Europe and Finland in the revolution of unmanned electrified aviation

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Contents

European and Finnish UAV policy & RDI landscape right now

Deep dive 1: Enabling sustainable air mobility in urban contexts in emergency and medical services (AiRMOUR)

Deep dive 2: Autonomous intelligent multi-purpose drone enabled business in evolving U-Space environment (Drolo)

Concluding remarks

-> A quick & dirty run-through to give a flavor of ongoing things and open up discussion

European UA landscape
Policy & RDI

UA – Unmanned Aviation / Aircraft

- “An aircraft without a pilot on board”
  - From terra firma controlled, human piloted, partially human piloted or autonomous devices in low level airspace
  - Including PUA – passenger carrying UA

European strategy background

- UA offers huge potential for developing innovative civil applications in a wide variety of sectors that (i) benefit European society and (ii) will contribute to creating new businesses and jobs.
- Within 20 years, the European UA sector is expected to
  - directly employ more than 100,000 people
  - have an economic impact exceeding €10 billion per year, mainly in services
- As civil aviation evolves towards more automation, UA technology will also be crucial for the competitiveness of the European aeronautics industry as a whole
- The European Commission actively contributes to the development of a UA ecosystem supporting the emergence of this promising sector
  - EASA, Eurocontrol, etc. activity
  - The single European sky ATM research joint undertaking (SESAR JU) is a PPP pooling together the entire European ATM community
  - Other support mechanisms as well (H2020, HE, etc.)

Source: European Commission

European strategy cornerstones

- European Commission strategy “A new era for aviation”
  - supports the progressive development of the unmanned aircraft market in Europe
  - also addresses concerns of safety, security, privacy, liability and public acceptance
- Ensuring
  - safe and secure integration of RPAS into the European aviation through
    - a common safety regulatory framework, to enable a single European market for civil drones applications
    - the necessary enabling technologies (sense and avoid, command and control communication link etc.) within the SESAR JU & other initiatives
    - measures to the protection of citizens (safety, privacy, insurance, etc.)
    - measures to support market development and European industries.

Source: European Commission

Regulatory framework

- EASA develops an operation centric, proportionate, risk- and performance-based regulatory framework for all unmanned aircraft

- Establishing three categories of UAS operations (‘open’, ‘specific’ and ‘certified’) with different safety requirements, proportionate to risks
  - **Open** category: UAS operation that considering the risks involved, does not require a prior authorization by authority nor a declaration by the UAS operator before operation takes place;
  - **Specific** category: UAS operation that requires authorization before the operation takes place (mitigation measures identified in a systemic operational risk assessment SORA);
  - **Certified** category: UA operation that requires the certification of the UAS, a licensed remote pilot and an operator approved by the authority, to ensure an appropriate level of safety.

- Based on the market’s needs, priority has been given to ‘open’ and ‘specific’ category and ‘certified’ is currently under development.

Regulatory progress

- UTM & U-Space:
  - EC mandated SESAR to develop a UTM concept for Europe, called U-Space: A blueprint 2017 with a preliminary vision for the U-space & set of services enabling complex drone operations in all types of operational environments

- In Europe, the key player chain ‘from regulation to implementation’ includes EASA, EC, EP, member states’ parliaments, MS CAAs, MS ANSPs, etc.

- All this supported by EC funded RDI programs and instruments e.g.
  - Horizon 2020 up to now
  - Horizon Europe 2021->
  - SESAR JU

Some spearheading projects

CINEA (European Climate, Infrastructure and Environment Executive Agency, formerly INEA) Horizon 2020 projects

1 finished project:

- MONIFLY (RIA)

5 ongoing projects:

- AW-Drones (CSA)
- 5D-Aerosafe (RIA)
- Drones4Safety (RIA)
- LABYRINTH (RIA)
- RAPID (RIA)

4 projects recently launched on Urban Air Mobility:

- AiRMOUR, AURORA and FF2020 awarded from topic MG-3-6-2020: Towards sustainable Urban Air Mobility (RIA)
- ASSURED-UAM awarded from topic MG-1-12-2020: Prepare for the deployment of Urban Air Mobility in urban and peri-urban areas (CSA)

European Commission

Some spearheading projects

SESAR JU 2020 very large demonstrators (VLD)

- AMU-LED: Air Mobility Urban - Large Experimental Demonstrations
- CORUS-XUAM: Europe-wide UAM VLD and definition of ConOps
- GOF 2.0: Gulf of Finland - Integrated urban airspace VLD
- SAFIR-MED: Safe and Flexible Integration of Advanced U-Space Services Focusing on Medical Air Mobility
- TINDAIR: Tactical instrumental deconfliction and in-flight resolution
- USpace4UAM: Urban air mobility in Europe

Research landscape in Finland

- European & international
  - AiRMOUR (H2020, a few words on this later)
  - Flying Forward 2020 (H2020 sibling)
  - 5G Drones (H2020)
  - GOF & GOF 2.0 (SESAR)
  - Hyfliers (H2020), Nordic Drone Initiative, etc.
- Nationally funded
  - Drolo (Business Finland, more later)
  - FUAVE (Academy of Finland)
  - RoboMesh (Academy of Finland)
  - VED, SURE, CityLog, etc. etc.
- Foci including drone ecosystems, 5G, cross-border, eVTOL, logistics, U-Space, ground infra, autonomy, propulsion tech, business models, education, etc.
- Involved are businesses, academia & RTOs, administrations and cities

P2P Collab?

European examples

- AiRMOUR, FF2020, Aurora, Assured UAM
- UIC2
- SESAR JU VLDs
- Eu U-Space demonstrators
- EASA & Eurocontrol seminars etc.
- Polis, Eurocities, WEF, etc. etc.
- And only scratching the surface here (e.g. ITS World Hamburg – the 2-day UAM Forum barely mentioned any of the above!)

Two VTT led activities in brief

Case 1

AIRMOUR

AIRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

The project in brief

AiRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

AiRMOUR in a nutshell

- Enabling sustainable AiR MObility in URrban contexts via use cases in emergency and medical services
- AiRMOUR is a Horizon 2020 research and innovation action supporting urban air mobility
- Running 1.1.2021 – 31.12.2023
- 13 partners from six countries, with a total EU funding of 6M€
- Lead partner VTT Technical Research Centre of Finland Ltd.
- Demonstrations in three cities: Stavanger (NO), Helsinki (FI), Kassel (DE)
- Simulations in three cities: Luxembourg, Stockholm and Dubai
- 10+ Replicator cities
- Strong international and European support: NASA, JUIDA (Japan UAS Industrial Development Association), Dubai Future Foundation, EASA, Eurocontrol, EIT KIC Urban Mobility, European cities UIC^2, etc.

AiRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

Expanding mobility into the third dimension – the airspace

AiRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

Why AiRMOUR?

Cities will have a major role in UAM – along with civil aviation administration and national transport authorities

Emergency Medical Services (EMS) will be likely first adopters of eVTOL people transport



AiRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

Consortium

AIRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

Global outreach

FF2020 AiRMOUR AURORA etc.

AiRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

Towards increased urban air mobility competences and excellence

AIRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

Main output of AiRMOUR

The UAM Toolbox for aviation and urban authorities, validated in real-life settings

- **UAM Guidebook for cities,** operators and other stakeholders
- **UAM GIS tool for urban planners**
- **UAM Training programme** and masterclasses
- Semi-autonomous flights

AiRMOUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006601

Case 2

DROLO

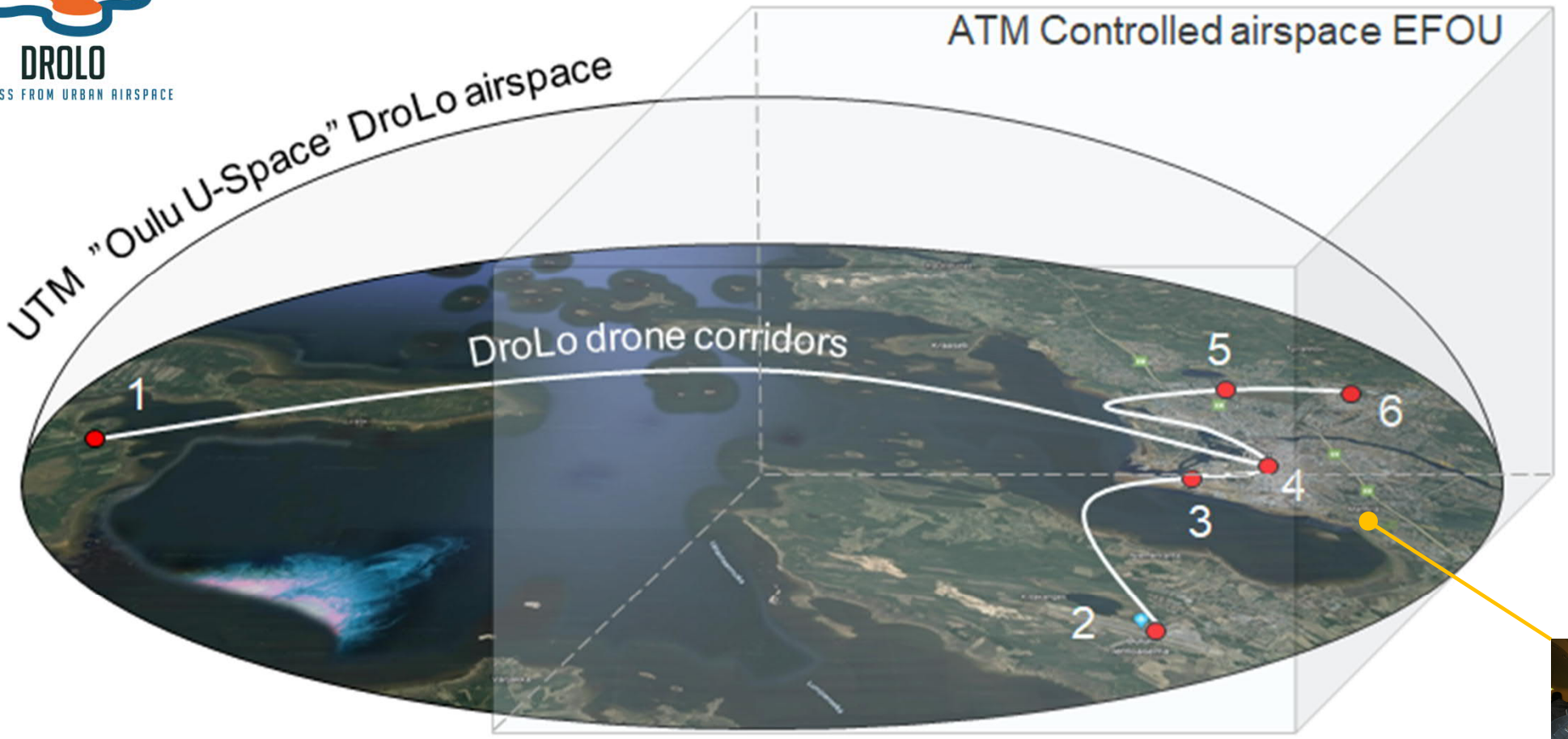
BUSINESS FROM URBAN AIRSPACE

DROLO

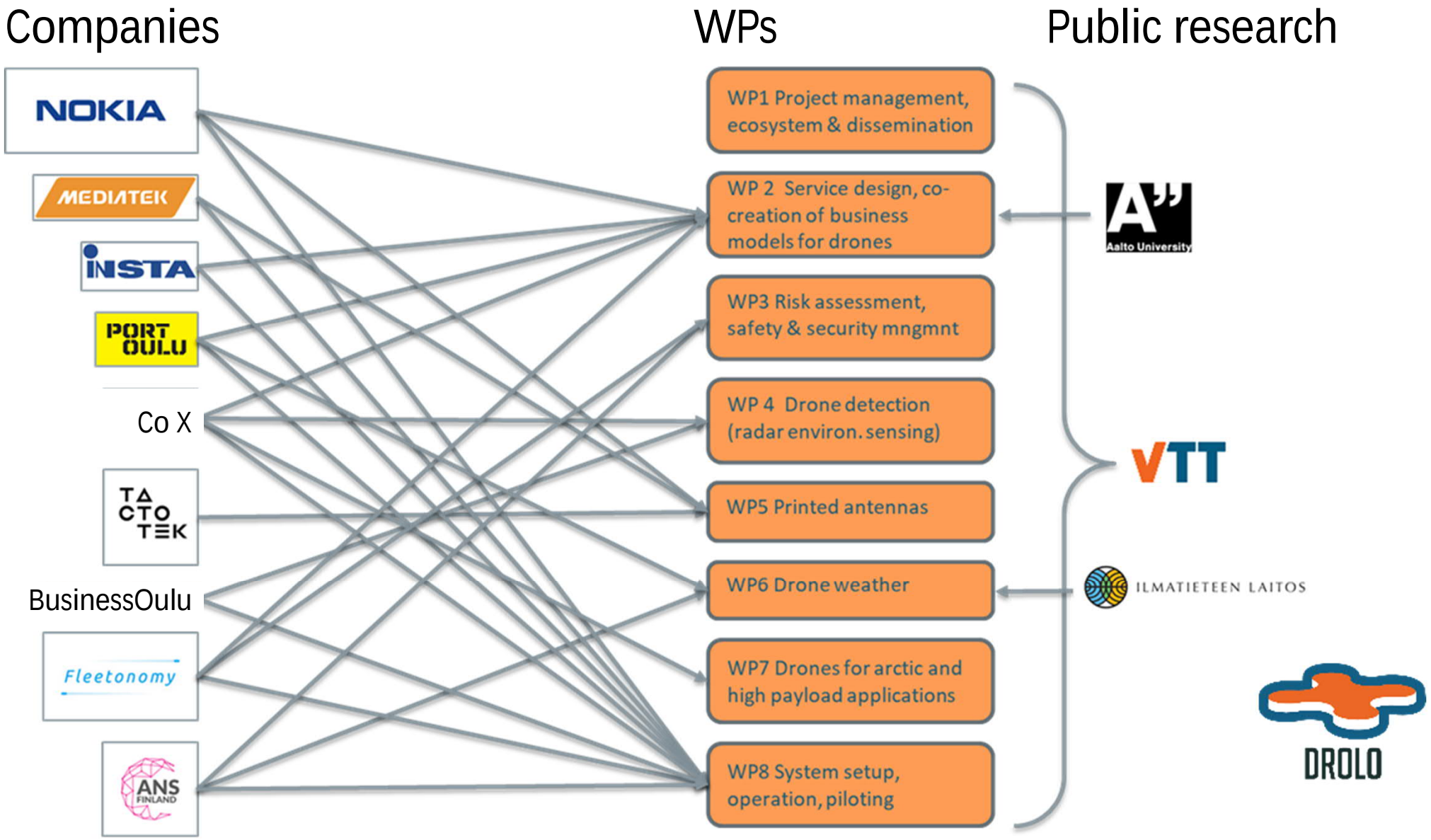
2 years 7.5 M€
11 partners + ecosystem
U-Space demonstrator
Drone business development
Drone technology RDI
Concept RDI

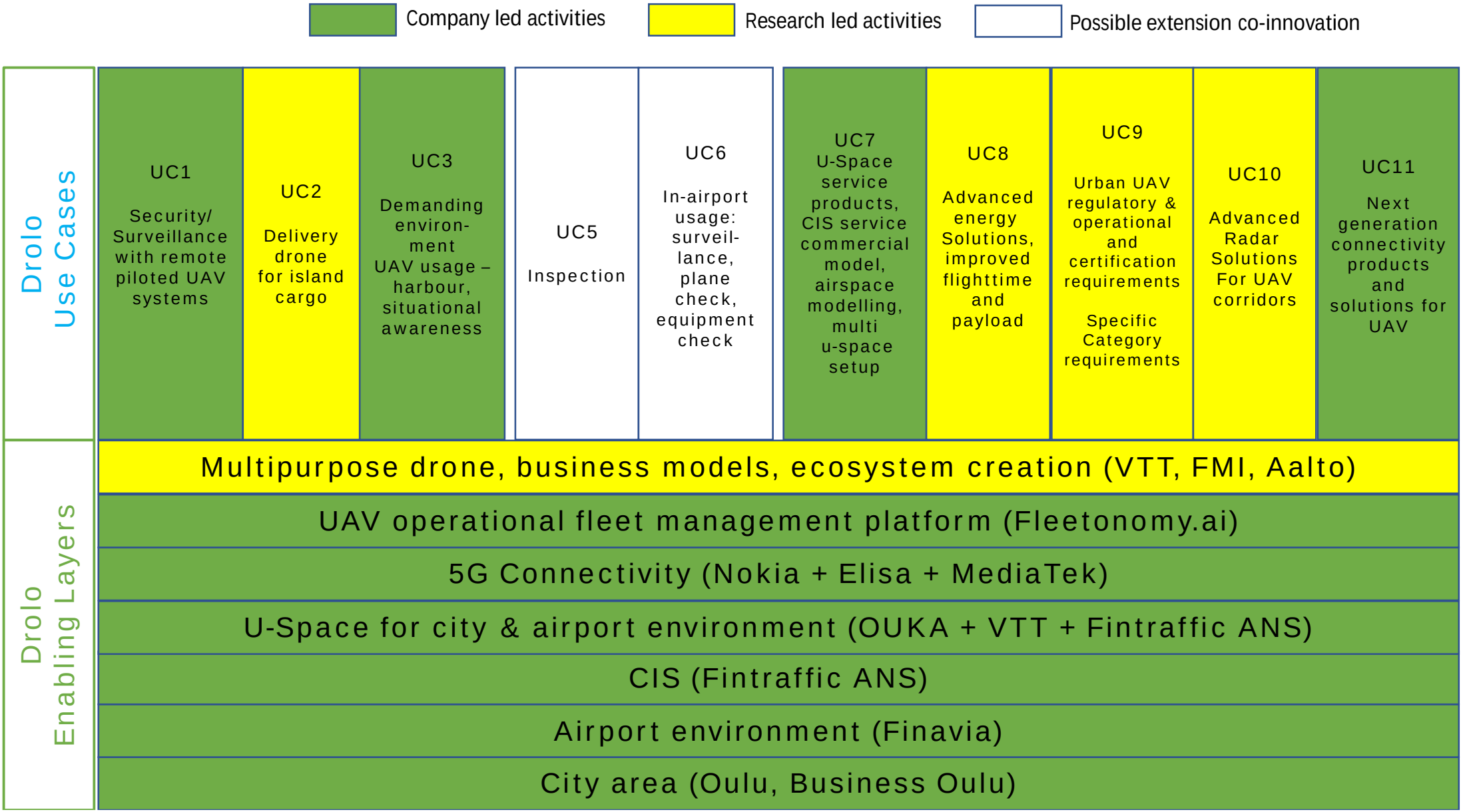
DROLO

BUSINESS FROM URBAN AIRSPACE



1. Hailuoto
2. Airport
3. Harbour
4. Oulu City centre
5. Technology campus
6. Rusko 5G test site


Companies
WPs
Public research
NOKIA
MEDIATEK
INSTA
PORT OULU
Co X
TACTOTEK
BusinessOulu
Fleetonomy
ANS FINLAND
WP1 Project management, ecosystem & dissemination
WP 2 Service design, co-creation of business models for drones
WP3 Risk assessment, safety & security mngmnt
WP 4 Drone detection (radar environ. sensing)
WP5 Printed antennas
WP6 Drone weather
WP7 Drones for arctic and high payload applications
WP8 System setup, operation, piloting
Aalto University
VTT
ILMATIETEEN LAITOS
DROLO


Company led activities
Research led activities
Possible extension co-innovation
Drolo Use Cases
UC1 Security/ Surveillance with remote piloted UAV systems
UC2 Delivery drone for island cargo
UC3 Demanding environ-ment UAV usage – harbour, situational awareness
UC5 Inspection
UC6 In-airport usage: surveil-lance, plane check, equipment check
UC7 U-Space service products, CIS service commercial model, airspace modelling, multi u-space setup
UC8 Advanced energy Solutions, improved flighttime and payload
UC9 Urban UAV regulatory & operational and certification requirements Specific Category requirements
UC10 Advanced Radar Solutions For UAV corridors
UC11 Next generation connectivity products and solutions for UAV
Drolo Enabling Layers
Multipurpose drone, business models, ecosystem creation (VTT, FMI, Aalto)
UAV operational fleet management platform (Fleetonomy.ai)
5G Connectivity (Nokia + Elisa + MediaTek)
U-Space for city & airport environment (OUKA + VTT + Fintraffic ANS)
CIS (Fintraffic ANS)
Airport environment (Finavia)
City area (Oulu, Business Oulu)

Schedule

A lot on USSP's plate
- Inter-USSP data exchange, CIS as the integration point, feasible?
- Methods to convey UAV location data from U-Space to ATM actors
- Handover operability between USSPs at country borders, a lot of undefined interfaces and options

Project start

Consortium agreement

Steering group (every 4 months)

Define, design, implement, validate

Test flight activity (to archipelago etc.)

UTM vendor?

U-Space setup

Banking on the estimated EU legislation schedule

Pre-commercial U-Space / UTM

Commercial U-Space

Airport corridor definition

5G network analysis

5G flights

Fuel cell drone

2021									2022												2023					
Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun

DROLO
BUSINESS FROM URBAN AIRSPACE

UTM & CTR challenge

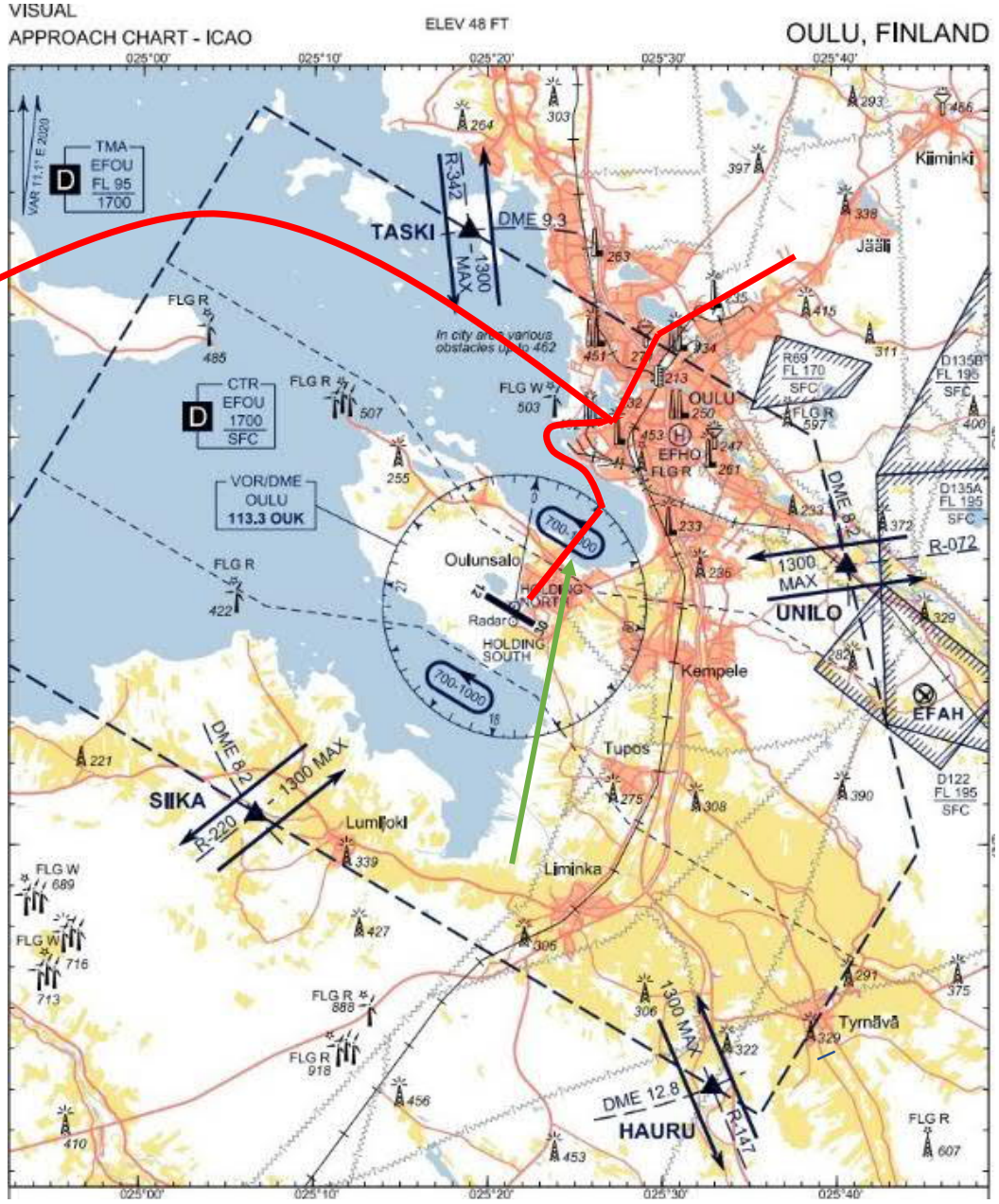
Acknowledgeing that in the end state when operating close to airport, the UAV certification levels and automation must be high (air- and trustworthiness, redundancies, risk levels etc.)

Fintraffic

FINAVIA

VTT

TRAFICOM



Ecosystem Launchpad (led by VTT)

DROLO
BUSINESS FROM URBAN AIRSPACE

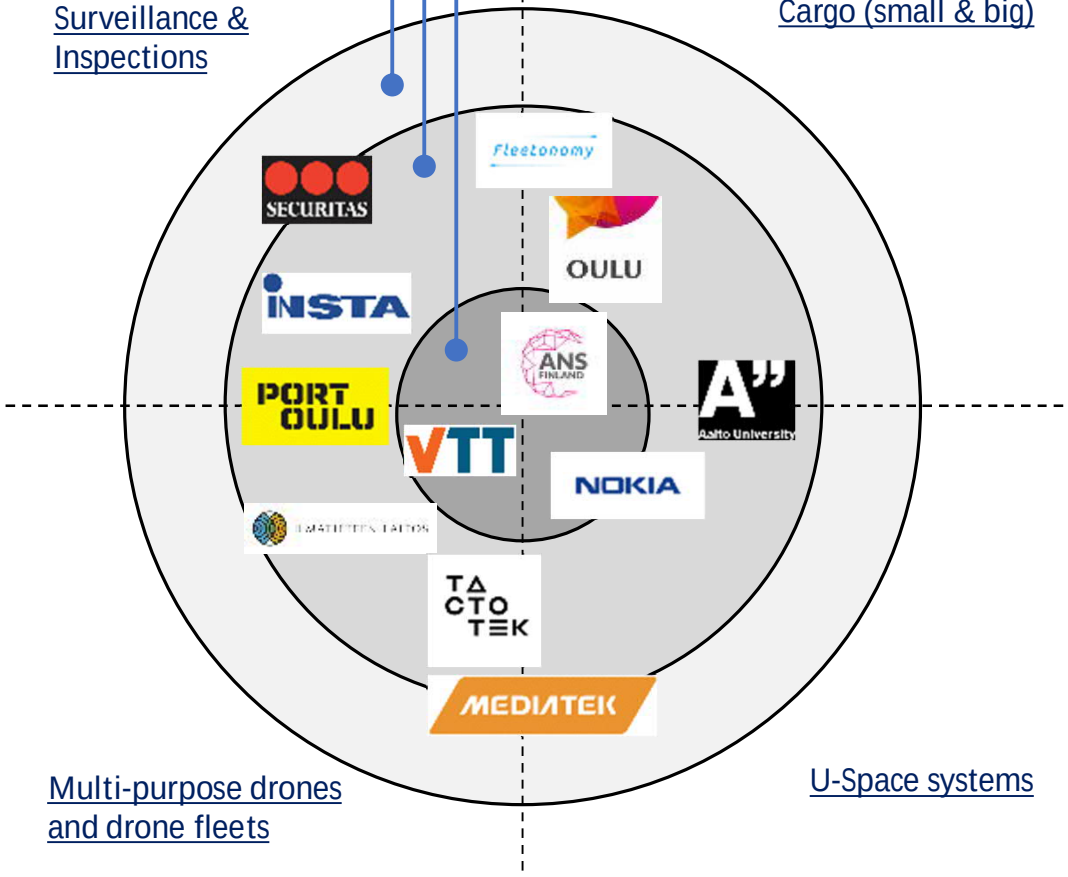
Partners & enablers directly connected to the co-innovation project
Committed partners with ecosystem co-innovation project
Core partners / drivers / business champions

Committed enablers of DroLo project implementation

FINAVIA
Traffic Management Finland
Hailuoto
elisa
Yliopiston Apteekki

Surveillance & Inspections

Cargo (small & big)



Multi-purpose drones and drone fleets

U-Space systems

Subcontractors, co-creation partners and other stakeholders & enablers that have already been contacted

robots.expert
MATKAHUOLTO
SKYDATA
UNIFLY
FinnHEMS
Wing
NODEON
posti
LÄHITAPIOLA
AVIAMAPS
SOLITA
TRAFICOM
futurice
Rumble Tools
Pyhtää Redstone Aero
AVARTEK
POLIISI
Pohjoista voimaa
oulunenergia.fi
storaenso

Examples of some foreseen subcontractors, co-creation partners and other stakeholders & enablers that will be contacted immediately at project & ecosystem start

Cities & regions

Telia
SATAMA
DB SCHENKER
DHL
SILO.AI
Metsä
WÄRTSILÄ
SITOWISE
VAISALA
...etc, etc...

Conclude

UA is one of the fastest-ever developing domains and opportunities within mobility (and beyond)	Useful to sponge all advancements and demonstrators on the field	Next gen of RDI is in the pipeline (HE?, SESAR, BF, etc.)
Personal claim: this hype is not about to wither	Much of it not in Finland	Join an ecosystem or talk to your trusted RTO or university

Thank you!

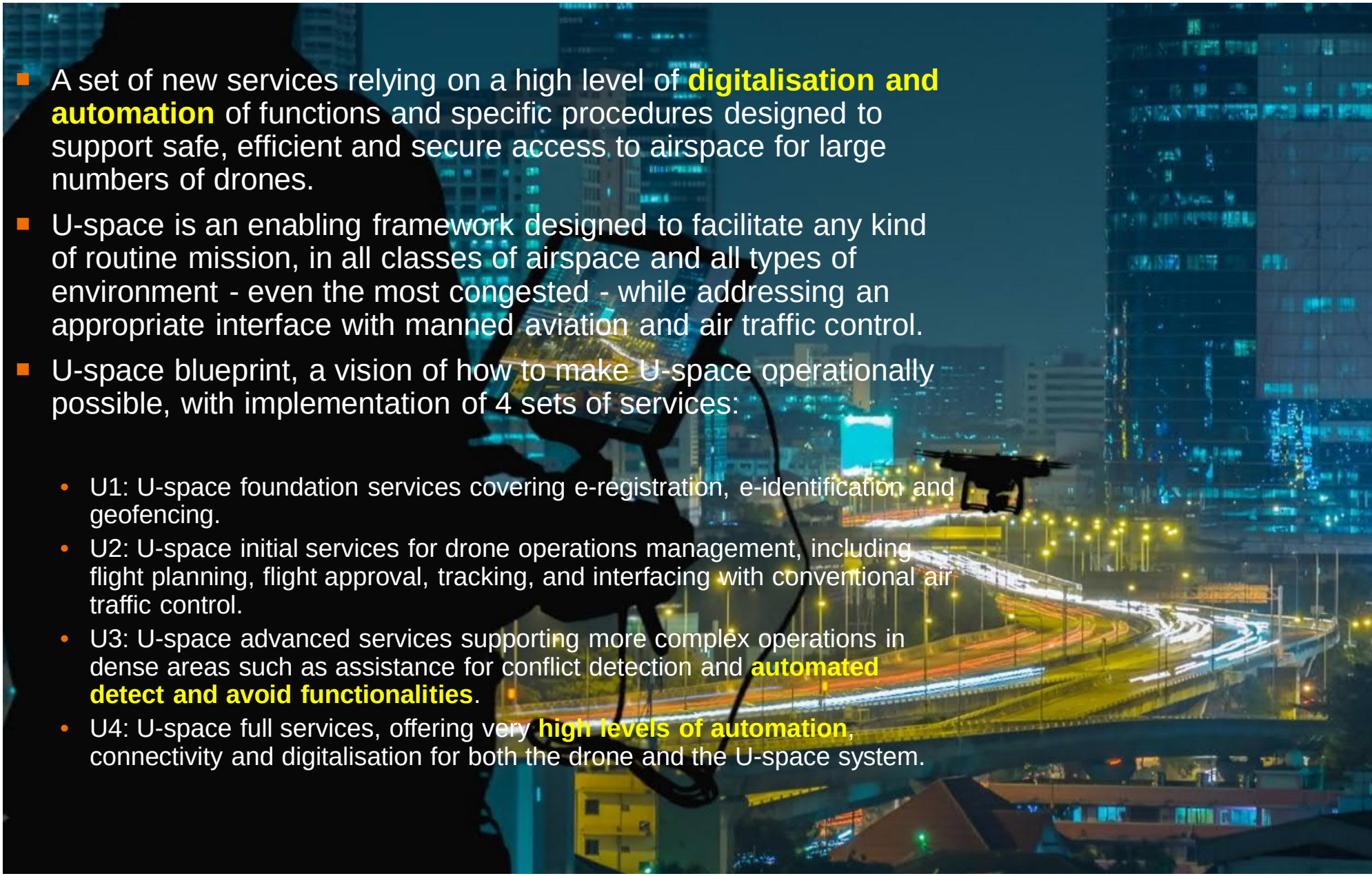
Supporting material

Command, Control & Management

Command & Control

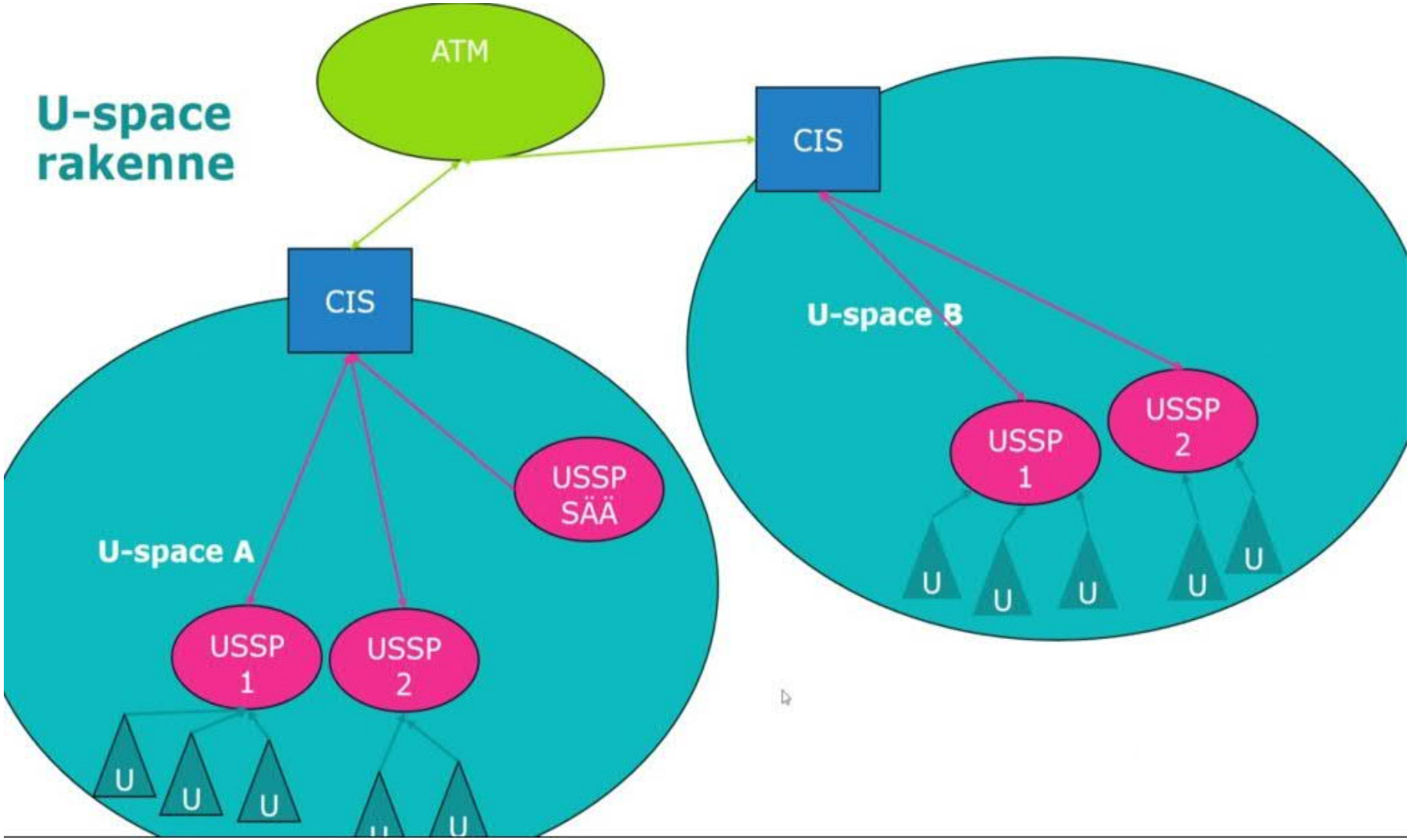
- Control of the devices (avionics)
  - Dev driven by demand -> manufacturers
  - AI and ML emegring strongly
  - AI & gyroscope based stability control has leapfrogged
  - Automated features e.g. for routing becoming standard practise
- Control of traffic
  - U-Space – a full set of services
  - Including UTM – Unmanned aviation Traffic Management
  - Kin to ATM and connected to ATM
  - Currently lots of manual processes, automation coming fast
- All relying fully on ICT and largely on robotics, AI, ML, VR, AR etc.

U-Space



- A set of new services relying on a high level of **digitalisation and automation** of functions and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones.
- U-space is an enabling framework designed to facilitate any kind of routine mission, in all classes of airspace and all types of environment - even the most congested - while addressing an appropriate interface with manned aviation and air traffic control.
- U-space blueprint, a vision of how to make U-space operationally possible, with implementation of 4 sets of services:
  - U1: U-space foundation services covering e-registration, e-identification and geofencing.
  - U2: U-space initial services for drone operations management, including flight planning, flight approval, tracking, and interfacing with conventional air traffic control.
  - U3: U-space advanced services supporting more complex operations in dense areas such as assistance for conflict detection and **automated detect and avoid functionalities**.
  - U4: U-space full services, offering very **high levels of automation**, connectivity and digitalisation for both the drone and the U-space system.

U-space rakenne



Roles and how to get involved

Roles

Phase / task

Actor or stakeholder

	RDI	Regulate	Enable	Operate	Profit
Businesses	++			+++	+++
Cities or regions	++	+	+++	+	+
Academia	+++	++	+	+	
Authorities	+	+++	+		

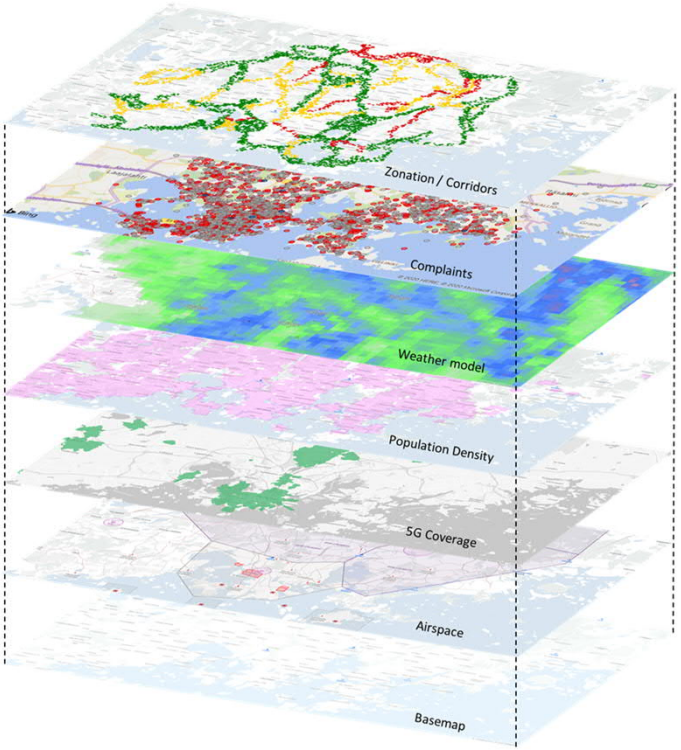
How to get involved?

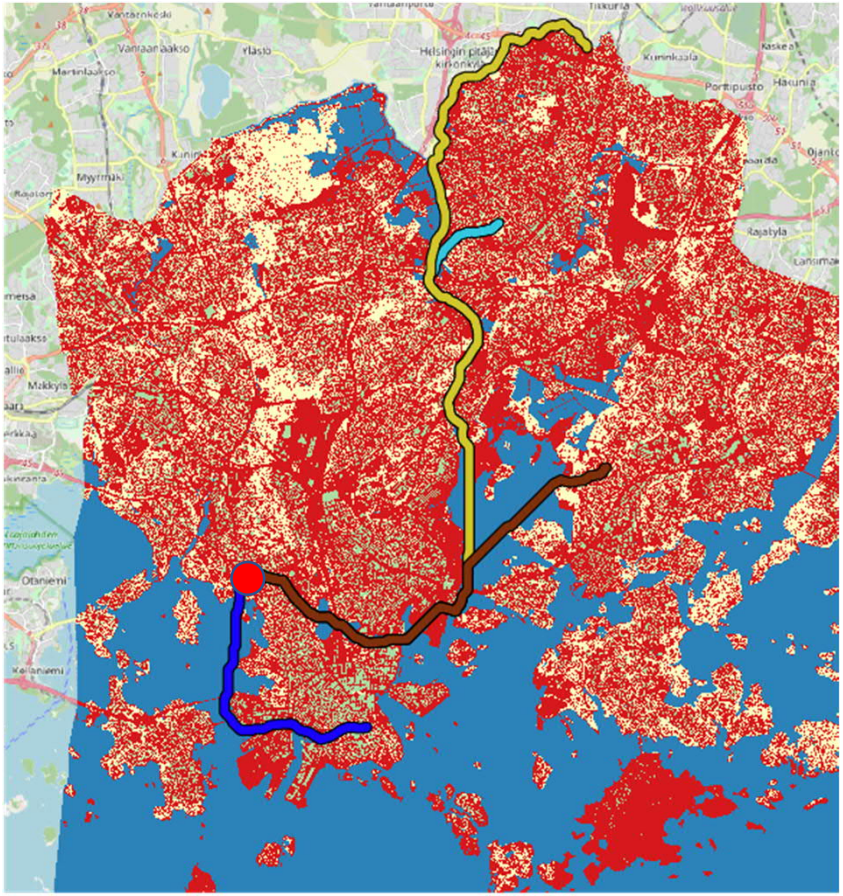
- Drolo ecosystem (@ VTT), for business & CoI
- FUAVE (@ VTT et al.), for academia & business
- AiRMOUR Replicator (@ VTT), cities
- EU U-Space Demonstrator network (Eurocontrol, EASA, EC, SESAR)
- etc., many others, for different stakeholder types

robots.expert
Shaping Unmanned Aviation

AiRMOUR GIS Tool - Least Cost Path Analysis

SPATIAL DATA PROCESSED AND VISUALISED TO ENABLE CORRIDOR AND ZONATION MANAGEMENT





Corridors between
Meilahti Hospital and
Surgical Hospital
Herttoniemi Hospital
Malmi Hospital
Far end of Helsinki