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# Team Information

## Batch

* August 2022 – November 2022

## Members

* **Group Lead**: Mohan Sami
* Anuradha Kapoor
* Reema Chhetri
* Sachin Ghewde

## Github Repository

<https://github.com/sachin-gg/ACSECapstone>

# Project Goals

Developed a unique blockchain based ticket management system for Eagle Airlines to entice users with transparency, and automated refunds and delay penalties.

## Blockchain

* Develop a Private Ethereum Blockchain implementation, using **geth** nodes running directly on a 3 **AWS EC2** (Ubuntu) servers.
* Use **Clique PoA** (Proof of Authority) as the consensus protocol.
* Develop a base Flight ticket management smart contract in **Solidity**.
* Use **MetaMask** as the wallet for Customers.
* Demonstrate contract behavior via **Remix** connected to the private blockchain.

## Smart Contract

### Basic

* The customer should be able to trigger a cancellation anytime till 2 hours before the flight start time. This should refund money to the customer minus the percentage penalty predefined in the contract by the airlines. The penalty amount should be automatically sent to the airline account.
* Any cancellation triggered by the airline before or after departure time should result in a complete amount refund to the customer.
* The airline should update the status of the flight within 24 hours of the flight’s start time. It can be on-time start, cancelled, or delayed.
* 24 hours after the flight departure time, the customer can trigger a claim function to demand a refund.
  + They should get a complete refund in case of cancellation by the airline.
  + In case of a delay, they should get a predefined percentage amount, and the rest should be sent to the airline.
  + If the airline hasn’t updated the status within 24 hours of the flight departure time, and a customer claim is made, it should be treated as an airline cancellation case by the contract.

### Advanced

* Add support for multiple cancellation penalties in favor of the airline, and delay penalties in favor of the customer, based on various time ranges in the contract.

# Assumptions

1. All flights travel nonstop from origin to destination.
2. All seats will be the same class (like economy) and will be priced the same (10 ETH for domestic or 25 ETH for International).
3. Three Airline (miner) accounts will be created through genesis configuration file and prefunded with 9000 ETH each.
4. Four customer accounts will be created for ease of simulation through genesis configuration file and prefunded with 9000 ETH each.
5. Airline cancellations should result in 100% refund to the customer immediately without any claim process.
6. Customers can claim a refund for cancellation anytime before 2 hours of the flight’s scheduled departure time. Cancellation penalties need to follow the rules below for refund.

|  |  |
| --- | --- |
| Rule: Based on DIFFERENCE of (Scheduled Departure Datetime – Cancellation Datetime) | Refund Amount  (% of Ticket Price) |
| If >= 24 hours | 100% |
| If >= 10 hours and < 24 hours | 80% |
| If >= 2 hour and < 10 hours | 40% |
| If < 2 hour | 0% |

1. Flight delays by airline will make customers eligible for a refund. These rules will apply in 2 scenarios.
   1. Flight lands and the Airline contract automatically closing the ticket.
   2. Flight has not landed, then the customer can claim a refund after 24 hours of scheduled departure time.

|  |  |
| --- | --- |
| Rule: Based on DIFFERENCE of (Scheduled Departure Datetime – Actual Departure Datetime) | Refund Amount  (% of Ticket Price) |
| If < 2 hours | 0% |
| If >= 2 hours and < 10 hours | 10% |
| If >= 10 hours and < 24 hours | 40% |
| If >= 24 hours | 100% |
| If Airline failed to provide any status updates within 24 hours of scheduled departure time. | 100% |

# 

# Deliverables

1. All the code including an aggregated script of commands used to create and set up the nodes and accounts (with comments), the actual solidity code of the contract(s), configuration settings (textual README and/or screenshots of AWS console screen configurations), etc.
2. Architecture diagram showing your entire system architecture.
3. Multiple screenshots highlighting interaction with your system and its behavior.
4. Presentation talking about the process and the output.

# Eaglepoa network Layout

A diagram of a blockchain based ticket management system

Description automatically generated

# AWS Infrastructure and Configuration

A computer screen with a white screen

Description automatically generated

### Security Group Configuration

Security – Inbound Rules (Required for MetaMask & Remix):

|  |  |  |
| --- | --- | --- |
| Protocol | Port | Source |
| TCP (listener) | 9001 | 0.0.0.0/0 |

A screenshot of a computer

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# Blockchain node setup

## List of Commands used to set up the nodes and accounts.

Ethereum & Geth **Github**: <https://github.com/sachin-gg/ACSECapstone/blob/main/FinalDocs/readme.md>

### Gensis File (eaglepoa.json)

      "config": {

      "chainId": 80801,

      "homesteadBlock": 0,

      "eip150Block": 0,

      "eip155Block": 0,

      "eip158Block": 0,

      "byzantiumBlock": 0,

      "constantinopleBlock": 0,

      "berlinBlock": 0,

      "clique": {

            "period": 30,

            "epoch": 30000

      }

      },

      "difficulty": "1",

      "gasLimit": "8000000",

      "extradata": "0x0000000000000000000000000000000000000000000000000000000000000000168AaBAc0c700eF95269b0876931F6ECbBbbE5970000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000",

      "alloc": {

            "168AaBAc0c700eF95269b0876931F6ECbBbbE597": { "balance": "9000000000000000000000" },

            "c2bdaE1D229f9554A676081FD68916e93C8420c9": { "balance": "9000000000000000000000" },

            "406CC1CF7bADb242eF5fC2d64Af68677F36B5fAb": { "balance": "9000000000000000000000" },

            "d9cAa7ecb5500c5FafcA1F4A954Db75EA34c3361": { "balance": "9000000000000000000000" },

            "A4A19c7b7cAfE09063498F697E647971dC236dca": { "balance": "9000000000000000000000" },

            "E69F4c213c19a6E421869e3a62162f92dDE3050E": { "balance": "9000000000000000000000" },

            "0F97E2dFA64A4ceDcAd9F2Ad5f00578308d73b2e": { "balance": "9000000000000000000000" }

      }

}

### 

### Nodes & Accounts

* Network ID: 80801
* Total Three nodes. No Bootnode
* Total Seven Accounts
  + 1 Contract Owner/Airline Account

"168AaBAc0c700eF95269b0876931F6ECbBbbE597": { "balance": "9000000000000000000000" },

* + 1 Airline Domestic account

"c2bdaE1D229f9554A676081FD68916e93C8420c9": { "balance": "9000000000000000000000" },

* + 1 Airline International account

"406CC1CF7bADb242eF5fC2d64Af68677F36B5fAb": { "balance": "9000000000000000000000" },

* + 4 **Customer** accounts on Eagle1 node:

"d9cAa7ecb5500c5FafcA1F4A954Db75EA34c3361": { "balance": "9000000000000000000000" },

"A4A19c7b7cAfE09063498F697E647971dC236dca": { "balance": "9000000000000000000000" },

"E69F4c213c19a6E421869e3a62162f92dDE3050E": { "balance": "9000000000000000000000" },

"0F97E2dFA64A4ceDcAd9F2Ad5f00578308d73b2e": { "balance": "9000000000000000000000" }

* **Node: Eagle1** (Node-1): Airline Miner

A screenshot of a computer screen

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* **Node: Eagle2** (Node-2): Domestic

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* **Node: Eagle3** (Node-3): International

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### Add as Peers

Eagle1 as peer of Eagle2

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Eagle1 as peer of Eagle3

A screenshot of a computer

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### Connectivity Check

Getting Balance of one node from other nodes

A screen shot of a computer

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### MetaMask Configuration

Network name: eaglepoa (connect to Node - Eagle1).

New RPC URL: http://[EC2 Public IP]:9001

Chain ID: 80801

Currency symbol: ETH

# Solidity contract Setup

## Solidity source code - Github

**<README.md>**: <https://github.com/sachin-gg/ACSECapstone/blob/main/eaglepoa/readme.md>

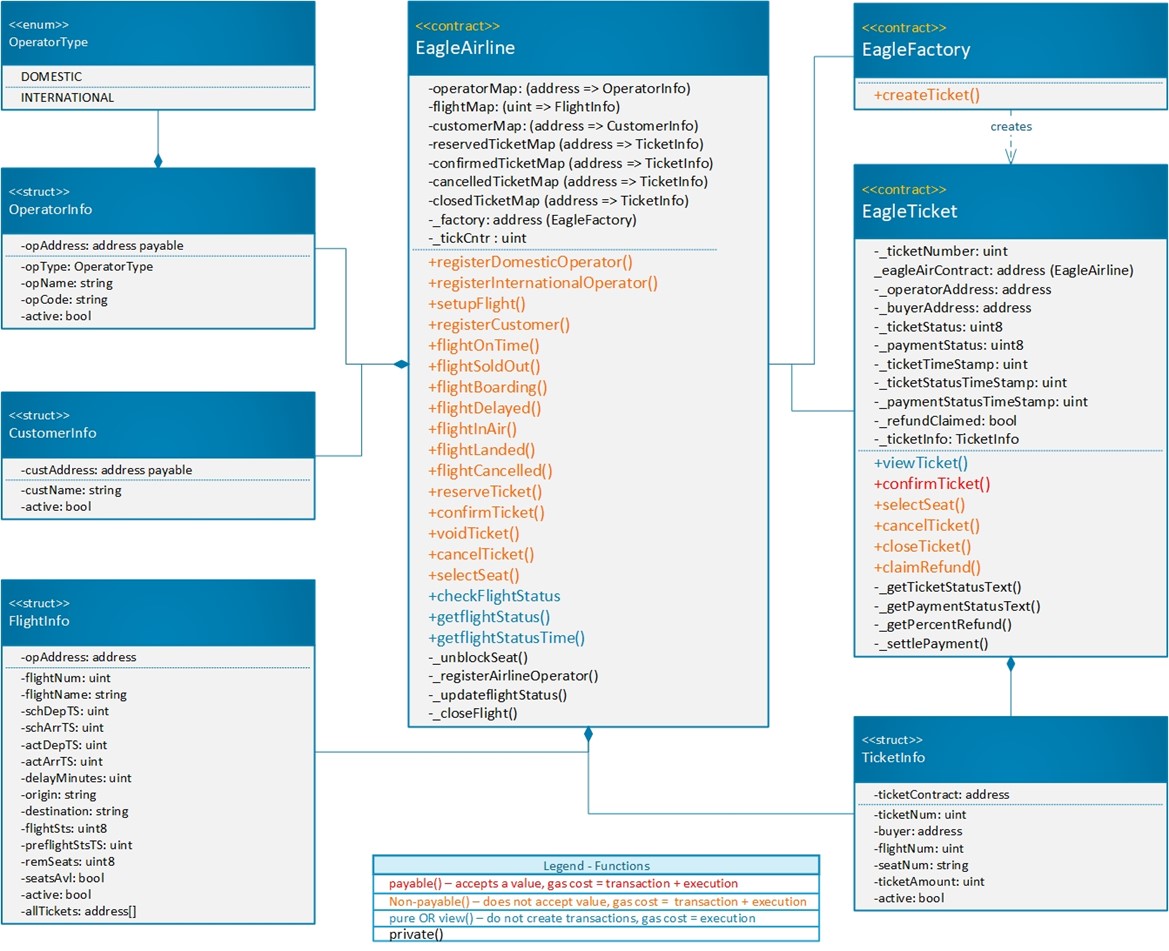
**<EagleTicket.sol>**: <https://github.com/sachin-gg/ACSECapstone/blob/main/solidity/EagleTicket.sol>

**<EagleAirline.sol>**: <https://github.com/sachin-gg/ACSECapstone/blob/main/solidity/EagleAirline.sol>

**<EagleLib.sol>:** <https://github.com/sachin-gg/ACSECapstone/blob/main/solidity/EagleLib.sol>

## Contract Architecture: Contract Structure

### Overall Contract structure:



### Contract – EagleFactory

A screen shot of a computer

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### Contract – EagleAirline

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### Contract - EagleTicket

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## Contract Architecture: High-level Sequence diagrams

### Airline Functions

A diagram of a company

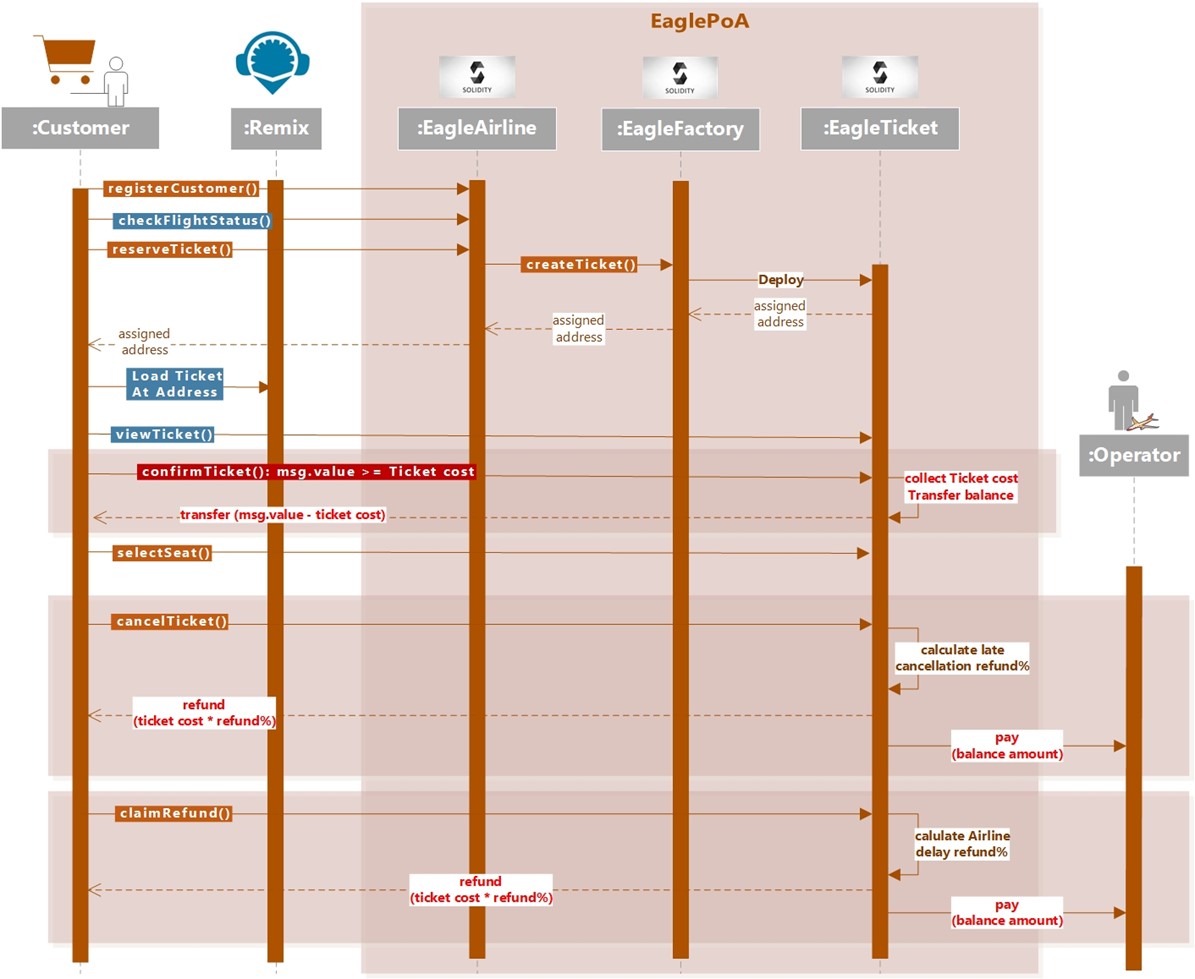
Description automatically generated

### Flight Operator Functions

A diagram of flight operations

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### Customer Functions



## EC2 Execution Screenshots

### EC2 Node startup – Eagel1

A screenshot of a computer program

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### EC2 Node startup – Eagel2

A screenshot of a computer program

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### EC2 Node startup – Eagel3

A screen shot of a computer

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### EC2 Node Peers

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## MetaMask Integration Screenshots

### MetaMask: EaglePoA Network connection setup

A screenshot of a computer

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### MetaMask: EaglePoA Account setup

* Import Airline & Customer Accounts into Metamask

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## Remix – MetaMask Integration Screenshots

### Injected Provider – MetaMask setup

A screenshot of a computer

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## Remix – Deploy & Run Transactions

### Deploy EagleFactory

#### Confirm Contract Deployment

A screenshot of a computer program

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#### geth Contract Creation

A screen shot of a computer

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#### Deployed Contract

A computer screen shot of a program

Description automatically generated

### Deploy EagleAirline

#### Confirm Contract Deployment

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#### Geth Contract Creation

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#### Deployed Contract

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#### MetaMask Contract Deployed confirmation

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### Contract Execution

#### Operator: EagleAirline.registerDomesticOperator

A computer screen with text

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#### Operator: EagleAirline.setupFlight

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#### Operator: EagleAirline.setupFlight

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#### Customer: EagleAirline.registerCustomer

A computer screen shot of text

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#### Customer: EagleAirline.checkflightStatus

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#### Customer: EagleAirline.reserveTicket

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#### Remix: Load EagleTicket “At Address”

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#### Customer: EagleTicket.viewTicketInfo (Reserved Ticket)

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#### Customer: EagleTicket.confirmTicket

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#### Customer: EagleTicket.selectSeat

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Description automatically generated

#### Customer: EagleTicket.viewTicketInfo (Confirmed Ticket)

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#### Operator: EagleAirline.flightBoarding

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#### Operator: EagleAirline.flightInAir

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#### Operator: EagleAirline.flightLanded

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Description automatically generated

### Contract Execution - Cancellation

#### Customer: EagleTicket.cancelTicket (80% Refund)

A screenshot of a computer

Description automatically generated

#### Operator: EagleAirline.flightCancelled

**[vm]**

**from:** 0xAb8...35cb2

**to:** EagleAirline.flightCancelled(uint256) 0xf8e...9fBe8

**value:** 0 wei

**data:** 0xe8f...00065

**logs:** 3

**hash:** 0xc6b...363f1

**Debug**

|  |  |
| --- | --- |
| **status** | true Transaction mined and execution succeed |
| **transaction hash** | 0xc6b9d81a9fcd7e25ceb6ed9a2d926b88ad14c2869e7d5974df1b293a9ca363f1 |
| **block hash** | 0xe84761ffe6964d3a3956886dcb6bd0b645ed24fb02676f56c777687cab5f3838 |
| **block number** | 18 |
| **from** | 0xAb8483F64d9C6d1EcF9b849Ae677dD3315835cb2 |
| **to** | EagleAirline.flightCancelled(uint256) 0xf8e81D47203A594245E36C48e151709F0C19fBe8 |
| **gas** | 773808 gas |
| **transaction cost** | 538476 gas |
| **execution cost** | 584472 gas |
| **input** | 0xe8f...00065 |
| **decoded input** | { "uint256 flightNum": "101" } |
| **decoded output** | { "0": "bool: true" } |
| **logs** | [ { "from": "0x5C9eb5D6a6C2c1B3EFc52255C0b356f116f6f66D", "topic": "0x9d768ac2a59d50fdc8755ef01b3016e47e3b8fabaa9114e9c37d09286373f789", "event": "TicketClosed", "args": { "0": "1000000000001", "1": "10000000000000000000", "2": "0", "3": "10000000000000000000", "4": "INFO: Ticket Closed", "ticketNumber": "1000000000001", "refundAmount": "10000000000000000000", "paidAmount": "0", "collectedAmount": "10000000000000000000", "message": "INFO: Ticket Closed" } }, { "from": "0xb8f43EC36718ecCb339B75B727736ba14F174d77", "topic": "0x9d768ac2a59d50fdc8755ef01b3016e47e3b8fabaa9114e9c37d09286373f789", "event": "TicketClosed", "args": { "0": "1000000000002", "1": "10000000000000000000", "2": "0", "3": "10000000000000000000", "4": "INFO: Ticket Closed", "ticketNumber": "1000000000002", "refundAmount": "10000000000000000000", "paidAmount": "0", "collectedAmount": "10000000000000000000", "message": "INFO: Ticket Closed" } }, { "from": "0xf8e81D47203A594245E36C48e151709F0C19fBe8", "topic": "0xe15e622369f6cd215131b21a6219d8216334c9c314c5293389f99fa06927e608", "event": "FlightUpdate", "args": { "0": "101", "1": "CANCELLED", "flightNum": "101", "uMsg": "CANCELLED" } } ] |
| **val** | 0 wei |