Contract No. R-040-051
"Portable Solar Array Modules Phase II"
Submitted by Packet Digital
Principal Investigator: Andrew Paulsen

PARTICIPANTS

Sponsor	**Cost Share**	
U.S. Naval Research Laboratory	$500,000	
Subtotal Cash Cost Share		$500,000
North Dakota Industrial Commission	$500,000	
Total Project Cost		$1,000,000

Project Schedule – 10 months
Contract Date – 8/14/2019
Start Date – 5/1/2019
Completion Date – 4/30/2019

Project Deliverables:
Progress Report: 8/31/2019 ✓
Progress Report: 11/30/2019
Progress Report: 2/28/2020
Final Report: 5/31/2020

OBJECTIVE/STATEMENT OF WORK:
Building on the first phase of this project, the purpose of this phase is to enhance the design of the portable solar power generation system to prepare for production:

1. Simplify the manufacturing/assembly process,
2. Refine the system to comply with customer requirements, and
3. Perform industry and military standard tests.

Packet Digital is partnering with the Naval Research Lab and Nishati, a Virginia based company to develop the product. Manufacturing will occur at Chiptronics in Dunseith. Navigant Research forecasts the portable solar market will grow from $550 million in 2014 to $2.4 billion in 2024 (15.87% CAGR.)

The product that Packet Digital developed in Phase I and will enhance in Phase II provides portable solar with 36% more power in 42% less space and 80% less setup time compared to what is currently available on the market.

STATUS:

The contract has been executed.

August 2019
Status report received. The report states in part:

Substantial progress has been made during this period, primarily focusing on the electronic tests and debug activities on the product from Phase I design. Activities in this period include:

- Rigorous field tests at Nishati's test center in Gilbert, AZ. The portable solar generation system was tested for functionality and performance under the hot Arizona climate with average daily temperature above 100˚F, day and night continuously. Any issues encountered or ideas that came up during field test were communicated immediately for remote firmware updates.

- Firmware updates to support feedback from field tests. Multiple firmware updates were sent for various improvements such as but not limited to: removal of low frequency oscillations on the inverter, stability improvement in the control loop, make the system more resilient to solar panel shadowing effect, and user indicator of 80% battery capacity threshold during charging.
- Rebuilding one module that got damaged due to debris induced short circuit (see Appendix A).
- In house laboratory hardware tests. After rebuilding the damage module, several tests were done in the lab to ensure proper functionality as well as fine tuning of the overall system.
- Battery runtime tests, resulting in more understanding about the BB2590 internal operation which allow Packet Digital to develop battery charge and discharge algorithm improvement to extend the overall battery runtime. Using the current BB2590 batteries that Packet Digital purchased, the average runtime was improved to about 8% with this algorithm.
- Development and implementation of algorithm to solve inverter lockup condition. The inverter that is used in the system has a built-in under voltage protection that will lock the inverter output when repeated under voltage condition is detected. This situation is undesirable since it requires manual user intervention to reset the inverter. The new algorithm that Packet Digital implemented removes this limitation.
- The original design from Phase I was successfully field tested at Nishati's test center. Upon completing the in-house lab test, and implementing the new algorithms, PSG1 was sent back to Nishati for further field tests in their facility and the test results were beyond satisfactory.
- Objective 1 for Phase II, electronic boards design refinement followed by assembly and tests will start in August 2019.

Updated 8/16/19