CS120 Project Tutorial

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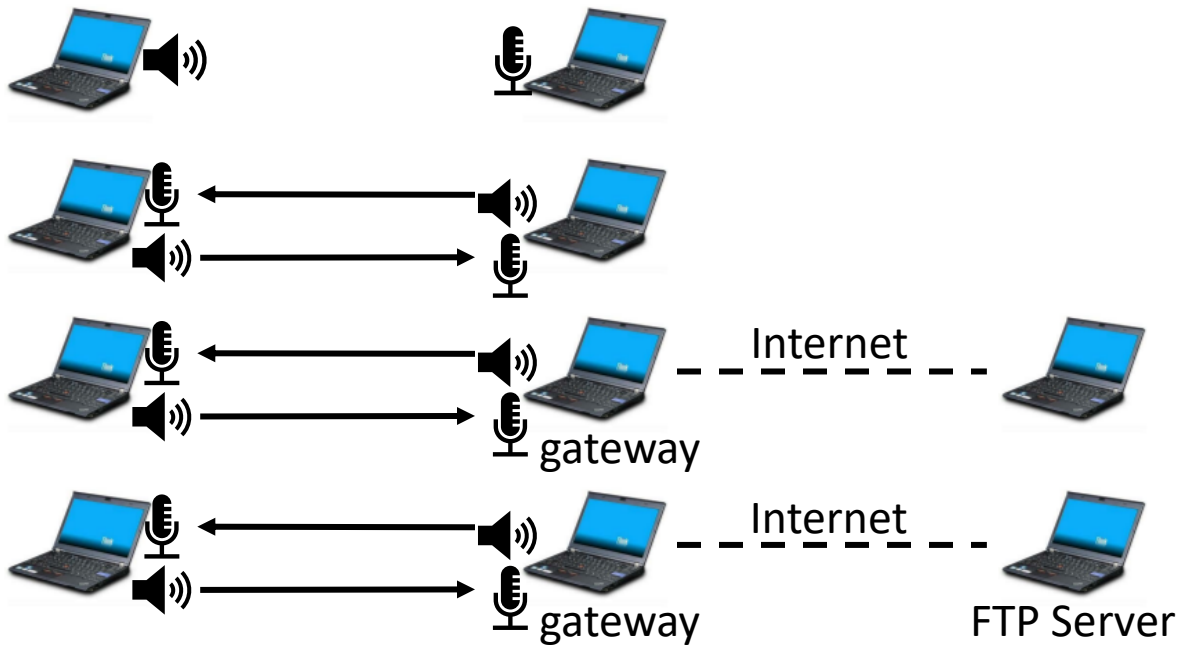
Overview

- Build an acoustic toy computer network(Athernet). Each layer is built upon the former layer.

- Project 1: Physical Layer
- Project 2: MAC Layer
- Project 3: TCP/IP Layer
- Project 4: Application Layer

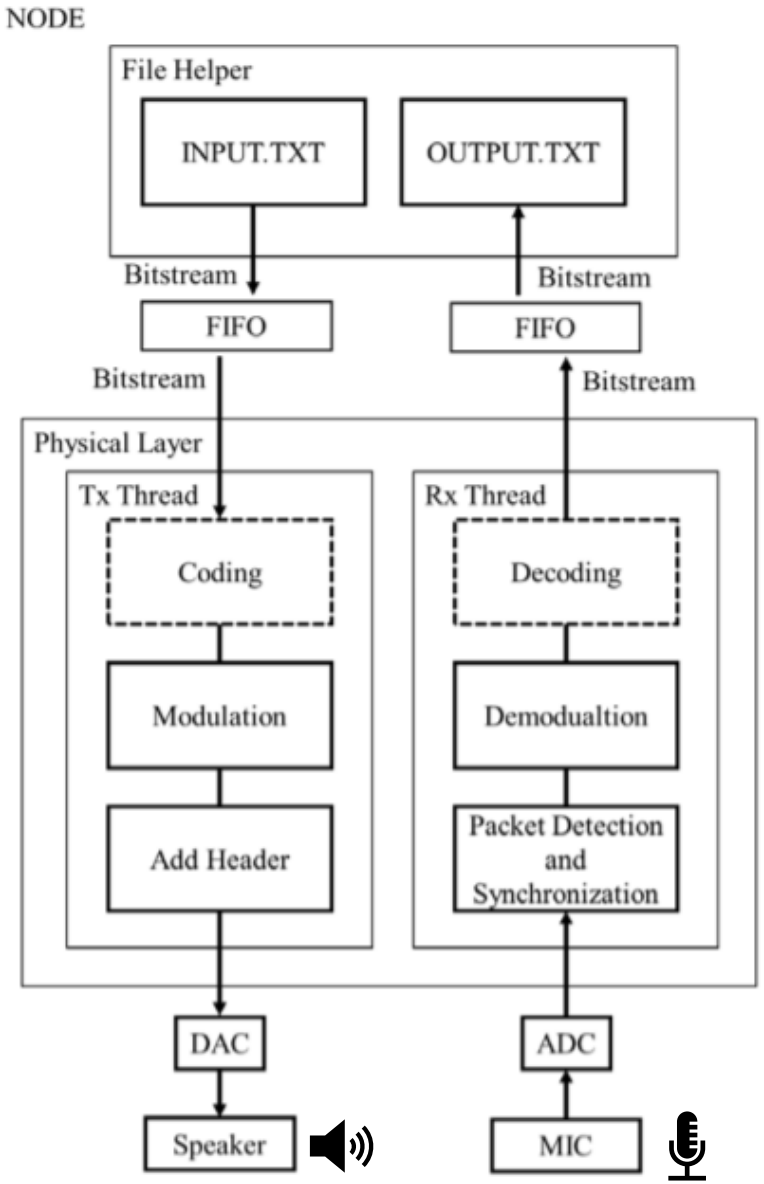


Project 1 Acoustic Link

- Project 1 is the basis of ATNet, parameters in project 1 are very important when you are facing some magic problems.
- Tools
  - JUCE & Projucer (C++):

    get rid of some annoying work (e.g. multi-thread for speaker and mic)
  - Windows OS:

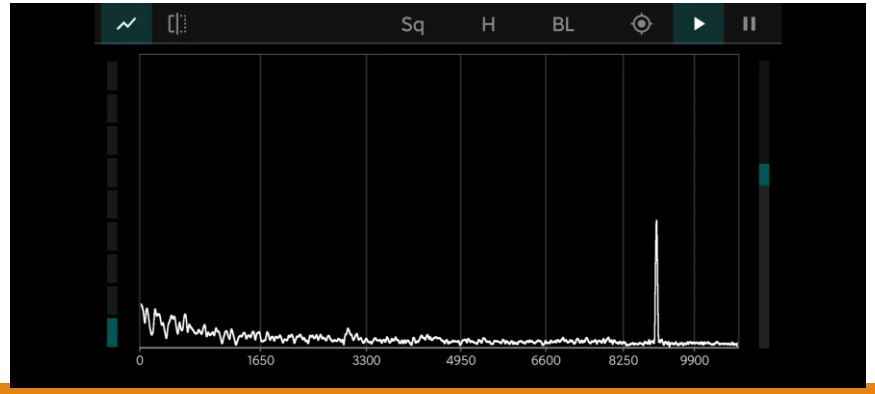
    sound card may give bad performance in MacOS
  - You can also use other languages (e.g. Python and Java).



Play with the Sound Card

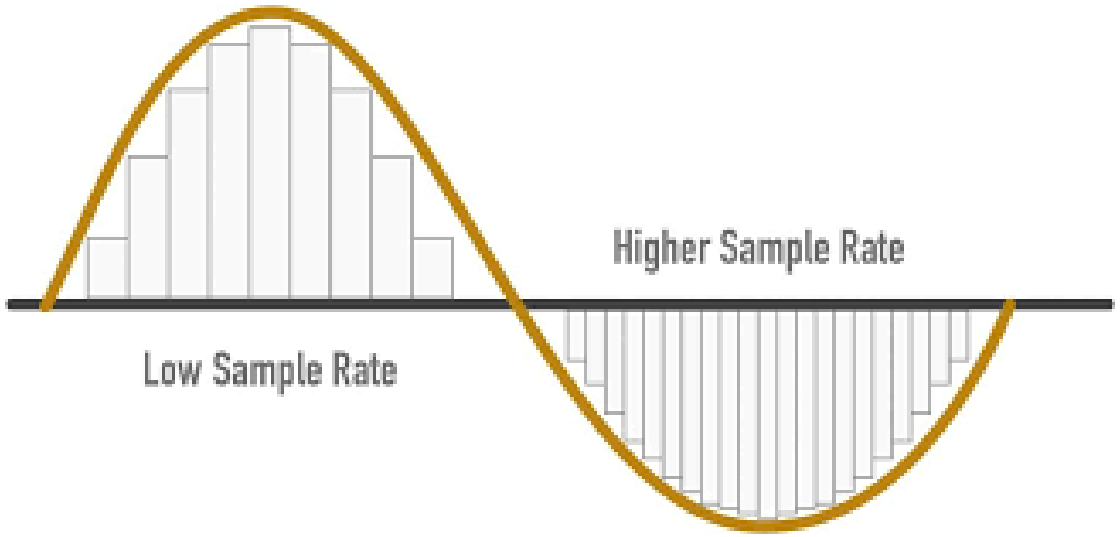
- Recommended Tools for Windows
  (https://github.com/SIST1C407/ATNet/blob/main/doc/01_win_asio_juce)
  - Microsoft Visual Studio
  - ASIO Driver and SDK
  - JUCE Library and Projucer
- Sample Player

  (https://github.com/SIST1C407/ATNet/tree/main/doc/02_write_a_player)
- Useful Apps



Basic signal knowledge

- ADC: takes in a continuous analog signal and converts it into a discrete digital signal by sampling
- Sample rate: number of samples of signal per second
- Common: 8k, 44.1k, 48k



Basic signal knowledge

- Bit depth: quantization fineness of the signal

  Common bit depth: 16

- Channel: number of output channels from a DAC, can be mono (1channel) or stereo (2 channels)

- Frequency Offset: Devices usually use a single oscillator to derive clocks for sampling and modulation. But the oscillators in the transmitter and receiver do not run at the exact same frequency.

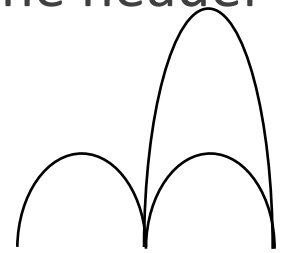
Modulation and Demodulation

- Modulation
  - the transmission of a signal by using it to vary a carrier wave
  - Use carrier wave to represent 0 and 1
  - Check Lec 3 for more details
- Demodulation
  - Use correlation
    - Sample 0 * carrier wave > 0
    - Sample 1 * carrier wave < 0 (PSK)
    - But the threshold may not be 0

Header and frame detection

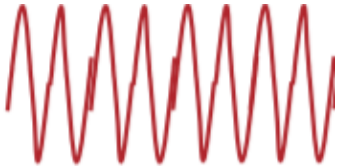
- Header
  - Help receiver to find out the accurate start of a frame.
  - Just add a predefined wave pattern before your data.
  - Select a signal with good autocorrelation.

- Frame detection and synchronization
  - When receiving enough samples, do correlation between header and received samples to determine whether there is something transmitting.
  - Once the occurrence of a new frame is confirmed, synchronize the header and find the start of the frame.



Summary

File ⇄ (code / decode) 010100101 ⇄ (modulate / demodulate)



add header ⇄ (synchronize)

⟷ sound

Practical issue

- Find a balance between transfer rate and accuracy(>99%).
  - A higher rate leads to a lower accuracy, and vice versa

- Each frame contains a header, the longer the frame is, the shorter the total length is, the less time you use.
  - Speaker needs time to warm up, do not use short header

Project 1 Check

- Deadline: Oct.16 afternoon
- Each group has around 10 minutes, show your checkpoints to TAs and gain corresponding points.
- After check, submit your code to Blackboard on the spot. You can only submit once.
- I'll send the time arrangement before deadline to you.