Hacking the Solar System Internet

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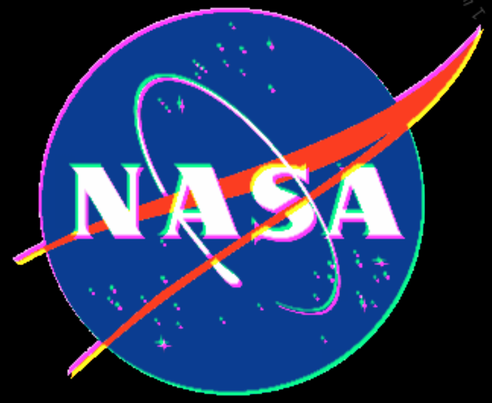
My NASA Internship Experience



INTRODUCTION

- From West Fargo, ND
- Junior at Valley City State University
  - Majoring in Software Engineering
  - Minoring in Computer Science
- Graduate of SANS Technology Institute
  - Undergraduate Certificate in Cybersecurity
  - Awarded full scholarship via Cyber FastTrack Competition

NASA INTERNSHIP

- I interned virtually at NASA Goddard Space Flight Center
  - Summer and Fall of 2020
- Part of Space Communications and Navigation (SCaN)
  - Program office responsible for all of NASA’S space communication activities
- My fall internship was funded by the North Dakota Space Grant Consortium

INTERNSHIP HIRING PROCESS

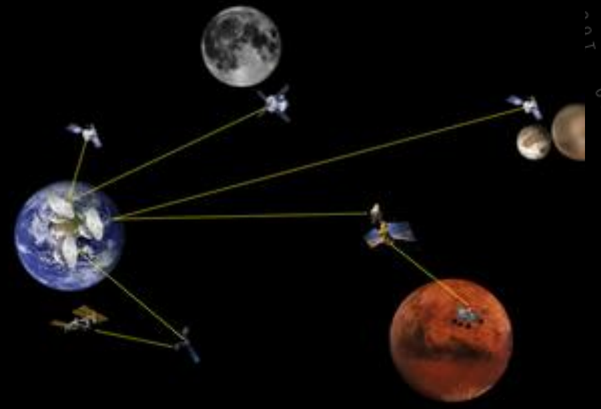
1. First apply at intern.nasa.gov
2. I was contacted about a month before the start of my internship to schedule a video interview
3. I interviewed with my prospective mentor and his supervisor

   I was asked about:

   - Past experiences
   - Situational and behavioral questions
   - Why I want to intern with NASA
4. Received an offer letter a week after my interview

My mentor later told me I caught his attention because of my cybersecurity scholarship

BACKGROUND ON MY PROJECT

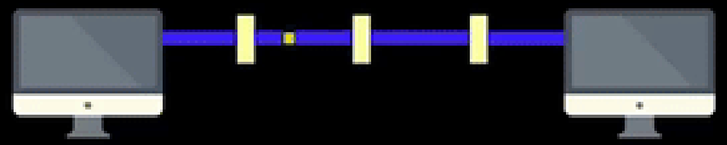


- NASA SCaN operates 3 networks
  - Near Earth Network
  - Space Network
  - Deep Space Network
- Despite having “network” in the name, they operate more like a two-way radio than the internet
  - They have no routing capability - only directed and relayed communication
- NASA is currently developing internet like capabilities for space called the Solar System Internet
  - Using Delay/Disruption Tolerant Networking (DTN)

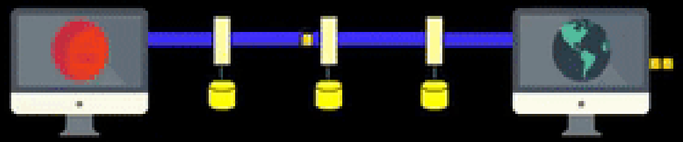
DELAY/DISRUPTION TOLERANT NETWORKING

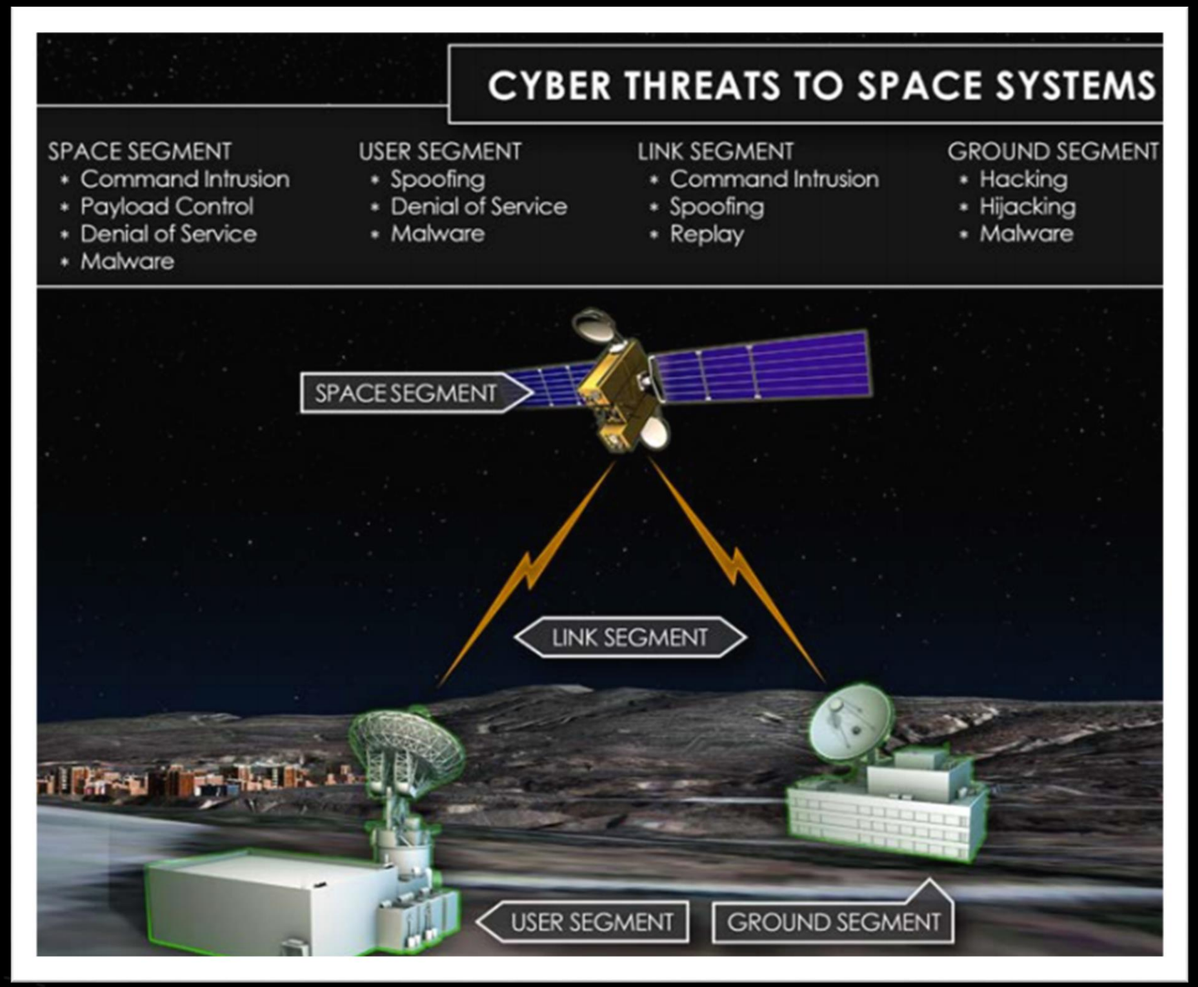
- DTN is a protocol suite designed for environments where there may be long delays and high error rates
  - Space communication often experiences
    - Large delays
    - Environmental interference
    - Limited communication periods (ex. orbiting satellite)
- Terrestrial internet (TCP/IP) does not work in those environments
- DTN uses a “store-and-forward” mechanism to ensure data delivery
- Experiments have been done on the ISS
- First mission to use DTN will be NASA’s PACE satellite in 2023
- Expected to be used on LunaNet for Artemis program

TCP/IP



DTN



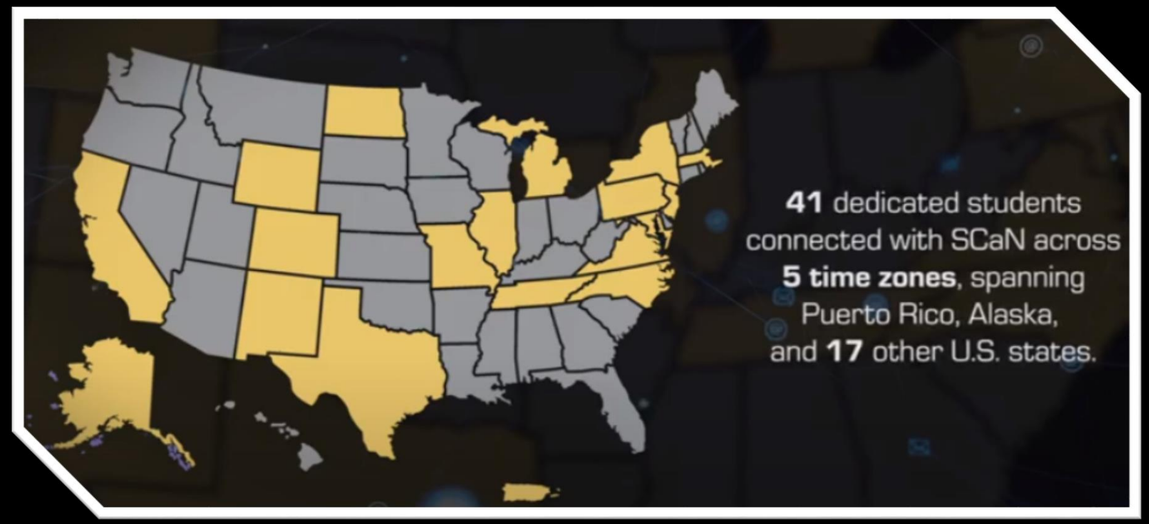


MY PROJECT

- My project was to secure DTN network protocols by hacking into them
  - Summer project was focused on spoofing
  - Fall project I built a packet crafting tool
- Most of my time I worked independently with advising from my mentor
- I occasionally met with other engineers and researchers from
  - NASA
  - Johns Hopkins Applied Physics Laboratory
  - MITRE Corporation

MY EXPERIENCES

- There were about 40 other SCaN interns at Goddard during the summer
  - Very diverse group
- I worked more closely with 5 other DTN interns
- Despite the virtual environment, we participated in a variety of events, seminars and socials
- Some notable events include:
  - DTN conference where I met Vint Cerf (one of the inventors of the internet)
  - Presentations from NASA leadership
  - Mission controller simulation
  - Bomb defusing game
  - Amateur radio club
  - Project presentation



MY EXPERIENCES CONT.

- Due to security being a high priority I had some unique privileges
  - I had regular meetings with a NASA HQ security deputy program manager
  - I was chosen along with a small group of other interns to present exclusively to HQ leadership
    - Opportunity to distinguish myself
  - SCaN leadership asked me to intern part time during the fall
    - NDSGC generously provided my stipend

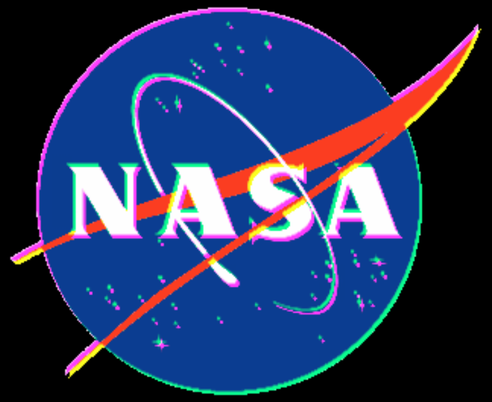
CHALLENGES AND LESSONS LEARNED

- Improved technical skills
  - Many technical challenges involved in hacking esoteric DTN network protocols
    - How to effectively read technical documents and specifications
- Improved interpersonal skills
  - Communicating in a professional manner in the digital domain
  - Convey complex technical ideas to other engineers
- Improved presentation skills
  - Learned how to convey my research to both technical and non-technical audiences
  - Learned how to present security concerns while not jeopardizing project

FUTURE

- I am expecting to graduate from VCSU in 2022
- I currently am a Red Team Researcher for Synack
  - Get to hack into government organizations and companies and get paid for it
- Future career plan is to work in the cybersecurity industry
- My NASA internship has been invaluable to my professional and personal life
  - Made many connections with NASA engineers and interns

Thank you!
I will take any questions



Additional resources:

- https://www.nasa.gov/feature/Goddard/2020/nasa-interns-extending-internetworking-off-world
- https://www.nasa.gov/directorates/heo/scan/communications/outreach/internships
- https://www.nasa.gov/directorates/heo/scan/engineering/technology/disruption_tolerant_networking