Satellite Reception on Inexpensive Equipment

Satellite	
Downlink Frequency	
Encoding	
Pass Start Time	
Pass End Time	
Elevation	
Azimuth	

Supplies Required:

- RTL-SDR or equivalent - Any FM radio with a receive bandwidth of >34kHz
- Antenna capable of receiving at 137MHz (~2.2 meters), RHCP. Directional is preferred.
- Laptop or Android phone with SDR control software. I will be using CubicSDR, however other software, such as SDR#, GQRX, or SigDigger will work nicely as well.
- Tripod with antenna mast
- Compass
- Satellite tracker

Introduction

Material to cover:

- Weather satellites provide critical information to meteorologists
    - This is important for aircrews
    - Provides a “birds-eye view” of storms
    - Allows us to: - **ask**
        - Track movement of storms
            - Most importantly hurricanes
        - Locate and track wildfires
        - Pollutants
- NOAA/APT background
    - What is APT
        - APT (automatic picture transmission)
        - Form of Slow-Scan Television or SSTV
        - Developed in 1960s
        - First tested on TIROS-8
        - Has resolution of 4km on NOAA POES
        - At one point, many satellites used this
        - Is being phased out in favor of newer LRPT/HRPT/GRB
    - Orbits
        - POES (polar earth-orbiting satellites) - **ask**
        - Polar orbits are lower orbits, that cross over the poles
            - This allows them to cover entire globe
    - Radio
        - Sent over a 137MHz carrier
        - Using a Yagi-Uda antenna - **ask**
            - Same as used on TV aerials
            - Forward, shorter elements direct signal - **ask**
                - Smaller than wavelength - **ask**
            - Rear, large element reflects signal
                - Larger than wavelength
        - Point the antenna towards the clearest signal
            - Should hear a repeating ping and a lower-pitched clunking sound
            - Play audio
            - Shouldn’t hear static in between pings
        - Doppler effect - **ask**
            - Adjust radio frequency continuously, it will shift
    - Decoding
        - File is imported to NOAA-APT
        - Don’t use map overlay

Hands-on (~30min)

- Have students set up tripod and secure antenna mast
- Have students set phones to airplane mode
    - This is to minimize interference
- Attach the antenna to the mast
- Assign jobs:
    - Pointing the antenna
    - Monitoring and adjusting the radio for doppler shift
    - Monitoring and announcing the elevation
- Have student point antenna to correct azimuth, and about 5 degrees above the horizon
    - Begin recording
        - Use 11.025kHz Sample rate
        - Can also do baseband (.IQ) recording if possible
    - Move antenna left and right a few degrees until signal is picked up
- After satellite has passed it's max elevation, roll antenna 180 degrees for proper antenna polarisation
- After the signal is no longer being picked up, continue recording for 1 minute, then stop.
- Disassemble equipment
- Go back inside
- Decode signal