

DICUAM 2022

**Delft International Conference
on Urban Air-Mobility**

On-site and online: March 22-24, 2022



TU Delft

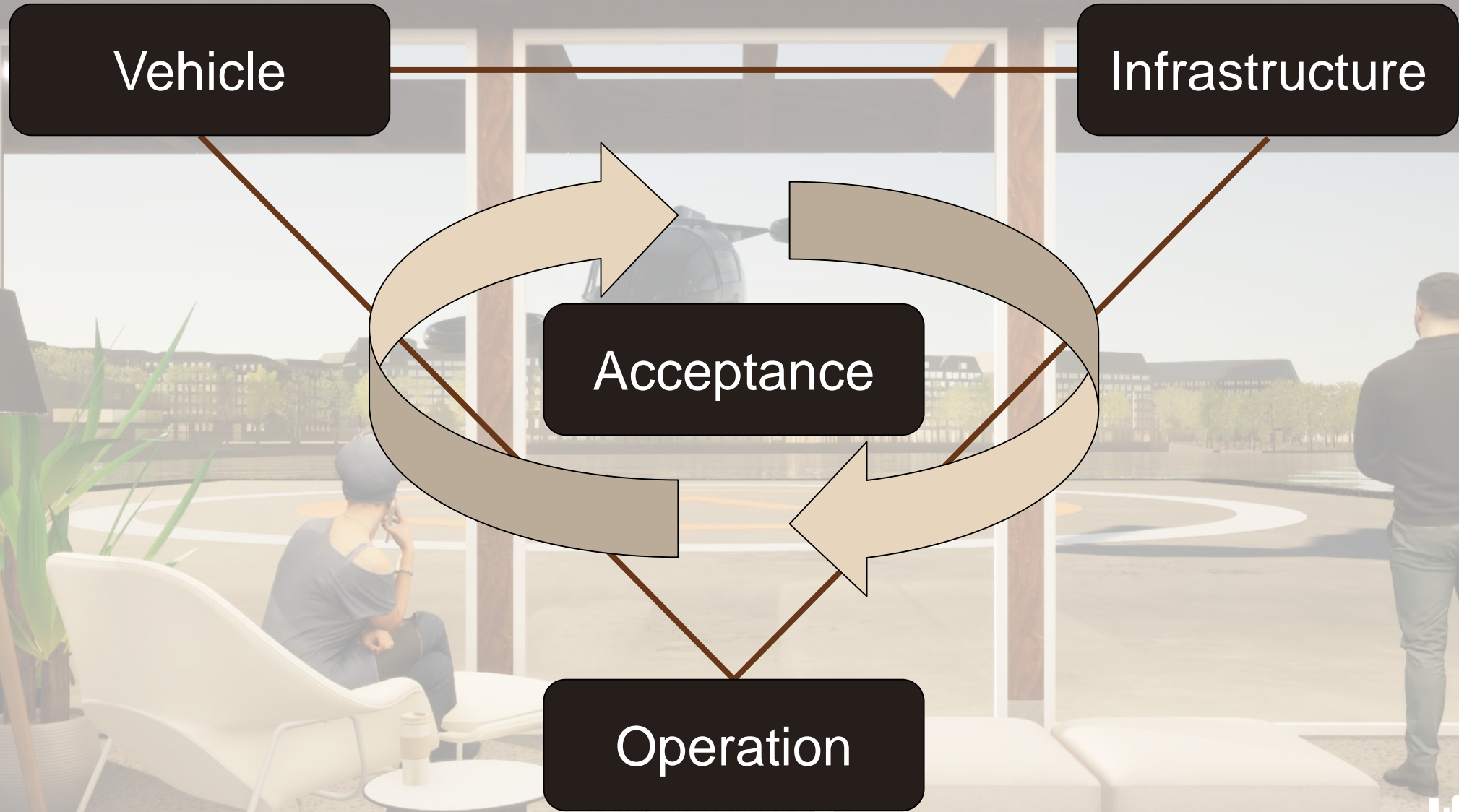
More than an Air Taxi – Intermediate Results of DLR’s HorizonUAM Project

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Urban Air Mobility Research at the German Aerospace Center (DLR)

Objective: Assessment of chances and risks of air taxis and urban air mobility (UAM) concepts

Main content

- Forecast of UAM market share
- Model-based UAM system simulation
- Air taxi vehicle system development
- Flight guidance concepts for vertidromes
- Public acceptance
- Airport integration of UAM traffic
- Scaled flight demonstrations in model city

📅 Duration: 07/2020 – 06/2023 (36 months)

📅 Scope: 51.4 PJ (FL: 19.6) / 9.0 M€ (FL: 3.2)

👤 Participants: DLR FL (lead), AT, FT, FW, KN, LY, ME, PA, SL, UX

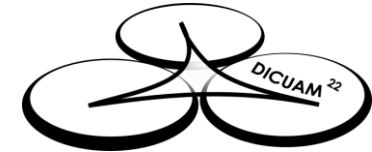


Further reading:

- B.I. Schuchardt et al., Urban Air Mobility Research at the DLR German Aerospace Center – Getting the HorizonUAM Project Started, AIAA Aviation, 08.2021, <https://doi.org/10.2514/6.2021-3197>

Vehicle



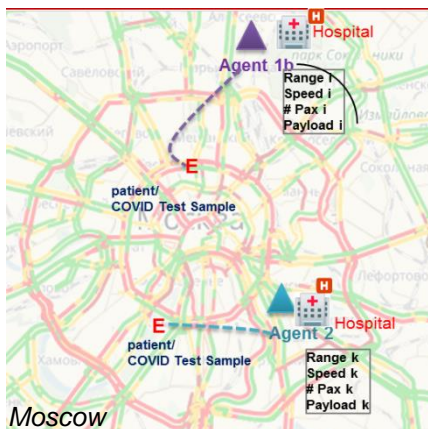


Top Level Aircraft Requirements

System-of-system Simulation

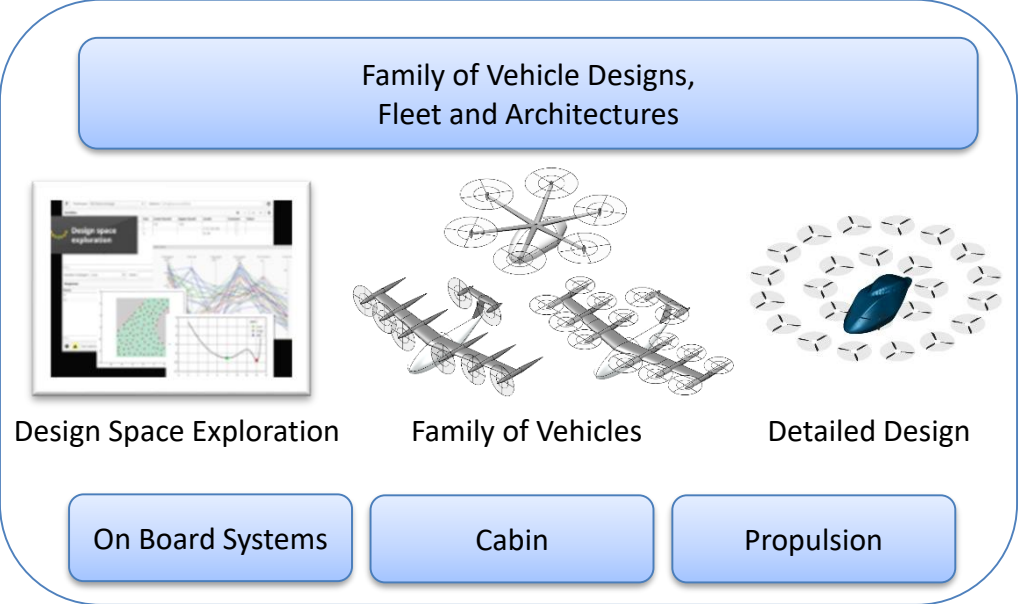
Many Unknown Unknowns:

- TLAR of aircraft or fleet
- Homogeneous or heterogeneous fleet
- Point to point or hub & spoke
- Speed, range, etc.



To convert :
“Unknown” Unknowns
 → **“Known” Unknowns**
 Agent based and discrete event simulation for vehicle/family design

For multiple scenarios
 Multiple concept vehicles



DICUAM 2022:
Tackling the Threat of Wildfires: Design and Assessment of Advanced Aerial Firefighting Fleets,
 Prajwal Shiva Prakasha, Nabih Naeem, Patrick Ratei, Nazlican Cigal, Björn Nagel,
 Thu. 13:40-14:00

Further reading:

- P.S Prakasha et al., Aircraft architecture and fleet assessment framework for urban air mobility using a system of systems approach, Elsevier Aerospace Science and Technology, Special Issue 'DICUAM 2021', 09.2021, <https://doi.org/10.1016/j.ast.2021.107072>
- P.S. Prakasha et al., System of Systems Simulation driven Urban Air Mobility Vehicle Design and Fleet Assessment, AIAA Aviation, 08.2021, <https://doi.org/10.2514/6.2021-3200>
- O. Bertram, Impact of different powertrain architectures on UAM vehicle concepts, DLRK, 09.2021



Infrastructure



- K. Schweiger et. al., An exemplary definition of a vertidrome's airside concept of operations, Elsevier Aerospace Science and Technology, Special Issue 'DICUAM 2021', 10.2021, <https://doi.org/10.1016/j.ast.2021.107144>
- K. Schweiger et al., Urban Air Mobility: Vertidrome Airside Level of Service Concept, AIAA Aviation, 08.2021, virtual, <https://doi.org/10.2514/6.2021-3201>

Vertidrome Airside Level of Service



How do we decide if a vertidrome satisfies our requirements from an operational perspective?

Vertidrome Level of Service (VALoS) Concept

		Who?	What?	How?		
		Stakeholder Requirements				
		Reference	Passenger	VTOL Vehicle	Vertidrome	
VALoS	Acceptable	Flow [Processed Operations/ Time Interval]	$\emptyset d_{PAX}$	$t_{AFT} - t_{NFT}$	$\geq 95\% \text{ Flights} \leq d_{TF}$	Metric
			$\leq 2 \text{ Minutes}$	$\leq 5 \text{ Minutes}$	$d_{TF} = 2.5 \text{ Minutes}$	Objective
	Non-Acceptable		$\emptyset d_{PAX}$	$t_{AFT} - t_{NFT}$	$< 95\% \text{ Flights} \leq d_{TF}$	Metric
			$> 2 \text{ Minutes}$	$> 5 \text{ Minutes}$	$d_{TF} = 2.5 \text{ Minutes}$	Objective

Nomenclature

d=delay
t = time (duration)
AFT = actual flight time
NFT = nominal flight time
TF = total flight
PAX= passenger



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Vertidrome Airside Level of Service

How do we decide if a vertidrome satisfies our requirements from an operational perspective?

Vision



150? arrivals & departures / hour
expected by 2028 „The Paw“

Reality



116 arrivals & departures / hour
(2019) Frankfurt Airport

Vertidrome Level of Service (VALoS) Concept



**Demand
Distribution**



**Vertidrome Layout and
Operational Concept**

Insights about...

- Processing Airside Performance*
- Resilience Capability*
- Behaviour of Flow Rates*
- Degree of Stakeholder Satisfaction*



Operation



Impact of Air Taxis on Air Traffic in the Vicinity of Airports



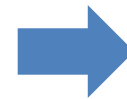
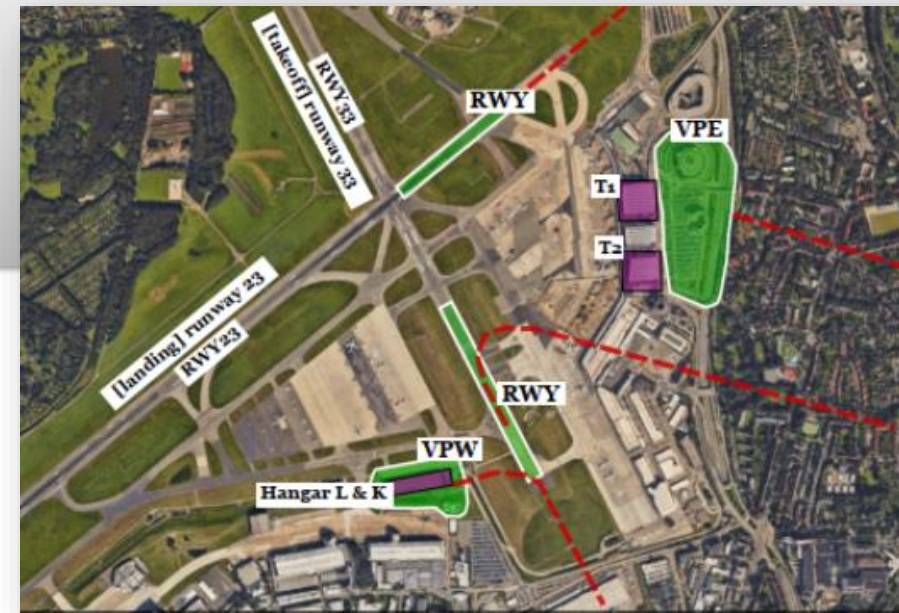
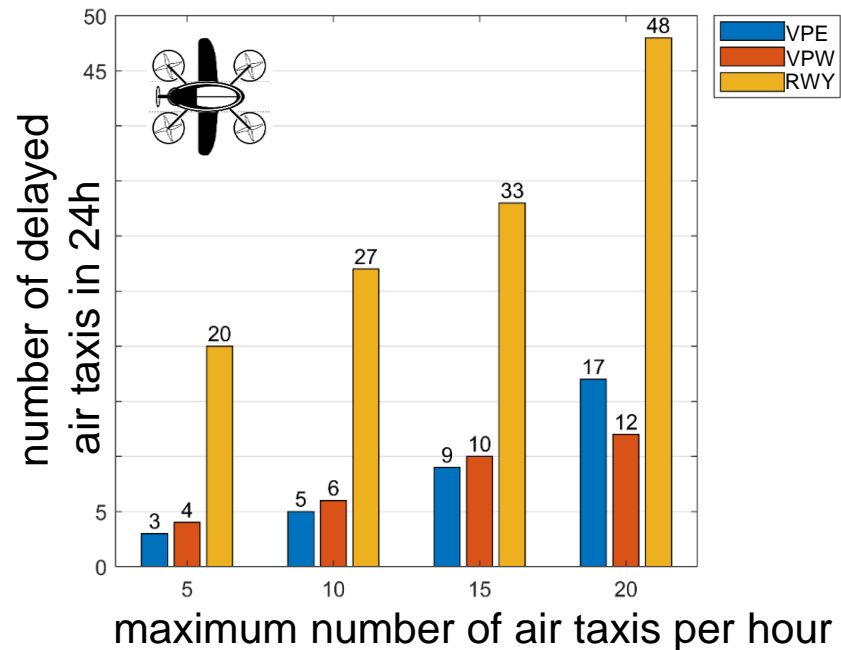
Analytical model for air taxi (AT) operations at Hamburg airport based on fast time simulation



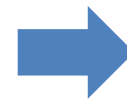
3 touchdown and lift-off areas (TLOF)



Energy consumption analysis of air taxis



Runway-Integration not advisable for medium traffic airports



Vertiport-Integration allows traffic volume up to 20 AT /h



Battery capacity shows bottleneck for AT operations



N. Ahrenhold et. al, Impact of Air Taxis on Air Traffic in the Vicinity of Airports, MDPI Journal Infrastructures, 10.2021, <https://doi.org/10.3390/infrastructures6100140>



Impact of Air Taxis on Air Traffic in the Vicinity of Airports



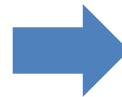
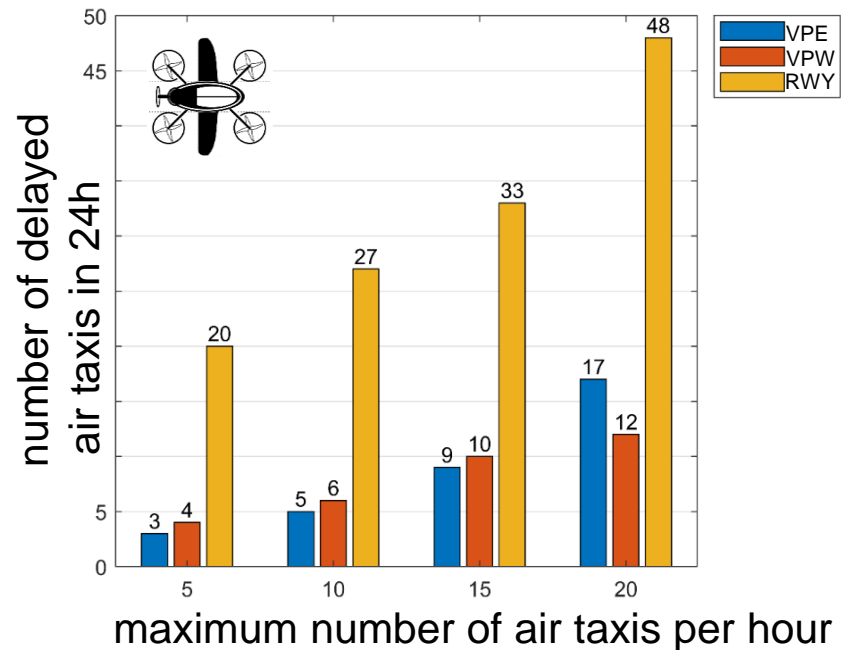
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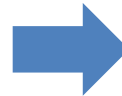
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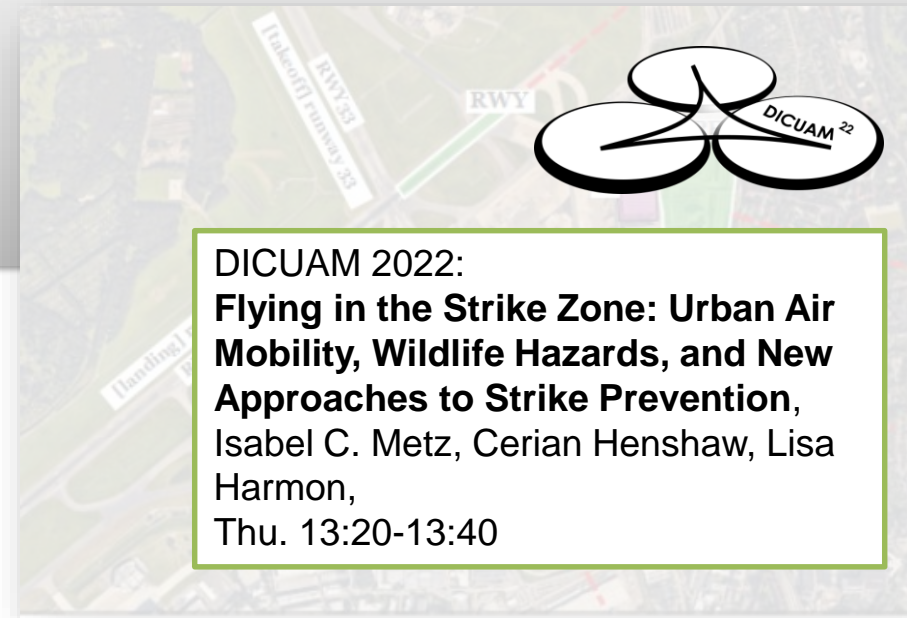
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VPE = Vertiport East, VPW = Vertiport West, RWY = Runway Integration



Public Acceptance





UAM Cabin Simulator

Work in progress:

- Mixed reality UAM cabin simulator under development
- Real cabin mock-up combined with selected virtual elements, defined near-field elements such as own body remain visible
- Cabin interior design study



Conceptual ideas and first sketches for different seating arrangements

DICUAM 2022:
See it, hear it, feel it - Using virtual reality to identify risks and benefits associated with drones in urban environments,
Maria Stolz, Anne Papenfuß, Michaela Rehm, Fabian Utesch, Martin Fischer,
Thu. 14:40-15:00

Further reading:

- I. Moerland-Masic et al., Urban Mobility: Airtaxi Cabin from a Passengers Point of View, Comfort Congress, 09.2021
- M. Stolz et al., A User-Centered Cabin Design Approach to Investigate Peoples Preferences on the Interior Design of Future Air Taxi, DASC, 09.2021



Simulator set-up with cabin mock-up and head-worn mixed reality display, virtual Hamburg scenery



Conclusion

- Urban Air Mobility is more than vehicle design!
- Research within HorizonUAM addresses urban air mobility as system-of-systems, including aspects of
 - Vehicle design
 - Infrastructure development
 - Operations and airspace integration
 - Public acceptance

HorizonUAM Symposium 2022

- September 2022, DLR Braunschweig, Germany
- Technical presentations, simulator demonstration, facility tour
- 2 days in-person event
- Further details will follow soon: <http://www.horizonuam.dlr.de/>



– HorizonUAM –

Project lead:

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