Spacecraft-Control-Center Training and Testing Environment (STaTE)

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Introduction

Jesse S.

Scrum Master & Full Stack

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Back-end/Front-end Developer

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Front-end Developer

Jeff C.

Back-end Developer

Kyle G.

Full Stack Developer

Jeremy M.

Back-end Developer

A. Summer

Back-end/Database Developer

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01

Product vision

Product Vision

"STaTE will serve as a simulated learning platform for use in the training and testing of students in the Space Flight Operations degree program."

Target Student Outcomes:

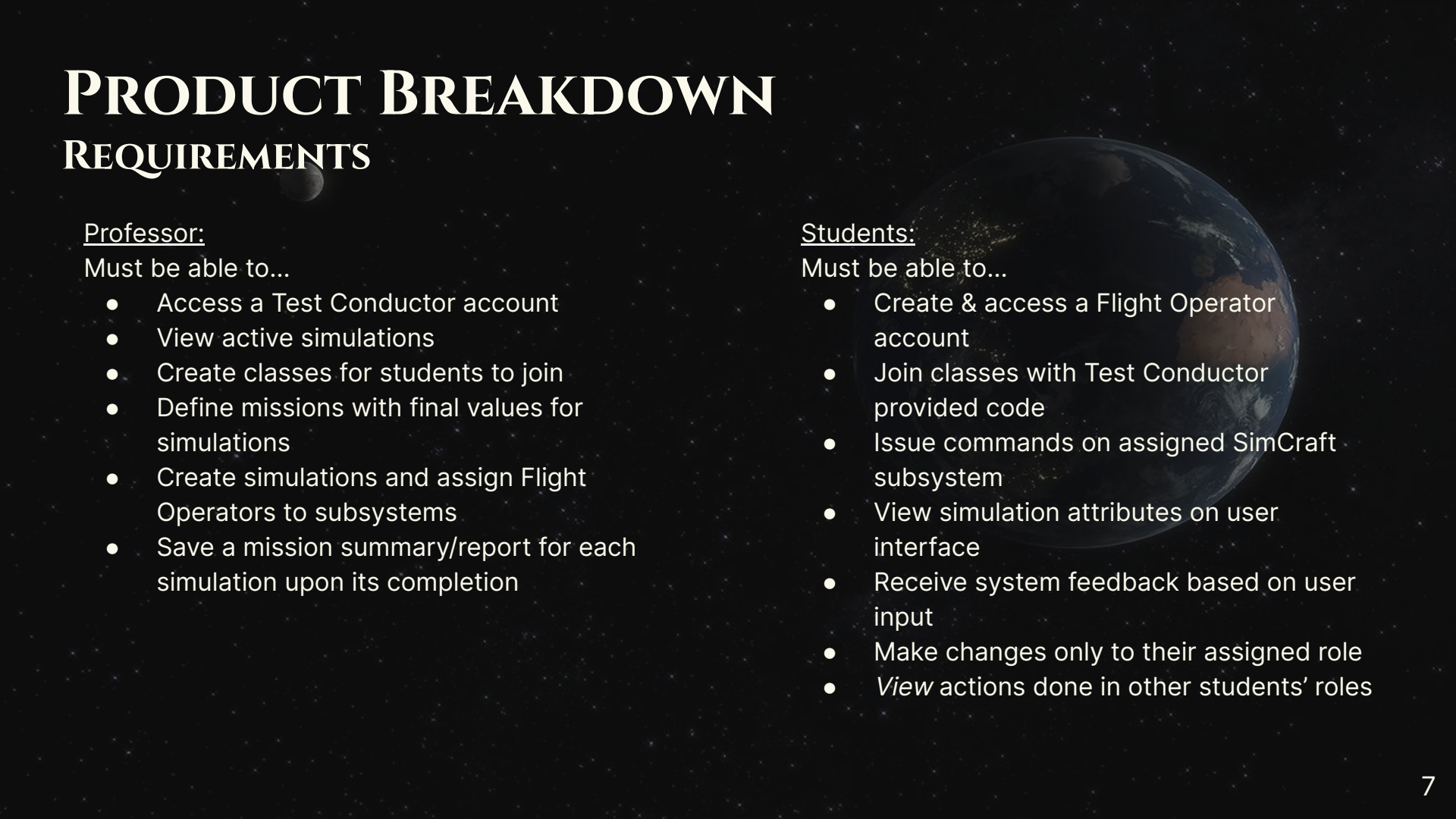
- Understand more about spacecraft control consoles
- Improve troubleshooting skills by properly addressing spacecraft management situations and anomalies in real-time
- Gain broader experience by performing several different roles and responsibilities
- Work as a team of students to operate a simulated spacecraft (SimCraft) and complete an assigned mission objective

02

Product Breakdown

Product Breakdown

Requirements



Professor:

Must be able to...

- Access a Test Conductor account
- View active simulations
- Create classes for students to join
- Define missions with final values for simulations
- Create simulations and assign Flight Operators to subsystems
- Save a mission summary/report for each simulation upon its completion

Students:

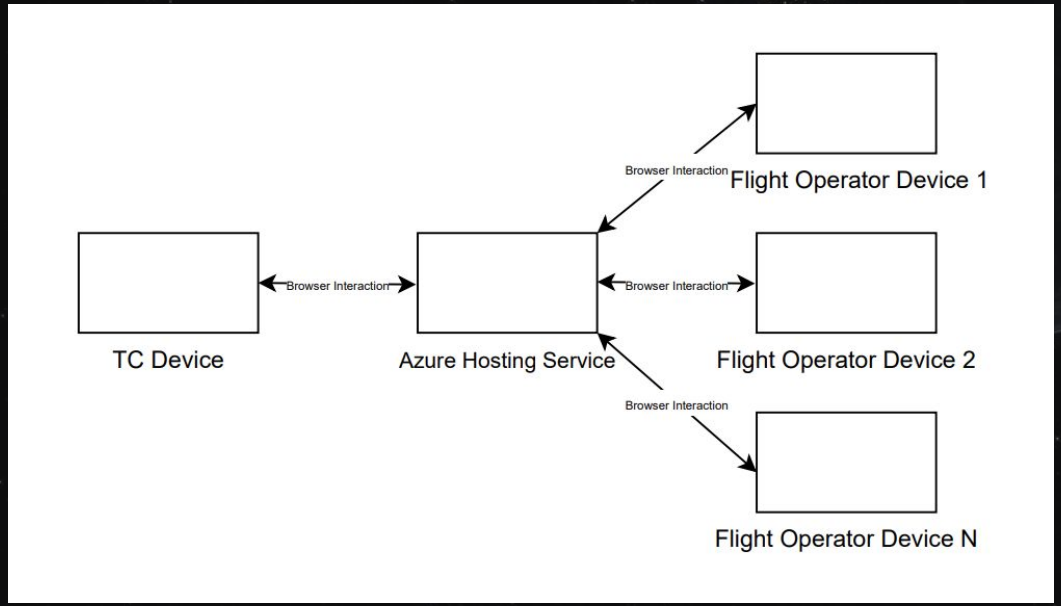
Must be able to...

- Create & access a Flight Operator account
- Join classes with Test Conductor provided code
- Issue commands on assigned SimCraft subsystem
- View simulation attributes on user interface
- Receive system feedback based on user input
- Make changes only to their assigned role
- *View* actions done in other students' roles

Product Breakdown

System Architecture

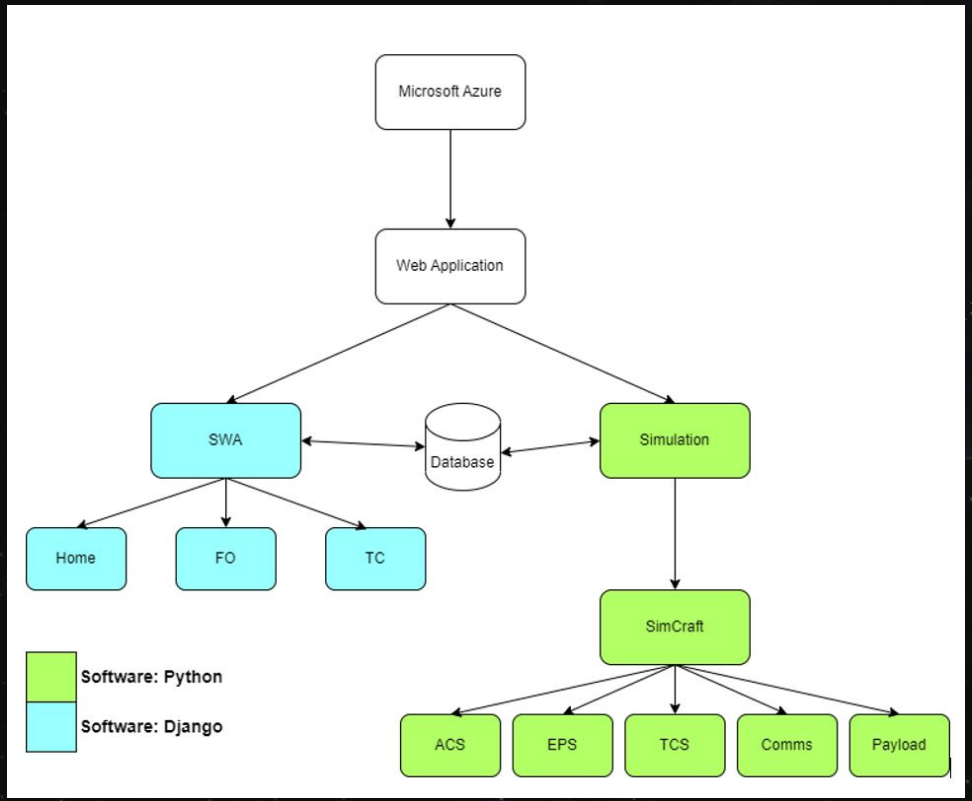
Hardware:



Product Breakdown

System Architecture

Software:



Product Breakdown

Implementation

Framework:

- Django serves as the framework for the STaTE Web Application

Back-End:

- Manages database
- Defines SimCraft
- Hosts active simulations as independent threads

Front-End:

- Serves user web pages
- Collects Test Conductor inputs
- Collects Flight Operator inputs

Product Breakdown

Mission Objective

"A SimCraft is orbiting Earth in LEO. At a certain timestamp, the SimCraft will be overtop ERAU. Students must stabilize and reposition the SimCraft by the time it reaches a target longitude to snap a clean photo of ERAU."

If a SimCraft is stable at target longitude and photo is captured...

- Simulation ends
- Test Conductor receives report of inputted commands by assigned Flight Operators

If SimCraft is unstable at target longitude and photo is unable to be captured...

- Simulation continues, students must wait until SimCraft reaches target longitude to capture image and complete mission

What does this mean?

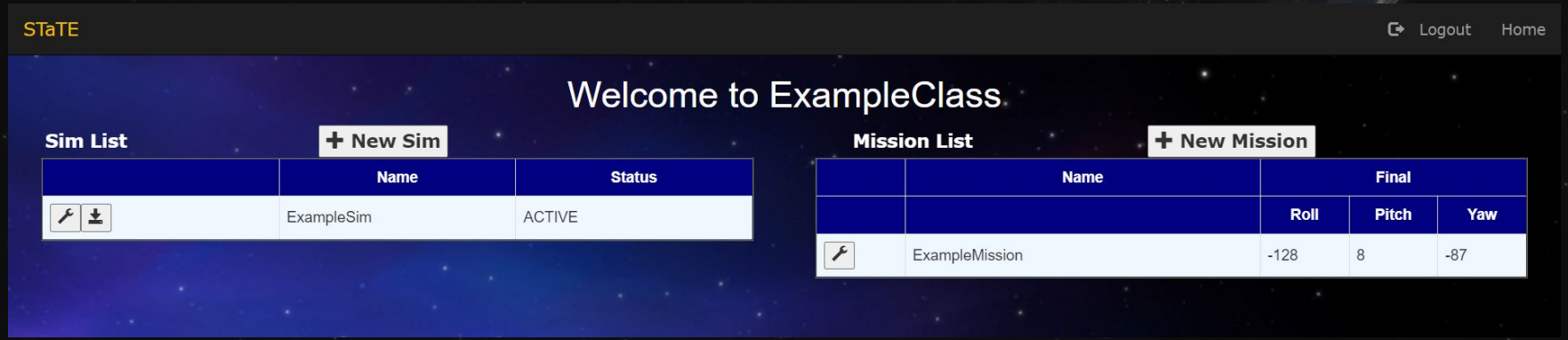
Mission completion can range from minutes to days!

Product Breakdown

Test Conductor Interfaces

Test Conductor

- Defines SimCraft final target state
- Creates new types of simulation combinations
- Assigns roles/subsystems to Flight Operators in a sim
- Creates & edits classes
- Creates a new simulation
- Creates a new mission
- Views active simulations

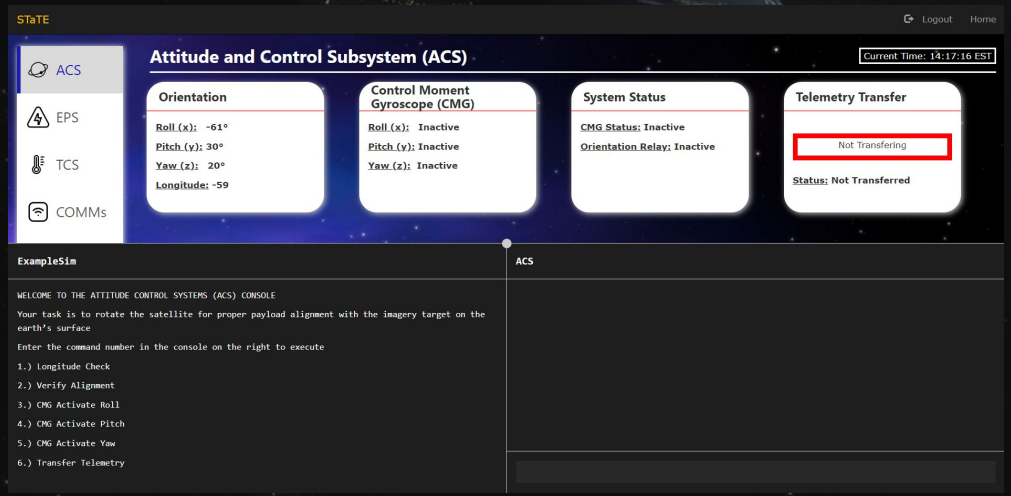


Product Breakdown

Attitude and Control Subsystem (ACS)

Flight Operator (ACS)

- Tracks SimCraft orientation and longitude
- Checks for valid Roll/Pitch/Yaw values
- Initiate Control Moment Gyroscopes to adjust Roll/Pitch/Yaw
- Initiates telemetry transfer from ACS to COMMs subsystem
- Must ensure that ACS subsystem is stable to be able to complete mission

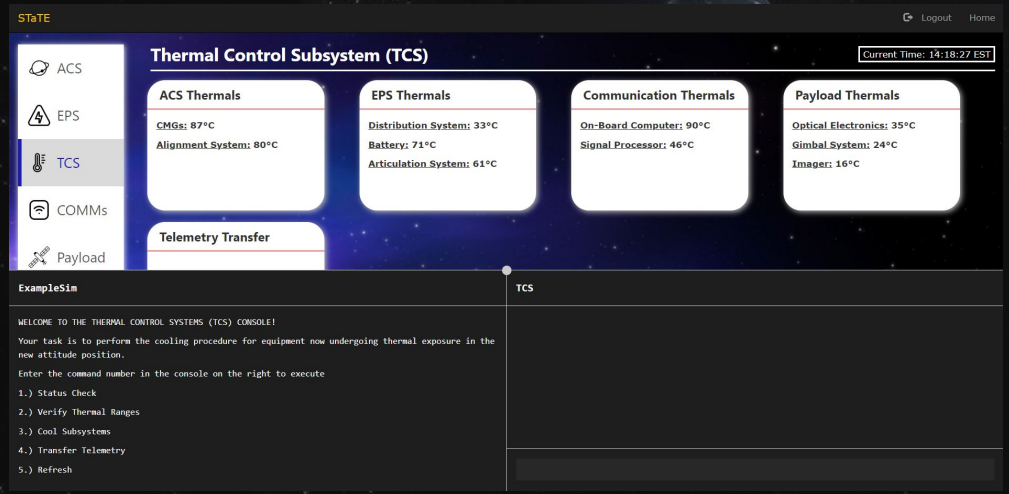


Product Breakdown

Thermal Control Subsystem (TCS)

Flight Operator (TCS)

- Ensures TCS heating elements are within range, internal bus connection is reached, and TCS telemetry signal is reached
- Ensures that all components across the SimCraft remain in thermal range
- Initiates cooling components of every subsystem if needed
- Initiates telemetry transfer from TCS to COMMs subsystem
- Must ensure that TCS subsystem is stable to be able to complete mission

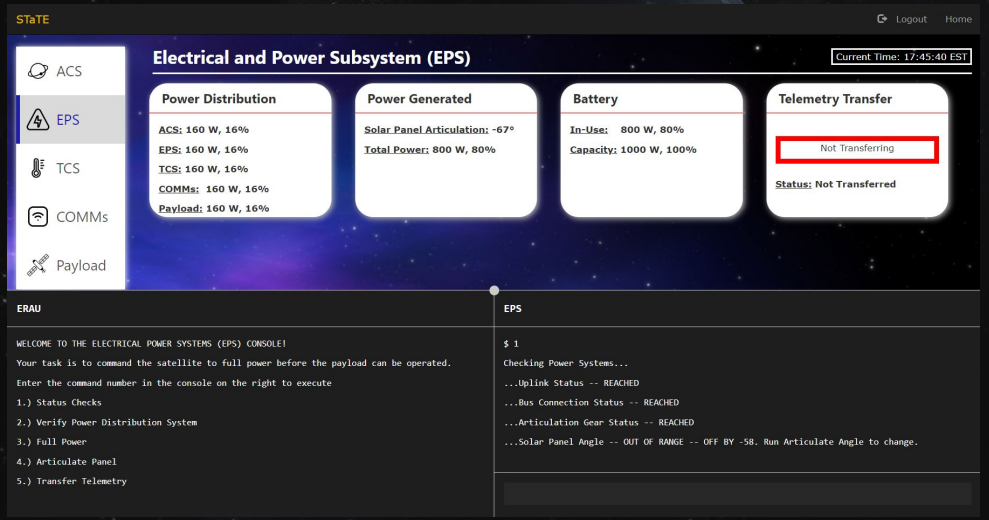


Product Breakdown

Electrical and Power Subsystem (EPS)

Flight Operator (EPS)

- Tracks power distribution to each subsystem
- Ensures full power is reached for mission completion
- Tracks & stabilizes the solar panel angle for power consumption
- Initiates telemetry transfer from EPS to COMMs subsystem
- Must ensure that EPS subsystem is stable to be able to complete mission

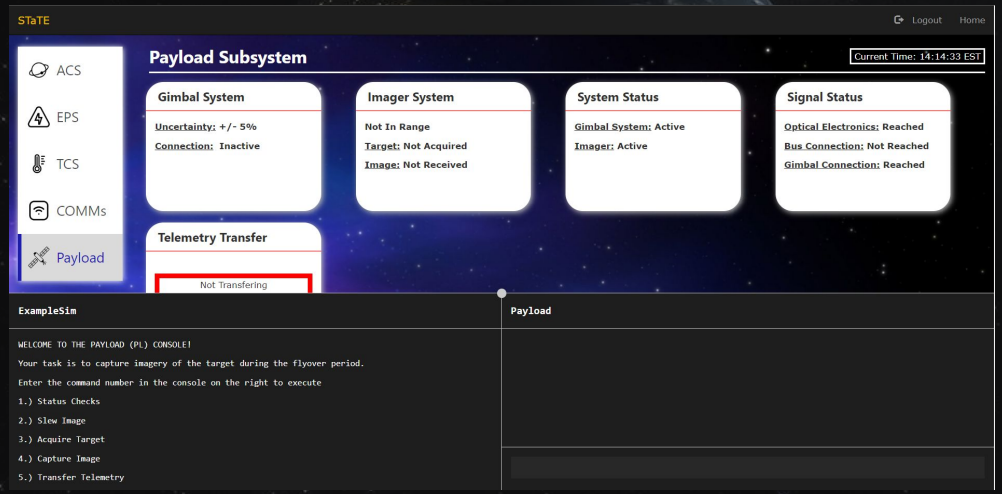


Product Breakdown

Payload Subsystem

Flight Operator (Payload)

- Tracks gimbal system status
- Tracks imager system status
- Ensures subsystem statuses remain valid
- Captures image if status, orientation, and location are reached
- Ensures proper telemetry transfer from Payload to COMMs subsystem
- Must ensure that Payload subsystem is stable to be able to complete mission

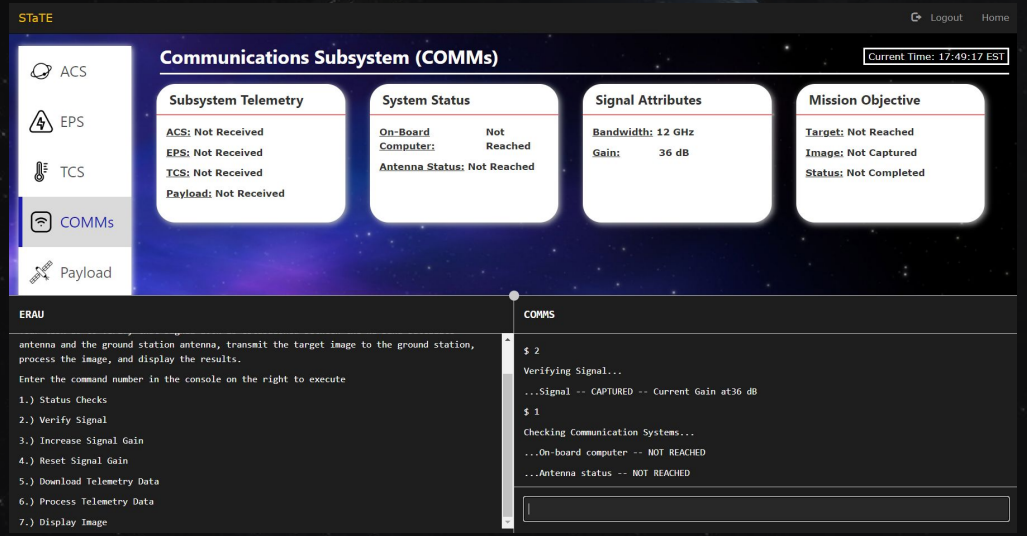


Product Breakdown

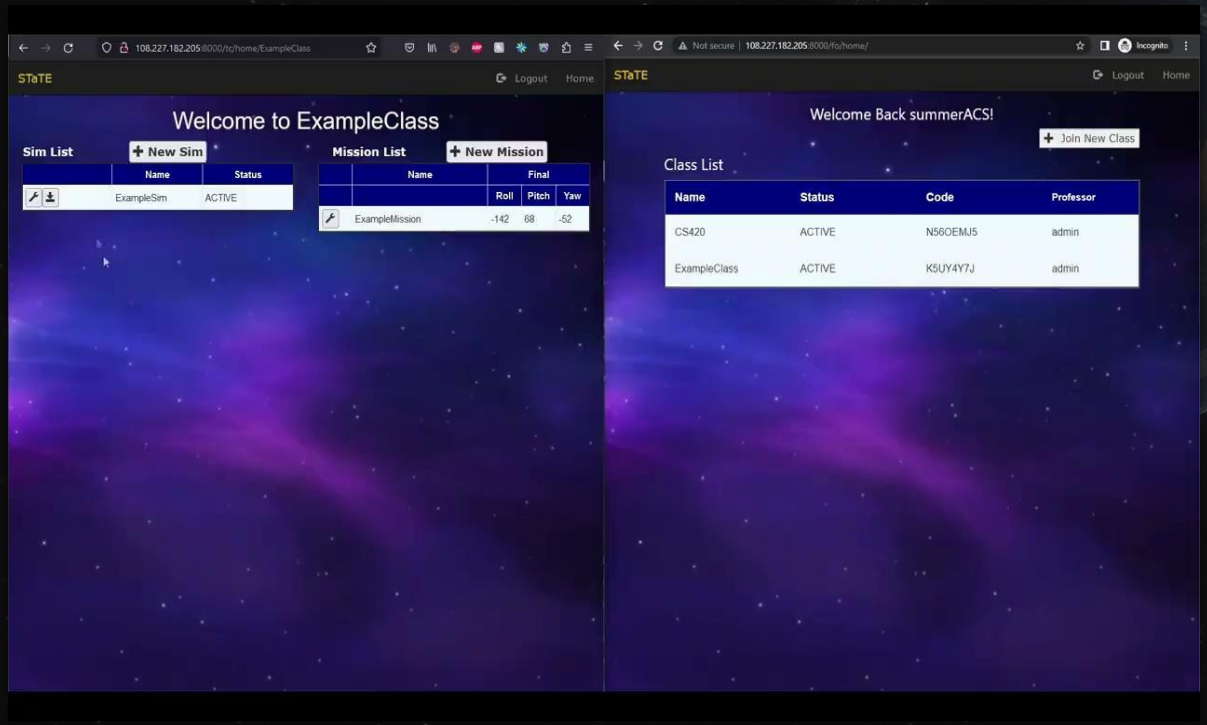
Communications Subsystem (COMMS)

Flight Operator (COMMs)

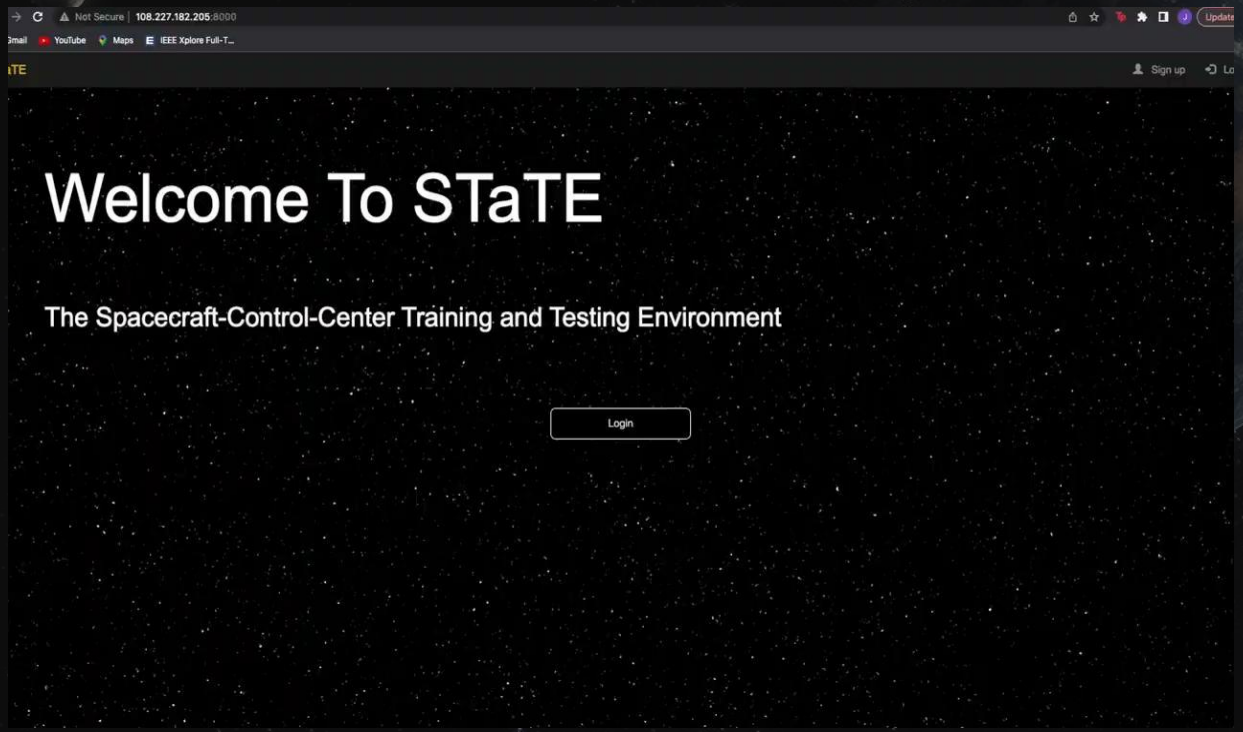
- Tracks if telemetry from other subsystems has been received
- Ensures signal statuses are reached
- Ensures valid antenna signal by having the ability to adjust the antenna gain
- Must ensure that COMMS subsystem is stable to be able to complete mission
- When the COMMS subsystem is completed, all subsystems are able to access the link for the captured image and the mission is completed



Demo


STaTE
Logout
Home
Welcome to ExampleClass
Sim List
New Sim
Name
Status
ExampleSim
ACTIVE
Mission List
New Mission
Name
Final
Roll
Pitch
Yaw
ExampleMission
-142
68
-52
STaTE
Logout
Home
Welcome Back summerACS!
Join New Class
Class List
Name
Status
Code
Professor
CS420
ACTIVE
N56OEMJ5
admin
ExampleClass
ACTIVE
K5UY4Y7J
admin

Demo


Not Secure | 108.227.182.205:8000
YouTube
Maps
IEEE Xplore Full-T...
Sign up
Welcome To STaTE
The Spacecraft-Control-Center Training and Testing Environment
Login

Product Breakdown

Deployment

- The STaTE project is currently deployed on a development team member's personal PC
  - This deployment will be terminated upon completion of the project
- The STaTE project is yet to be officially deployed on a web hosting service
  - IT accounts are required to host the project on Microsoft Azure Web Hosting
  - These accounts are needed to maintain the project and charge hosting fees
- The STaTE team will supply instructions to the Product Owner for project deployment

09

Challenges & constraints

Challenges & Constraints

- Database Complications
  - Challenge: Number of read/write operations quickly overloads SQLite database.
  - Solution: SimCraft are managed in threads to combat excessive database operations.
- Subsystem Synchronization
  - Challenge: SimCraft subsystems operate concurrently and must share some data.
  - Solution: Shared data is maintained by SimCraft and accessed by subsystems as needed.
- Version Control
  - Challenge: Large team working concurrently on project files
  - Solution: Assignment of team members to specific areas/features to avoid conflicts and double-work

04

Conclusion

Conclusion

Project Summary

Goals:

- Create a web application that...
  - Manages Flight Operator and Test Conductor user accounts
  - facilitates Flight Operator management of SimCraft and Test Conductor review of performance
- Deploy the web application on a hosting service

Accomplishments:

- The team has completed a web application that fulfills requirements and is deployed on a team-owned server PC
- Documentation for project specifications has been created for project users and adopters
- Documentation for deployment is being created for product owner to deploy the web application on the Azure Web Hosting Service

Questions?