Optimal Radio Wave Distance for Interstellar Communication

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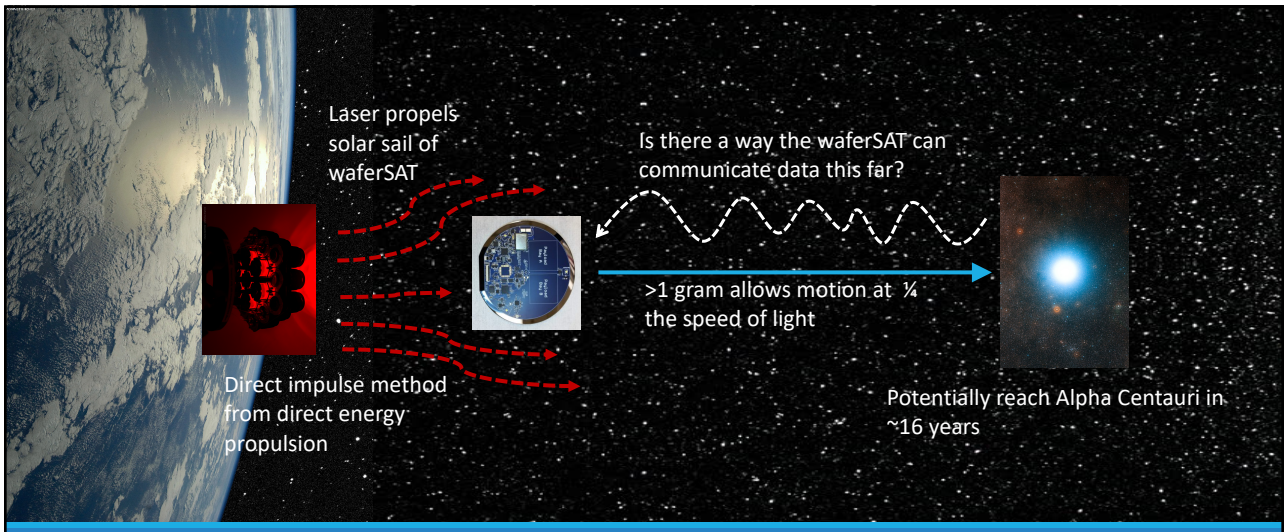
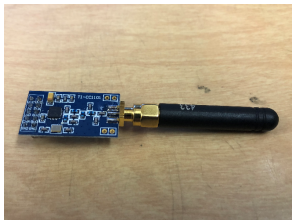


Picture: *Keck Institute for Space Studies*

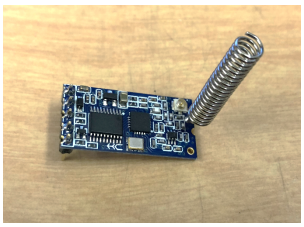
Near stars that will take millennia to travel…
can be reached within a decade and a half

Goal: Overcome Radio Frequency Constraints

1. Understand properties of RF to compare what radio is the "best"

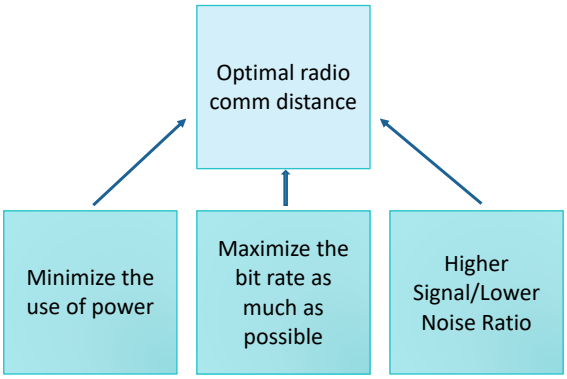


TI-CC1101 Transceiver Radio



SI-4464x Transceiver Radio

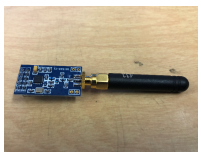
2. Test/modify radio to communicate at optimal distance



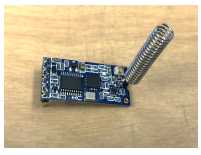
Phase one: How to Determine the "Best" Radio

Communication Protocols:

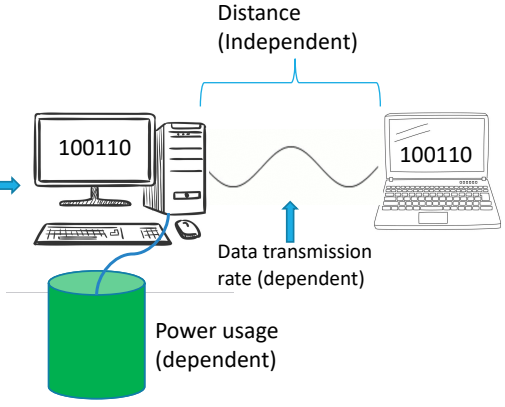
- Universal Asynchronous Receiver/Transmitter (UART)
- Serial Peripheral Interface (SPI)
- Inter-Integrated Circuit (I^2C)



TI-CC1101 Transceiver Radio



SI-4464x Transceiver Radio



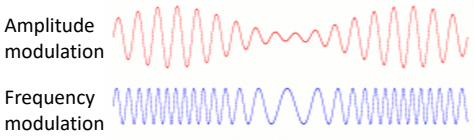
Phase two: Configure the radio's distance based on its bandwidth

Proportionality b/w bit rate and power to increase distance

Friis's free-space propagation:

- As signal is traveling from receiver to transmitter, energy from that signal is being lost over time.

Generating a higher signal to lower noise ratio

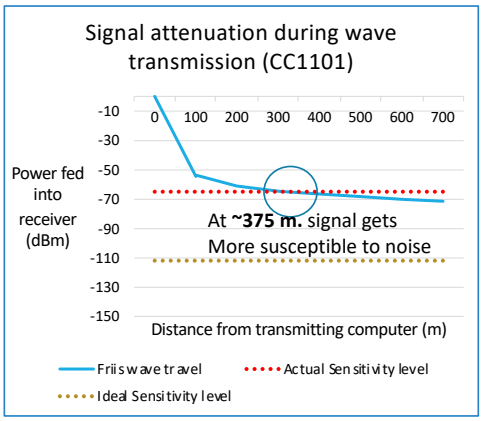


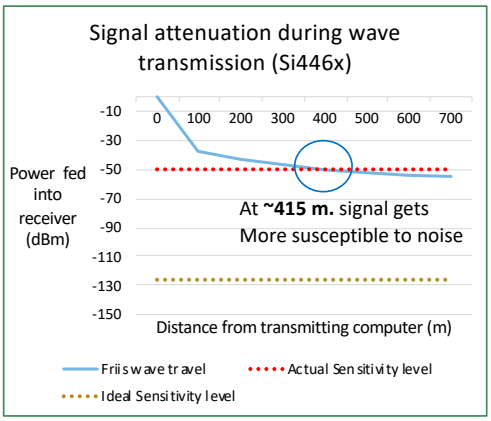
$$\frac{S}{N} = \frac{p_s\,(energy\ of\ signal)}{P_N(energy\ of\ noise)}$$

- There is an inverse relationship b/w wanted and interfering signal; **signal can be controlled, noise not so much**.
- Measuring in dB:

$$\frac{S}{N}(dB) = 10log\frac{p_s}{P_N}$$

Theoretical radio range calc. shows that Si446x can communicate farther than CC1101



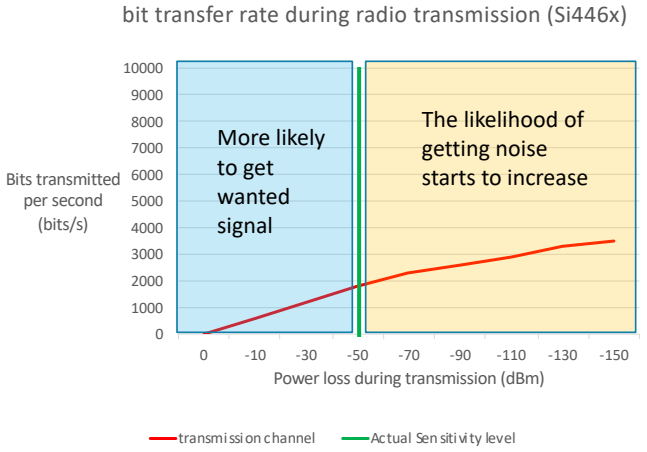


Type of noise that is physically Impossible to bypass:

-Thermal noise-

Limit at which electrons in radio become agitated, causing those Charges to interfere with signal

Minimizing the effects of noise to transmit as much wanted signal as possible



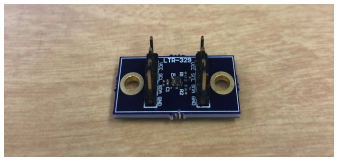
Calculated with radio transmitted through F.M.

Frequency Modulation is more resilient to noise compared to amplitude modulation, so in free space, it can communicate at longer distances.

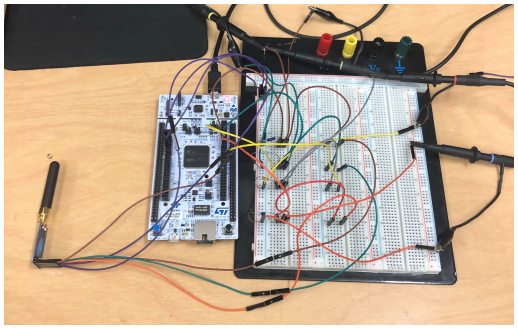
Testing slightly different variants of F.M.

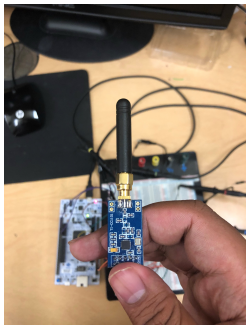
Current stage: testing CC1101 Radio to communicate with SPI

Learned how to program I2C Protocol…



Now learning how to communicate with SPI





ARM mbed

Three-step process toward radio communication development

PHYSICS

learned the theory of Radio wave propagation and the process of Radio frequency

→

PROGRAMMING

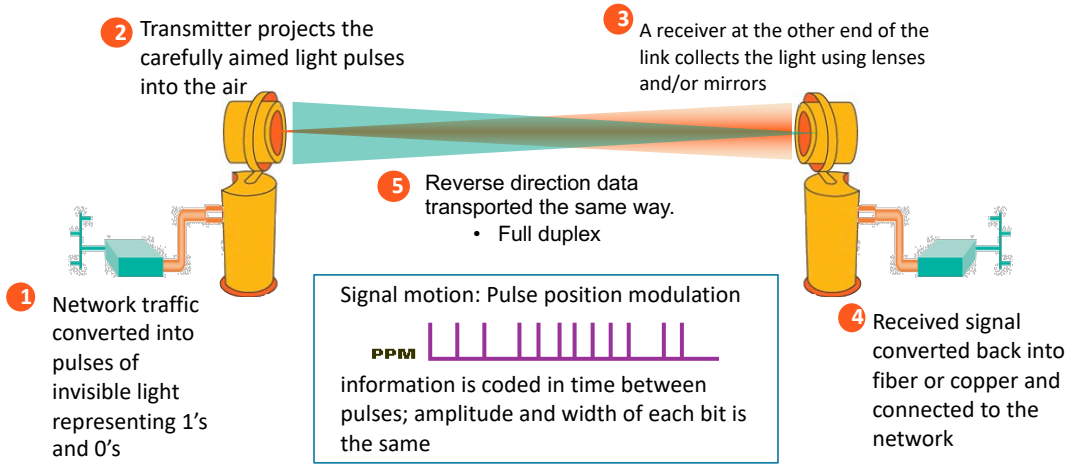
Learned how to program communication protocols and figuring adv. and disadv. of I^2C, SPI, and UART

→

TESTING

Analyzed the limitations of radio communication; balancing out high comm. Distance with little power use

Long-Term Goals: Communication using lasers



Model and numbered captions: *"Free Space Optics (FSO) Overview", John Schuster, Terabeam Corporation*

Acknowledgements

CSEP

EUREKA!

CNSI

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