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2022 FAA Challenge

Morgan State University

A Simulation of a Real-Time Cloud-Based Communication Bluetooth Low Energy (BLE) System in Automatic Dependent Surveillance-Broadcast (ADS-B) for Unmanned Aerial Systems (UAS)

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- Objectives

-We want to create a cloud-based environment that allows UAVs to connect, communicate and share flight patterns while taking in data from various sensors in order to effectively utilize UAV drones to complete various task.

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- Existing Solutions
 - UAS communication utilizes radar as the communication
- Our Solution
 - BLE in ADS-B solution to create a collision avoidance system to connect up to thousands of UASs.

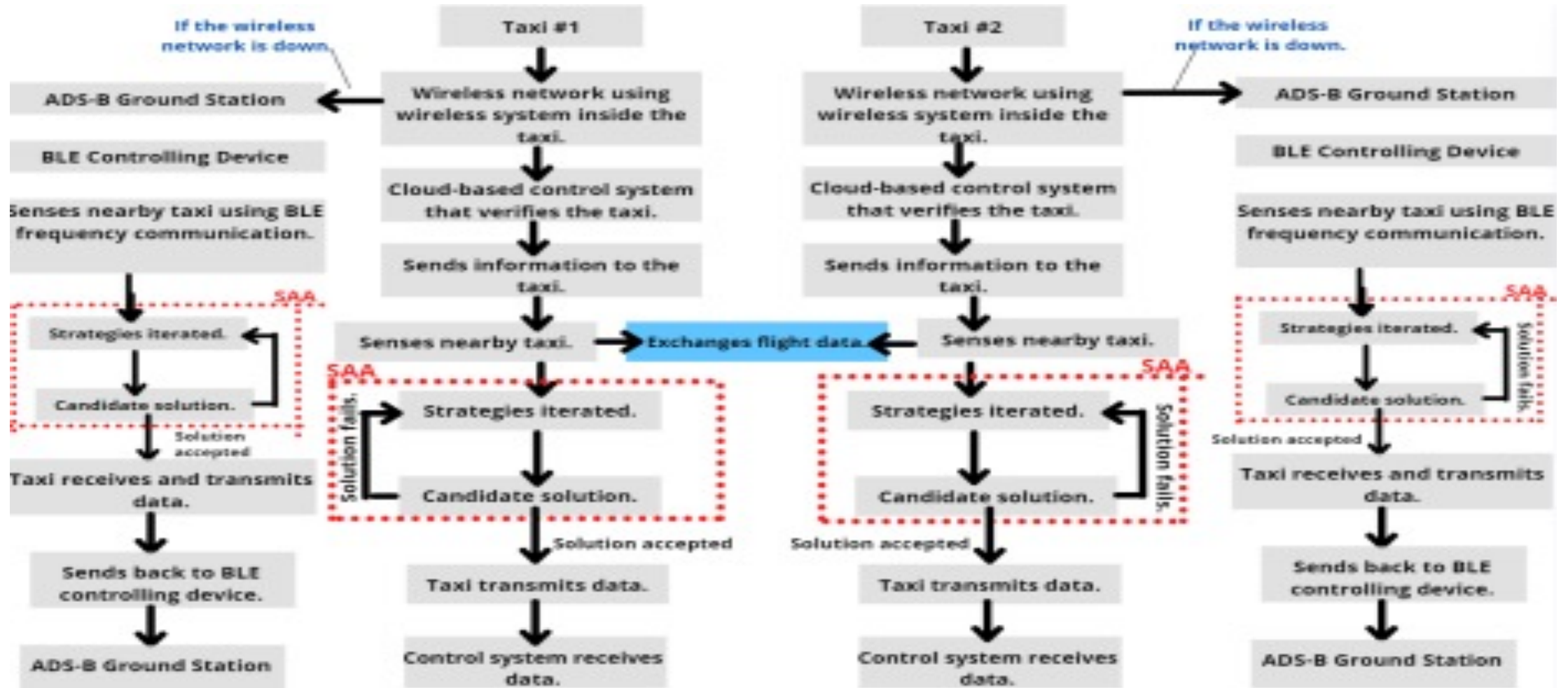
2022 FAA Challenge Scenario #1 Drone to Drone Collision



2022 FAA Challenge Scenario #2 Drone to Taxi Collision



2022 FAA Challenge Scenario #3 Taxi to Taxi Collision

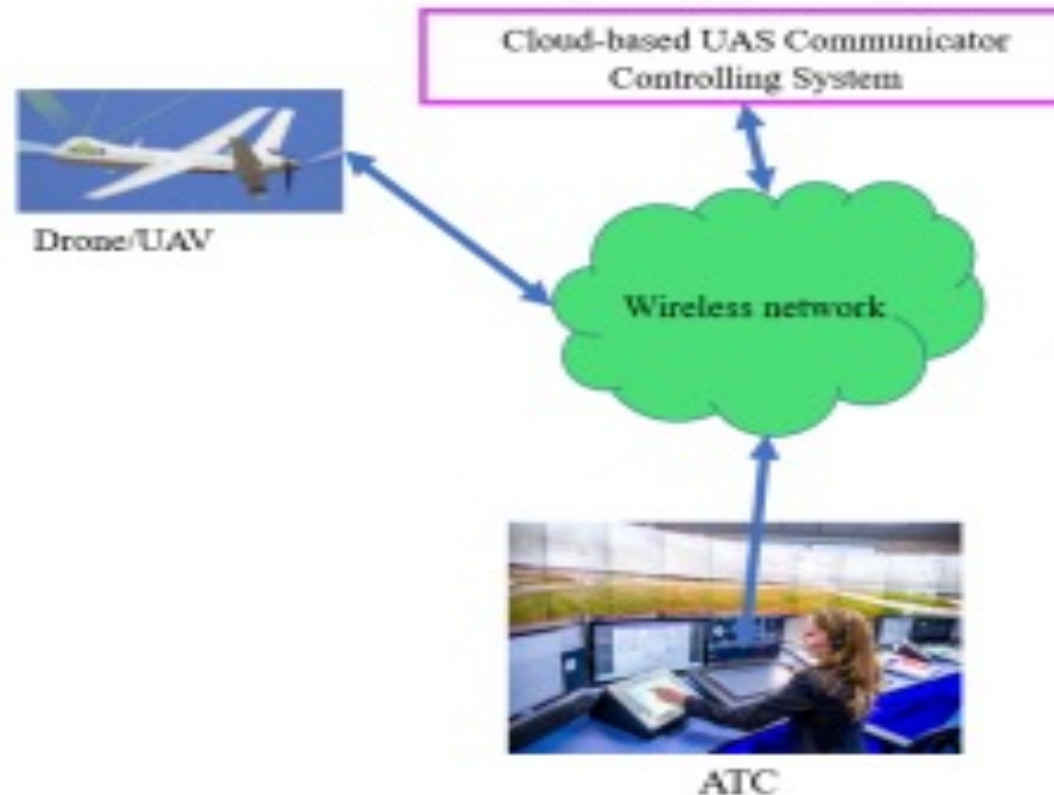


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When the wireless network is operating correctly:



When the wireless network is disrupted, resulting in connectivity issues:



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- Areas of Application
 - (Healthcare) Providing accessibility to rural areas that lack high quality healthcare
 - (Transportation and logistics) Automation to different venues including but not limited to warehouses, shipping ports/terminals, and arenas.
 - (Infrastructure) Maneuver around tall structures that can not be accessible by workers regularly and use cameras to diagnose multiple situations
 - (Economy) Creation of 100,00 jobs
 - (Security) Aerial Surveillance
 - (Environment) Environmentally friendlier than delivery trucks

Risk Assessment

Risk	Description	Impact of Risk	Level of Risk	Mitigation Strategy
Cost	- Transitional costs from shifting to a cloud-based control system. [2]	No risk to human life or infrastructure.	Low	Apply for grants; Obtain sponsorships through partnerships.
Range	- In cloud-based systems, data communication can be disconnected due to possible network issues. Unpredictable computational lag can also affect system performance. In addition, increased server space usage can lead to slower performance. [2]	Could lead to risk to human life and infrastructure if this occurred during operation times.	High	Frequent network maintenance; Incorporate higher capacity servers.
	- BLE operates at 2.4 GHz and can be affected by surrounding obstacles. The orientation and design of the BLE device can also affect the performance. [3]	May lead to risk to human life and infrastructure if this occurred during operation times.	Medium	Limit surrounding obstacles; Ensure that the orientation of the device on the UAS is correct.
	- ADS-B depends on on-board navigation devices and on-board broadcast transmission systems to provide surveillance information. [4]	No risk to human life or infrastructure.	Low	Cloud-based communication will mainly be used except in the case that the wireless network is down.
Data Throughput	- The data rate at which BLE transmits data can be 1 Mbps for Bluetooth 4.2 and earlier versions. For Bluetooth 5 and later versions, the data rate can either be 1 Mbps or 2 Mbps. [3]	No risk to human life or infrastructure.	Low	Utilize Bluetooth 5 for higher data transmission speed.
	- For ADS-B, the aircraft/vehicle transmitting the broadcast may or may not have the knowledge that the users (ground-based or aircraft) receiving the broadcast have. [4]	May lead to risk to human life and infrastructure if this occurred during operation times.	Medium	Ensure that all systems involved are supplied with the necessary information for efficient flight.
Security	- Cybercriminals may target the cloud-based system. [2]	Could lead to risk to human life and infrastructure if this occurred during operation times.	High	Ensure that safeguards and security blocks are well-integrated in the cloud system.

Project Timeline



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		Month					
		1	2	3	4	5	6
Activity	Gathering materials, Further Research	█					
	Simulation		█				
	Prototype Assembly			█			
	Prototype Testing/Re-testing				█	█	
	Evaluation and Next Steps						█