Low Cost Antenna Control Unit

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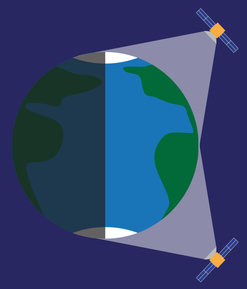
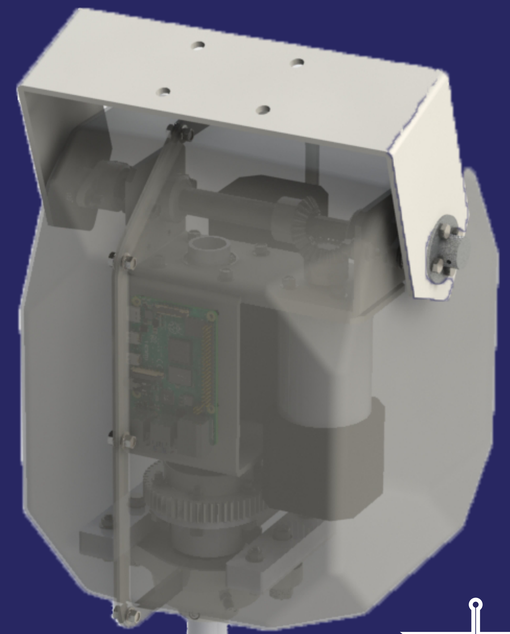
Rationale

By using satellites in Medium Earth Orbit and Highly Elliptical Orbit, signal latency and setup cost are reduced, making internet more accessible. However, the ground station has to track the satellites for a consistent signal

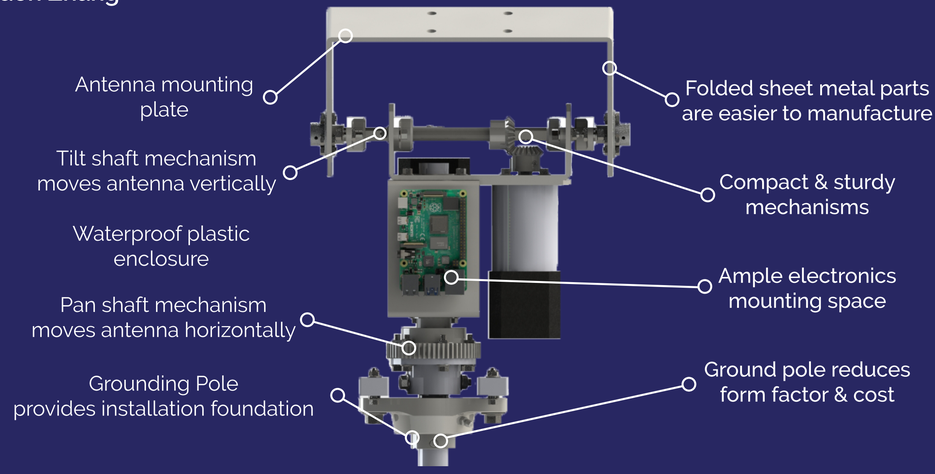


In addition, this ground station must be cost-efficient and user-friendly. This will allow manufacturing to scale with the increasing network.

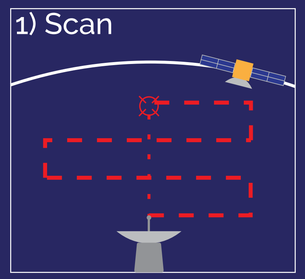
Final System Cost: $750



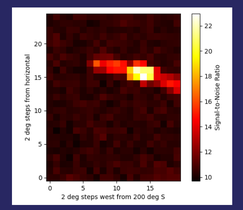
Mechanical Design



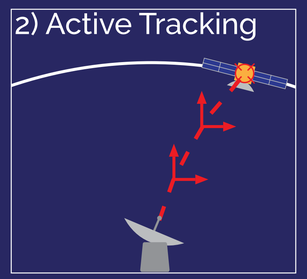
Tracking Software



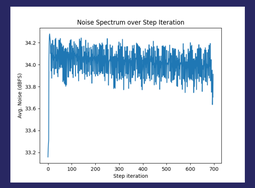
The ACU starts with the scan function, which moves in a left-to-right rastering pattern. If it detects a peak corresponding to a satellite frequency, it moves on to active tracking



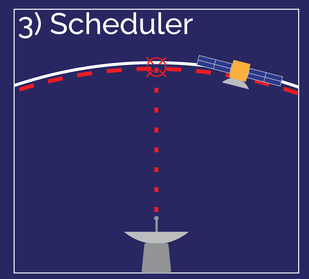
A heatmap showing the results of a scan



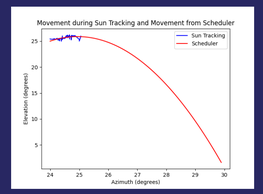
During active tracking, the ACU uses a gradient ascent algorithm. Each step, it calculates the direction of the gradient by finding the change in signal strength in the vertical & horizontal axes, then moves in that direction



A graph of the measured signal over time while tracking the sun.

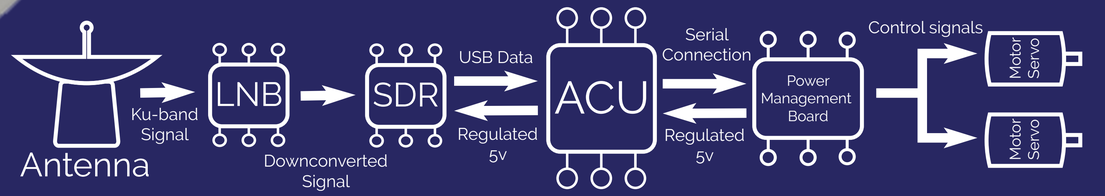


When the satellite dips below the horizon, the ACU switches to the scheduler function. This interpolates the motor movements during active tracking and "backtracks" to find a new satellite

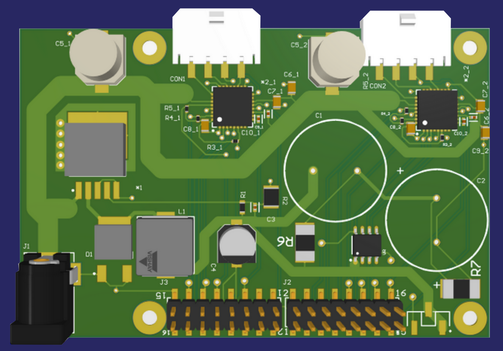


A graph of the backtrack in red versus the recorded movements in blue

Electrical Design



A map of the electrical system of our ACU, showing the flow from antenna signal to motor control signals.



Our custom power management board has the following advantages over the COTS parts used in the alpha prototype:

- Power loss detection to increase longevity of Raspberry Pi
- Streamlined power distribution and peripheral interfacing
- Modified motor control solution
- Robust physical connectors