Mobile GPS Payload

Design Review 4

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Introduction

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Project Brief

- Sponsor:
  - Space Vehicles Directorate, Air Force Research Lab (AFRL) – Advanced GPS Technologies Program (AGT)

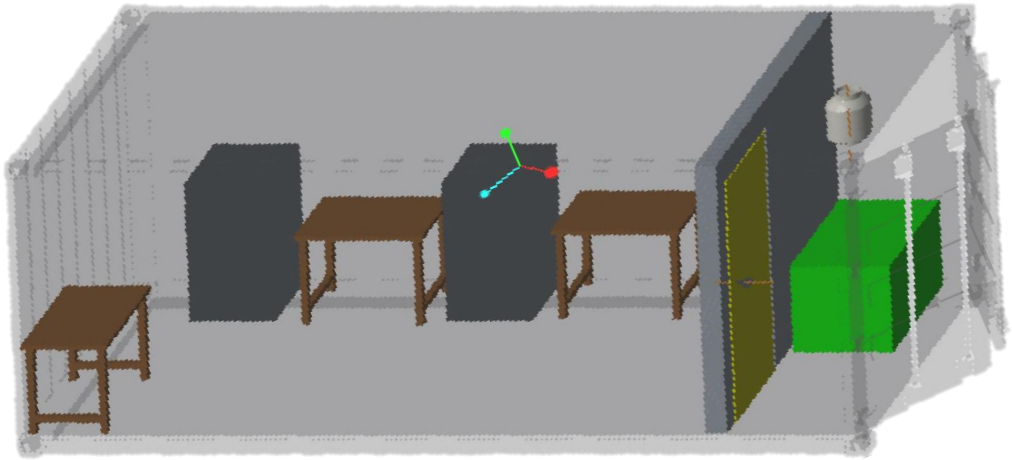
- Design a mobile GPS lab with the capability to test components of a position, navigation, and timing payload.
  - cost effective
  - user friendly
  - as simple as possible

Concept Selection

- Outer shell/ vehicle
  - Enclosed trailer
  - RV
  - Box Truck
  - Shipping container
- Ergonomic Interior Layout

Requirement Updates

- Acronym: AGT Navigation Instrumented Mobile Lab (ANiML)
- Container: 20’ → 40’
- Operators: 3 → 4
- Workstations: 3 → 4
- Equipment Racks: 2 → 4
- EMI/RFI Shielding



Raine Sagramsingh

EMI/RFI Shielding

EMI/RFI Shielding

➢The lab needs 80dB of attenuation of outside signals.*

➢The shielding effectiveness of an ISO shipping container is about 45dB.

➢Need an additional 35dB+ of attenuation.

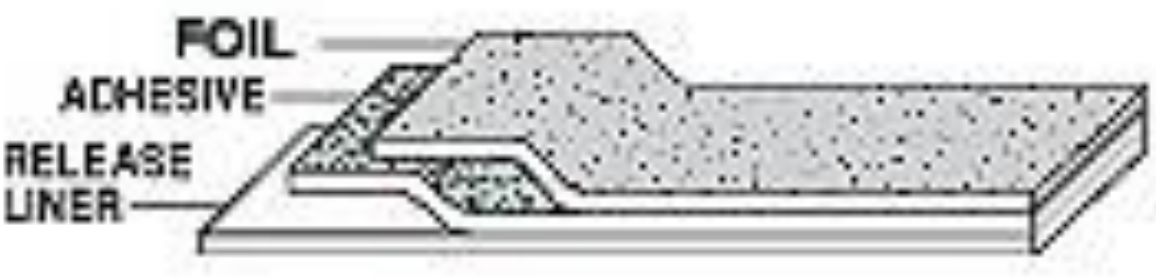
* - Attenuation is marked in decibels (dB) that correspond to the ratio between field strength with and without the presence of a protective medium.

Shielding Options

1. Having an RFI room installed in the container:
   - Cost: $270,000
   - Attenuation: 140 – 185dB
2. Shielded panels:
   - Cost: $55 per panel (4’ x 8’)
   - Attenuation: 60dB

Shielded Panels

- Provide shielding and insulation.
- Overall cost: $2,000
- Total attenuation: 105dB



Ricky Gal

HVAC & Power Generation

HVAC

- 40’ ISO Container → 320 ft^2
- Energy Star Calculations:
  - Base 8,000 BTU/h
    - Sunny = +10%
    - More than 2 people = +600 BTU/h/person

$$\left(8{,}000\,\frac{BTU}{h}\right)(110\%) + 2\left(600\,\frac{BTU}{h}\right) = 10{,}000\,\frac{BTU}{h}$$

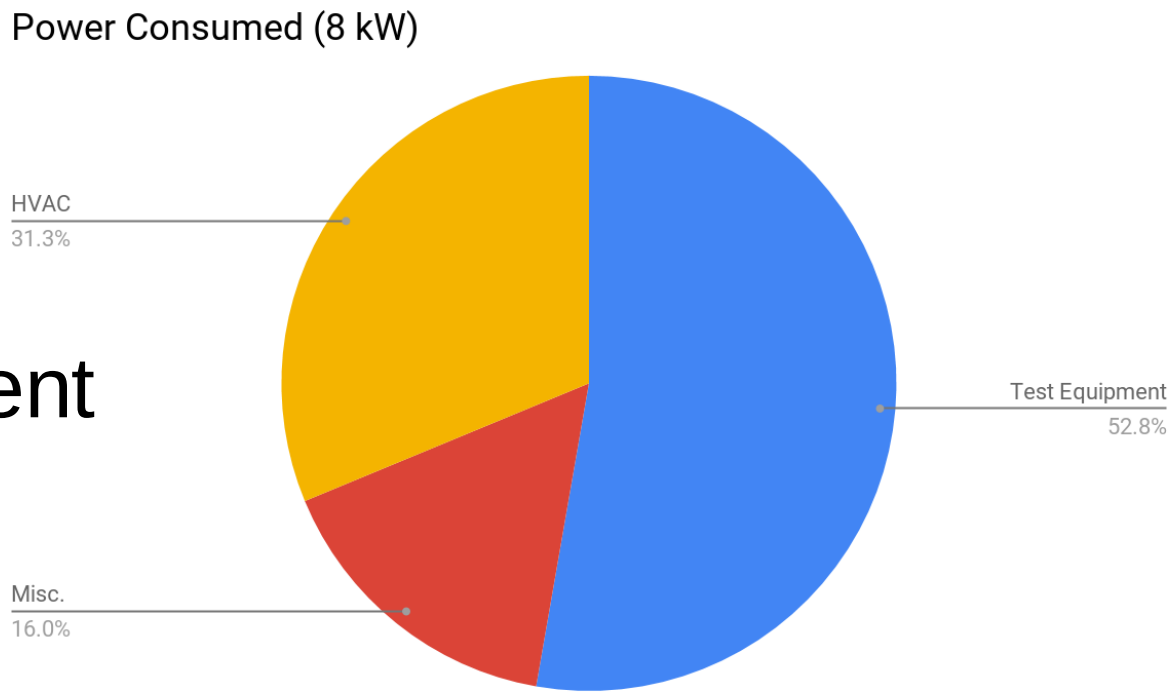
- 10,000 BTU/h = 0.83 Ton
  - Result verified by other methods of calculation

HVAC Unit Selection

- ➢Bard W12AAA Wall Mounted unit
  - 12,000 BTU
  - Externally mounted to maximize inner space
  - Cost: $2,550

Total Power Required

- HVAC
  - 2500 W
- Misc.
  - 1280 W
- Test Equipment
  - 4220 W



Power Generation

- 8 kW required to power equipment
- 12 kW generator
  - Allows for a 40% tolerance
- Cummins Onan Quiet Diesel Generator
  - Cummins Onan QD 12000
  - Cost: $10,000

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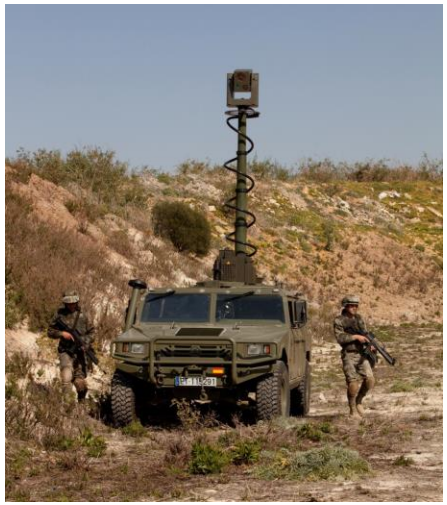
Antenna Operation

Requirements

- Mast Requirements:
  - Extendable to 30’ height
  - Payload weight 10 lbs.
  - Payload area 4 ft2
- Storage Environment
  - Temperature: 0 to 110°F
  - Wind: 60 mph
- Operational Environment
  - Temperature: 15 to 105°F
  - Wind: 50mph

Stiletto Telescoping Mast

- No guylines
- Self-locking sections
- High strength, low weight
- Electro-mechanical screw drive
- Cost: $

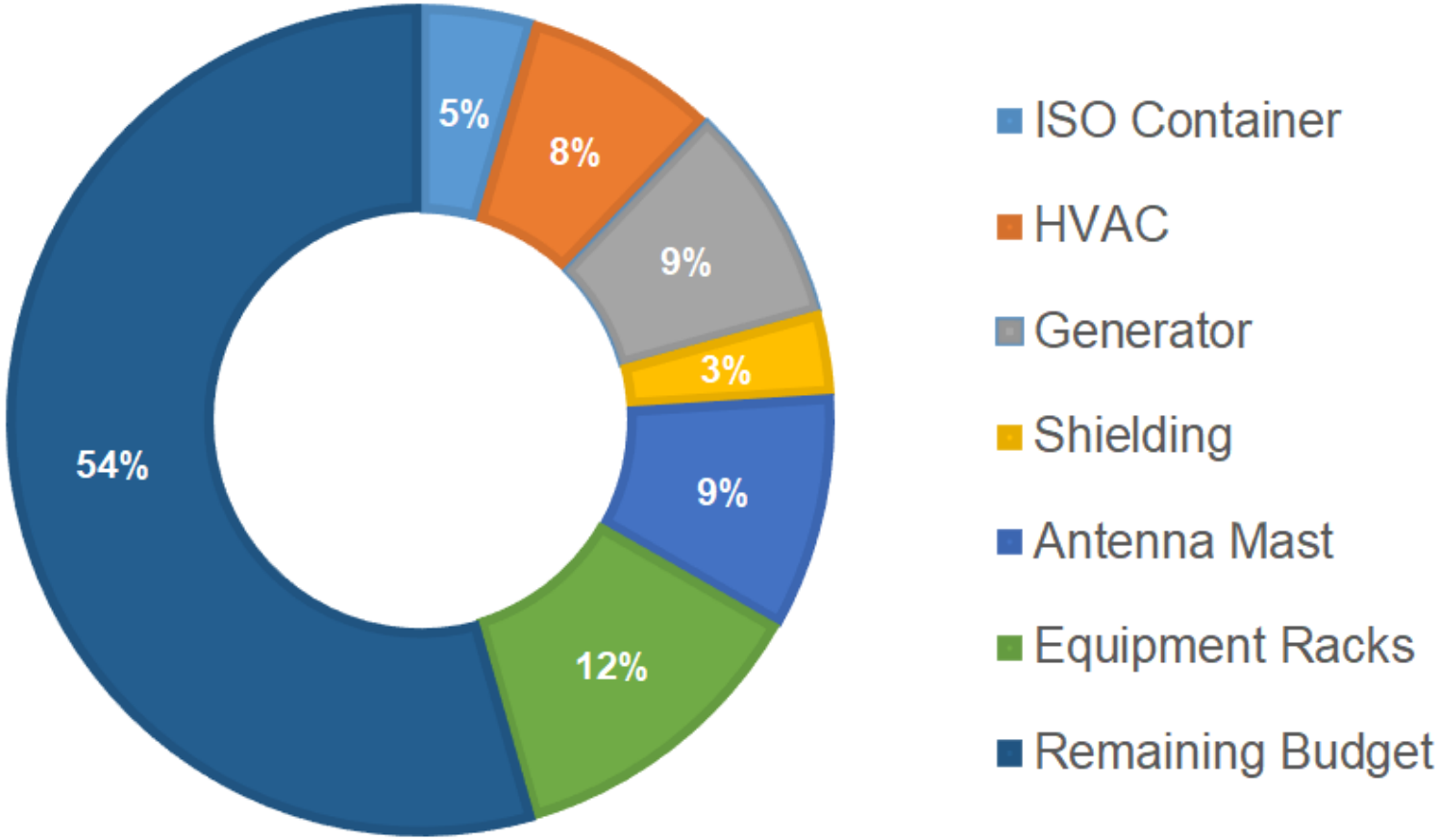


Model	10 Meter
Nested Height (+0 in. / -1.0 in.)	68 in. / 1.73 m
Extended Height (+4 in. / -0 in.)	32.5 ft. / 9.9 m
Payload Capacity (Rated)	175 lb. / 80 kg
Payload Capacity (Maximum*)	250 lb. / 113 kg
Erection Time (with Power)	2 min., 45 sec.
Erection Time (Manual)	6 min., 30 sec.
Typical Payload Sail Area (CD = 1.5)	6 sq. ft. / 0.56 sq. m
Deployment Wind Speed	34 mph / 55km/h
Survival Wind Speed	80 mph / 129 km/h
Number of Sections	9

Travis Bruner

Budget & Next Steps

Budget


5%
8%
9%
3%
9%
12%
54%
ISO Container
HVAC
Generator
Shielding
Antenna Mast
Equipment Racks
Remaining Budget

Next Steps

- CAD Model & Drawings
- Model Simulation/Walkthrough
- 3D Printing
  - Printing in Tallahassee and New Mexico
- Website

Questions?

References

Back-Up Slides

Acronyms

GPS	Global Positioning System
ME	Mechanical Engineering
ECE	Electrical/Computer Engineering
AFRL	Air Force Research Lab
AGT	Advanced GPS Technologies
HVAC	Heating, Ventilation and Air Conditioning
PNT	position, navigation, and timing

PNT Equipment

- High power amplifiers
- On-orbit Reprogrammable Digital Waveform Generators (ORDWG)
- New antenna concepts
- Supporting electronics
- Algorithms and new signal combining methods
- Satellite bus technologies for increased resiliency and lower Size, Weight, and Power (SWaP)
- Advanced cyber technology

Decibels

- Logarithmic unit used to express the ratio of one value of a physical property to another, and may be used to express a change in value (e.g., +1 dB or -1 dB) or an absolute value

EMI/RFI

- Electromagnetic Interference
- Radio Frequency Interference

HVAC Considerations

- Overshooting HVAC requirement causes unnecessary cycling, which leads to premature failure.
- Energy Star Manufactured Home Cooling Equipment Sizing Guidelines
  - 18,000 BTU (Minimum size of 840 sqft.)
- Online calculators
  - https://kobiecomplete.com/cool-tips/btu-calculator/
    - 8360 Btu
  - https://www.highseer.com/hvac-load-calculator/
    - 8019.66 BTU