Solar Door Panel

Jeff Kelley
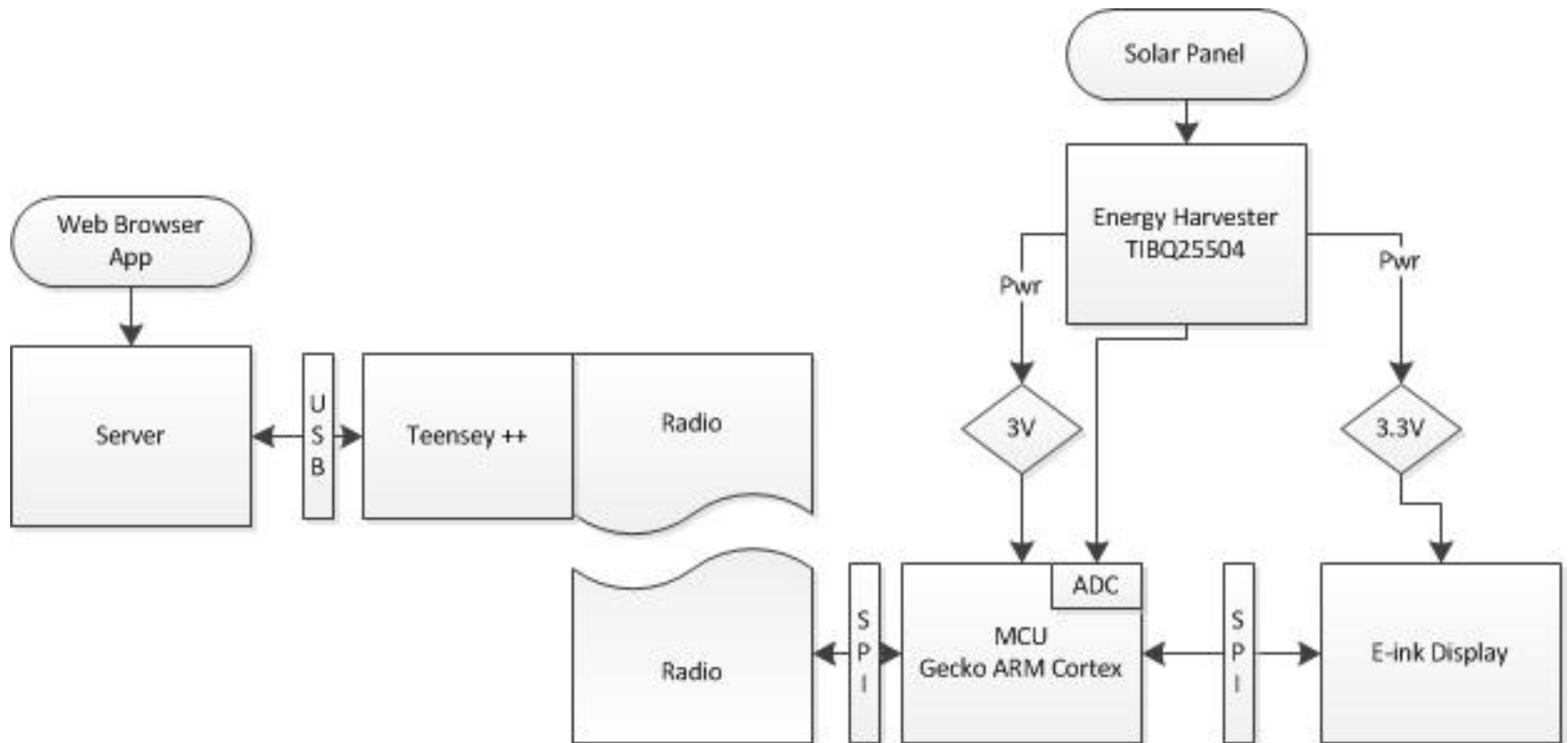*Tyson Hunt*
David Hurst

Overview

Normal Door Signs are boring and lame!

- Functional Description
- Tasking
- MCU, Display, and Radio
- Energy Harvester and Power
- Software Applications
- Parts List
- Schedule/Risks

Functional Description

Tasking

Tyson

MCU, Display, Radio and communication.

David

Energy Harvester, Power management, PCB & Packaging
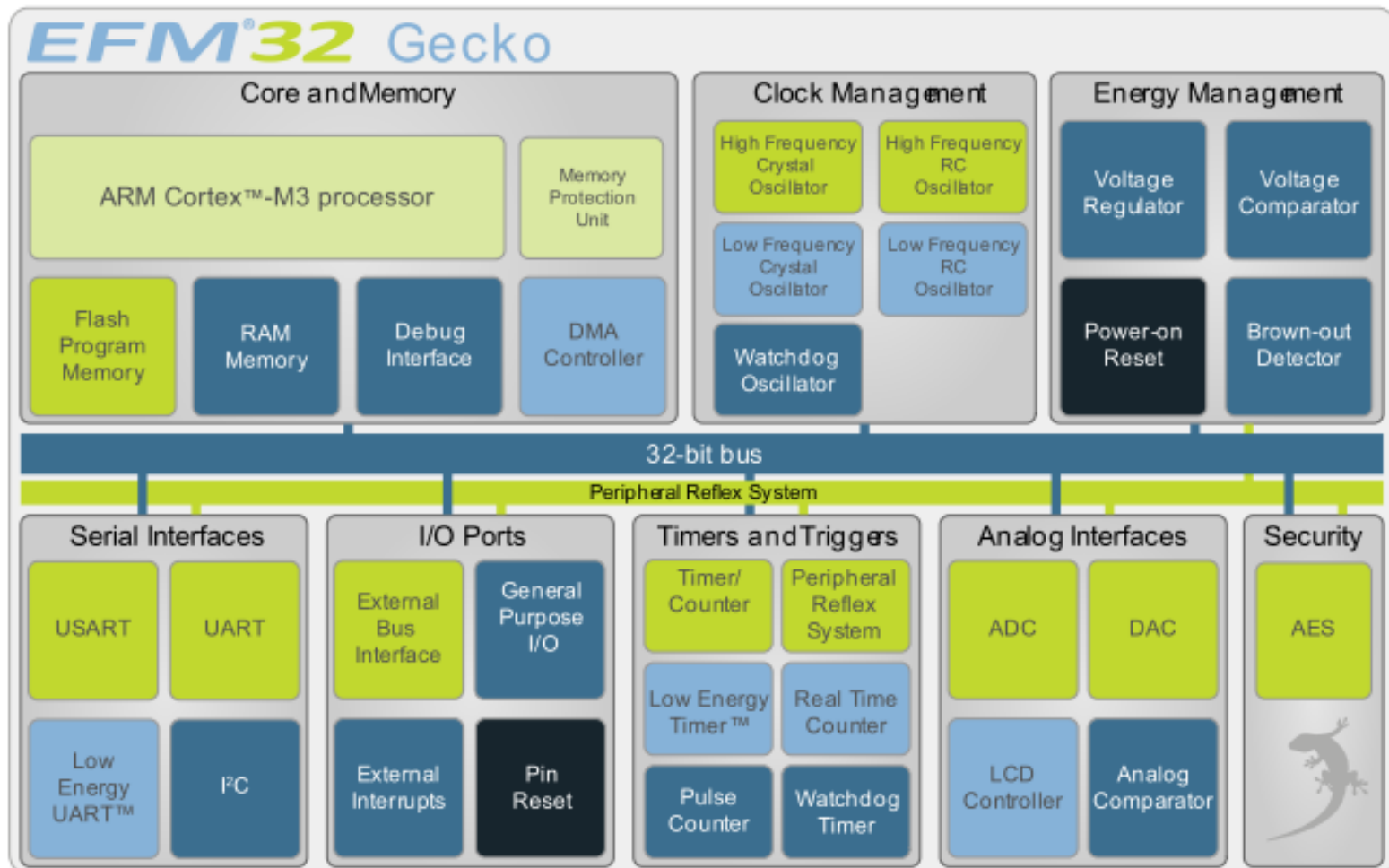
Jeff

Server, Web Interface, and Android App

MCU Chip Design

Flexible Energy Management System

- 20 nA @ 3 V Shutoff Mode
- 0.6 µA @ 3 V Stop Mode
- 0.9 µA @ 3 V Deep Sleep Mode,
- 45 µA/MHz @ 3 V Sleep Mode
- 180 µA/MHz @ 3 V Run Mode

MCU Schematic

Note

In the block diagram, color indicates availability in different energy modes.

MCU - Server Protocol

Device:

1) Wake up every x time

2) Send ready signal

3) Wait y time for response from server

4) If response

    I) Get data

    II) Send data

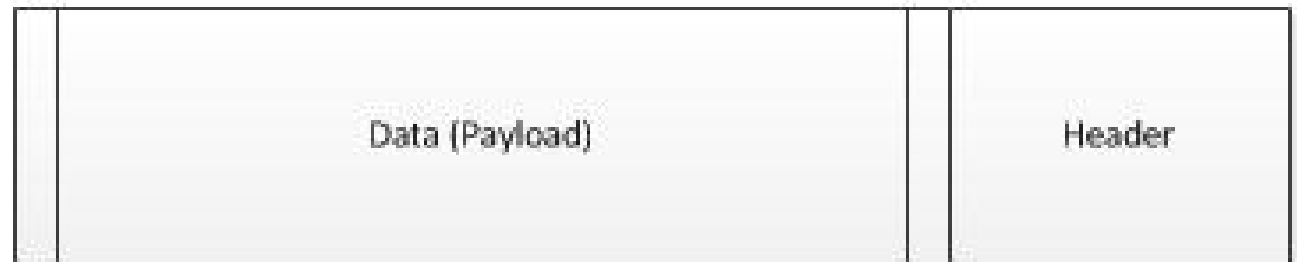   III) Receive Done signal

5) Sleep

6) Repeat steps 1-6

Server:

1) Wait for ready signal

2) Send acknowledgement once received

3) Send data

4) Receive Data

5) Send done signal

6) Repeat steps 1-6

Data Transmission Structure

CMD's
- Update
- Status
- Metrics

Data Structure

Data (Payload)		Header

Header
Structure

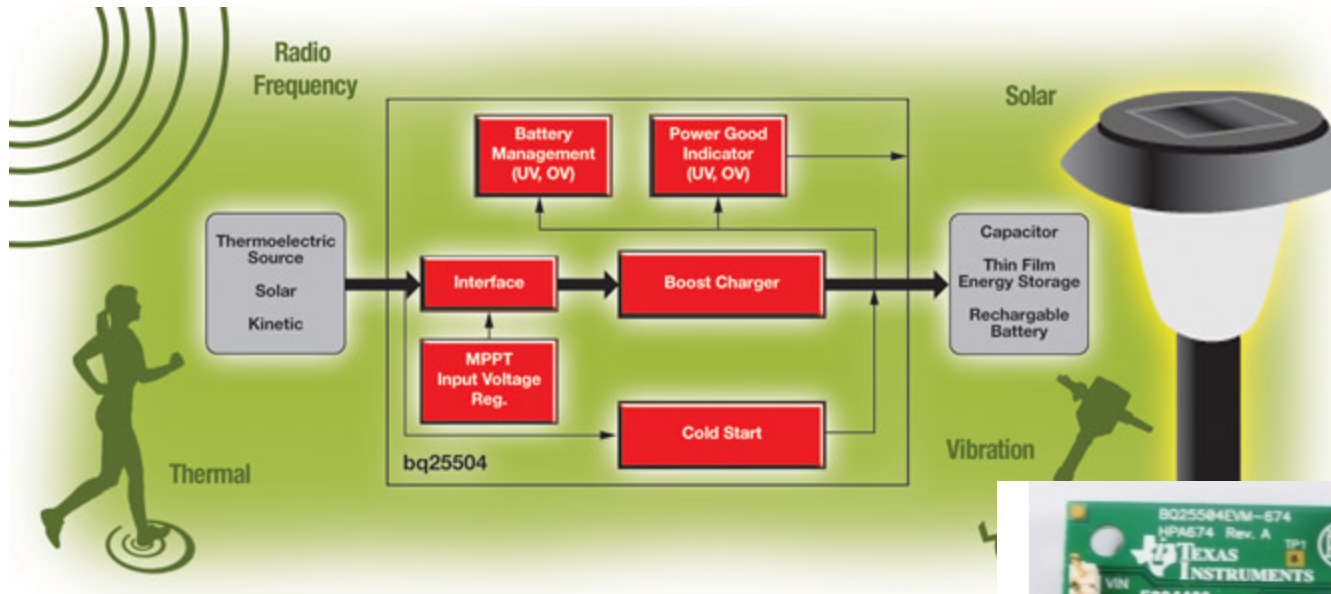| Payload Size		CMD

Failure Protections

User Settings

- Enable Components <-> Has Power
- Save power statistics (onboard)
- Critical Level
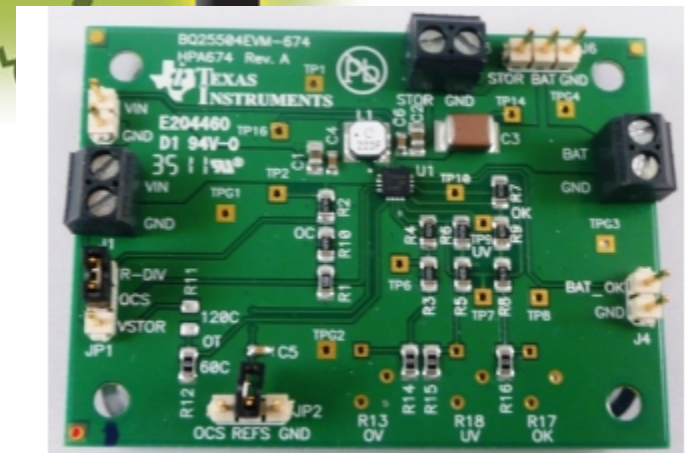- Backup Battery
- Manual Wakeup

Harvesting Solar Energy

-Solar Panels output voltage varies

-What if there is no light?

-Need to charge caps at their rated voltage

-Protection from overcharging storage device

Energy Harvester

TI BQ25504 Usage & Dev Kit

Images from http://www.ti.com/product/bq25504

Energy Harvester, cont.

Smart Energy Management

  -TI BQ5504 Low Power Boost Charger

  - Programmable Dynamic Maximum Power Point Tracking

  -.25V - 5.25V Output

  -As low as 80mV Input

  -Can warn of pending power loss

Power Consumption

Power Draw:

-RF: 18mA Rx, 25mA Tx

-MCU: 180uA/Mhz Run, .9uA Sleep

-Display:~300mJoules (150mW for 2 seconds)
    -Sleep Mode 10uA

-Regulator: 20uA - 100uA

-Energy Harvester: 300nA

Power Source:
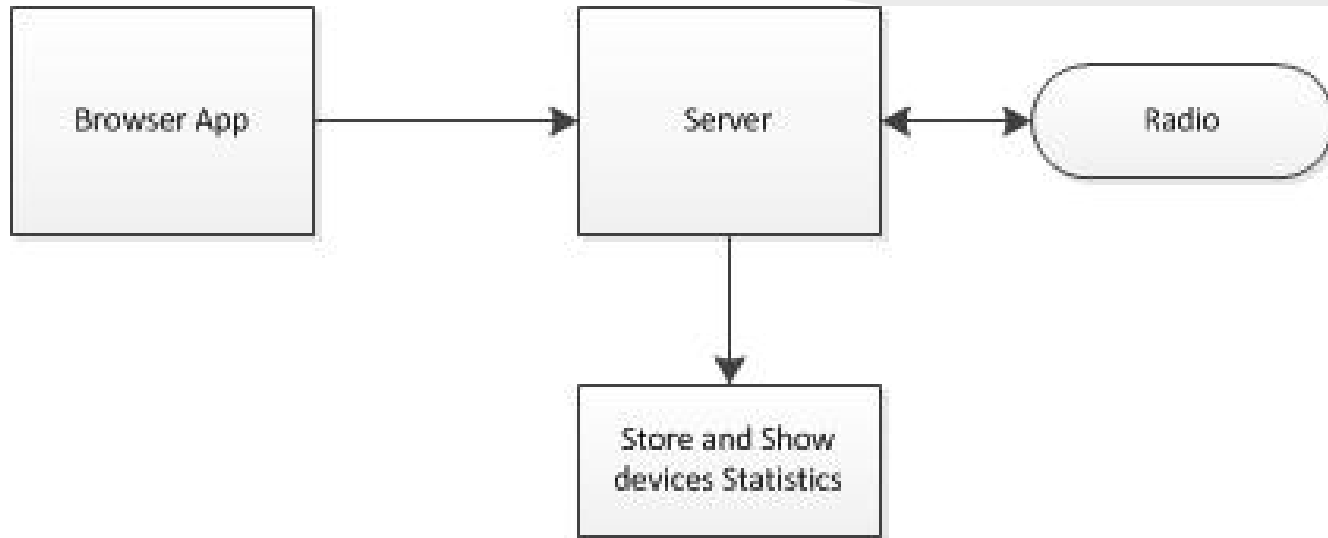
-Solar Panel: 6V, 3 Watt Amorphous

Power Metrics

-Battery OK line will tell MCU status of charger

-Toggles differently if charging or discharging

-MCU will read capacitor voltage levels before and after update
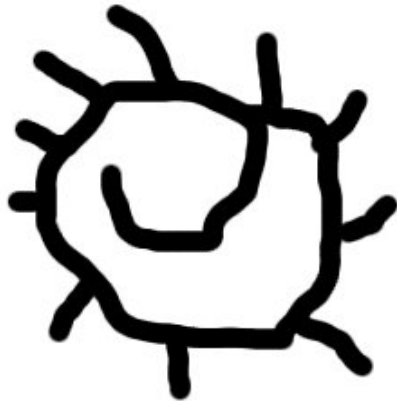
~5V   ~4V

Image from

Server & Software

-Convert picture or HTML file for transmission

-Display power consumption metrics

-Display Web Interface

Web Page Prototype

Finalized BOM

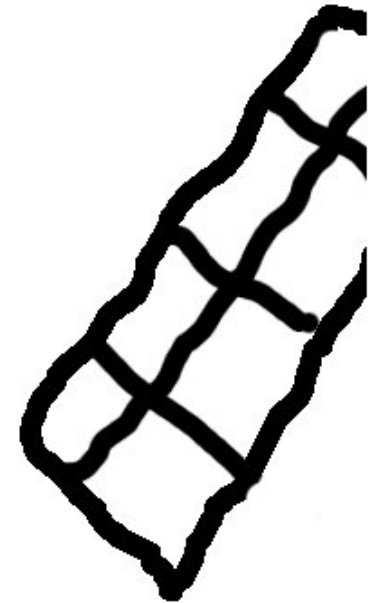**MCU + RF:** Gecko EFM32 + CC2520
RF to USB Adapter: Teensey 2.0
Display: 5.7" 320x240 Kent Display
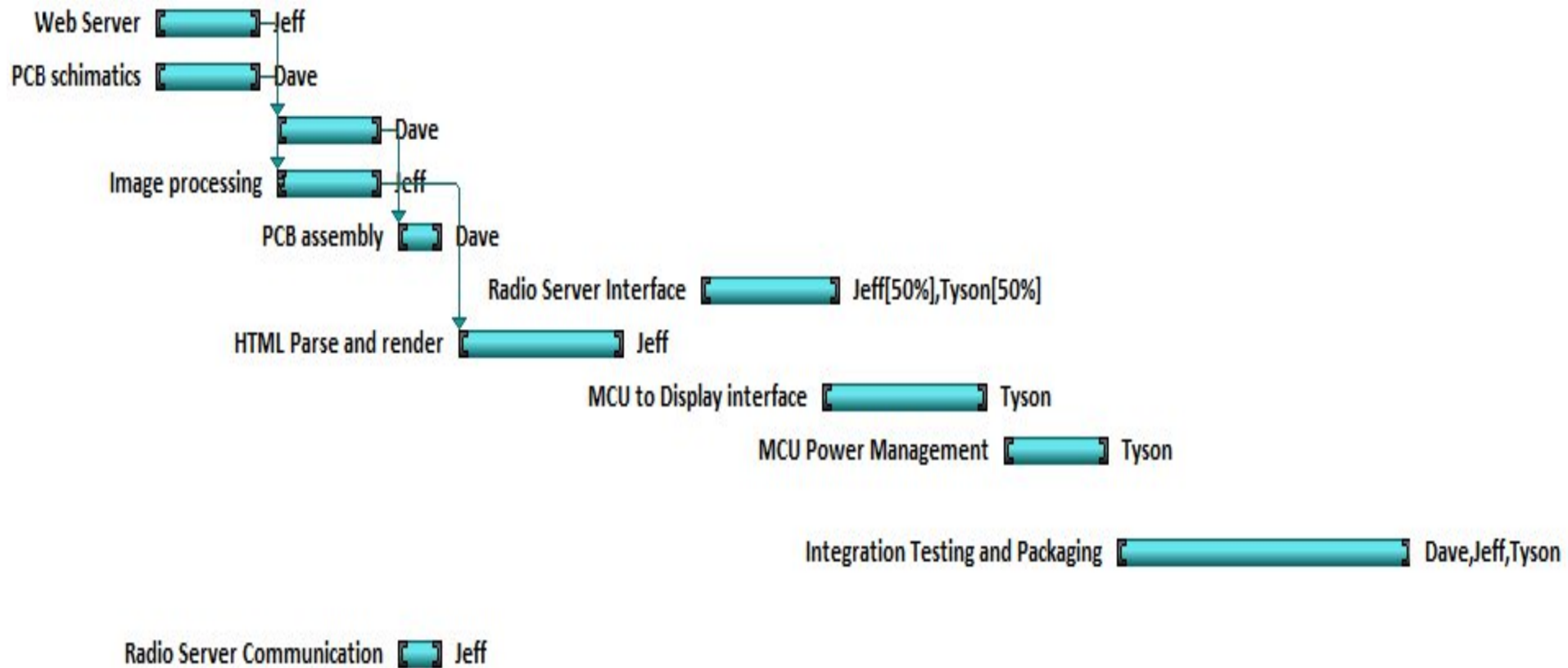**Energy Harvester IC:** TI BQ25504
PCB: Manufacturing, Assorted Resistors/Capacitors
Solar Panel: 6V 3 Watt Amorphous
Super Capacitor: Panasonic S5R5H155 (5.5V 1.5 Farad)
Voltage Regulator: ST LD39050XX LDO

Schedule

Web Server — Jeff

PCB schimatics — Dave

— Dave

Image processing — Jeff

PCB assembly — Dave

Radio Server Interface — Jeff[50%],Tyson[50%]

HTML Parse and render — Jeff

MCU to Display interface — Tyson

MCU Power Management — Tyson

Integration Testing and Packaging — Dave,Jeff,Tyson

Radio Server Communication — Jeff

Risk Assessment

- MCU Radio Driver
- Radio Range/Throughput
- Super Capacitor Discharge Rate
- Limited Power

Demo Day

- Portable display
- Server on a laptop
- User displays text from GUI
- Show Logo
- Set sleep time to ~1min -> update?
- Show power usage/Settings
- Disconnect Solar Cells -> Backup Battery

Hopefully all components run on Solar Cells only!

Questions?