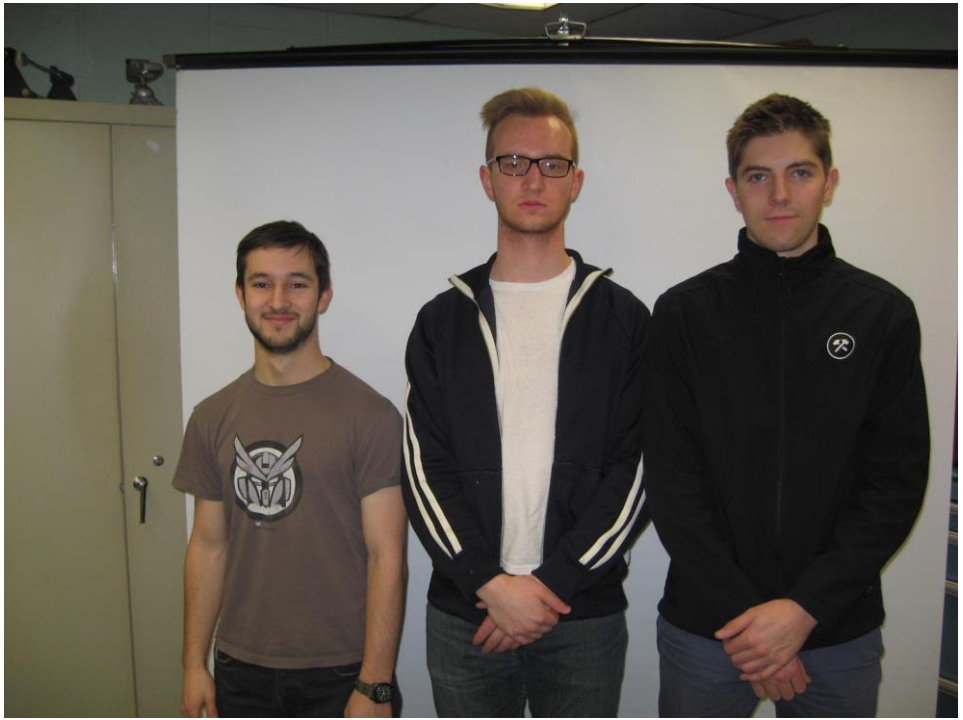
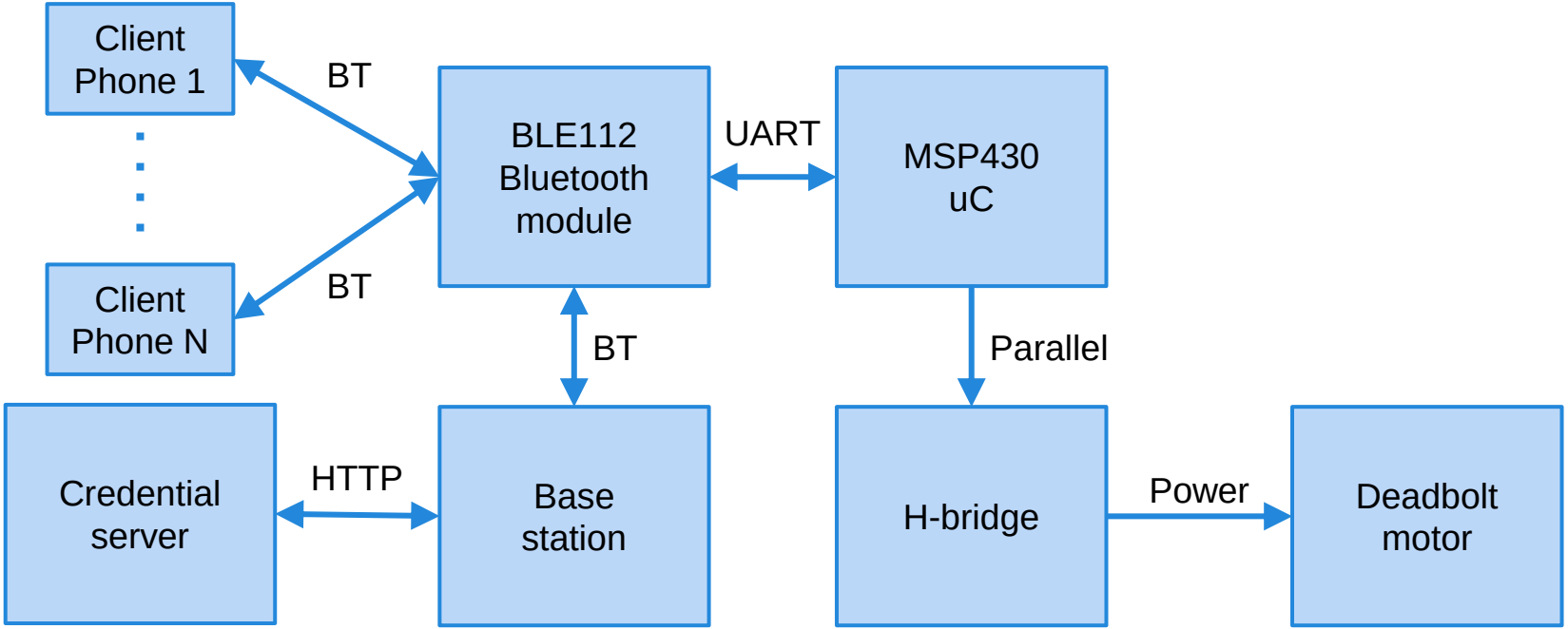
ECE 477 Design Review

Team15 – Social Lock

Team



System Block Diagram



PSSCs

1. An ability to securely determine whether a given mobile device is authorized to unlock the door.
2. An ability to mechanically displace the deadbolt to unlock and relock the door.
3. An ability to monitor the battery state and indicate a low battery condition to the user.
4. An ability to grant and revoke access to additional smartphones without either being physically present at the lock.
5. An ability to use grant temporary access to additional smartphones which expires automatically at the appointed time.

Component Selection Rationale

Microcontroller
Bluetooth Module
H Bridge
LDO Regulator
Battery Monitor

Microcontroller

TI MSP430F6659

Strong Community
Powerful
Our team is familiar
with the tools

Bluetooth Module

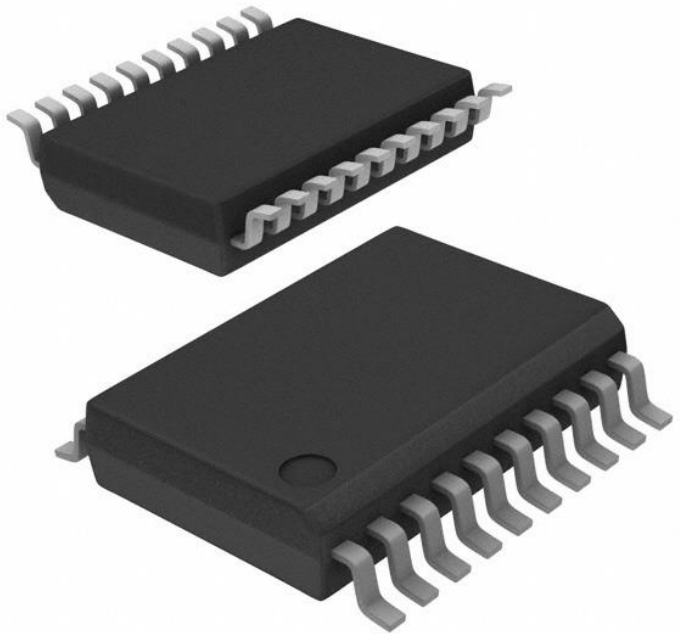
Bluegiga BLE112

Built in
  microcontroller
UART
Programmable
Well-supported

H Bridge

Toshiba TB6593FNG

- Low minimum motor supply voltage (< 3V)
- Low ambient current draw
- High current capacity (1.2A)
- Analog control



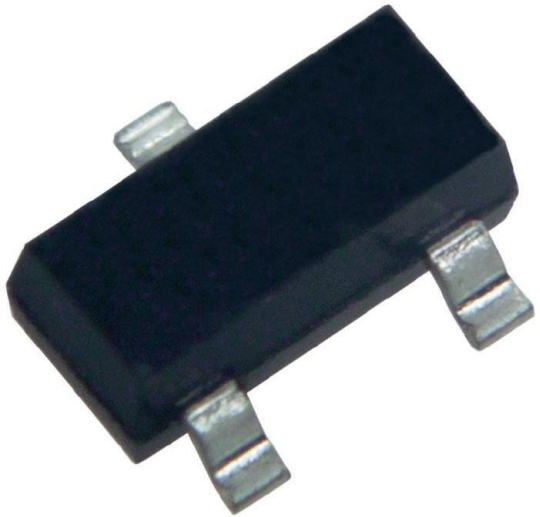
LDO Regulator

Microchip Technology MCP1700T

Simple, 3 pin package

Max power consumption: ~150mW

Sleep power consumption: ~15 uW



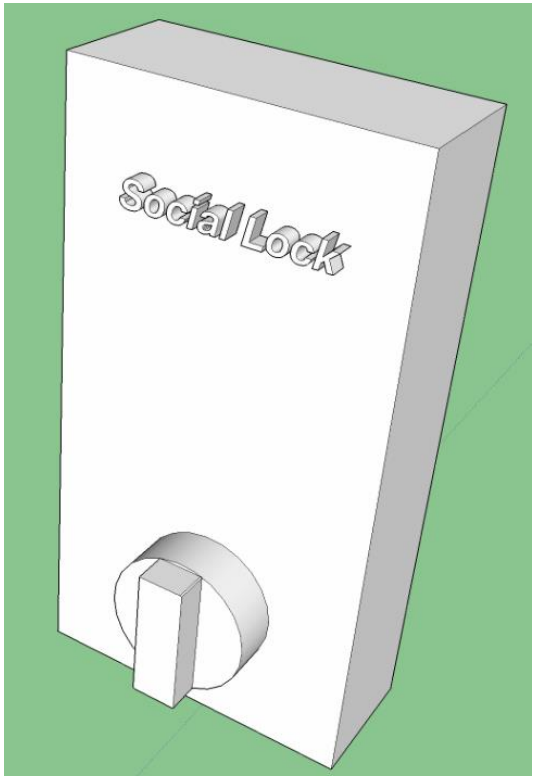
Battery Monitor

Maxim 6775XKA+T

Low, 0.87uA current draw
1% Accuracy
Only need to indicate low battery warning
Simpler than coulomb counte

Packaging Design

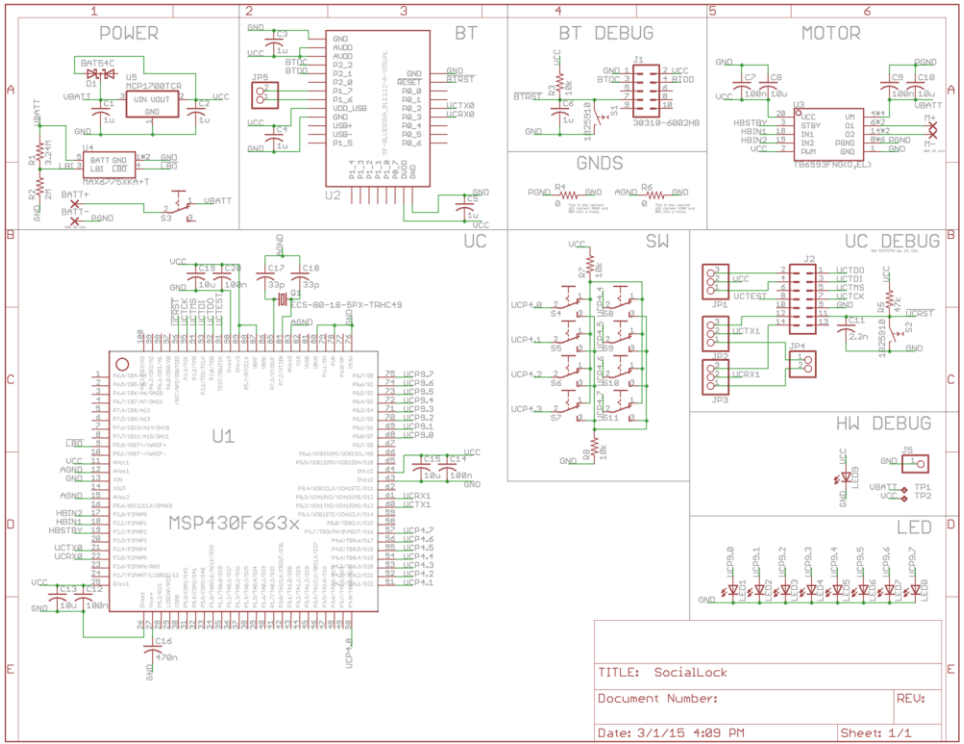
- 3D printed box that fits over deadbolt
- Does not require any tools to install
- Removable adhesive affixes device to door



Schematic/Theory of Operation

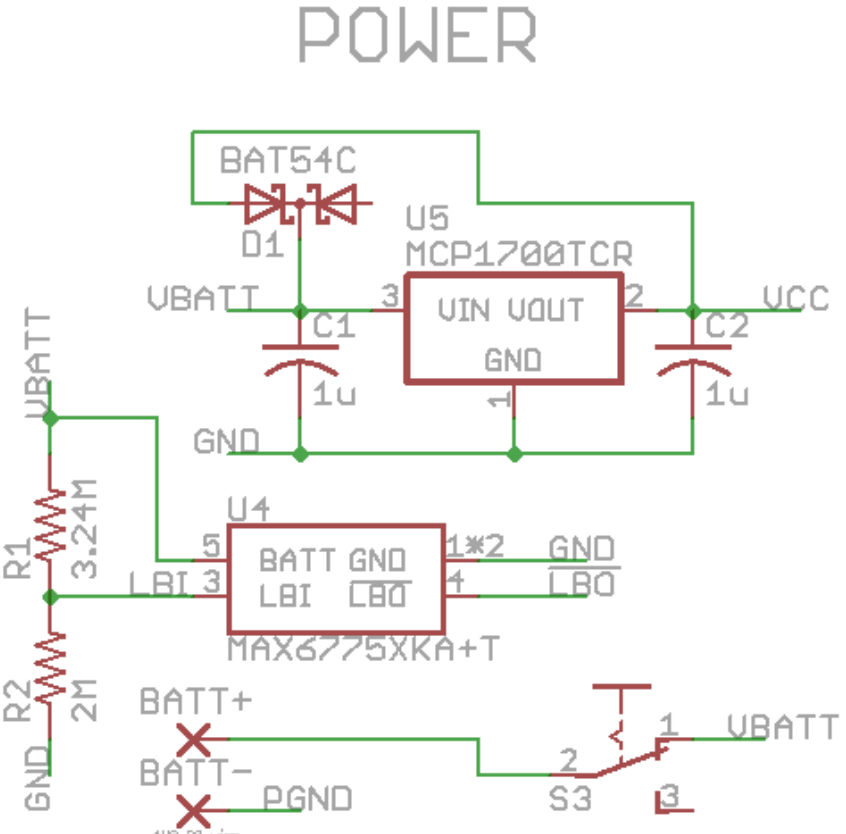
Schematic broken into blocks

Each block covered in following slides

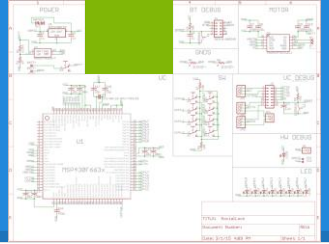


Power Block

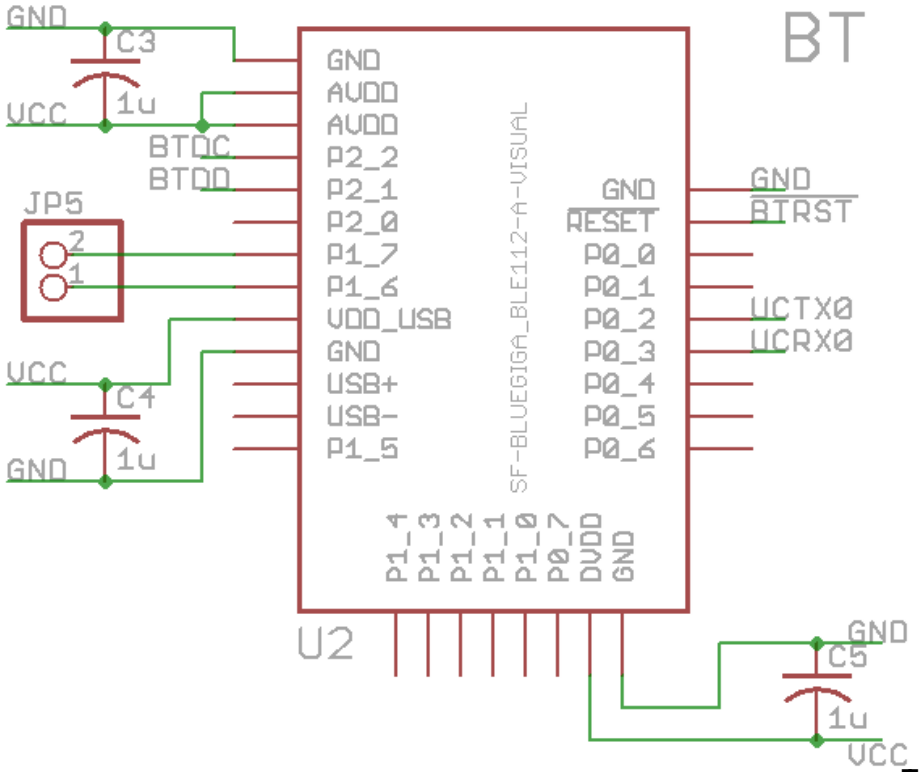
- Battery leads
- LDO regulator
- Battery monitor
- Power switch



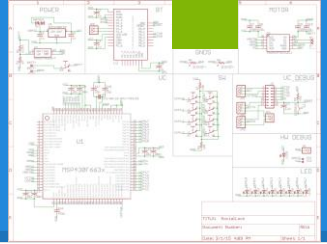
Bluetooth Block



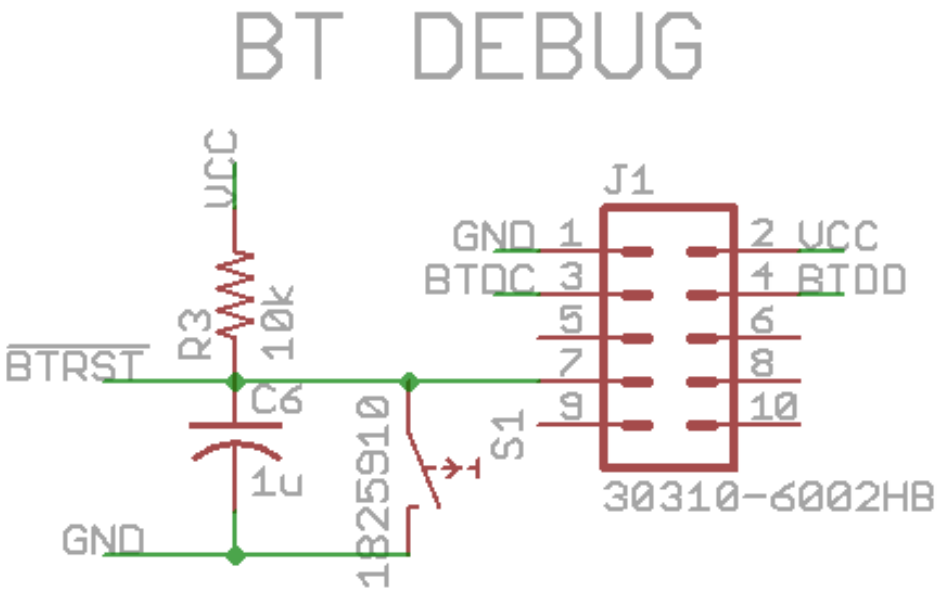
BLE112A module
Decoupling caps
uC UART
Debug UART



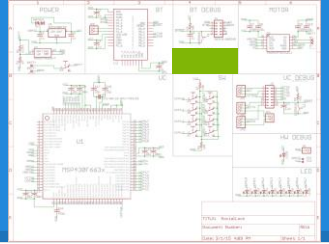
Bluetooth Debug Block



10-pin JTAG
nRST switch
Vcc sense (not supply)

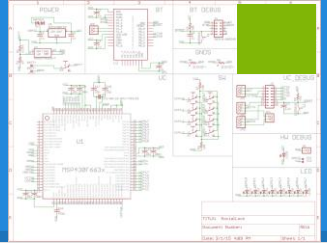


Grounds Block

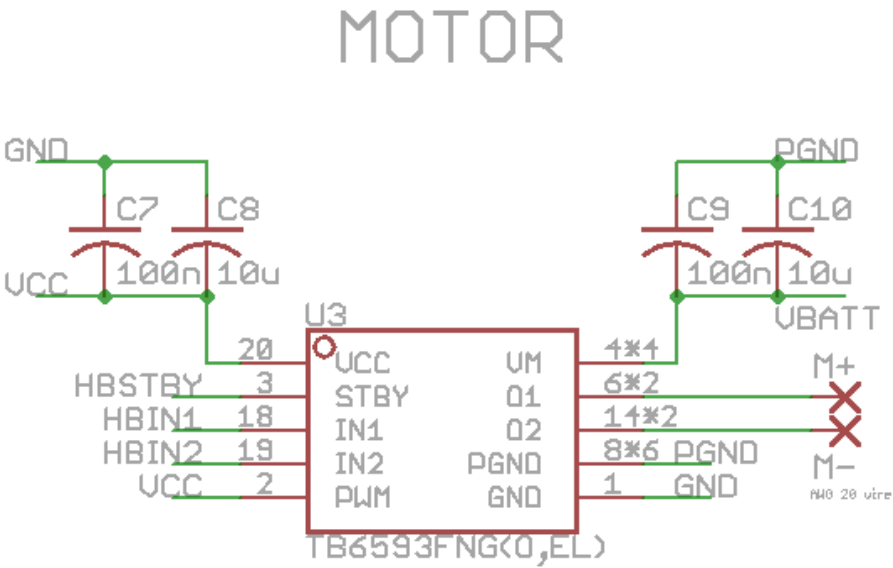


Fake resistors
Connect AGND,
PGND to GND

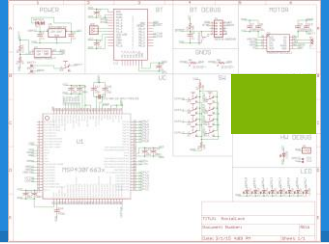
Motor Block



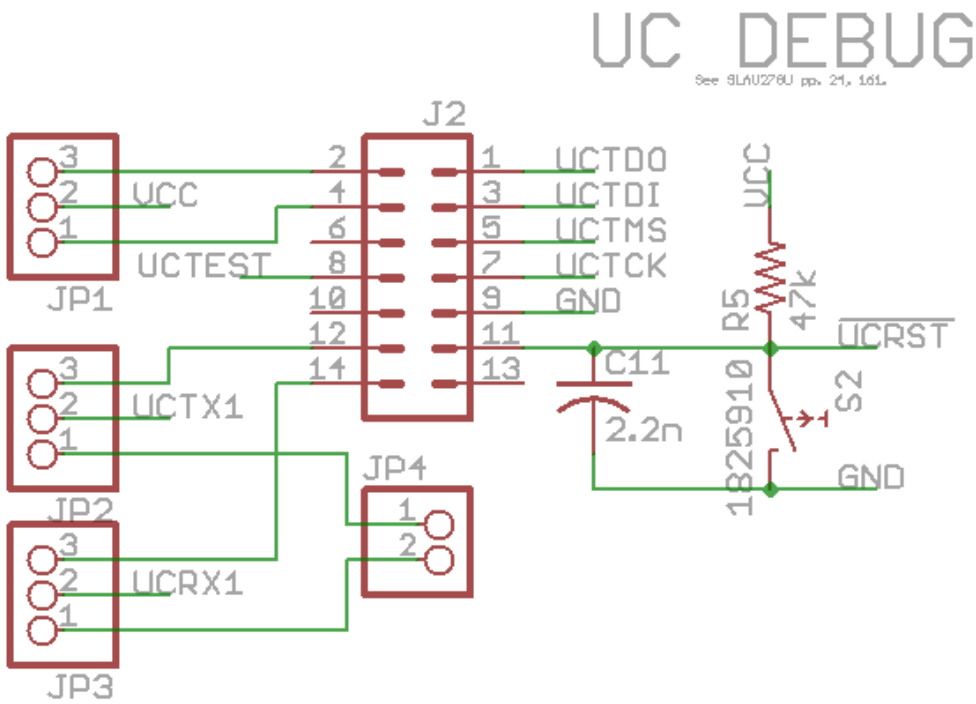
- H-bridge
- Decoupling caps
- uC control
- 20-SSOP, 5 pins
- Unregulated VBATT
  - for motor



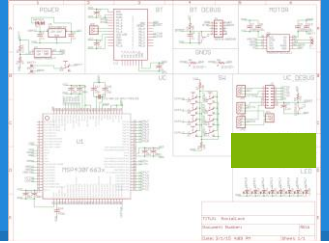
uC Debug Block



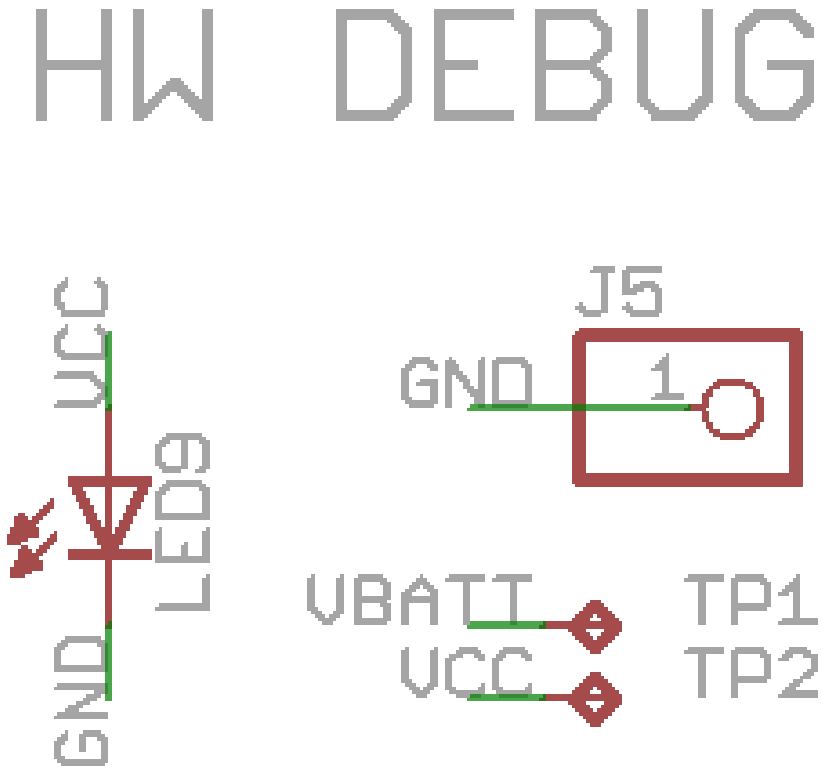
- 14-pin JTAG
- nRST shared with debugger
- Backchannel UART
- Power source selection



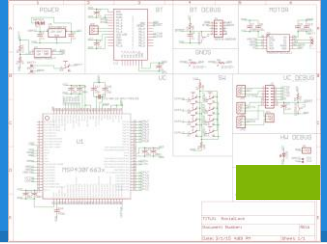
HW Debug Block



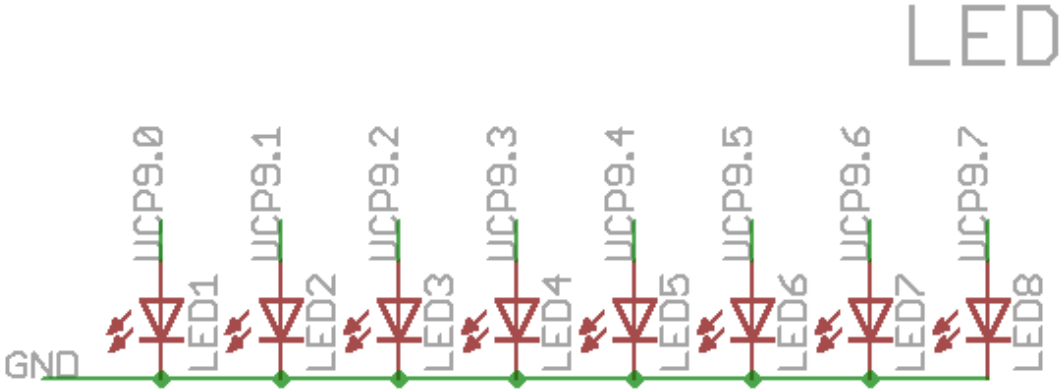
Power LED
Voltage test points



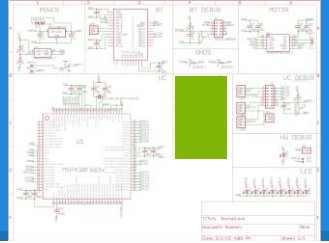
LED Block



Output LEDs for uC

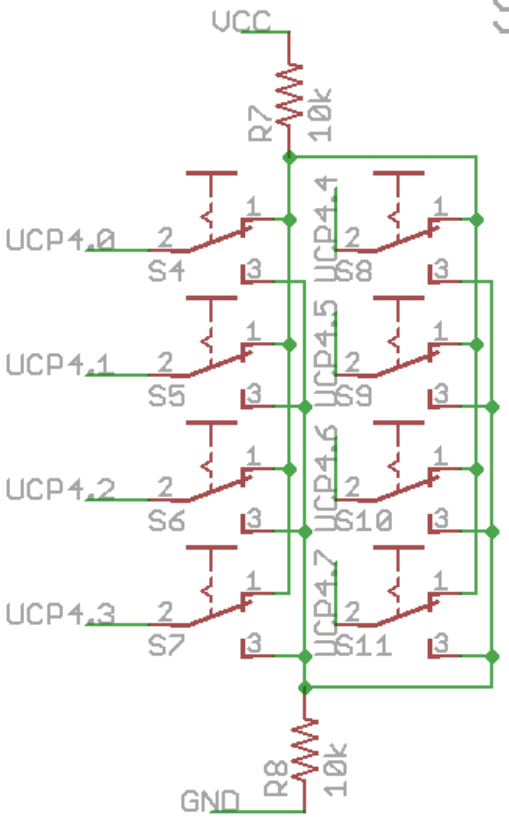


Switch Block



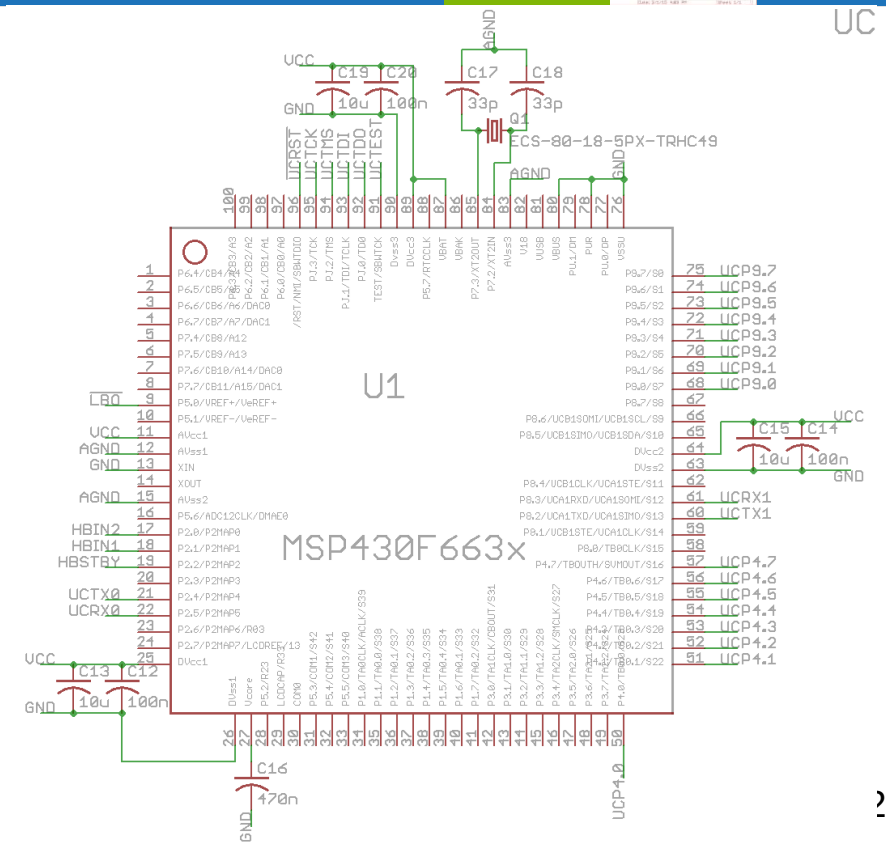
SW

Input switches for uC

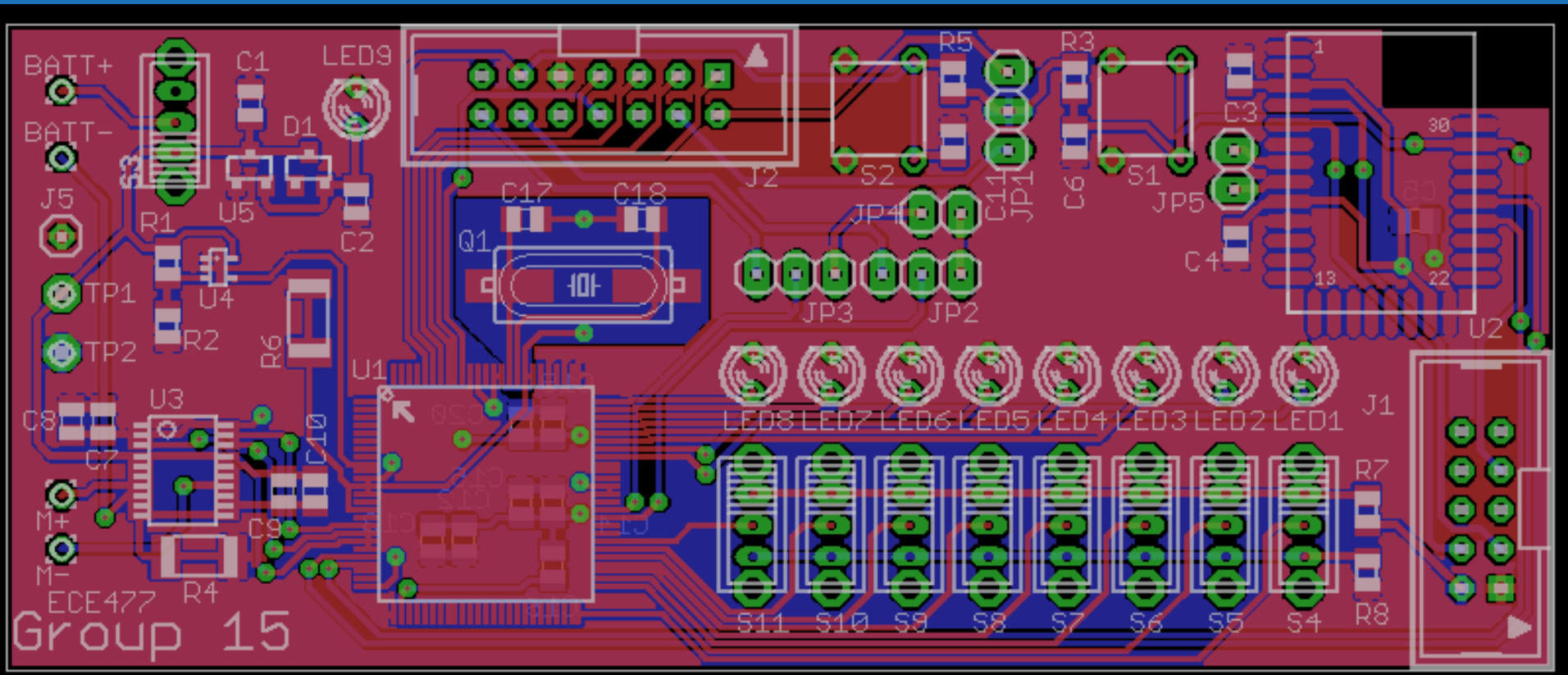


uC Block

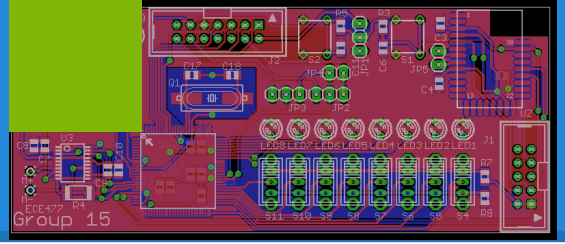
- Isolated 8 MHz crystal
- Decoupling caps
- Signal lines to everything else



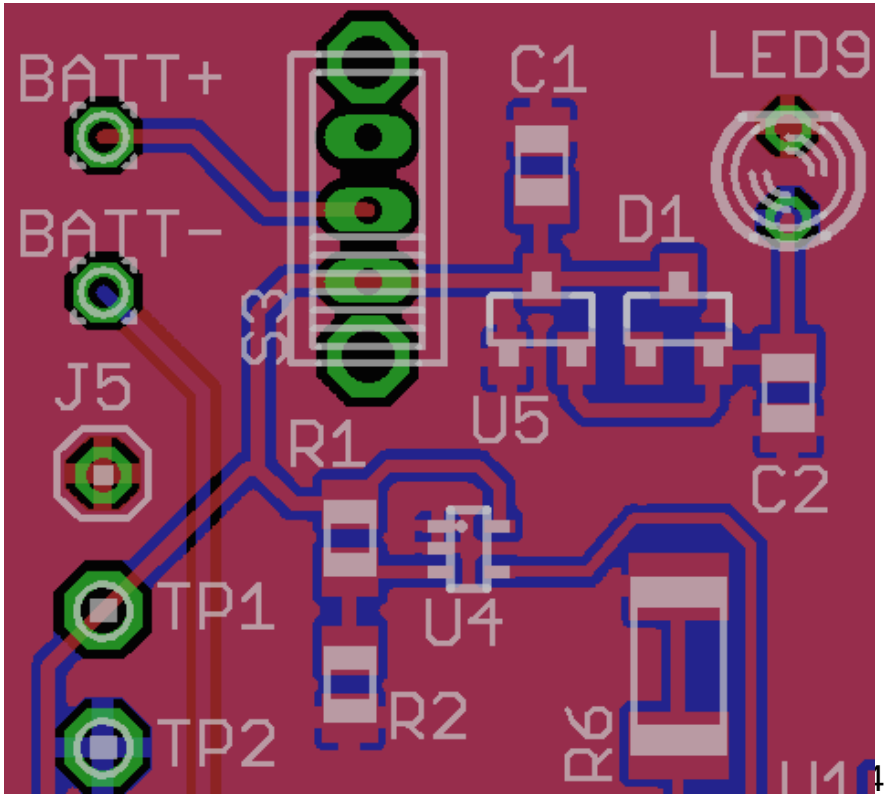
PCB Layout – 1.65”x3.95”



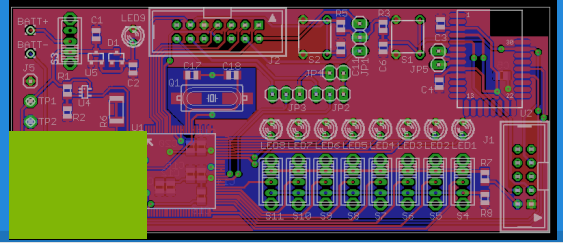
Power Layout



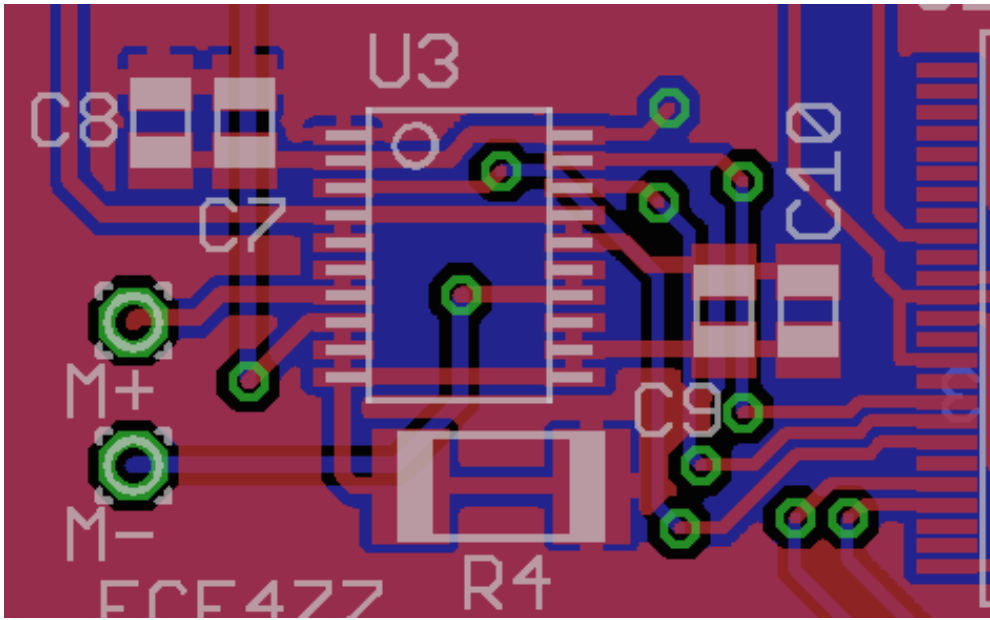
- Power switch
- Indicator LED
- Back-voltage protection via Schottky diode



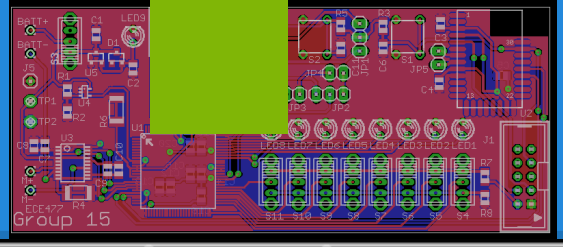
Motor Layout



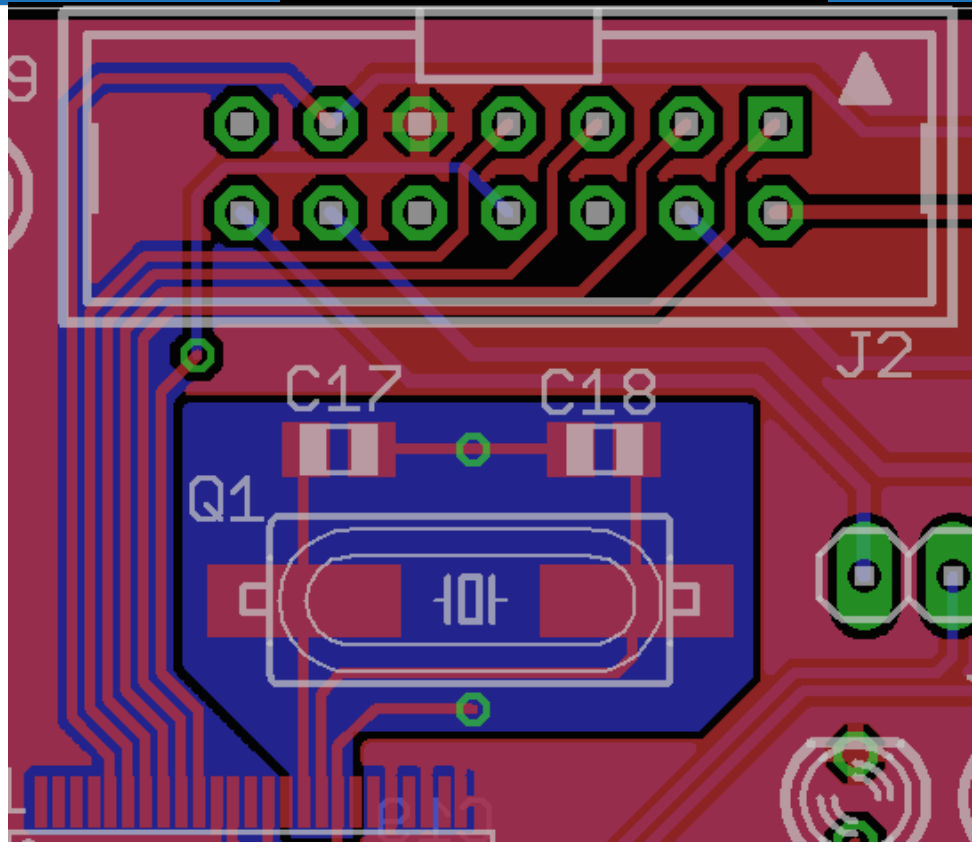
- Pins inconveniently configured
- Most vias per pin of all components
- PGND connected to GND at R4
- uC at right



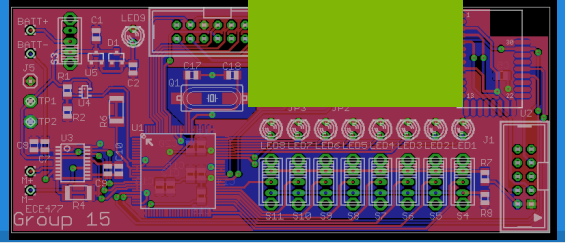
JTAG-14 Layout



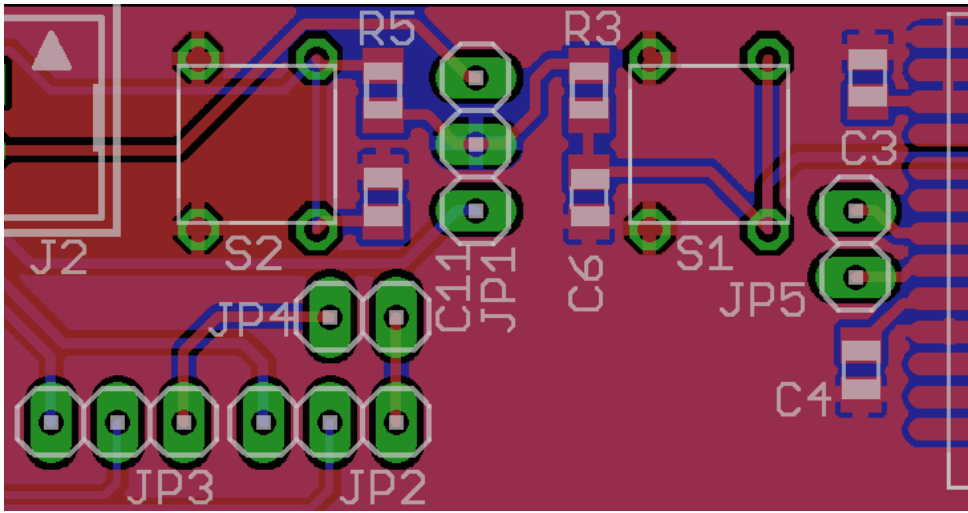
- Most difficult routing
- Originally farther
  - from uC
- Solution: signals
  - from left on top;
  - from right, bottom



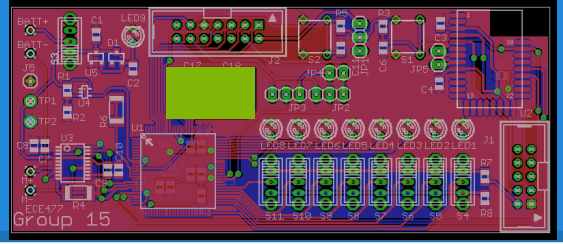
Jumper Layout



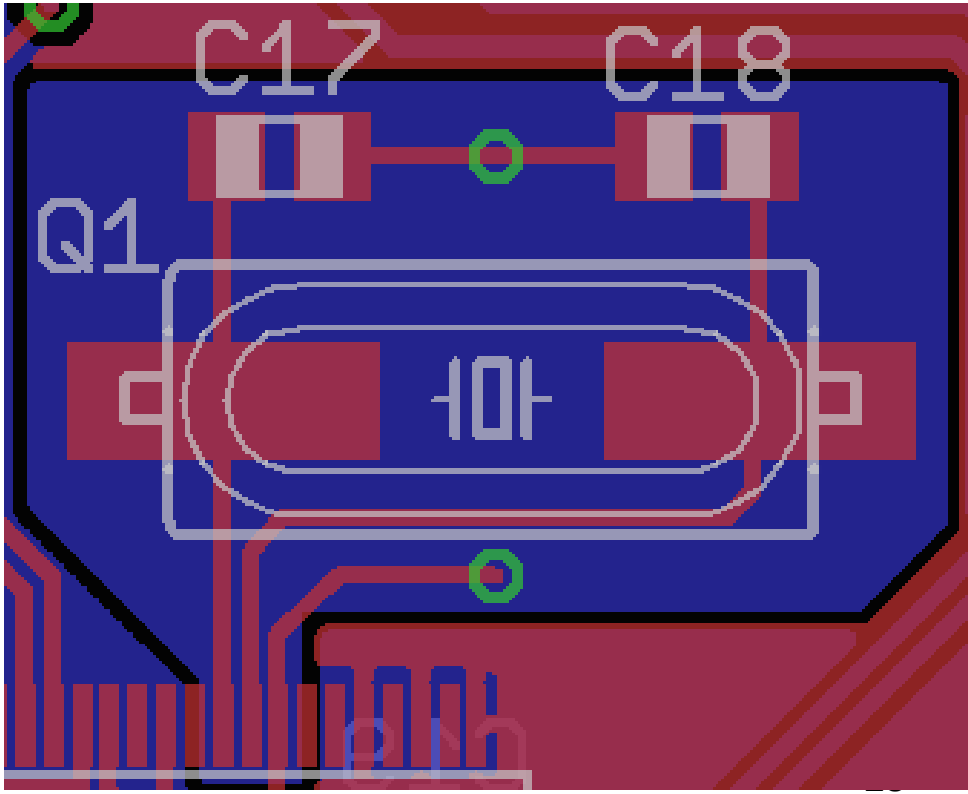
Allows selection of uC UART path
Includes adjacent nRST switches



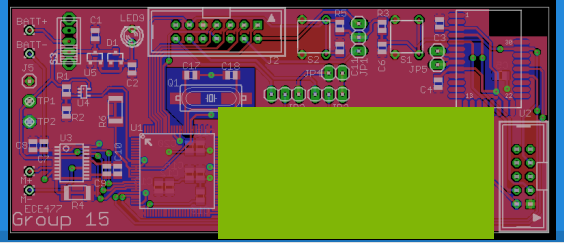
Oscillator Layout



- Analog circuit
- Isolated analog ground plane
- Equal-length load capacitor traces

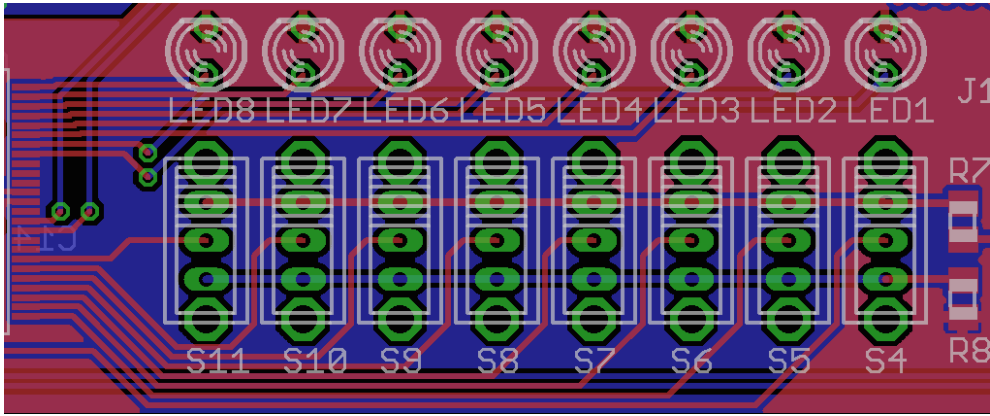


Switch & LED Layout

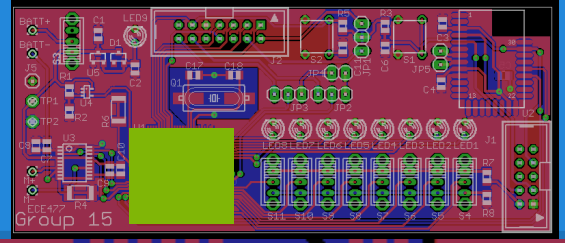


8-bit I/O for debugging

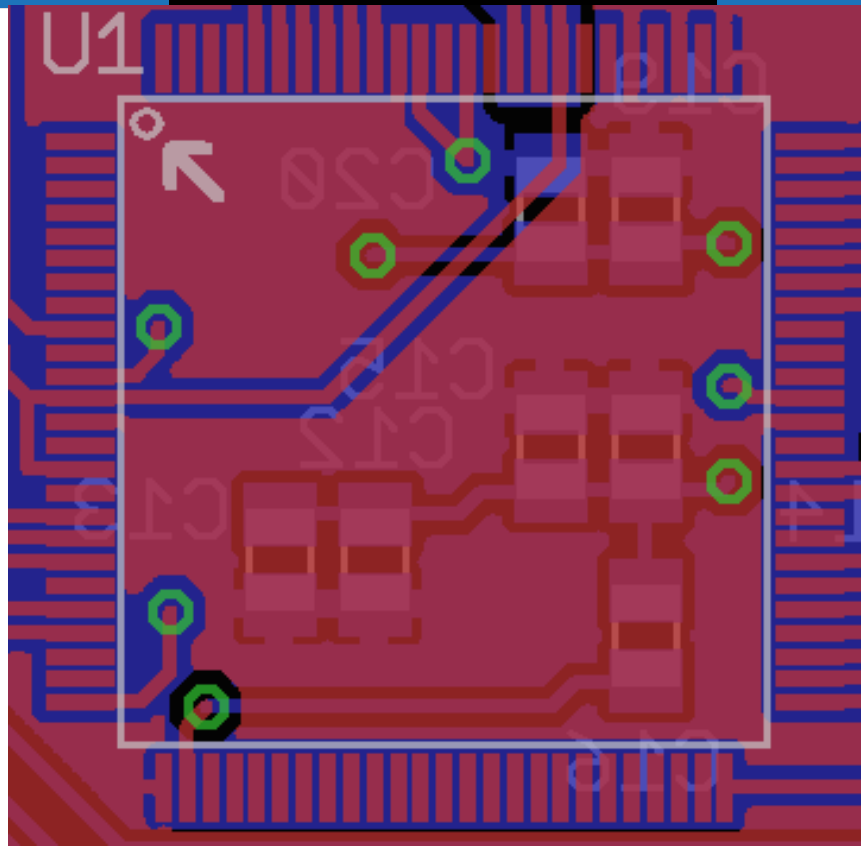
Switches include PU/PD resistors for safety



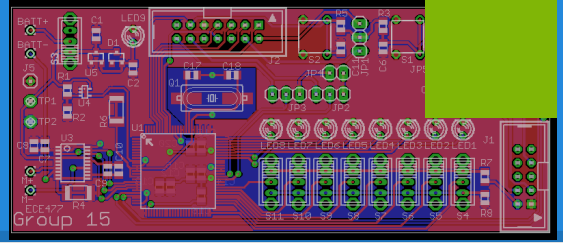
uC Layout



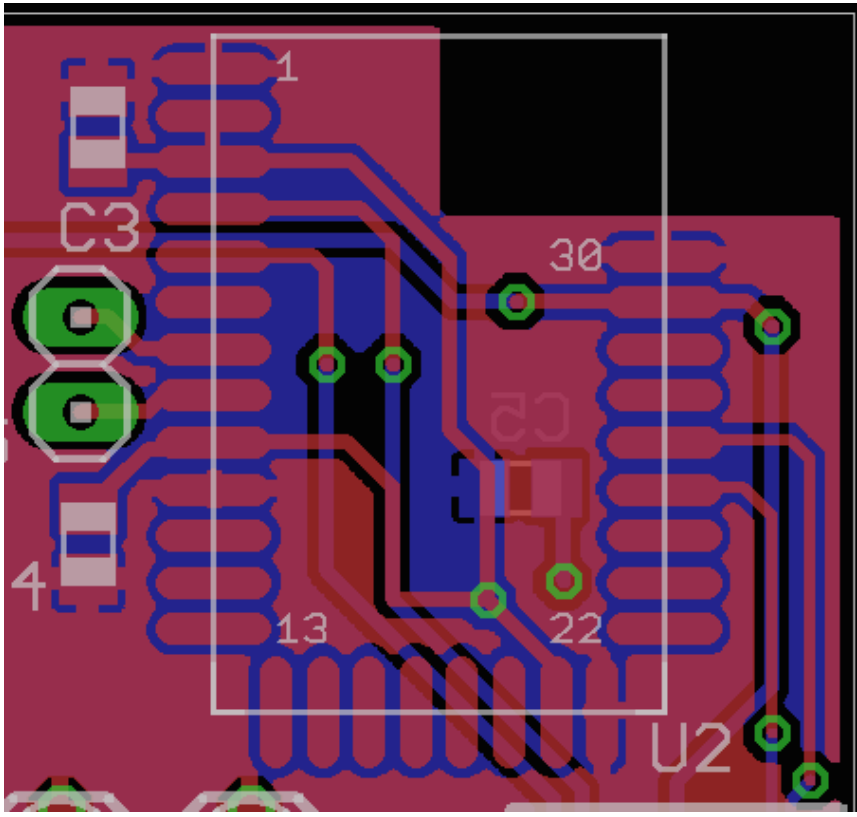
Decoupling caps on bottom layer



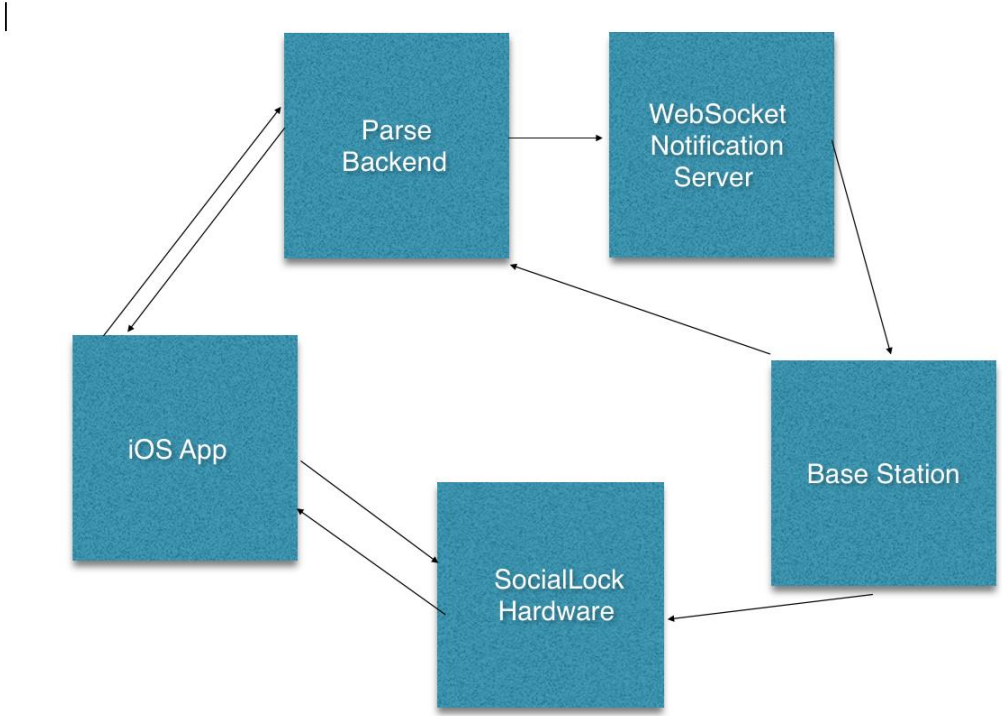
Bluetooth Layout

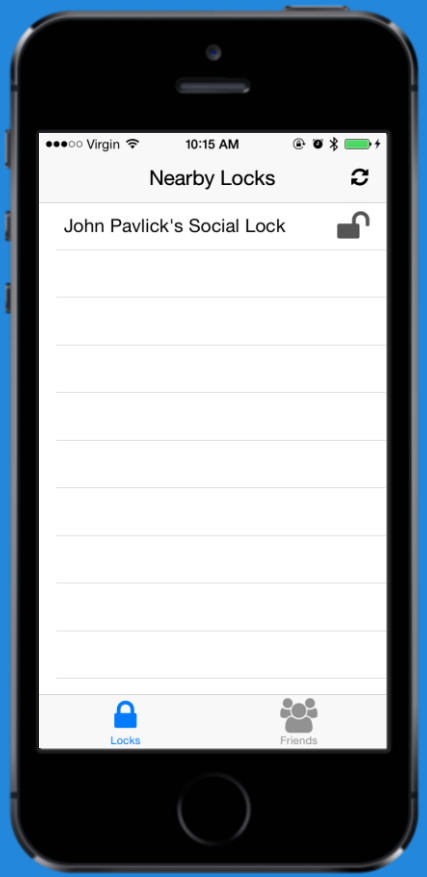


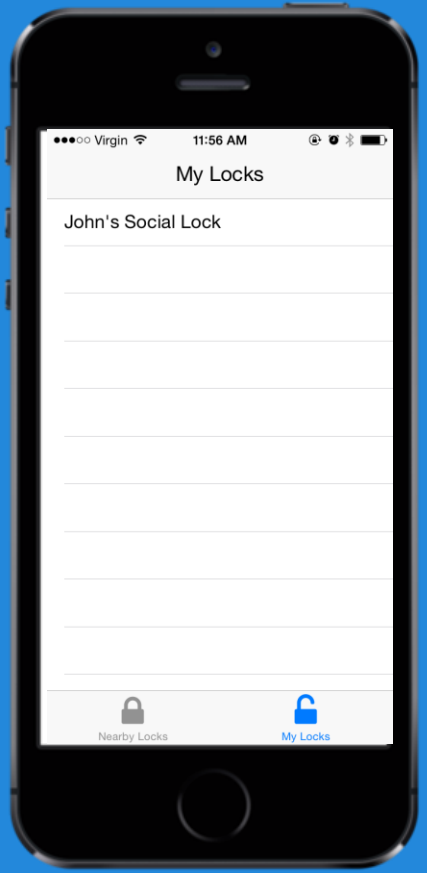
- Signal planes
  - restricted near antenna
- Chip near corner for minimal EMI
- Debug UART header

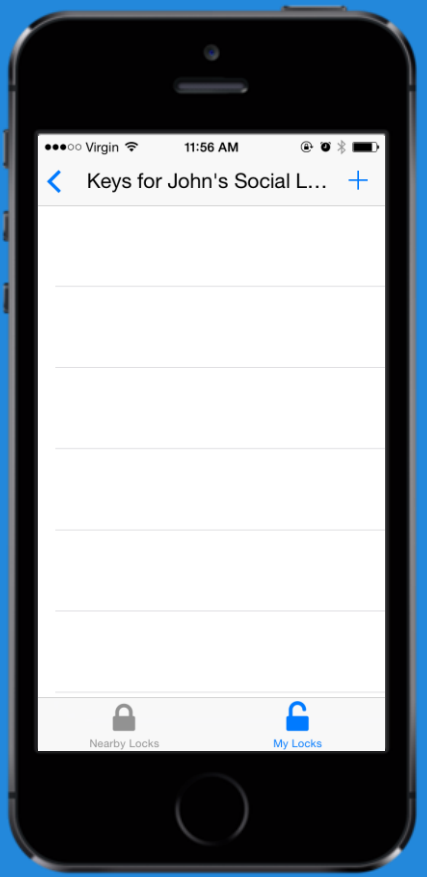


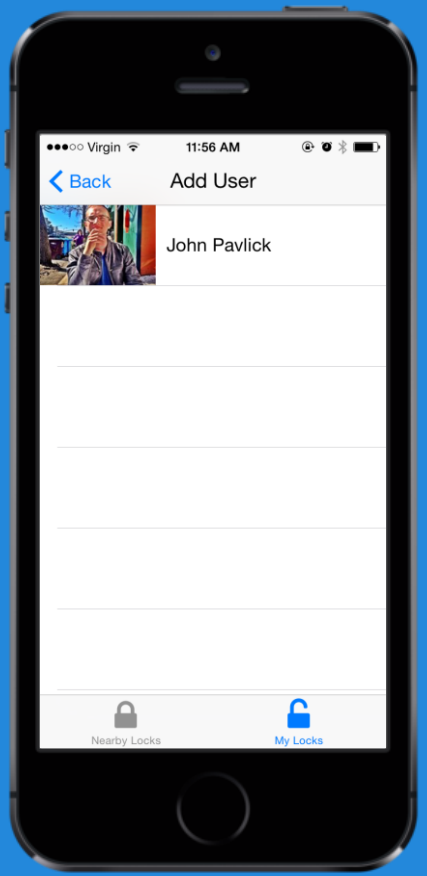
Software Structure and Status

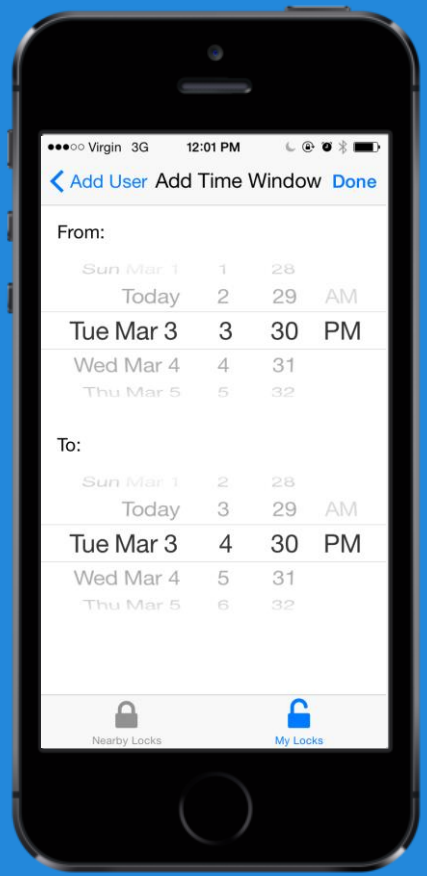


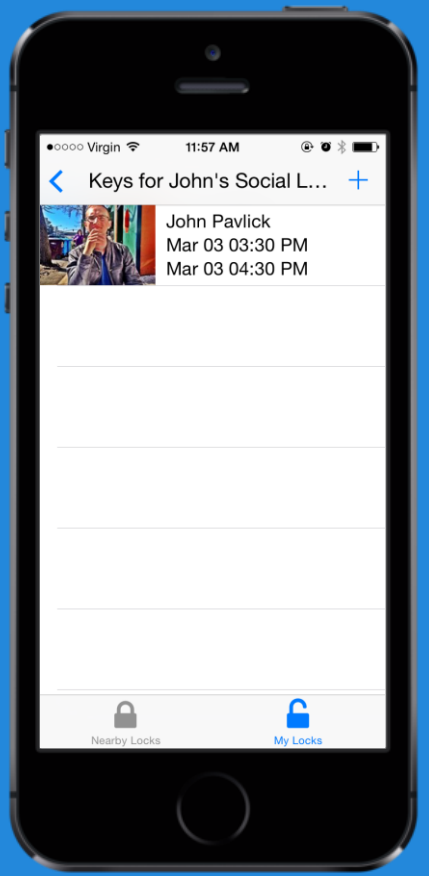

Virgin
10:15 AM
Nearby Locks
John Pavlick's Social Lock
Locks
Friends


Virgin
11:56 AM
My Locks
John's Social Lock
Nearby Locks
My Locks

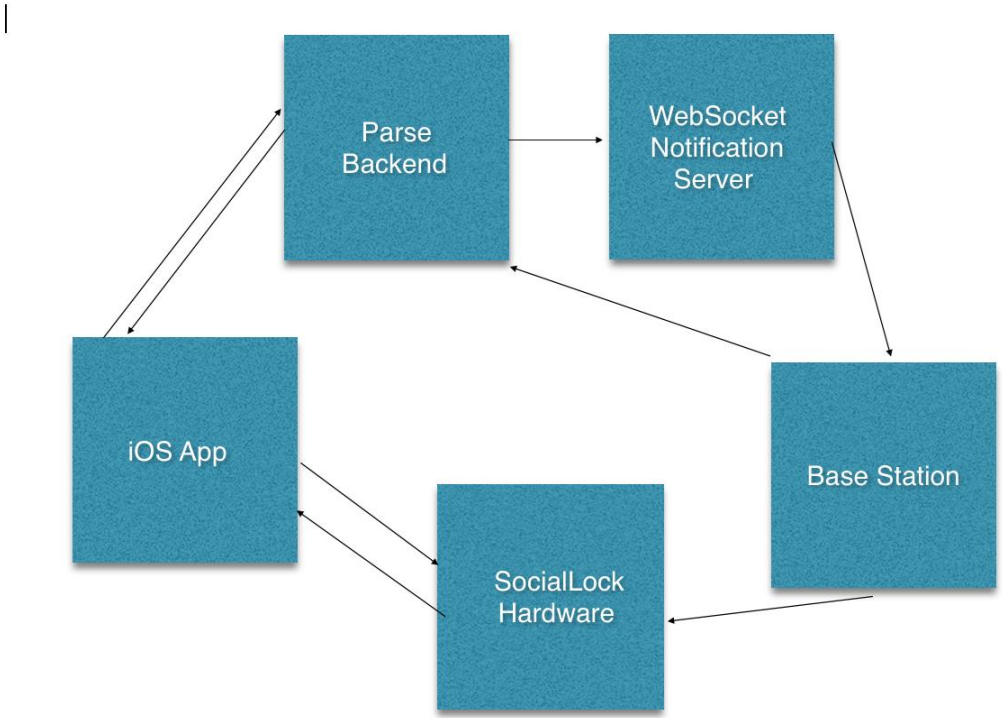

Virgin
11:56 AM
Keys for John's Social L...
Nearby Locks
My Locks


Virgin 11:56 AM
Back
Add User
John Pavlick
Nearby Locks
My Locks


Virgin 3G 12:01 PM
Add User
Add Time Window
Done
From:
Today 2 29 AM
Tue Mar 3 3 30 PM
Wed Mar 4 4 31
To:
Today 3 29 AM
Tue Mar 3 4 30 PM
Wed Mar 4 5 31
Nearby Locks
My Locks

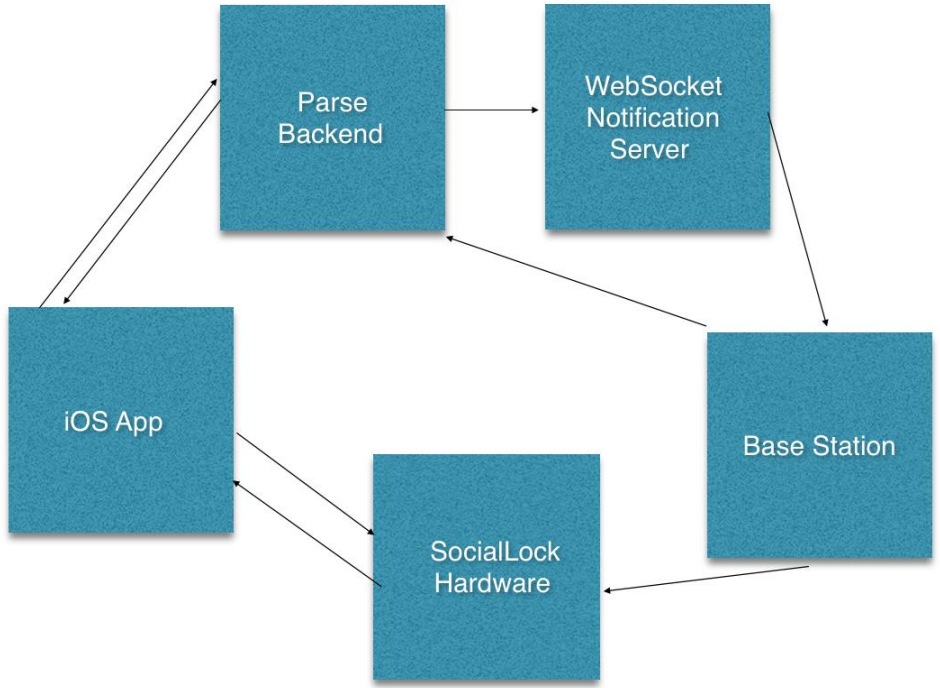

Virgin 11:57 AM
Keys for John's Social L...
John Pavlick
Mar 03 03:30 PM
Mar 03 04:30 PM
Nearby Locks
My Locks

Software Structure and Status

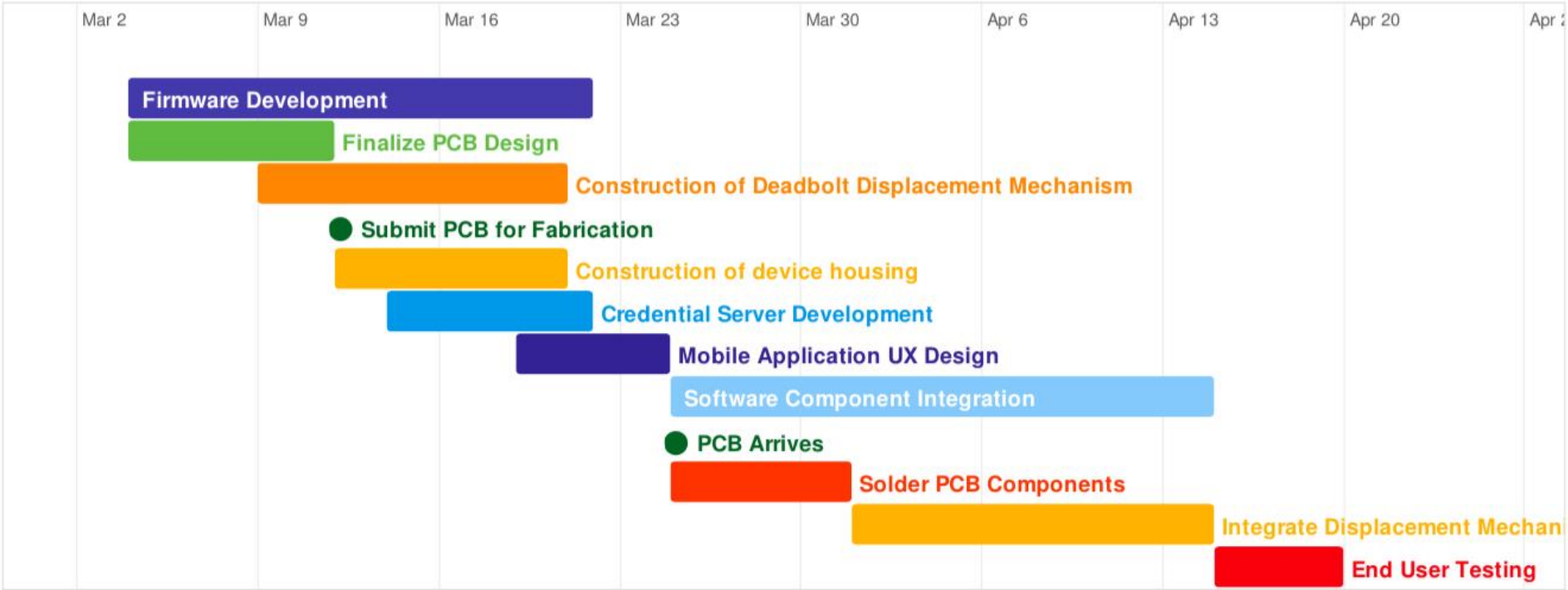


Software Structure and Status

- iOS App: Complete
- Parse Backend: Complete
- Base Station: Complete
- Bluetooth Chip: In Progress
- MSP430: In Progress



Project Completion Timeline



Questions?