



INTERNATIONAL UNION  
OF RAILWAYS

*unity, solidarity, universality*

# DRONES FOR RAILWAY INFRASTRUCTURE MONITORING (DRIM)

UNESCAP

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Alexey Ozerov

UIC

# What is Drone?

Unmanned Aerial  
Vehicles (UAV)

Unmanned  
Aircraft (UA)

Unmanned  
Aircraft System  
(UAS)



Remotely Piloted  
Aircraft Systems  
(RPAS)

Remotely Piloted  
Aircraft (RPA)

Pilotless Aircraft  
(PA)

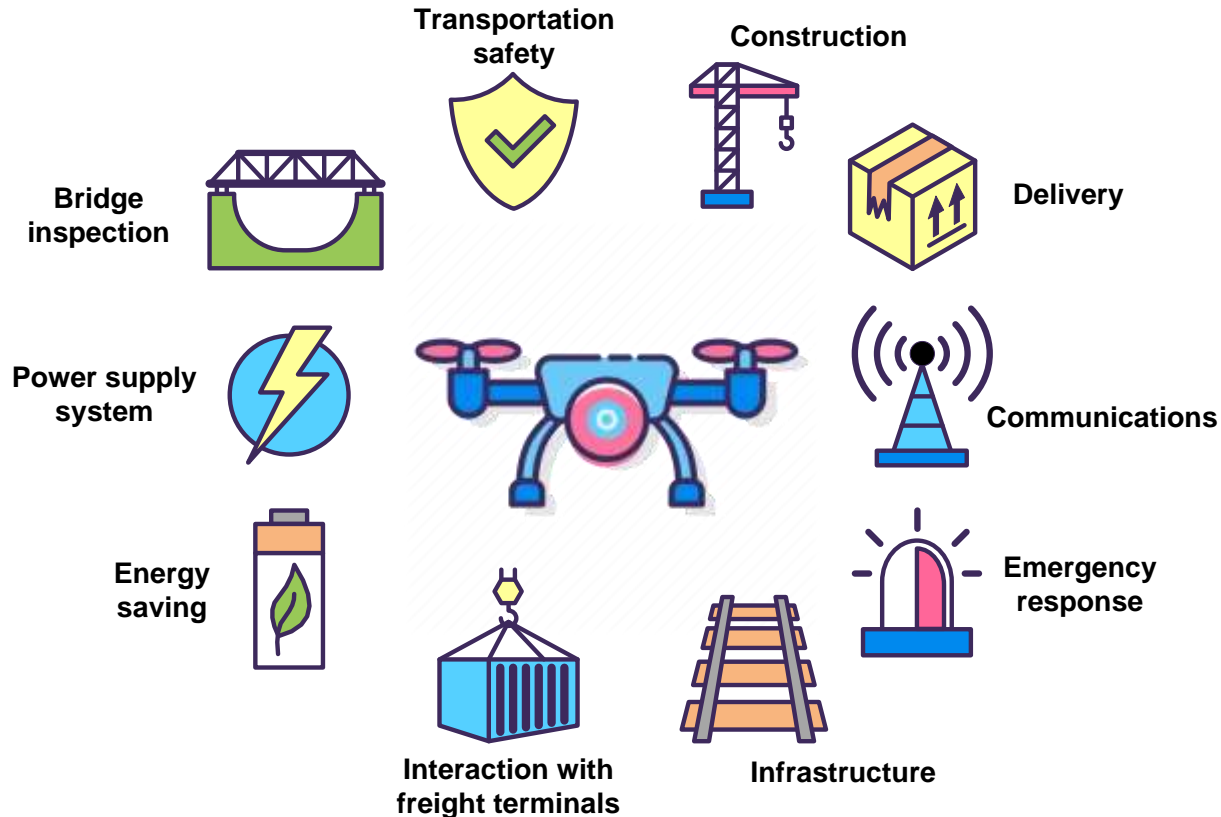
The term '**drone**' is the generic popular term of any aircraft without a pilot on board, although technically 'drone' would include unmanned craft designed to be used underwater

# Commercial Application of Drones

- **Agricultural Services** (agricultural services, ranging from precisely spraying pesticides and fertilizers, monitoring crops growth);
- **Search and Secure** (monitoring of catastrophes, monitoring of natural disasters, searches for missing persons);
- **Surveillance** (monitoring public events, border controls against illegal cultivation and investigation of crimes);
- **Inspection and Monitoring** (inspection of infrastructures, pipelines and the atmosphere)



# Application of Drones in Railways



## Benefits of using drones in the railway industry:

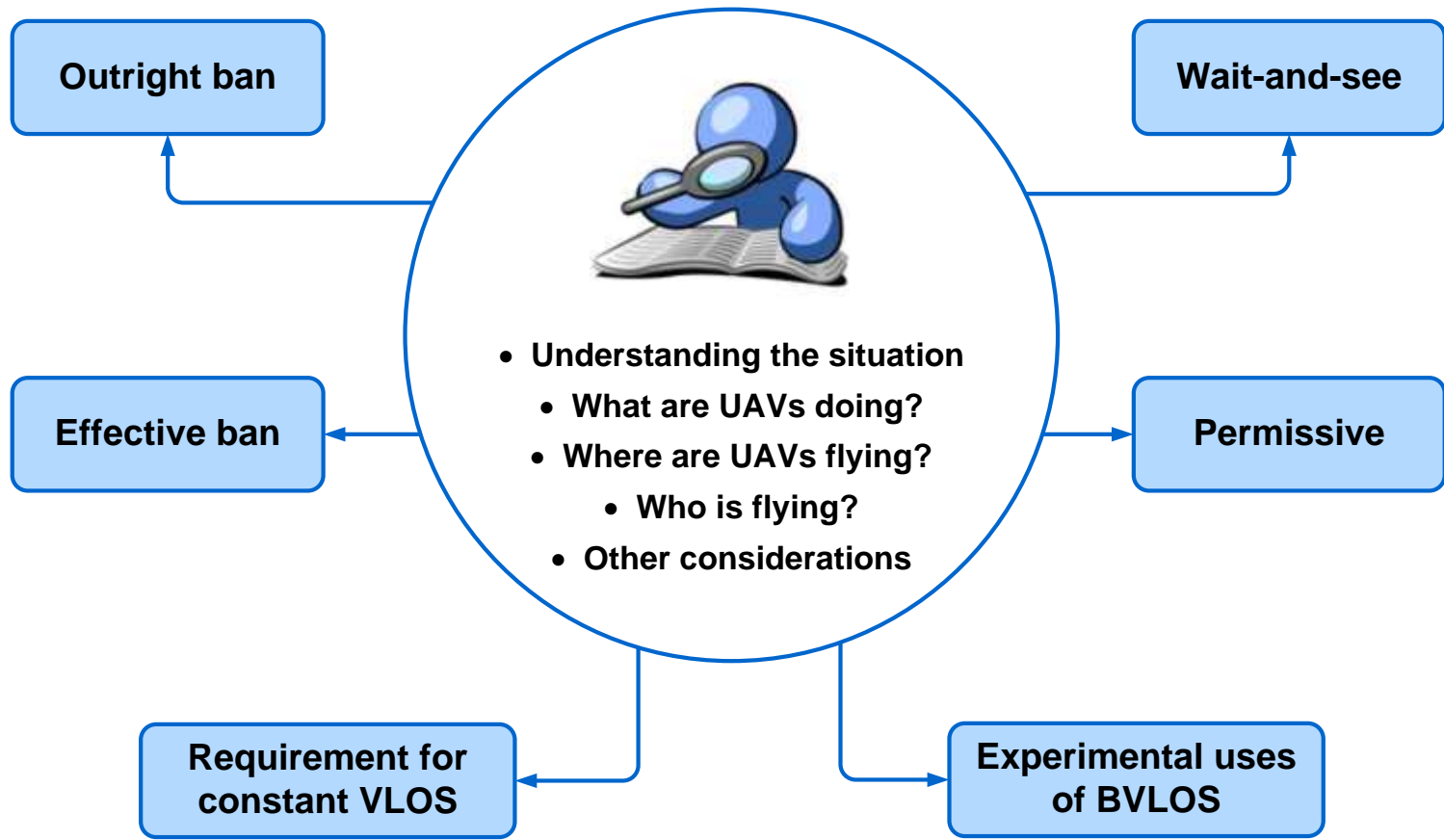
- Reduction of risk to staff and people and infrastructure in the project area;
- Reduced planning cycle;
- More efficient work processes;
- More flexible, affordable verification tools;
- Higher quality data available in larger quantities at lower costs.

## Risks Associated with Application of Drones

- **Privacy, ethics and legal related issues** (unauthorized data collection, privacy violation, photography);
- **Cybersecurity related issues** (unauthorized access to sensitive communication networks, theft of information on critical infrastructure);
- **Physical related issues** (UAS flies through controlled airspace and across flight paths, collisions between drones and piloted aircrafts, damage/injure any critical assets/people);
- **Breaching secure perimeters** (military bases, boundaries of other states).



# Approaches to Drone Regulation



# EU Regulations

**COMMISSION IMPLEMENTING REGULATION (EU) 2019/947 of 24 May 2019**  
on the rules and procedures for the operation of unmanned aircraft

**COMMISSION DELEGATED REGULATION (EU) 2019/945 of 12 March 2019**  
on unmanned aircraft systems and on third-country operators of unmanned aircraft systems

## Open category (low risk)

- No prior authorization
- C0 to C4 classes of UAV
- < 25 kg
- 120 meter height limit
- Keeping UAV at a safe distance from people
- Keeping UAV in VLOS
- No carrying dangerous goods
- No dropping any material

## Specific category (increased risk)

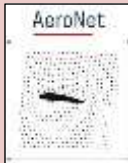
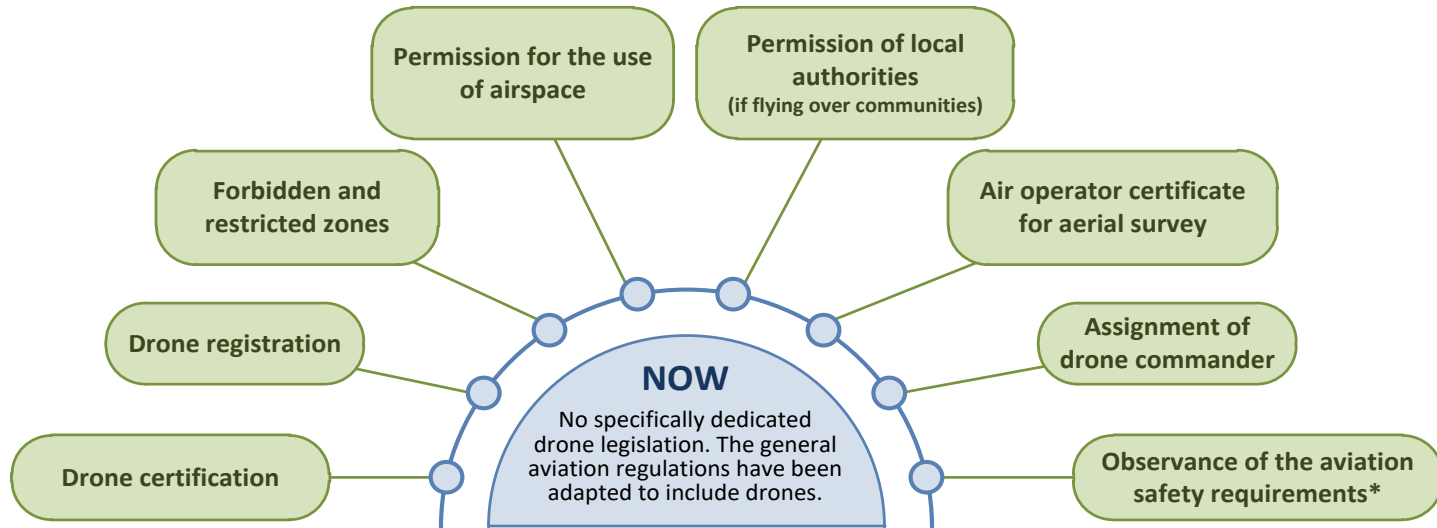
- One of the requirements for open category is not met
- Operational authorisation
- Operator shall perform a risk assessment
- Operational limitations to be set out in the operational authorisation

## Certified category (high risk)

- Over assemblies of people
- Transportation of people
- Carrying dangerous goods
- Certification of the UAV
- Certification of the UAV operator (licensing of the remote pilot)

U-SPACE

# Russian Drone Regulation



## AeroNet National Technological Initiative

the associated roadmap for the purpose of legislation improvement and elimination of administrative barriers (approved by order of the Government of the Russian Federation no. 576-r of 03.04.2018)

### Anticipated AeroNet results include:

- No permission for the use of airspace (VLOS operations) within 150 meter height limit;
- No permission of local authorities for flying over communities

### Benefits for railway domain:

It will allow to use a drone as part of a recovery train. A drone could be flown in near real time (one hour after receiving a message about an accident), at altitudes up to 150 meters above ground level and within a radius of 1 km from the scene of an accident

\* ICAO recommendations



# Concept for UAV Application in Russian Railways

## Infrastructure

- Integrity of superstructure elements
- Engineering structures condition
- Quality of switch heating
- Quality of current roadbed maintenance

## Transportation safety

- Perimeter control
- Provision of real-time data for facility certification
- Vulnerability assessment and transportation safety planning

## Construction and overhauling

- Construction supervision at all stages with progress assessment
- 3D simulation of structures with subsequent control of deviations from design parameters

## Emergency response

Situational awareness as part of damage assessment, assignment of recovery assets, real-time management, emergency development prediction, recovery supervision

## Power supply system

- Detection of clamp and pull-off wire defects
- Condition control of catenary support and foundation elements
- Detection of insulator contamination, deviations from thermal conditions of conductive elements



# Concept for UAV Application in Russian Railways

## Communications

Communication relay during possessions, when communication is not available



## Bridge inspection

Assessment of the technical state of railway bridges



## Delivery

Delivery of cargo and documents



## Interaction with freight terminals

- Assessment of bulk goods terminals loading
- Supervision of wagon clearance before delivery to classification station

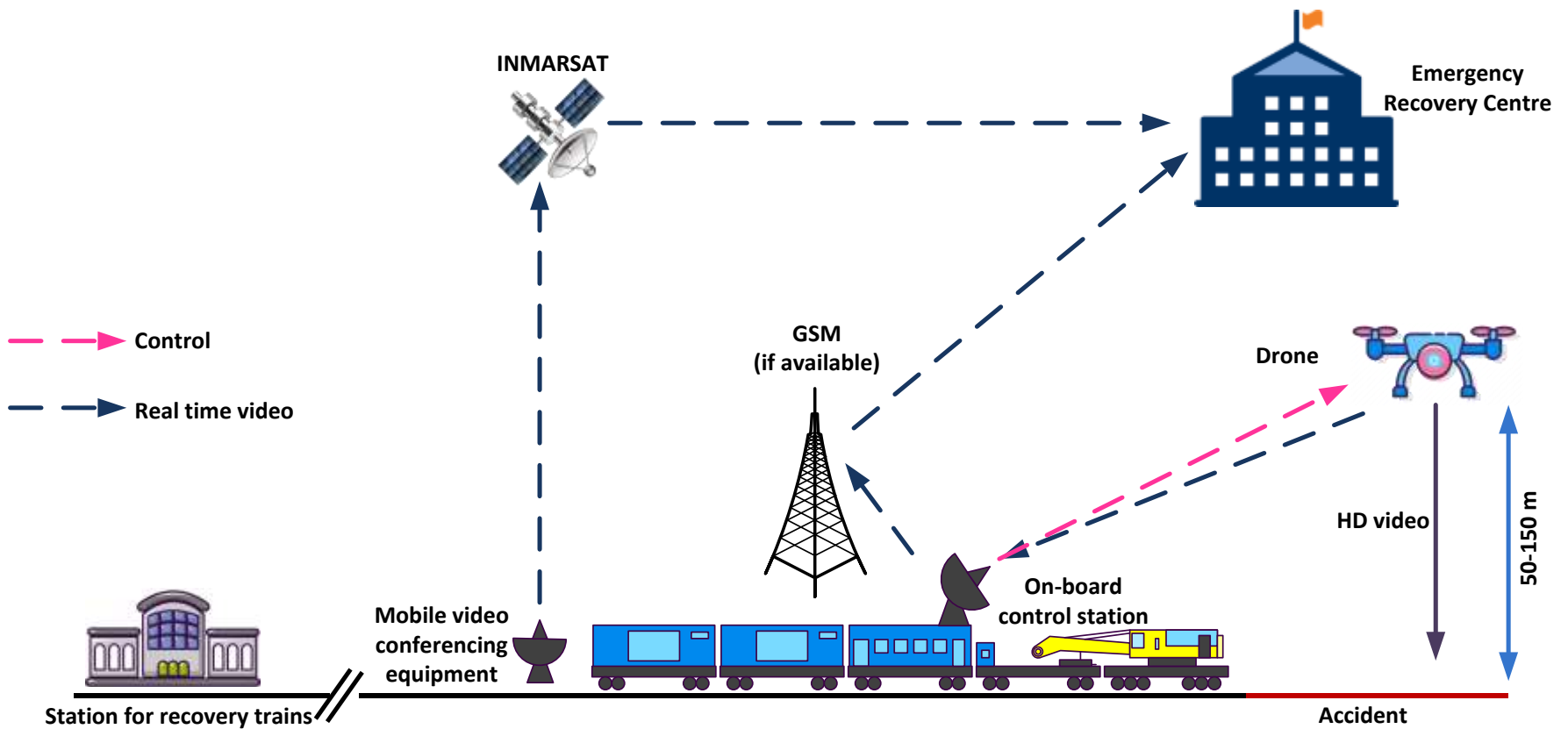
## Energy saving

Monitoring of heat and water supply systems (boiler houses)

## Construction activities supervision

Monitoring of possession execution

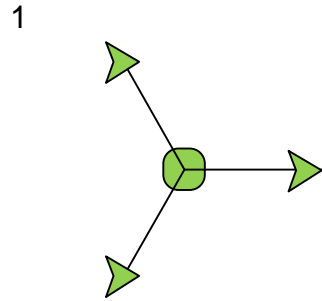
# Case “Drones for Recovery Trains”



# The Future of Drone Applications with AI

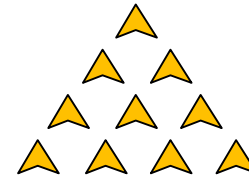
## 1. Physical coupling:

- connection via physical links;
- leader-follower control scheme;
- physically constrained motion;
- low number of vehicles



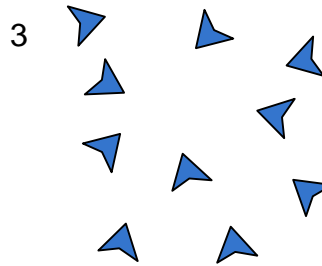
## 2. Formations:

- not physically coupled;
- user-defined distances with other group members;
- new members can be introduced;
- relative motions are strongly constrained to keep the formation



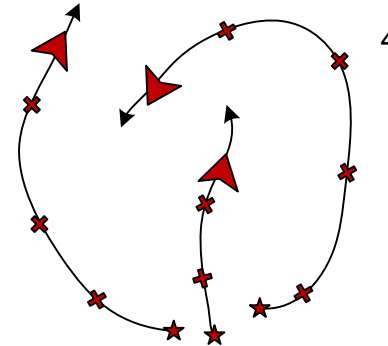
## 3. Swarms:

- collective behavior of drones ;
- cooperation based on concepts from biology (homogeneous individuals);
- agents execute the same program, and interact only with other nearby agents



## 4. Intentional cooperation:

- moving according to trajectories defined by individual tasks;
- these trajectories typically are not geometrically related;
- determination of tasks for each drone



**THANK YOU!**