Believe It or Not: Wireless Walking on Air Drones and Wireless Security

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UAVs

UAVs change the wireless landscape and will have dramatic security implications

- UAVs will come in a variety of sizes and shapes, with a wide range of cyber-capabilities
  - Tasks: environmental monitoring, item delivery, recreation, etc.
  - Use wireless for control
  - Have the potential to cause physical harm
- UAVs change the "wireless game"
  - Require strict guarantees in communication performance
  - Have an elevated perspective that has pros/cons
  - Easy access by hobbyists
  - Advanced "tactical" UAVs have quite different security considerations (talk to me offline!)

- Drones are already commodity technology:
  - DJI Phantom, 3DR, etc… easily accessible and affordable
  - Software kits available for app development (e.g. 3DR's DroneKit API, DJI SDK)

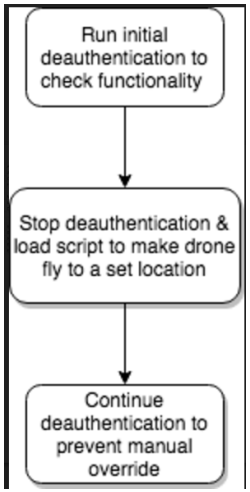
A Case Study illustrates the potential risks associated with UAV: Football Stadium

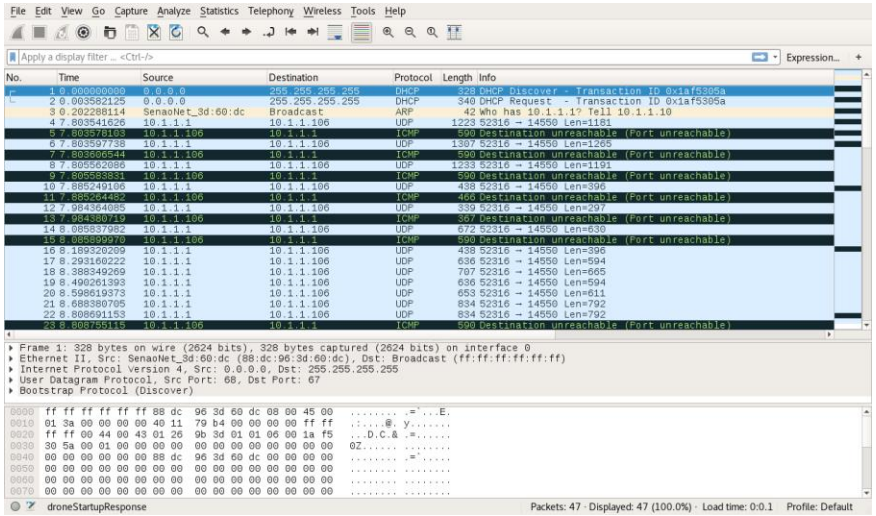
- A recent Rutgers investigation into the use of recreational drones near football arenas:
  - Hobbyists try to fly drones over games to watch the event
    - *Safety: A crash can harm life and infrastructure*
    - *Revenue implications*
  - Sensors deployed around a stadium, with new commercial software used to detect drones
- Lessons learned:
  - Most drone vendors use commodity wireless tech (e.g. Wifi), and most detection uses "wireless" to find the controller.
  - Controller detection was usually successful within 30seconds, location within 150m about 80% of time.
  - Detection performance is dependent upon deployment "geometries"
  - Having an up-to-date drone "RF" signature database (MAC addresses, etc)
- Pre-planned missions or many drones: Not easy to detect→ need for other forms of drone detection

- Legal limitations:
  - The law limits what can be done "to counteract" drones
  - Can't disarm or disable drones, even if they would cause physical harm
  - FAA limitations are ignored by hobbyists
  - Concerns that anti-drone defense systems (jammers) might impact other societal systems (navigation)
  - Need to re-evaluate these limits

It is relatively easy to pwn a drone… sort of.

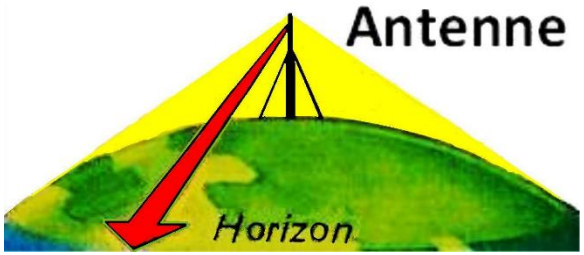
- In a separate study, Rutgers investigated the susceptibility of commercial drones to simple, cyber attacks
- Goals:
  - Analyze drone communications
  - Understand attack vectors to control/disable drone
- Attack scenario:
  - Laptop running Kali Linux
  - Wireshark - packet capturer
  - Aircrack-ng - wireless exploit suite
  - 3DR Solo Drone
  - Sololink - controller/drone wifi network
- We were able to:
  - Capture and replay packets (sent to the drone)
  - Deauthenticate the drone
  - Redirect the drone with the DroneKit API
- Good news: Deauth on the drone did not lead to a crash… drone hovers but does not have a controlled descent.



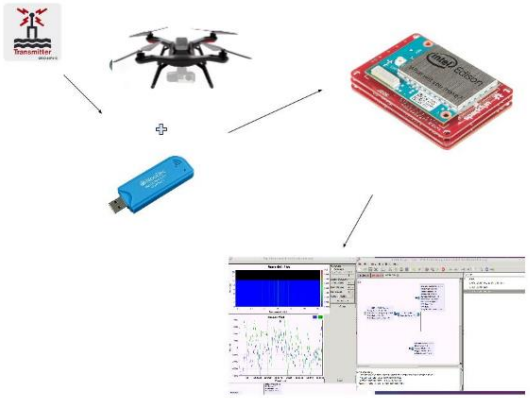


Elevated implications on spectrum: a double-edged sword

- UAVs are an elevated platform
  - Able to receive RF signals from "further away"
  - Able to transmit RF and impact receivers "further away"
- Simple line of sight arguments imply a larger RF footprint/ radio horizon for a drone
  - Larger L1 interference footprint
  - Larger L2 (MAC-layer) impact– think carrier sensing
  - Larger L3 impact (everything is the drone's neighbor)
- The good:
  - UAVs as mobile, emergency cellular basestations
  - UAVs as repeater (bridge between two non-line-of-sight RX)
  - Enhanced spectrum sensing (needs more research on signal separation, spectrum cartography!)
- The bad:
  - But what about a rogue, software-based LTE basestation (e.g. OpenAir LTE)?
  - Jammers…



Picture from Wikipedia



WINLAB spectrum sensing on a drone

- GPS + RF SDR dongle
- Problems with weight, GPS stability

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