WORKSHOP GARR 2025

NET MAKERS

Resilienza e Infrastrutture Critiche

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Introduction

Natural, CBRN (Chemical, Biological, Radiological, Nuclear) and man-made disasters can cause massive destruction, high mortality and many casualties not only in urban areas but also in critical infrastructures, usually, without warning; this is particularly true for earthquakes.

Earthquakes involve more than 30% of the total fatalities from natural disasters in the last 20 years. On average, about 7 lethal earthquakes were occurring each year in the 20th century.

Entrapment is also the result of collapsed structures due to accidental or deliberate explosions (e.g. collapsed mines, technical failures, confined spaces).

Disaster impacts are high in Critical Infrastructures for a number of reasons; CIs are positioned over large regions, are overpopulated, have very tall and extended building blocks with complicated street patterns

Background

- Current large crises → Transboundary crises
  - Multiple jurisdictions, multiple policy sectors
  - Multiple infrastructures
  - Multiple levels of response
  - Rapid evolution & escalation

- Necessity to improve large-crisis management → Efficiency
  - *Ex: Sept 11th 2001*
    Partial pick up of radio transmissions (difficulties in high-rises), leading to incomplete COP (common operational picture) & improvisation
  - High pressure upon crisis communication & response networks
  - Failures in communication, information sharing & coordination, mainly during the 1st phase

Background

- Existing barriers for effective use of an emergency management system
  - Culture
  - Trans-border crises
  - Language, definitions

→ **Not technical**

→ **Ambiguity**

- <u>Integrated information</u>
  - Culturally neutral system
  - Collaborative tools
  - Better coordination of actions of diverse organizations
  - Multi-faceted crisis response mechanism

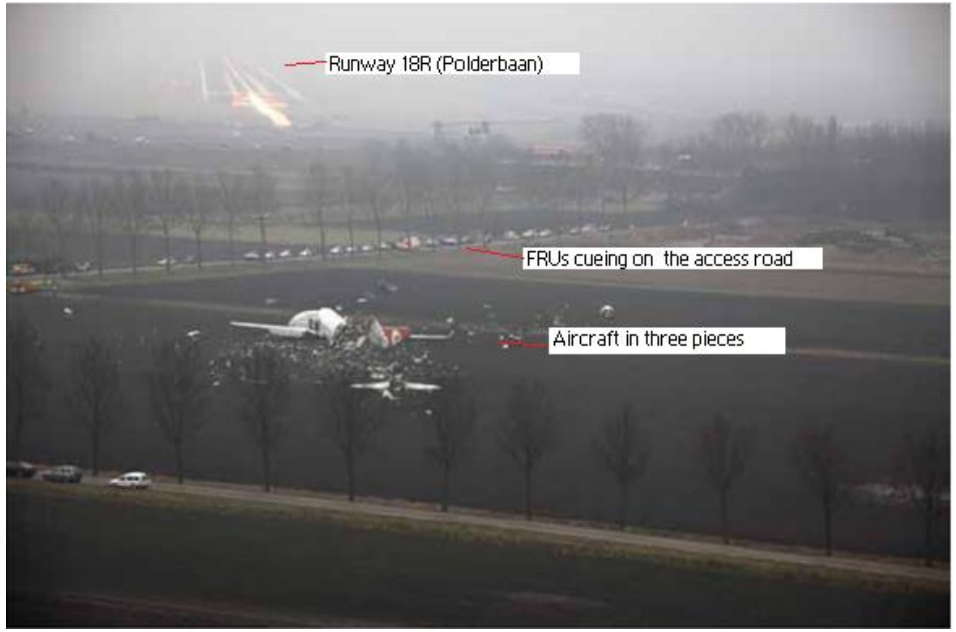
FIRE ON FACTORY

FUKUSHIMA

EARTHQUAKE

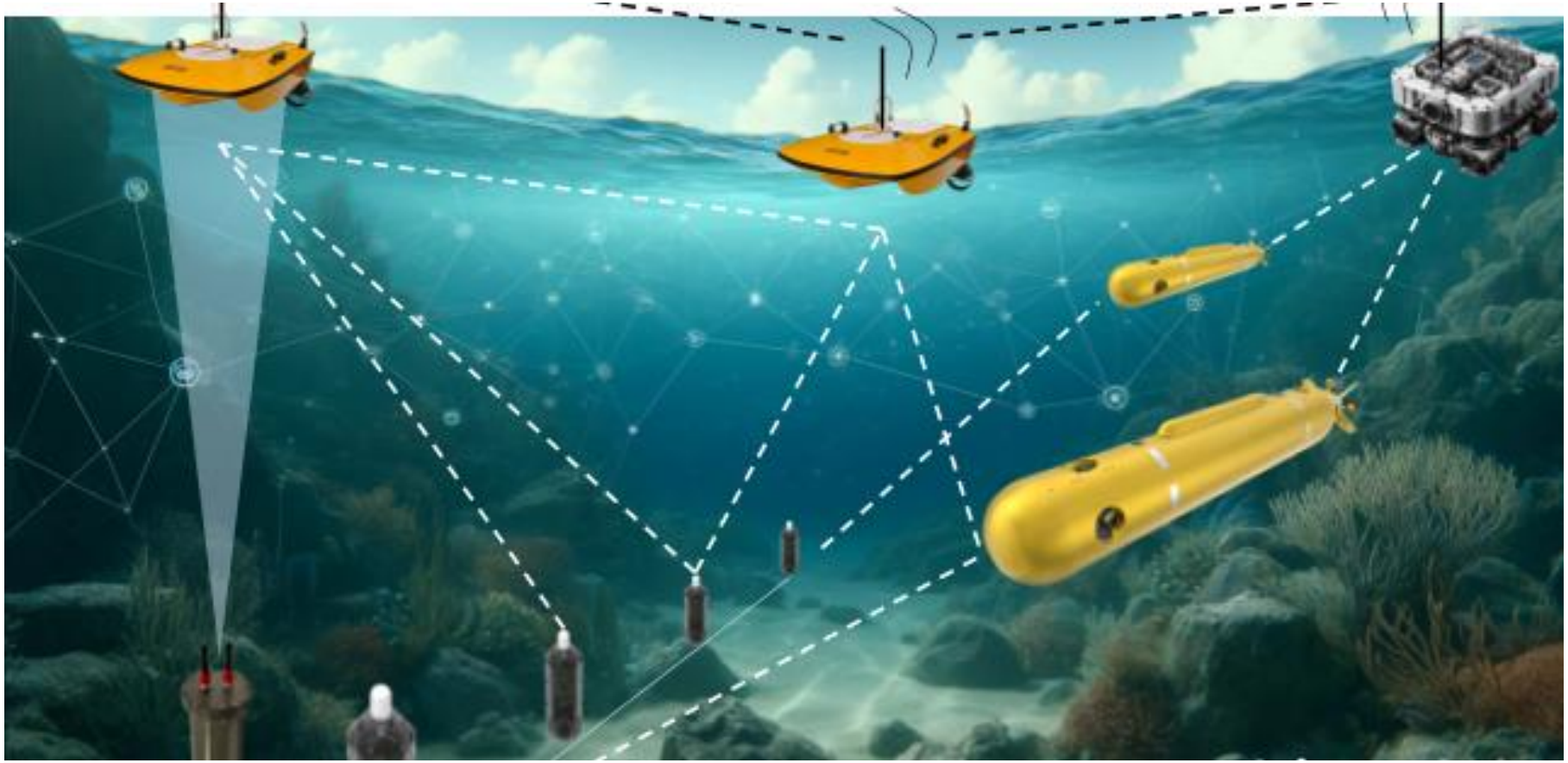
TRAIN ACCIDENT

AIRCRAFT CRASH at SCHIPHOL AIRPORT (NL)



VESSEL FIRE

SUBMARINE CABLES



Emergency Networks: past experience

Lack of interoperability among systems of different organizations:

- Lack of specific standards;
- Proprietary solutions often not compatible;
- E.g.: World Trade Center, 9/11/01

Lack or limited data service and applications:

- Compared to recent wideband wireless networks;
- E.g.: important data such as maps, building plants, videostreaming systems

Excessive trust in fixed infrastructures:

- Communications towards hit by destructive events;
- E.g.: Katrina, New Orleans, 2005

Disasters: operational scenarios

1. **“Day to Day”/routine operations**: include normal and regular types of incidents that PPDR users handle on a daily basis. e.g. Road traffic accident in which two cars are severely crashed. From one of the cars the fuel tank is damaged causing a leakage that sets a fire on its rear side. In addition drivers and passengers suffer different types of injuries and some of them are trapped inside the vehicles.
2. **“Large Planned”** : Planned event that cannot be considered as routine operations. E.g. G7 summit, the visit of the Pope, the EU football champions’ league final,… With respect to telecommunications, additional capacity to existing infrastructure could be added by mean of portable antenna towers.
3. **“Disasters /unplanned major events”:** Addressing situations that are usually associated with a crisis, such as flooding, earthquake, airplane accident, terrorist acts, upheavals, etc.; permanent damage of the majority of the telecommunication infrastructure while the FRs have to organise the appropriate actions for survivors evacuation and research actions

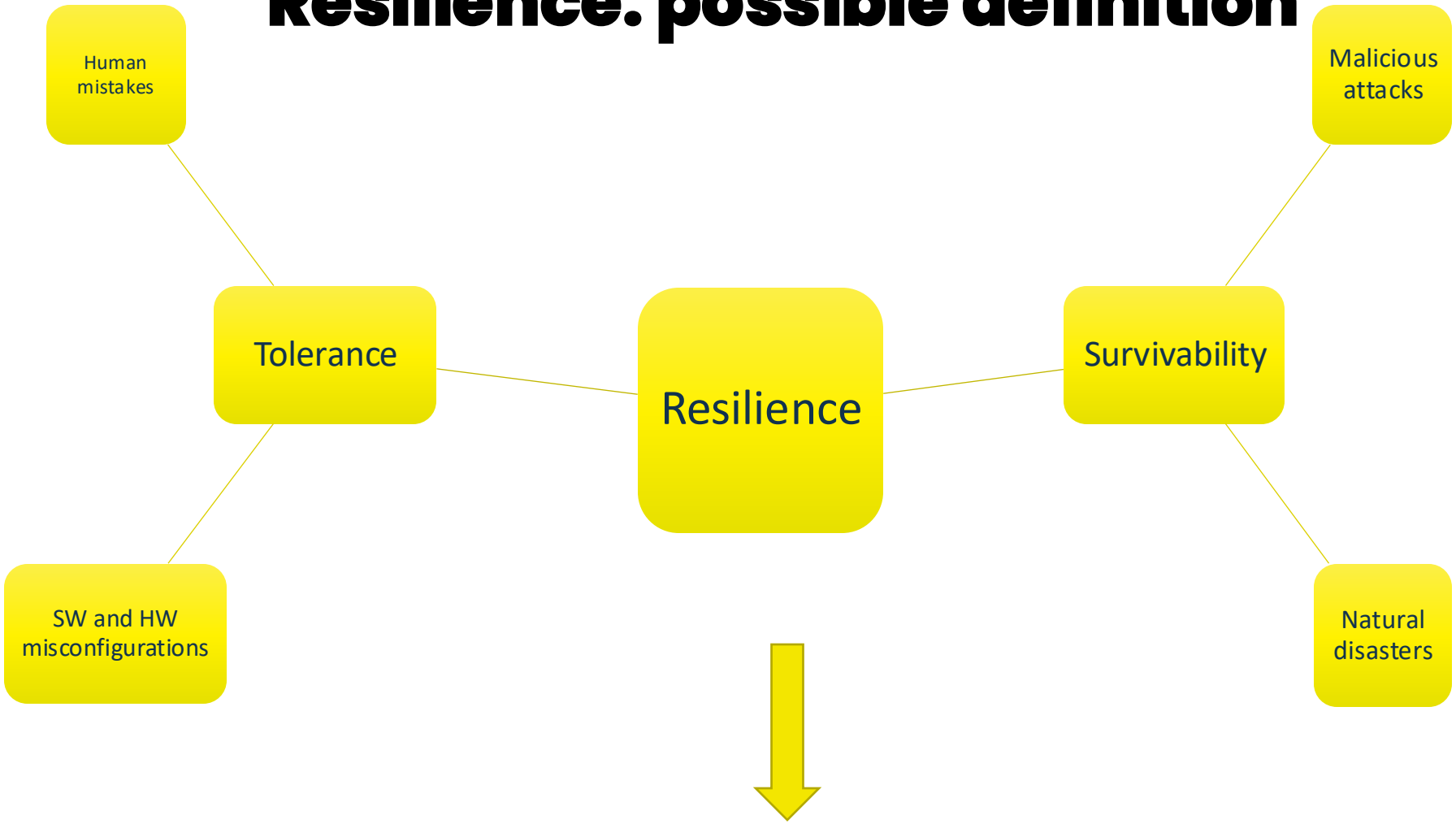
Definitions (some)

Danger: intrinsec feature of an event, object, action (etc.) to potentially cause damages

Risk: when the source of damage exists together with a possibility it causes damages; it is a probabilistic concept given by probability of occurrence of an event capable to cause damages to (e.g.) people

Resilience: ability to absorb or avoid damage without suffering *complete* failure

Resilience: possible definition



PERSISTENCE OF SERVICE

Possible Approaches to Resilience (some)

Survivable Network Design

- Plan in advance
- Build the infrastructure by inserting **redundancy** wherever possible
- Let the network react to localized failures through **Self-Organizing Network (SON) Features**
- Keep ready some fast to deploy and easy to configure **ad-hoc mobile networks** with additional backhaul mechanisms for unrecoverable failures and mission-critical applications

Interoperability

- Share network infrastructure among multiple owners, through multiple administrative domains
- Network Function Virtualization (**NFV**) for sandboxed and replaceable operations in core networks
- Software-Defined Networking (**SDN**) for equipment interoperability and quick substitutability

Resource Pooling

- **Multihomed** devices with dedicated network protocols (e.g. **MultiPath-TCP**)
- **Collaborative** frameworks through **SDN** and 5G or **SDN** and NFV in 4G

SMART CITIES OF THE FUTURE: SAFETY AND RESILIENCE OF CITIZENS

- Airports and harbours
- Highways
- Industrial areas
- Water channels
- Places to monitor (public, religious, crowded..)

For possible:

- Natural disasters
- Human attcks

PERSISTENCE OF SERVICE

HERE MEANT AS:

Capacity of the citizen to safely live and enojoy urban environment, made actually of many

CRITICAL INFRASTRUCTURES

First Challange:

Collect data of vehicles and pedestrian mobility to provide safety to citizens

URBAN ENVIROMENT: CHALLANGES

Challenges

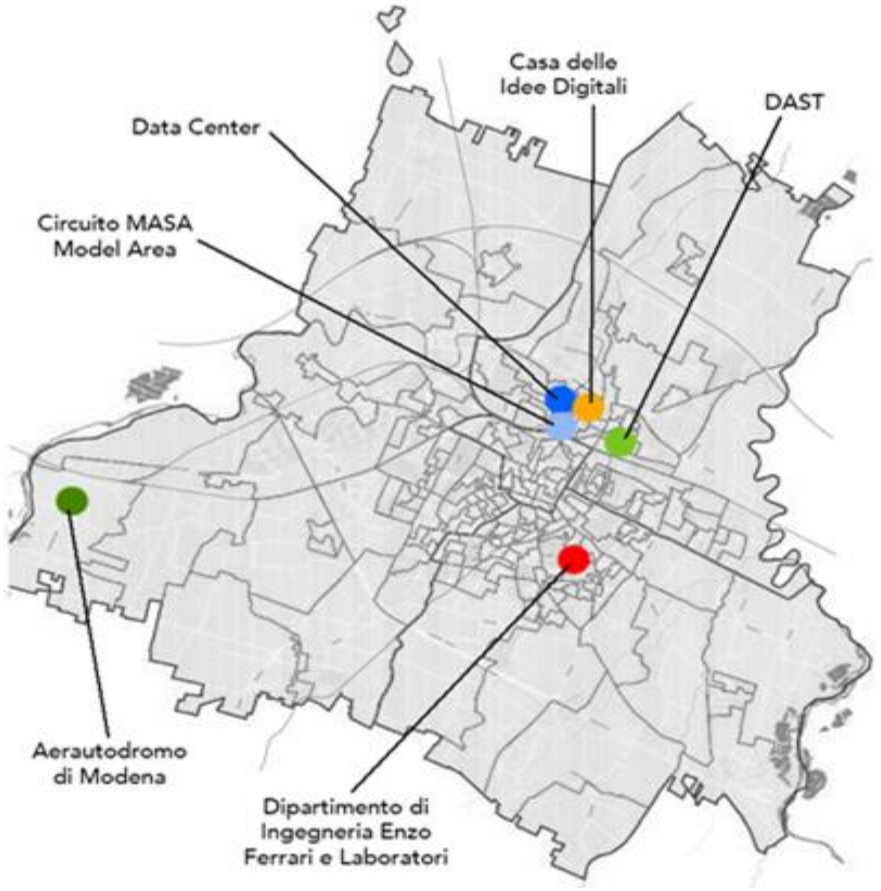
- Other vehicles *(CAVs* vs standard, connected vs not connected)
- Infrastructure support?
- Bicycle/pedestrians
- Intersections
- GPS positioning
- Signals, traffic lights
- …

CITIZEN MOBILITY

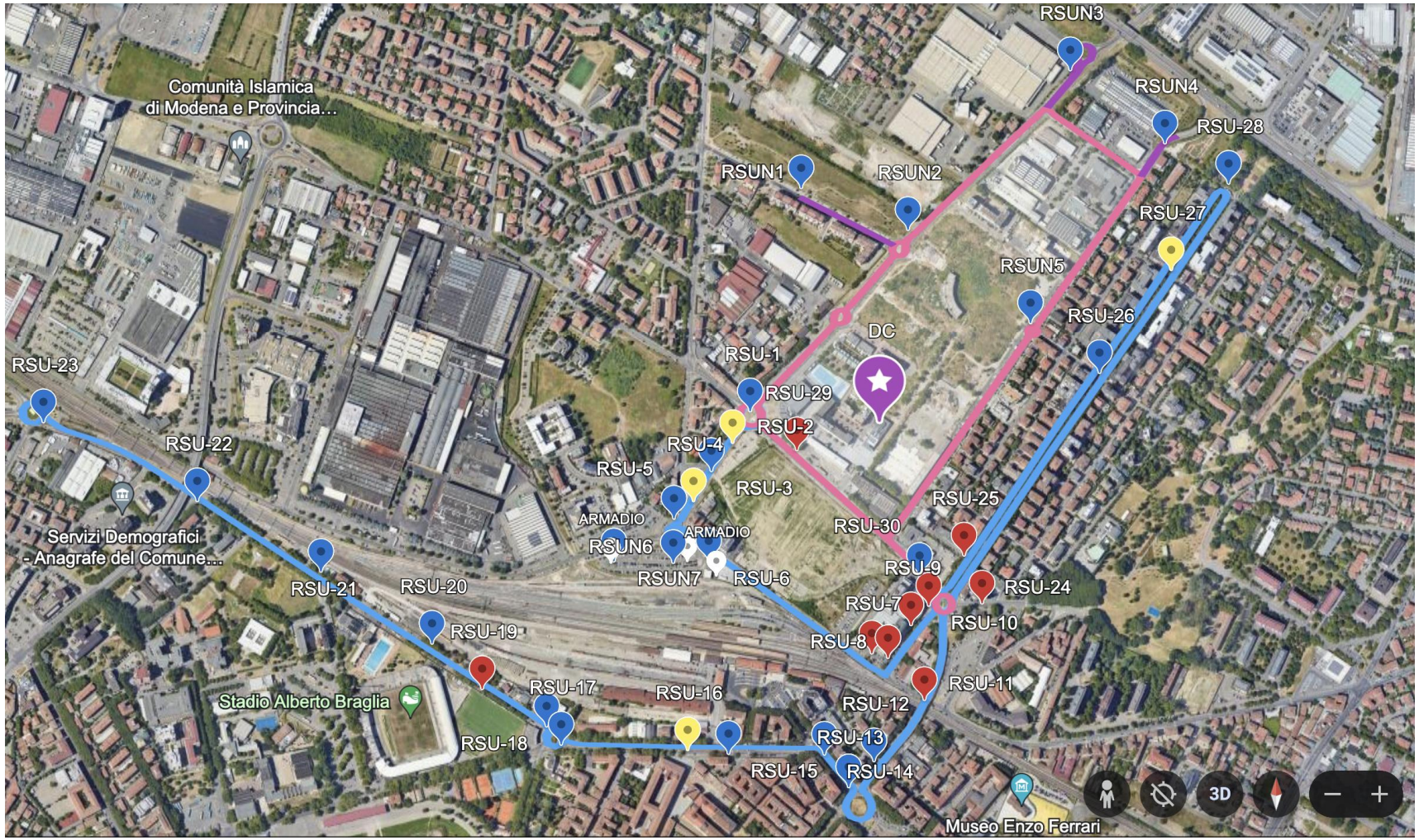
LIVING LABS IN MODENA

1) Modena Automotive Smart Area (MASA), 4sq km urban area for CAVs testing and collection of datasets in real urban multi-vehicle environment in the city center of Modena

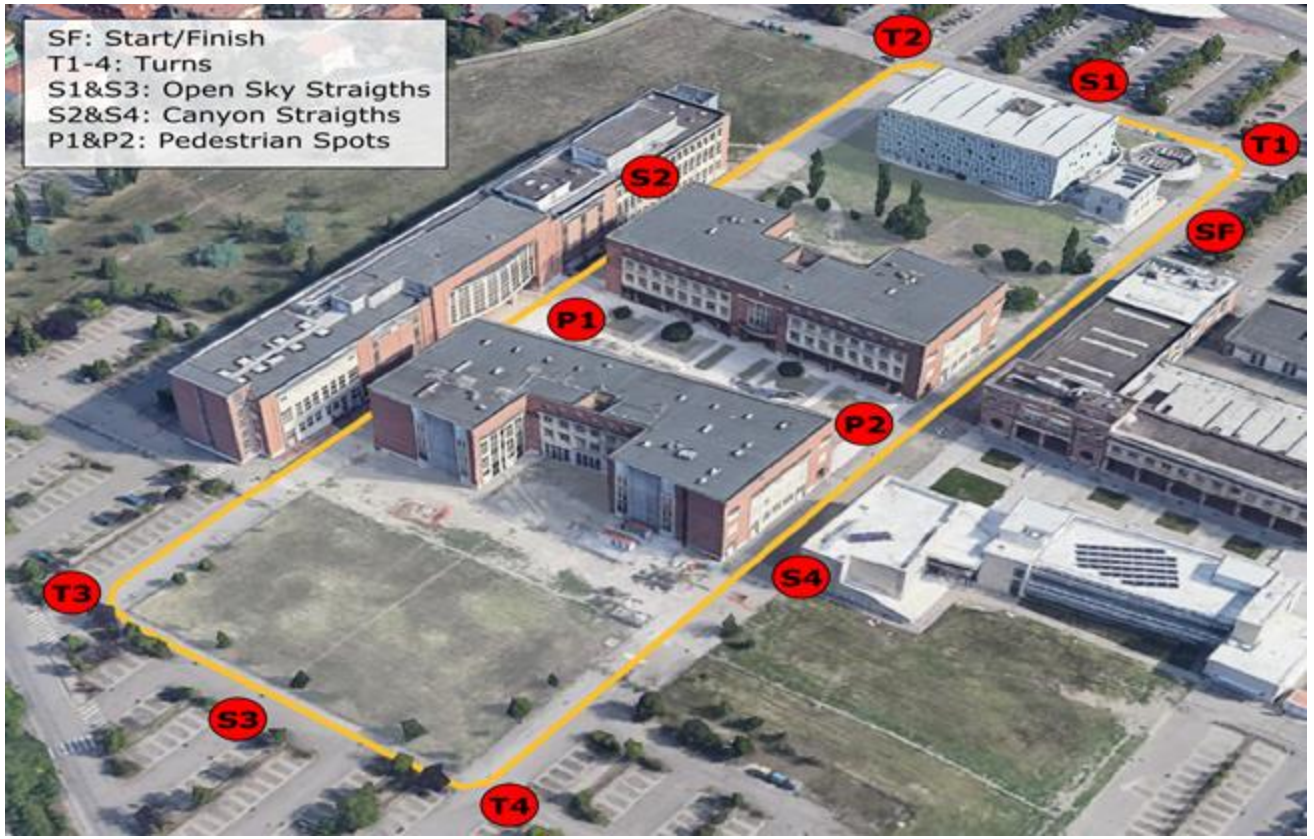
2) Marzaglia (Modena) racetrack, a 15sq Km area with a 2 km-long circuit, to be enhanced with technological equipment and V2X infrastructures for Euro NCAP as well as vehicle homologation and performance testing.



Modena Automotive Smart Area DEPLOYMENT



Vulnerable Road Users: GPS-based Awareness Messages



Thank you!
Questions?

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