Advancing ATM for AAM

Advancing ATM Infrastructures to Accommodate and Integrate Modern, Environmentally-Sustainable Advanced Air Mobility.

BearCat AEL

A bit about me

Mr. Noppadol Pringvanich is the Chief Executive Officer of **BearCat AEL Co. Ltd**, an international aviation consulting and training firm based in Bangkok, Thailand. He is serving as the national technical expert on Communications, Navigation, and Surveillance (CNS) for the **Civil Aviation Authority of Thailand**. He is also a Member of Thailand Technical Working Group on Unmanned Aviation System Integration, and a technical advisor to **ICCAIA**.

Before BearCat, Noppadol served as the Head (global) Air Traffic Management Engineering and Aviation Spectrum for International Air Transport Association (**IATA**), Montreal, Canada, where he was responsible for IATA global policies on air traffic management engineering, related avionics and aviation uses of frequency spectrum. He also served as the Chief, Asia-Pacific Regional Sub-Office (RSO) for the International Civil Aviation Organization (**ICAO**) where he established and led the ICAO office in Beijing, China. From 2020-2022, Noppadol also served as the Chairman of ICAO Communications Panel, responsible for developing and amending various ICAO technical Annexes. He had also served as a Member of ICAO Navigation Systems Panel, Surveillance Panel, and Frequency Spectrum Management Panel and led IATA delegation to ITU World Radio Communication Conferences.

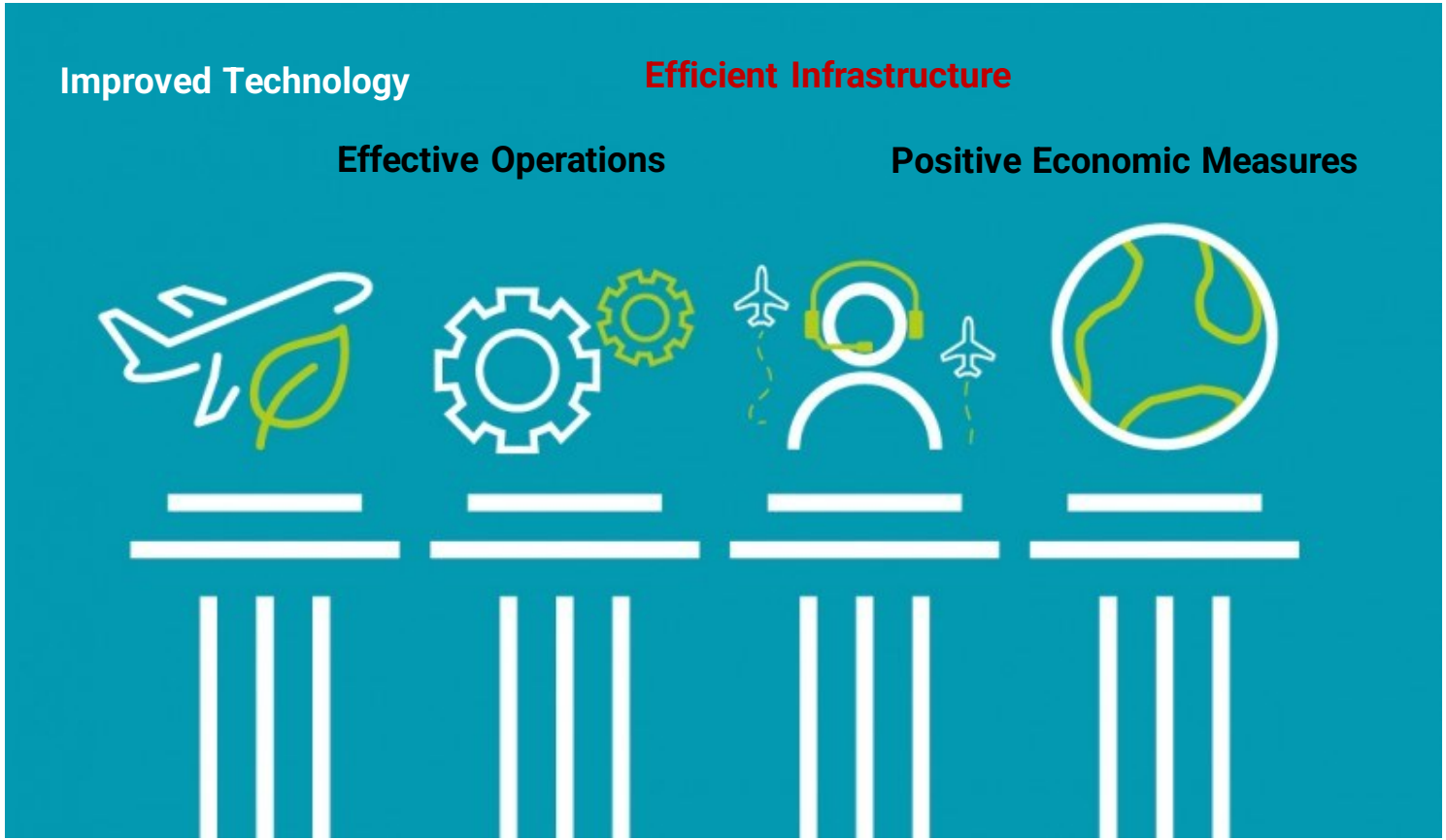
Prior to his international career, Noppadol served as **AEROTHAI**'s Director of Flight Procedure and Airspace Development. He received his Bachelor and Master of Science in Electrical Engineering from **Stanford University**, USA. He can be contacted via emailing **ceo@bearcat.co.th.**

BearCat's Areas of Expertise

- Communications, Navigation, Surveillance (CNS) infrastructures and avionics
- Air Traffic Management (ATM) and Air Traffic Flow Management (ATFM)
- Airport Master Plan and Airport Collaborative Decision Making (A-CDM)
- Airspace design and Optimization and Instrument Flight Procedure Design (IFPD)
- Aeronautical Information Services and Management (AIS/AIM)
- aeronautical frequency spectrum management
- aviation Safety Management and
- integration of new airspace users including UAS Integration.

Our team members have a wealth of strategic, project/product management experiences on aviation, transportation, and telecommunication industries at global, regional, and national levels. We have a solid understanding and deep insight on goals and expectations of aviation stakeholders and how to engage and influence regulators, airlines, air navigation service providers and airports. They have proven successes in commercializing new CNS/ATM products and services with recurring customers and solid revenue streams.

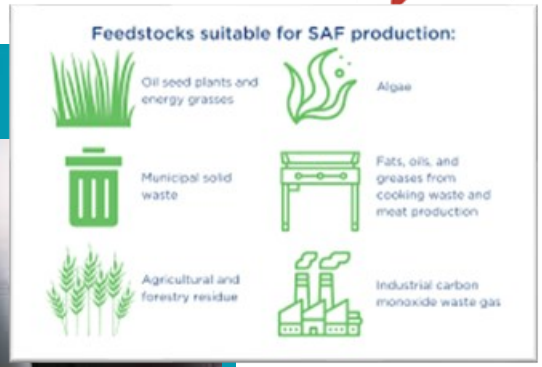
4-Pillar Strategy for Sustainable Aviation



4-Pillar Strategy for Sustainable Aviation

Improved Technology

- Sustainable Aviation Fuel
- Efficient Engine
- Efficient Aircraft Design



Advanced Air Mobility (AAM)

Advantages

Due to their low emissions and noise, these aircraft are well-suited for applications both within cities and between them.

Usages

Powered-lift operations have the potential for a variety of uses, from passenger transport in urban settings to short-haul operations such as air ambulance services and cargo.

Prepare for Take-off

The US FAA has issued a final rule for the qualifications and training instructors and pilots need to fly the next-gen aircraft, like eVTOLs, which have characteristics of both airplanes and helicopters. This ruling will address operational requirements, including minimum safe altitudes and required visibility.

Comparing AAM with Helicopters: Emission

- A study compares CO2 emissions per passenger seat and km flight distance between AAM eVTOL and selected helicopter models.

Aircraft	CO2 emission (kg/PAX-km)
Helicopter – Robinson R44	0.21
Helicopter – Airbus Helicopter H145	0.35
Helicopter – Bell 206	0.37
AAM eVTOL – Multi-copter configuration	0.14
AAM eVTOL – Tilt-roto	0.05

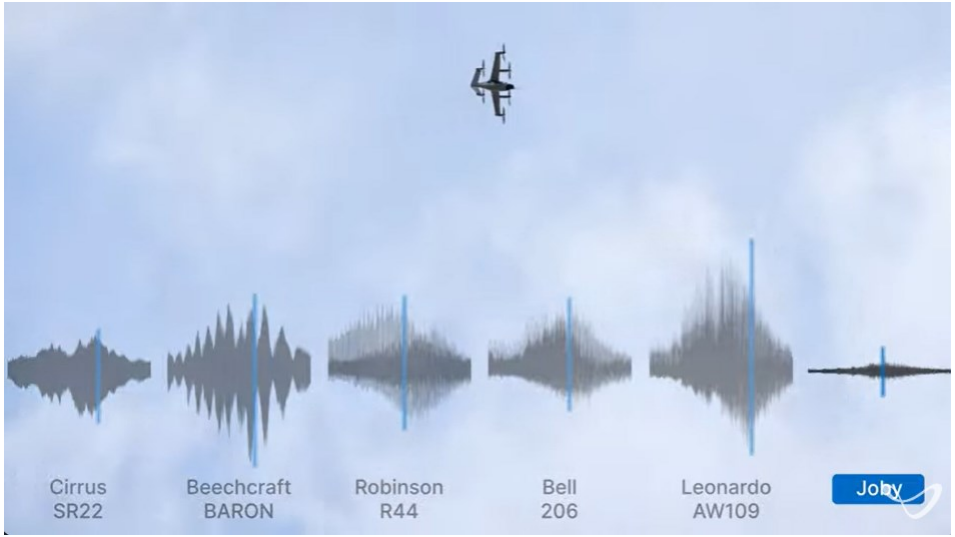
Note: The data is based on an average values for 8 different routes starting from Place de la Concorde in Paris and going to 8 different destinations with distances between 2 km and 29 km. Please note that for eVTOLs CO2 emission depends on eVTOLs' configuration.

Reference : https://arxiv.org/pdf/2310.01417#:~:text=In%20contrast%2C%20for%20regional%20travel,96%25%20more%20than%20electric%20trains.

Zero emissions in flight: eVTOL AAM are electric, which means they do not produce any carbon emissions during flight. This makes them more environmentally friendly than conventional aircraft that rely on fossil fuels.

Comparing AAM with Helicopters: Emission

Quieter operation: AAM sVTOL's electric motors are much quieter than traditional aircraft engines, and the distributed propulsion architecture in eVTOLs uses smaller propellers which make considerably less noise as compared with a large helicopter rotor. Their quiet operation makes eVTOL aircraft more suitable for use in populated areas.

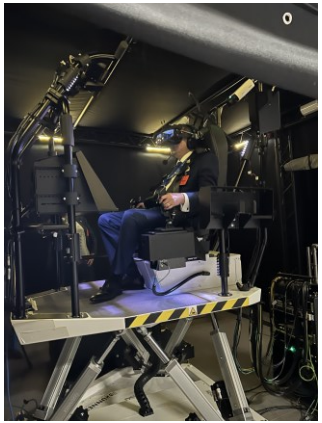


This is a demonstration by Joby - one of the leading eVTOL design and manufacturers based in the USA

VDO Link

Reference : https://www.youtube.com/watch?v=itP8-3j2UZI&ab_channel=JobyAviation

AAM – Ready for take off



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To Unlock Potential in Thailand and SEA

Regulatory Framework

Working with the CAAs to establish a legal framework for safety and collaborating with local governments to foster public acceptance

Airspace Integration

designing air routes and infrastructure to serve various destinations, considering safety, efficiency, and existing air traffic at major airports

Catalyst in 2024-2025

Certification of a new type of aircraft by US, EU, and Chinese regulators in 2024-2025, and successful implementation in other countries, will catalyze operations and commercialization in Thailand and SEA

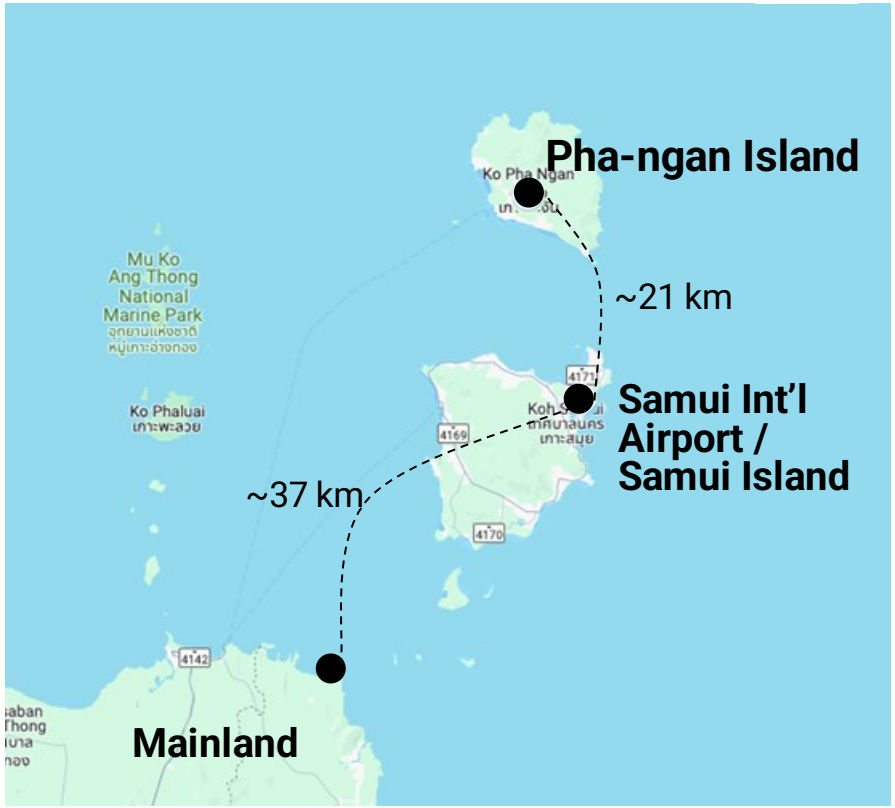
Samui & Pha-ngan Island

2.3 Million passengers at Samui International Airport in 2023. Samui island is a well-known tourist destination.[1]

1 Million tourists are attracted to Pha-ngan island annually (pre-covid)[2]. The island, accessible only by boat, is famous for its Full Moon Party.

AAM in Samui & Pha-ngan

- Transportation of ***passengers*** between Samui-Pha ngan and Samui-mainland
- ***Medical transportation*** (patients and medical supplies) between the islands and mainland
- ***Aerial sightseeing*** Samui-Phangan-Ang Thong National Marine Park



1. CAAT's State of Thai Aviation Industry Report 2. https://asia.nikkei.com/Life-Arts/Life/Thai-tropical-paradise-finds-opportunity-in-adversity

Eastern Economics Corridors (EEC)

U-Tapao Airport as a hub to connect passengers to key locations within the 50 km radius

Business and Leisure travellers

AAM can serve both business travellers visiting industrial estate in EEC and leisure travellers visiting Pattaya and other tourist attractions

Medical transportation - transportation of patients and medical supply between mainland and islands around the area

Ship-to-Shore transportation of goods, document and passengers within the seaports

Strategic Fit with the government's initiative to develop transportation infrastructure in EEC. Various government support are available.

Chiang Rai - Gateway to the North

1.9 Million passengers at Chiang Rai Airport in 2023.[1]

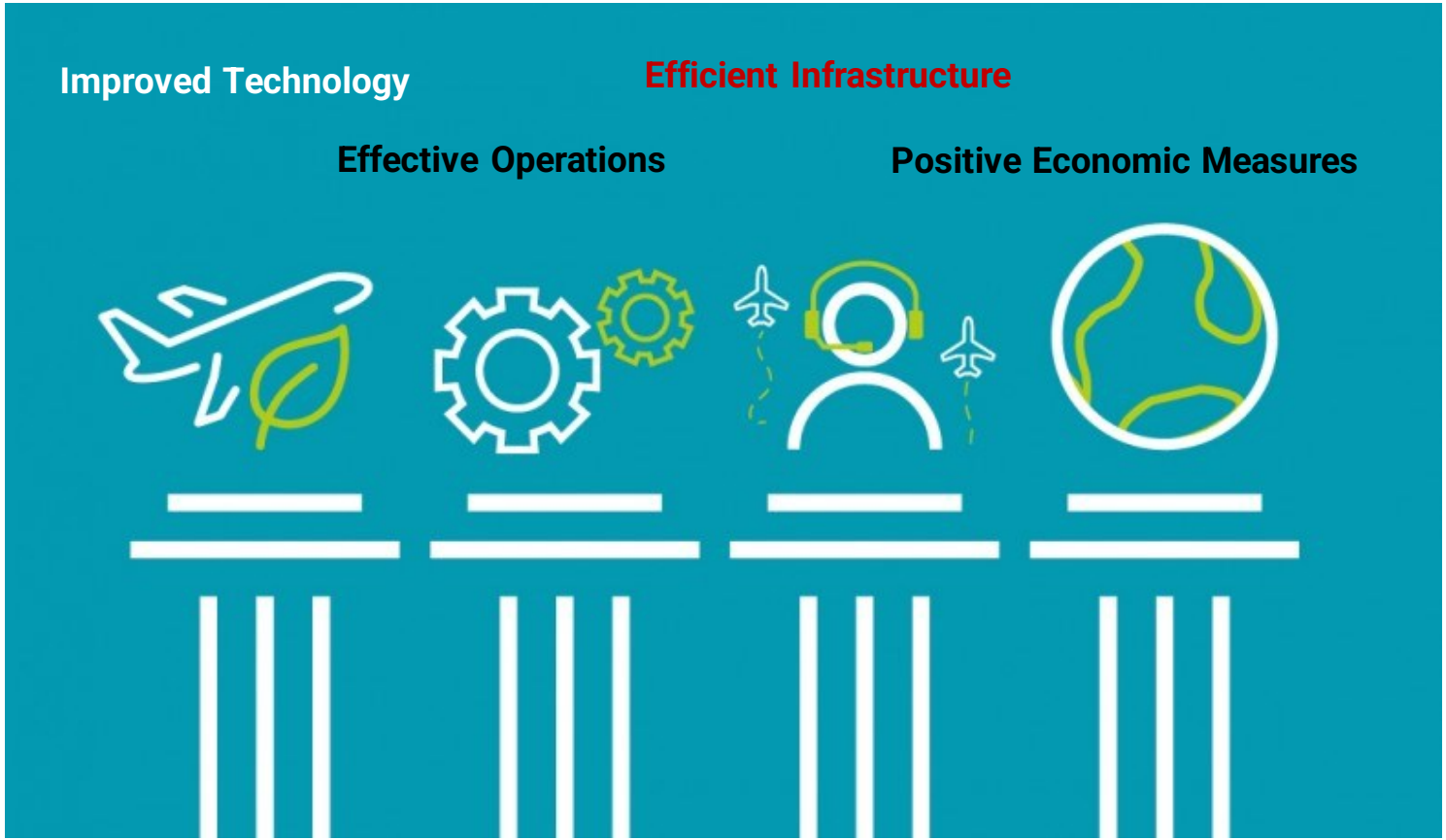
86.6 Million USD investment is expected in the Golden Triangle Special Economic Zone[2]

AAM in Chiang rai-Bokeo

- ***Passenger transportation*** from Chiang Rai Airport over the Thai-Lao border to the Golden Triangle Special Economic Zone
- ***Medical transportation*** from neighboring countries to well-equipped hospitals in Thailand

1. CAAT's State of Thai Aviation Industry Report 2. https://investlaos.gov.la/where-to-invest/special-economic-zone-sez/golden-triangle-special-economic-zone/

4-Pillar Strategy for Sustainable Aviation



4-Pillar Strategy for Sustainable Aviation

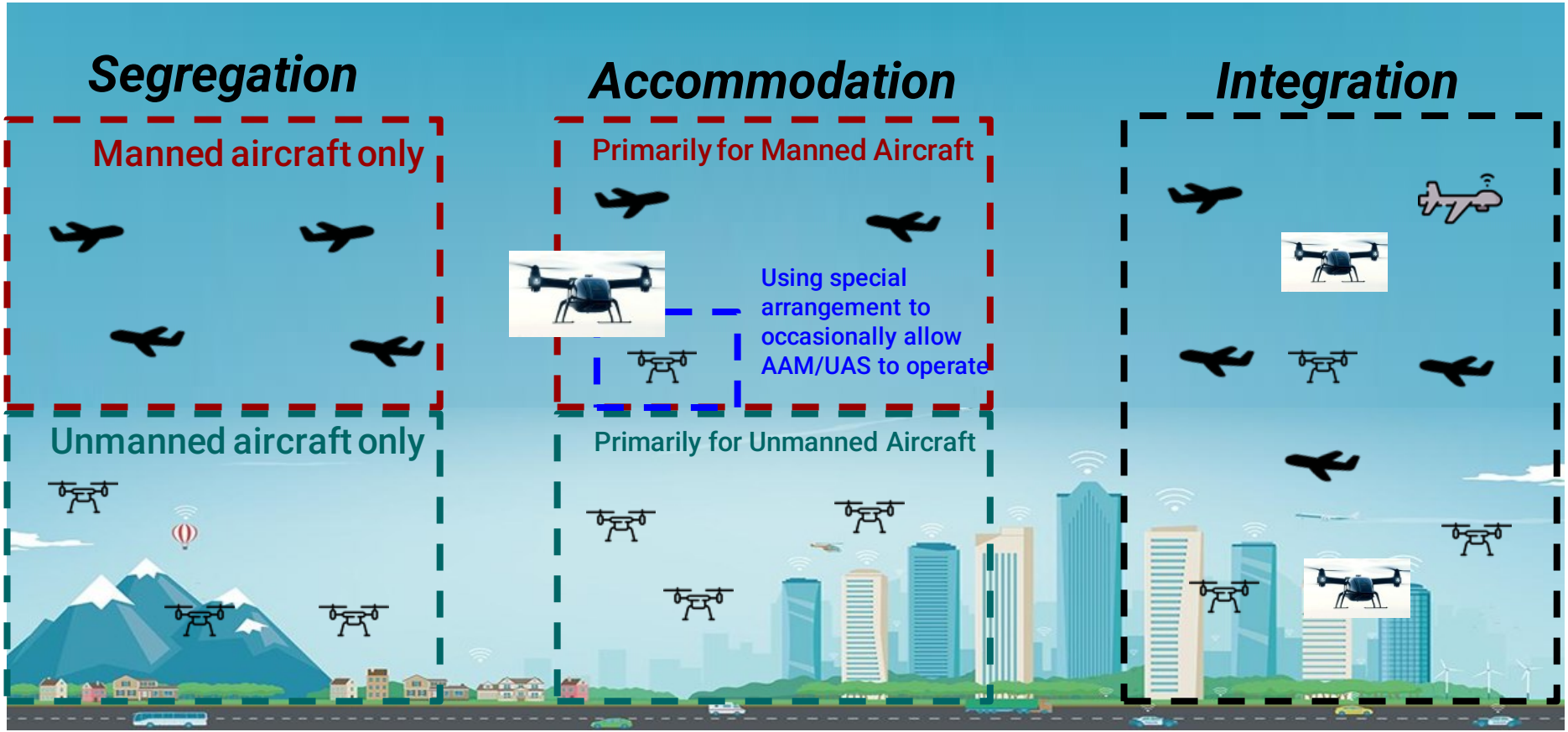
Efficient Infrastructure

- Airport
- Airspace
- Air Traffic Management

Introduction ->
Accommodation ->
Integration

Why Integration?

Segregation > Accommodation > Integration



Why Integration?

Increasing Demand

- Increasing no. of UAS
- Total of 628 manned aircraft registered in Thailand vs 21,000 UAS registered in 2023 alone

New type of Aircraft

- New & more advanced aircraft leads to new applications
- Ex. AAM, Passenger drones, delivery using BVLOS ops

Safety, Efficiency & Security

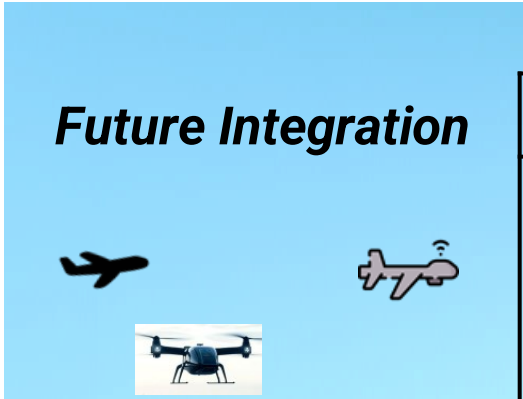
- Not just integration but a safe, secured and efficient integration

Introduction ->
Accommodation ->
Integration

Infrastructure

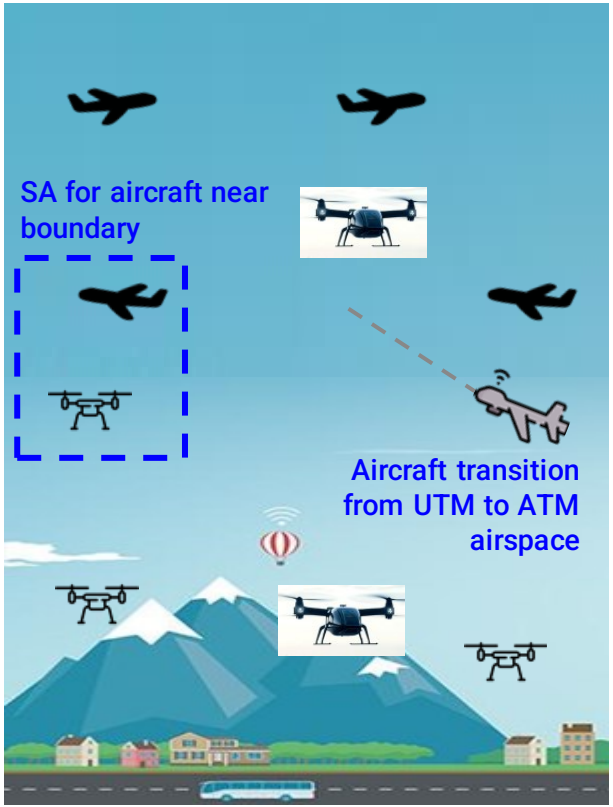
For AAM, UTM & ATM

Potential Future Scenarios



	Current	Future
Upper Airspace	• Managed by traditional Air Traffic Management (**ATM**) • Manned aircraft are allowed. UAS are occasionally given permission to fly in this airspace	• Managed by **ATM** • Conventional aircraft, AAM and UAS are allowed
		• Coordination / interaction between ATM-UTM
Lower Airspace	• Not used by manned aircraft except for take-off & landing and in emergency situations • Available for UAS and potentially AAM • No traffic management	• Managed by **UAS Traffic Management (UTM)** • Conventional aircraft, AAM and UAS are allowed

UTM-ATM Coordination/Interaction



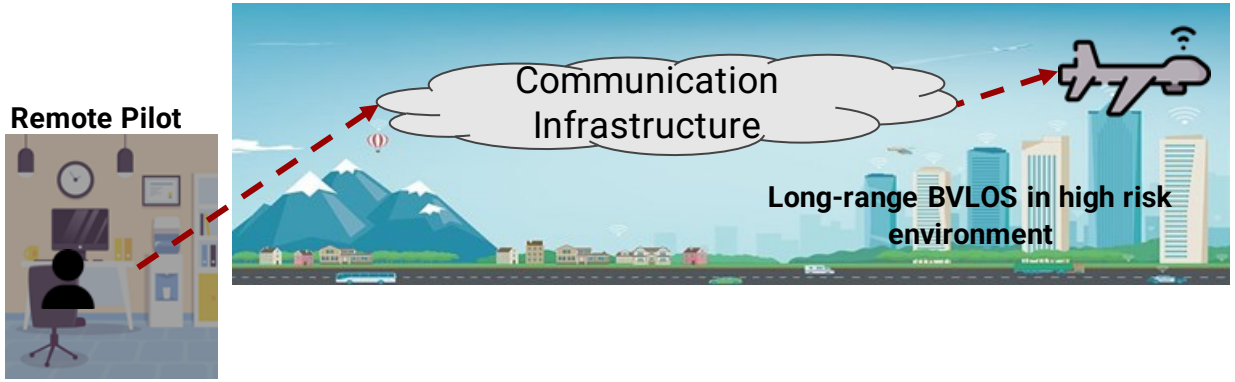
- Why ATM-UTM Coordination?
  - Situational Awareness for ***aircraft operating near the boundary*** between ATM & UTM airspace
  - Information sharing for aircraft ***transiting*** through both airspace

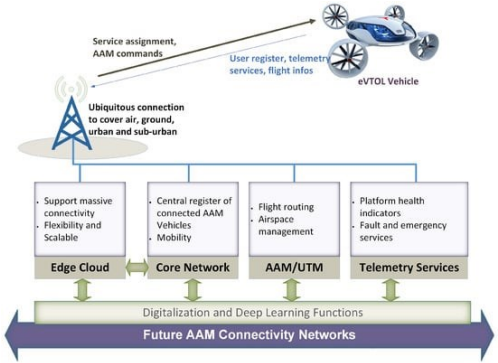
- ATM-UTM Coordination:
  - ***Info Sharing*** - data to be shared, data quality
  - ***System Integration*** - to consider system availability and security

Introduction ->
Accommodation ->
Integration

Communication, Navigation & Surveillance (CNS) Infrastructure

C - Communication





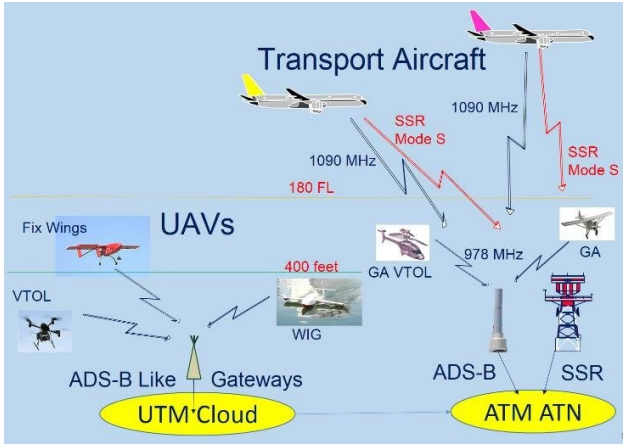
- Communication Infrastructure to support C2 Link between remote pilot and his aircraft
- [Operation in ATM Airspace] Communication Infrastructure to support pilot-ATC communication
- [Operation in UTM Airspace] Communication Infrastructure between aircraft and UTM
- To consider security, latency, integrity, availability and frequency spectrum

N - Navigation

- Characteristic of navigation system - accuracy, integrity, continuity
- GPS-challenged environments (e.g. urban) making GPS as a sole mean for navigation insufficient.

- Requirement on aircraft navigation capability (Nav Spec) differs from airspace to airspace (depending on risk, terrain and obstacles)
- Harmonized position reference: Conventional aircraft, AAM and UAS may use different position reference system (ex. Pressure altitude vs height above ellipsoid vs height above local terrain)

S - Surveillance



- Surveillance / Tracking:
  sharing aircraft location among UTM/ATM/AAM

- Available technology
  - Sharing location of aircraft via Internet Protocol (5G/4G)
  - Sharing location via a dedicated communication channels
  - Coventional aircraft surveillance technology such as ADS-B

- Consideration
  - Data quality (integrity, latency, availability etc.)
  - Security
  - Scalability - ability to handle vast number of aircraft such as frequency saturation

Make it Happen for Thailand and SEA

Proposed AAM Implementation Strategy

The three-phase strategy for AAM Operation Trail in Thailand

Phase I

One-time demo Flight to showcase AAM Technology

- **One-time test/demo flight**
- **Location** : Flying within a confined space for that airfield or within the CAAT regulatory sandbox, such as EEC WangChan Valley. Airspace structure (i.e. routes for other aircraft above the airfield) should also be considered when selecting the airfield. The more complex the airspace, the longer and harder the regulatory approval process.

Phase II

Regular/Scheduled Flights

- **Regular & scheduled flights** in sparsely populated tourist area
- **Location :** Carefully selecting locations based on your business strategy and *'risk in the air and on the ground.'* The lower the risk the easier and faster the approval process. However, we also understand that AAM operators don't want to fly in the middle of nowhere.
- Collecting more safety data for CAAT approval for the next phase

Phase III

More populated areas

- **Regular & scheduled flights** in more populated tourist area (allowing AAM operators more opportunities to do advertising/PR for the services)
- Collecting data and preparing for approval/certification to operate commercially

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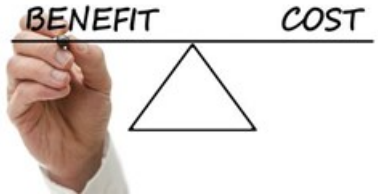
Make it Happen for Thailand and SEA

Infrastructure enables integration & advanced ops



It comes with cost and benefit

Don’t wait but start experiment

Plan together

BEARCAT
Aviation.Engineering.Logistics

Contact Information:

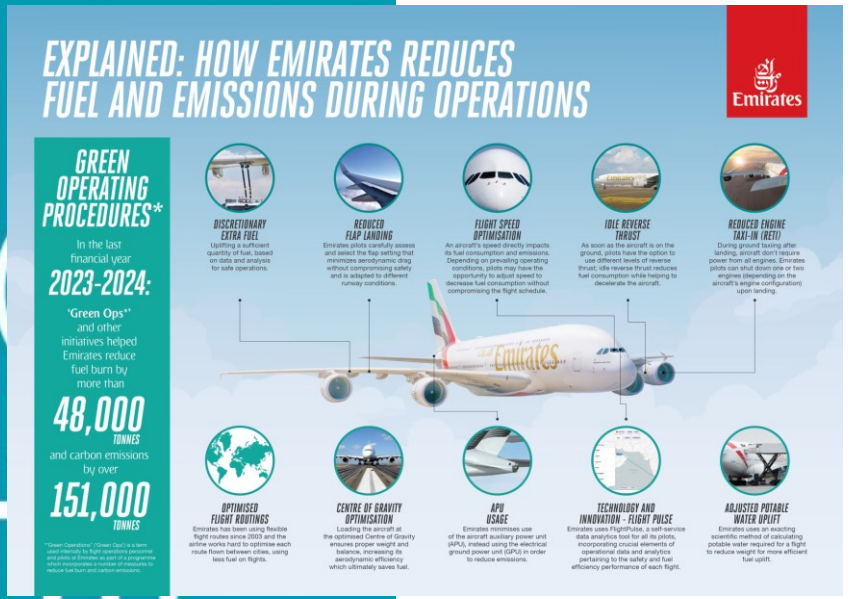
Mr. Noppadol Pringvanich

Mobile: + 66 93 058 8555 (Thailand)
+ 1 438 458 8822 (Canada)
Email: ceo@bearcat.co.th
Facebook: https://www.facebook.com/flyingbearcat
LinkedIn: https://www.linkedin.com/company/flyingbearcat

4-Pillar Strategy for Sustainable Aviation

Effective Operations

- Discretionary extra fuel
- Efficient ground procedures
- Efficient flight profiles and routing



4-Pillar Strategy for Sustainable Aviation

Positive Economic Measures

- LTAG
- Carbon Credits and CORSIA
- Government Supports

Who are we?

- BearCat AEL is an international aviation training and consulting company.
  - with in-depth aviation knowledges, solid technical, operational and regulatory experience and innovative processes and technologies.

- At Bearcat AEL, we
  - accelerate operational improvements and integrations of modern, complex procedures and new airspace requirements,
  - streamline coordination among key stakeholders,
  - are fully aligned with global ICAO standards, and
  - are localized to local regulations and requirements.

BearCat's Services

- advanced and Integrated trainings for aviation personnel
- policy development and investment planning for airspace users, air navigation service providers, and airports,
- avionics and CNS/ATM infrastructure master planning/roadmaps,
- airspace design and optimization,
- engineering/operational performance and system design,
- safety and cybersecurity risk assessments and aeronautical studies
- global/international standardization process,
- deployments and commercialization of CNS/ATM technologies.