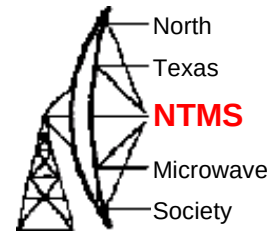


Steps Towards The Moon: Raspberry Pi, Az El Drive Components, Trailer

Dave McCoy N5RJX

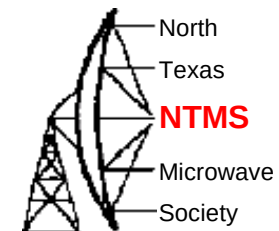
Dec 5, 2020

Background

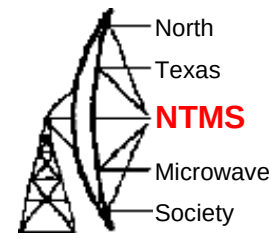


- Want to build an EME trailer for 23 cm
- Had a good discussion last time on overall trailer configuration and practical concerns
- There are some secondary goals as well:
 - Bonus basic power and radio capability for other bands, modes, QRO ops, other space communications perhaps
 - Trailer could carry 4x8' building materials
 - Basic RV shelter for grid square tours, astronomy trips
 - If setting up a tent and moving a lot of supplies in and out can be avoided, then there are 1-2 extra hours a day for travel, operating, naps [tested this recently]

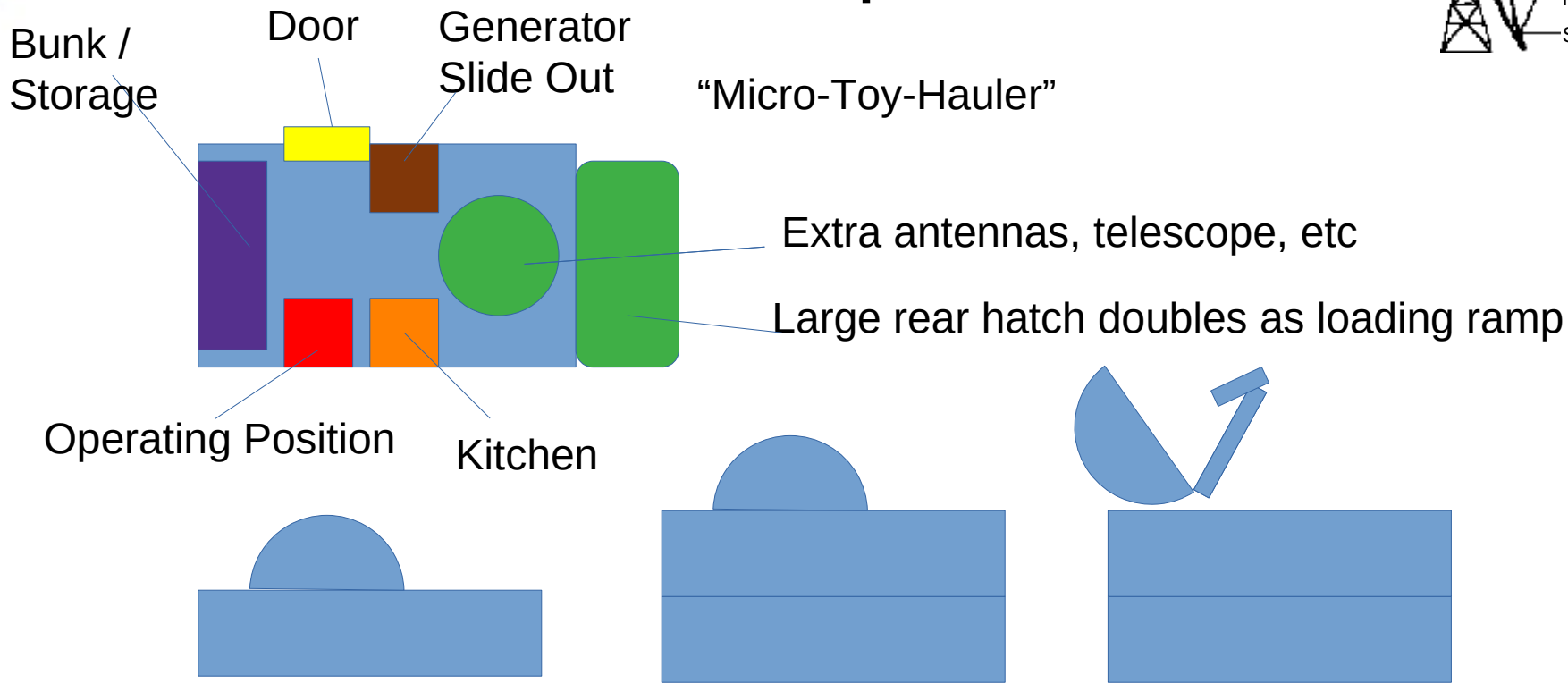
Commercial Equivalents



- This is something similar from Verizon. This is about what I want, however it needs to pop up/down to fit my garage height.
- The T-100 from Ground Control at right is the same idea without the shelter
- The military has some dish trailers that are similar fold-flat dish designs
- Expect that the outrigger stabilizers are not needed due to wide beam width at 23 cm, these are Ku band systems at 10 times the frequency.
- Note that the dish and feed folds flat for transport – that is key for a compact configuration



Current Concept – In Work



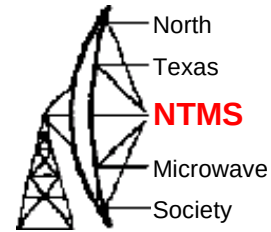
Travel and Storage

Deploy Shelter

Deploy Antenna

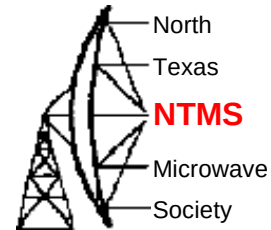
Desirable to have operation from tow vehicle or shelter depending on how much RF there is. Thinking about fiberglass pole for HF and a basic mast for cheap yagis.

Raspberry PI



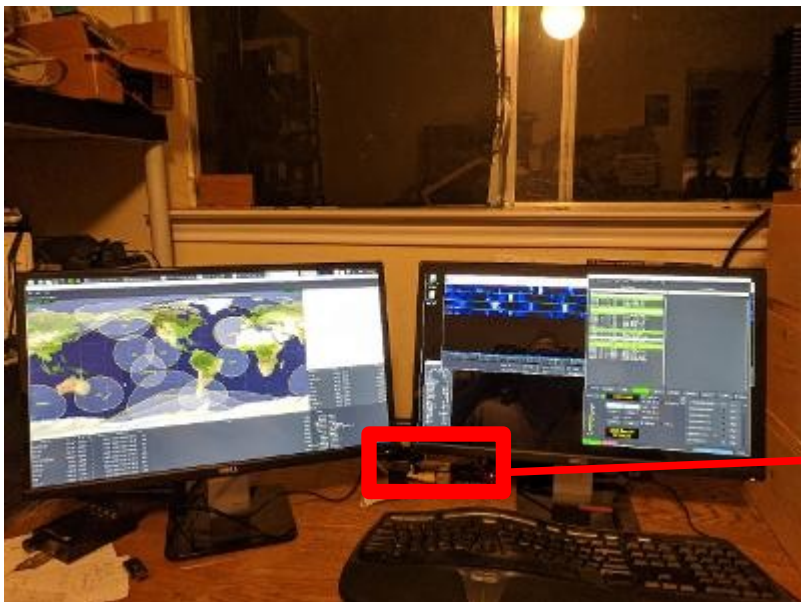
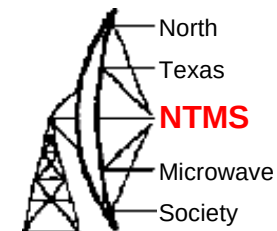
- Recently my ham laptop (about 8 years old) became completely unreliable
- The question I had was: can one of the newer Raspberry PI 4's replace a laptop for typical ham applications?
- Size, Weight and Power (SWAP) are good
- Cost is reasonable compared to a laptop
 - Can use existing old monitors, keyboards, etc
- Raspberry PI also has great IO for sensors and motor control, I2C bus, etc.

Raspberry PI Informal Tests



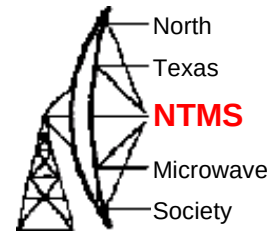
- Talked to my Icom-9100 ok at 19200 baud
 - Ran WSJTX for FT 8 – seems pl
 - Tried it on MSK144, using 1/3 of the indicated processing time (no decodes)
 - Ran Gpredict satellite program ok, uses about 1/3 of the CPU
 - Required a special script another ham wrote to get it to talk Icom.
 - Ran Direwolf soundcard modem and received a few packets from the ISS
 - Direwolf is an enabler to run WinLink which gets an emergency communications point
- »
- Pi has run camera and software defined radio app GQRX at the same time
 - I tested with a mix of pre-compiled and built from source applications, however the smart way might be to use HamPi a special distribution for Raspberry PI with 80 ham applications all integrated
 - This seems completely workable

Raspberry PI - Winner



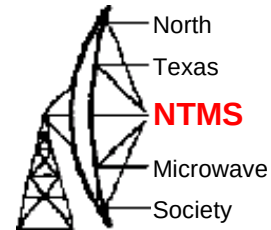
- This PI has been through a lot of changes
 - Seems to hang up after about two days monitoring WSJTX
- Clean operating system image might be better
- Red box shows PI size

Az El Drive Components

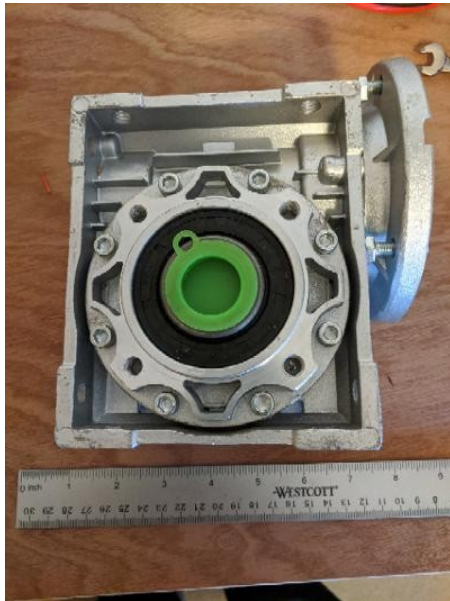


- Gathering parts at this point
- Adapting commercial worm gear boxes, 100:1 reduction
- Using gear motors
 - Car window motors and equivalents
 - Torque 20+ Nm
 - Torque trivia – a Newton Meter is very close to $\frac{3}{4}$ of a foot-lb
- Planning on 10 turn pots for position feedback
 - Gear shafts up to get a few turns of pot for operating range
- Plan to use 16 bit A/D converters and 12-bit PWM I2C boards from AdaFruit with Raspberry PI I2C interface
- Planning to use basic PID control loop
- Need to make some shafts/adapters

Az El Drive Components

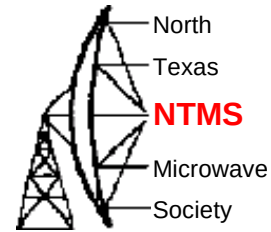


Clockwise from upper left:
Window motors,
15A H-bridge dual channel driver module,
16 bit A/D converter,
PWM module for I2C interface,
10 turn 1K ohm pot, and
100:1 worm gear box



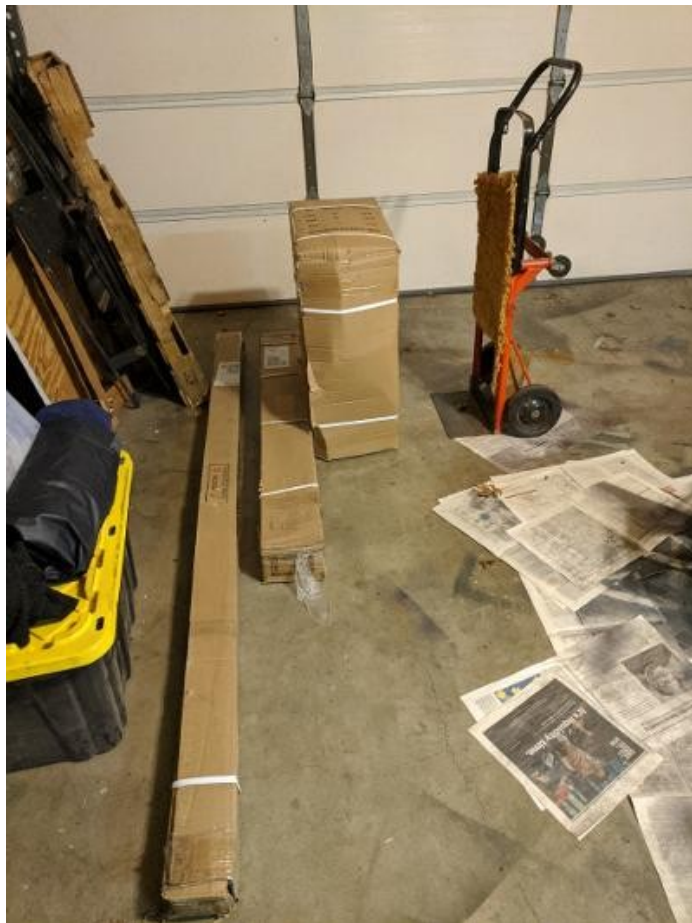
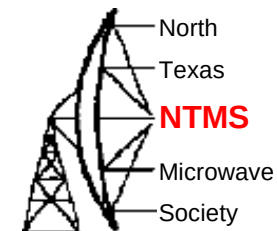
Keep in mind the homebrew robotics suppliers like DFRobotics. They have strong components for the “robot wars” people

Trailer



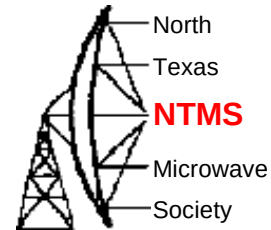
- Ordered 5x8' Northern Tool trailer Oct 3.
- Arrived this week (Dec 3), had a lot of calls with Northern, finally got them to admit the first one was lost
- They gave a free home delivery though
 - Which was a problem because I did not expect a pallet, however the truck driver helped out with a pallet jack
- But they seem to have lost the Manufacturer's Certificate necessary to register the trailer
- I had another order with them that worked fine, so your mileage may vary.

Trailer Assembly



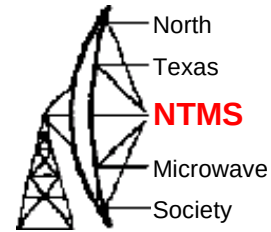
- Three “easy to handle” pieces of 65,85 and 105 lbs
- The pictures in the manual help some, except when they are backwards
- And the manual doesn’t agree with the parts as shipped
- Found out after assembly that the manual for the 4x8 version was better and had photographs
- On-line videos from users helped much more than the official materials
- Need metric sockets
- Also metric crescent wrench ;)

Trailer Partial Assembly



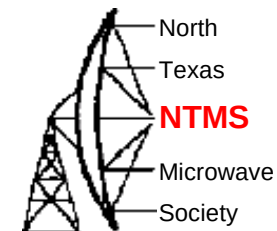
- Lesson learned – do not tighten bolts until each set of holes is lined up with a bolt started finger tight or less
- Had to look up torque for the bolts M10 8.8, 41 foot-lbs, manual left that out. There are about 100 bolts.
- Got steel trailer to allow for welding corners for additional stability or to add accessories
- Cotter pins in hubs difficult to install
 - Need spares
- Only plan to load to 50% or less of maximum vehicle and trailer towing capacity
- Conflicting information about maximum speed
- Planning on a series of test drives and hub temperature checks at progressively larger speeds and loads

Trailer Partial Assembly



- Manual has a difficult approach of assemble almost the entire trailer upside down then flipping the entire beast over
- I planned to start up-side down but flip it over earlier when the weight is less
- The diagram was so poor I ended up building it right side up from the start by accident, so I just kept working right side up.
- Raising it up a little to reach underneath was a good alternative to the flip procedure

Next Steps



- Raspberry PI
 - Standardize configuration using HamPi distribution to enable using an identical backup PI in the field
- Start putting Az EI components together
- Detail trailer design before going much farther with trailer construction
 - Continue to pursue registration paperwork