

LSIC Surface Power Focus Group

June 24, 2021

Begins at 11:03



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Confluence Discussion:
<https://lsic-wiki.jhuapl.edu/display/SP/24+June+2021+SP+Telecon>

Overview

- Community updates

- LSIC Surface Power Focus Group First Anniversary!
- Current/upcoming activities
 - Power User Survey – underway
 - Power Beaming Workshop Dates Finalized
 - July 22/23, ~12:00 to 5:00 ET
 - Discussion happening right now on Confluence!
- VSAT summary
- Potential off-cycle meeting: Appropriate power increments
 - 10 kW VSAT – is there a higher power increment to consider?

- Standards/Interoperability

- Presentation: Mark Mazzara, Matt DeMinico
- Q&A and open discussion



LSIC Activities

LSIC Spring Meeting was May 11-12

- Presentations are now archived online
 - <http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=124>

Upcoming LSIC Workshops (<http://lsic.jhuapl.edu/News-and-Events/>)

- Power Beaming Workshop (7/22-7/23)
- Excavation and Construction Workshop (~8/20)
- Commercial Lunar Payload Services Workshop (TBD Fall 2021)
- TBD Joint Focus Group Workshop(s) (starting Fall 2021)

LSIC Community

- ISRU: Networking session
- Many New APL Members

On to year two!



- The LSIC Surface Power focus group one year anniversary is tomorrow!
- Ice-breaker, put your answer in the chat:
 - What would you like to know by this time next year?

Reminder of what the LSIC is all for... You!



Reminder for those new to LSIC about our code of conduct:

- http://lsic.jhuapl.edu/Resources/files/Code%20of%20Conduct_05222020.pdf

LSIC | Surface Power: Who's Who in Surface Power

Confluence link:

<https://lsic-wiki.jhuapl.edu/display/SP/Who%27s+Who+in+LSIC-Surface+Power>

Who are you?

(individual or institution)

What do you do?

What do you want others to know about you?

Other Comments

Contact info, POC, etc.

- Keep filling out this resource
 - May supplement with content from lightning talks, etc.
 - Email about Confluence set-up if you need access

LSIC | Surface Power User Survey

- Inventory of potential lunar surface power users and needs
- The information you provide will shape our feedback to NASA, which can influence future solicitations and the direction of the field.
- For info, email Jodi Berdis (Jodi.Berdis@jhuapl.edu)



Power User Survey

The Lunar Surface Innovation Consortium Surface Power Focus Group is conducting an inventory of potential lunar surface power users and needs. The purpose of this Power User Survey is to capture the power needs of different systems that will be used for lunar exploration and human presence on the Moon.

Responses will be anonymized and can be updated

<https://forms.gle/yhvxA3xoYKMAU587>

What are the power needs of this technology's/system's operation during periods of lunar night (electrical and/or thermal)? Consider shorter and longer durations as appropriate for your relevant lunar environment.

How much power does it take to accomplish a primary objective of your system?
How long does it take to accomplish this primary objective? *

Your answer

LSIC | Surface Power Focus Group Upcoming Activities

Power Beaming Workshop

July 22-23, 2021

Day 1: Context and Demand

Day 2: Deeper Technical Discussions

Under development: Breakout Session topics

Day 1: Use cases for power beaming

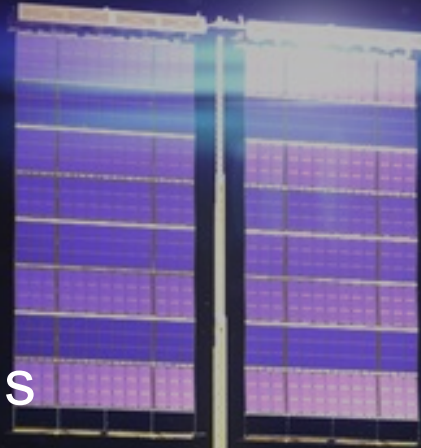
Day 2: Technically-focused breakouts

Registration:

<http://lsic.jhuapl.edu/News-and-Events/Agenda/index.php?id=142>

Confluence Discussion:

<https://lsic-wiki.jhuapl.edu/display/SP/Power+Beaming+Workshop>



LSIC | VSAT (May Special Monthly Meeting)

Chuck Taylor, Project Manager for VSAT

VSAT Awardees:

Space Systems Loral (Maxar Technologies)

Tom Cameron

Honeybee Robotics

Richard Margulieux

ATK Space Systems (Northrop Grumman)

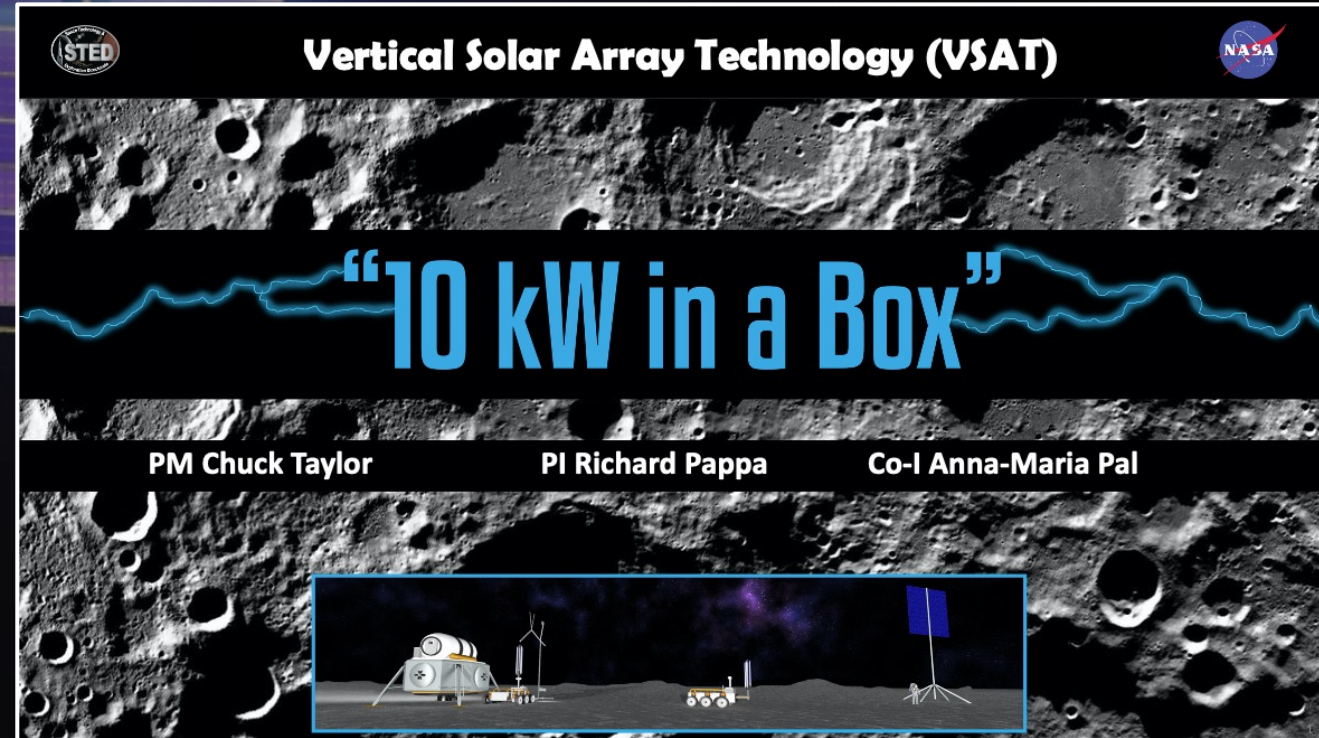
Michael McEachen

Lockheed Martin

Christy Edwards

Focus Group presentations from:

Dust Mitigation (Jorge Núñez) and Extreme Environments (Ben Greenhagen)



The slide features a background image of the lunar surface with a rover and a lander. At the top left is the STED logo and at the top right is the NASA logo. The title "Vertical Solar Array Technology (VSAT)" is centered at the top. Below the title is a large, stylized blue lightning bolt graphic with the text "10 kW in a Box" written across it. At the bottom, three names are listed: "PM Chuck Taylor", "PI Richard Pappa", and "Co-I Anna-Maria Pal". An inset image at the bottom center shows a 3D rendering of a lunar lander and rover on the surface.

Vertical Solar Array Technology (VSAT)

“10 kW in a Box”

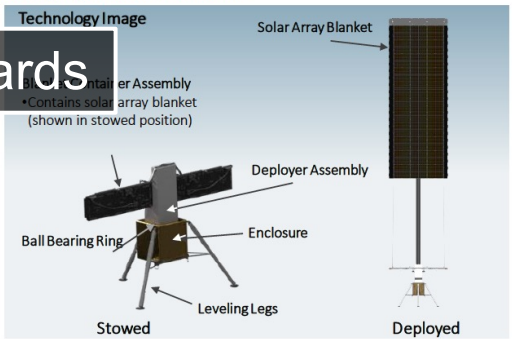
PM Chuck Taylor PI Richard Pappa Co-I Anna-Maria Pal

LSIC | VSAT (May Special Monthly Meeting)

Lockheed Martin's Vertical Solar Array Technology (VSAT)

The VSAT operational system concept combines innovative modifications to existing solar array technology, deployment/retraction mechanisms, and a composite mast design with leveling legs, gimbal, sun sensors, avionics, power and thermal systems while accommodating for the challenging lunar environment.

Christy Edwards



- Commercial Impact:**
- Reduce barrier of entry for lunar surface assets by providing mobile power station
 - Reducing functionality required of surface assets
 - Catalyzing a commercial services by reducing environment risk for long-term lunar surface assets
 - i.e. dust mitigation, surviving lunar night
 - Offering new, affordable capabilities for lunar surface applications

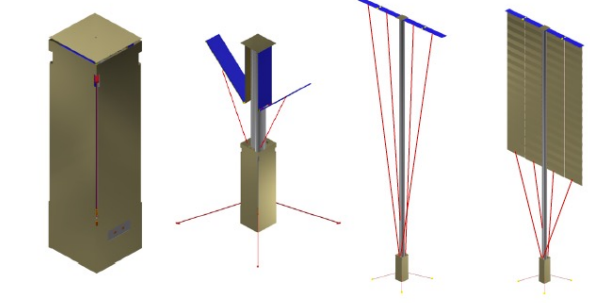


LAMPS (Lunar Array, Mast, and Power System)



Richard Margulieux

LAMPS



From left to right: stowed; partially deployed; fully extended, fully deployed

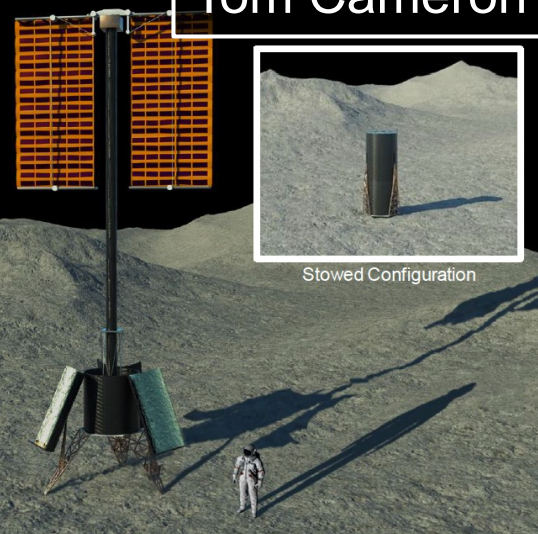
- Lunar power station designed to provide 10kW of continuous power at beginning of life
- 18 meter, single-axis tracking solar array boom for the southern polar region of the moon.
- Capable of multiple autonomous deployment/retract cycles
- Fully transportable per NASA requirements
- Heritage technologies developed/under development for lunar environment
 - Mechanisms for dusty environment drilling
 - Avionics and power electronics
 - Thermal control system designed for lunar diurnal cycle



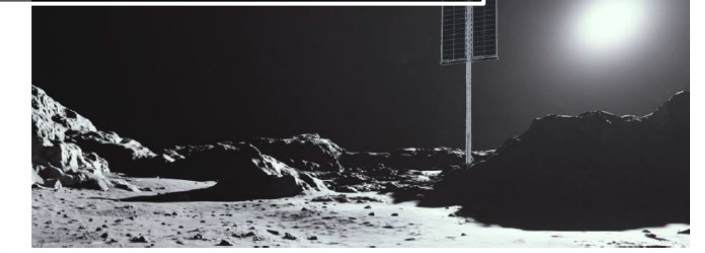
SolarHub

- Maxar's SolarHub is an autonomously deployable and relocatable 10 kW lunar surface solar array system
- SolarHub draws upon:
 - Maxar's high-heritage, high-reliability components derived from the commercial communications satellite industry
 - Maxar's dust-tolerant robotic mechanisms working 15+ years on Mars, and flying to the Moon in 2022
 - Innovative technologies including lightweight solar cell, deployable boom, and dust shielding
 - Partnerships with NASA Langley and NASA KSC
- In its vertical solar array blanket configuration, SolarHub is efficient for the low illumination angles near the lunar poles
- The scalable SolarHub system will support the development of the power infrastructure required for a sustained and growing human and robotic presence on the lunar surface

Tom Cameron



Michael McEachen



Northrop Grumman's LV-CTA for NASA's Lunar Vertical Solar Array Technology (LVSAT)



Project Overview

- Base Phase:**
- Develop "point design" baseline for all key elements of LV-CTA performing trade studies, preliminary design and analysis, subsystem prototyping to validate goals and objectives
 - Determine limitations and drivers associated with Point Design
 - Develop detailed plans for Option Phase
- Option Phase:**
- Perform detailed design, culminating in design review, with part drawings and analysis.
 - Complete assembly and comprehensive test campaign to validate LV-CTA operation in relevant lunar landed environment.

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LSIC | VSAT (May Special Monthly Meeting)

- 182 unique Zoom participants
- Highly active Zoom chat
- 52 comments in Confluence

Takeaways from Q&A & Discussion:

- Modularity vs. design for replaced
- Retractable and redeployable

VSATs and Dust Mitigation & Extreme Environments

Dust

- Optical effects (obscuration and scattering) + abrasion effects (issue for mechanisms)
- Smallest particles of dust will be the most difficult to mitigate (though fortunately, they block the least sunlight)
- Power holds us back from landing pad development

EE

- 5-6 locations, site has not been selected yet, so we can't plan tech for the specific location
- In addition to dust, thermal fatigue is also an issue
- Initial development means tech may fly twice, then we learn the environment, tech could evolve rapidly once we get there

Presentation: A DoD example of MOSA

- **Matt DeMinico**
 - GRC STMD Power Portfolio Manager

- **Mark Mazzara**
 - More than a decade working interoperability in the Robotic Systems Joint Project Office





JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

