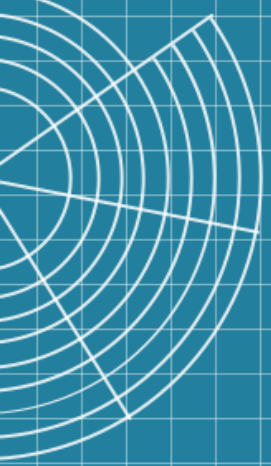
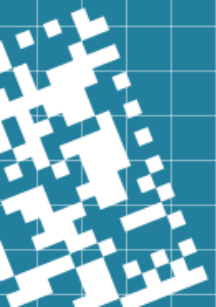
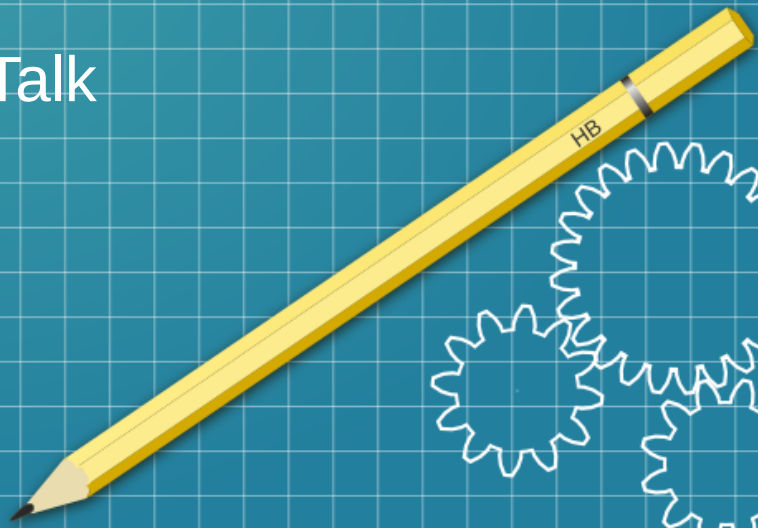
Build Your Own Internet from the Ground Up

Part 1: How Computers Talk

James Arcus



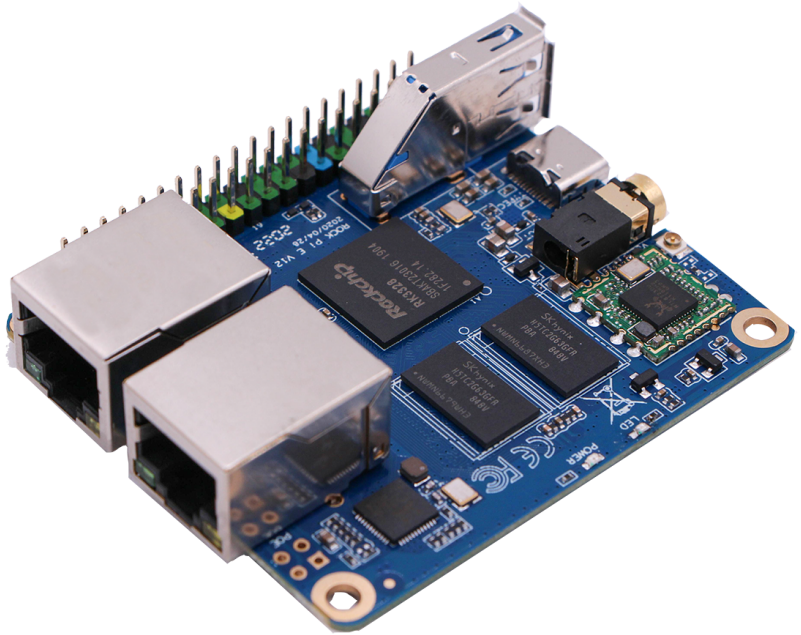




Introduction

- Today’s workshop:
  - Basic Linux setup
  - Origins of computer communication
  - Demo: Serial connection between two computers
  - Overview of Ethernet
  - Demo: Inspecting Ethernet frames
- Helpful knowledge: Basic Linux command line usage
- Many tutorials: https://ubuntu.com/tutorials/command-line-for-beginners is but one
- Don’t worry too much

(This is Where I Wanted You to) Meet the Boards



- Model: Rock Pi E
- Think Raspberry Pi, but less powerful
- But has 2x Ethernet ports
- No HDMI/video though, so command line only

Never Mind, They Showed Up

- This afternoon!
- No chance to actually set them up, though...

Initial Setup

- Basic system image has been created for you
  - Debian Linux, VM running in the UCC VM cluster
- For now, we'll start with a single machine
  - We are imagining we're "pre-internet" after all
  - I'll demonstrate some initial setup
  - Then, you can SSH to demo@130.95.13.172
    - from the UCC network
  - You can each set up an account, and then use that

Demo: E-mail

- Let’s send each other some email, the old fashioned way

Computer Communication

- Before computers, were the TeleTYpewriters (in the 1800's!)
- Needed a way to encode characters as an electrical signal, and not get mangled
- Settled on asynchronous communication due to hardware limitations
- RS-232 standard codified in 1960
- Pretty soon, was co-opted by computer manufacturers
  - First for communication to TTYs and modems, but soon used for computer-to-computer connections as well

Serial Communication

- TL;DR: Each character is sent with a start bit (0), the 8 bits that make it up, and then an end bit (1)
  - Sending can happen at any time
- Ben Eater's video on RS-232 is great if you want to know more: https://www.youtube.com/watch?v=AHYNxpqKqwo
- The Arduinos use +5 and 0 volts instead of +12 and -12 volts, pretty much the same otherwise
- Let's see it in action!

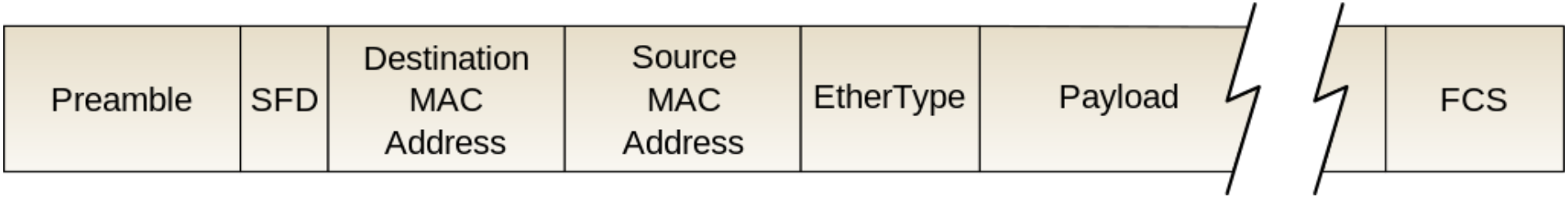
Demo: Things Over Serial

- Sending text backwards and forwards
- Logging in to one system from a serial terminal
- Next time (with the Rock Pis) if people are interested: network over serial using PPP

- Serial is slow and only really good for point-to-point links
  - What comes next?
  - De-confliction, and addressing
- Several technologies come and go for both WAN and LAN networks
  - Ethernet wins on the LAN
  - More and more, Ethernet wins on the WAN as well
- What does Ethernet do?

Demo: Capturing Ethernet Frames

- I could tell you about what Ethernet carries, but why not show you?
- Let’s go over to Wireshark...



Wrap Up & Questions

- Hopefully not too much of an info dump
- Next time, we'll play with the actual hardware
- Hands on with the IP protocol, addressing and routing
- Will be more practical
- Questions?

This work is licensed under a Creative Commons Attribution-ShareAlike 3.0 Unported License.
It makes use of the works of Mateus Machado Luna.