

ECE 471 – Embedded Systems

Lecture 15

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Announcements

- Hand back midterm



SPI bus

- Serial Peripheral Interface Bus
- Synchronous full-duplex serial bus named/formalized by Motorola. No real standard.
- What does synchronous mean? (Separate clock line)
- What does full-duplex mean? (Transmit and receive at same time)



What used for?

- LCD displays
- Optional interface to SD cards
- LED strips
- JTAG



Hardware Setup

- Master/slave with multiple slave select lines
- 4-wire bus
- SCLK – serial clock (output from master)
- MOSI – master out, slave in
- MISO – master in, slave out
Must be high impedance if more than one slave



- CS0, CS1, etc – slave chip selects



SPI protocol

- Pulls chip-select of desired slave low
- Master starts clock
No set speed, just what the slave can handle.
Up to a few MHz
- Must both Send *and* receive (at same time over MISO/MOSI wires)
Doesn't have to be useful data, but must be done both ways



- Master transmits data bits as long as it has it. When done turns off clock and maybe deselected slave.



Clock Polarity/Phase

- Many have adopted Freescale's terminology
- CPOL=0 – base clock is zero
 - CPHA=0 – data captured on rising edge
 - CPHA=1 – data captured on falling edge
- CPOL=1 – base clock is one
 - CPHA=0 – data captured on falling edge
 - CPHA=1 – data captured on rising edge



- Also given as “mode” numbers, 0 - 3. CPOL/CPHA.
This can vary by manufacturer. Check your data sheet!



Connection

- “independent” – One slave per select line
- “daisy-chain” – MISO to MOSI, like long chain of shift registers, only need one SS line.



Interrupts

- Possible... think touch screens and such. Not officially specified



Errors

- No way to indicate errors
- Some chips will ignore if invalid data sent (wrong number of bits) some not



SPI advantages

- Full-duplex
- fast (no set speed limit)
- arbitrary message size in bits
- low power (no pullup resistors)
- Can be implemented with minimal hardware (just a 74HC495 shift register)



- no arbitration
- no unique ids
- unidirectional signals
- clock provided by master (no oscillator needed in slaves)



SPI disadvantages

- more pins (4 plus ground plus power plus one more each slave)
- short distances
- no flow control
- no error reporting
- no standard



SPI bus on Raspberry Pi

- SPI1 is on the header
- Pin 23 – SCLK
- Pin 19 – MOSI
- Pin 21 – MISO
- Pin 24 – CE0
- Pin 26 – CE1



- Unlike some boards, no nIRQ (SPI interrupt) pin

