Abstract
Vertiport airside management services for highly automated traffic management in advanced U-space

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Innovative air mobility is a novel concept that is designed to augment the existing transport networks with safe, secure and sustainable air mobility in a new integrated multi-modal transport system. The main business cases involve inner city and regional passenger transport, cargo operations, and specialized transports of medical personnel and goods using new types of vertical take-off and landing capable aircraft (VCA). A baseline for this new mobility is U-space, introduced by the European as an initial regulatory framework for unmanned aircraft traffic management, see [1, 2, 3]. U-space, as currently envisioned, focuses on a set of services that need to be used for an aircraft to enter an airspace that is declared U-space. The vision of IAM extends the base U-space concepts to also include highly complex operations in the specific as well as the certified categories. A more complex set of services, as well as a more extensive set of stakeholders are required to facilitate the safe integration of a high number of airspace users in a highly automated traffic management system.

One of these stakeholders is the vertiport. It provides the facilities and services needed to enable VCA operations and serves as the intermediary node between air and ground transportation in a multi-modal transport system. To define the airside procedures for VCA at a vertiport, we have to consider several points. 1. Only a remote pilot might control a VCA. 2. VCA will have lower energy capacities than conventional traffic with high energy consumptions in hover and vertical flight and 3. Urban vertiports are integrated in highly complex environments from obstacles to highly local weather conditions.

In this presentation we focus on three main services that enable highly automated procedures of VCA operations at a vertiport, i.e., vertiport availability, vertiport dynamic capacity management, and emergency management, for the airside management of VCA inside a vertiport traffic zone (VTZ) and at the vertiport itself. The VTZ is not a separate airspace, however it serves similar functions to the terminal airspace around airports. Inside this zone, the vertiport will take over some of the functions of the USSP, e.g., conformance monitoring and strategic deconfliction for the aircraft flying inside this zone.

Vertiport Availability is the main service that is provided by the vertiport, which is used in the U-plan creation process as well as in the tactical phase to provide real-time resource and route availability information to VCA that want to use the vertiport for an arrival, departure, or a contingency operation. The availability is ensured by using a slot-based approach which reserves the necessary infrastructure elements of the vertiport for the booked operation. To depart or arrive at a vertiport such a slot is needed to be booked in the strategic phase, with possibly only a short time before the start of the flight. The slots are booked on demand and do not follow an a-priori fixed schedule. For more information on the process of booking such slots see [4]. All infrastructure elements of the

slot and the associated route between the FATO and a transition point at the edge of the vertiport traffic zone (VTZ) are monitored in real-time to ensure their availability for the operation using a variety of sensor data to provide the remote pilot with the accurate information necessary to perform the operation as no visual verification is possible by a pilot on-board, see point 1.

Vertiport Dynamic Capacity Management is a supporting service with direct ties to vertiport availability. The focus of this service is on generating routes for the VCA to follow between the FATO and the transition point at the edge of the VTZ. These routes are highly complex that rely on the local environment in their creation as specified by the 3. point. While most ground obstacles, like surrounding buildings, are fixed in their position, the routes have to respect local weather conditions, noise and visual pollutions and other dynamic factors. A selection or generation of a route is performed based on forecasts of these factors as part of the slot booking process in the vertiport availability service taking the energy constraints, see 2. point, into account. However, they are also monitored during the whole flight time and are dynamically updated as necessary. As part of this monitoring process, the routes are used to absorb delays of flights by adjusting the route or the speed of the aircraft in the route to avoid longer holding pattern that might not be feasibly for the lower energy capacities of the VCA as stated in point 2.

Emergency Management is the third service provided by the vertiport. It has again direct ties into the vertiport availability in the form of contingency slot bookings to provide the required landing options as specified by EASA [5]. In case of emergencies in the vertiport traffic zone that cannot use a pre-specified contingency option directly, the vertiport emergency management service will ensure that a landing spot is cleared and all affected traffic is handled in a safe way until the emergency operation is concluded.

[1] European Parliament (2021). Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space. Official Journal of the European Union.

[2] European Parliament (2021). Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic management/air navigation services and other air traffic management network functions in the U-space airspace designated in controlled airspace. Official Journal of the European Union.

[3] European Parliament (2021). Commission Implementing Regulation (EU) 2021/666 of 22 April 2021 amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space airspace. Official Journal of the European Union

[4] Bassimir, Bernd (2026) Initial concepts of availability and slot management for high density vertiports operations in advanced U-space. In: DICUAM Delft International Conference on Urban Air Mobility 2026, 2026-03-25 – 2026-03-27, Delft, Netherlands

[5] European Parliament. Commission Implementing Regulation (EU) 2024/1111 of 10 April 2024 amending Regulation (EU) No 1178/2011, Implementing Regulation (EU) No 923/2012, Regulation (EU) No 965/2012 and Implementing Regulation (EU) 2017/373,

as regards the establishment of requirements for the operation of manned aircraft with a vertical take-off and landing capability, 2024.

Biography

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Bernd Bassimir is a scientific researcher at the DLR Institute of Flight Guidance with a focus on services provided at a vertiport. He studied computer science at the Friedrich-Alexander-Universität Erlangen-Nürnberg and is pursuing his Ph.D. with a focus on robust optimization in timetabling.