UCAirLink: A Vertical Takeoff and Landing-Based Air Transportation System for Optimizing Commuter Efficiency

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ABSTRACT

Vertical lift technologies present a promising solution for civil transportation between separated metropolitan and urban regions. This paper introduces the University of California Air transportation Link (UCAirLink), an electric vertical takeoff and landing (eVTOL)-based air transportation system for reducing overall commute times between regions. By leveraging flight operations in the National Airspace System (NAS), the UCAirLink connects the four northernmost University of California (UC) or the Center for Information Technology Research in the Interest of Society and the Banatao Institute (CITRIS) campuses. The UCAirLink addresses key aspects of urban air mobility (UAM) including optimal vehicle selection, infrastructure design, and flight route planning given regulations from the Federal Aviation Administration (FAA). A detailed trade study is presented for the selection of an optimal eVTOL aircraft. The eVTOL's flight routes cruise primarily in Class E and G airspaces to adhere to FAA flight regulations and ensure safe passenger-operations. Preliminary analysis shows a threefold reduction in overall travel time compared to traditional ground-based transportation modes, with selected eVTOL completing flight routes in less than 40 minutes.

NOTATION

ATC	=	Air Traffic Control
ATM	=	Air Traffic Management
DEP	=	Distributed Electric Propulsion
eVTOL	=	electric Vertical Take-Off and Landing
FATO	=	Final Approach and Take-Off Area
IFR	=	Instrument Flight Rules
NAS	=	National Airspace System
TLOF	=	Touch-down and LiftOff Areas
UAM	=	Urban Air Mobility
UCAirLink	=	University of California Air transp. Link
VFR	=	Visual Flight Rules

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INTRODUCTION

Civil transportation in metropolitan regions for short and medium distances is centered on ground vehicles, infrastructure, and operations [1]. In these increasingly population-dense regions, the trends of gradual increases in commute time have led to a decline in overall commuter efficiency in recent years [2-4]. With the growing technology developments of Urban Air Mobility (UAM), vehicles such as electric vertical take-off and landing (eVTOL) aircraft present a promising solution to bypassing commuter congestion [5].

This paper presents the University of California Air transportation Link (UCAirLink), a novel air transportation system in the San Francisco Bay Area network (SF Bay Area network), connecting many urban and metropolitan regions. The UCAirLink comprises necessary eVTOL infrastructure, adequate eVTOL aircraft model, operations architecture, and total costs for network development and flight operations.

Case Study: CITRIS

The Center for Information Technology Research in the Interest of Society and the Banatao Institute (CITRIS) comprises of the four northernmost University of California (UC) schools, and promotes innovation, research, and development [6]. Located in the SF Bay Area network, the four CITRIS campuses include: UC Berkeley, UC Davis, UC Santa Cruz, and UC Merced. This network includes a diverse set of population densities and airspace geometries, and connect larger metropolitan regions like San Francisco to more rural urban regions like the central Californian Valley. Fig. 1 shows the geographical locations and separations between the CITRIS campuses. In networks like the four CITRIS campuses, which includes links of longer distance and links in congested regions, UAM networks can be a viable means of enabling efficient civil transportation.

The UCAirLink spans the four CITRIS campuses which includes airspaces in the SF Bay Area network, restricted, and controlled zones. The UCAirLink includes a trade study consideration for optimal eVTOL aircraft selection, flight route planning, adherence to Federal Aviation Administration (FAA) restrictions, supporting infrastructure design, and environmental impact assessments. These considerations result in a system that guarantees up to three times faster commute travel time.

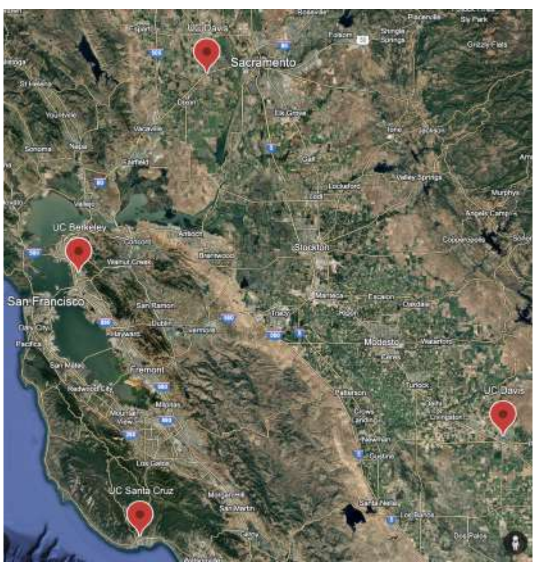

Figure 1. Google Earth image of the four CITRIS campus locations labeled by red markers.

VEHICLE SELECTION

A diverse range of UAM aircraft models can be implemented into air transportation systems. However, selecting the most suitable aircraft for UCAirLink involves considering multiple factors such as range, fuel consumption, passenger capacity, cost, and noise levels. These criteria directly influence the system's passenger transport time, commuter efficiency, and scalability of operations. To determine the best vehicle for the UCAirLink, a detailed trade study was conducted to evaluate the performance of various eVTOL aircraft across a range of key metrics. Tables 1-6 outline the evaluation matrix used to compare twelve eVTOLs from different manufacturers based on ten critical performance factors, including market readiness, range, cruise speed, noise, passenger capacity, and cost.

Each aircraft was scored on these factors, with weights assigned based on their importance to the network's objective. For example, higher weighting was given to range and cruise speed, as these factors directly impact the system's reduction in commute times. After evaluation, the Joby S4 2.0 (S4) emerged as the most suitable aircraft due to its high cruise speed (up to 322 km/h), extended range (241 km), and relatively quiet operation (45 dB), making it ideal for urban environments where noise pollution is a concern [7]. The S4, as seen in Fig. 2, combines aircraft performance, reliability, and environmental sustainability, making it the optimal choice for UCAirLink.

Figure 2. The Joby S4 2.0 eVTOL in flight [7].

With a total flight range of 150 miles, the S4 can also accommodate up to four passengers with a combined maximum payload weight of 1,000 pounds. A maximum cruising speed of 200 miles per hour (mph) ensures that all target destinations can be reached within 40 minutes. Additionally, the S4 is one of the quietest eVTOLs on the UAM market, producing only 45 decibel A-weighted (dBA) during cruise, minimizing environmental noise impact and enabling operations at lower altitudes.

While the recommended cruising altitude is 5,000 feet above ground level (AGL), well aligned with our proposed controlled airspace classes altitude, the S4 is also capable of reaching altitudes up to 10,000 feet, offering greater operational flexibility. Its compact dimensions, with a wingspan of approximately 37 feet and a length of 24 feet, make it ideal for our vertiport infrastructure design, requiring less space for landing and parking. Given that newly developed aircraft can take more than six years to achieve FAA certification, selecting the S4 aircraft streamlines UCAirLink's deployment.

Table 1. eVTOL Vehicle Comparison (Airbus CityAirbus & AirEV Air One).

Specs	Airbus CityAirbus	Air One
Market Readiness (0-10)	5	5
Range (km)	95	177
Cruise speed (km/h)	120	250
Noise (dB)	65	74
Number of Passengers	4	2
Fuel Type	Electric	Electric
Cost ($ US Millions)	1.129	0.15
Autonomy (1-3)	3	2
Diameter (m)	12	11
Total Score	31.75	35.5

Table 2. eVTOL Vehicle Comparison (Archer Midnight & Beta Tech Alia-250).

Specs	Archer Midnight	Alia-250
Market Readiness (0-10)	7.5	5
Range (km)	80	460
Cruise speed (km/h)	241	270
Noise (dB)	45	90
Number of Passengers	4	5
Fuel Type	Electric	Electric
Cost ($ US Millions)	5	4
Autonomy (1-3)	2	2
Diameter (m)	14.6	15
Total Score	28.5	36.75

INFRASTRUCTURE

The infrastructure required to support UCAirLink consists of two primary components: vertiport landing pads for eVTOL Touch-down and LiftOff Areas (TLOF) operations, and associated refueling and charging facilities. Key considerations for vertiport construction include site size, location, and utility integration. To minimize disruption to existing environments and expedite deployment, UCAirLink adopts a modular construction strategy that enables vertiports to be built atop pre-existing flat-topped structures. This modular approach reduces both costs and construction complexity, while allowing for rapid scalability as the passenger demand grows.

Vertiport site selection further considers FAA regulations, prevailing wind conditions, and proximity to ground-based transportation networks [8, 9]. Integrating vertiports with existing transportation infrastructure ensures seamless multi modal connectivity for passengers, while the modular design framework facilitates future expansion to accommodate increased demand. In the SF Bay Area network, flight paths are carefully planned to minimize interference with conventional commercial take-off and landing (CTOL) operations, optimizing transit efficiency between the CITRIS campuses.

Table 3. eVTOL Vehicle Comparison (Eve Air Eve & Jaunt Air Journey).

Specs	Eve Air Eve	Jaunt Air Journey
Market Readiness (0-10)	2.5	7.5
Range (km)	100	129
Cruise speed (km/h)	185	282
Noise (dB)	65	70
Number of Passengers	4	4
Fuel Type	Electric	Electric
Cost ($ US Millions)	3	3
Autonomy (1-3)	3	2
Diameter (m)	N/A	15.4
Total Score	22.5	36.25

Table 4. eVTOL Vehicle Comparison (Joby S4 2.0 & Lilium Jet).

Specs	Joby S4 2.0	Lilium Jet
Market Readiness (0-10)	10	7.5
Range (km)	241	250
Cruise speed (km/h)	322	250
Noise (dB)	45	60
Number of Passengers	4	7
Fuel Type	Electric	Electric
Cost ($ US Millions)	2	10
Autonomy (1-3)	2	1
Diameter (m)	11.8	13.9
Total Score	47.75	37.25

The vertiport design draws inspiration from Lilium's modular infrastructure model [10], known for its adaptability across a variety of site conditions, scalability, and configuration flexibility. Each vertiport is composed of three main elements: a TLOF, parking stands, and a terminal facility, shown in Fig. 3.

Each vertiport is equipped with integrated battery charging stations and vehicle maintenance areas within the parking structures. Larger vertiports feature dedicated passenger and cargo loading zones, while smaller facilities enable boarding directly at parking stands. To maximize capacity in constrained spaces, vertical parking stations may be considered alongside traditional horizontal layouts, with further evaluation during the implementation phase in collaboration with regulators and site operators. The number of TLOFs and parking spaces at each location will be determined based on site-specific structural assessments. Prior to construction on existing structures, a comprehensive structural analysis is required to validate load-bearing capacity and ensure operational safety.

A significant portion of the parking stand and terminal infrastructure is prefabricated off-site to enable rapid vertiport construction. Vertiports are designed for seamless integra-

Table 5. eVTOL Vehicle Comparison (Supernal SA-1 & Vertical Aero VA-X4).

Specs	Supernal SA-1	Aero VA-X4
Market Readiness (0-10)	2.5	5
Range (km)	293	161
Cruise speed (km/h)	290	241
Noise (dB)	45	65
Number of Passengers	4	4
Fuel Type	Electric	Electric
Cost ($ US Millions)	N/A	4
Autonomy (1-3)	3	2
Diameter (m)	N/A	15
Total Score	28.5	34.75

Table 6. eVTOL Vehicle Comparison (Volocopter VoloRegion & Wisk Aero G.6).

Specs	VoloRegion	Wisk Aero G.6
Market Readiness (0-10)	5	5
Range (km)	100	144
Cruise speed (km/h)	180	222
Noise (dB)	65	45
Number of Passengers	4	4
Fuel Type	Electric	Electric
Cost ($ US Millions)	N/A	N/A
Autonomy (1-3)	3	3
Diameter (m)	N/A	15
Total Score	29.75	31.75

tion with existing environments, supporting installation on rooftops of tall structures, mid-rise parking garages, and flat open fields. Site selection prioritizes integration with current infrastructure and transportation networks by targeting existing buildings, sites planned for demolition, and undeveloped fields. Selected vertiport sites include parking garages, new development sites, and grass fields, allowing deployment within a five-year timeline and minimizing the need for major structural modifications, particularly as parking garages offer strong load-bearing capacity. Each vertiport incorporates essential systems, including eVTOL charging stations, air traffic control infrastructure, security sensors, and digital check-in platforms.

Charging and maintenance facilities are integrated directly into parking areas. Representative modular vertiport configurations are shown in Fig. 4. Vertiports are designed to meet FAA security standards, emphasizing access control to restrict unauthorized entry of personnel, animals, equipment, and debris into operational areas [12]. For ground-level vertiports (i.e. vertiports located at UC Merced, UC Santa Cruz, and NASA Ames), a three-meter high perimeter wall surrounds the site, as per FAA regulation.

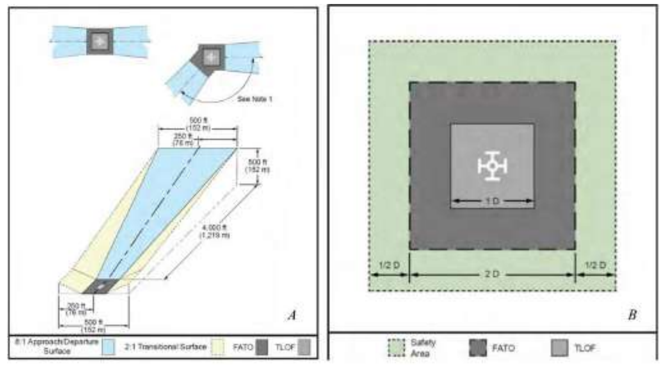

Figure 3. A) VFR Vertiport Approach/Departure Surfaces; B) Relationship and Dimensions of TLOF, FATO, Safety Area, and Dimension D [11].

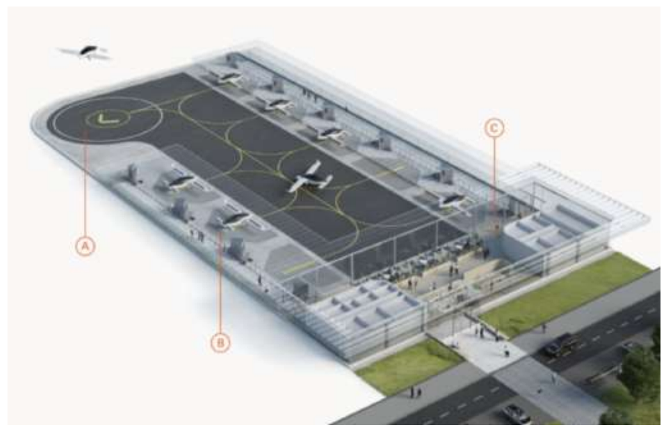

Figure 4. Example vertiport layout. A) TLOF, B) Parking stations, and C) Terminal

VERTIPORT LOCATIONS

The six vertiports are located at the following campuses and research centers: UC Berkeley, UC Davis, UC Merced, UC Santa Cruz, NASA Ames Research Center, and Lawrence Livermore National Laboratory. Furthermore, we considered the historical wind direction at each vertiport location to inform the takeoff and landing paths in the direction of the wind.

UC Berkeley

The vertiport at UC Berkeley is located ontop of the Lower Hearst parking garage on the northern-side of the campus. Using parking garages as the structural base allows us to construct multiple vertiports while minimizing the physical intrusion into the existing infrastructure. As the UC Berkeley campus is the primary destination all of UCAirLink's flight routes, a larger vertiport capable of accommodating higher volumes of traffic will be stationed ontop the Lower Hearst garage. This location is selected due to its proximity to the campus (within a two-minute walk), large flat-roof surface area, and low current utilization for parking. Fig. 6 shows a aerial rendering of the UC Berkeley vertiport concept with three verti-

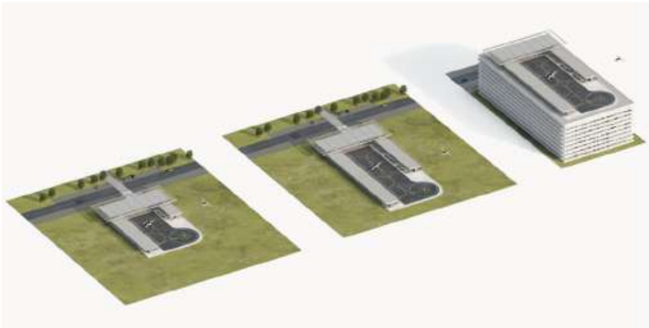

Figure 5. Different vertiport designs with three main elements: Take-off area, parking, and terminal

ports and other eVTOL supporting infrastructure such as parking stalls and eVTOL terminal locations.

Figure 6. UC Berkeley vertiport location layout from the aerial view, showing three constructed vertiports and connected infrastructure for parking and refueling.

The garage's lower levels can be used for ground vehicle parking, while the roof is used for eVTOL taxing and storing. Additionally, it is conveniently located, structurally adequate, and close to the existing transportation networks such as AC Transit and the Bay Area Rapid Transit (BART). More specifically, the vertiport is within a ten-minute walking distance of the BART station and closer to numerous AC transit bus stops. Currently, the parking lot can accommodate three vertiports with eVTOL wingspans up to 50 feet (dimension D = 50 feet).

UC Davis

The vertiport at UC Davis is located ontop of the UC Davis Pavilion Structure, a parking garage on the western side of campus. The selection is based on its flat rooftop, expansive dimensions (capable of housing three vertiports), and robust structural design engineered to endure substantial loads. The vertiports TLOF is sized at 50 feet by 50 feet to fit most of the eVTOL identified earlier in the vehicle selection section. The nearest campus bus stop is a five minute walk, and the structure is located near related ground infrastructure such as the I-80 highway. Fig. 7 shows a aerial rendering of the UC Davis vertiport concept with three vertiports and other eVTOL supporting infrastructure such as parking stalls, eVTOL terminal locations, and fire-safety systems.

Figure 7. UC Davis vertiport location layout from the aerial view, showing three constructed vertiports and connected infrastructure.

The structure is also well located within the UC Davis campus, allowing for access to campus buildings by bike, scooter, or foot. Like the Lower Hearst garage at UC Berkeley, lower garage levels can still be used for vehicle parking while the roof is used for eVTOL transportation.

UC Merced

The vertiport at UC Merced is the space next to the UC Merced Greenhouse. It was chosen because it is an open land without many surrounding buildings. It takes about fifteen minutes to walk from the vertiport to any other building on campus. Due to the relatively smaller size of the campus, this space will contain two ports, totaling 200 feet in length and 100 feet in width seen in Fig. 8.

UC Santa Cruz

The vertiport at UC Santa Cruz occupies the area just south of the UC Santa Cruz Athletics & Recreation Fitness Center. Its selection stems from its expansive open space with minimal surrounding structures, complemented by a bus stop located 400 feet away. This designated area will accommodate two ports, spanning 200 feet in length and 100 feet in width as shown in Fig 9. The vicinity boasts relatively flat terrain, ensuring compliance with FAA regulations.

NASA Ames Research Center

NASA Ames Research Center serves as an innovation hub for both research and design of future aviation systems. The proposed vertiport at NASA Ames is located on grassland next to the Defense Innovation Unit (DIU) parking lots with two ports in total, spanning 200 feet in length and 100 feet in width. Fig.

Figure 8. UC Merced vertiport location layout from the aerial view, showing three constructed vertiports and connected infrastructure.

Figure 9. UC Santa Cruz vertiport location layout from the aerial view, showing two constructed vertiports and connected infrastructure.

10 shows the aerial view of the NASA Ames vertiport. The location is on the southern part of Moffett Field, and is conveniently placed next to roads and a car parking lot on the NASA Ames Research Park. It is also in close proximity to facilities home to NASA Ames such as the N45 wind-tunnel enabled drone facility, and other aviation research labs. Vertiports at NASA Ames, in close proximity to Moffett Field airfield, give links between UC Berkeley and UC Santa Cruz and resting point for refueling.

Lawrence Livermore National Laboratory

The vertiport at Lawrence Livermore National Laboratory (LLNL) is at located at LLNL Lot D-4E on the South inner loop of the center. The FATO will span 200 feet in length and 100 feet in width and be constructed above the current parking lot. The location was chosen for its proximity to the facilities. The terminal will replace some of the parking spots on the

Figure 10. NASA Ames vertiport location layout from the aerial view, showing two constructed vertiports and connected infrastructure.

ground level.

Figure 11. LLNL vertiport location layout from the aerial view, showing three constructed vertiports and connected infrastructure.

ARCHITECTURE

Three eVTOLs are stationed at each of the UC Berkeley and UC Davis vertiports, while two vehicles are based at each of the remaining four vertiports (NASA Ames, LLNL, UC Merced, and UC Santa Cruz), resulting in a total fleet of 14 aircraft. Scheduling was further optimized by ensuring that a vehicle is only dispatched if at least one aircraft remains available at the departure vertiport. Ridership data from the UC Berkeley–UC Davis Shuttle collected during November 2023, December 2023, and January 2024, is used to inform the scheduling model. Several assumptions are made: passenger demand is distributed evenly across 30 days per month, resulting in an average of approximately 24 passengers per day. Demand across all vertiports was modeled consistently, following the same Poisson distribution previously established for the Berkeley-Davis route. Flight durations were standardized to 40 minutes across all routes. For simplicity, the model only considers direct connections between linked vertiports (e.g., UC Berkeley to LLNL or NASA Ames to UC Santa Cruz), excluding multi-leg routes (e.g., UC Berkeley to UC Merced via LLNL). At this stage, potential Air Traffic Control (ATC) constraints around NASA Ames from Moffett ATC (KNUQ) were not considered.

Flight route selection

Routes and destinations shown in Fig. 12 are generated defined according to FAA regulations, with flight routes designed to minimize intrusion into controlled airspaces, favoring Class E and Class G airspaces. Visual Flight Rules (VFR) are employed under clear weather conditions, allowing pilots to navigate by sight, while Instrument Flight Rules (IFR) are used when visibility conditions such as fog, rain, or night operations demand instrument-based navigation [13].

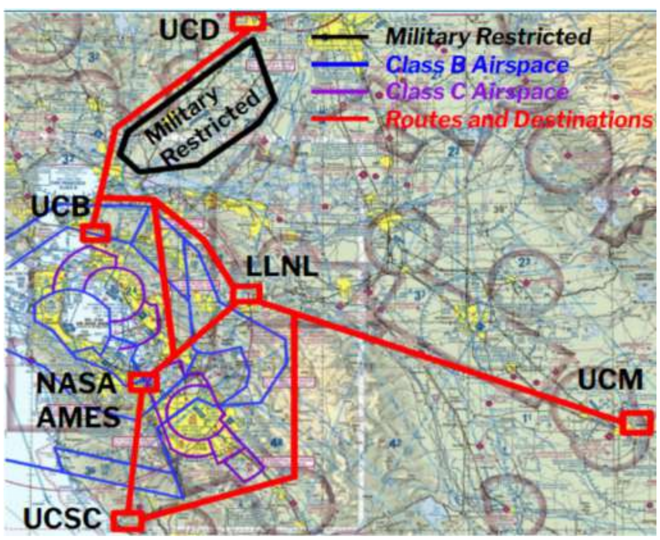

Figure 12. Flight Plan printed on Visual Flight Rules (VFR) Map including the red-boxed vertiport locations and solid red lines for eVTOL flight trajectory.

As outlined by FAA regulations, different airspace classes are determined by altitude. In Fig. 12, blue boundaries represent Class B airspace and purple boundaries represent Class C airspace, both typically associated with major airports and thus avoided to prevent competition with commercial airline traffic. While coordination with ATC is anticipated when necessary, minimizing reliance on ATC remains preferable for operational efficiency. The primary cruise altitude will be within Class E airspace, with operations in Class G airspace restricted to take-off and landing phases. However, flight paths near NASA Ames inevitably intersect Class B, C, and D airspaces, requiring mandatory coordination with ATC to ensure safe and legal passage. Further engagement with the FAA will be necessary to facilitate streamlined operations and airspace access.

UCAirLink's flight strategy prioritizes the use of Class E airspace for cruise operations and Class G airspace for take-off and landings, balancing safety, regulatory compliance, and operational efficiency.

Figure 13. Airspace Map from 1,000 ft to 18,000 ft MSL, including class B (6,000 - 10,000 ft MSL), class C (0 - 4,000 ft MSL), and class D (0 - 2,500 ft MSL)

Flight Time Assessment

The chart in Tables 7-8 provides a comparison the current travel times using ground transportation with the projected travel times via eVTOL. Current travel times were calculated based on average speeds and common commute routes, while eVTOL travel times are derived from the S4's cruise speed and the direct flight distances between locations. The total eVTOL travel time accounts for an additional ten minutes for gate operations and passenger disembarkation. No additional time was factored in for traditional modes of transportation, such as finding parking, starting a vehicle, or traffic delays, ensuring a conservative estimate of the time saved by using the eVTOL system.

Table 7. Travel Time Breakdown (Part 1)

Origin-Destination	Current Travel Time
UC Davis $\leftrightarrow$ UC Berkeley	1hr 25 mins (62.4 miles)
UC Berkeley $\leftrightarrow$ LLNL	1hr (39.6 miles)
UC Berkeley $\leftrightarrow$ NASA Ames	1hr 15 mins (45 miles)
NASA Ames $\leftrightarrow$ UC Santa Cruz	57 mins (39.6 miles)
LLNL $\leftrightarrow$ UC Merced	1hr 40 mins (91 miles)
LLNL $\leftrightarrow$ UC Santa Cruz	1hr 37 mins (74.1 miles)

Table 8. Travel Time Breakdown (Part 2)

eVTOL Travel Time	Opportunity Cost
27 mins (57.81 miles)	$88 (Current) / $40.7 (eVTOL)
24 mins (48.24 miles)	$60 (Current) / $37.4 (eVTOL)
28 mins (59.26 miles)	$82.5 (Current) / $41.8 (eVTOL)
18.5 mins (28.69 miles)	$57.2 (Current) / $31.35 (eVTOL)
42 mins (73.8 miles)	$110 (Current) / $57.2 (eVTOL)
31 mins (69.24 miles)	$106.7 (Current) / $45.1 (eVTOL)

Travel Architecture

In the initial phase of UCAirLink's deployment, a fixed-schedule travel architecture is implemented to provide regular and predictable service intervals based on anticipated demand patterns. To more accurately reflect real-world commuting behavior, passenger arrivals are modeled using a Poisson distribution, which captures peak demand periods at 8:00 am, 12:00 pm, and 5:00 pm. Noon is treated as a mid-peak period, accounting for more variable travel patterns during the day. Aircraft are deployed whenever cumulative demand exceeds four passengers, resetting the demand counter after each dispatch. Based on this model, scheduled flights from UC Berkeley to UC Davis depart at 7:48 am, 8:12 am, 8:36 am, 11:48 am, 4:54 pm, and 5:18 pm, as shown in Figure 15.

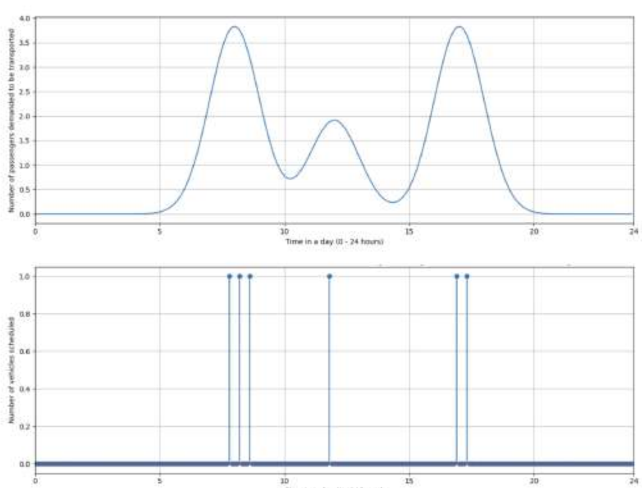

Figure 14. Passenger demand distribution and optimized vehicle scheduling for the UC Berkeley to UC Davis route.

Fixed-schedule operations differ from future flexible architectures in two principal ways: real-time decision-making for departure times is not required, and users are offered a set of predefined flight options. To optimize fixed-schedule deployment, the pulp optimization package in Python is used to solve the integral scheduling problem. The algorithm's pseudo-code is detailed in Listing 1, and the optimized results inform the operational model adopted during early system roll out.

A comparative analysis between eVTOL travel times and current ground transportation times illustrates significant gains in commuter efficiency. Ground transportation times are based on conventional estimates, while eVTOL travel times are computed from the cruise performance of the S4, with an additional 10 minutes incorporated to account for boarding and disembarkation operations. An opportunity cost analysis, based on the estimated hourly salary of UC Berkeley faculty members ($66 per hour), highlights the substantial economic and time-efficiency advantages associated with the proposed aerial mobility system.

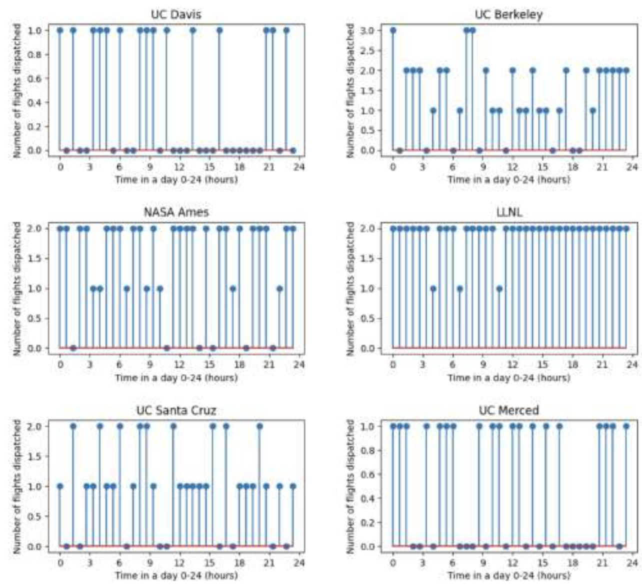

Figure 15. Expanded system schedule originating from UC Berkeley, accounting for six vertiport locations.

SOFTWARE

Route Database

The Route Database (RD) compiles three-dimensional mapping data of the UC Berkeley campus and surrounding areas, incorporating geographic, infrastructural, and regulatory features. Restricted airspaces, including those governed by FAA regulations, are incorporated into the database to ensure compliance with flight path planning requirements. In addition to official restrictions, community considerations are addressed through localized surveys and stakeholder interviews, identifying specific regions where residents and campus members prefer to minimize aerial traffic overhead. This integrated approach ensures that route generation prioritizes regulatory compliance and environmental sensitivity.

Fixed Schedule

Although flexible scheduling is a future objective, the system will initially operate under a fixed-schedule model to simplify early implementation. In fixed-schedule mode, the Client Application is streamlined by storing predefined departure times in the Route Database and presenting users with a standard booking pathway. Customers select from scheduled flights with available capacity without influencing departure times. Emergency bookings operate similarly but without additional charges, ensuring accessibility during urgent situations. The fixed scheduling optimization process is formulated using the pulp package in Python, where an integral optimization model determines the optimal distribution of flights based on expected demand.

```
% Minimize the total amount of dispatches
Min Objective function sum(dispatch(i,j,t,num)) as
    integers
% Define connections between stations
Define station connections[(i,j)]
num_vehicle[i,t] % Define problem variable for
    vehicle parking at station at time t
% Generate demand according to the Poisson
    distribution
for _ in 1000 test times:
    if in connections:
        demand_temp(i,j,t)     Poisson random peak
            (8,12,17) intensity (10,5,10)
    if not in connections:
        demand(i,j,t)     0
    % Average to lower influence of randomness
    demand = sum(demand_temp)/test times
    unserved_demand(i,j,t) % Define demand not sent
         yet at route (i,j) at time t
% Defined constraints
num_vehicles <= station_capacity % Cannot park more
     vehicles than station capacity
num_vehicles[i,t] == num_vehicle[i,t-1] + arriving
    dispatch - departure dispatch
% Update vehicle number at each station at time t
sum(dispatch(i,j,t)) over destinations j <=
    num_vehicles(i,t)
unserved(i,j,t) == unserved(i,j,t-1) - demand sent
    by dispatch + new demand at t
% Update the demand to be served at each station at
     time t
served(i,j,t) <= unserved(i,j,t) % Cannot send more
     than unserved demand at station i at time t
2*dispatch <= served(i,j,t) <= vehicle_capacity*
    dispatch
% Only send dispatch of 2-4 passengers
% Optimize dispatch schedule
Optimizer     dispatch(i,j,t,num)
% Extract schedule information
for i in stations 1-6:
    form the table (source station i, destination
        station j, departure time t)
```

Listing 1. Pseudo Code for Fixed Schedule Algorithm

IMPLEMENTATION PLAN

Successful deployment of the aerial transportation system depends on collaboration with several key stakeholder groups. These include the FAA, academic institutions, research centers, private-sector aviation companies, faculty and research communities, and government agencies. Each plays a distinct role in enabling system implementation. The FAA is responsible for certifying eVTOL aircraft, approving operational procedures, and overseeing regulatory compliance.

Regulatory compliance forms a cornerstone of the project's execution strategy. Required clearances include operational permits for eVTOL flights across multiple airspace classes, initial authorization to operate under Visual Flight Rules (VFR), and potential future authorization under Instrument Flight Rules (IFR) conditions. Additional regulatory requirements include site-specific clearance for vertiport takeoff and landing operations, adherence to vertiport security protocols, firefighting and emergency response planning, and compliance with ongoing maintenance standards for both aircraft and ground facilities. A comprehensive suite of permits, emergency procedures, and airspace coordination protocols must be established to ensure safe, legal, and reliable system operations from initial deployment through full-scale expansion.

Estimated Cost

The total estimated cost of the transportation system is \$33,000,000. However, the highest cost is the aircraft cost, at \$28,000,000. The tables below breaks down the considered cost variables:

Table 9. System Cost Estimate: Calculation Basis.

Item	Calculation Basis
Vertiport Construction	-
Joby S4	-
Site Preparation	15% of const
Environmental Mitigation	3% of const
Prelim Eng + Env Review	2.5% of const
Program and Design Management	5% of const
Final Design	5% of const
Construction + Procurement Management	5% of const
Risk Management	6% of const
Contingency Cost	25% of const

Table 10. System Cost Estimate: Total Item Costs.

Item	Total Cost ($)
Vertiport Construction	3,000,000
Joby S4	28,000,000
Site Preparation	450,000
Environmental Mitigation	90,000
Prelim Eng + Env Review	75,000
Program and Design Management	150,000
Final Design	150,000
Construction + Procurement Management	150,000
Risk Management	180,000
Contingency Cost	750,000
Total Cost	**32,995,000**

CONCLUSIONS

This paper presents UCAirLink, an integrated eVTOL-based Urban Air Mobility system designed to enhance commuter efficiency across the SF Bay Area network. UCAirLink's system architecture encompasses vehicle selection, vertiport infrastructure design, operational scheduling, regulatory compliance, and environmental sustainability considerations. Through detailed trade studies and system modeling, the S4 emerges as the optimal vehicle and preliminary analysis shows that UCAirLink can achieve a threefold reduction in travel times compared to existing ground-based transportation methods. UCAirLink establishes a scalable and sustainable foundation for the future of regional aerial mobility between the four CITRIS campuses.

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