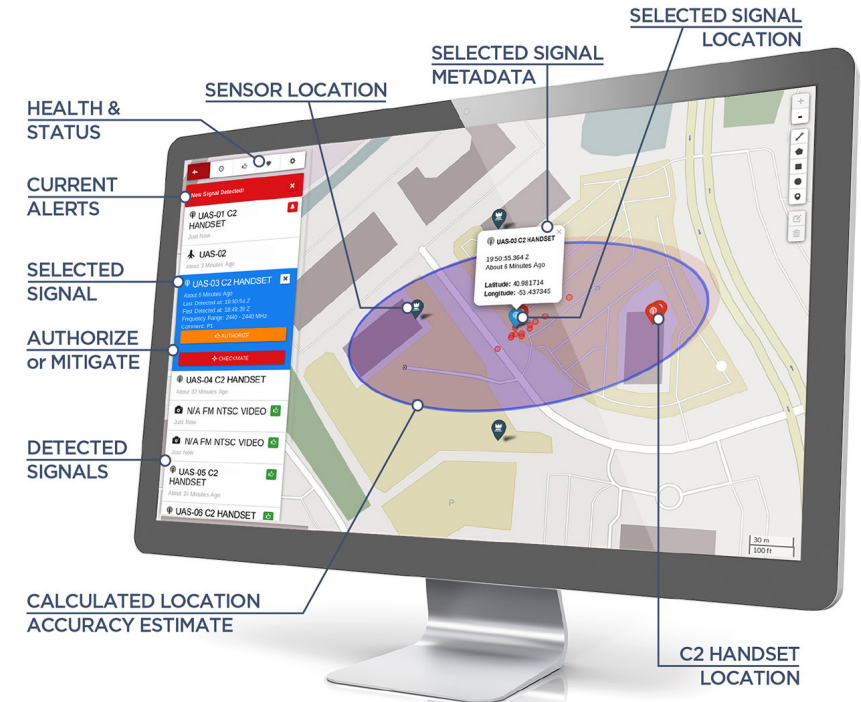
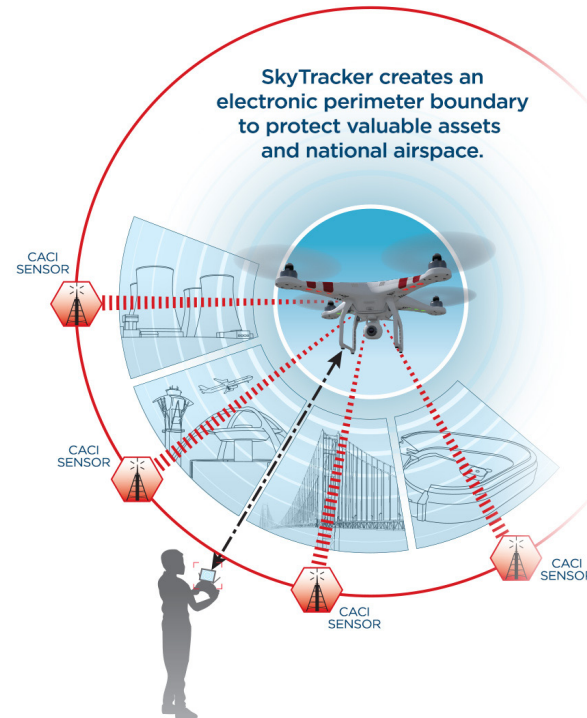
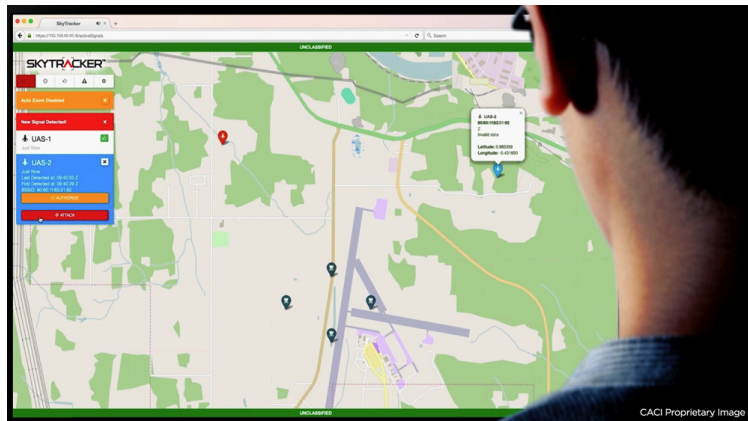
Drone Defenses Gone Wild

DRONE DETECTION AND ALERTING SYSTEMS



[DRONELIFE - What's So Secret About the FAA Contract with CACI? - 06Apr2016](#)

- *“The FAA announced a partnership with CACI, an information services company, and the Department of Homeland Security to create a drone detection system, according to a press release.”*



SkyTracker - by CACI - UAS Precision Tracking System

- <http://www.caci.com/skytracker/>



Drone Defenses Gone Wild

DRONE DETECTION AND ALERTING SYSTEMS



AOPA.org - Sensofusion AIRFENCE - Drone fence arriving in Denver - 03Nov2016



DRONE FENCE ARRIVING IN DENVER

November 3, 2016 | By Jim Moore

Drones approaching sensitive facilities can be instantly identified and tracked; their operators located; and, if need be, the defense system developed by a company called **Sensofusion** can even force the offending drone to land at a location designated in advance—all without need for human intervention. The essential equipment is roughly the size of a wireless router commonly found in homes and offices, or a set-top cable television box. Add an antenna and a computer, and you're up and running. Soon there will be an **Airfence** at **Denver International Airport**.



The **Airfence** system by **Sensofusion** uses a small electronic device to detect and control drones that enter sensitive areas, and will soon be installed at Denver International Airport. Airfence device photo courtesy of Sensofusion.

Sensofusion – AIRFENCE – Drone Detection and Tracking System

- <https://www.sensofusion.com/>



Drone Defenses Gone Wild

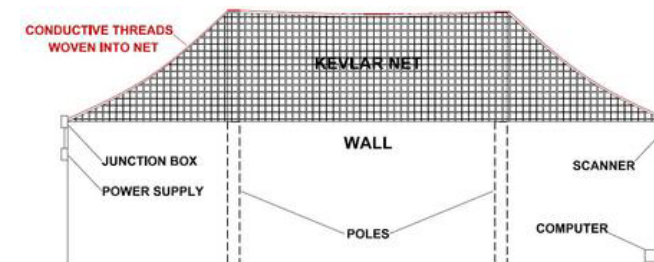
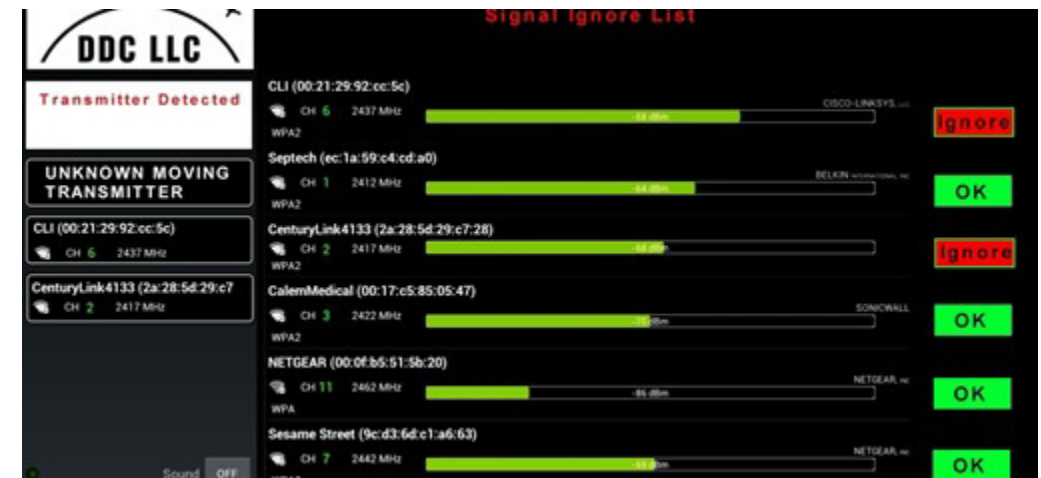
DRONE DETECTION AND ALERTING SYSTEMS

~\$40k



[DDC LLC - Domestic Drone Countermeasures - Drone Detection Systems](#)

- The Basic **Personal Drone Detection System** consists of three boxes: a Primary Command and Control Module and two Detection Sensor Nodes. These three boxes **create a mesh network** that can triangulate moving transmitters.



DDC LLC - Domestic Drone Countermeasures - Drone Detection Systems

- <http://www.domesticdronecountermeasures.com/home.html>

Drone Defenses Gone Wild

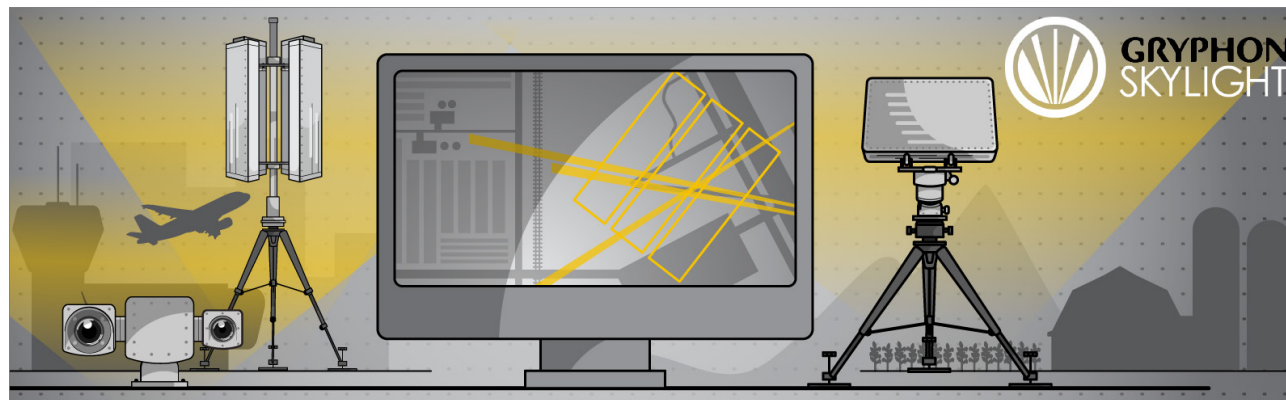
DRONE DETECTION AND ALERTING SYSTEMS

~\$235k

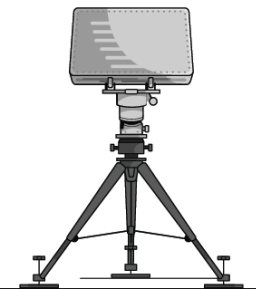


SAMI

SAMI (Skylight Airspace Monitor Interface) is the glue that brings our sensors together to give you a complete airspace picture.



SKYLIGHT SYSTEM MULTISPECTRAL SENSORS



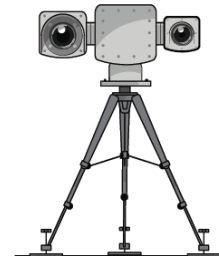
R1400* - PRIMARY RADAR

- Large area, precision surveillance
- Drone security and Detect & Avoid applications
- 10km (sUAS), 27km (General Aviation)
- Low false alarm rate
- Low size, weight and power (SWaP); man transportable



SPECTRUM SENSING (S2)

- Fast target acquisition
- Strong positive confirmation for targets of interest
- Provides line of bearing
- Up to 5km detection range
- Up to 360° coverage



SLEW-TO-CUE CAMERA

- Visual Target Identification
- Optical Tracking
- Thermal and EO lenses
- 3km detection range
- 360° Pan Rotation
- 180° Tilt Rotation



Gryphon Sensors - Skylight - Drone Detection and Tracking

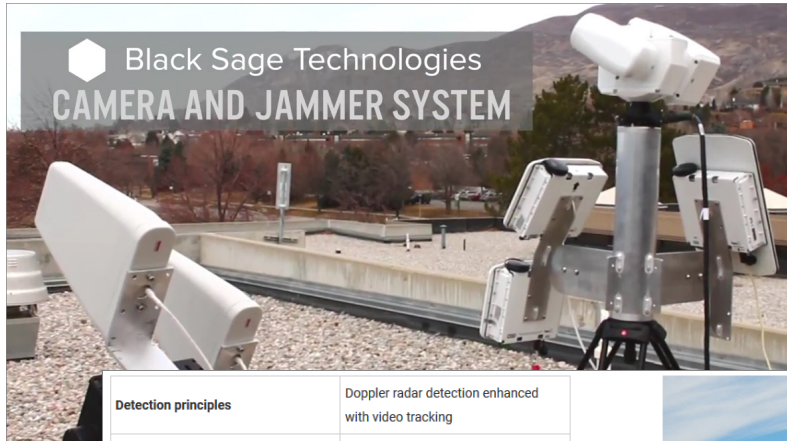
- <http://gryphonsensors.com/products/>

Drone Defenses Gone Wild

DRONE DETECTION AND ALERTING SYSTEMS



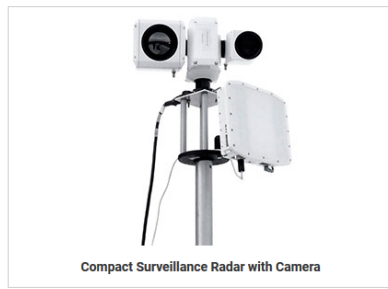
[Wired.com](http://www.wired.com) - An Amazing (Illegal) Plan to Defeat Terrorist Drone Attacks - 28Feb2017



Detection principles	Doppler radar detection enhanced with video tracking
Range	500 m
Coverage angle	90°
Constant Internet connection	Not required



The **Black Sage Technologies BST-UAVX detection and tracking system** comprises the Compact Surveillance Radar augmented by the Daylight Camera and the Thermal Camera, the Mobile Supercomputer for incoming signals processing, and the software for UAVs visualization and saving forensics.



Black Sage's UAVX was recently used in a staged event at a major college campus open-air football stadium with a seating capacity in excess of 60,000 people. The goal of this event was to simulate a terrorist attack using a UAV to fly over the stadium and disperse a nerve agent on the crowd. The test was conducted jointly with Black Sage, The University (which cannot be named), The National Guard, local fire and police departments, and Emergency Management Services.

Event officials utilized a DJI Inspire quadcopter UAV to simulate the attack by flying over the stadium.

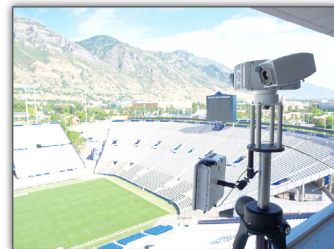
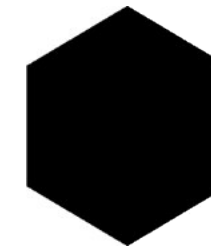


Figure 12-13 - UAVX mounted on tripod at skybox-level with thermal camera system and radar



Black Sage Technologies

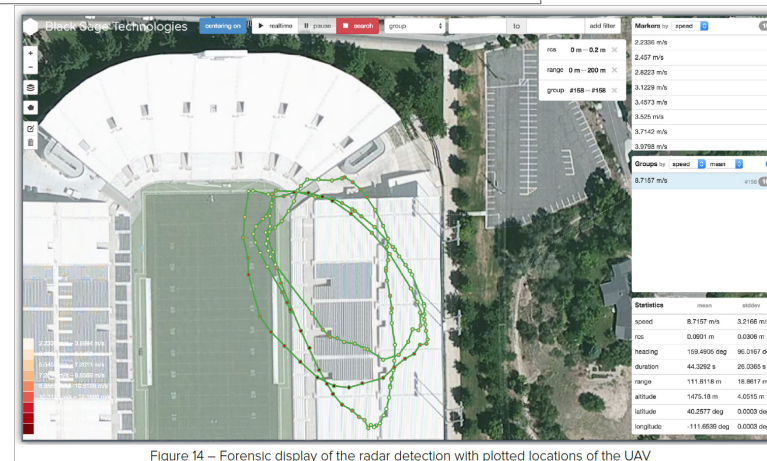


Figure 14 - Forensic display of the radar detection with plotted locations of the UAV

Black Sage - UAVX - BST-UAVX - AI-Based Counter-UAV Radar Detection and Video Tracking System (built with [SpotterRF](http://www.spotterrf.com))

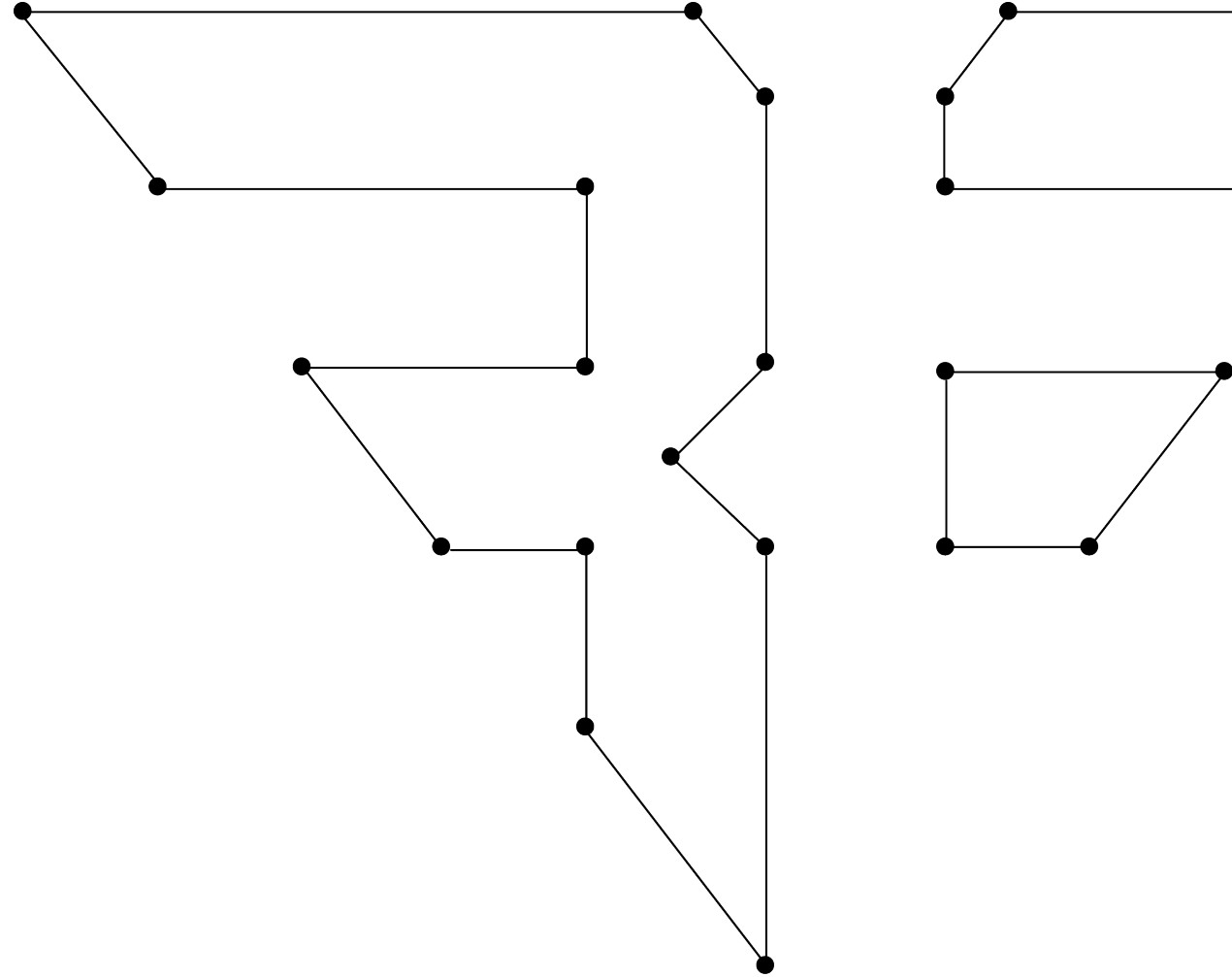
- <https://www.blacksagetech.com/whitepapers/2015/9/26/uav-detection-and-tracking>





PREDATOR BIRD

EAGLES & FALCONS PLUCKING DRONES FROM SKY





Drone Defenses Gone Wild

FALCONS AND EAGLES TRAINED TO ATTACK DRONES



[The Washington Post - Terrorists are building drones. France is destroying them with eagles. - 21Feb2017](#)

[Fox News - Watch a police eagle take down a drone - 01Feb2016](#)



*"I'd like to spend my security training budget on **falconry** classes, please."* –

Every Security Professional Next Year



Guard From Above - Using birds of prey to intercept hostile drones

- <http://guardfromabove.com/>

Drone Defenses Gone Wild

FALCONS AND EAGLES TRAINED TO ATTACK DRONES



Initial Investment (example) Prices excluding VAT and depending on availability of birds



1 GFA Team (Bird and Birdhandler training):

GFA Bird <small>(365 days specialist training, caretaking and drones)</small>	EUR 98.000,--	USD 104.370,--
GFA Birdhandler Training (20 days)	EUR 25.000,--	USD 26.625,--
GFA Training/Deployment equipment	EUR 4.000,--	USD 4.260,--
Additional advice <small>((estimate)For example: export/transport)</small>	EUR 20.000,--	USD 21.300,--
Total Investment:	EUR 147.000,--	USD 156.555,--

Long term Investment

- Eagles live around 60-80 years
- Deployable for 40 years

Guard From Above - Using birds of prey to intercept hostile drones

- <http://guardfromabove.com/>



Drone Defenses Gone Wild

FALCONS AND EAGLES TRAINED TO ATTACK DRONES



Life-cycle cost analysis (LCCA) example

Yearly cost per 1 GFA trained Bird of prey for 1 year (365 days):

Bird quarters Construction (Basic)	EUR 2.000,--	USD 2.130,--
Food	EUR 1.000,--	USD 1.065,--
Medical care (Perodic checks and basic care)	EUR 1.500,--	USD 1.597,50
Individual Equipment (yearly)	EUR 1.500,--	USD 1.597,50
Contingencies	EUR 500,--	USD 532,50
Training drones (depending on the client demand: Brand/type)	EUR	USD
Daily caretaking and training (by client staff 365x 1,5 h (547,5 hours))	EUR	USD
Total yearly investment (for 1 bird)	EUR 6.500,--	USD 6.922,50

Guard From Above - Using birds of prey to intercept hostile drones

- <http://guardfromabove.com/>



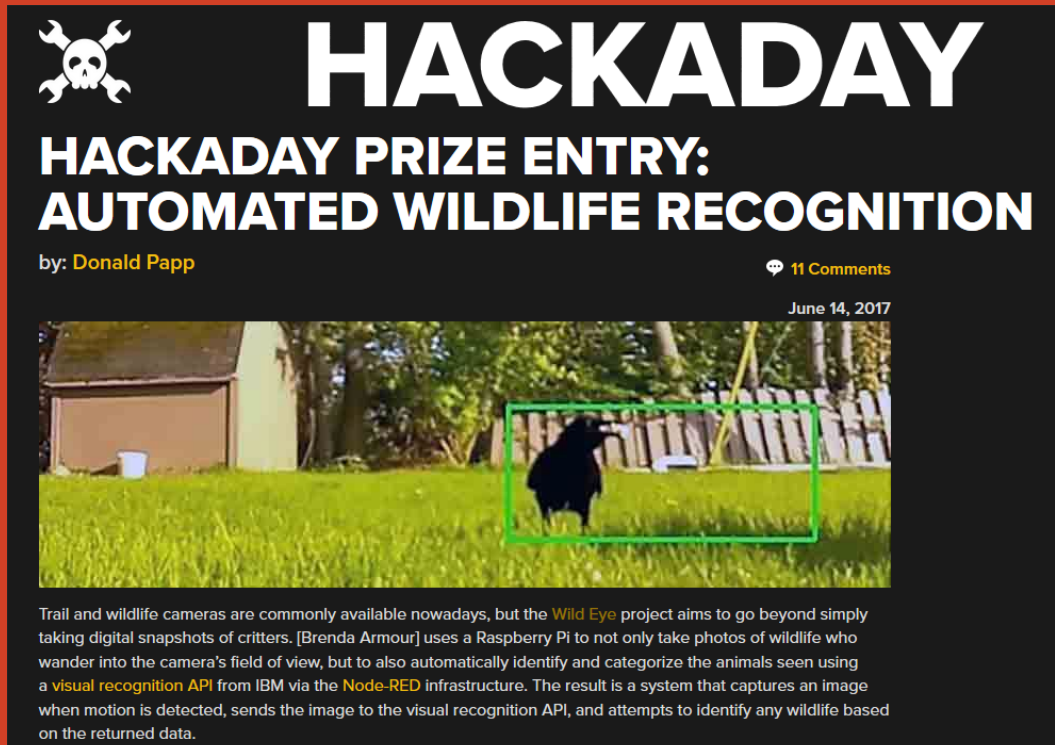
Defeating Birds of Prey Defenses

FALCONS AND EAGLES TRAINED TO ATTACK DRONES



Detection and response to incoming eagles or falcons.

Detect Incoming Eagles:



HACKADAY
**HACKADAY PRIZE ENTRY:
AUTOMATED WILDLIFE RECOGNITION**
by: Donald Papp 11 Comments
June 14, 2017

Trail and wildlife cameras are commonly available nowadays, but the *Wild Eye* project aims to go beyond simply taking digital snapshots of critters. [Brenda Armour] uses a Raspberry Pi to not only take photos of wildlife who wander into the camera's field of view, but to also automatically identify and categorize the animals seen using a *visual recognition API* from IBM via the *Node-RED* infrastructure. The result is a system that captures an image when motion is detected, sends the image to the visual recognition API, and attempts to identify any wildlife based on the returned data.

Responses: Carrot or Stick



Bacon Countermeasures



OR

Offensive
Countermeasures



Won't "Fly" in the United States

EAGLES ARE PROTECTED AND LIMITED IN PERMITTED USAGE IN THE STATES



<https://www.fws.gov/midwest/eagle/protect/laws.html>



U.S. Fish & Wildlife Service

Bald Eagle

Midwest Region

- Home
- About Bald Eagles and Their Recovery
- Numbers of Bald Eagles
- Places to See Eagles and Eagle Images
- Laws that Protect Bald Eagles
- Post Delisting Monitoring Plan
- Eagle Permits
- Archives: Proposed and Final Rules to Delist
- Links for More Information
- Midwest Region Endangered Species
- Midwest Migratory Birds

Federal Laws that Protect Bald Eagles

Bald and Golden Eagle Protection Act

The bald eagle will continue to be protected by the Bald and Golden Eagle Protection Act even though it has been delisted under the Endangered Species Act. This law, originally passed in 1940, provides for the protection of the bald eagle and the golden eagle (as amended in 1962) by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, **unless allowed by permit (16 U.S.C. 668(a); 50 CFR 22)**. "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb (**16 U.S.C. 668c; 50 CFR 22.3**). The 1972 amendments increased civil penalties for violating provisions of the Act to a maximum fine of **\$5,000 or one year imprisonment** with \$10,000 or not more than two years in prison for a second conviction. Felony convictions carry a maximum fine of \$250,000 or two years of imprisonment. The fine doubles for an organization. Rewards are provided for information leading to arrest and conviction for violation of the Act.

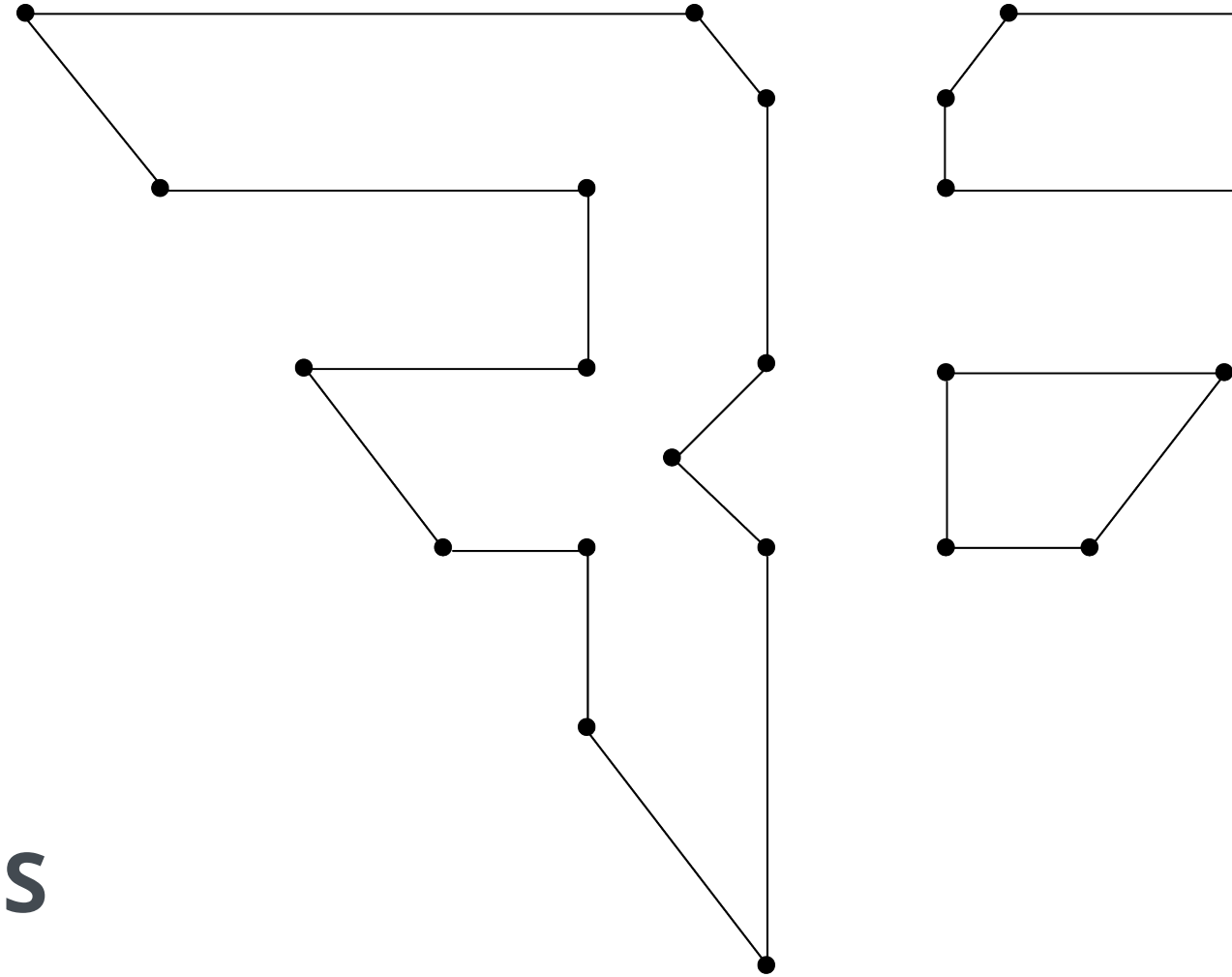


[Go here for more information about the Bald and Golden Eagle Protection Act and permits issued under that Act.](#)



DRONE SHOOTING

SHOOTING NETS AT DRONES FROM THE GROUND



Drone Defenses Gone Wild

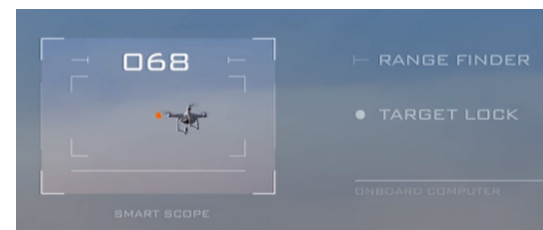
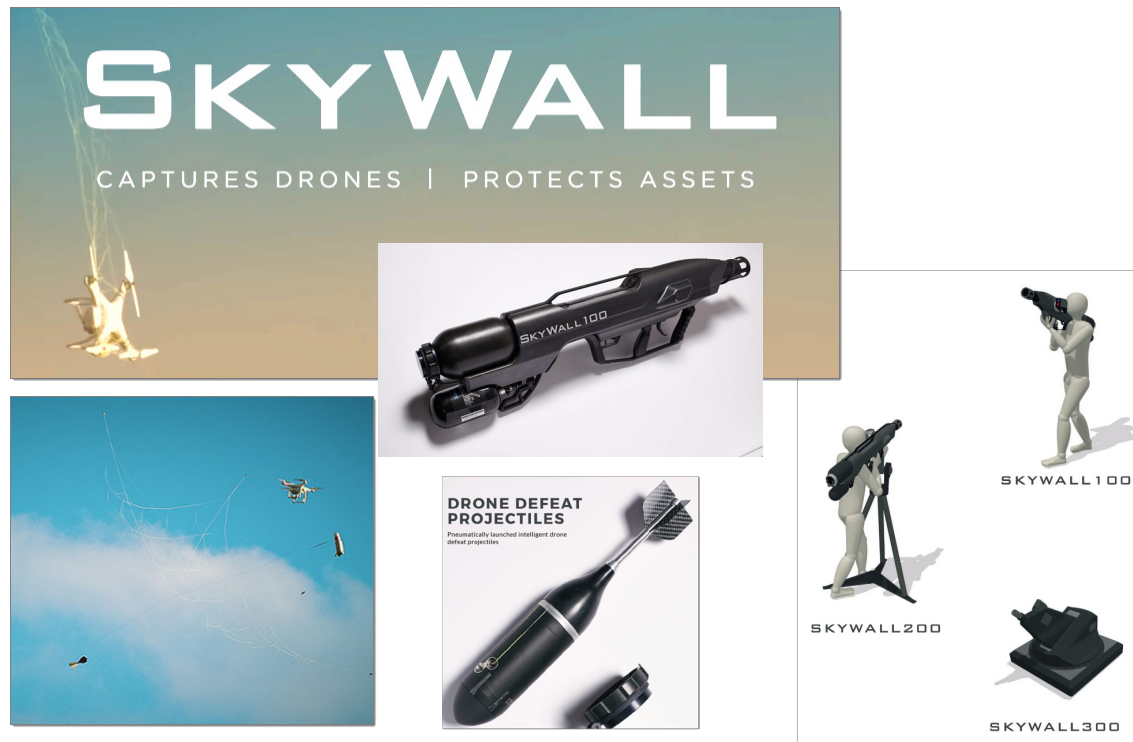
BAZOOKA SHOOTING NETS WITH PARACHUTE AT DRONES

~\$70k - \$80k



[Mashable - SkyWall gun stops drones dead with net, then gives a parachute landing - 05Mar2016](#)

[Popular Science - SkyWall Is A New Anti-Drone Net Bazooka For Police - 07Mar2016](#)



OpenWorks Engineering - SkyWall

- <https://openworksenineering.com/skywall>

Drone Defenses Gone Wild

DRONE NET GUN - SMALL FLASHLIGHT SIZED



DroneDefence.co.uk - Net Gun X1



Net Gun X1 Operation

The Drone Defence Net Gun X1 is a simple to use, versatile & economical device for Law Enforcement & Security Officers to tackle unwanted drone incursions. With two types of capture net the operator can select the appropriate configuration, dependent on the environment. The Type 1 capture net provides an protective barrier wall, which a drone cannot penetrate. Type 2 allows the operator to attempt the direct capture of a drone in flight.



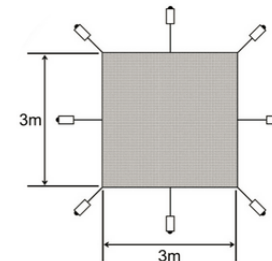
*Depending on capture net type and weather conditions.



Drone Defence - Net Gun X1

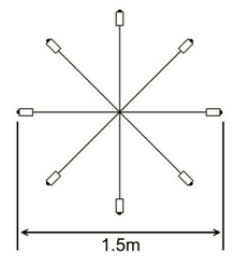
- <http://www.dronedefence.co.uk/net-gun-x1>
- <http://www.net-gun.com/net-gun-spider-brochure.pdf>

Multiple Capture Net Types



Type 1 - Mesh

Effective Range: up to 10m
Net Size: 9 meters squared (3m x 3m)
Mesh Size: 15cm
Deployment Time: 1 second
Velocity: 10 meters per second



Type 2 - Spider

Effective Range: up to 15m
Net Size: 2 meters squared (1.5m radial)
Deployment Time: 1 second
Velocity: 10 meters per second

Drone Defenses Gone Wild

DRONE NET GUN - SMALL FLASHLIGHT SIZED - SPIDER STYLE

~\$500



Standard package

- (1). Net Gun main unit
- (2). Reused catch net
- (3). Reused training net
- (4). 12g CO2 gas bottle x4
not include
- (5). Gas bottle cartridge x2
- (6). Quick-release belt clip
- (7). Collecting net Fixture
- (8). Carrying bag

Quick release belt click

Stand by (at belt) shooting (at belt) quick release shooting

Demonstration

Training Net 3m Catch Net 3m



12 Gram Non-Threaded CO2 Cartridges



BigUrb - Tactical Net Gun

- <https://www.amazon.com/BigUrb-Tactical-Net-Gun/dp/B01N6VRY9D/>
- <http://www.net-gun.com/net-gun-spider-brochure.pdf>



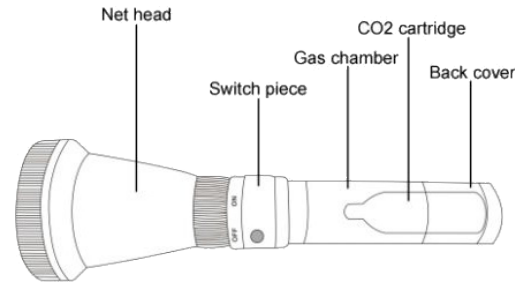
Drone Defenses Gone Wild

DRONE NET GUN - SMALL FLASHLIGHT SIZED

~\$600 - \$800



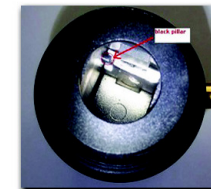
TheNetGunStore.com - Net Guns for Drone Defense - 20Nov2014



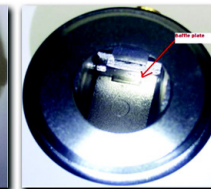
Shoots up to ~45 feet



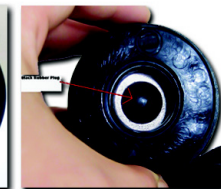
16 Gram Non-Threaded CO2 Cartridges



pic:1



pic:2



pic:3

TheNetGunStore - Net Gun

- <http://www.thenetgunstore.com/product/the-hero-net-gun/>



DEMO: Defeating Net Defenses with Protective Cage

CHICKEN WIRE FOR THE WIN



Chicken Wire Cage = ~\$15

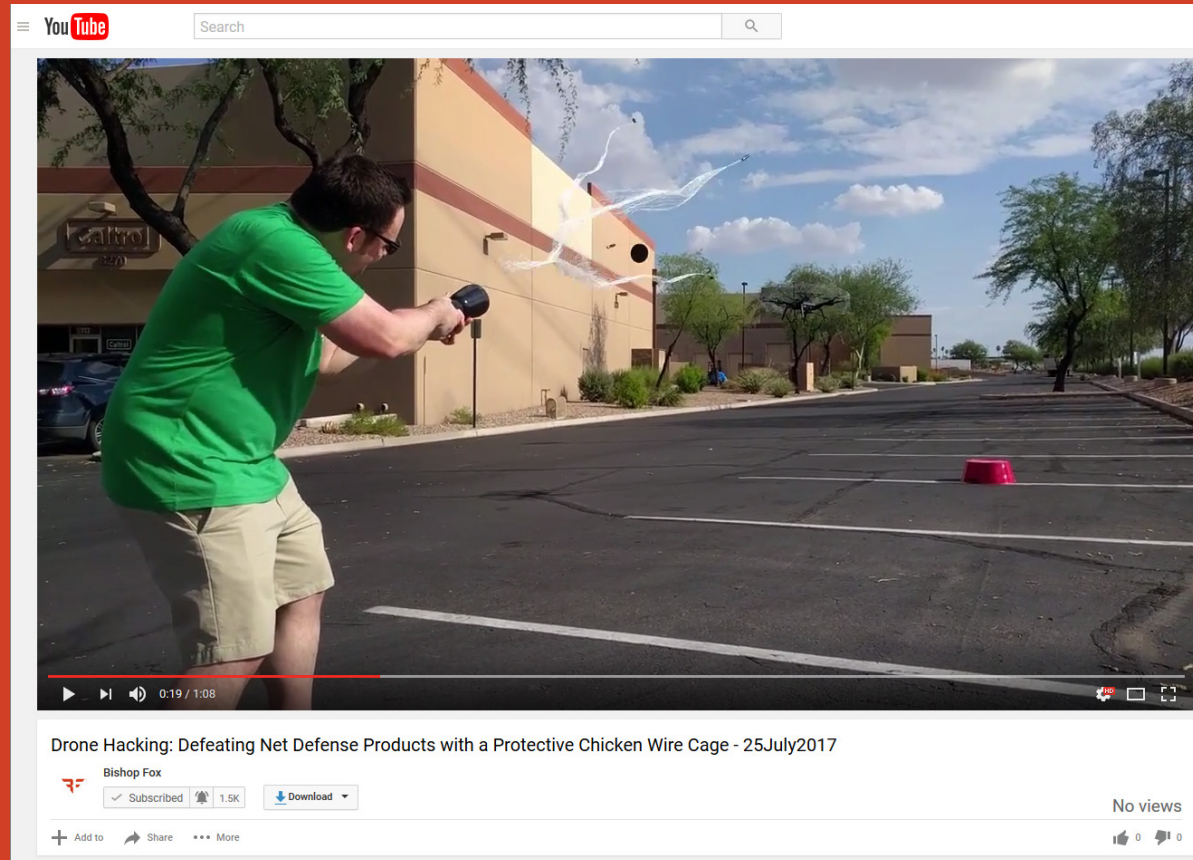
VS.



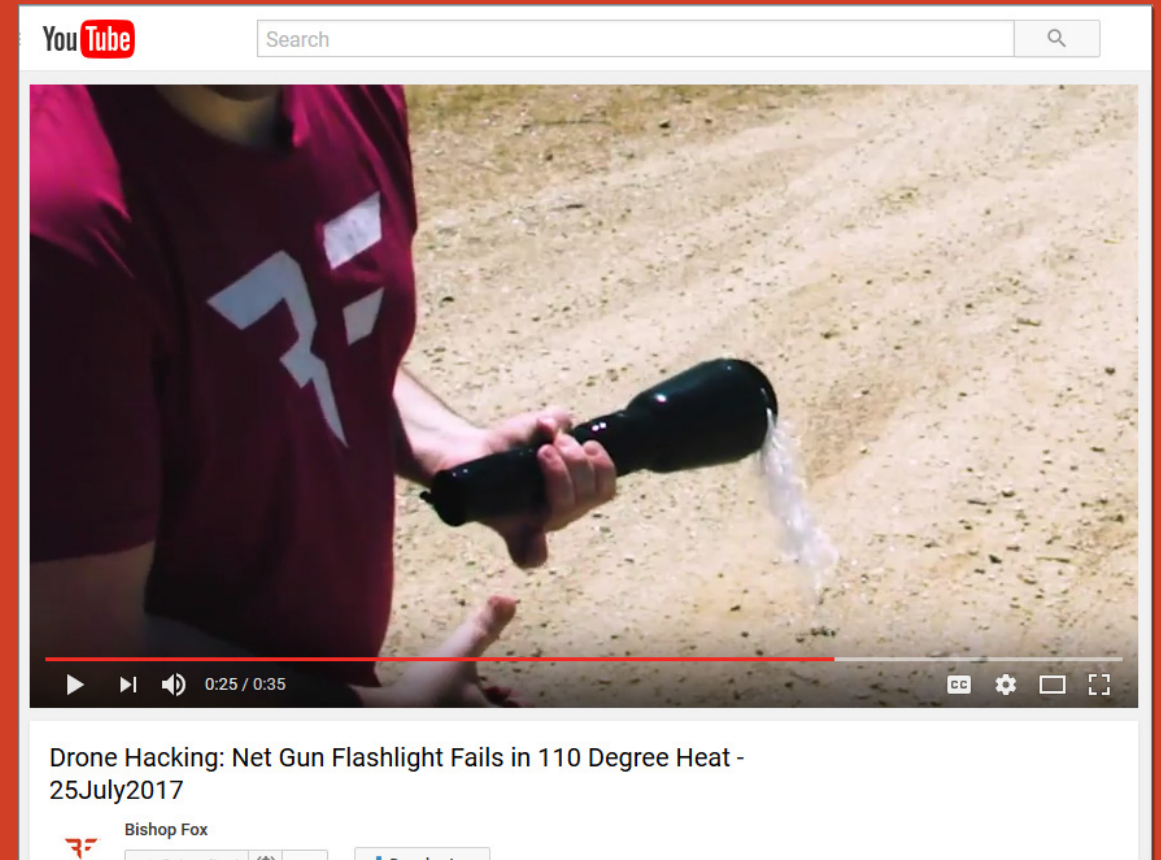
Flashlight Net Gun = ~\$600-\$700

DEMO: Defeating Net Defenses with Protective Cage

CHICKEN WIRE FOR THE WIN, ARIZONA HEAT FOR THE WIN TOO!



https://www.youtube.com/watch?v=m2qSQ5__agA



<https://www.youtube.com/watch?v=jlGdPrhRvBA&t=99>



Drone Defenses Gone Wild

DIY DRONE NET GUN

~\$40 - \$75



[LifeHacker - Build a Drone-Catching Net Gun Out of Basic Plumbing Parts - 24Feb2017](#)

Build a Drone-Catching Net Gun Out of Basic Plumbing Parts

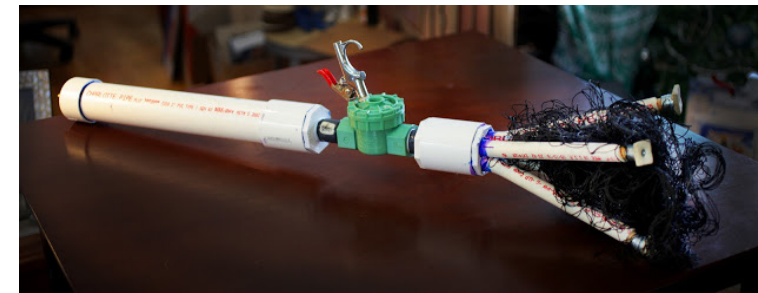
Patrick Allan
2/24/17 4:02pm · Filed to: DIY

lifehacker

NET GUN



If you're looking for a way to shoot down snooping drones in the near dystopian future, or just want to pretend to be Batman, this fun DIY build is for you.



DIY Net Gun for Drones - William Osman

- <http://www.williamosman.com/2016/12/diy-net-gun.html>

Drone Defenses Gone Wild

DRONE NET GUN SHOTGUN SHELLS

~\$20 for 3 shells



[Advanced Ballistics Concepts - Skynet™ Drone Defense](#)



SKYNET – Drone Defense – Shotgun Net Shells

- <http://store.mibullet.com/skynetdronedefense.aspx>

DEMO: Defeating Net Defenses with Protective Cage

SHOTGUN SHELLS WIN



Chicken Wire Cage = ~\$15

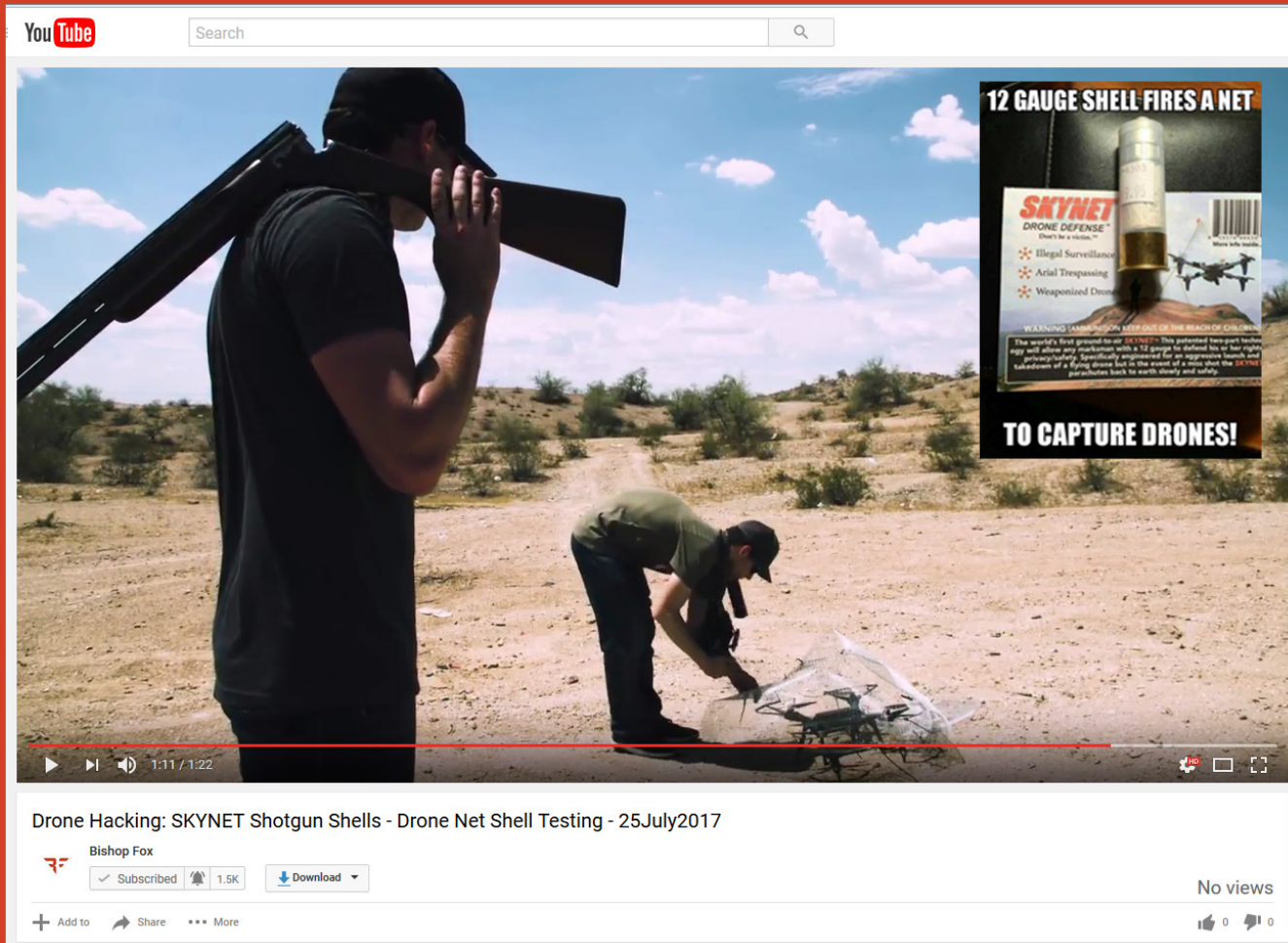
VS.



SkyNet Drone Net Shotgun Shells (3 pack) = ~\$20

DEMO: Defeating Net Defenses with Protective Cage

SHOTGUN SHELLS WIN



The video player shows a man in a black t-shirt and cap carrying a shotgun on his shoulder, looking towards another man in a green shirt who is crouching in a field. A drone is on the ground. An inset image shows a product box for 'SKYNET DRONE DEFENSE' with a 12 gauge shell. The box text includes: '12 GAUGE SHELL FIRES A NET', 'SKYNET DRONE DEFENSE', 'Don't let a drone...', 'Illegal Surveillance', 'Aerial Trespassing', 'Weaponized Drones', 'WARNING: LAMBDA-1000 KEEP OUT OF THE REACH OF CHILDREN', and 'TO CAPTURE DRONES!'. The video player interface includes a search bar, play button, volume, and progress bar.

Drone Hacking: SKYNET Shotgun Shells - Drone Net Shell Testing - 25July2017

Bishop Fox

Subscribed 1.5K Download

No views

Add to Share More



X Products - Can Cannon - w/ Net Launcher

PROTOTYPE AMMO - WITH ANTI-DRONE NET PROJECTILE LAUNCHER



<https://www.xproducts.com/product-category/can-cannon-and-launchers/>

[The Firearm Blog - X Products Can Cannon Net Launcher and Grappling Hook Prototypes - 01Apr2015](#)



X Products - Can Cannon:
Soda Can Launcher (AR-15)



Blanks



Grappling Hook



WIRED
How to Shoot Down a Drone | WIRED

Concept Sketches: IR Proximity Projectile Type Net Launcher

From Left Above: Telescoping Rifle Grenade Shaped Projectile; Sketch Of Electric Primer Powered Net Projectile; Alibaba IR Proximity Switch; Edwards CO2 Jet Cartridge Powered Net Guns With Net Partially Ejected, CO2 Cartridge Powers Projectiles And Net Is Pulled In Drogue Format.

Original Concept Sketches: Muzzle Blast Type Net Launcher

Above: James Malarkey Concepts For Direct Fire Net Gun Powered By Blank Round Muzzle Blast, NOTE: Projectiles Are Attached To The Net.

Concept Sketches: IR Proximity Projectile Type Net Launcher

Can Cannon Net Round Attack Profile:

Estimated Range: 350 - 400 Feet

Above: User Activates Projectile, IR Sensor Transmits After Accelerometer Signal, Object In Field Reflects IR Beam To Detector, Net Fires Capturing Drone. NOTE: Net Projectile Parachutes For Re-Use And Remains Connected To Net Over Entangled Drone Acting To Further Weigh Target Down.

18317_KENT.pdf - 18317 - Anti-Class One Drone and Multi-Purpose 66mm Launch System For The M-4 Carbine - 02May2016

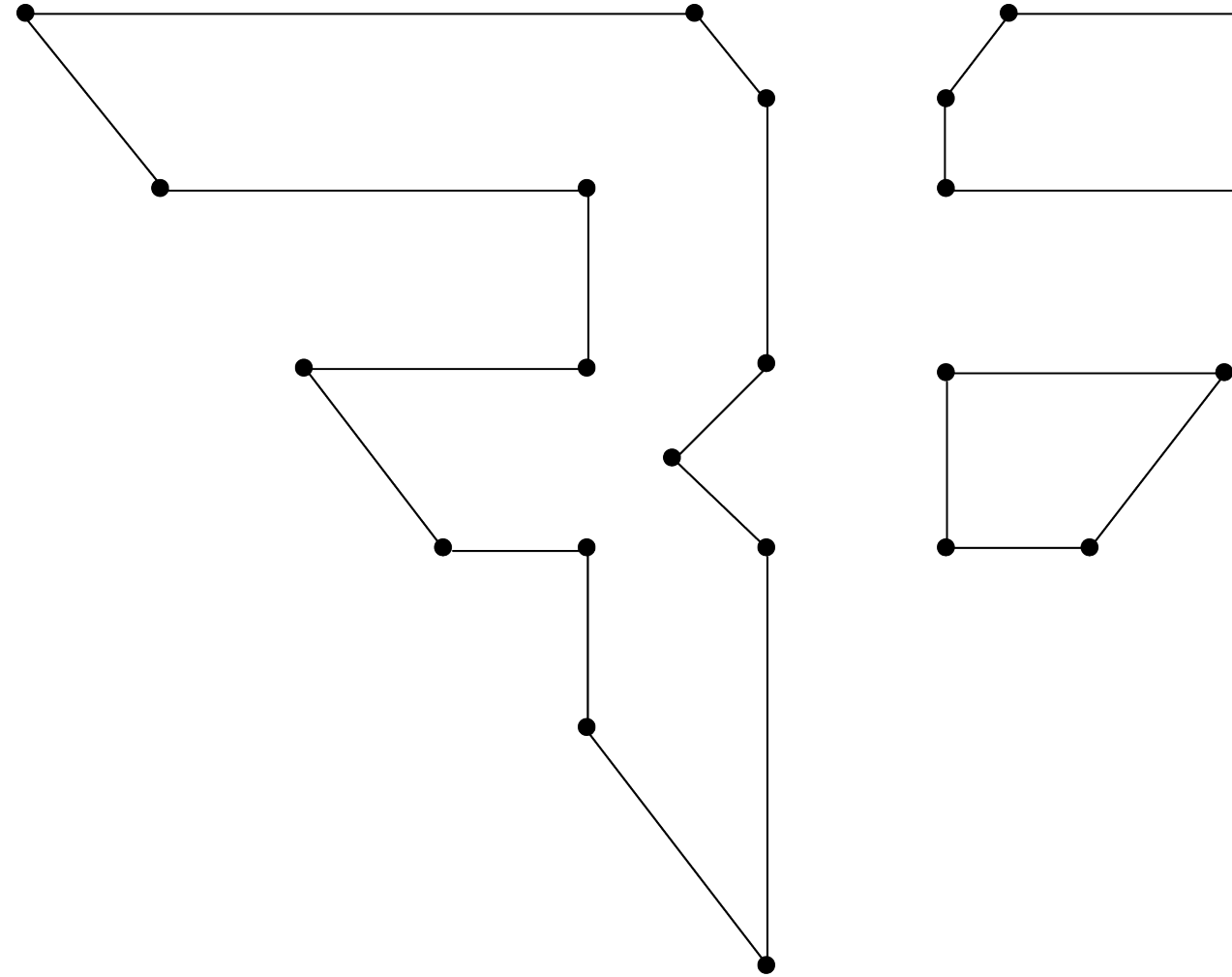
- http://www.dtic.mil/ndia/2016/armament/18317_KENT.pdf





DRONE SHOOTING

DRONES SHOOTING NETS AT DRONES



Drone Defenses Gone Wild

DRONES SHOOTING NETS AT OTHER DRONES

~\$30,000 Euro

“Hoping to ship first units by the end of 2017”



[DroneCatcher - Catching a Drone with a Drone - 19Aug2016 -YouTube](#)

[Security Affairs - The DroneCatcher evolves featuring a new improvement - 04April2016](#)



Specifications	
DroneCatcher	Flying system
Dimensions	775 x 755 x 350 mm
Speed	Currently up to 20 m/s 44.7 mph
Operating time	Up to 30 min.
Netgun range	Up to 20 meters 65.6 feet
Weight	< 6 kg



DroneCatcher - DelftDynamics

- <http://dronecatcher.nl/>



Drone Defenses Gone Wild

DRONES SHOOTING NETS AT OTHER DRONES



Michigan
Technological
University



[Popular Mechanics - Drone-Mounted Net Cannon Snags Other Drones with Ease - 12Jan2016](#)

[TheNextWeb - Watch Michigan Tech's 'Robotic Falcon' snatch this drone out of mid-air - 13Jan2016](#)



Michigan Tech - Robotic Falconry

- <http://me.sites.mtu.edu/rastgaar/hirolab/>

Drone Defenses Gone Wild

DRONES SHOOTING NETS AT OTHER DRONES

“Millions of dollars” in cost – according to them on phone



[WSJ - Its Drone vs. Drone as Airspace Systems Takes Flight - 09Mar2017](#)

[Gizmodo - Watch a Drone-Hunting Quadcopter Attack Its Prey - 13Oct2016](#)

[Airspace Systems Inc One Touch Interceptor TI - 22Oct2016 - YouTube](#)



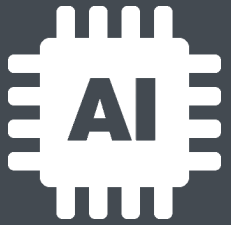
Airspace Systems - One-Touch Interceptor

- <http://airspace.co>

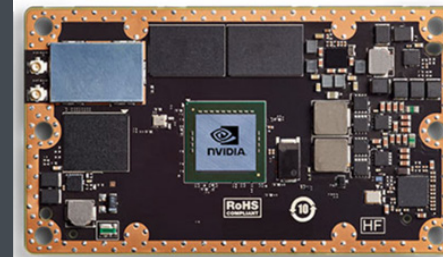


TREND: Defensive Drones Going Autonomous

ONE-TOUCH 'CLEAN THE SKY' SOLUTIONS – AUTO-MAGICALLY FIND AND ELIMINATE 'ROGUE DRONES'



- Most air-to-air drone defenses starting to incorporate **A.I.** and **machine learning** to deploy **automated anti-drone** products
- **One-touch** search-and-destroy **autonomous** drones, i.e. no need to teach your employees how to be **Top Gun's** in order to defend against 'rogue drones'



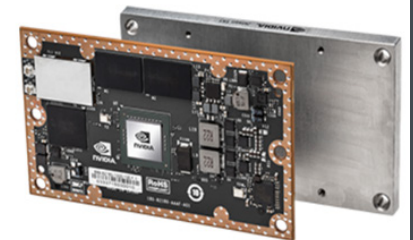
JETSON TX1 MODULE

This AI supercomputer features NVIDIA Maxwell™ architecture, 256 NVIDIA CUDA® cores, 64-bit CPUs, and a power-efficient design. Plus, it includes the latest technology for deep learning, computer vision, GPU computing, and graphics—making it ideal for embedded AI computing.

BUY NOW

NVIDIA Jetson is the world's leading visual computing platform for GPU-accelerated parallel processing in the mobile embedded systems market. Its high-performance, low-energy computing for deep learning and computer vision makes Jetson the ideal solution for compute-intensive embedded projects like:

- > Drones
- > Autonomous Robotic Systems
- > Mobile Medical Imaging



<https://news.developer.nvidia.com/autonomous-drone-hunts-down-rogue-drones-from-the-sky/>

NVIDIA DEVELOPER

NVIDIA Developer - Autonomous Drone Hunts Down Rogue Drones From the Sky - Powered by NVidia Jetson TX1 Board - 18Oct2016

Comments 59 Shares

Autonomous Drone Hunts Down Rogue Drones From the Sky

October 18, 2016

Once it classifies the object, the **Jetson-powered Airspace drone** fires a tethered net to capture the other craft from the sky and safely returns it to its landing pad.

Airspace is the only drone security solution capable of identifying, tracking, and autonomously removing rogue drones from the sky.

The start-up is using **GeForce GTX 1080 GPUs** and **DIGITS** to train their **deep learning** model to detect anomalies in the sky and classify rogue drones. Once trained, the drone is equipped with an **Jetson TX1 on-board**, and uses **VisionWorks, TensorRT and CUDA** to **classify and react to rogue drones in real-time.**



Drone Defenses Gone Wild

DRONES SHOOTING NETS AT OTHER DRONES

~\$3,500 in Nov 2016

~\$47,500 in 2017 (Fortem)



[Net Gun Drone - Excipio | Flite Test - 11Jan2016 - YouTube](#)

- "*Excipio*" is Latin for "*capture*"
- Rebranded "*Fortem - Drone Hunter*" in 2017:
- <http://fortemtech.com/dronehunter/>



Excipio Aerial Netting System



Theiss UAV Solutions, LLC has released the EXCIPIO, a patent pending non-electronic, non-destructive Anti-Drone system. The EXCIPIO (Latin for "I Capture") is a unique Interception and neutralizing system that allows for surgical removal of a potential threat. Though the initial system concept was focused on intercepting and neutralizing an airborne UAS (or "Drone"), the conceptual applications have expanded to include manned aircraft, ground vehicles, people, and animals (whether airborne or on the ground).

The EXCIPIO Aerial Netting System can be mounted to a variety of fixed wing or rotorcraft platforms for use. The EXCIPIO is launched when a threat target has been identified and then flies to intercept the target. When the EXCIPIO has reached the threat target, it fires a net upon the target when commanded by the EXCIPIO System operator. Once the target has been "netted," the EXCIPIO can either release the net with the neutralized target ensnared (utilizing a small drag chute to slow the fall of the neutralized target) or keep the net tethered to the System for the purpose of relocating the net and neutralized target to a desired location before releasing them to the ground.

Please contact us via email for more information, or to order the EXCIPIO Aerial Netting System.

Excipio - Net Gun Drone - thisisuv.com

- <http://www.theissuav.com/researchanddevelopment/>



Drone Defenses Gone Wild

DRONES SHOOTING NETS AT OTHER DRONES

~\$3,500 in Nov 2016

~\$47,500 in 2017 (Fortem)



[Mashable - This drone was built to detect and take down 'rogue' drones - 19Dec2018](#)

- Formerly "*Excipio*" (which is Latin for "*capture*")
- Rebranded "*Fortem - Drone Hunter*" in 2017



Drone Hunter – Fortem Technologies

- <https://fortemtech.com/products/dronehunter/>





Drone Defenses Gone Wild

DRONES SHOOTING NETS AT OTHER DRONES



[SPARROWHAWK PHASE ONE - Search Systems](#)

[SparrowHawkFinal_1_1.mp4 - 07Mar2016](#)



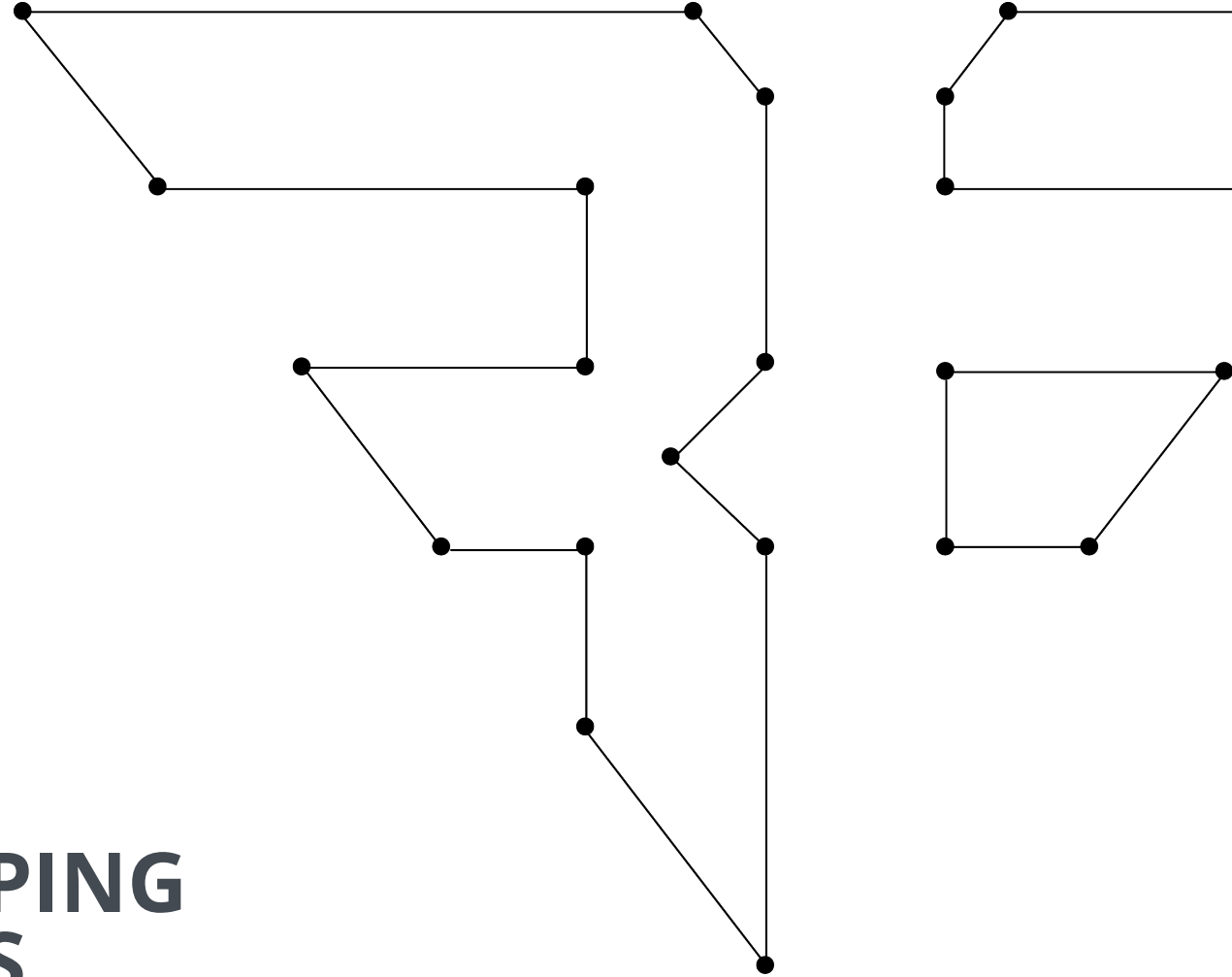
Search Systems - SparrowHawk Phase One (2016) - Counter UAV

- <http://searchsystems.eu/sparrowhawk/>



DRONE NETTING

DRONES WITH NETS SWOOPING AT AND SNAGGING DRONES





Drone Defenses Gone Wild

DRONES WITH NETS SWOOPING IN AND SNAGGING DRONES



[Tokyo police drones use nets to catch illegally flown devices - 14Dec2015 - YouTube](#)

[Daily Mail Online - Tokyo police reveal bizarre 'UAV drone catcher' - 11Dec2015](#)



Tokyo Police - Drone Interceptor

Drone Defenses Gone Wild

DRONES WITH NETS SWOOPING IN AND SNAGGING DRONES

~\$25,000 Euro



[Popular Mechanics - This Drone Interceptor Captures Your Pathetic Puny Drone With a Net - 11Feb2015](#)

M.A.L.U.
Mission Aérienne Légère à Organisation Unique

Main page Store Articles Contact

GroupeAssmann

Drone Interceptor MPI 200
The drone interceptor MPI 200 neutralizes the intruder with his net. It can capture up to 6 Kg drones. He can drop his net immediately without limit of weight or size of the captured drone. Handy, accurate, he can go to a top speed of over 100 km / h.

[See our offer >>](#)

Drone MP 200
The recognition with guided or fu

[See our offer >>](#)

© M.A.L.O.U. - Groupe as



M.A.L.U.
Mission Aérienne Légère à Organisation Unique

GroupeAssmann

https://web.archive.org/web/20160106162945/http://www.malou-tech.fr/Documentations/OffreMpi200_US.pdf

MPI 200
COMMERCIAL OFFER

06 Jan 2016

Reference	Designation	Quantity	U.P. (EUROS)	T.P (euros)
MPI 200	INTERCEPTOR DRONE (patent protection) including : - Aluminum frame 1.02 version - Packs of batteries LIPO - Double nacelle for GOPRO and zoom camera with movable axis - Type radio futaba T 14 with battery charger - Transmitter/receiver 5.8 Ghz - Management video screen - Bezel immersion with micro SD for	1	25 000.00 €	25 000.00 €



Malou Tech - Drone Interceptor MPI 200

- <http://groupe-assmann.fr/malou-tech/>



Drone Defenses Gone Wild

DRONES WITH NETS SWOOPING IN AND SNAGGING DRONES

<http://searchsystems.eu/gallery.html>

[sparrowhawk_2.mp4 - 07Mar2017](#)

<http://www.dji.com/matrice600>



~\$11k =
\$5k drone (DJI M600) +
\$6k attachment (£5k)



A screenshot of the Search Systems website showing the Sparrowhawk product page. The website has a dark header with the Search Systems logo and navigation links: HOME, SOLUTIONS, PRODUCTS, CONTACT, GALLERY, and a button for REQUEST FURTHER INFO. The main content area features a large image of the Sparrowhawk drone with a red net attached. Below the image is the text: SPARROWHAWK Counter uav (c-uav) for capture and safe recovery of rogue uav's. To the right of the image are logos for SPARROWHAWK and RESPONDER MULTI MISSION UAV. Below the main image is an OVERVIEW section with text describing the system's capabilities, including its ability to capture and recover rogue UAVs up to 20kg, its portability, and its secure video relay system. A small inset image in the bottom right corner shows the Sparrowhawk drone in flight over a city skyline with a bridge.



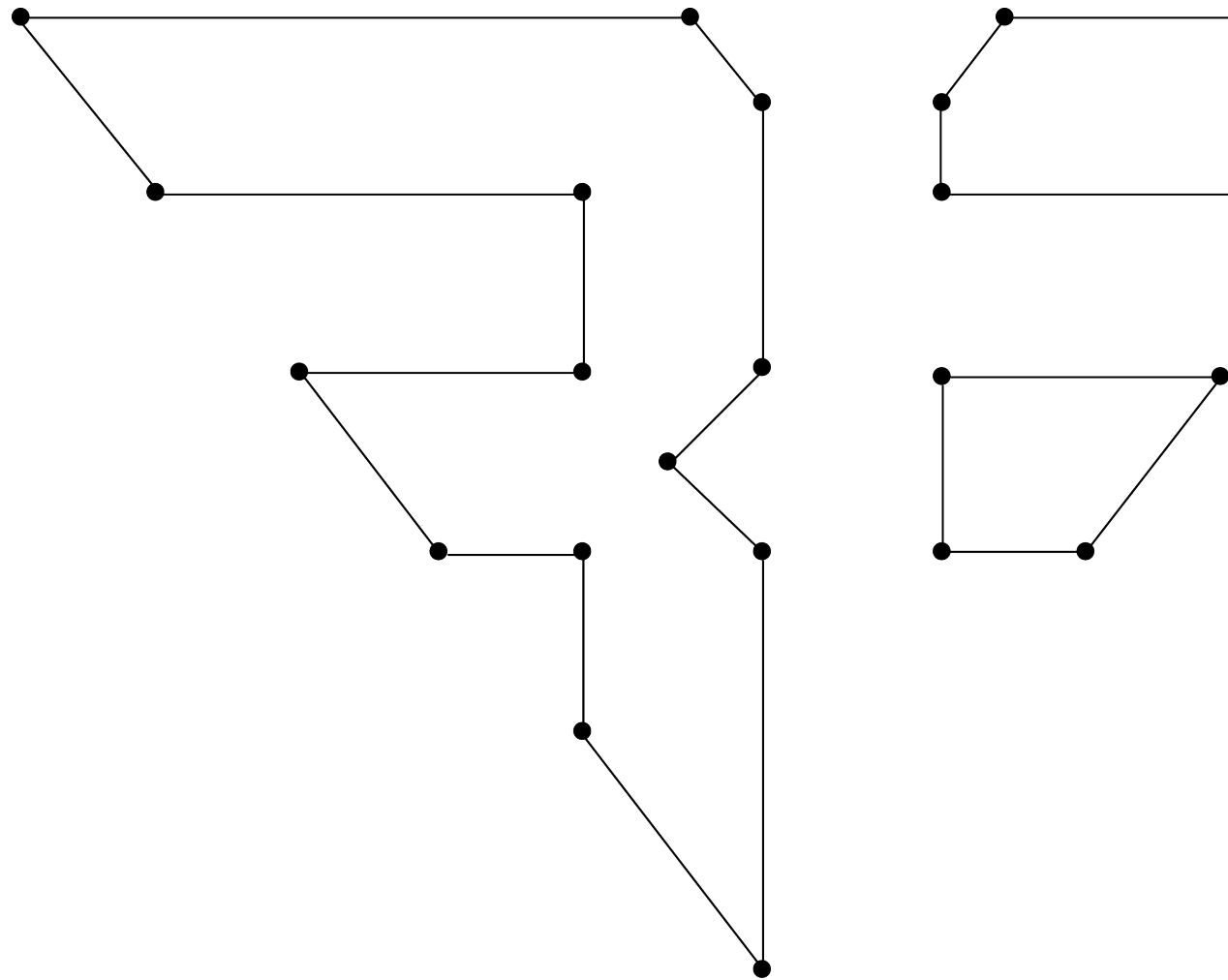
Search Systems - SparrowHawk v2 (2017) - Counter UAV

- <http://searchsystems.eu/sparrowhawk.html>



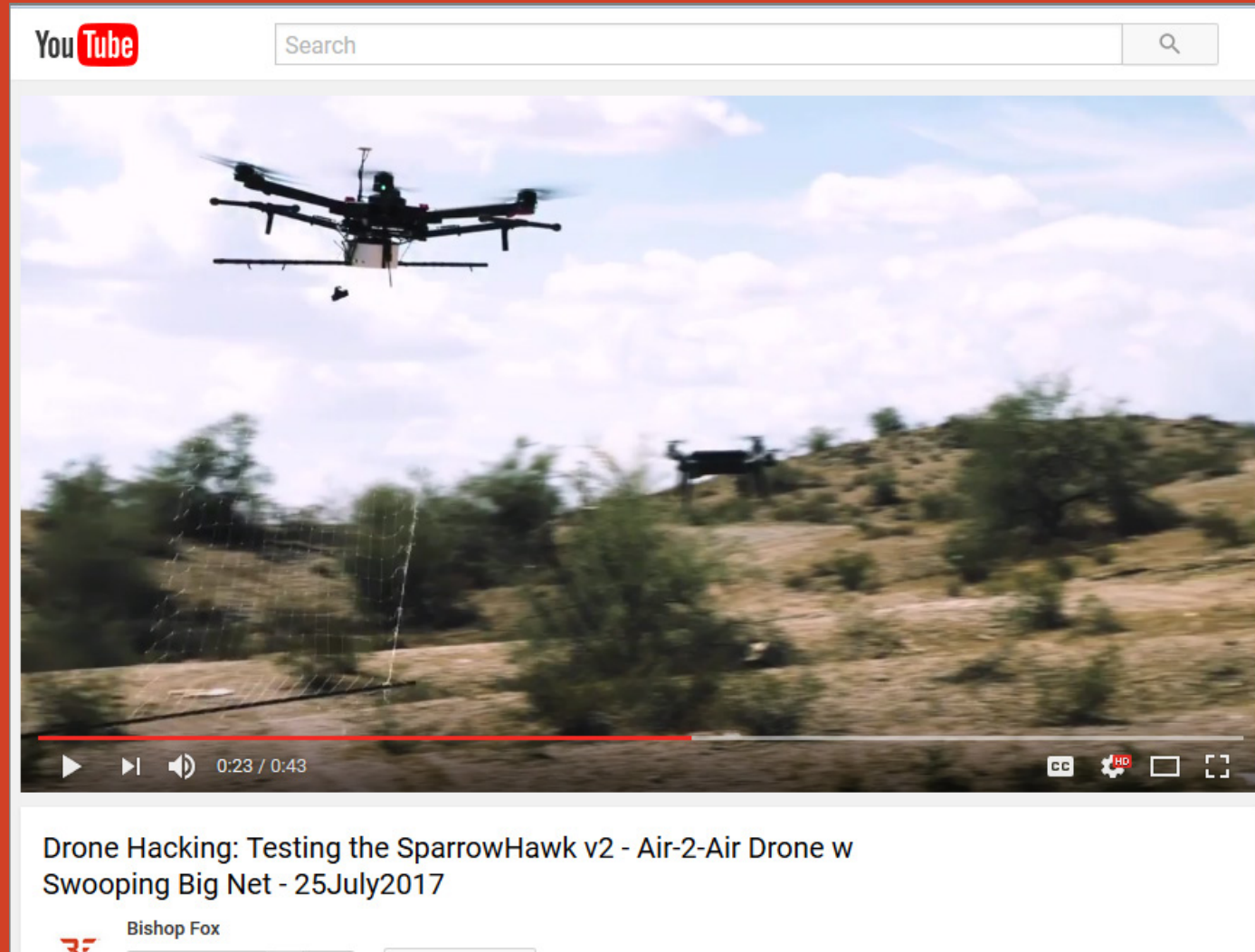
DRONE NETTING

DEMO



DEMO: Testing the SparrowHawk v2 Prototype

AIR-TO-AIR COMBAT DRONE DEFENSE WITH LARGE NET FOR SWOOPING



The video player shows a large drone in flight against a blue sky with white clouds. A smaller drone is visible in the distance, and a large net is being deployed from the ground to intercept it. The video player interface includes the YouTube logo, a search bar, and playback controls at the bottom. The video title is "Drone Hacking: Testing the SparrowHawk v2 - Air-2-Air Drone w Swooping Big Net - 25July2017" and the channel name is "Bishop Fox".

YouTube Search

0:23 / 0:43

Drone Hacking: Testing the SparrowHawk v2 - Air-2-Air Drone w Swooping Big Net - 25July2017

Bishop Fox

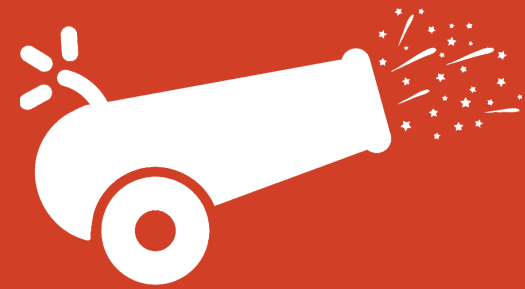


DRONE NETTING

<https://www.youtube.com/watch?v=jlGdPrhRvBA&t=129>

Defeating Drone Nets w/ Confetti Gun

SHOOTING CONFETTIN AT ONCOMING DEFENSIVE DRONE



CONFETTI GUN

PM

Popular Mechanics - Confetti Cannons Are a Drones Worst Enemy - 29Jun2017
<http://www.popularmechanics.com/flight/drones/a27131/drone-confetti-cannon/>

Confetti Cannons Are a Drone's Worst Enemy

When the house is rocking, leave the drone at home.



By Darren Orf Jun 29, 2017

There are lots of ways to dispose of a drone, but this one might be the most inventive. A YouTube user caught a drone getting fatally entangled while in the path of a confetti cannon. After this badly timed collision, gravity takes care of the rest.

The drone likely belonged to either the DJ's management or the festival as these aerial cameras have become increasingly more popular at concerts. Although a confetti cannon is a first, other bands have taken matters more directly into their hands when it comes to disposing of a pesky drone.

Overall though, confetti cannons plus massive crowds sounds like a situation worth

Make - Livestream-Interactive Confetti Cannon - 12 Dec 2017

MAKE: PROJECTS LATEST PROJECTS GUIDES MAKER FAIRE SHOP GET INVOLVED

<https://makezine.com/projects/livestream-interactive-confetti-cannon/>

Livestream-Interactive Confetti Cannon

By Tyler Wiegman Time Required 1-3 Hours Difficulty Moderate Price \$9 \$50

PARTS / TOOLS
Adafruit Feather Huzzah (1)
6-pin female headers (2)
8-pin female headers (2)
Adafruit Latching Relay FeatherWing (1)
Adafruit Seven Segment Display Backpack (1)
9v Battery Clip (1)
Hookup Wire (1)

Ok, I'll admit, this one is a little silly - but ever since I've been doing live broadcasts on the regular, I've wanted to increase the number of ways that live stream audiences can interact with the broadcast. I was inspired by projects like Twitch Plays Pokemon and Letsrobot.tv, and wanted to create an easy to use system so people can easily create whatever hardware they imagine, and let their audiences take control of it, no matter what platform they're streaming on. <https://www.twitch.tv/twitchplayspokemon>

It turns out that for Twitch.tv, it's a relatively simple task. Twitch's chat is based on IRC (the Internet Relay Chat protocol) so it's relatively simple to have a wifi-capable microcontroller sign into that IRC server, start listening in on the chat, and when it detects certain keywords, can trigger a hardware event. But I wanted a system that would be completely platform agnostic, so I turned to my favorite mobile IoT solution, Blynk. <http://letsrobot.tv/>

How to make a Confetti Cannon with Raspberry Pi & Opto 22 I/O

1,744 views

Opto Video Published on Dec 30, 2016

<http://info.opto22.com/raspberry-pi-10>

Video shows how to make an automated Raspberry Pi controlled confetti cannon using Opto 22's Raspberry Pi digital I/O starter kit.

OPTO 22

OPTO-P1-STARTERKIT-1

Digital I/O for Raspberry Pi Starter Kit (AC/DC)

Small parts G4 I/O modules

Interface cable Carrier Board G4 mounting rack

Use your Raspberry Pi in the real world! The Digital I/O for Raspberry Pi Starter Kit gets you started sensing and switching industrial-level electrical loads with your own Raspberry Pi. Now you can monitor and control real-world devices like industrial motors, pumps, and sensors.

The system uses the same field-tested, reliable Opto 22 G4 input/output (I/O) modules that have served automation applications worldwide for nearly 40 years. Just bring your Pi and its power supply, and you're ready to begin.

The Starter Kit includes all of the following:

- OPTO-P1-40P Digital I/O Carrier Board, including interface cable, Pi board mounting standoffs, and spare fuse for mounting rack
- G4P8BH 8-module mounting rack
- G4IACS 90-140 VAC/VDC input module
- G4IDCSMA 10-32 VDC input module with manual/auto switch
- G4OACS 12-140 VAC output module
- G4ODCS 5-60 VDC output module

The Starter Kit works with any model Pi with a 40-pin header connector and gives you room to expand. Add up to 4 more G4 I/O modules from the extensive [list of compatible G4 inputs and outputs](#).



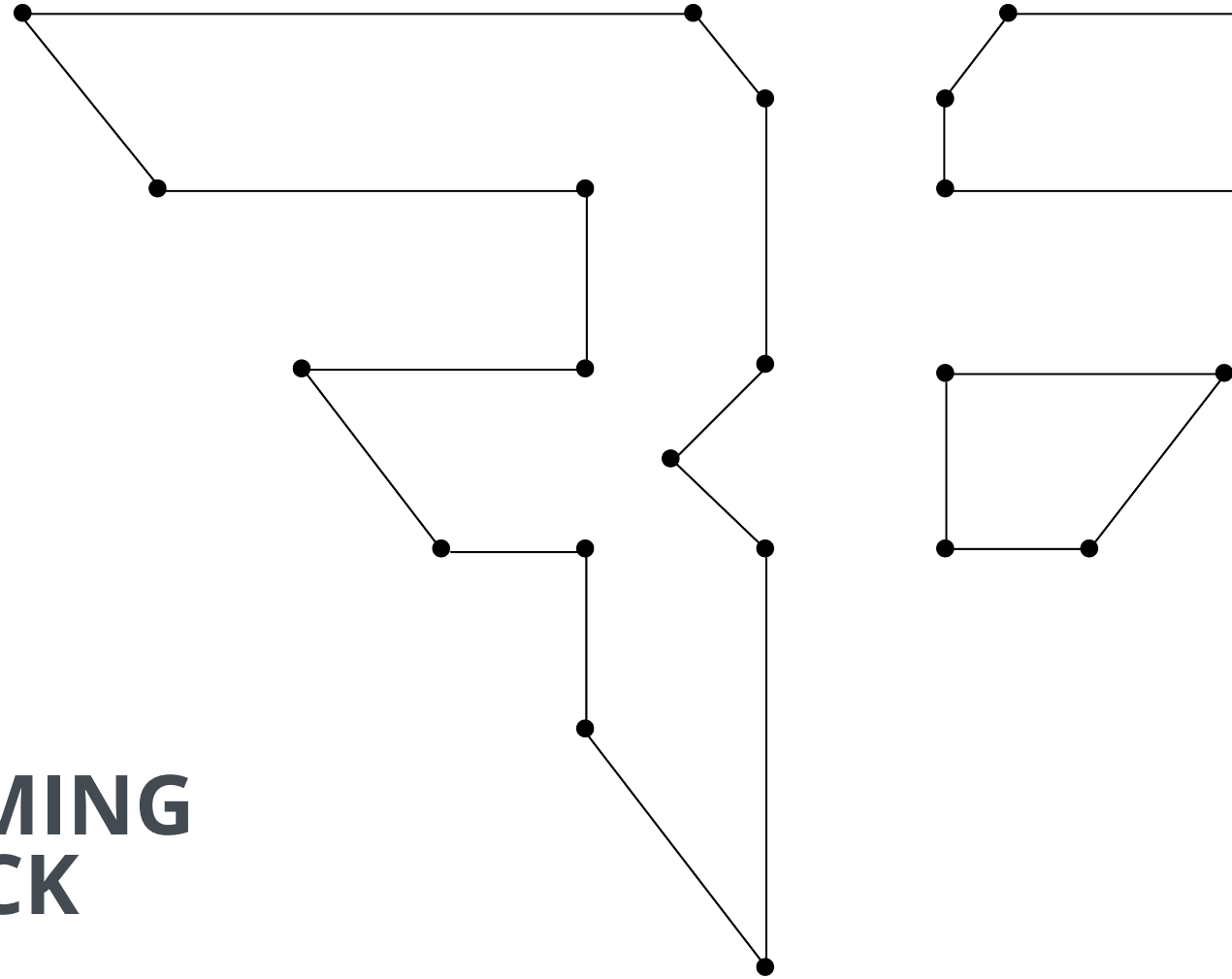
Popular Mechanics - Confetti Cannons Are a Drones Worst Enemy - 29Jun2017

• <http://www.popularmechanics.com/flight/drones/a27131/drone-confetti-cannon/>



JAMMING

**CANNONS SHOOTING JAMMING
SIGNALS OR EMPS TO KNOCK
DRONES OUT OF SKY**



Drone Defenses Gone Wild

CANNONS SHOOTING JAMMING OR EMP SIGNALS TO KNOCK DRONES OUT OF SKY

"10's of thousands of dollars"








[Mashable - DroneShield - DroneGun - Here is the anti-drone gun of your Rambo fantasies - 27Nov2016](#)

- DroneGun may **not** be used or offered for sale in the U.S., other than to the government and its agencies. That's because the **FCC** "prohibits the operation, marketing, or sale of any type of jamming equipment."



Exhibit 2: DroneShield Key Products

https://www.droneshield.com/sites/default/files/JAW_Drop_V27_04-25-17.pdf

Product	Function	Available To:	Pricing	Quick Details
 WideAlert Sensor	Passive Detection	Consumers and Up	~\$6k/yr (base)	180° detection coverage, up to 200m distance
 FarAlert Sensor	Passive Detection	Consumers and Up	~\$6k/yr (base)	30° detection coverage, up to 1000m distance
 DroneGun	Active Counter	Militaries International Federal Agencies	10s of thousands (outright purchase)	2km range; jams 2.4/5.8 GHz, with optional GPS, GLONASS capabilities
 DroneShield UI	Management Software	Consumers and Up	Free (included)	browser-based monitoring and control application
 DroneSentry (in development)	Detection + Counter	Militaries International Federal Agencies	N/A	all-in-one solution comprised of multiple sensors and integrated jamming for manual or automatic activation on detection

Source: Company reports; Oppenheimer & Co. Inc.

We detail late-2016/2017 DroneShield announcements below in Exhibit 3; the recent elevated level of significant news flow was reflected in the financials as 72% of the company's 2016 revenue came in the 4th quarter.



DroneGun – by DroneShield

- <https://www.droneshield.com/dronegun>

Drone Defenses Gone Wild

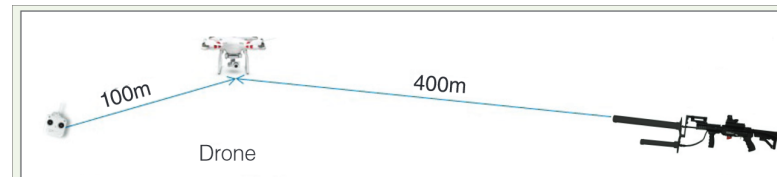
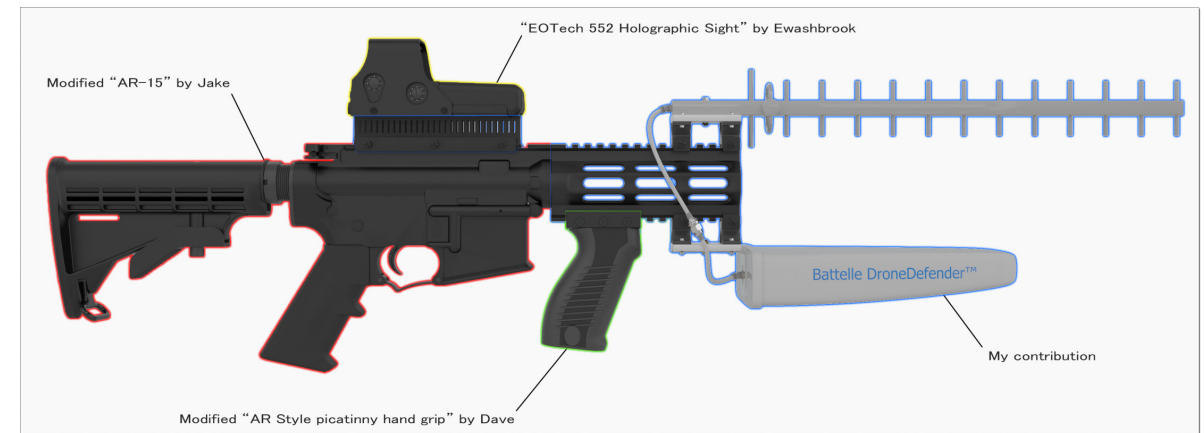
CANNONS SHOOTING JAMMING OR EMP SIGNALS TO KNOCK DRONES OUT OF SKY



[Security Affairs - DroneDefender, electromagnetic gun that shoot down drones - 16Oct2015](#)

- Only really work against Wi-Fi controlled drones, **ineffective** against those like the Danger Drone (i.e. **cellular/GPS control**)

BATTELLE
DroneDefender™



Effective range of 400 meters, with the adversary at 100 meters.



Antennas can mount to many platforms, including a Picatinny rail as in the nominal form factor shown above.

DroneDefender – by Battelle

- <https://www.battelle.org/government-offerings/national-security/aerospace-systems/counter-UAS-technologies/dronedefender>



Drone Defenses Gone Wild

CANNONS SHOOTING JAMMING OR EMP SIGNALS TO KNOCK DRONES OUT OF SKY

\$35k



[Popular Science - Skynet Anti-Drone Rifle Can Jam Signals In The Air - 15Sept2016](#)



Aim for the targeted UAV and pull the trigger while keep following the target with the antenna.



Drone Defenses Gone Wild

CANNONS SHOOTING JAMMING OR EMP SIGNALS TO KNOCK DRONES OUT OF SKY

\$19k

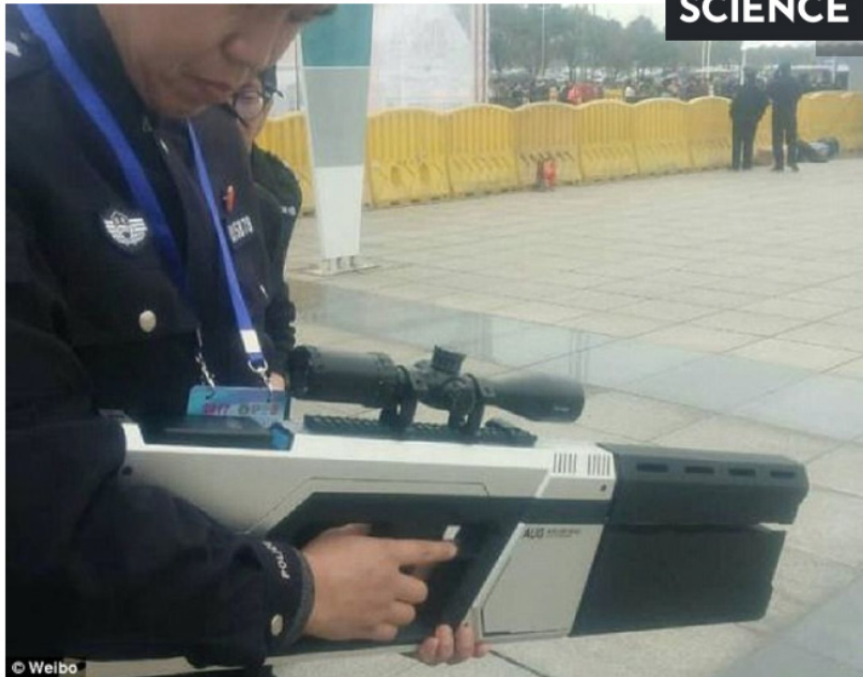


Here's how China is battling drones

THERE'S NO SHORTAGE OF TARGETS.

By Jeffrey Lin and P.W. Singer March 28, 2017

POPULAR SCIENCE



© Weibo

THE \$19,000 GUN

This drone-jamming gun, one of several owned by the Wuhan police, can shut off drones up to a kilometer away.

Weibo

At a March 11 soccer game in Wuhan, China, police faced a new kind of threat: drones trespassing near the stadium. Their response was to use a new kind of weapon: an anti-drone gun that jammed the control signals, forcing the trespassing drones to land automatically.



www.cnhubei.com

Chinese police test out their \$19,000 drone guns. Spending a fortune on drone jamming equipment shows how seriously Chinese police take the unmanned aircraft systems threat.

Hubei Government



Popular Science - Heres how China is battling drones - 28Mar2017

- <http://www.popsci.com/chinas-new-anti-drone-weapons-jammers-and-lasers>

Drone Defenses Gone Wild

DRONE PORTABLE JAMMERS



DroneDefence.co.uk - Dynopis Electronic Counter Measures (ECM)





Dynopis E1000MP Operation

The E1000MP is the ultimate man portable anti-drone solution. It is a safe, simple to operate and can be carried effortlessly by law enforcement and security officers. The device uses focused electronic counter measures to block the drone's control, GPS and video signals while minimizing the impact on other local devices. With a range of up to 1km if you can see the drone then you can stop it.

*Depending on power settings and environmental conditions.



Dynopis E1000MP	Dynopis E200BC
	
Operating Frequencies 433MHz 2.4GHz GPS 5.8GHz	Operating Frequencies 433MHz 915MHz GPS 2.4GHz 5.8GHz
Operational Range Omni-Directional Antenna - 500m Directional Antenna - 1km	Operational Range Up to 200m Omni-Directional
Weight 14.8kg without antennas	Weight 7kg including antennas
Effect on Drone Return to launch location or land immediately	Effect on Drone Return to launch location or land immediately



Drone Defense - Dynopis E1000MP - Man Portable Drone Jammer

• <http://www.dronedefence.co.uk/dynopis-ECM>

Drone Defenses Gone Wild

DRONE PORTABLE JAMMERS

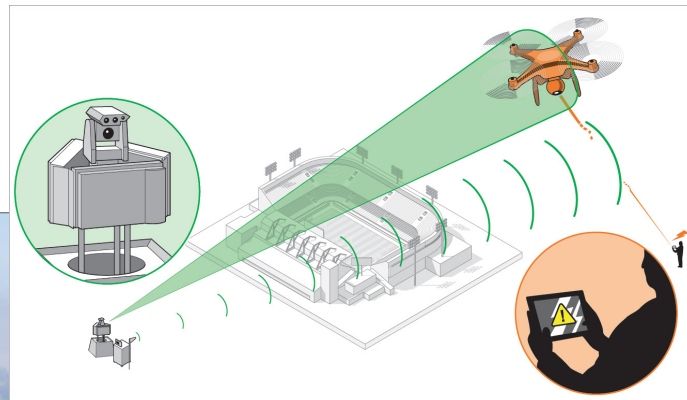
~\$500k



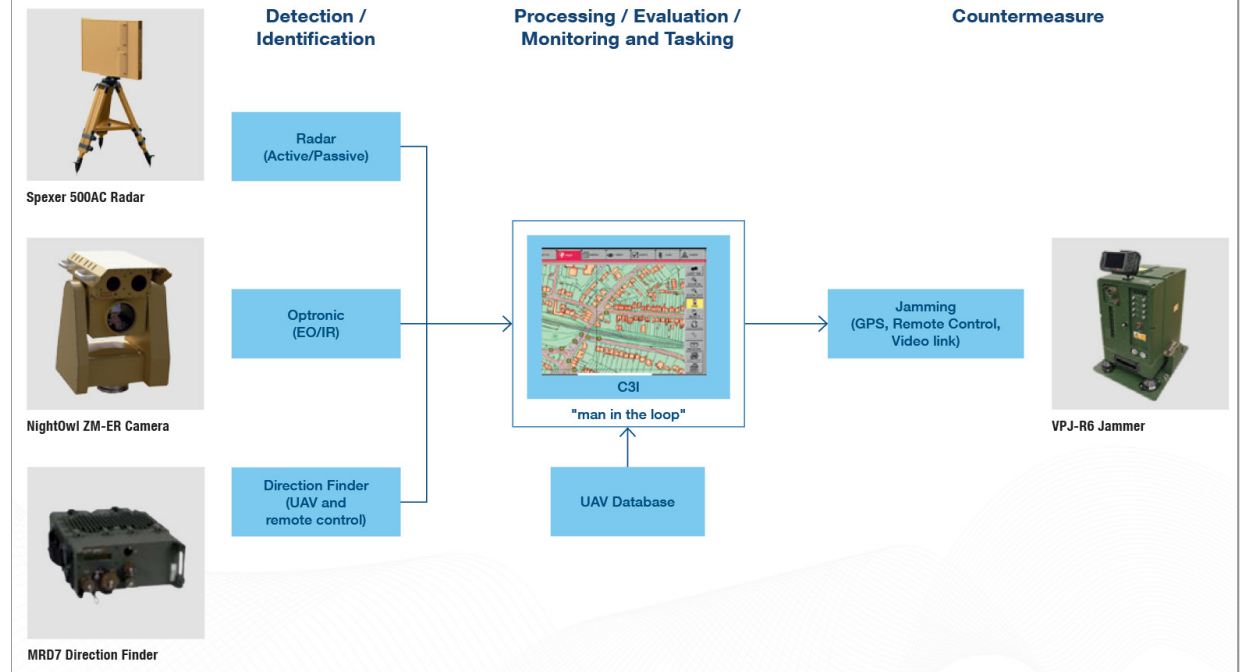
[Hensoldt.net - Xpeller - Counter UAV System Specsheel.pdf](https://www.hensoldt.net/counter-uav-system-specsheet.pdf)

[c4isrnet.com - Airbus expands counter-drone line \(acquired by Hensoldt - rebranded Xpeller\) - 17Jan2017](https://www.c4isrnet.com/airbus-expands-counter-drone-line-acquired-by-hensoldt-rebranded-xpeller-17jan2017)

[Airbus DS EBS Adds Portable Jammer to Its Innovative "Xpeller" Counter-UAV Product Family - 03Jan2017](https://www.airbus.com/press-releases/airbus-ds-ebs-adds-portable-jammer-to-its-innovative-xpeller-counter-uav-product-family-03jan2017)



HENSOLDT Sensors Core Approach



Hensoldt.net - Xpeller - Counter UAV System (formerly Airbus - Defense and Space - EBS)

- <https://www.hensoldt.net/solutions/land/electronic-warfare/xpeller-counter-uav-system/>





~£800k (~ \$1,037,656.00 USD)

Drone Defenses Gone Wild

CANNONS SHOOTING JAMMING OR EMP SIGNALS TO KNOCK DRONES OUT OF SKY



[The Register - FAA to test Brit drone-busting kit \(Blighter\) - 01Jun2016](#)

- “The **Blighter AUDS counter-UAV system** can detect a drone six miles (10km) away using electronic scanning radar, track it using precision infrared and daylight cameras and specialist video tracking software before disrupting the flight using an **inhibitor to block the radio signals that control it**. This detect, track, disrupt, defeat process is very quick and typically takes 8-15 secs.”

Blighter[®]
Surveillance Systems



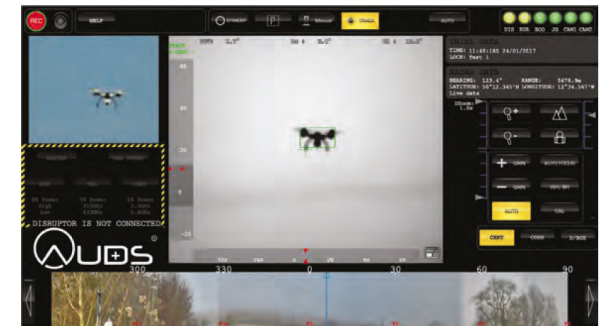
LITEYE



Blighter AUDS (shown with Blighter A422 radar with W20S antennas)



AUDES Radar GUI



AUDES EO/Inhibitor GUI

Blighter - AUDES (Anti-UAV Defence System) – Detect, Track, Disrupt, Defeat

- <http://www.blighter.com/products/auds-anti-uav-defence-system.html>

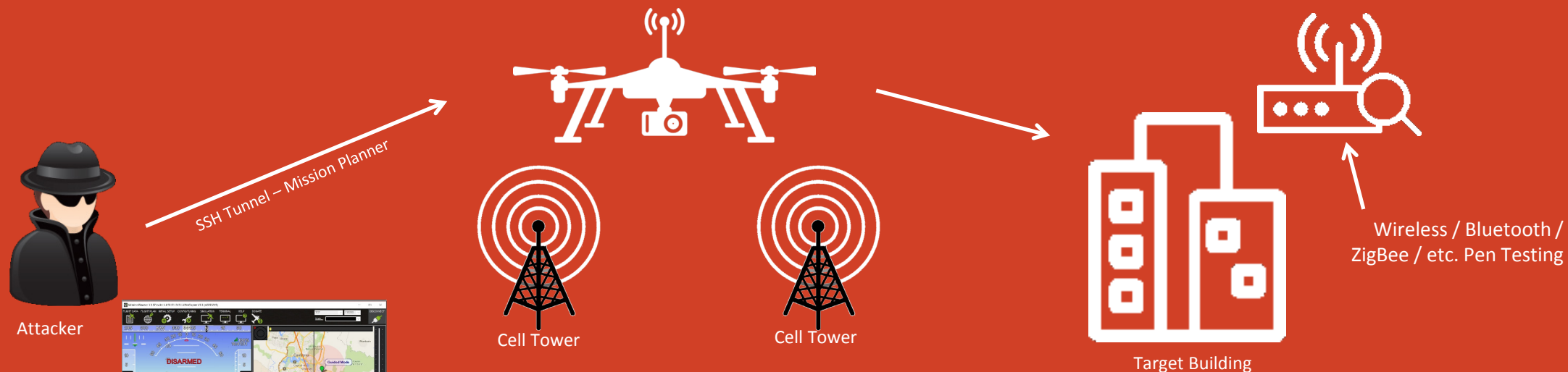


Defeating Jammers

HACKING PERIPHERALS – CELLULAR 3G USB & GPS – SECURE COMMAND & CONTROL



- Remote control over SSH tunnel via 3G USB cell connection. GPS & Cellular signals are illegal to jam (see FCC regulations), making it hard to defend against this type of drone.
 - <https://transition.fcc.gov/eb/jammerenforcement/jamfaq.pdf>



Mission Planner



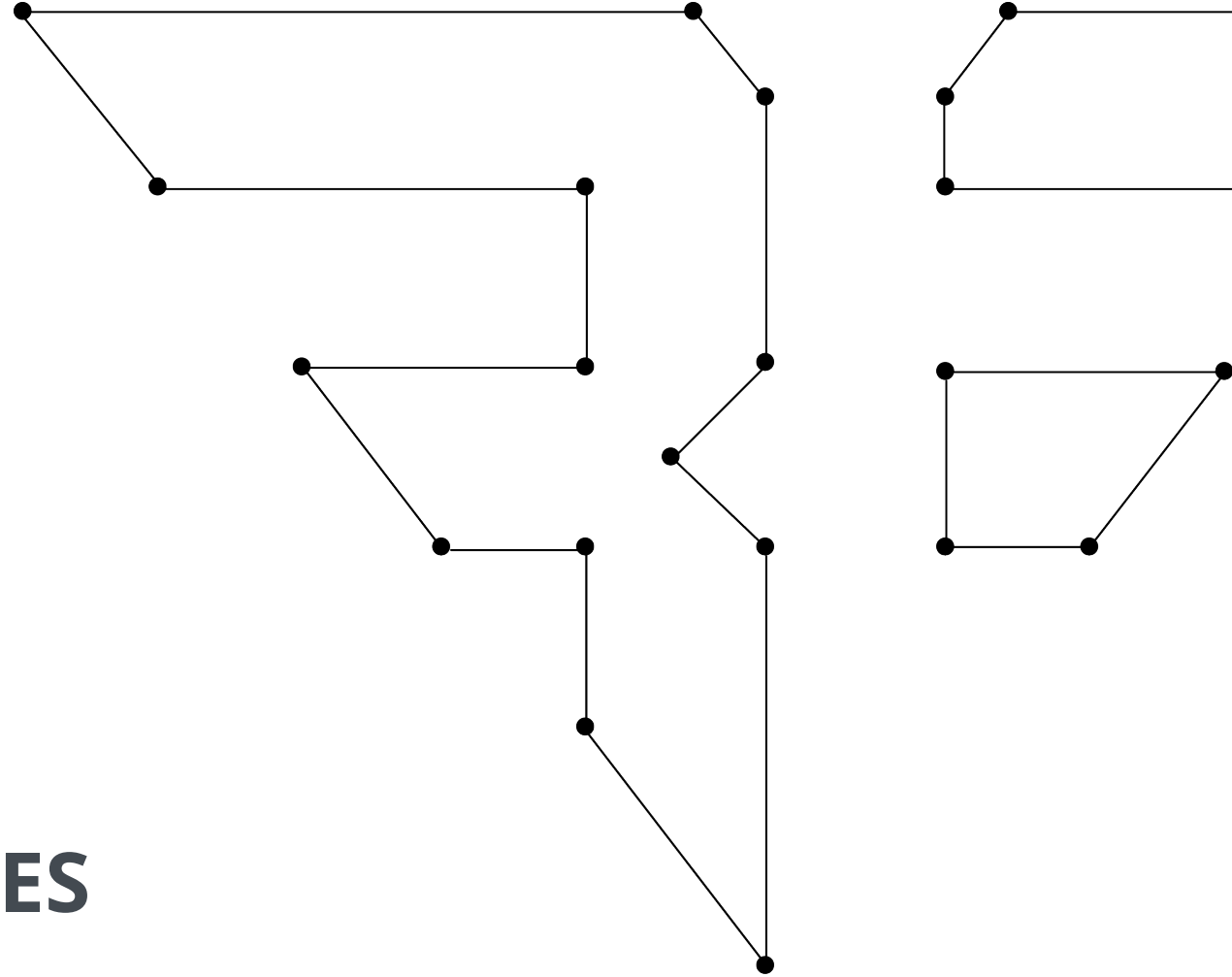
7.2 Mbps
3G USB Modem

For Android Tablets and Windows Laptops





REMOTELY HACKING DRONES TO DISABLE THEM



Drone Defenses Gone Wild

REMOTELY HACKING DRONES TO DEFEND AGAINST THEM

~\$311k



[Popular Science - Defense Company Unveils Anti-Drone System - 17Sept2015](#)

[Falcon Shield - 01Oct2015 - YouTube](#)

- “The material is vague on how exactly it stops small drones, but a video of the system shows the hypothetical threat: a quadcopter dropping a bomb in a stadium. The video then rewinds to show the same attack, foiled by Falcon Shield after mysterious beams take over the drone.”



Leonardo-Finmeccanica - Selex ES - Falcon Shield

- <http://www.leonardocompany.com/en/-/falcon-shield-launch>

Drone Defenses Gone Wild

REMOTELY HACKING DRONES TO DEFEND AGAINST THEM

~\$200k



Hijacking command and control signal, or "*mesmerizing*" the drone (as they say)

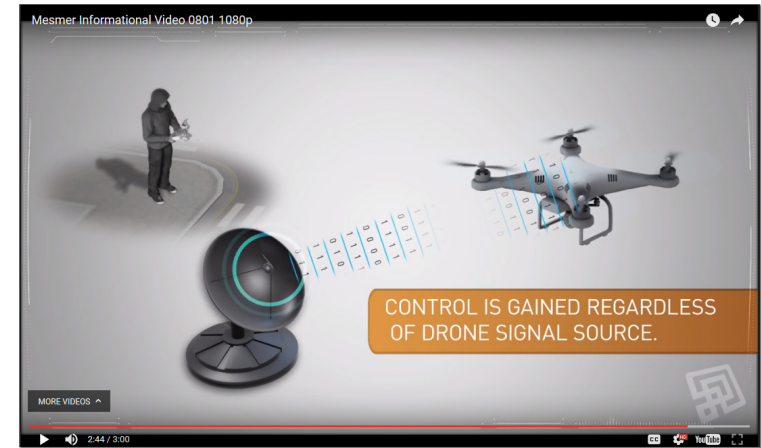
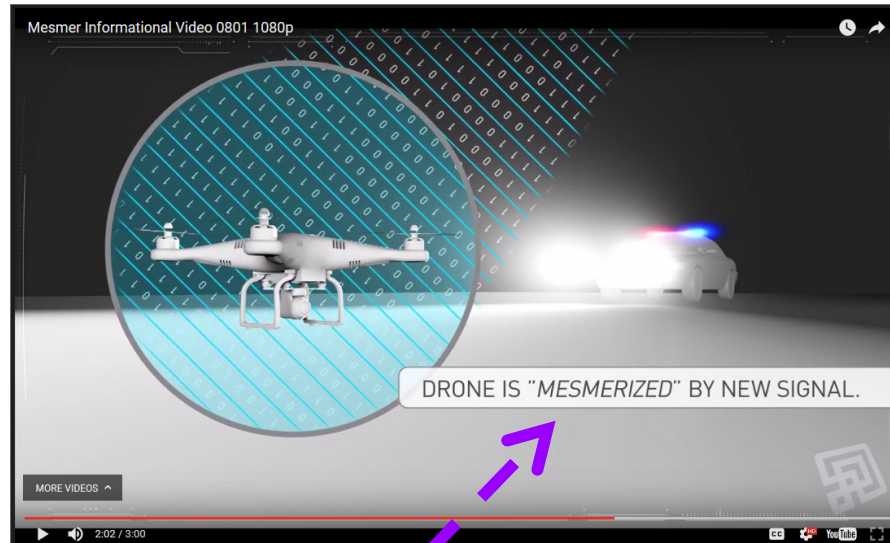


Figure 1 Mesmer V1

"Mesmerized"???



Mesmer - Department 13 - Counter Drone System - Hijack Command and Control Signal

• <https://department13.com/mesmer/>

Drone Defenses Gone Wild

REMOTELY HACKING DRONES TO DEFEND AGAINST THEM



Silent Archer™ Counter-UAS System

The operationally ready, field-proven, *Silent Archer* counter-UAS system detects, tracks, classifies, identifies and disrupts low, slow and small airborne threats.



System Components

Radar



EW System



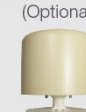
EO/IR Camera



User Display



Direction Finding Unit
(Optional)





Drone Defenses Gone Wild

REMOTELY HACKING DRONES TO DEFEND AGAINST THEM



ReDrone

By Tamir Eshel - Mar 1, 2017

379



ReDrone is a drone detection and neutralization system that detects, identifies, tracks and neutralizes different types of drones at a designated airspace. Photo: Elbit Systems

In 2016 [Elbit Systems](#) introduced ReDrone – a drone detection and neutralization system that detects, identifies, tracks and neutralizes different types of drones at a designated airspace. The system can separate the drone's signals from the stream coming from the operator's remote control unit, thus pinpoint both the drone and the operator's directions and location. The advanced detection system provides 360-degree perimeter protection and constantly updated situational awareness simultaneously handling multiple drones. After detecting a target, the ReDrone can activate the jammer to disrupt the drone's communication link, blocks its radio, video signals and GPS positioning data, to send it off track, preventing it from carrying out an attack.



Elbit Systems - Elbit Systems Reveals ReDrone – An Advanced Anti-Drone Protection and Neutralization System – 01Mar2017

http://defense-update.com/20170301_redrone.html



Drone Defenses Gone Wild

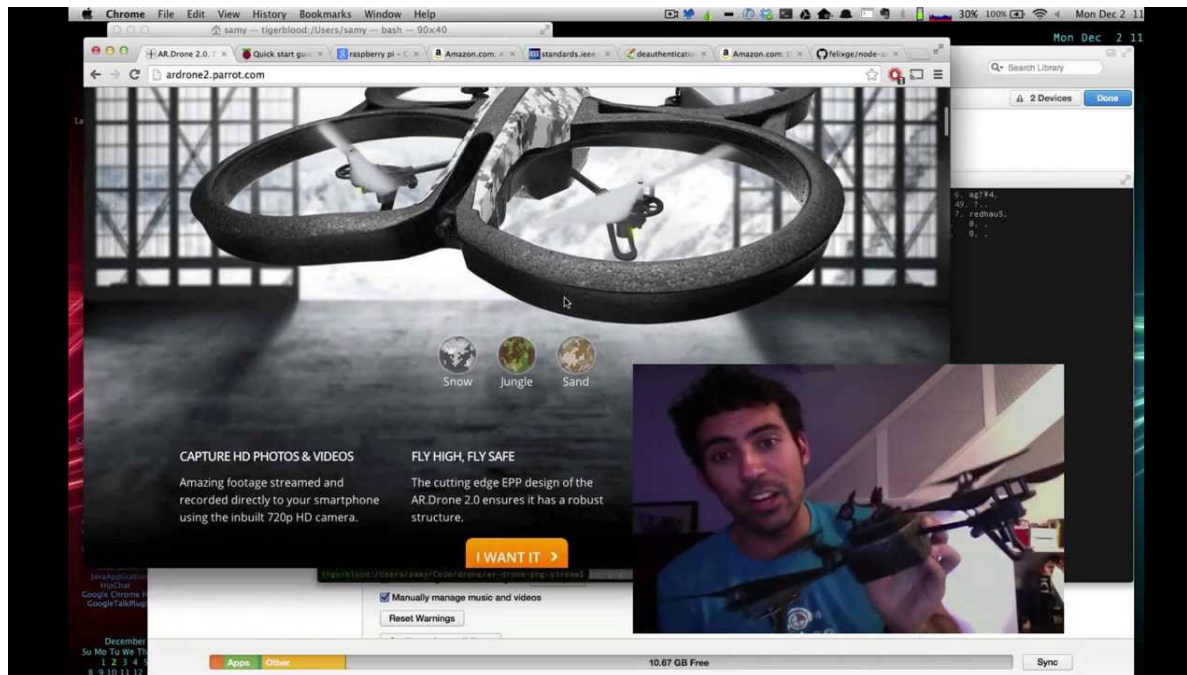
REMOTELY HACKING DRONES TO DEFEND AGAINST THEM



[Threatpost - How to Skyjack Drones for \\$400 - 03Dec2013](#)

[SkyJack - autonomous drone hacking w/Raspberry Pi, aircrack & Javascript - 03Dec2013 - YouTube](#)

- Raspberry Pi drone that autonomously seeks out, hacks, and takes remote control of other drones



SkyJack - Samy.pl - Raspberry Pi hacking

- <http://samy.pl/skyjack/>

Drone Defenses Gone Wild

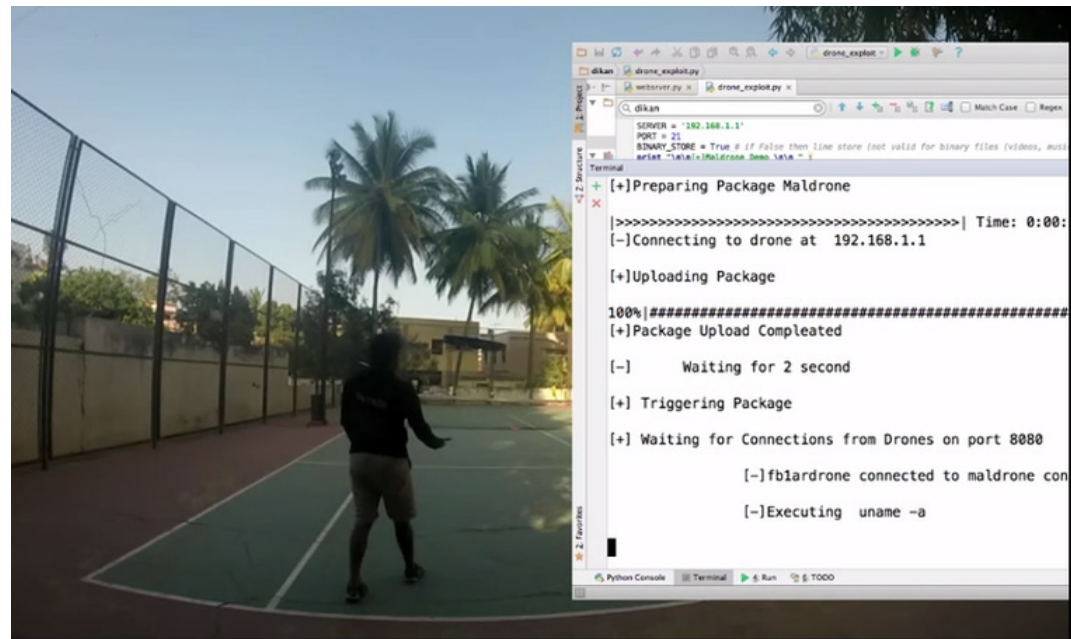
REMOTELY HACKING DRONES TO DEFEND AGAINST THEM



SecurityAffairs.co - A hacker developed Maldrone, the first malware for drones - 27Jan2015

[First Backdoor for Drones. Maldrone aka Malware for Drones - 26Jan2015- YouTube](https://www.youtube.com/watch?v=...)

- *"Security expert Rahul Sasi has discovered and exploited a backdoor in Parrot AR Drones that allows him to remotely hijack the UAV with the malware Maldrone."*



Maldrone – the First Backdoor for Drones

- <http://garage4hackers.com/entry.php?b=3105>



Drone Defenses Gone Wild

CANNONS SHOOTING JAMMING OR EMP SIGNALS TO KNOCK DRONES OUT OF SKY



[DRONELIFE - Anti-Drone Gun Uses Raspberry Pi - 11 May 2016](#)

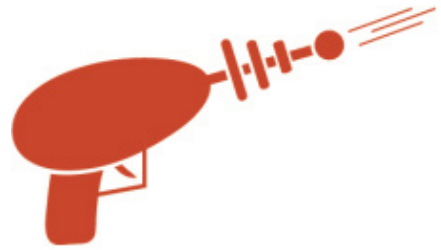
- Only really work against Wi-Fi controlled drones, **ineffective** against those like the Danger Drone (i.e. **cellular/GPS control**)

Make:



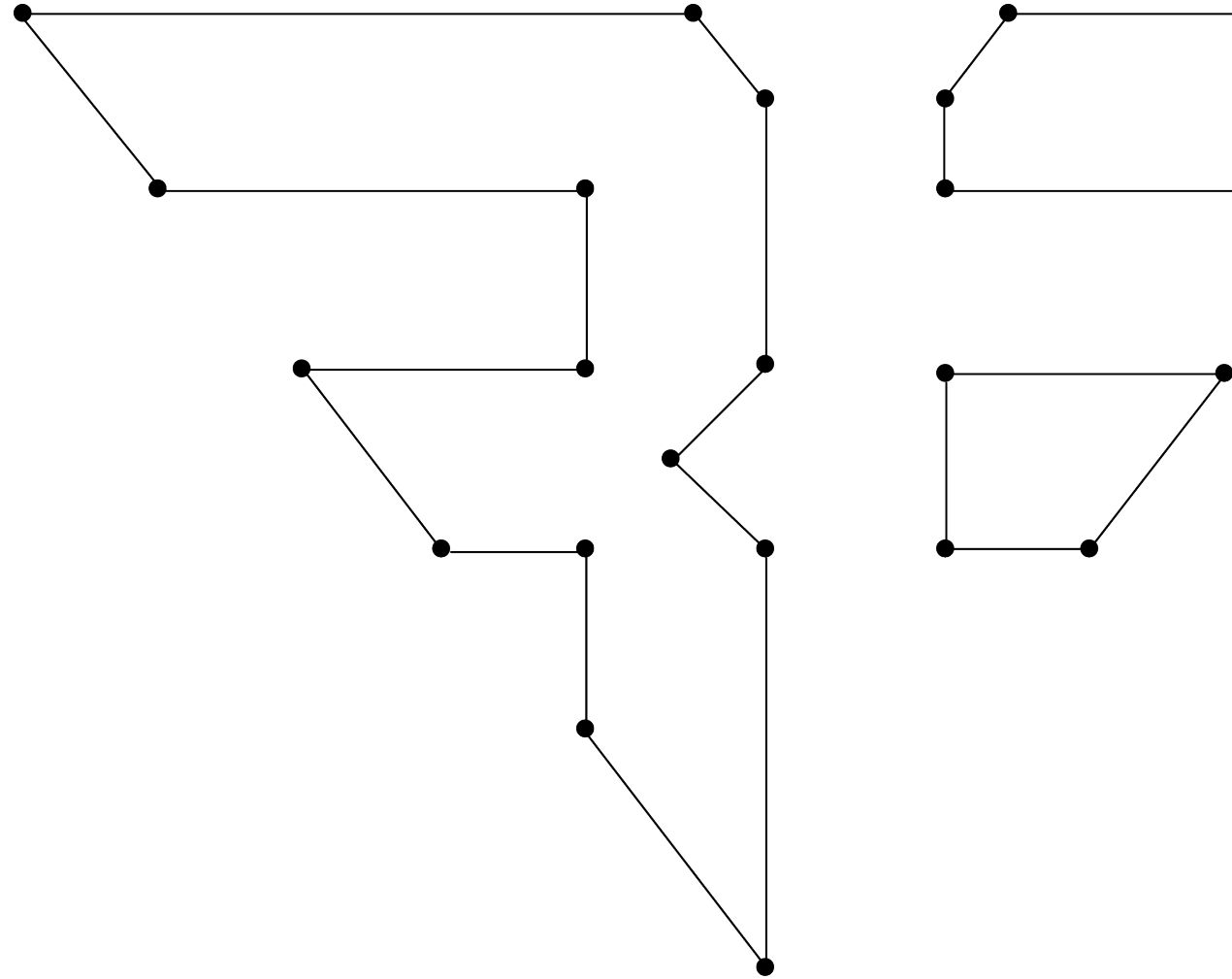
MAKE: Build a Wi-Fi Drone Disabler with a Raspberry Pi – May 2016

- <http://makezine.com/projects/build-wi-fi-drone-disabler-with-raspberry-pi/>



LASER

SHOOTING DRONES WITH FRICKIN LASER BEAMS



Drone Defenses Gone Wild

SHOOTING DRONES WITH FRICKIN LASER BEAMS

~\$11 million



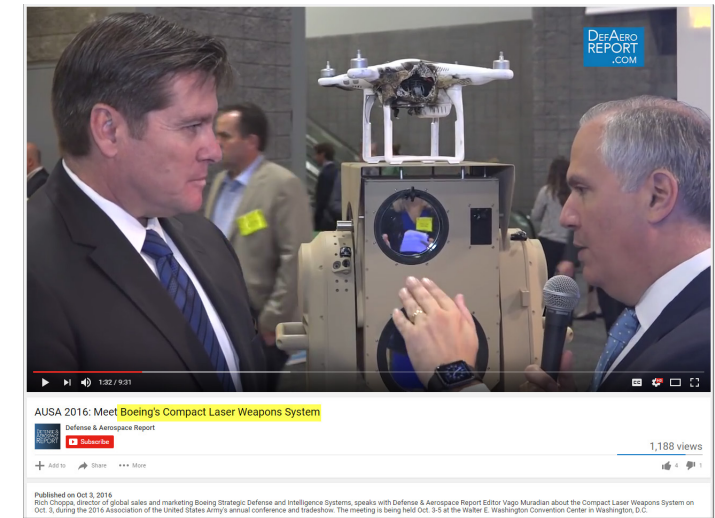
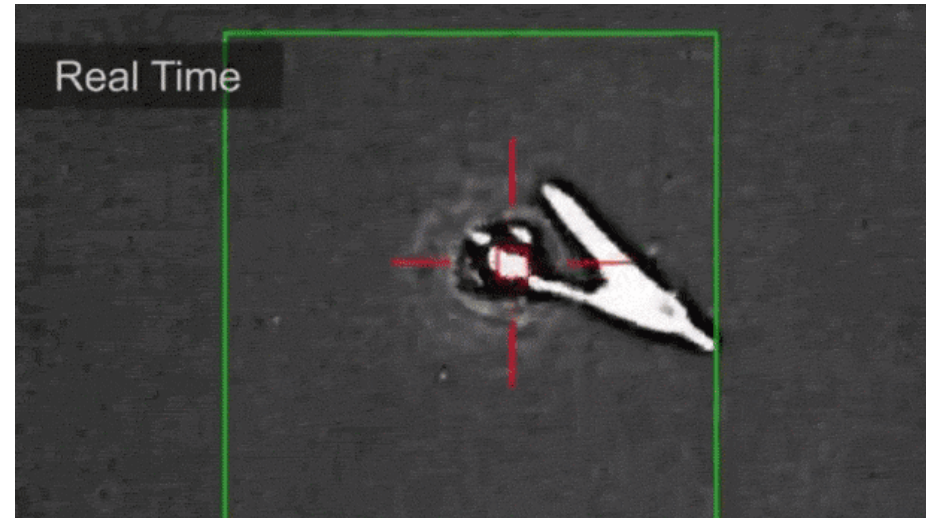
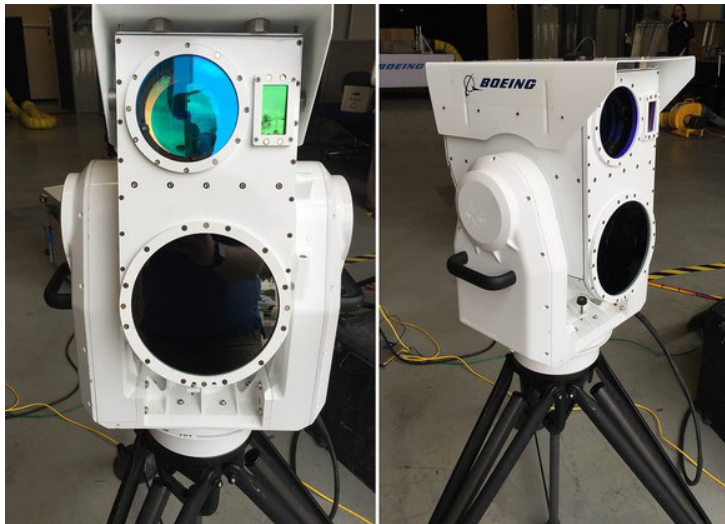
[LA Times - To keep drones out of high-risk areas, companies try hijacking them and shooting them down - 07Oct2016](#)

- “Last year, **Boeing unveiled its compact laser weapons system**, which ignites targeted drones. At a demonstration in California, Boeing said it took only about 15 seconds for its **2-kilowatt laser to disable the drone.**”

[Wired.com - Welcome to the World, Drone-Killing Laser Cannon - 27Aug2015](#)

- “The laser can take the 220 volts of power it needs from a generator or mobile battery pack and **is controlled with nothing more than a laptop and an Xbox 360 controller**, and the system will take over to track and fire on a drone itself once it's in range.

[Boeing's Compact Laser Weapons System: Sets Up in Minutes, Directs Energy in Seconds - 27Aug2015 - YouTube](#)



Boeing - Compact Laser Weapons System – “Directed Energy”

- <http://www.boeing.com/features/2015/08/bds-compact-laser-08-15.page>

Drone Defenses Gone Wild

SHOOTING DRONES WITH FRICKIN LASER BEAMS



POPULAR SCIENCE

The Navy Is Going To Test A Big Laser Soon

150 kilowatts of directed energy, pointed at an unknown date on a calendar.

By Kelsey D. Atherton June 24, 2016



Laser Weapon System On The USS Ponce

US Naval Research, YouTube Screenshot

Damage done by laser weapons is a function of power and time. The longer a laser can stay on a target, like a drone or an incoming missile, the more damage it can do. The more powerful that laser is, the less time it needs to spend burning its target. The U.S. Navy already has a 30-kilowatt laser mounted on a ship. Yesterday, at a summit on directed energy weapons in Washington, D.C., the Navy announced it plans to go bigger: 150 kilowatts.



Not yet lethal ? 11 December 2014, Atlantic Ocean, Senior Chief Master-at-Arms Shannan Richardson receives training in the use of an LA-9/P laser aboard the amphibious transport dock ship USS Arlington. Seen here mounted on a rifle stock, this hand-held GLARE/LA 9/P laser from B.E. Meyers, is used by individual Sailors out to 4 km at night and 1.5 km during daylight for hail and warning across linguistic and cultural boundaries. U.S. Navy photo by Mass Communications Specialist 2nd Class Stevie Tate



LASER WEAPON SYSTEMS
TURNING UP THE HEAT WITH SPEED-OF-LIGHT RESPONSE

U.S. Navy LaWS - AN/SEQ-3 Laser Weapon System or XN-1 LaWS

- https://en.wikipedia.org/wiki/Laser_Weapon_System



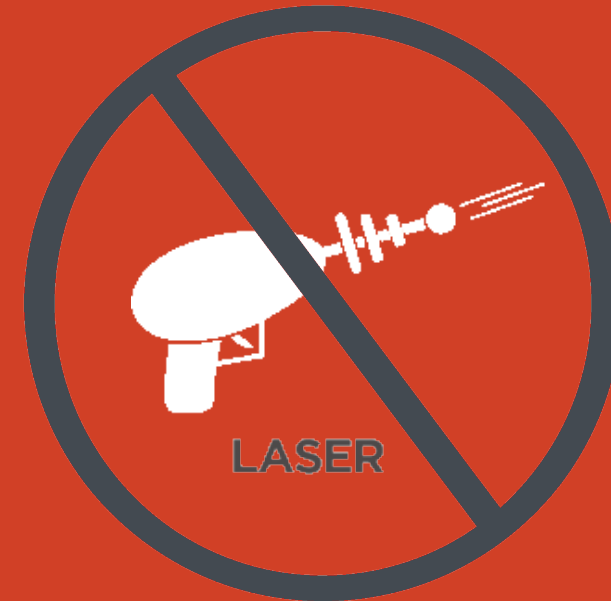


Defeating Laser Weapons

SHOOTING DRONES WITH FRICKIN LASER BEAMS



1. **Mirrors (Dielectric or Bragg)**
2. **Smoke, Dust, Obscurants**
3. **Thermal Transport Delay**
4. **Ablative Materials (heat -> gas)**
5. **Metamaterials (bend light like Predator)**
6. **Adsys Controls – Helios**
 - **Detects laser and fights back**



Popular Science – Defeating Anti-Drone Laser Weapons

- <http://www.popsci.com/laser-guns-are-targeting-uavs-but-drones-are-fighting-back>
- <http://www.popsci.com/china-plans-to-defeat-american-lasers-with-smoke>

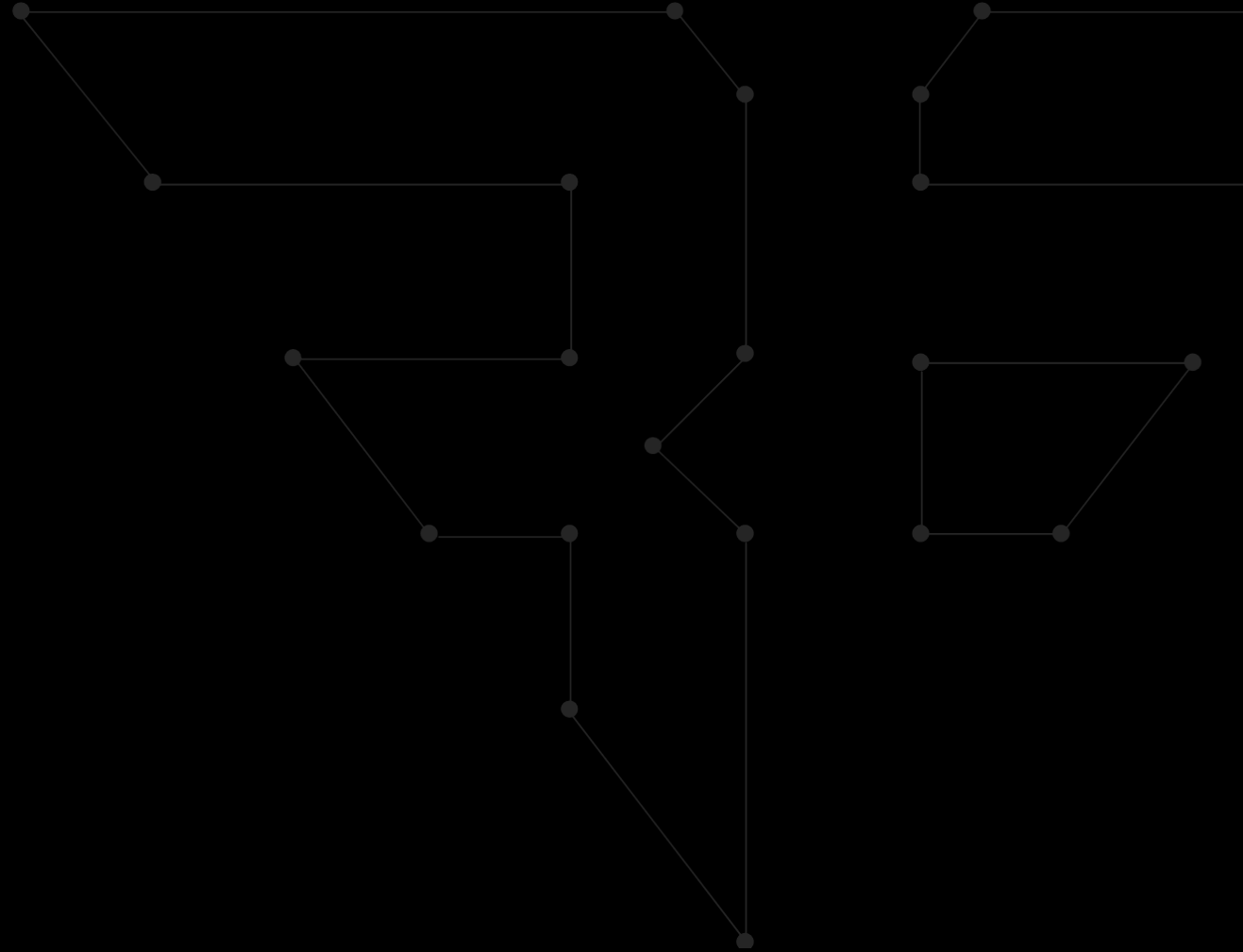
Counter Directed Energy Weapons - Office of Naval Research

- <https://www.onr.navy.mil/en/Media-Center/Fact-Sheets/Counter-Directed-Energy-Weapons.aspx>



LEGAL ISSUES

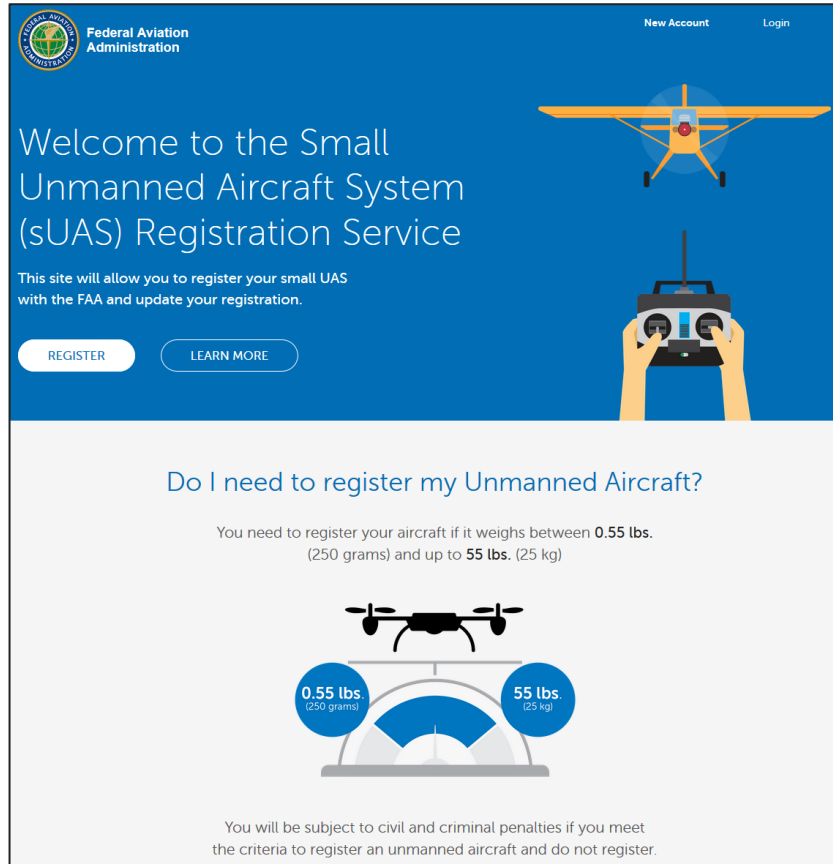
YOU HAVE THE RIGHT TO REMAIN FRUSTRATED



FAA Rule on Small Drones

CHANGING LEGAL LANDSCAPE

- <https://registermyuas.faa.gov/>



Do I need to register my Unmanned Aircraft?

You need to register your aircraft if it weighs between **0.55 lbs.** (250 grams) and up to **55 lbs.** (25 kg)

You will be subject to civil and criminal penalties if you meet the criteria to register an unmanned aircraft and do not register.

The rules for operating an unmanned aircraft depend on why you want to fly.

	Fly for Fun	Fly for Work
Pilot Requirements	No pilot requirements	Must have Remote Pilot Airman Certificate Must be 16 years old Must pass TSA vetting
Aircraft Requirements	Must be registered if over 0.55 lbs.	Must be less than 55 lbs. Must be registered if over 0.55 lbs. (online) Must undergo pre-flight check to ensure UAS is in condition for safe operation
Location Requirements	5 miles from airports without prior notification to airport and air traffic control	Class G airspace*
Operating Rules	Must ALWAYS yield right of way to manned aircraft Must keep the aircraft in sight (visual line-of-sight) UAS must be under 55 lbs. Must follow community-based safety guidelines Must notify airport and air traffic control tower before flying within 5 miles of an airport	Must keep the aircraft in sight (visual line-of-sight)* Must fly under 400 feet* Must fly during the day* Must fly at or below 100 mph* Must yield right of way to manned aircraft* Must NOT fly over people* Must NOT fly from a moving vehicle*
Example Applications	Educational or recreational flying only	Flying for commercial use (e.g. providing aerial surveying or photography services) Flying incidental to a business (e.g. doing roof inspections or real estate photography)
Legal or Regulatory Basis	Public Law 112-95, Section 336 – <i>Special Rule for Model Aircraft</i> FAA Interpretation of the <i>Special Rule for Model Aircraft</i>	Title 14 of the Code of Federal Regulation (14 CFR) Part 107

~~Effective: 29 Aug 2016~~

i The **NEW** Small UAS Rule (Part 107), including all pilot and operating rules, will be effective on **August 29, 2016**. For more detailed information, please see:

- [Summary of the Small UAS Rule \(PDF\)](#)
- [Small UAS Advisory Circular – How to Use the Rule \(PDF\)](#)
- [Complete Text of the Small UAS Rule](#)
- [Sample Aeronautical Knowledge Test Questions \(PDF\)](#)

Need more information? [Read about how to fly a UAS for your work or business.](#)

Update: 19 May 2017:

Law thrown out after lawsuit. No longer required to register drones with the FAA and \$\$\$ refunds for those that already did.



Taylor vs. FAA - Lawsuit Against Drone Rule

CHANGING LEGAL LANDSCAPE



19 May 2017

[RC Groups - Taylor v. FAA Update - 04Mar2017](#)

[DRONELIFE - The Lawsuit Over Drone Registration: Taylor vs. Huerta & FAA - 14Jun2016](#)

[Hackaday - Don't Like the FAA's Drone Registration? Sue Them! - 26Sept2016](#)

- “My case challenging the FAA's model aircraft registration regulation, and the application of DC-area flight zones to model aircraft is scheduled for **oral argument** in the U.S. Court of Appeals for the D.C. Circuit on **March 14, 2017.**”

How a little-known insurance lawyer became a symbol of (drone) liberty

When the Federal Aviation Administration started enforcing new rules around model aircraft pilots, John Taylor went from drone hobbyist to crusader.



John Taylor and one of the drones he custom built.

Slashdot

Stories

Firehose >

All

Popular

Polls

Deals

Submit

Americans No Longer Have To Register Non-Commercial Drones With the FAA

(recode.net)



113

Posted by msmash on Friday May 19, 2017 @03:20PM from the go-and-be-happy dept.

A federal appeals court on Friday struck down a federal rule that required owners of recreational drones and other model aircraft to register the devices with the Federal Aviation Administration. The FAA had announced the rule in 2015 in response to growing reports of drones flying near manned aircraft and airports. Drones have become increasingly popular with hobbyists and more than **550,000 unmanned aircraft were registered** within the first year it was required. From a report:

The court ruled that the FAA's drone registration rules, which have been in place since 2015, were in violation of a law passed by Congress in 2012. That law, the FAA Modernization and Reform Act, prohibited the FAA from passing any rules on the operation of model aircraft -- in other words, rules that restrict how non-commercial hobbyist drone operators fly. Now, if a person buys a new drone to fly for fun, **they no longer have to register that aircraft with the FAA.** But if flying for commercial purposes, drone buyers still need to register. The lawsuit was won by John Taylor, a model aircraft enthusiast, who brought the case against the FAA in January 2016. Since first opening the FAA's registration system in December 2015, more than 820,000 people have registered to fly drones.

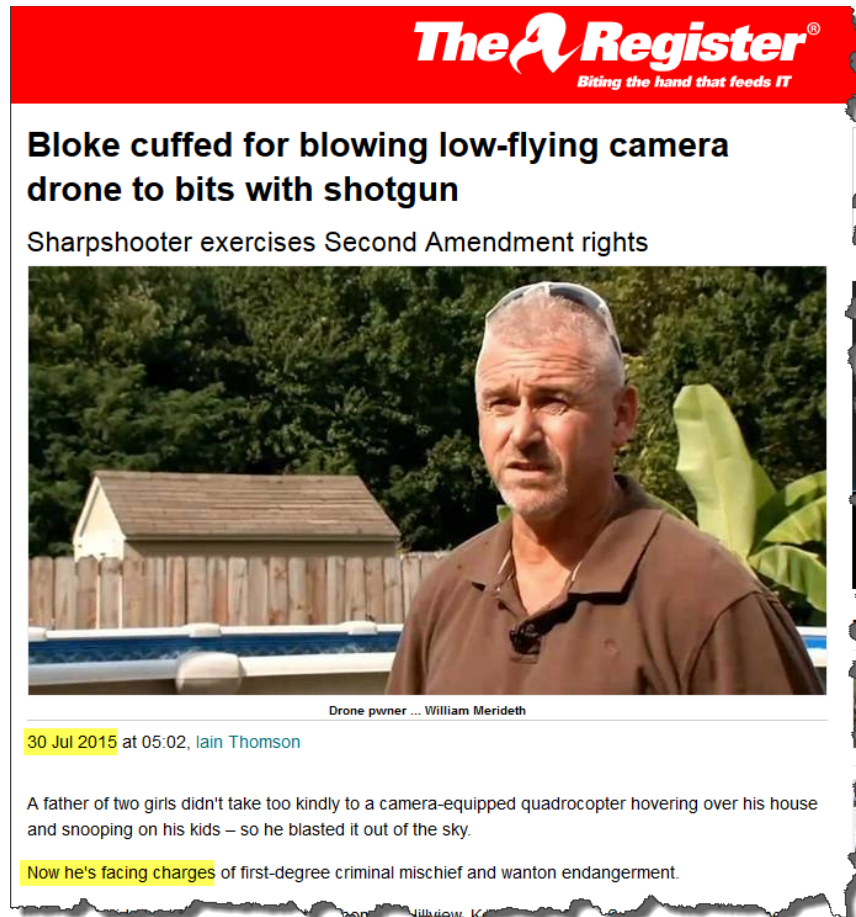
Hard to Legally Defend Against Drones

IF YOU CAN'T JAM THE SIGNAL, AND YOU CAN'T BLAST WITH A SHOTGUN... THEN WHAT?



[The Register - Bloke cuffed for blowing low-flying camera drone to bits with shotgun - 20July2015](#)


[Digital Trends - Drone Shooting is a Federal Crime - 17Apr2016](#)

A screenshot of a news article from The Register. The article title is "Bloke cuffed for blowing low-flying camera drone to bits with shotgun". The sub-headline is "Sharpshooter exercises Second Amendment rights". The main image shows a man, identified as William Merideth, standing in front of a swimming pool. The article text includes the date "30 Jul 2015 at 05:02, Iain Thomson" and a summary: "A father of two girls didn't take too kindly to a camera-equipped quadcopter hovering over his house and snooping on his kids – so he blasted it out of the sky. Now he's facing charges of first-degree criminal mischief and wanton endangerment." The Register logo is at the top with the tagline "Biting the hand that feeds IT".

The Register
Biting the hand that feeds IT

Bloke cuffed for blowing low-flying camera drone to bits with shotgun

Sharpshooter exercises Second Amendment rights



Drone pwner ... William Merideth

30 Jul 2015 at 05:02, Iain Thomson

A father of two girls didn't take too kindly to a camera-equipped quadcopter hovering over his house and snooping on his kids – so he blasted it out of the sky.

Now he's facing charges of first-degree criminal mischief and wanton endangerment.

*“What the h*** are we supposed to use, man, harsh language?” –*
Aliens (1986)



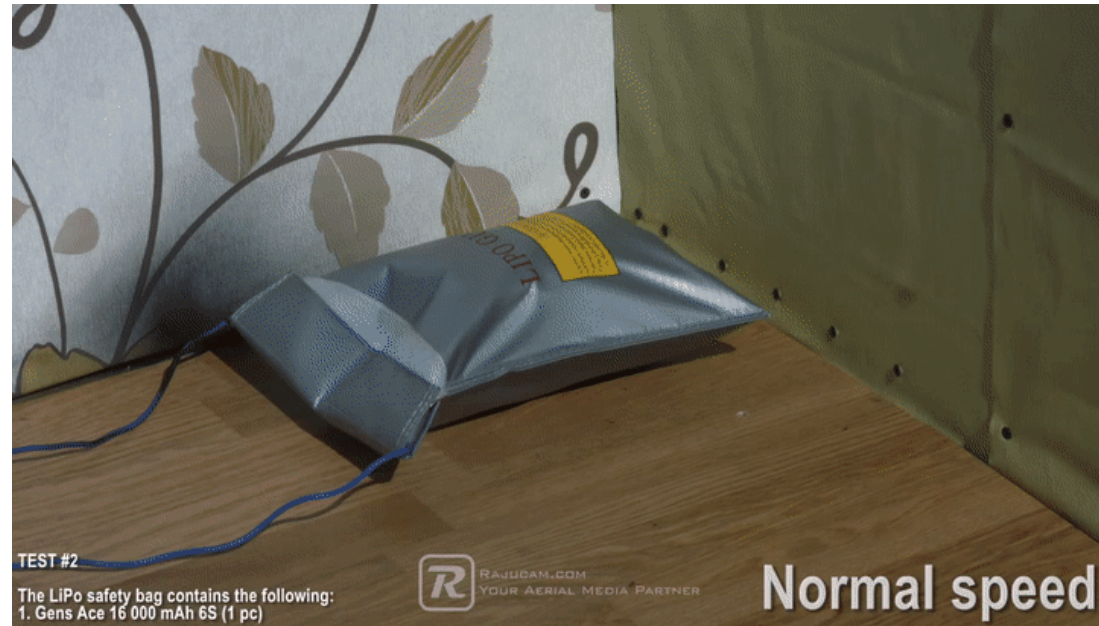
WARNING: Shooting LiPo Batteries Is Dangerous

BASICALLY AN UNSTABLE BOMB - POKE AND IT BLOWS UP, SPITTING FIRE



.50 CAL Includes Desiccant Packs

Safe Storage - 50 Cal Ammo Can (Rubber Seal REMOVED)



TEST #2

The LiPo safety bag contains the following:
1. Gens Ace 16 000 mAh 6S (1 pc)



RAJUDAM.COM
YOUR AERIAL MEDIA PARTNER

Normal speed



[YouTube - What happens when you puncture a LiPo battery - July2014](#)

[YouTube - How to store LiPo battery safely - In depth LiPo fire tests - 15May2016](#)

Hard to Legally Defend Against Drones

IF YOU CAN'T JAM THE SIGNAL, AND YOU CAN'T BLAST WITH A SHOTGUN... THEN WHAT?



[Digital Trends - Drone Shooting is a Federal Crime - 17Apr2016](#)

Aircraft Sabotage Law:

“Conviction for violating the FAA statute could result in a 5-year prison term.”

[Justice.gov - 2. Aircraft Sabotage - Law Statute 18 U.S.C. 32](#)



You can't shoot drones, it's a federal crime

EVEN IF YOU'RE BOTHERED BY THAT DRONE OVER YOUR HOUSE, YOU CAN'T SHOOT IT DOWN

By Bruce Brown — April 17, 2016 7:26 AM



The FAA wants people to stop shooting drones. At least 12 drones have been shot out of the sky in five U.S. states and the Federal Aviation Authority says it's a federal crime, according to a report in [Forbes](#). Even if they're over your house. Even if they're carrying [running chainsaws](#).

The FAA says you can't shoot them down and you can't disturb or interfere with someone flying a drone. Apparently drone pilot harassment is a bit less of an issue than, say, banging on the flight deck door on a passenger aircraft, but it's still against the law. Enforcement, however, seems sketchy — as in, no one's been arrested yet under the federal statute.

In response to a question from a Forbes reporter, the [FAA cited statute 18 USC 32](#). The [aircraft sabotage law](#) authorizes prosecution of anyone who damages an aircraft or commits a violent act against persons operating the aircraft, or even in the aircraft, should that act endanger the safety of the aircraft. Exactly what constitutes an “act of violence” is not defined in the statute, but clearly shooting a drone or its pilot would qualify.



More Drone Legal Guidance

CHANGING LEGAL LANDSCAPE



<https://jrupprechtlaw.com/drone-law-blog>

[JRupprechtLaw.com - US Drone Laws \(2017\) - Drone Laws by State](#)

[JRupprechtLaw.com - 7 Big Problems with Counter Drone Technology \(Drone Jammer, Anti Drone Gun, Etc.\) - 16Feb2017](#)

7 BIG PROBLEMS WITH COUNTER DRONE TECHNOLOGY (DRONE JAMMERS, ANTI DRONE GUNS, ETC.)

A Brief Background on the Brewing Drone Problem



As the drone industry is taking off, some individuals and groups have started using drones for malicious purposes around the globe. Many companies are watching the trend and are trying to get into the counter drone industry. They have introduced all sorts of drone guns, anti-UAS shotgun shells, attack birds, net cannons, lasers, missiles, radio signal jammers, radio spoofers, etc.

Types of Counter Drone Technology

The counter drone technology is getting lumped all into one bucket but I think it is best broken up into two categories: (1) detectors and (2) defenders. Keep in mind that these terms are my own.



More Drone Legal Guidance

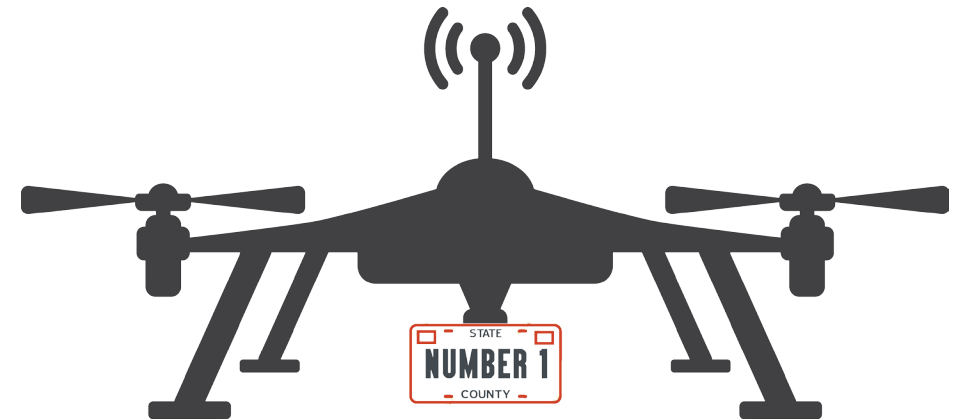
CHANGING LEGAL LANDSCAPE



Feb 2019

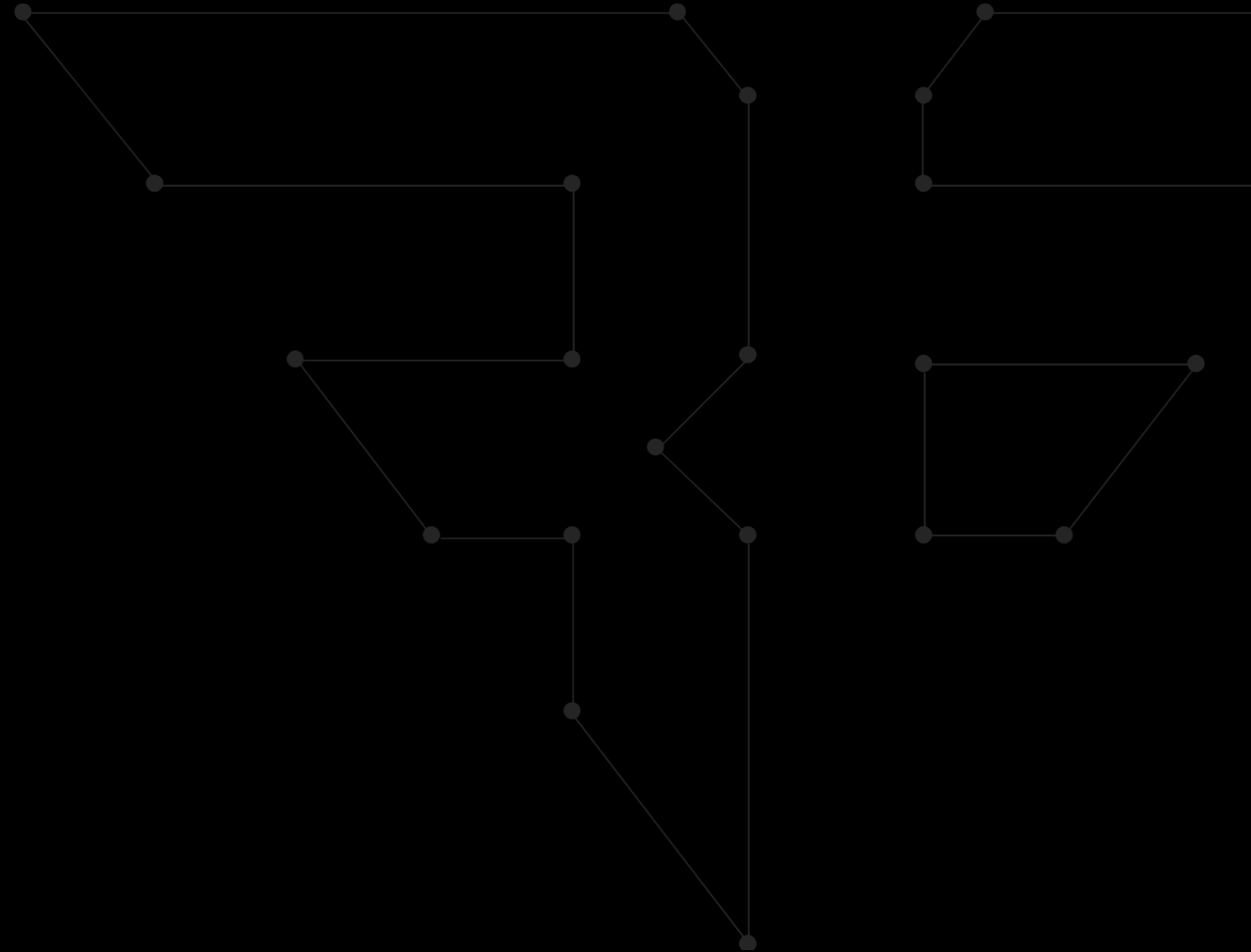
[Mashable - New ruling says drones must have external identification in the U.S. - 13Feb2019](#)

The screenshot shows a video player from Mashable. The video content features several drones flying in a field with two orange traffic cones in the foreground. A large red text overlay reads: "The Federal Aviation Administration filed a ruling mandating mini-license plates for all drones operating in the U.S." Below the video, the title "New ruling says drones will need to wear license plates" is displayed. There are social media sharing buttons for Facebook, Twitter, and others. At the bottom, a small text line states: "The FAA previously allowed drone owners to place the device's registration number inside the craft's battery compartment." The Mashable logo and navigation menu are visible at the top of the player interface.



FUTURE IS AWESOME

1980'S SCI-FI... FINALLY HAPPENING





The Future was on TV in the Past

GADGETS – SMALLER **FLYING DEVICES** & DROPPING OFF **GROUND DEVICES**



1. Drone Swarms
2. Hybrid Approaches
3. Under-water Drone
4. Micro / Bug-sized Drones



24 (TV) – Spy Bot



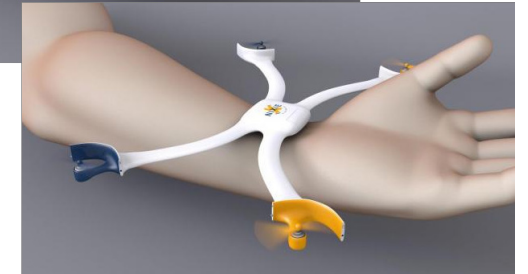
Drone Swarms



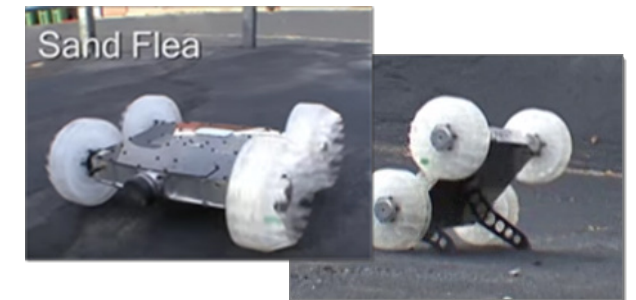
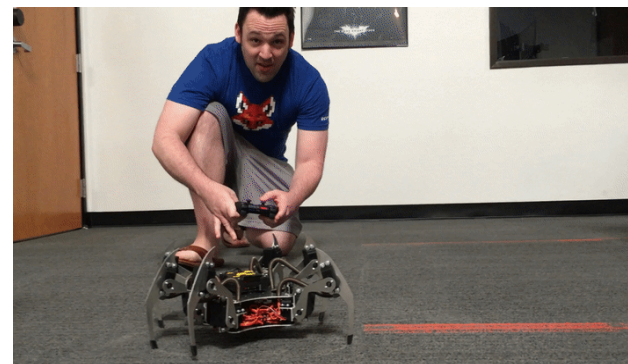
Call of Duty - RC-XD Remote Control Car (w Camera/Mic)



Wearable drones



Transformers – Laserbeak



Sand Flea - Jumping Infiltrating Robot





The Future was on TV in the Past

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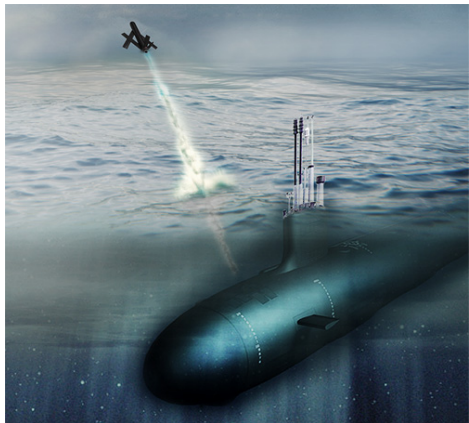
US Army – Micro Copters

This low-cost underwater drone aims to democratize the ocean for wannabe treasure hunters

Affordable ROV solution uses Raspberry Pi in advanced electronics package
by Michael Horne • 28 July 2016 • 0 Comments

California-based Blue Robotics has developed an affordable ROV solution using a Raspberry Pi. The Pi is used in their advanced electronics package for extra computing power and to stream 1080p video up the tether. You can read a lot more about it on their website.

RaspPi Submarine Drones



Hybrid Approaches



First Look: Behind-the-scenes with DragonflyEye
from Draper

DragonflyEye is a drone that uses live dragonflies to fly.

00:37 HD vimeo

DragonFly Cyborgs



Pollinating Drone Bees



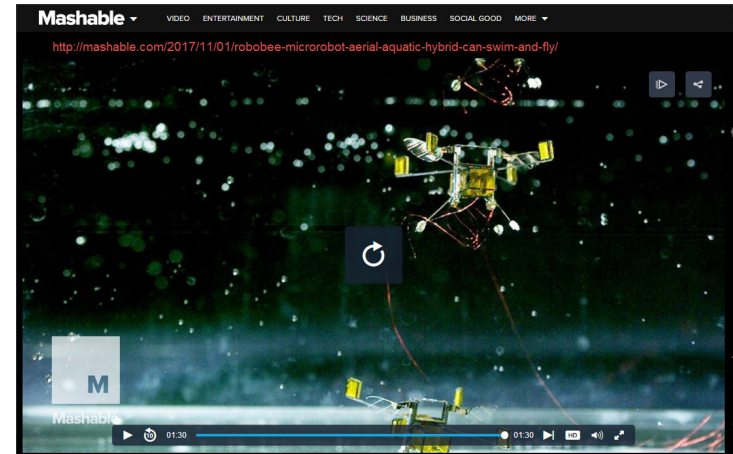
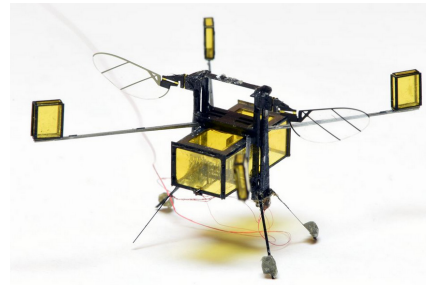


The Future was on TV in the Past

GADGETS – SMALLER **FLYING DEVICES** & DROPPING OFF **GROUND DEVICES**



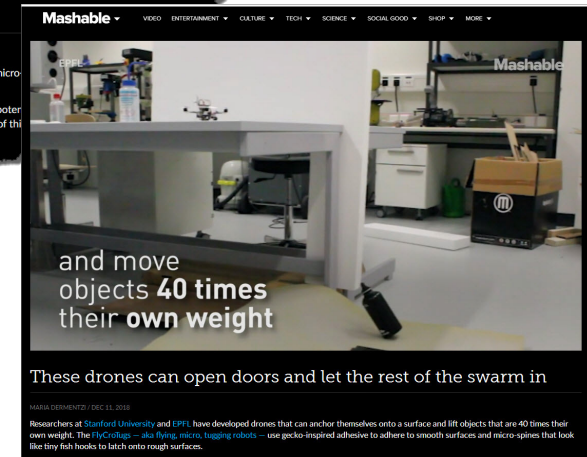
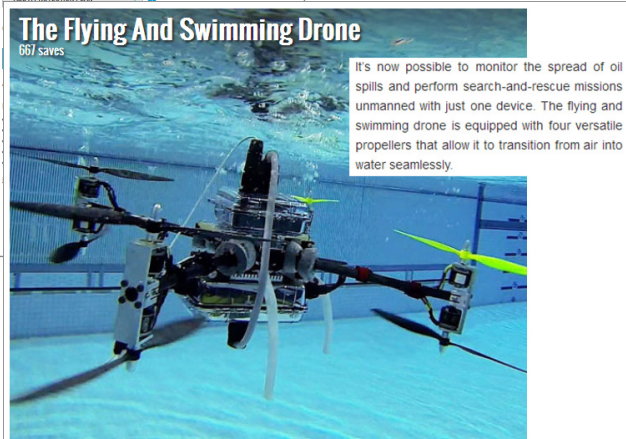
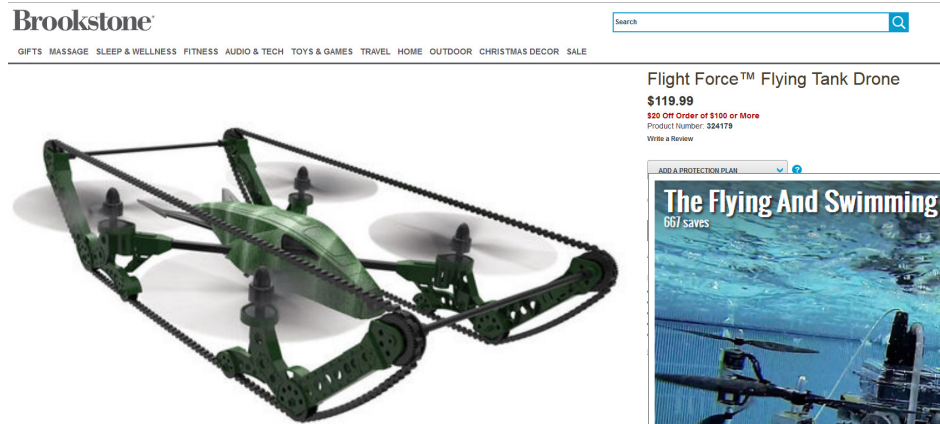
1. Drone Swarms
2. Hybrid Approaches
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Tiny micro-robot that is able to swim and fly could be the future of rescue missions

Share on Facebook | Share on Twitter | YouTube | LinkedIn | SoundCloud | RSS

MARIA DERMENTZI / NOV 01, 2017
Researchers at Wyss Institute for Biologically Inspired Engineering at Harvard University developed a hybrid micro-robot that can swim and fly. Although the "Robobee" is still at an early testing stage, the technology that powers it is thought to have the potential for future, including undertaking search-and-rescue missions and environmental monitoring. The coolest feature of this robot is that it can take off from the water surface and then take off from there to land on its feet.



The Future was on TV in the Past

GADGETS – SMALLER **FLYING DEVICES** & DROPPING OFF **GROUND DEVICES**



*3D mapping the insides of target buildings, kinda like **Batman** in 'The Dark Knight'*

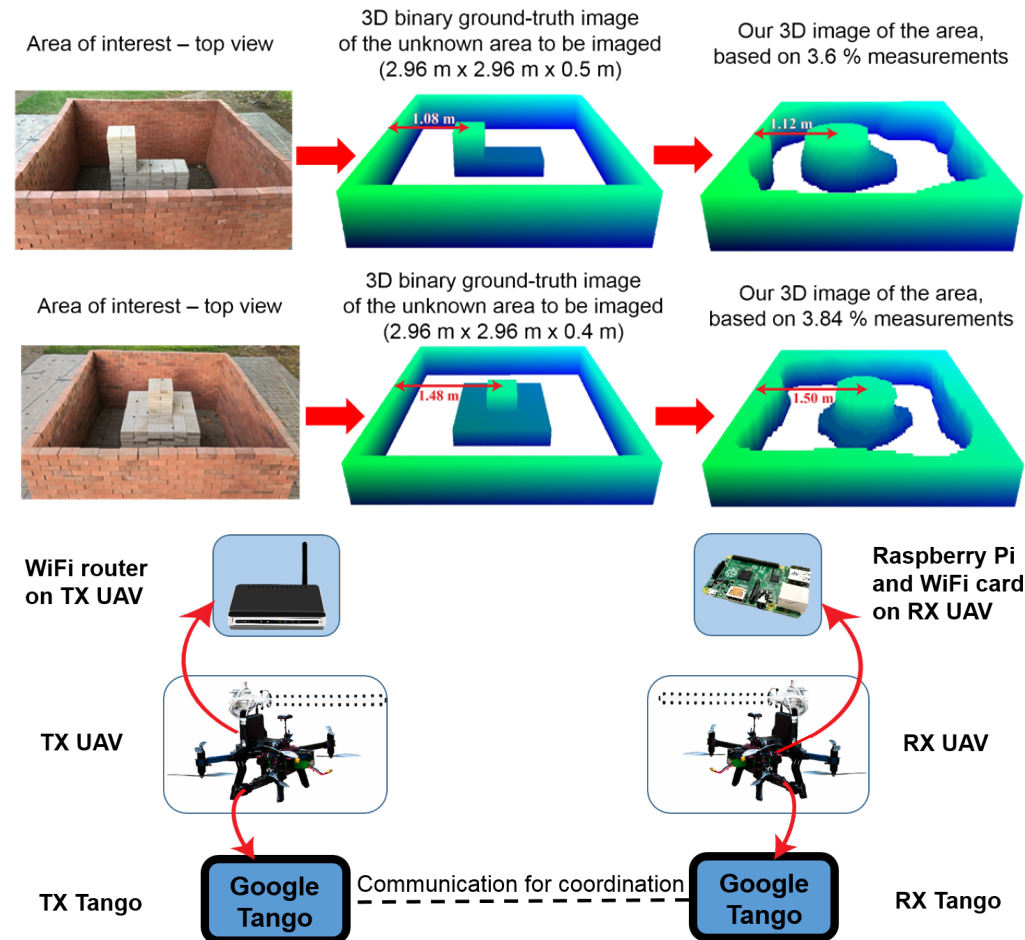


Drones can now see through walls — sort of.

Researchers at the University of California, Santa Barbara, just figured out how to use [Wi-Fi signals and drones](#) to create 3D maps of the inside of buildings. The video above demonstrates their process, which is also detailed in a [paper](#) published online.

For the experiment the team used two drones. One sent Wi-Fi signals from one side of the structure, while the other picked up what was left of the signal (the received signal strength or RSSI) on the other side of the walls. The result is a pretty decent image of what's inside the building.

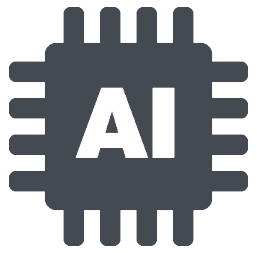
Instead of Superman and X-ray vision, we have drones and Wi-Fi. But like Superman, the drones might be able to take some 3D measurements of the inside of collapsed buildings and so on before emergency rescue arrives.



Mashable - These drones use wifi to make 3D images - 20Jun2017

- <http://mashable.com/2017/06/20/drones-3d-wifi-map/>



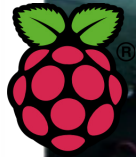
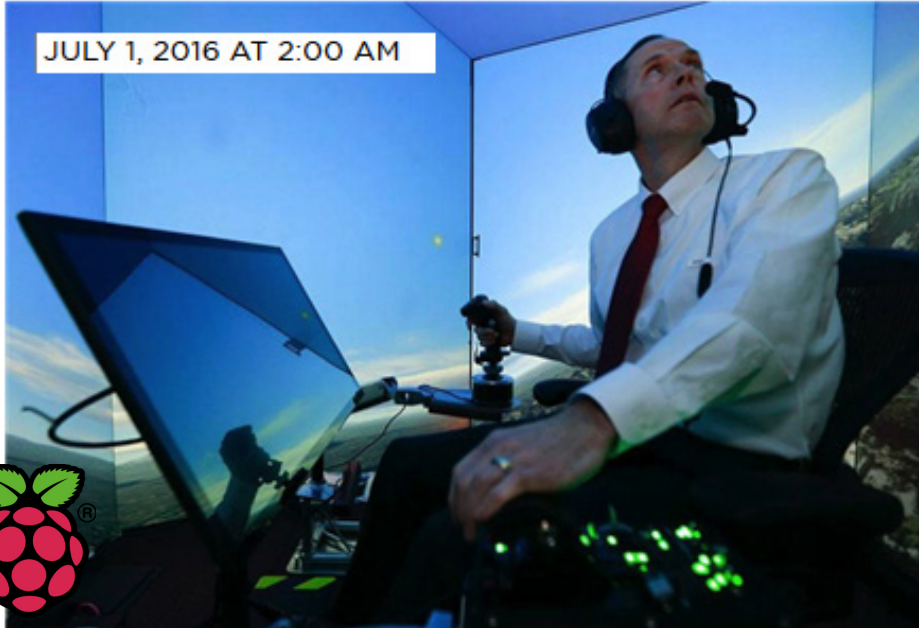


The Future was on TV in the Past

GADGETS – SMALLER **FLYING DEVICES** & DROPPING OFF **GROUND DEVICES**

Raspberry Pi-Powered AI Beats Human Pilot in Dogfight

JULY 1, 2016 AT 2:00 AM



An AI that runs on Raspberry Pi made headlines in [Newsweek](#) this past week.

When the Raspberry Pi computer was first launched in 2012 to promote the teaching of computer science, its creators probably didn't imagine the \$35 device would one day take on a professional fighter pilot in a dogfight—and win.

But that is exactly what a doctoral graduate at the University of Cincinnati set out to do when he built a Pi-powered artificial intelligence pilot. The AI, dubbed ALPHA, went up against retired United States Air Force Colonel Gene Lee in a series of simulated battles, beating Lee in every single engagement.

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Aerial Informatics and Robotics Platform

Established: February 15, 2017

Bridging the simulator-to-reality gap with **Aerial Informatics and Robotics** platform

Machine learning is becoming an **increasingly important artificial intelligence approach to building autonomous and robotic systems**. One of the key challenges with machine learning is the need for many samples — the amount of data needed to learn useful behaviors is prohibitively high. In addition, the robotic system is often non-operational during the training phase. This requires debugging to occur in real-world experiments with an unpredictable robot.

Autonomous robot security guard has a built-in drone to stop intruders



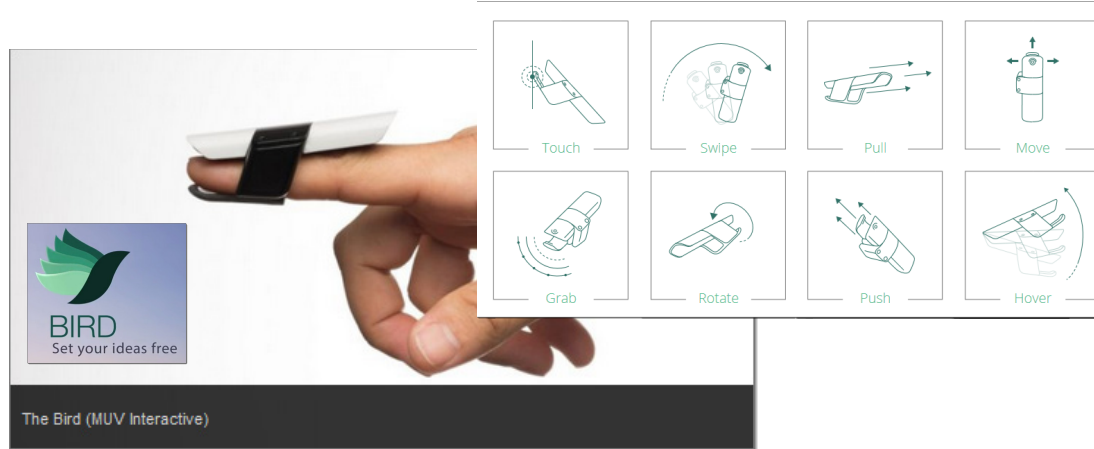
Rise of **A.I.** and **Auto-pilot** Software

Gesture Controlled Drones

MINORITY REPORT TYPE CONTROL SENSORS OF THE FUTURE



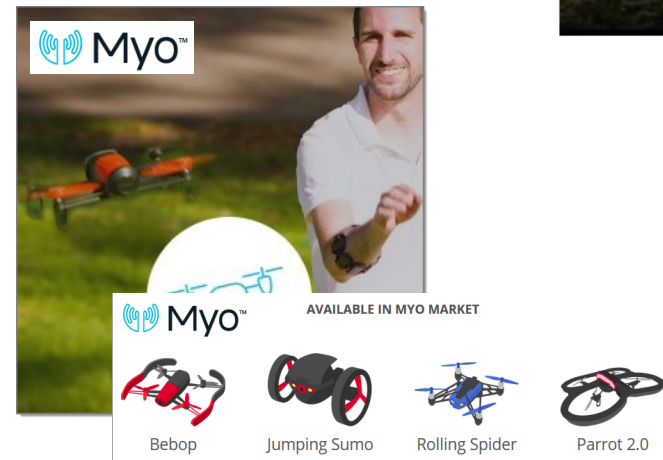
LEAP Motion



Bird - Finger Control of Drones



Myo - Gesture Control Band



HanDrone



Fox News - 'Bird' gadget lets you control a drone with your finger - 16Oct2015

- <http://www.foxnews.com/tech/2015/10/16/bird-gadget-lets-control-drone-with-your-finger.html>



Possible Future from Bishop Fox??

HACKING DRONES: STAY TUNED FOR FUN RESEARCH TO COME

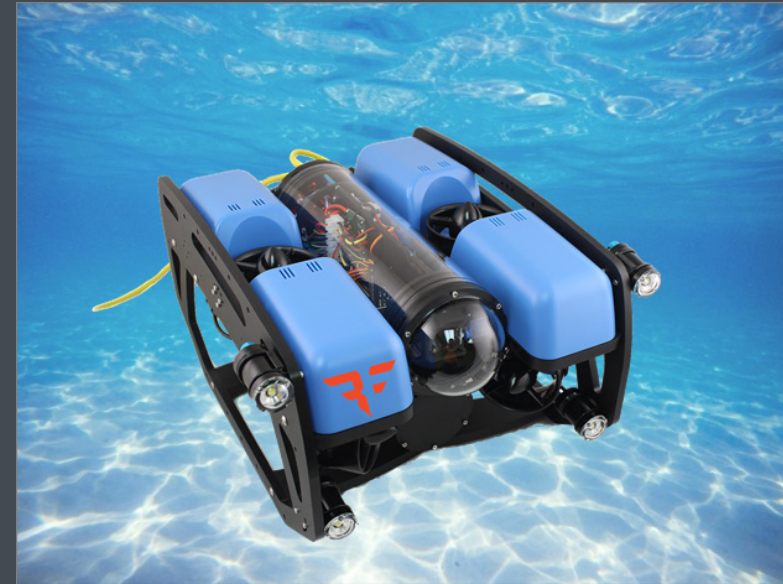


Check our project page for continued updates to our drone defense and penetration testing research:

- <http://DangerDrone.io>



Danger Blimps



Danger Subs



THANK YOU
THANK YOU
THANK YOU
THANK YOU
THANK YOU
THANK YOU

Have A Nice Day

Bishop Fox – Danger Drone Research:

- <http://dangerdrone.io>



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[Adapter image](#)

[ASUS USB image](#)

[Wi-Fi Antenna image](#)

[Blue-Tooth USB adapter image](#)

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