”Smart” First Responders:

INGENIOUS Tools & Services to protect them and enhance their operational tasks.

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Presentation Contents

1. WP2 Overview, objectives and goals
2. WP2 Technologies – Features, benefits and advances for the First Responder of the Future
3. WP2 Main Findings and Achieved results

WP2 Objectives

- Selecting platforms' building blocks for ensuring reliable, seamless and resilient operation in harsh environment.

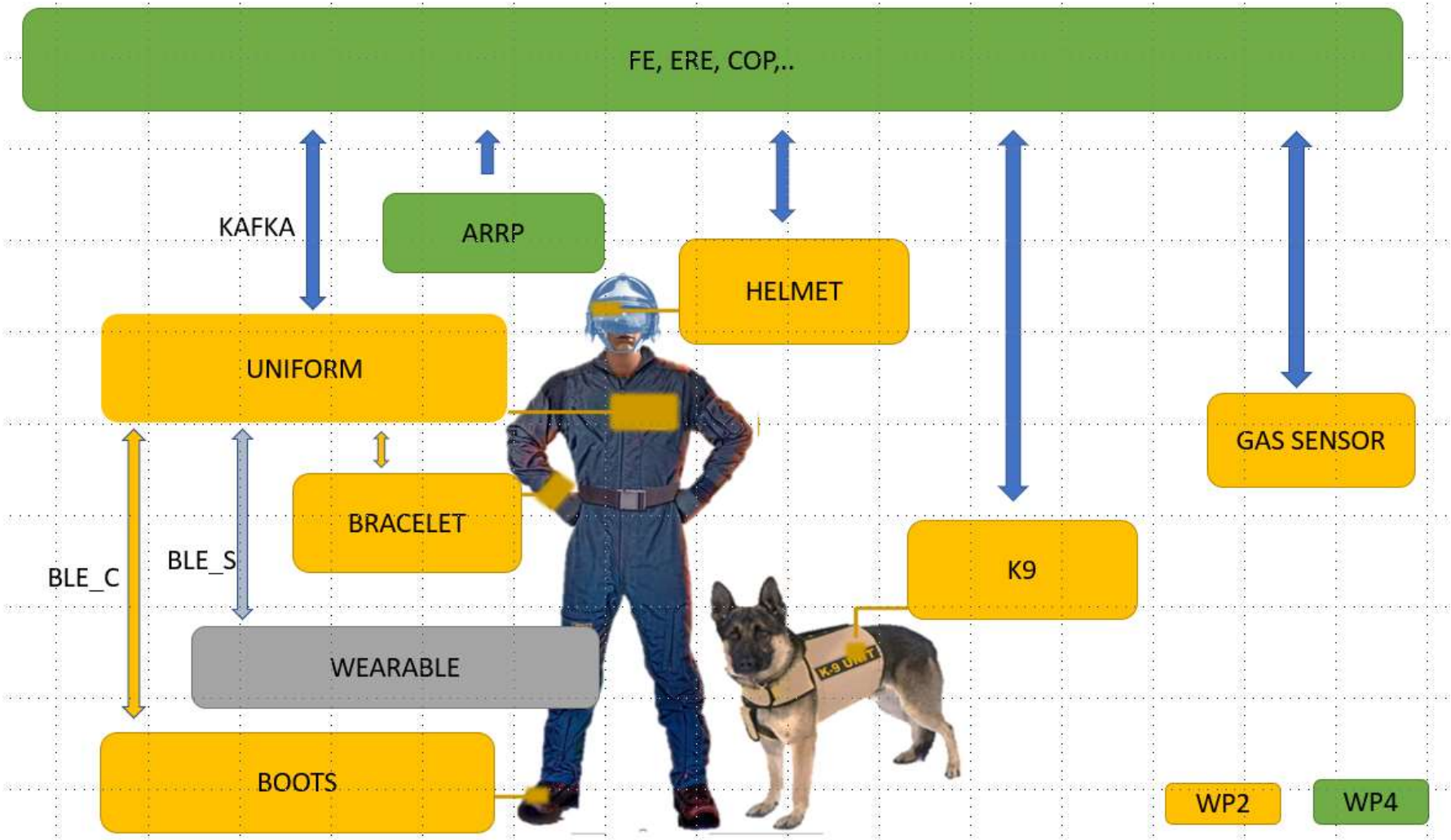
- Develop functional prototypes of worn parts of FRs and K9.

- To reach high performance of prototypes on:
  - protecting FRs,
  - augmenting their situational awareness,
  - allowing them to collaboratively respond.

WP2 Structure and roles

- T2.1 Definition and ruggedization of smart-wearables subcomponents (**TEK**, M3-M8)
- T2.2 Development & Prototyping of smart helmet and functions (**TEK**, M3-M40)
  - Helmet (**KIRO**)
  - Environmental Gas Sensor (**TUW**), Laser (**ALPES**)
- T2.3 Development & Prototyping of the smart uniform and functions (**TEK**, M3-M40)
- T2.4 Development & Prototyping of the smart boots and functions (**CYRIC**, M3-M40)
- T2.5 Development & Prototyping of the smart functions of the K9s (**ICCS**, M3-M40)

WP2 Overview



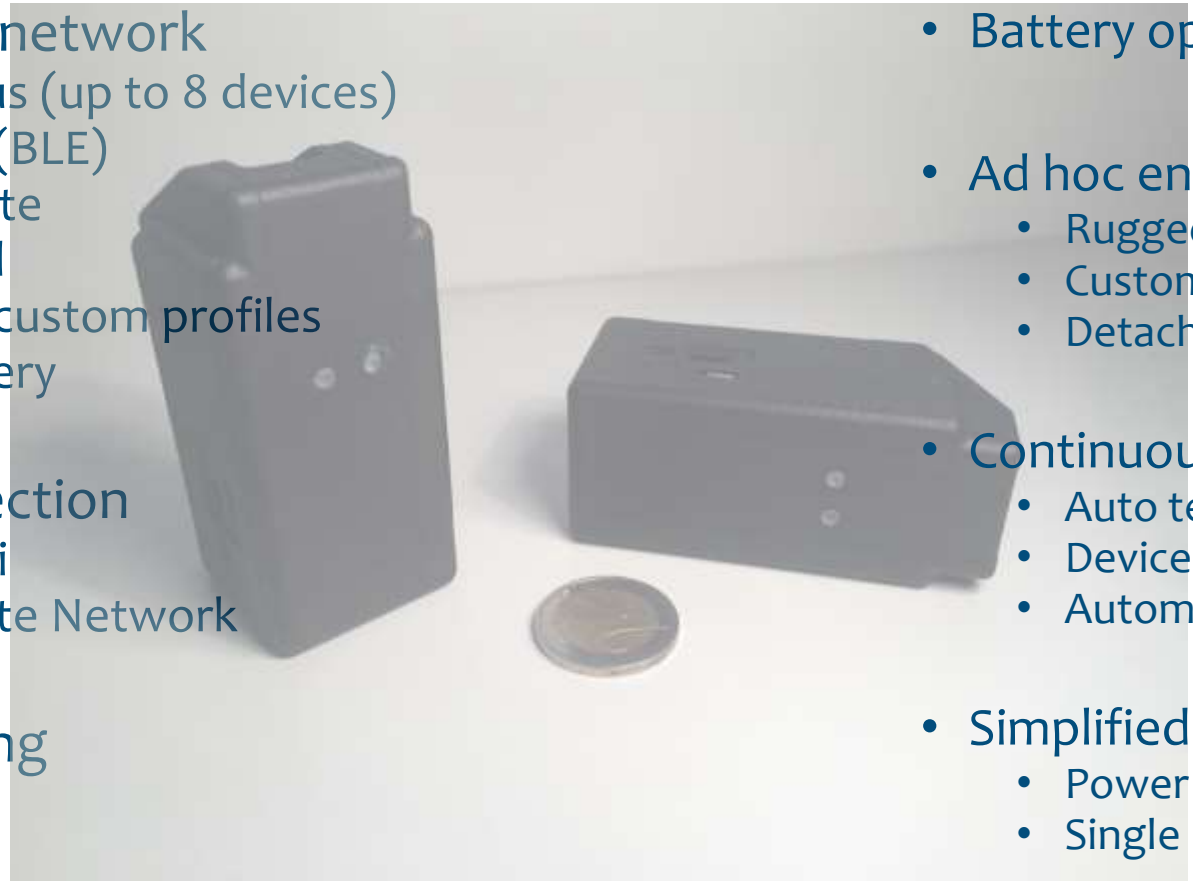
WP2 Technologies. Helmet

The helmet can be detachable for use by FRs of various agencies and can operate multiple devices at the same time.

- **Detachable** Helmet components
  - For to use of various types of helmets
  - Easy detachable structure & *compact HW*
  - Replaceable batteries
- **Multiple operated** prototype
  - Simultaneous video transmission of 2 or more
  - Real-time video transmission to the center
  - *Handheld or wearable(AR Glasses) IR video display*

WP2 Technologies. Smart Uniform

- Personal Area network
  - Simultaneous (up to 8 devices)
  - Low power (BLE)
  - High data rate
  - Bidirectional
  - Standard & custom profiles
  - Auto discovery
- Remote connection
  - On field WiFi
  - Virtual Private Network
- Edge processing
  - Linux OS
  - CPU XXX



- Battery operated
- Ad hoc enclosure
  - Rugged enclosure
  - Customized (Fire brigade & Police)
  - Detachable
- Continuous monitoring
  - Auto test
  - Device status (RSSI, BAT, T)
  - Automatic recovering
- Simplified User interface
  - Power ON /OFF switch
  - Single Led indicator

WP2 Technologies. Boots

Smart insoles for FR boots - features

- Physical design
  - Flexible 3D printed materials
  - Robustness, flexibility, comfort
- Electronics & sensors integration
  - Bluetooth
  - Integrated sensors
  - <12h battery autonomy
  - Wireless charging technology
  - Custom Wireless charger
- Event detection mechanism (ML model)
  - Event detection mechanism
  - Fatigue index indication
  - Mission report

WP2 Technologies. Boots

Smart insoles for FR boots

Benefits and advances for the FR

- Enhance H&S and situational awareness
- Real-time feedback for Team Leader
- Low-profile ergonomic design
- Wireless communication
- Easy to use

- Real-time detection
- Custom build event detection based on FR input
  - Immobilisation, Crawling, hanging from rope, heavy load
- Successfully tested in extreme heat and cold conditions

WP2 Technologies. K9 Vest

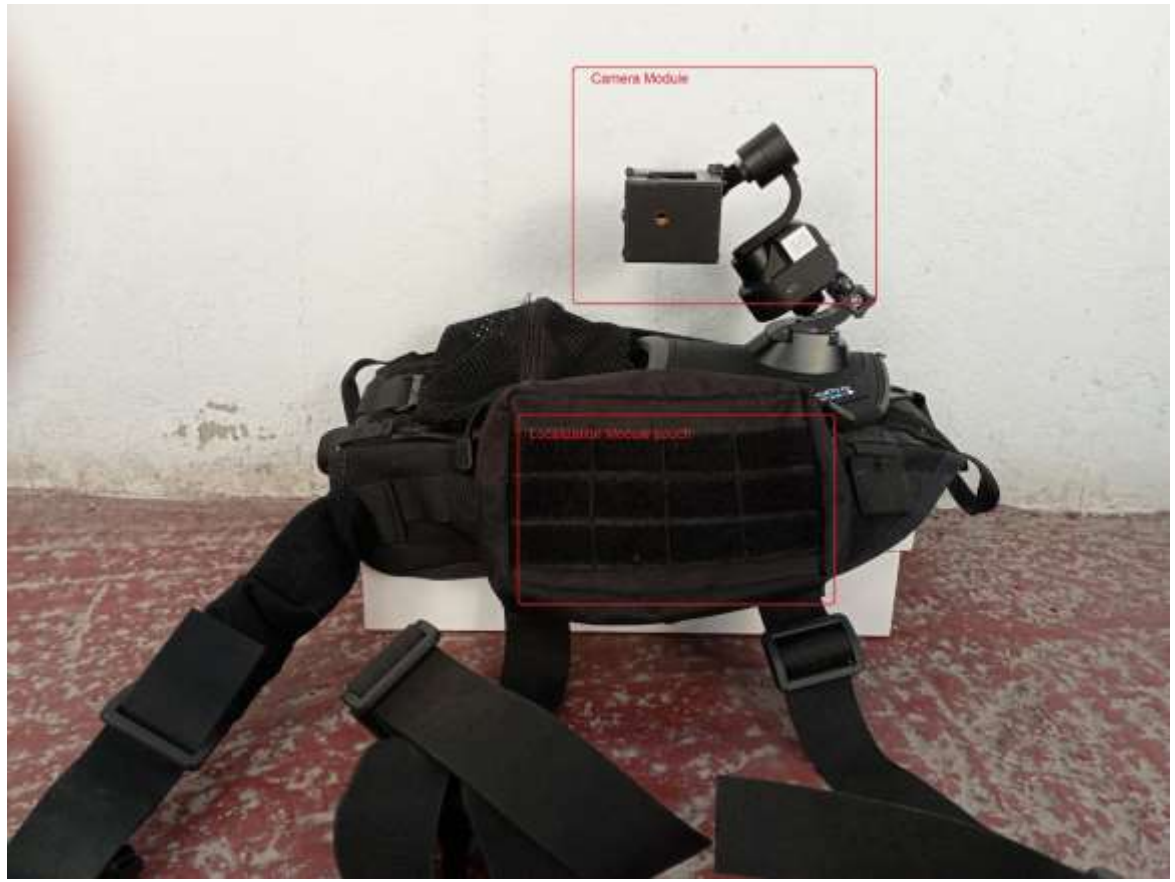
Modular K9 vest:

- **Camera module** with thermal and HD cameras streaming live to the COP or the local station.

- **Localization/Audio module** with GPS, dead reckoning and bidirectional audio.

WP2 Technologies. K9 Vest

- **Video streaming**
  - HD camera
  - Thermal camera
- **Localization**
  - GNSS receiver for GPS / Galileo / GLONASS
  - Accelerometer for dead reckoning in case of signal loss
- **Bidirectional audio:**
  - Dog -> Handler : Always on
  - Handler -> Dog : Push to talk



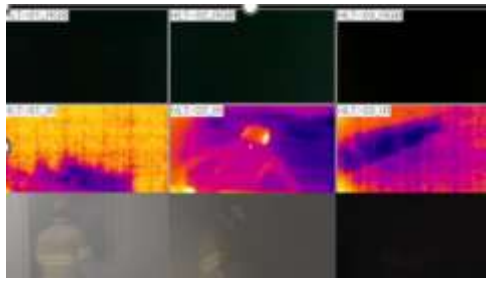
WP2 Main Findings and Achieved results. Helmet

Through various field tests, it was possible to directly listen to user opinions and improve the performance of the developed product.

- Successfully conduction of SST#1, FSX#1, SST#2, FSX#2
  - Gear improvements with feedback from First Responders
  - Experiments on the feasibility of use through demonstrations assuming disaster situations such as fire and collapse
- Improved usability through modification of functions such as wearability and easy battery attachment

SST #1 (Sweden)

FSX #1 (France)



SST #2 (Korea)

FSX #2 (Spain)

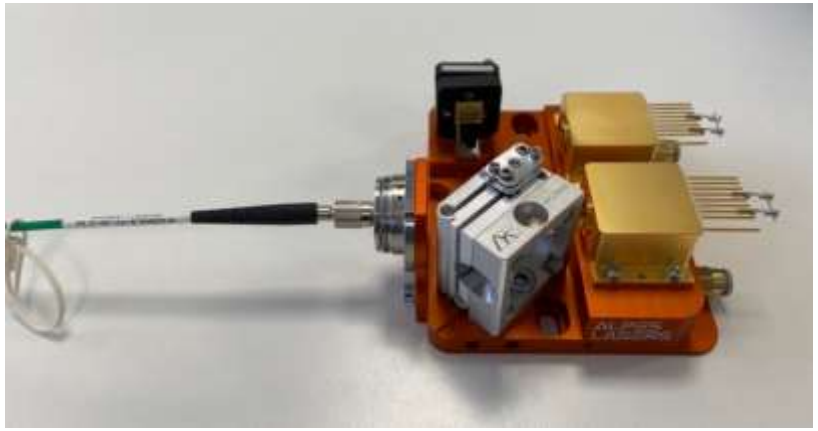
WP2 Main Findings and Achieved results. Gas Sensor

A highly innovative laser–based gas sensor has been developed based on the Quantum Cascade Lasers technology and the interferometric cavity-assisted photothermal spectroscopy (ICAPS) method

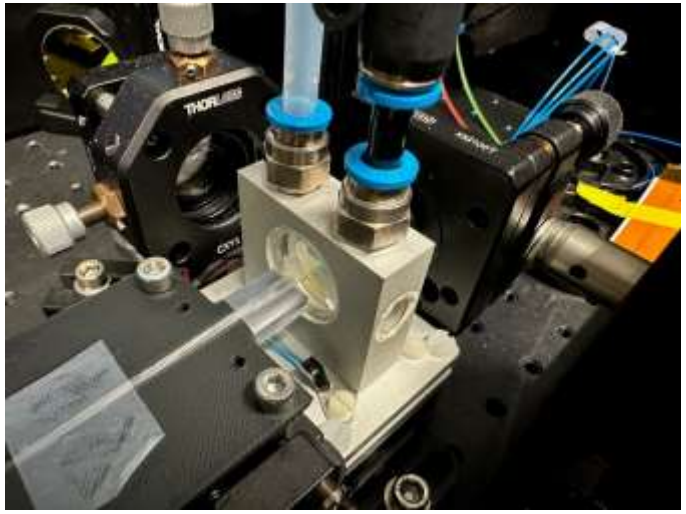
- Very **high-speed** response
  → the FR can be notified immediately on the presence of hazardous gas
- Very **low limit** of detection
  → able to detect minute quantities of the gas, at the few ppm range
- Very **broad detection** window
  → can detect very low and very high concentrations using the exact same setup
- **Compact and lightweight** design for multi-gas sensing
  → Portable AND high-performance devices

WP2 Main Findings and Achieved results. Gas Sensor

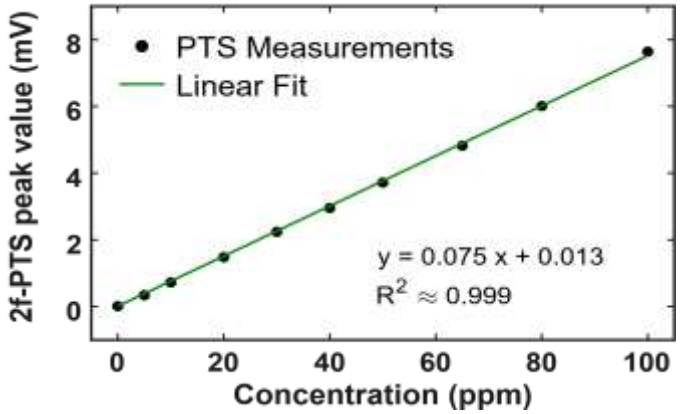
The new sensor has been demonstrated in lab-conditions



The tailored Quantum Cascade Lasers



Photograph of the new fiber coupled PTS gas sensor



Example: Quantification of carbon monoxide in air

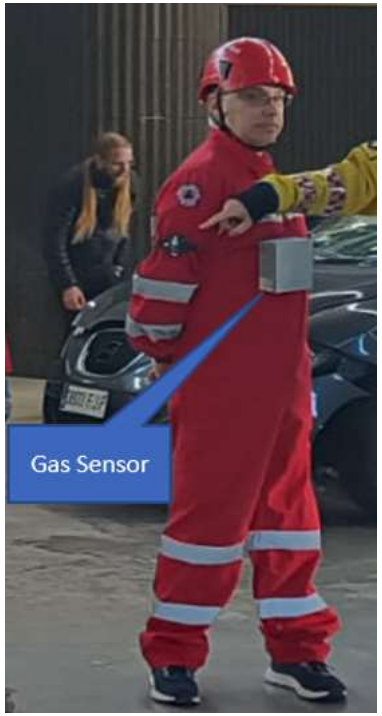
WP2 Main Findings and Achieved results. Gas Sensor

A portable gas sensor unit for the of ammonia and carbon dioxide tailored to the needs of FRs has been implemented and tested based on state-of-the-art electrochemical sensors

- Ease of operation (no buttons) | Portable (15 × 15 × 10), lightweight (<400g)
  Autonomous (battery last >10 h | Integrated to COP (sends data wirelessly)

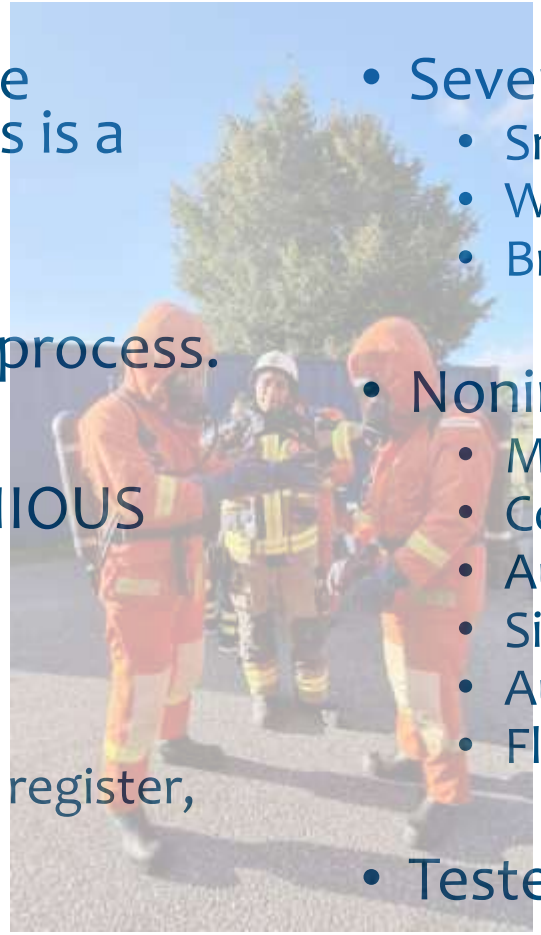
The measured areas are automatically annotated/flagged based on the detection of the hazardous gases

Green - Yellow - Red



WP2 Main Findings and Achieved results. Smart Uniform

- Early engagement and close collaboration with end users is a must.
- Iterative development test process.
- Fully integrated with INGENIOUS ecosystem
- Complementary tool:
  - Monitor, debug, integration, register, fault injection.



- Several (5) functional prototypes
  - Smart uniform
  - Wearable
  - Bracelet
- Nonintrusive valuable solution
  - Miniaturized
  - Compatible with current procedures
  - Auto discovery
  - Simplified interface
  - Auto recovery mechanisms
  - Flexible and scalable
- Tested and validated by End users

WP2 Main Findings and Achieved results. Boots

Smart insoles for FR boots

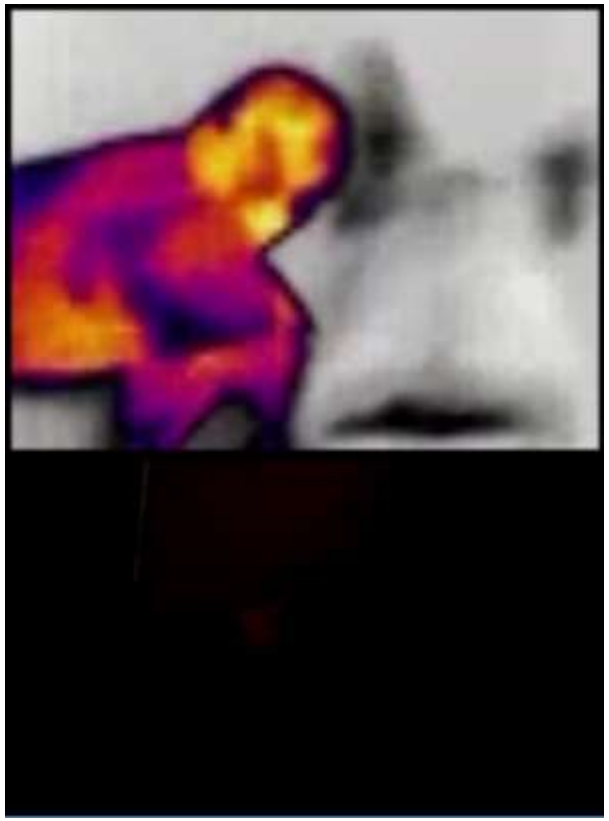
- A new validated product that enhances the safety of FR in the field
- Successful integration with the NGIT
- Tool validation in real environment

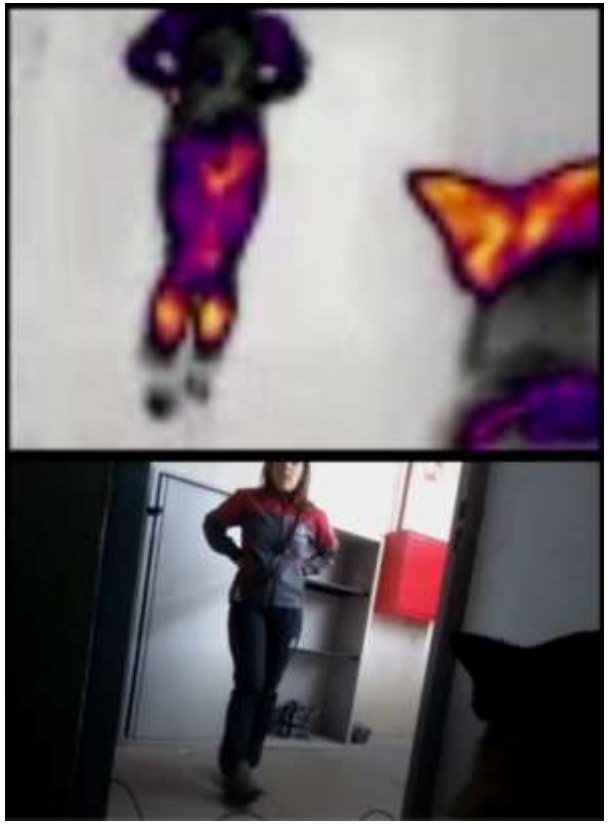
- Proper extraction of user requirements
- Close collaboration with end users

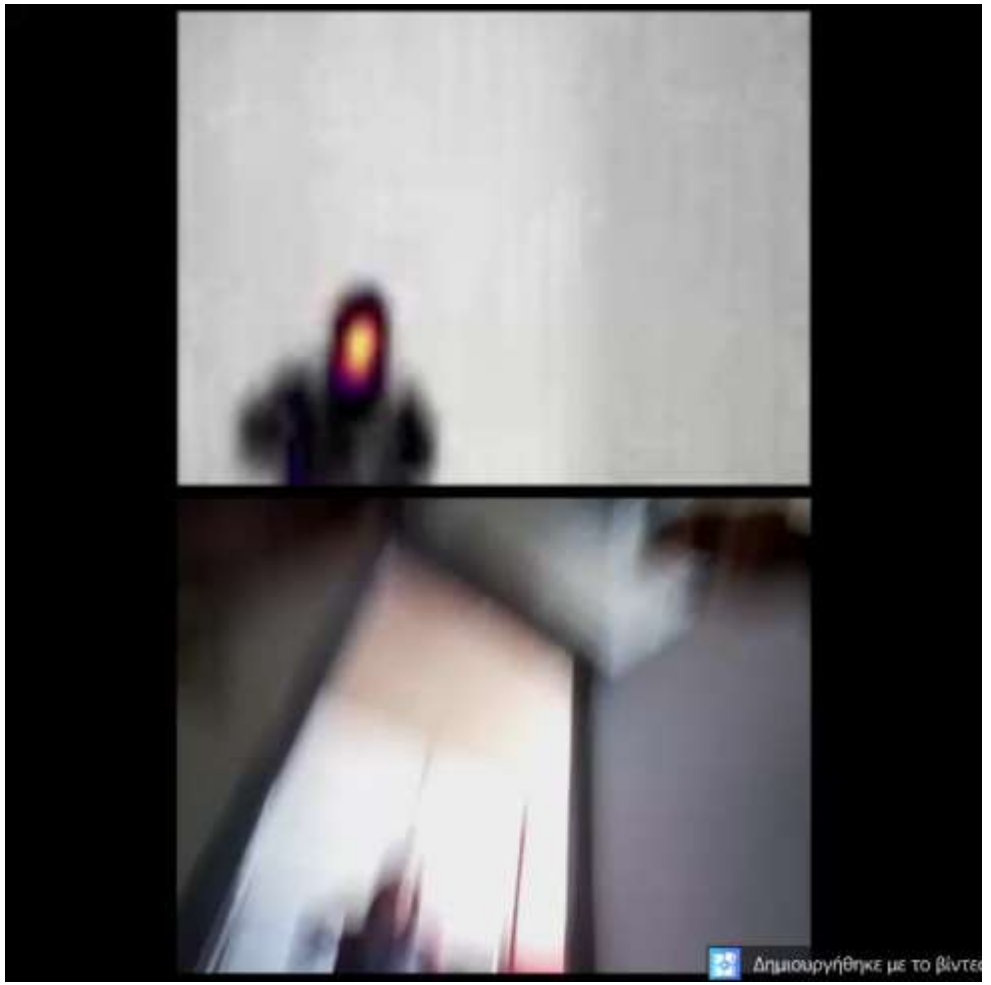
WP2 Main Findings and Achieved results

WP2 Main Findings and Achieved results. K9 Vest

- Thermal and HD camera (FSX #2)

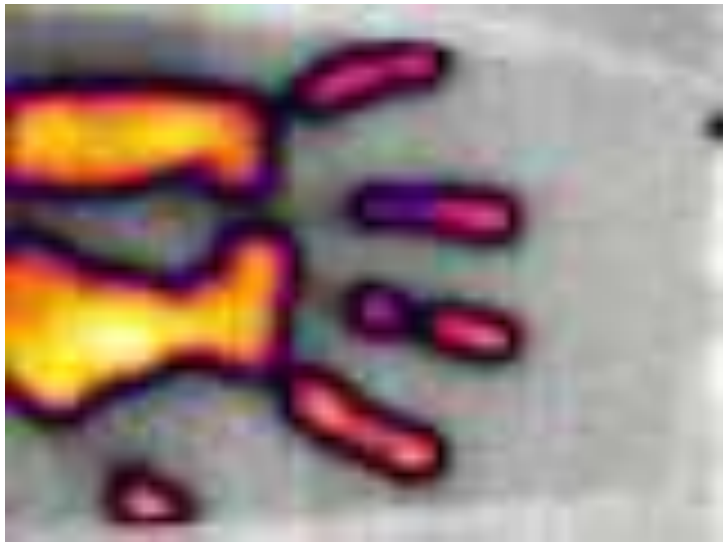




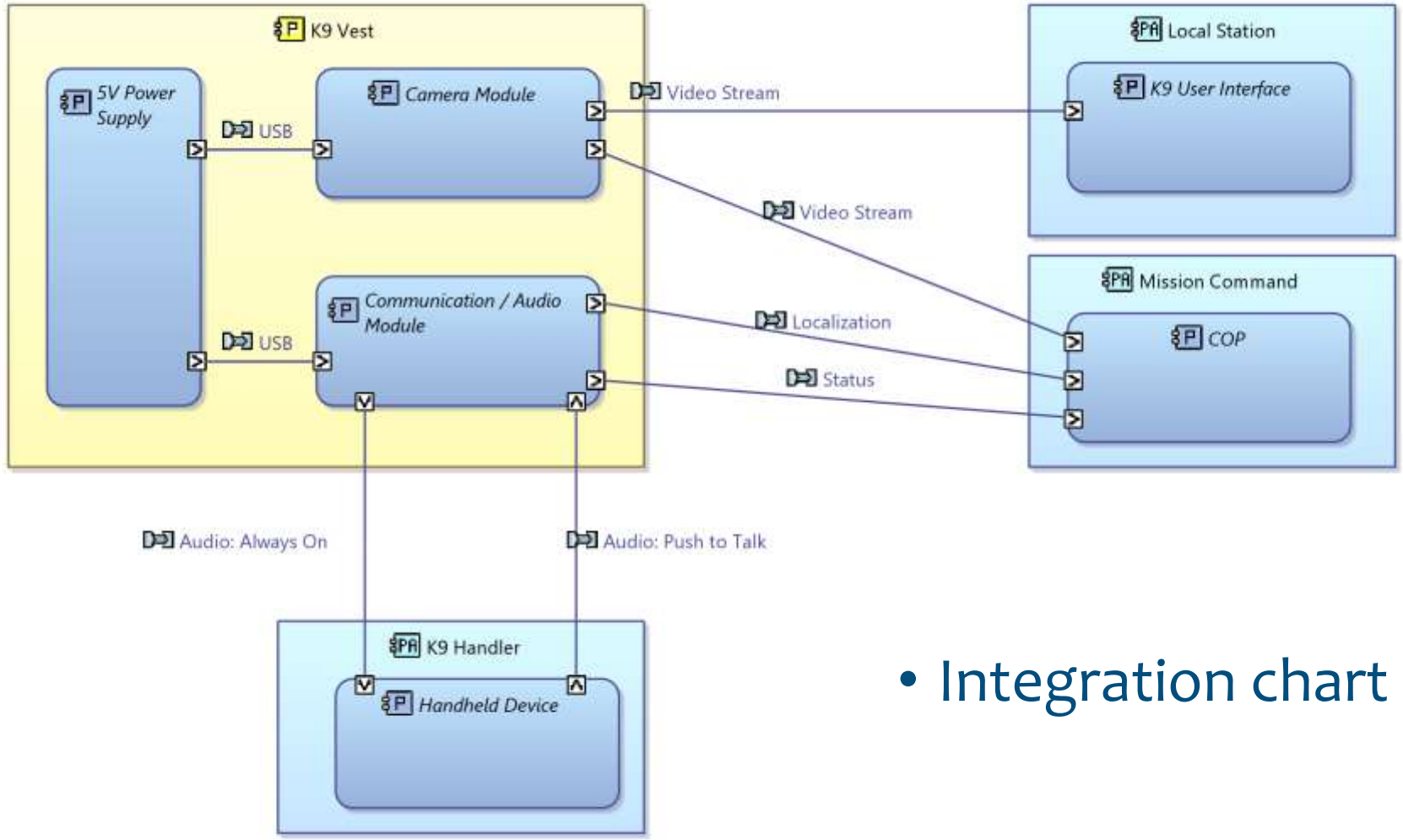


WP2 Main Findings and Achieved results. K9 Vest

- Thermal resolution (FSX #2)
  - Identification of human body at 50m
  - Thermal remnant of human body on stone surface



WP2 Main Findings and Achieved results. K9 Vest



- Integration chart

WP2 Conclusions

- Smart helmet
  - Development of smart helmet module that can be easily attached and detached and can be used for various types of helmets

- Uniform
  - End user engagement is a must
  - Successful nonintrusive valuable solution for FRs
  - Minor refinements needed:
    - Agencies, FR roles, alarm signaling, etc.

WP2 Conclusions

- Smart Boots:
  - Fully integrated design was delivered and test with end users in real operation environments
  - **Real time** event detection mechanism based on the user requirement developed and validated
  - The bigger the toolchain the higher the impact when a link breaks

WP2 Conclusions

- K9 Vest:
  - Cameras:
    - Thermal camera utility successfully demonstrated
    - Stabilization of HD camera can be explored further (camera on dog's head)
  - Localization:
    - Dead reckoning reliable for up to 10 minutes (when dog operates within enclosed spaces).
  - Bidirectional audio:
    - Communication of handler with victims successful.
    - Remote commands to dog require dedicated training.

Thank you for your attention

Any Questions ?

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