Initial Design Review

Self-Powered Wireless Thermal Camera

UCSB FLIR Capstone Team

Product Description

What:

- Solar-powered security camera that is reliable, easy to install, and power efficient

Who:

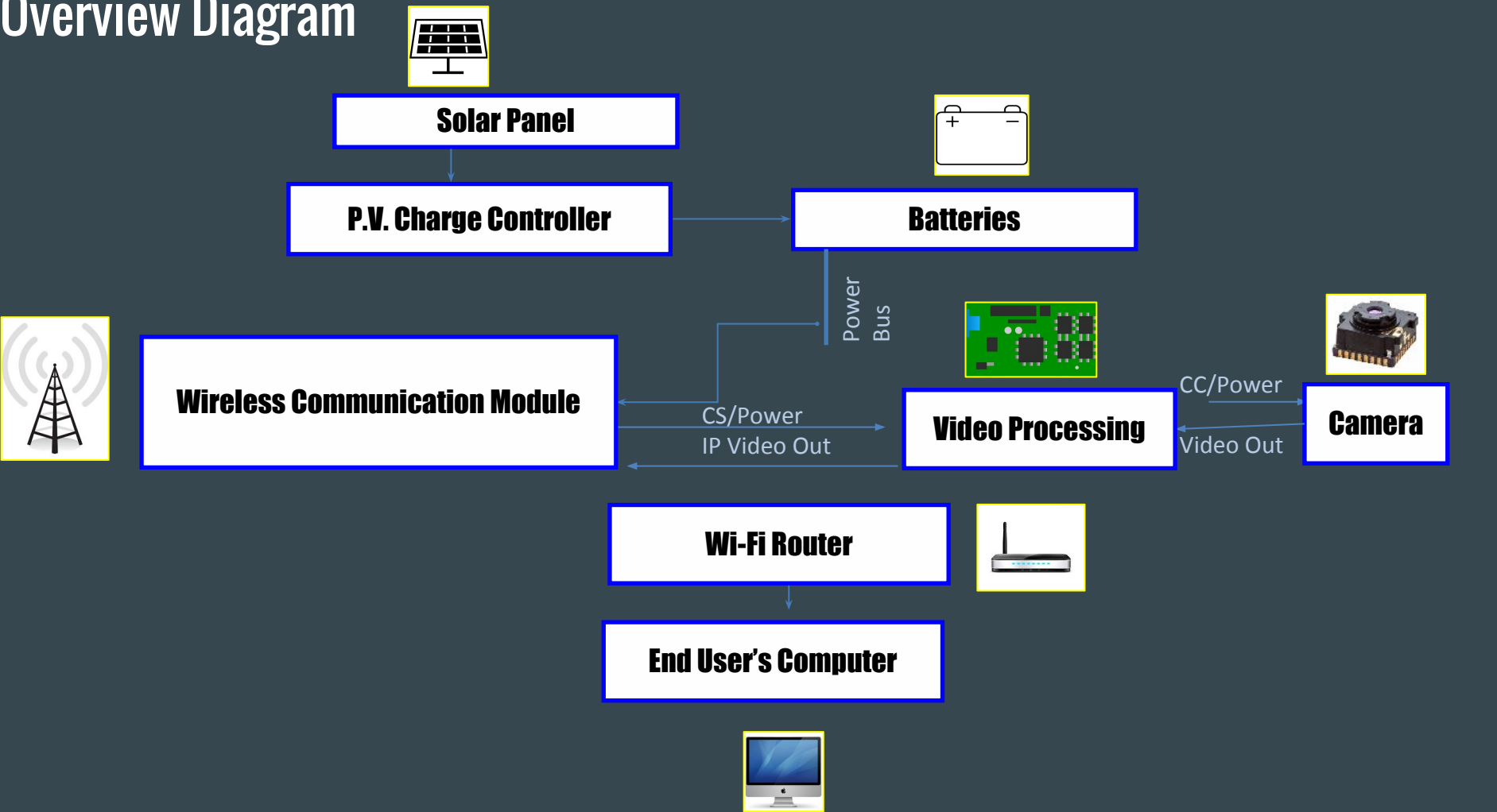- Homeowners, businesses, construction, ranchers

How:

- Record in both visual and thermal styles to allow 24/7 monitoring
- Wireless video stream to the web & phone
- Internal memory when needed.

Initial Specification

- Design for solar insolation levels in Seattle
- 100% Duty Cycle, 365 days a year
- IP67 Spec: Dust-tight, water immersion (up to 1m)
- Modular solar panel and radio antennae for maximum usage
- Multiple mounting options
- Combined visible and IR imaging
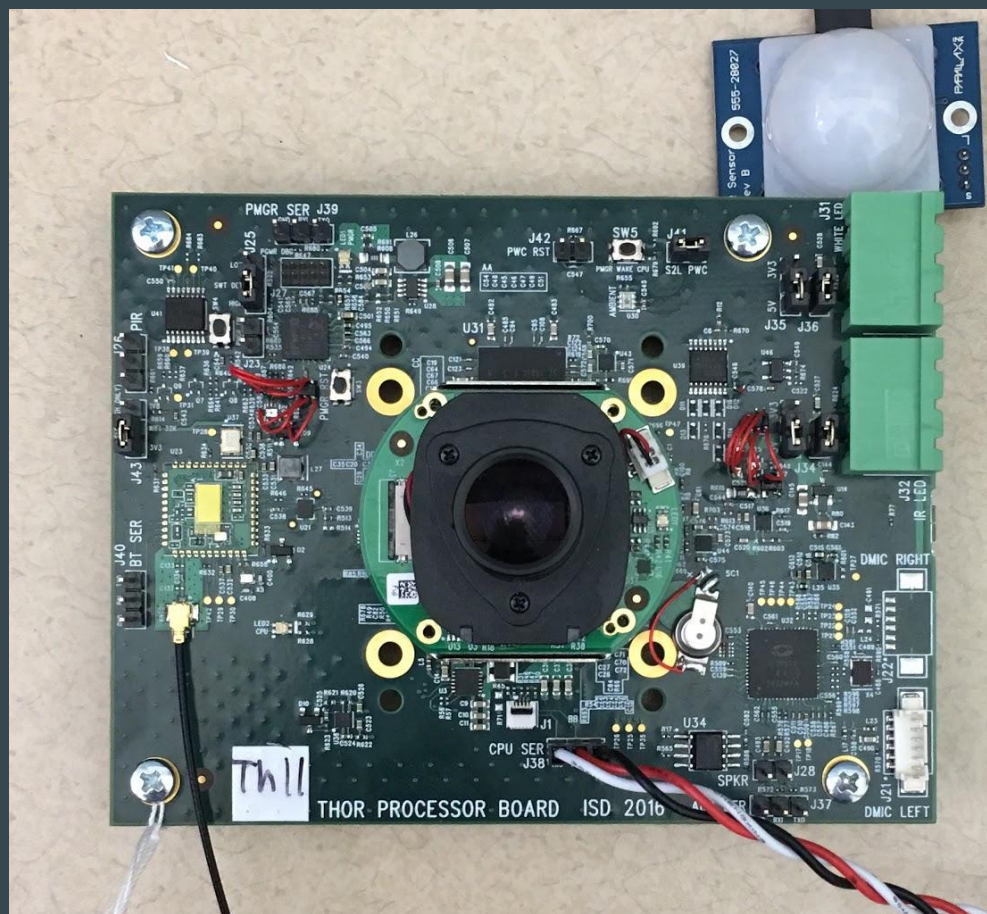- Accurate image detection: recording important objects

Overview Diagram

Solar Panel → **P.V. Charge Controller** → **Batteries**

Power Bus

Wireless Communication Module

CS/Power →
← IP Video Out

Video Processing

CC/Power →
← Video Out

Camera

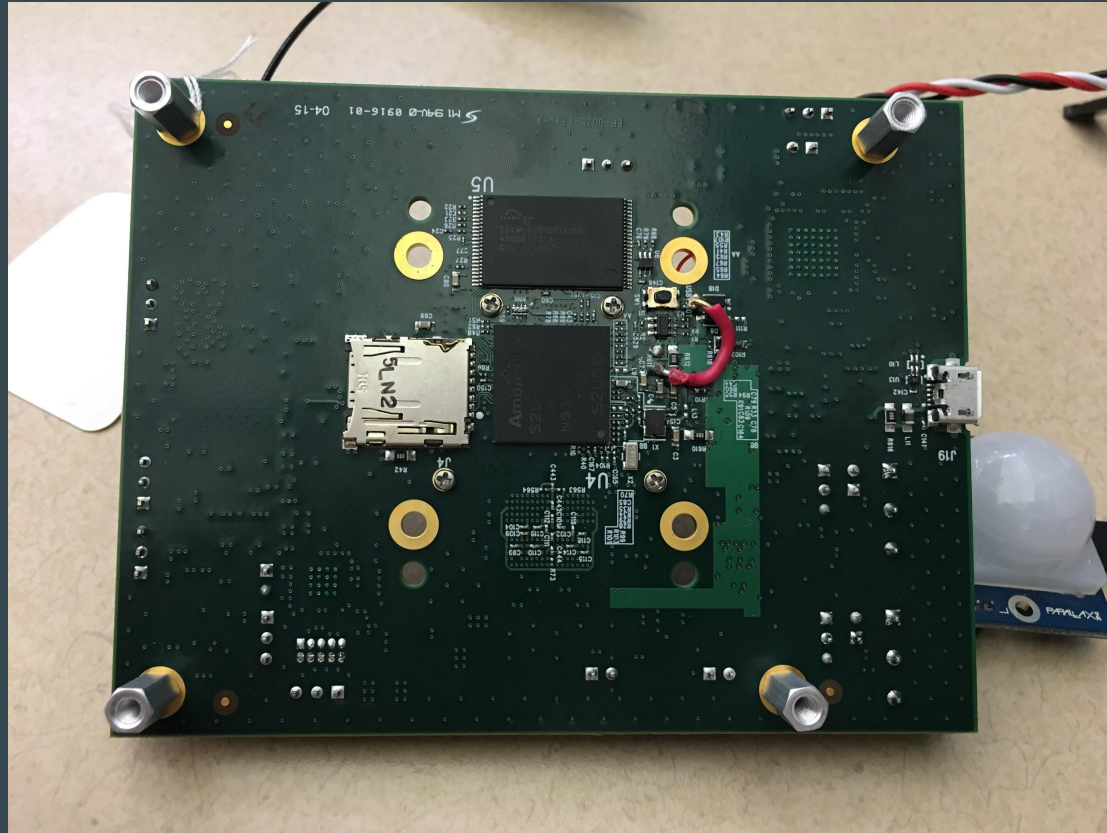**Wi-Fi Router** → **End User's Computer**

Board Block Diagram
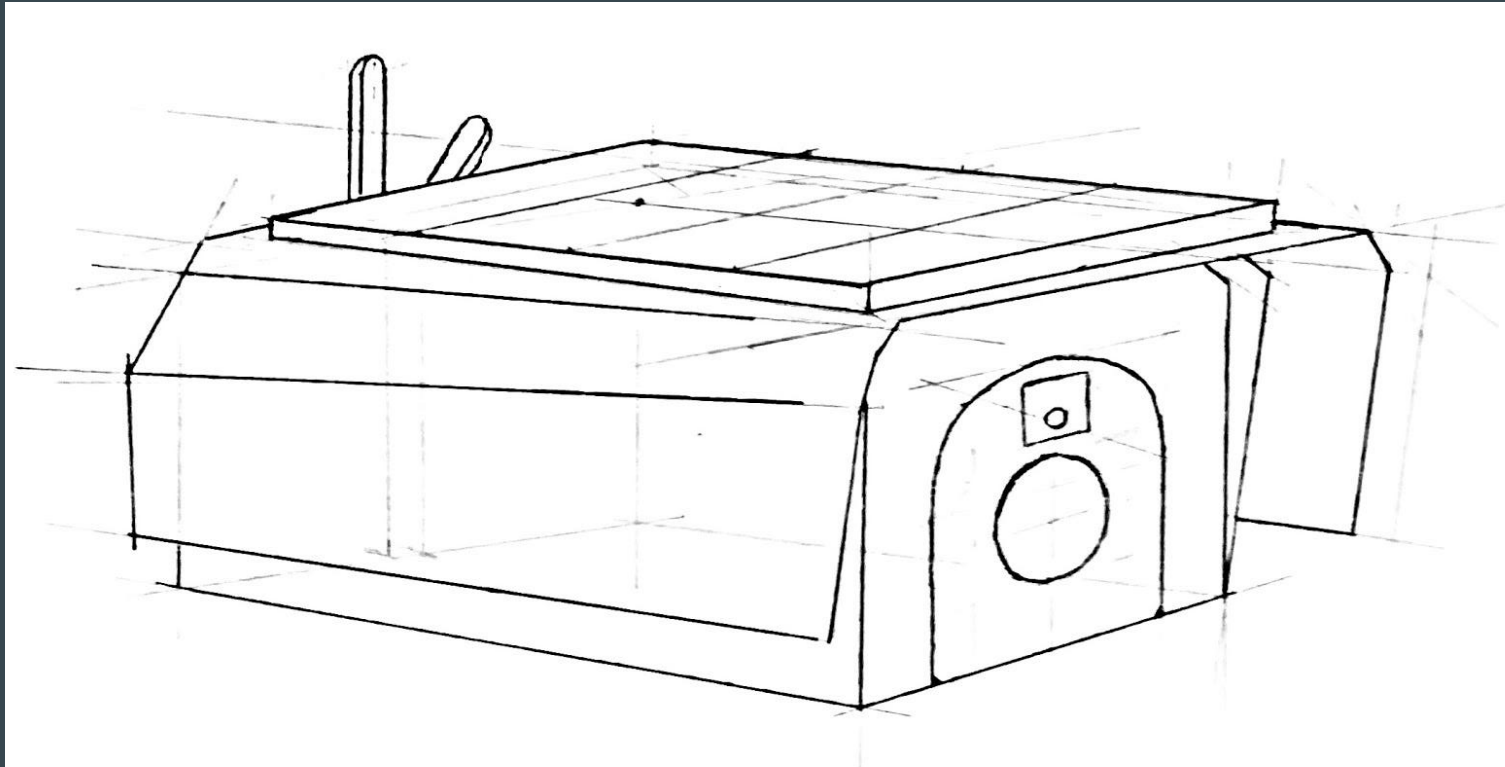
Red = Power
Blue = External
Yellow= Module

THOR Board

THOR Board (Bottom View)

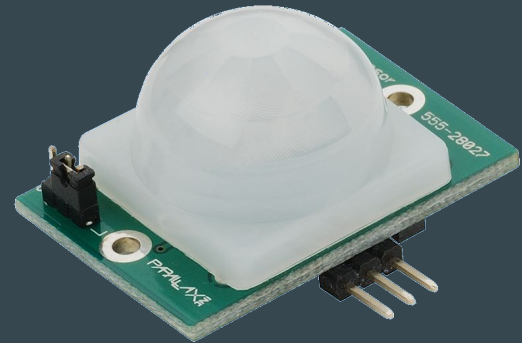Rough Sketch

Parts

Processor: Ambarella

- ARM Cortex A9 architecture, 28 nm process
- Core voltage: 1.1 V
- UART, I2C, SPI, USB, HDMI, I2S, NAND, 10/100 MAC, and more interfaces
- Linux SDK for development
  - Linux 3.8.x kernel with patches, drivers, tools, and more
  - Libraries for ISP, 3A, dewary, and codecs

Passive IR Sensor

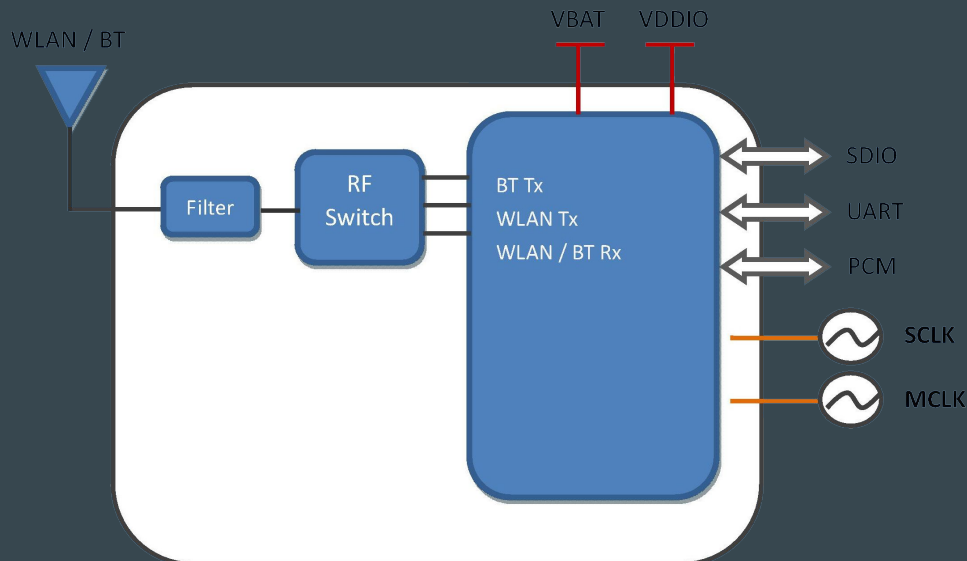Passive IR Sensor: Part # Parallax #555-28027 Rev. B

- Detect a person up to 30 ft away via heat levels emitted by surrounding objects
- Optional mounting for #2 sized screws
- Includes MCU and CPU wakeup control when PIR detects an object
- Source: 3.3 V DC, 3mA active
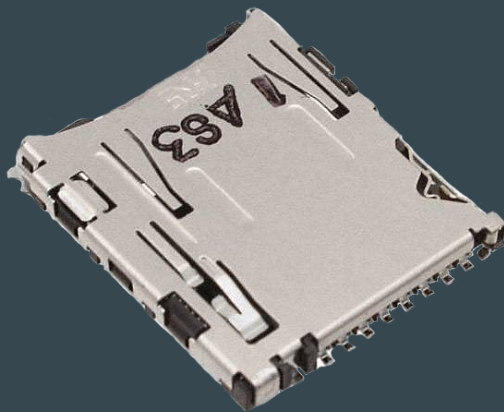
Parts

WiFi Module: Part # AMPAK AP6234

- Send video stream to connected hosts
- Integrated dual band (2.4GHz/5GHz) IEEE 802.11 a/b/g/n
- SDXC interface with processor
- Supports Bluetooth 4.0
- Module provides SDIO V2.0 Host interface for Wi-Fi
  - UART is provided for Bluetooth Host interface

Parts

SD Card Reader/Connector: Hirose DM3AT SF PEJM5

- Write to SD card when connection is unavailable or when not broadcasting
- SDXC Interface with the processor
  - Minimum Serial Speed 10MB/s
- 4-connection points of metal cover to PCB assures secure connection of ground circuit and provides EMI protection
- SDIO (Serial) spec: 3.3V at 220mA

Parts

Ambient Light Sensor: Part # ISL29102

- .3 lux to 10,000 lux range
- Temperature Range: -49 Celsius to +85 Celsius
- Close to human eye spectral response
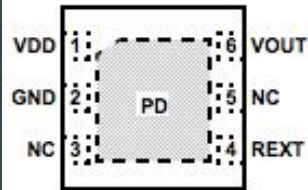- Good IR rejection
- 1.8V to 3.3 V supply Range

Illuminance		
	Examples	
400 lux	Sunrise or sunset on a clear day.	
1000 lux	Overcast day; typical TV studio lighting	
10000–25000 lux	Full daylight (not direct sun)	
32000–100000 lux	Direct sunlight	

ISL29102
(6 LD ODFN)
TOP VIEW

VDD	1			6	VOUT
GND	2		PD	5	NC
NC	3			4	REXT

Pin Descriptions

PIN NUMBER	PIN NAME	PIN DESCRIPTION
1	VDD	Supply (1.8V to 3.3V).
2	GND	Ground
3	NC	No connect
4	REXT	Connected to an external resistor to GND setting the light-to-voltage scaling constant.
5	NC	No connect
6	VOUT	Voltage Output.
-	PD	Thermal Pad. Thermal pad can be connected to GND or electrically isolated.

Parts

Accelerometer: Part # MMA8652FC

- Motion Detection for portable power saving ("Auto-Sleep" and "Auto-Wake")
- 3-Axis, 12-bit, Digital Accelerometer
- I2C interface with programmable Interrupts
- 1.95V to 3.6 supply voltage

Parts

MIPI Interface: Flex Cable

- Cable length: 6-12 in
- Uses D-PHY to support application requirements
- 1.5 Gbps per lane
- Low-power, low noise generation, and high noise immunity
- Half-Duplex Protocol
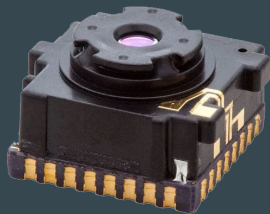- Works in conjunction with MIPI's Camera Serial Interface - 2.

Parts

Visible Camera:

- 2.8mm
- 4MP Camera
- Full 1080p video recording capabilities
- Connection through MIPI interface (explained later)

Parts

Lepton Thermal Camera:

- Captures infrared radiation input and outputs a uniform thermal image
  - Used during low-light situations or favorable weather conditions (for thermal imaging)
- MIPI/SPI Video Interface
  - Export compliant frame rate (< 9 Hz)
  - Field of View: 50 deg
  - Image size: 80x60px
- Uses standard cell-phone-compatible power supplies:
  - 2.8V to sensor, 1.2V to digital core, and flexible IO from 2.5V to 3.1V
  - Low operating power, nominally 150 mW (< 160 mW over full temperature range)

Critical Elements

- THOR board + SDK Complexity
- Confining to Military Spec
- Overheating
- Power Management with the THOR Board
  - Solar Panel size, power draw without recharging

Product Development Team

- CE Team (5)
  - Ben May (leader), Garrison Carter, Aaron Chang, Carlos Beltran, Salim Benhaddou
- EE Team (3)
  - Weiyi Zhou (leader), Yiyue Ma, Xinwei Zhang
- ME Team (5)
  - Madeline Dippel (leader), Michael Cosley, Nick Besse, Kate Anvick, Dane Frederick
- FLIR team
  - Marcel Tremblay, Louis Tremblay, Kai Moncino, Rebecca Potter, Sean Tauber, Travis Frecker

CE Development Responsibilities

Ben May - Embedded Systems, S/W

Garrison Carter - Embedded Systems, Structural

Aaron Chang - Embedded Systems, Networking

Carlos Beltran - Embedded Systems, Power

Salim Benhaddou - Embedded Systems, S/W

FLIR Team SubGroups

Thermal	Structural	Power	Emb. Sys.	Software
Maddy Dane Yiyue	Maddy Kate Garrison Nick	Weiyi Xinwei Dane Carlos	Ben Garrison Carlos Salim Aaron Yiyue	Carlos Salim Aaron

Questions?