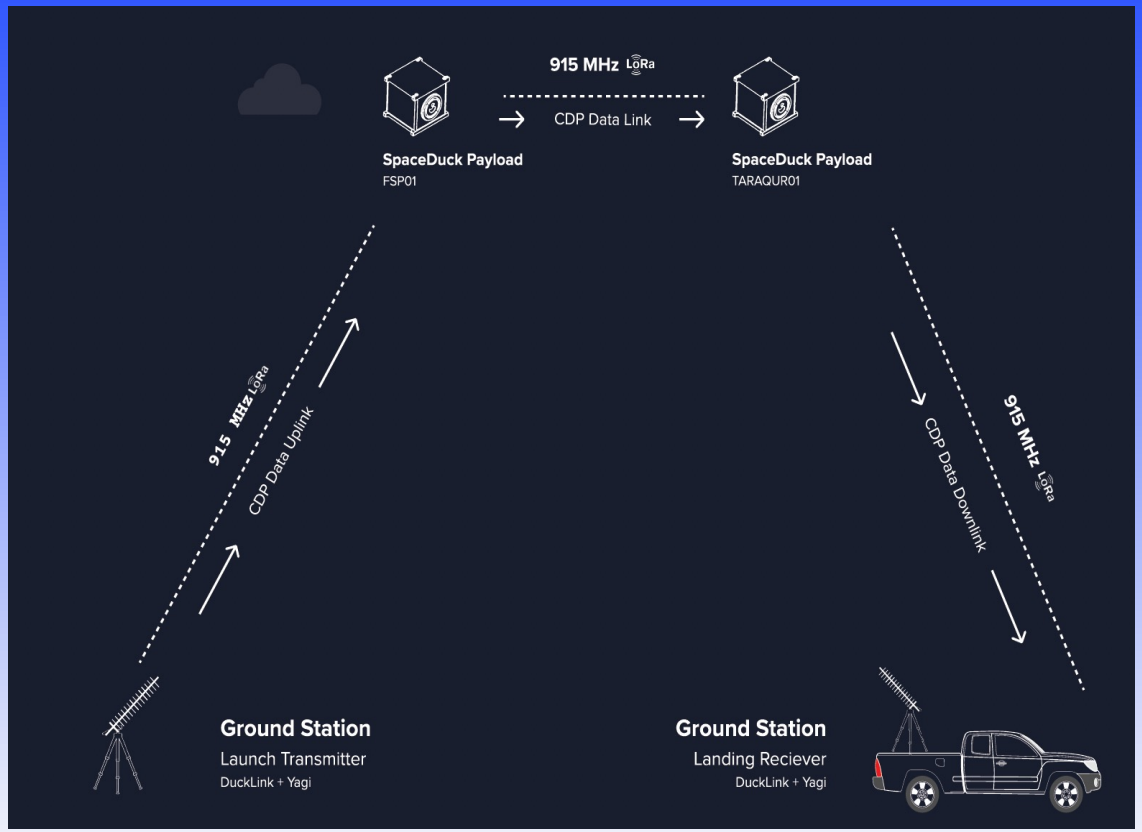
CAL POLY'S MULTI-YEAR COLLABORATION WITH OWL INTEGRATIONS TO FLY

DUCKS IN SPACE

Steve Dunton

April 22nd, 2024



OWL

CAL POLY
SAN LUIS OBISPO

contact: sdunton@calpoly.edu

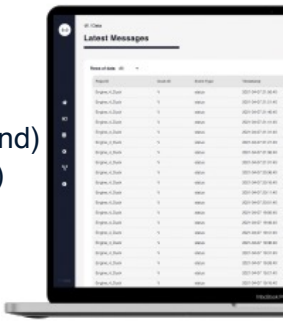
OWL Integrations Background

- OWL provides **o**rganization, **w**hereabouts, and **l**ogistics through a simple communications and sensor network solution
- Creates comm infrastructure where lacking or destroyed
  - Remote locations (exploration)
  - Disaster (fire, ice storm, post *Hurricane Maria* deployment)
  - War zone

Hardware
DuckLink Wireless Device

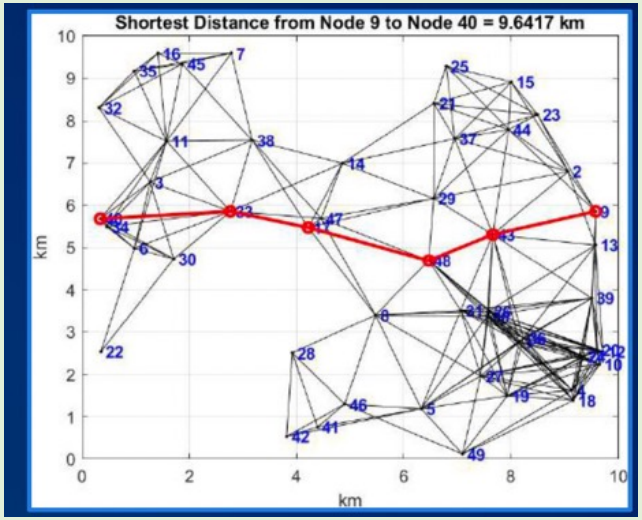
OWL

- Low-cost handheld radios (ISM band)
- Low data rate (text, possible voice)
- Bluetooth connection to cell phone
- LoRa based, open source
  "ClusterDuck Protocol"



Software
OWL Data Management System (DMS)

Ad Hoc Mesh Network



STTR Phase II Award


SOLICITATION/CONTRACT/ORDER FOR COMMERCIAL PRODUCTS AND COMMERCIAL SERVICES

NOTE: OFFEROR TO COMPLETE BLOCKS 12, 17, 23, 24, AND 30.

FA864923P1261

28 Sep 2023

KIMBERLY ALLEN

Net Days 30

See Schedule

Prime Contract Awarded 9/29/2023

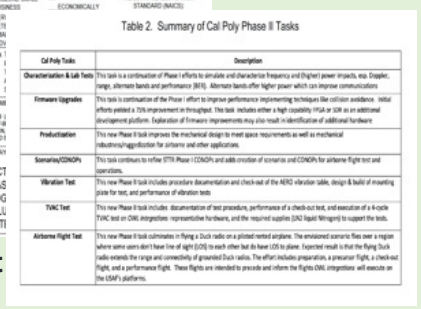
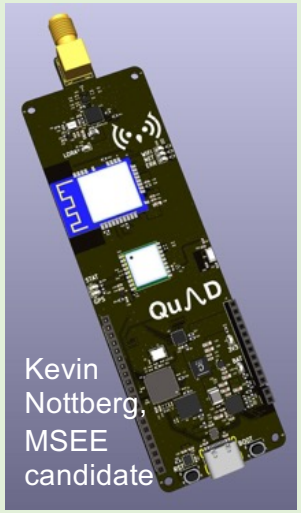


Table 2. Summary of Cal Poly Phase II Tasks

Cal Poly Tasks	Description
Characterization & Lab Tests	This task is a continuation of Phase I efforts to simulate and characterize frequency and (higher) power impacts, esp. Doppler, range, alternate bands and performance [BER]. Alternate bands offer higher power which can improve communications
Firmware Upgrades	This task is continuation of the Phase I effort to improve performance implementing techniques like collision avoidance. Initial efforts yielded a 70% improvement in throughput. This task includes either a high capability FPGA or SOM as an additional development platform. Exploration of firmware improvements may also result in identification of additional hardware
Productization	This new Phase II task improves the mechanical design to meet space requirements as well as mechanical robustness/ruggedization for airborne and other applications.
Scenarios/CONOPs	This task continues to refine STTR Phase I CONOPs and adds creation of scenarios and CONOPs for airborne flight test and operations.
Vibration Test	This new Phase II task includes procedure documentation and check-out of the AERO vibration table, design & build of mounting plate for test, and performance of vibration tests
TVAC Test	This new Phase II task includes documentation of test procedure, performance of a check-out test, and execution of a 4-cycle TVAC test on OWL integrations representative hardware, and the required supplies (LN2 liquid Nitrogen) to support the tests.
Airborne Flight Test	This new Phase II task culminates in flying a Duck radio on a piloted rented airplane. The envisioned scenario flies over a region where some users don't have line of sight (LOS) to each other but do have LOS to plane. Expected result is that the flying Duck radio extends the range and connectivity of grounded Duck radios. The effort includes preparation, a precursor flight, a check-out flight, and a performance flight. These flights are intended to precede and inform the flights OWL integrations will execute on the USAF's platforms.

SOW

Current Hardware Design

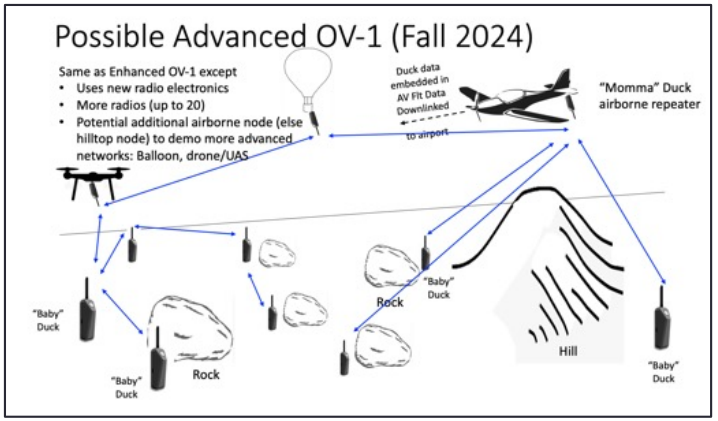


Kevin Nottberg, MSEE candidate

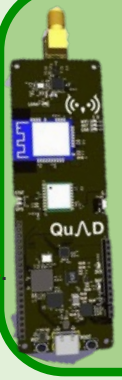
Start-up Partner OWL Awarded >$1M STTR Phase II
40% Share with Research institution (Cal Poly)

Student Activity: "Learn By Doing"

- 20+ undergraduate and graduate students actively involved across 3 masters thesis projects and multiple senior projects
- Key EE activities include hardware design, test, and new SDRs
- Key AERO activity supporting environmental test
- Major events:
  - Spring environmental tests
  - June "SpaceDucks IV"
  - Fall environmental test repeated with updated hardware
  - Repeat of demo scenarios



Gen0, Gen1 (Legacy)
Semtech LoRa Chipset/ Waveform
Non-trusted/foreign (China): PCB and peripherals, Power, Microcontroller, I/O, GPS, etc.



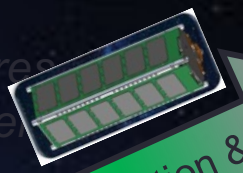
Gen2 (In-work)
Semtech LoRa Chipset/Waveform
Trusted features (USA, UK, Fr, Japan): PCB and peripherals, Power, Microcontroller, I/O, GPS, etc.

Gen3 (Future)
Programmable Waveform
Trusted process (USA only): PCB and peripherals, Power, Microcontroller, I/O, GPS, etc

Virtex UltraScale+ shown

Project OWL-Cal Poly Roadmap

Developing & demonstrating a space capable product assures a robust platform for airborne and disadvantaged users



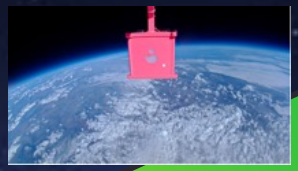
Key

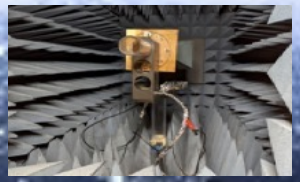
- ✓ Complete
- ○ In work

Funding Sources

- Internal/ Private
- STTR I
- **STTR II**

Initial Capability & Updates → Space Feasibility → Improvements & Lab Tests → Productization & Pathfinder Demos

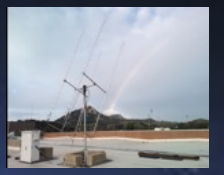




SpaceDuck One 2019	SpaceDuck II / Cal Poly Capstone 2020-2021	1st STTR 2022	**SpaceDuck III** 2nd STTR 2022-2023	**SpaceDuck IV** STTR II 2023-2024
✓ Initial Electronics **(Foreign Chipset)**	✓ Balloon Range Demo (Balloon) (>25 km)	✓ BER Test Environment (Lab)	✓ Improved Firmware Demo (>25 km)	○ **Alt. SDR Implementation**
✓ Initial High-Altitude Flight (Balloon)	✓ Improved Electronics **(Foreign Chipset)**	✓ Space Range Demo (Lab) (850 km)	✓ Alt. Band Set-up for Improved Range (Lab)	○ **Improved Electronics & Firmware Integrated Demos (Drone / Aircraft)**
			✓ Improved Thru-put Firmware (>75%)	○ **1U Form Factor Integrated Antenna**
			✓ Space Test Plan & CONOPs	○ **Improved Electronics (Domestic Chipset)**
			✓ Static Doppler Simulation (Lab)	○ **Space Pathfinder Environment Test (vibration, TVAC)**
				○ **Automated Electrical Test Environment**

Cal Poly Facilities

Airborne Test



Ground Stations

TVAC Test

Vibration Test

Cleanroom

Questions

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