Mobile GPS Payload

Virtual Design Review 2

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Introduction

Taylor Davis
Administrative Lead

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Sponsor Liaison

Michael Connell
ME Lead

Travis Bruner
Webmaster & Financial Lead

Ricky Gal
ECE Lead

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

Target Summary

Customer Need	Target
The mobile lab is technician friendly.	Interior temperature of 68-77°F
The lab has workstations for multiple operators.	Accommodate 1-3 test operators
Lab equipment functions inside of the vehicle.	Equipment runs at 32-104°F
The unit holds varying sizes of equipment.	Storage for racks of heights up to 6’
The unit is self-sufficient.	Provides at least 6kW of power
	Runs for 55 hours without recharge
The vehicle withstands various environments.	Can withstand up to 75 mph winds
Operators have access to a restroom on site.	Restroom within 5 min. drive
The design provides a reasonably priced option.	Non-recurring costs: ~$150,000
The design minimizes operational costs.	Each deployment: < $2,500

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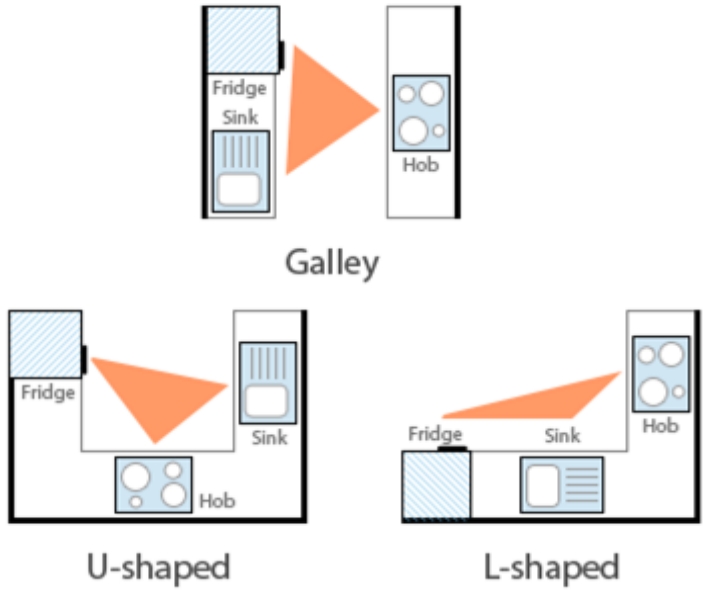
Concept Generation

1. Vehicle selection:
   a. Motorhome
   b. Camper Trailer
   c. Enclosed Trailer
   d. Shipping Container
   e. Step Van

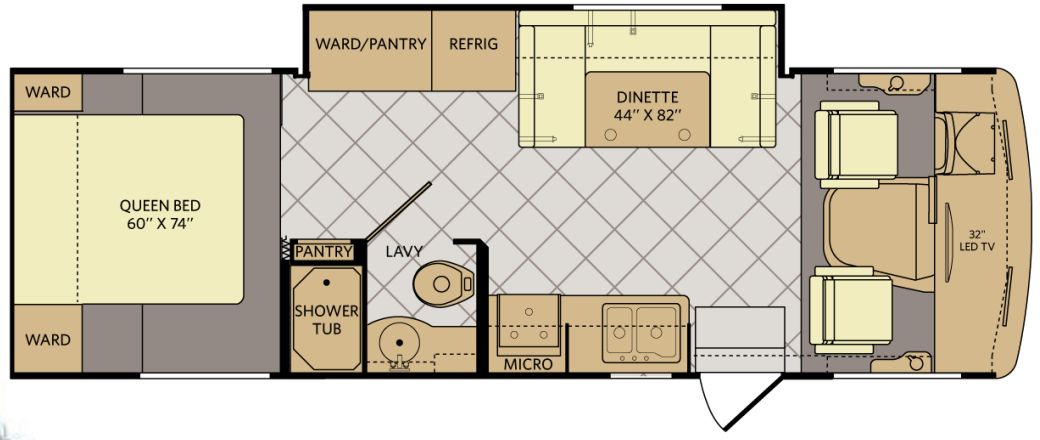
2. Interior Floor Plan
   a. 3 different plans
   b. Based off of Kitchen Work Triangle concept



Michael Connell

Vehicle Concepts

Concept 1 - Motorhome



Class A: $80,000+

Concept	Interior temp	Restroom	1-3 operators	Storage of racks up to 6’	Overall cost of $150,000	Deployment cost of $2,500
Motor Home	X	X	X	X	X	X

Concept 1 - Motorhome

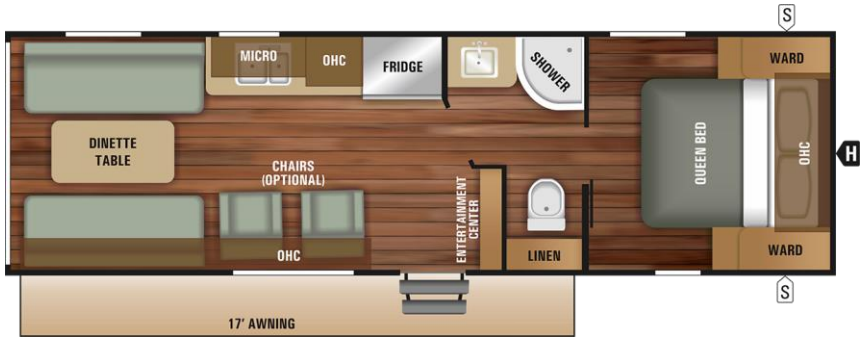
PROS:

- Meets all targets
- Models come standard with:
  - Restroom
  - HVAC
  - Generator
- Toy hauler models have a ramp for easy loading
- All inclusive
  - No need for a separate tow vehicle
- Low deployment cost

CONS:

- Highest initial cost
- Regular maintenance associated with an automobile

Concept 2 - Camper Trailer



Cost: $10,000+

Concept	Interior temp	Restroom	1-3 operators	Storage of racks up to 6’	Overall cost of $150,000	Deployment cost of $2,500
Camper Trailer	X	X	X	X	X	X

Concept 2 - Camper Trailer

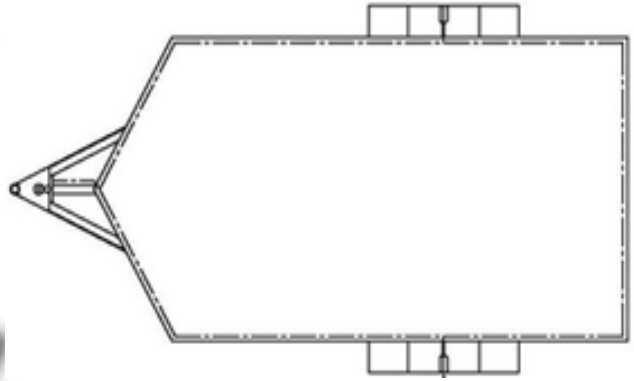
PROS:

- Meets all targets
- Models come standard with:
  - Restroom
  - HVAC
  - Generator
- Toy hauler models have a ramp for easy loading
- Low deployment cost
- No regular automobile maintenance
  - Tow vehicle rental

CONS:

- Higher initial cost
- Separate tow vehicle required

Concept 3 - Enclosed Trailer



Cost: $1,200 - $30,000

Concept	Interior temp	Restroom	1-3 operators	Storage of racks up to 6’	Overall cost of $150,000	Deployment cost of $2,500
Enclosed Trailer	(mod)	(mod)	X	X	X	X

Concept 3 - Enclosed Trailer

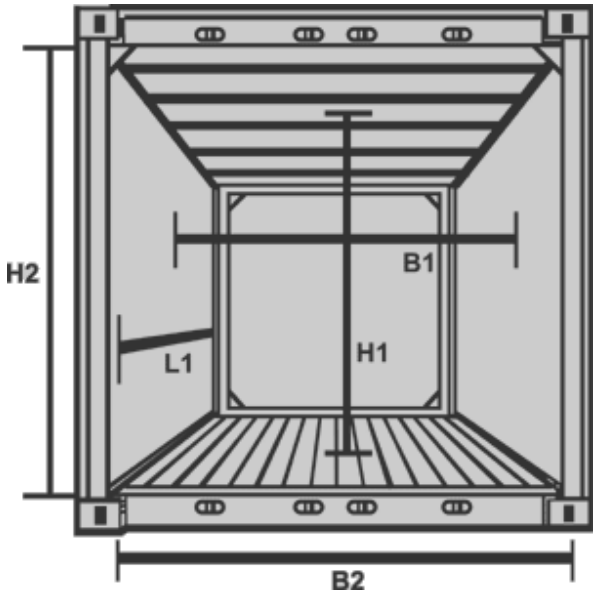
PROS:

- Can meet all targets
  - Needs modifications
- Comes standard with a loading ramp
- Some models have HVAC
- Easily customizable option
- Inexpensive to purchase standard model
- Low deployment cost
- No regular automobile maintenance

CONS:

- A tow vehicle is required
- Requires more labor costs to meet all targets

Concept 4 - Shipping Container



Cost: $3,000 - $7,000

Concept	Interior temp	Restroom	1-3 operators	Storage of racks up to 6’	Overall cost of $150,000	Deployment cost of $2,500
Shipping Container	(mod)	(mod)	X	X	X	X

Concept 4 - Shipping Container

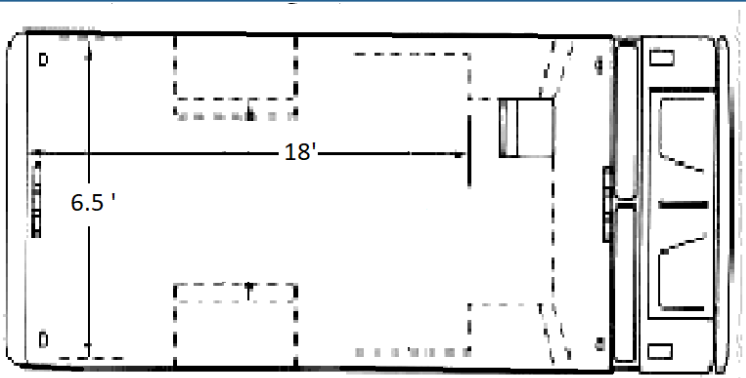
PROS:

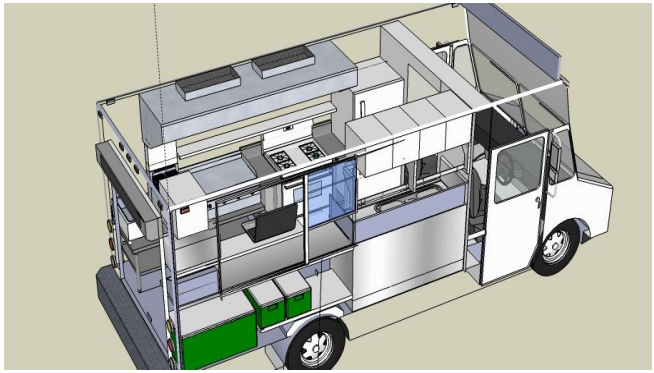
- Can meet all targets
  - Needs modifications
- Easily customizable option
- Inexpensive before modifications
- There are companies that specialize in shipping container mods

CONS:

- An expensive transport vehicle is required
- Requires more labor costs to meet all targets
- Limited sizing options

Concept 5 - Step Van





Cost: $50,000 - $70,000

Concept	Interior temp	Restroom	1-3 operators	Storage of racks up to 6’	Overall cost of $150,000	Deployment cost of $2,500
Step Van	(mod)	(mod)	X	X	X	X

Concept 5 - Step Van

PROS:

- Can meet all targets
  - Needs modifications
- Some models have HVAC
- Easily customizable option
- All inclusive
  - Self Propelled

CONS:

- Requires more labor costs to meet all targets
- Regular automotive maintenance and repairs
- Limited seating while in transit

Raine Sagramsingh

Interior Floor Plan Concepts

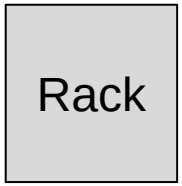
Interior Floor Plan

- Designed for 3 operators with 2 racks of equipment

1. Blue Operator

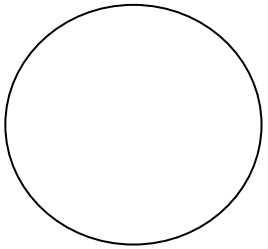
2. Yellow Operator

3. Green Operator



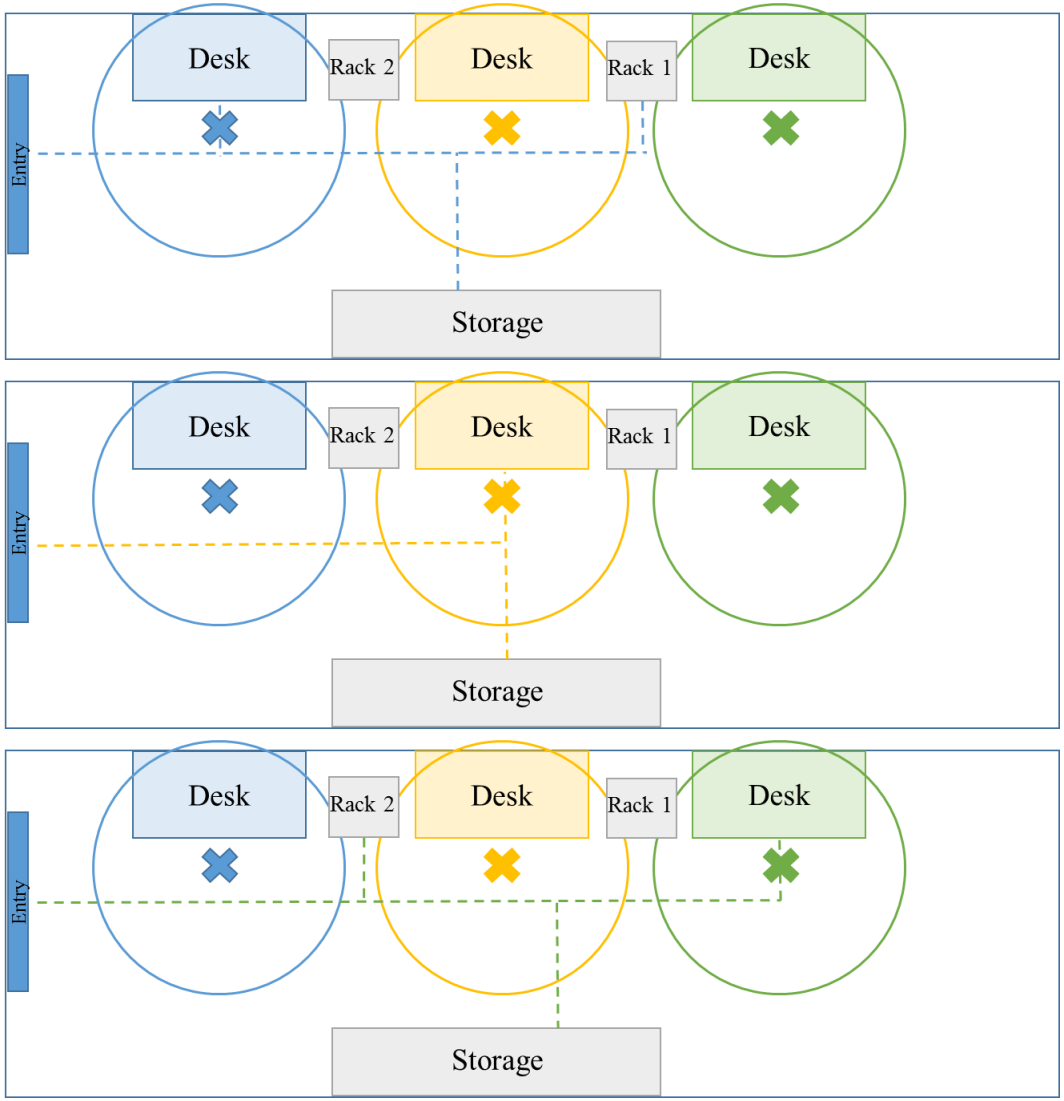
Seated Position

Reach Radius



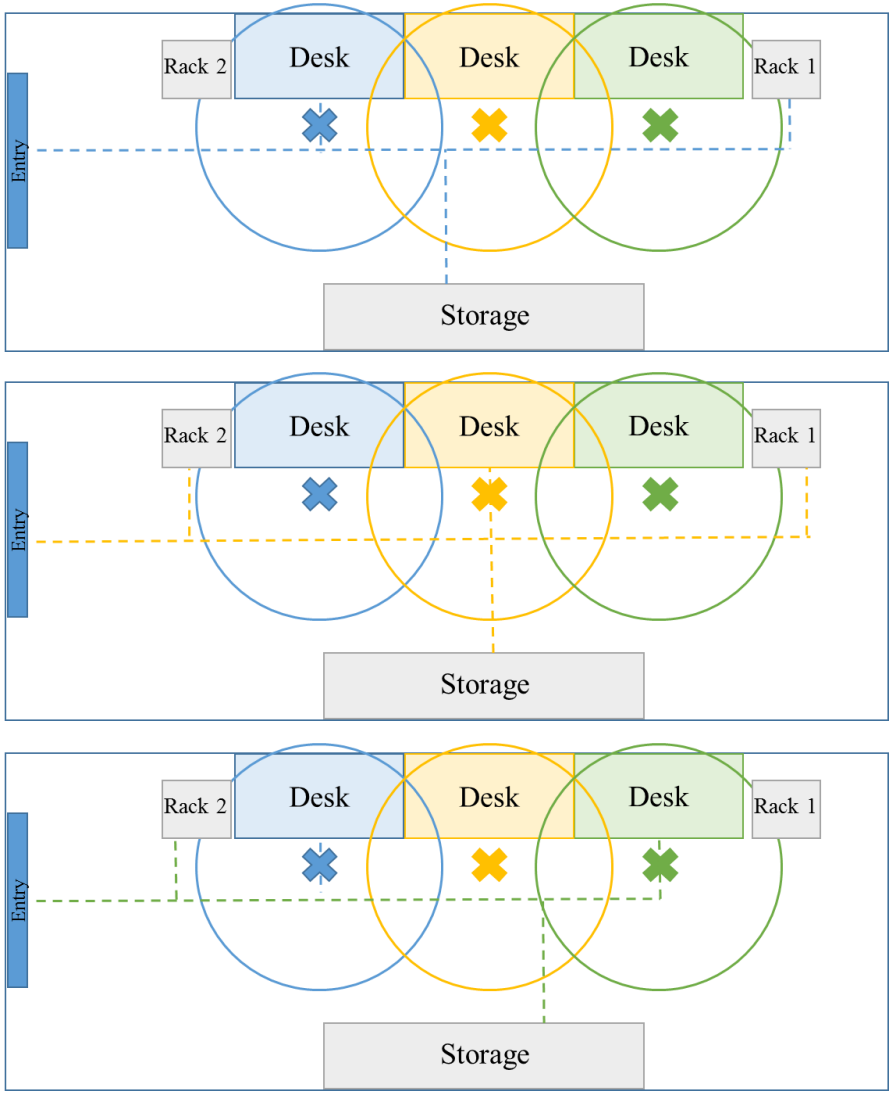
Walking Path

Interior Floor Plan 1



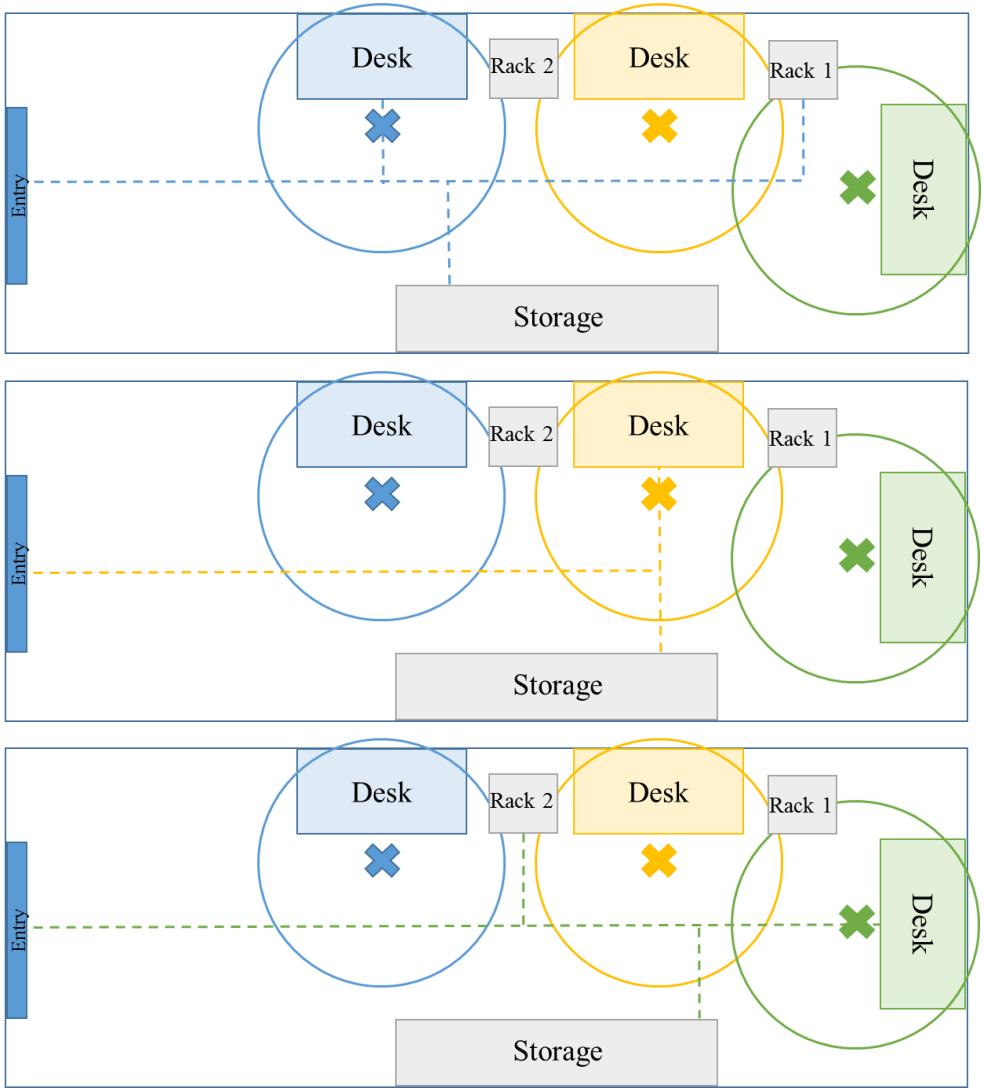
- Blue operator:
  - Primary: Rack 2
  - Occasional movement to Rack 1
- Yellow operator:
  - Access to both racks
- Green operator:
  - Primary: Rack 1
  - Occasional movement to Rack 1

Interior Floor Plan 2



- Blue operator:
  - Primary: Rack 2
  - Occasional movement to Rack 1
- Yellow operator:
  - Frequent movement to Rack 1
  - Occasional movement to Rack 2
- Green operator:
  - Primary: Rack 1
  - Occasional movement to Rack 2

Interior Floor Plan 3



- Blue operator:
  - Primary: Rack 2
  - Occasional movement to Rack 1
- Yellow operator:
  - Access to both racks
- Green operator:
  - Primary: Rack 1
  - Occasional movement to Rack 2

Ricky Gal

Next Steps

Next Steps

- Vehicle Selection
- Interior will be fully designed after vehicle selection, taking into consideration:
  - Ergonomics
  - Efficiency
  - Weight distribution
  - Sponsor preference
- Project Plan
- Website

Questions?

References

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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

Kitchen Work Triangle

- Defined by the National Kitchen and Bath Association:
  - An imaginary straight line drawn from the center of the sink, to the center of the cooktop, to the center of the refrigerator.

- Main goal: efficiency
  - keeps major work stations near the cook
  - minimizes traffic within kitchen
  - prevents kitchen from being cramped

Vehicle Concepts

Concept	Interior temp	Restroom	1-3 operators	Storage of racks up to 6’	Overall cost of $150,000	Deployment cost of $2,500
Motor Home	□	□	□	□	□	□
Camper Trailer	□	□	□	□	□	□
Enclosed Trailer	□	□	□	□	□	□
Shipping Container	□	□	□	□	□	□
Step Van	□		□	□	□	□

Legend:

□ - Can meet target with modification

□ - Meets target when purchased

Vehicle Concepts

- Some vehicle options do not meet all of the targets at the time of initial purchase, but all vehicles have ability to be modified to meet targets.
- When completing analysis to select vehicle, the team will consider:
  - vehicle cost
  - modification time and cost
  - labor time and cost

Reach Radius

- Term used in ergonomics
- Definition:

  reach radius = upper arm + forearm + hand
- For horizontal reach, the 5th percentile female (151.1 cm) is used