

# SimHack 2024

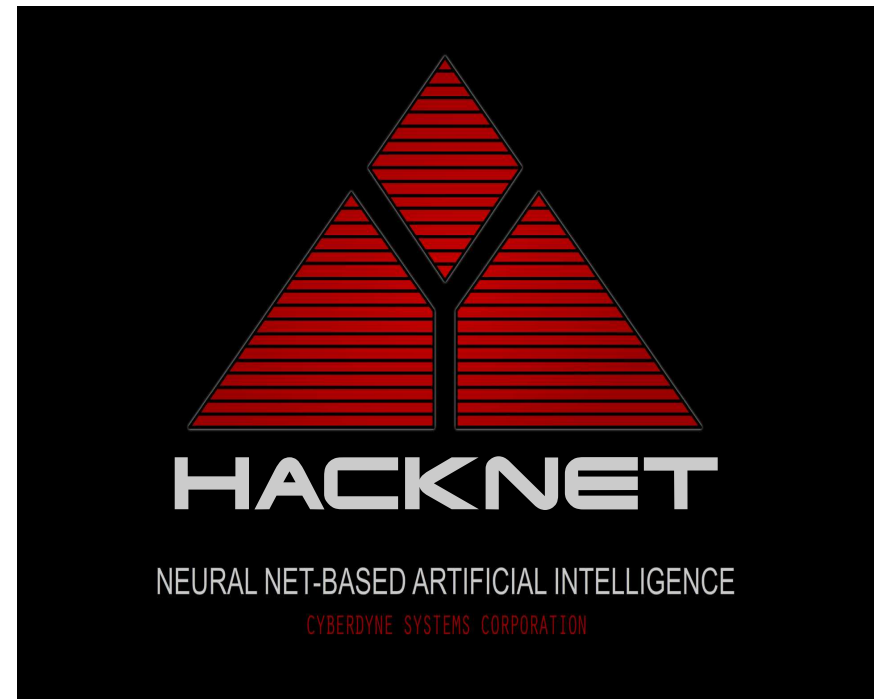
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(he/him/his – ally)



**CAL POLY**

# The Future is Now

## Space Based Internet Service



# The Goal

- Your goal is to model, simulate and present results for connecting people on the ground to each other with a space-based internet link. Think of StarLink as an example ([https://en.wikipedia.org/wiki/StarlinkLinks to an external site](https://en.wikipedia.org/wiki/StarlinkLinks_to_an_external_site)). We will call this system, **HackNet**. The goals of HackLink are to maximize the total number of users on the system, and the total amount of data flowing through the system.

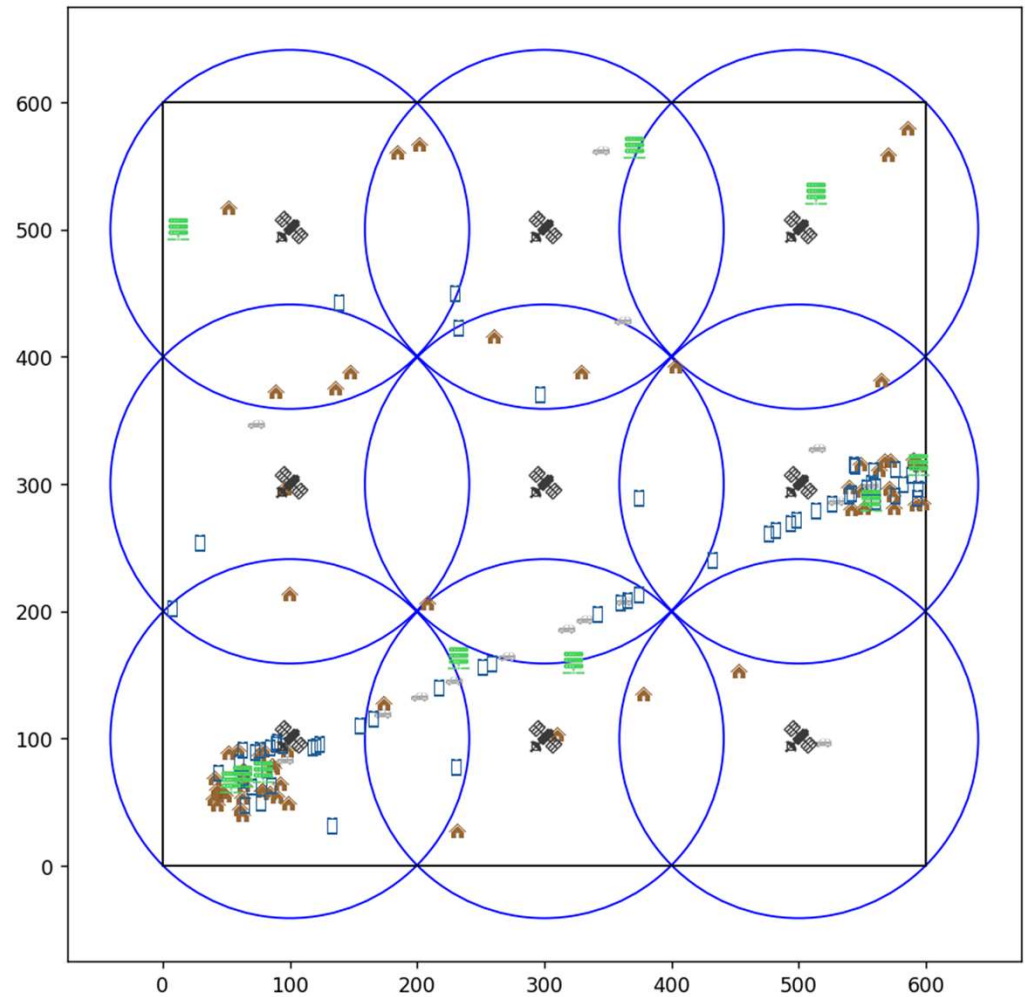
# Assumptions

## The World

For the purposes of the SimHack we will make some simplifying assumptions. They are:

1. The world is flat. All users and servers are located on a grid which is defined below. The world is 600 units by 600 units.
2. The space-based communication relays are flying around at a constant altitude with a constant velocity. The relays fly at an altitude of 100 units
3. When communication relays reach the edge of the world, they reappear on the opposite edge of the world with the same velocity.

# Initial State



# Assumptions

## Model Elements

Assumptions regarding the HackNet system relays and users are:

1. All parts of HackNet are known as Resources. There are five types of resources, Relays, Severs, Houses, Cars, and Phones. More detail on each is below.
2. Data transmitted and received between resources comes in four colors, Orange, Green, Blue, Yellow.
3. Each color represents a channel. Each channel can only be used to transmit or receive. Channels cannot transmit and receive simultaneously. However, data can be received from multiple users at once on the same channel, as well as transmitted to multiple users on the same channel. The Tx/Rx Rate represent total channel capacity of each Resource in HackNet.
4. Relays can handle three colors of data, all other resources can handle two.

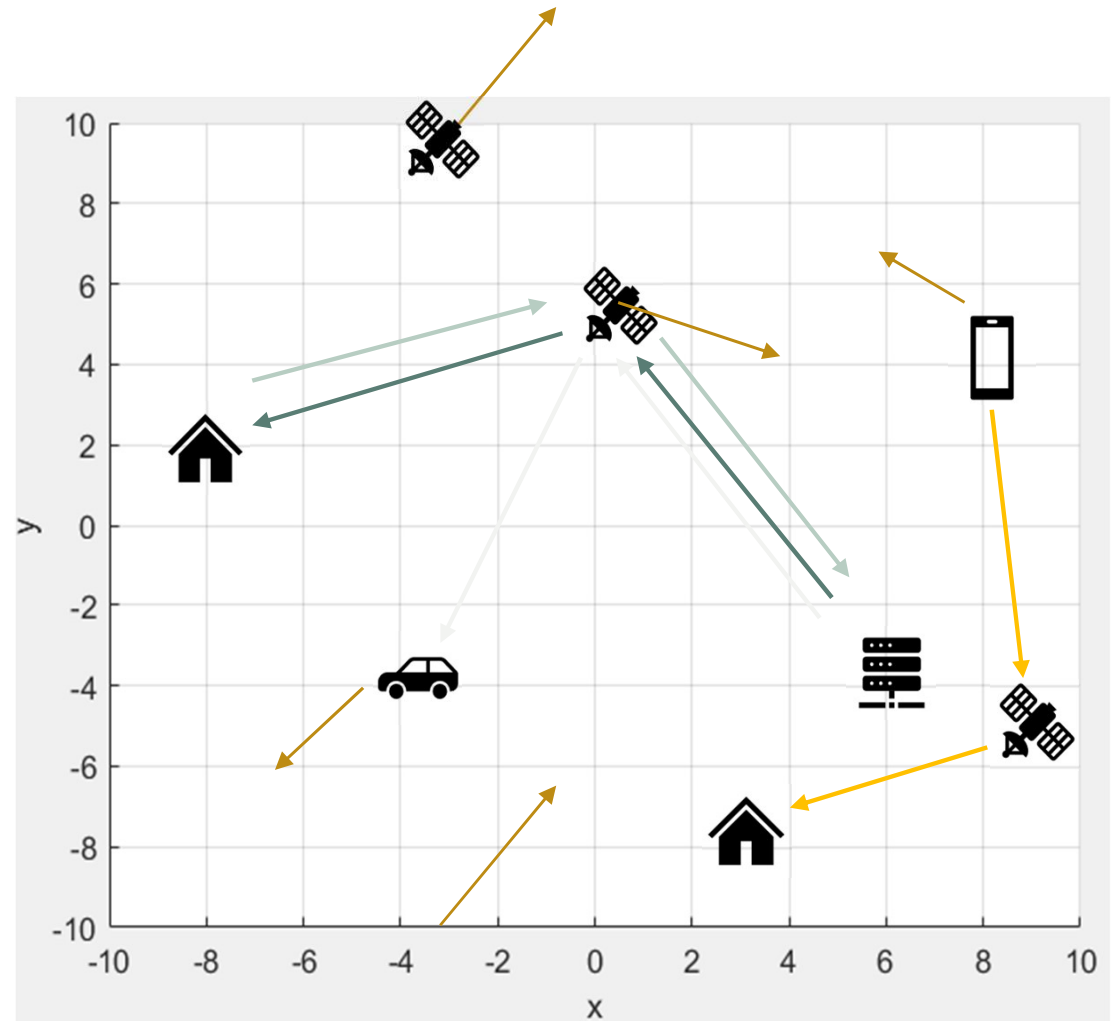
# Assumptions

## Model Elements

Assumptions regarding the HackNet system relays and users are:

5. A Relay can only establish a link with another resource when the distance between the Relay and the resource is less than 225 units. There are two exceptions, a Relay and a Server can establish a link when they are 400 units apart and any Relay can establish a link with an adjacent Relay and those links can be chained together. Due to our world wrapping assumptions, that means all Relays are adjacent to each other.
6. See the table below with additional Resource Descriptions:
7. The initial set-up for all Resources is generated with the following code: [https://github.com/emehiel/SimHack\\_2024.git](https://github.com/emehiel/SimHack_2024.git). Links to an external site.
8. Each Resource has a 'connection' attribute which establishes the connection between two Resources. For those resources to communicate, they must transmit and receive through one or

# Model Elements





# Model Element Details

| Resource Type | Tx/Rx Connections                                    | Tx/Rx Rates (units/sec)   | Velocity (units/sec) | # Data Colors |
|---------------|--|---|----------------------|---------------|
| Relay         | Any  | Tx Rate 200<br>Rx Rate 100                                      | [10, 10, 0]          | 3 - at Random |
| Home          | Tx - Server, Phone<br>Rx - Server, Phone             | Tx Rate - 1<br>Rx Rates - [1, 2, 5] at Random                   | [0, 0, 0]            | 2 - at Random |
| Car           | Rx - Server  | Tx Rate - 0<br>Rx Rates - [.25, .5, 1] at Random                | [5, 5, 0] max        | 2 - at Random |
| Phone         | Tx - Server, Phone, Home<br>Rx - Server, Phone, Home | Tx Rates - [.5, 1] at Random<br>Rx Rates - [.5, 1, 2] at Random | [2, 2, 0] max        | 2 - at Random |
| Server        | Any  | Tx Rate - 100<br>Rx Rate - 30                                   | [0, 0, 0]            | 2 - at Random |

# Let's go SimHack

## Project scope and timeline:

- Given the information above, and for a single instant in time, develop a simulation to maximize:
  - The total number of users on the system
  - The total amount of data flowing through the system
  - Extra Credit - Evolve the system in time and re-solve the problem, i.e., solve for the maximum usage of HackNet as the Resources move around.
- You will have 2hr 15min to complete the project
- All teams should produce:
  - Simulation Code
  - Description of your algorithms, system and assumptions
  - Any visualizations you developed
  - A short 2-3 minute max presentation on the above
- Once all teams have presented, we will vote as a class for the coolest solution.