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Internet of Things and its applications

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Network Changes in IoT Era (1)

1. Enormous number of IoT (up to trillions, the maximum value is 50 trillions, according to J.-B. Waldner “Nano-computers and swarm intelligence”)
2. Self-organized structure (instead of «heavy» infrastructure of the existing networks)
3. Super-dense heterogeneous networks (5G includes mobile and sensor networks, VANET, telemedicine)
4. Ultra-low latency networks (Tactile Internet, telemedicine)

Network Changes in IoT Era (2)

4. Augmented Reality plus IoT – new application
5. Flying networks (network which is not sensitive to delays, various applications)
6. Decentralized network architecture is used for IoT applications

Changing paradigms

Classic Internet:

- Content is developed by human for a human being
- Major consumer of Internet services is a human being

Internet of Things:

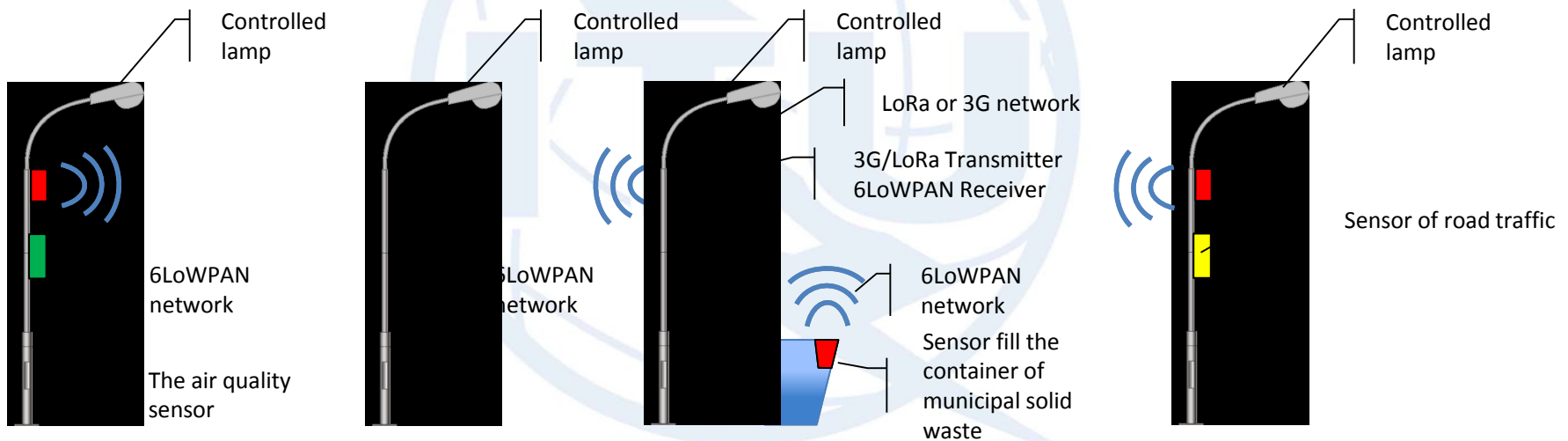
- Interaction "Human-to-Machine» (H2M) and "Machine-to-Machine» (M2M)
- Open tools for establishing interconnection with machines
- Major consumer of IoT services is a thing

The moment of transition:

- The appearance of new telecommunication technologies

IoT-devices in a Smart City

- Most of devices are able to provide info about their status and receive control commands



Basic technologies of IoT

For consumer devices

Wi-Fi
Bluetooth

*High speed
Short distance
Topology "Star" or "Point to Point"*

Middle range
(< 1 km)

Z-Wave
ZigBee
6LoWPAN
Thread

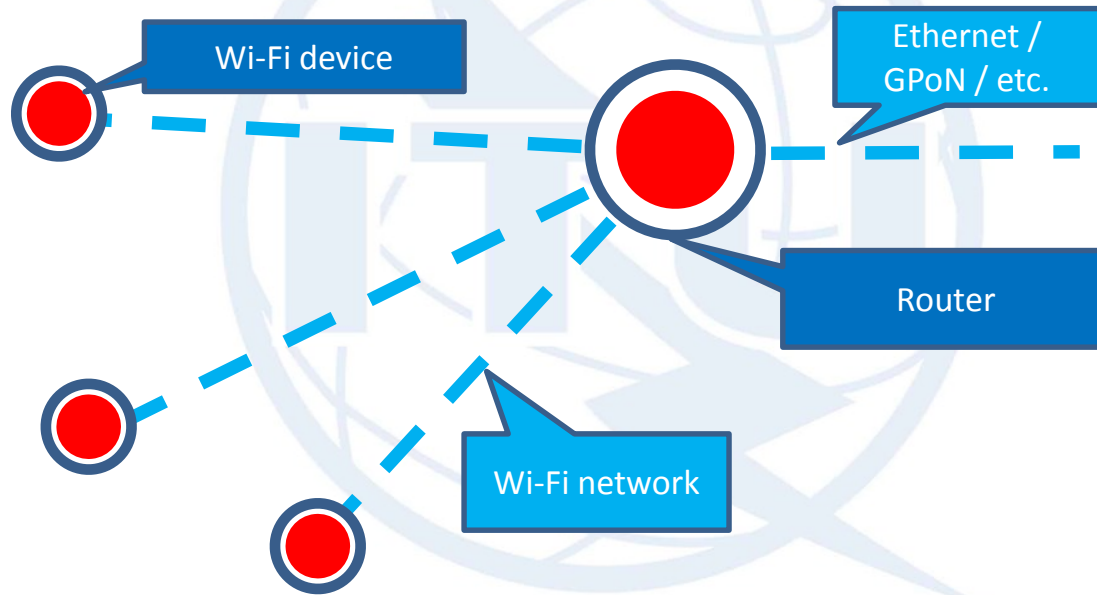
*Low power consumption
Topology "mesh"*

Large range
(1-50 km)

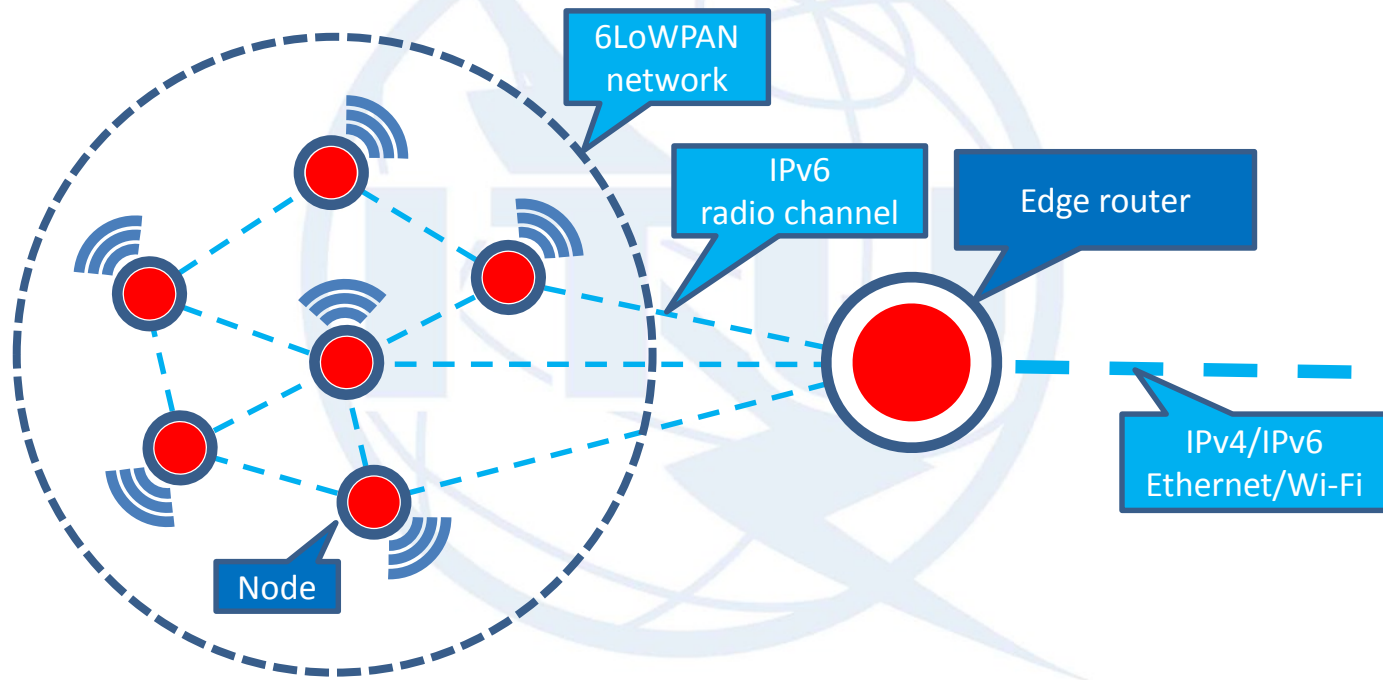
Sigfox
Strij
LoRa
NB-IoT

*Low power consumption
Large distance
"Star" topology*

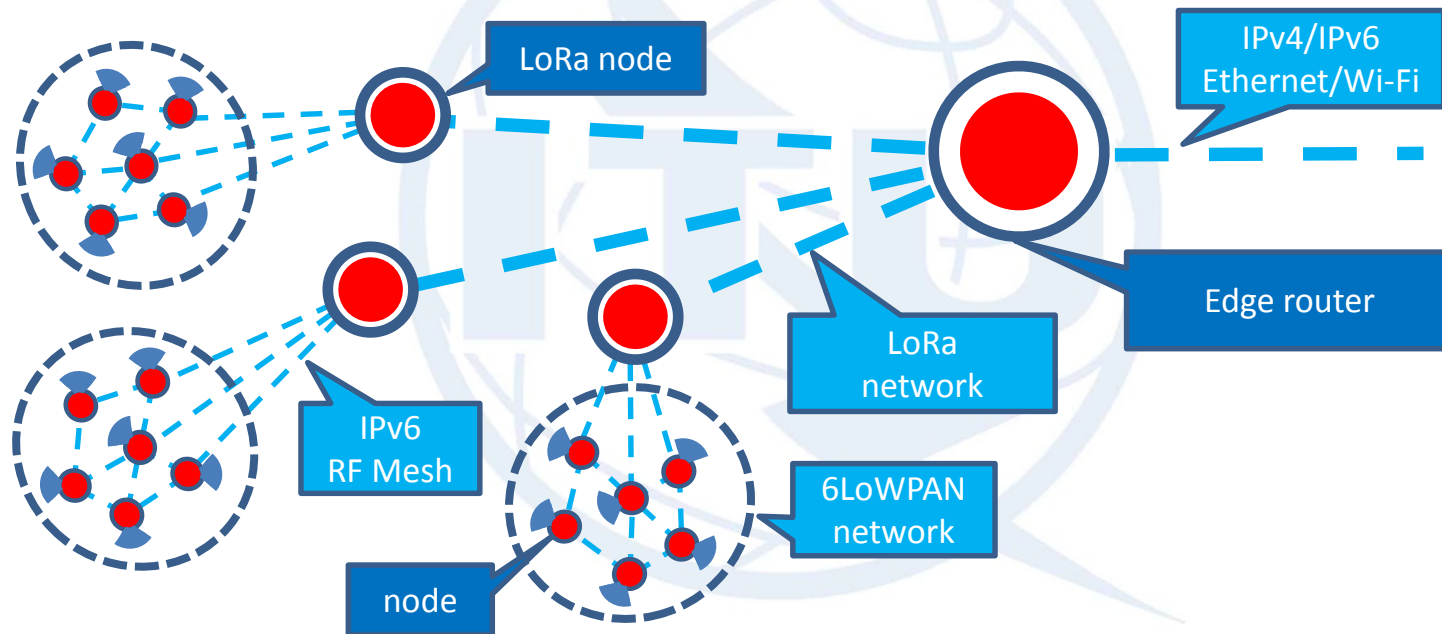
“Star” topology



“Mesh” topology



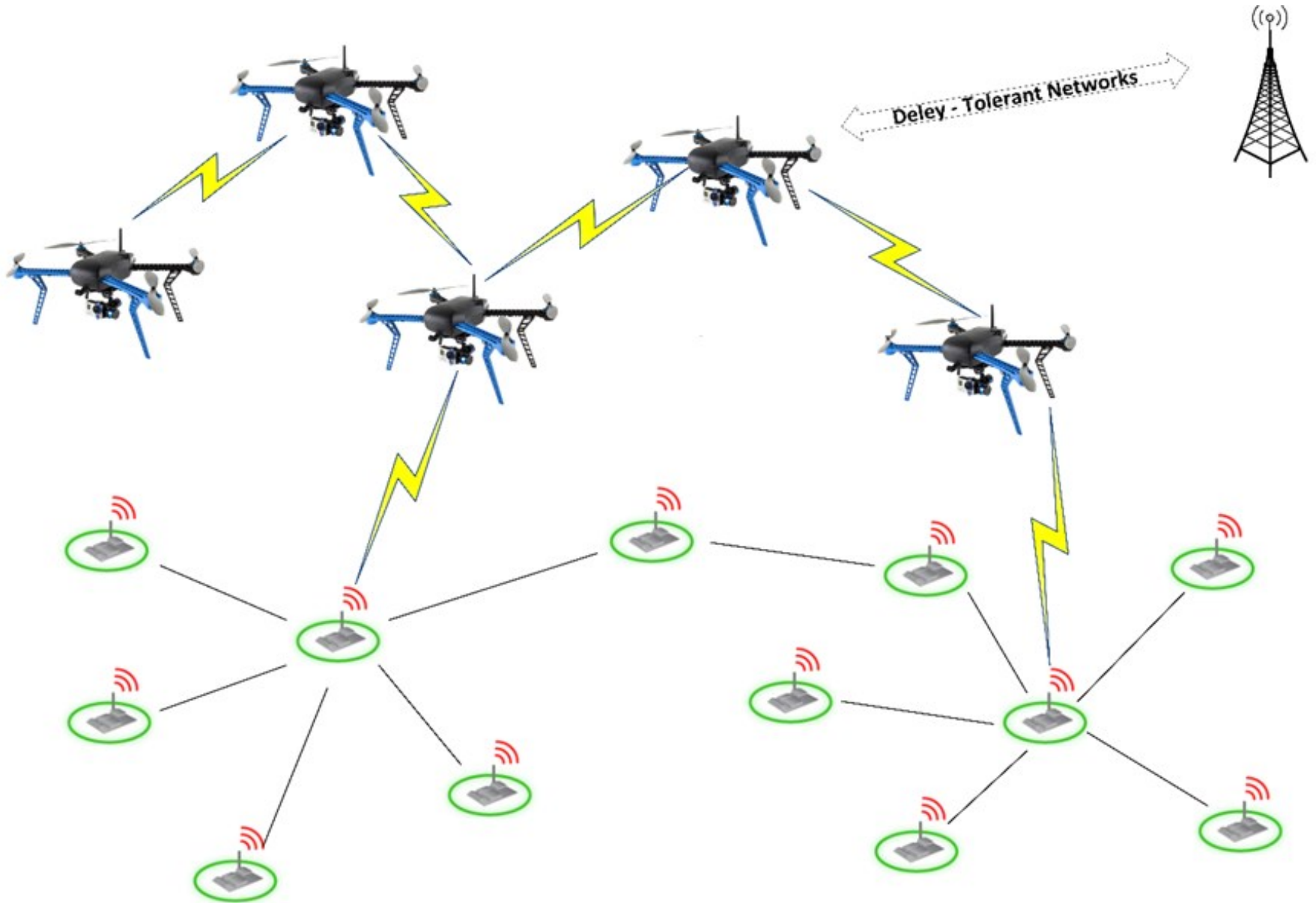
Heterogeneous networks



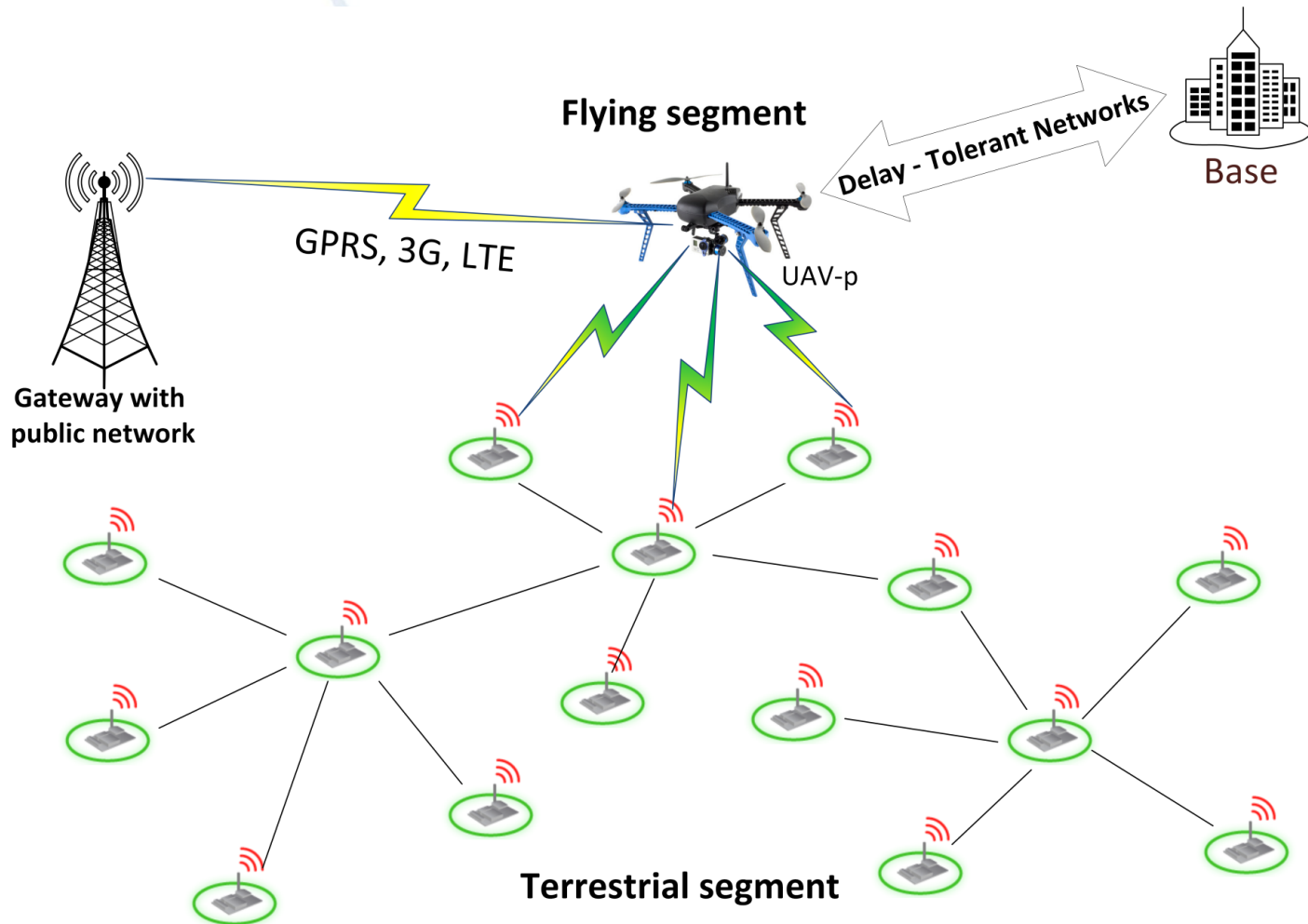
Classification of Internet of Things (computing power)

- without ADCs (SAW)
- based on a microchip (RFID, NFC)
- based on a microcontroller (MCU)
- based on microprocessor (computers, microcomputers) (MPU)

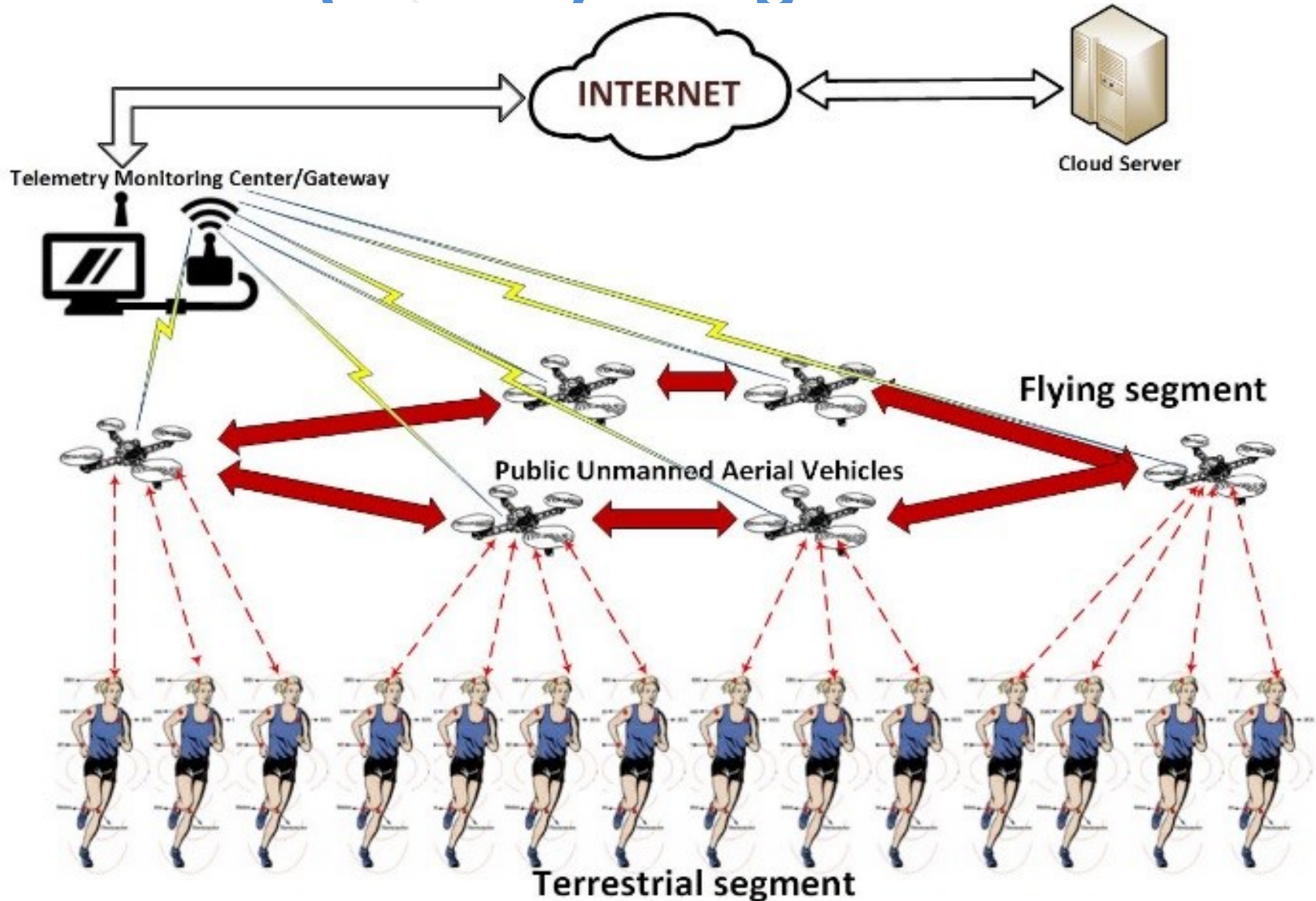
Flying Ubiquity Sensor Networks



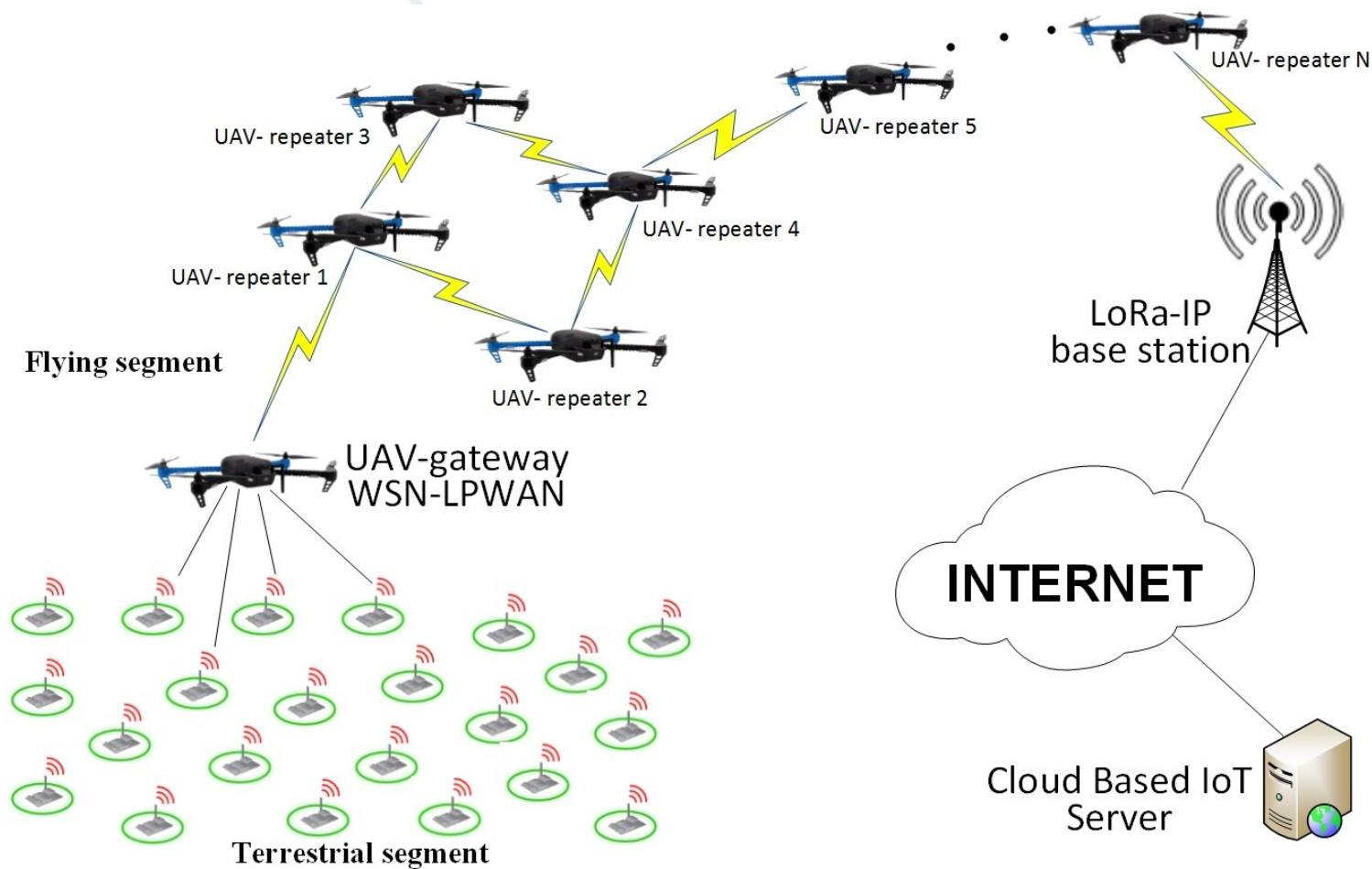
Methods of data delivery from the sensor field to Public Communication Network



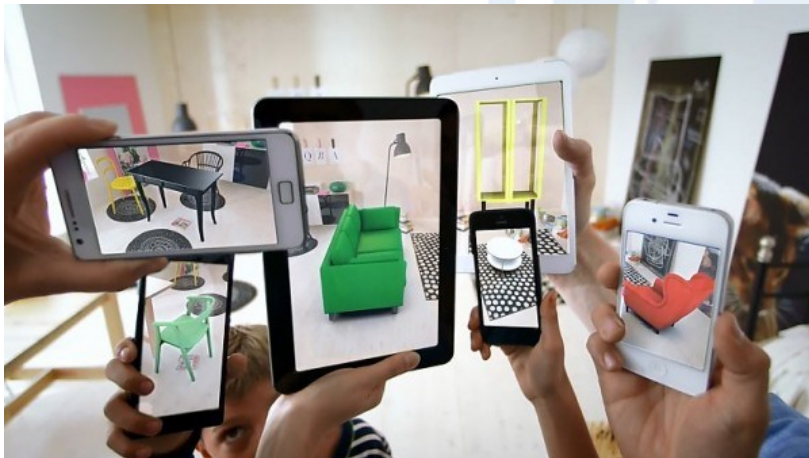
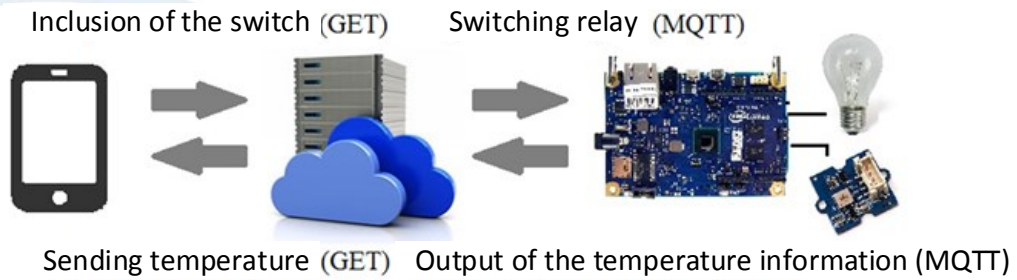
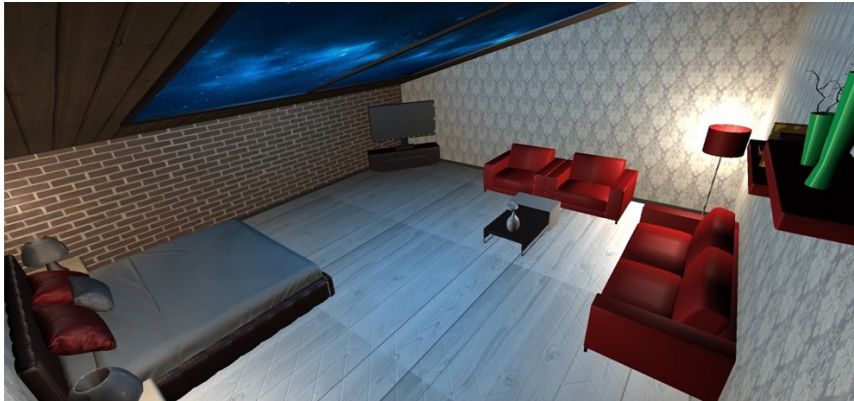
Gathering data from wearable networks (WBAN) using FUSN



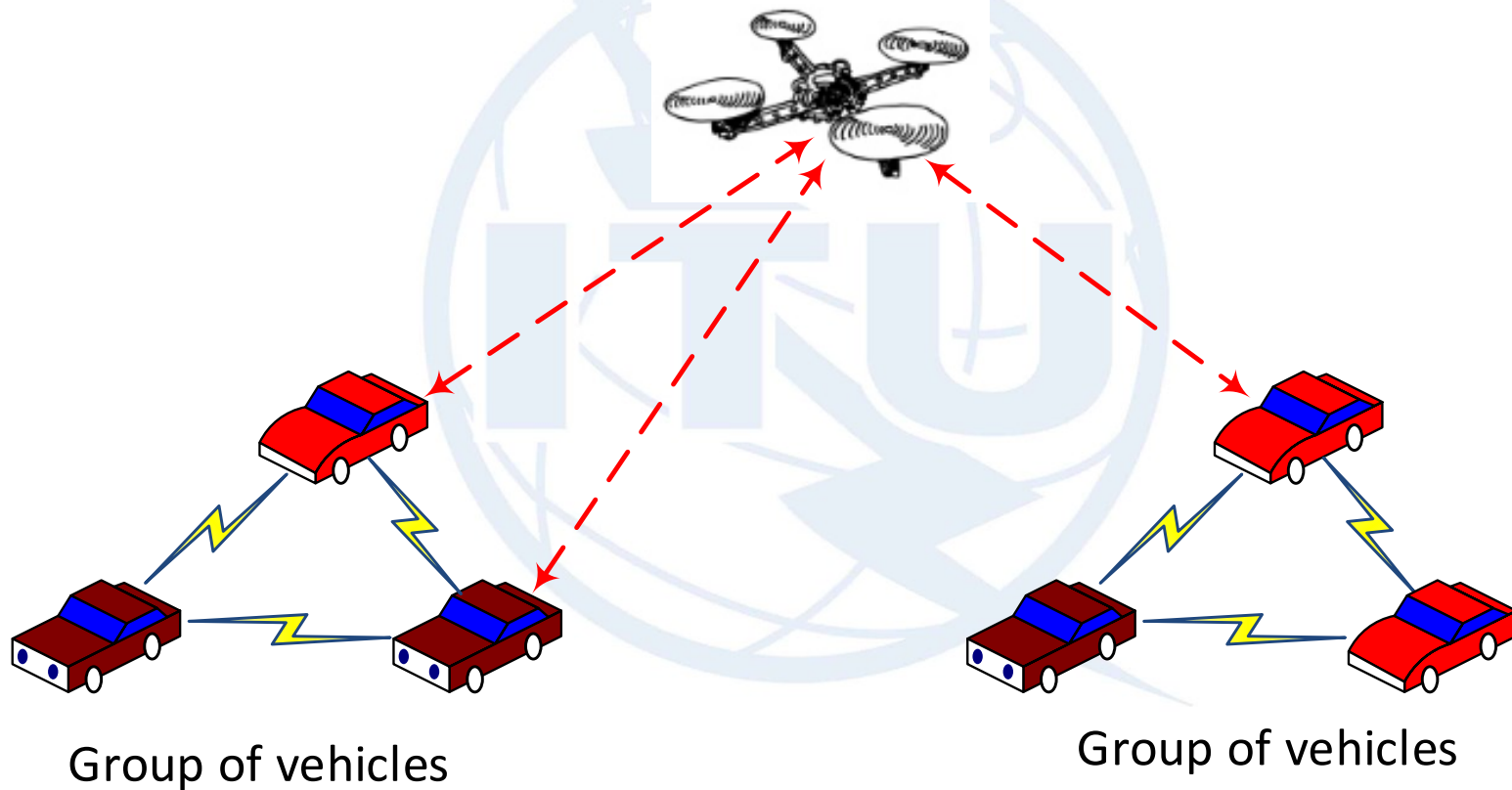
Data delivery from the sensor field via LoRa network



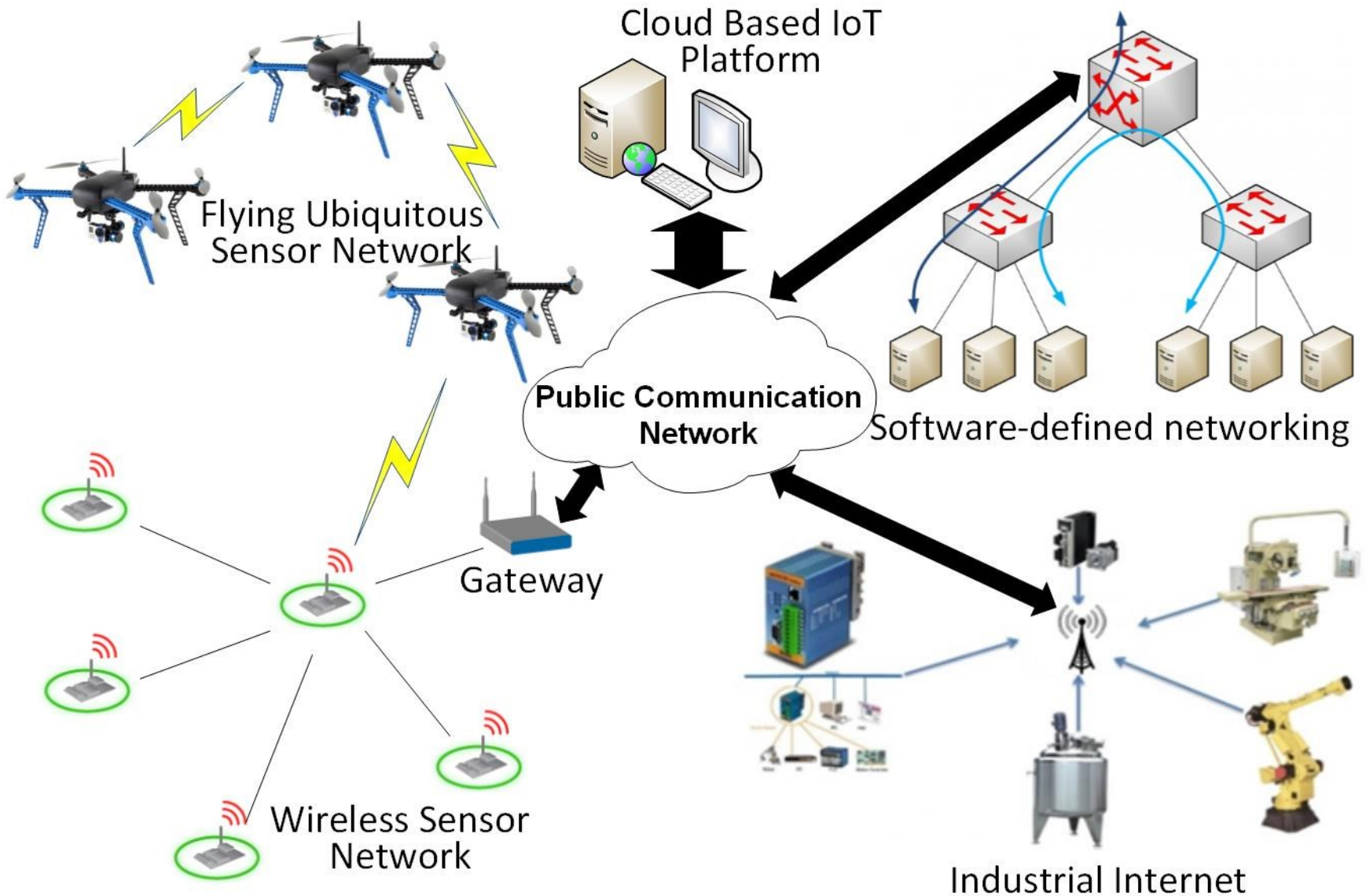
Augmented Reality + Internet of Things



Using UAVs for connecting VANET segments



Architecture of the model networks of the Internet of Things Laboratory (SPbSUT)



Conclusions (1)

1. Many new services will appear in the era of the Internet of Things. Most of services will be collecting data from the real world and transfer it to a virtual world
2. Low power technologies may lead to the appearance of new types of interconnection among devices
3. Currently, different types of networks merge to one heterogeneous network

Conclusions (2)

- 4. A new application of IoT is a flying ubiquitous sensor network
- 6. Drones may help to connect remote VANET segments
- 5. Applications of augmented and virtual reality will be used for controlling and managing IoT
- 6. Model network for Internet of Things can be used as beta-testing of new technologies, services. It may help developers to define bottlenecks

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