A Smart Textiles Framework for First Responders

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What Smart Textiles Framework (STF) is: An Introduction

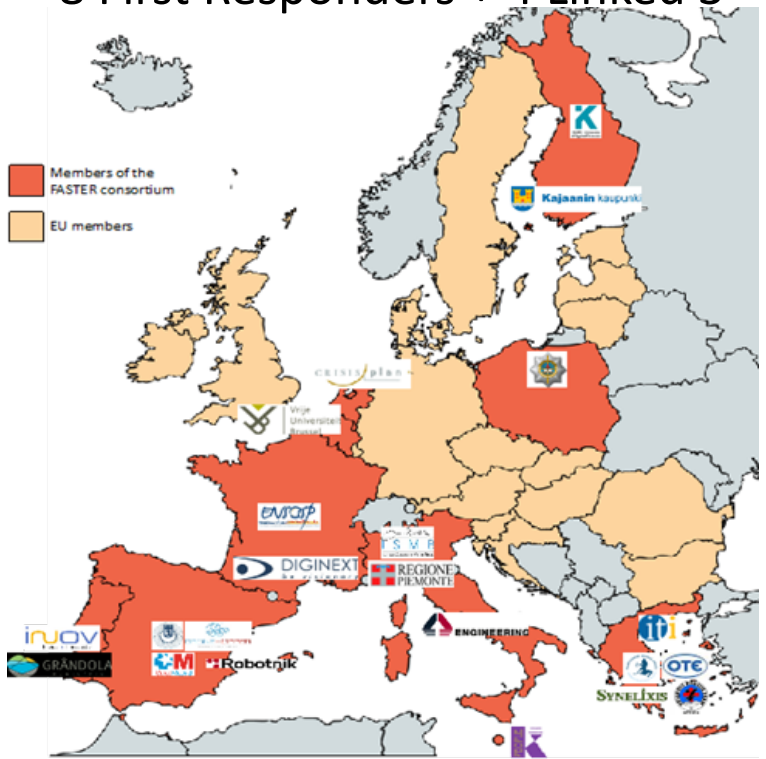
- STF is a complete solution consisting of
  - A textiles prototype for use by First Responders
    - Biometrics & Environmental modules
  - An Android application for collecting, visualizing and processing data
  - Alert Propagation both locally and to the Cloud
- The goal is to design and implement a solution that is modular enough to receive extensions in the future.
  - GDPR compliant

At the beginning we had to go FASTER

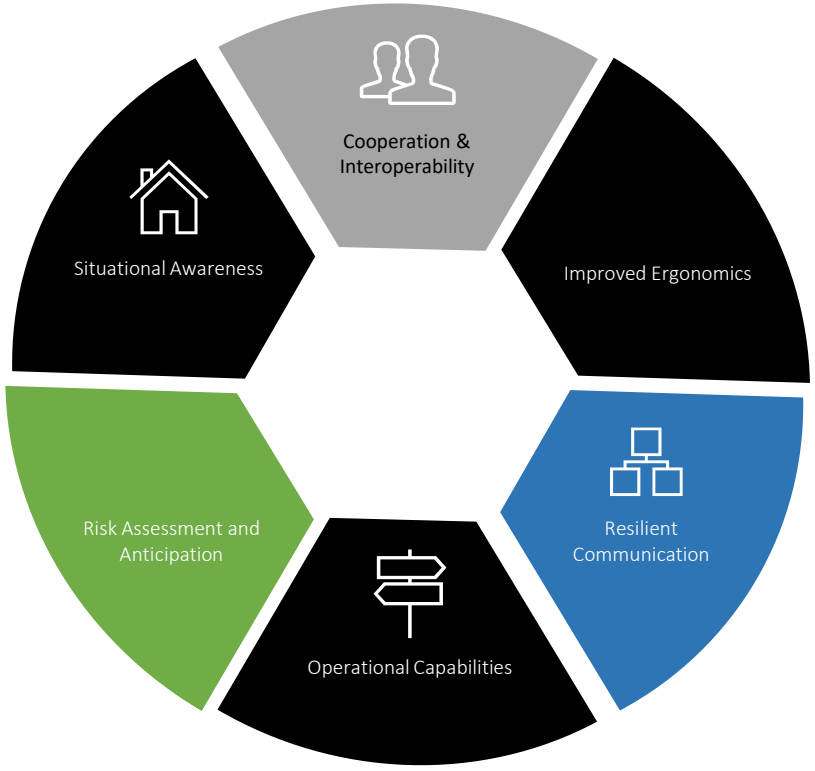
FASTER

Project acronym:	FASTER
Project full title:	First responder Advanced technologies for Safe and efficienT Emergency Response
Call identifier:	H2020-SU-SEC-2018
Type of action:	RIA
Start date:	01/05/2019
End date:	30/04/2022
Grant agreement no:	833507

- 23 partners
  - 3 Industry | 4 SMEs
  - 8 Research/Academic
  - 8 First Responders + 4 Linked 3rd Parties (FRs)



FASTER in a glimpse: Aims & Tools



- FASTER aims to develop state-of-the-art technical solutions to protect first responders in complex environments while enabling them to operate in a seamless and efficient way in any environment.

Communication

5G network utilization,

Infrastructure-less communication,

Body and Gesture based User Interfaces,

Ad-Hoc relay networks,

Blockchain-based trusted network

Mobiles & Wearables

AR devices for improved situational awareness,

Smart textiles for bio-monitoring,

K9 wearables,

mobile mission management

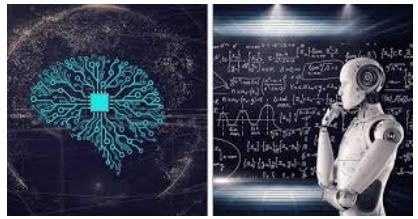
Situational Awareness

Portable Common Operational Picture,

UAVs and UGVs for inspection, mapping (but also intervention),

Risk assessment utilizing AI-based data processing

CONSERT Interests



AI – Machine Learning

Cloud Computing

IoT & Smart Objects

Blockchain / DLTs

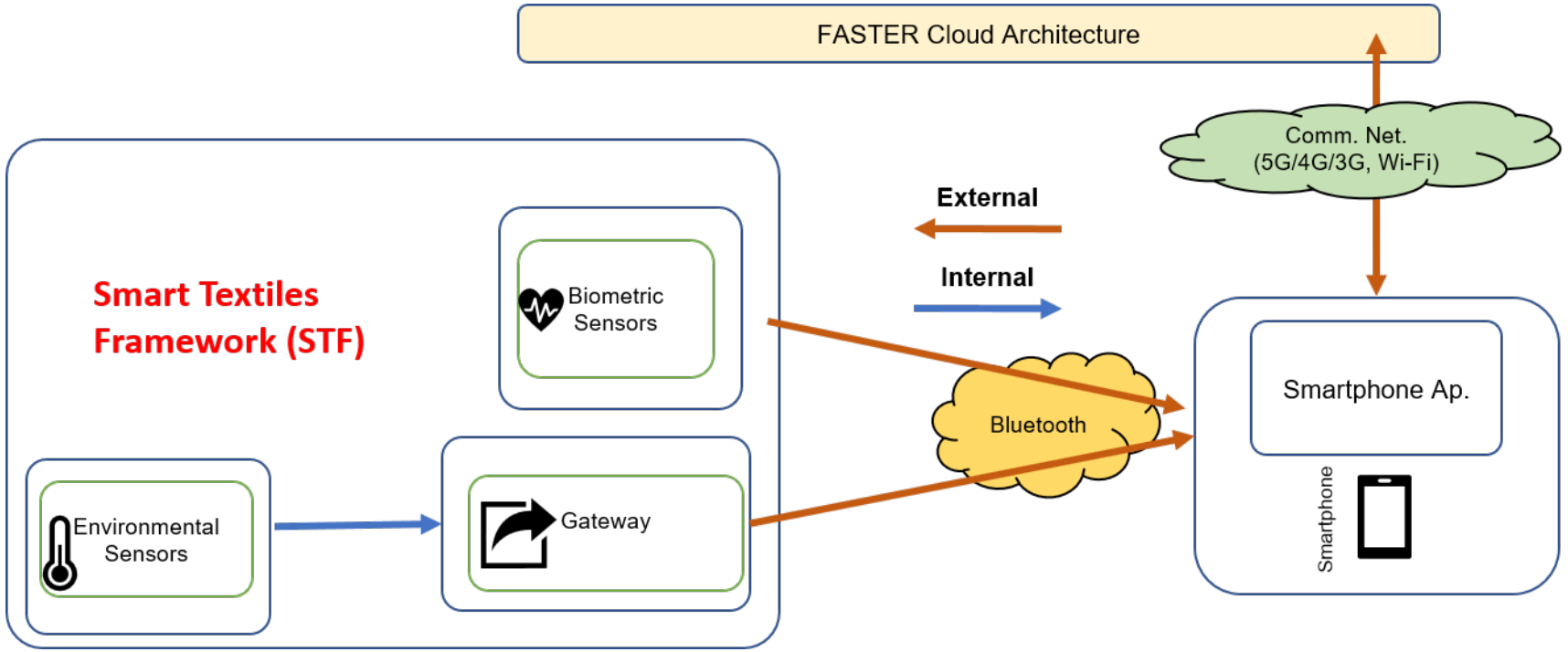
Mobile / Wearable apps & services

- **Find us at https://consert.eee.uniwa.gr/**

STF KPIs for FASTER

- **Textile wearable prototype** for first responders integrated with clothing, to *avoid obstructing* rescue operations, durable under severe conditions and *washable 50 times* in standard conditions.
- Continuous assessment of critical health conditions in real time anomaly detection (*every 1s*)
- Real time anomaly detection in the environment conditions (*≤500 ms*)

STF Architecture and Data Flow



Biometrics Module Description

- Consists of a commercial solution that provides a set of biometric sensors.
  - It complies with International standards.
  - It allows to test the scalability of the framework by connecting a commercial solution to it.
  - A strap-on belt is needed to place the module
  - A T-shirt for the FR to place the belt was prepared for the use in the project's pilot tests

Biometrics Module Details

Parameter	Reporting Frequency (Hz)	Range	Units	Description
General Data Packet				
Heart Rate	1	0-240	BPM	Beats per Minute
Breathing Rate	1	0-120	BPM	Breaths per Minute
Posture	1	±180	Degrees	Vertical = 0°, Inverted = 180°
Peak Acceleration	1	±16	g	
Strap Worn Status	1	0, 1		0 = not worn
Battery Percentage	1	0-100	%	% of full capacity
Breathing Data Packet				
ECG Data Packet				
ECG Sensor output	250	0-1023	bits	512 = 0 mV 1 bit = 0.025 mV
Summary Data Packet				
Heart Rate	1	0-240	BPM	Beats per Minute Invalid value: 65535
Breathing Rate	1	0-120	BPM	Breaths per Minute Invalid value: 6553.5
Estimated Core Temperature	1	33-41	°C	386 = 38.6 Invalid value: 6553.5

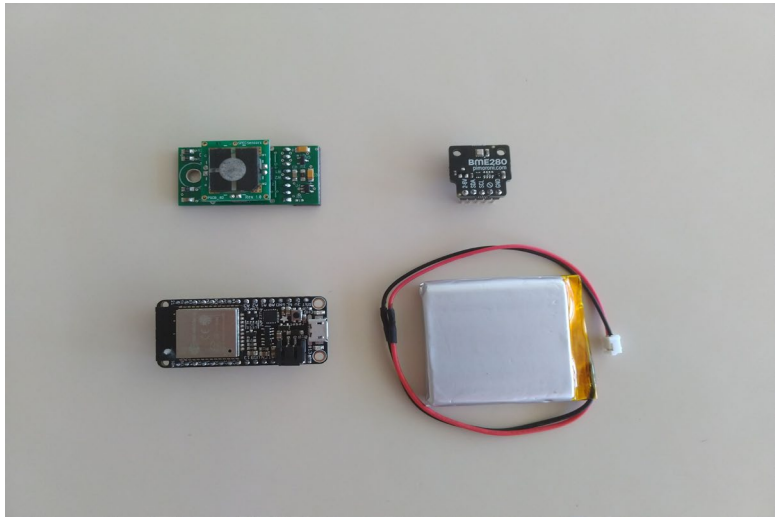
Environmental Module Details

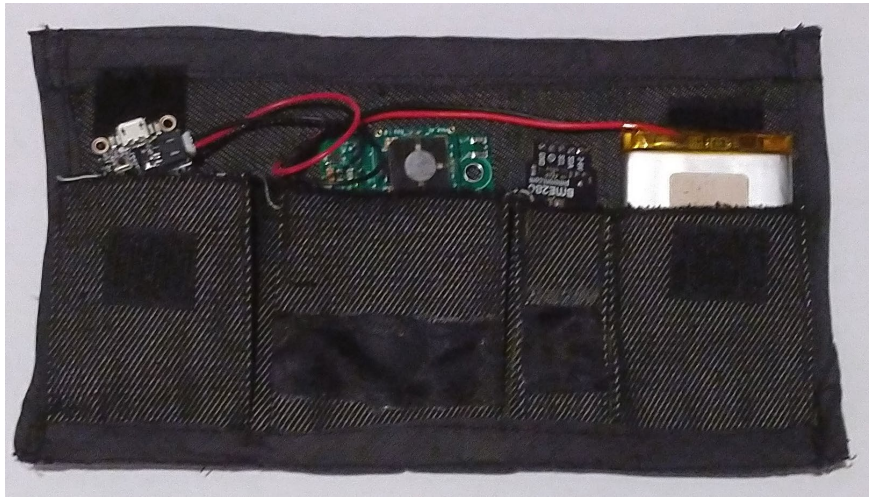
Part	Reference Name	Description	Main Characteristics
SoC MCU	ESP32	32-bit Dual Core CPU with 2.4 GHz Wi-Fi & Bluetooth/BLE	240 MHz dual core 4 MB flash Integrated 802.11b/g/n Wi-Fi transceiver Integrated Bluetooth (classic and BLE)
Environmental Sensor Module	BME280	Temperature & Humidity Sensor	3.3V or 5V compatible I2C or SPI Interface
Gas Sensor	DGS-CO 968-034	Electrochemical Carbon Monoxide (CO) Digital Sensor module	Factory calibrated 2.6V to 3.6V Voltage Supply Low Power (0.15 to 12 mW) Integrated Temp. & RH Sensors UART Interface
Battery	BATT	Polymer Lithium Ion Battery	3.7v 1850 mAh

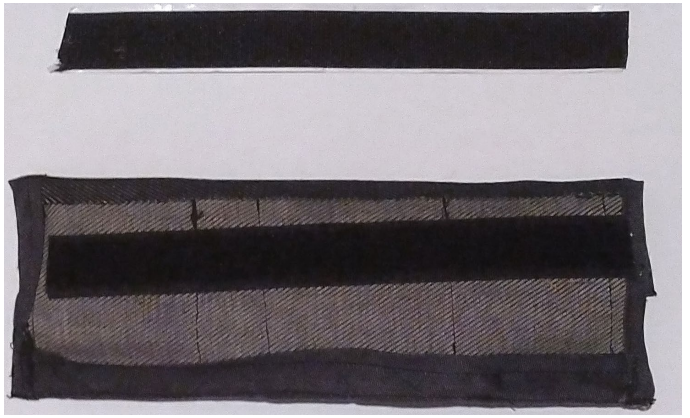
The environmental module consists of:

- A gateway to collect and send data
- 3 sensors: *temperature, humidity, CO*
- A casing that is easy attach and detach

Environmental Module: Photos & Casing

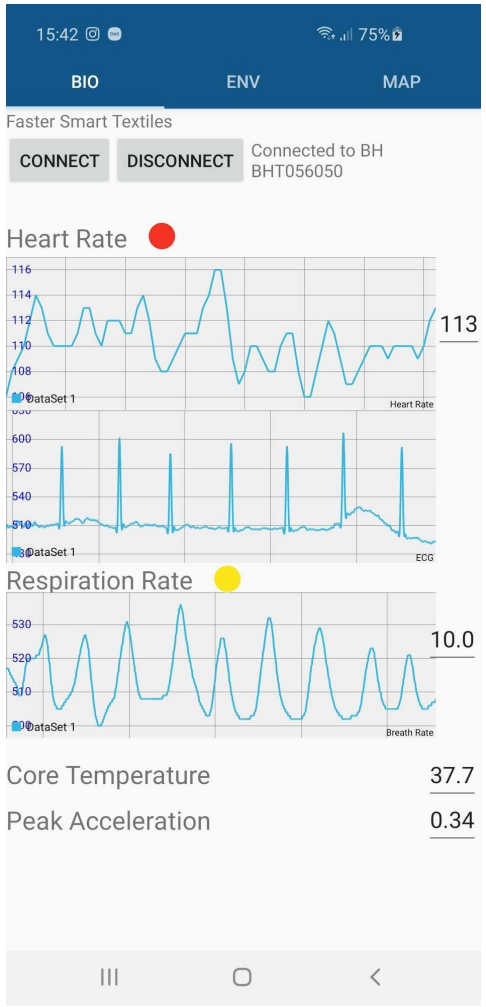


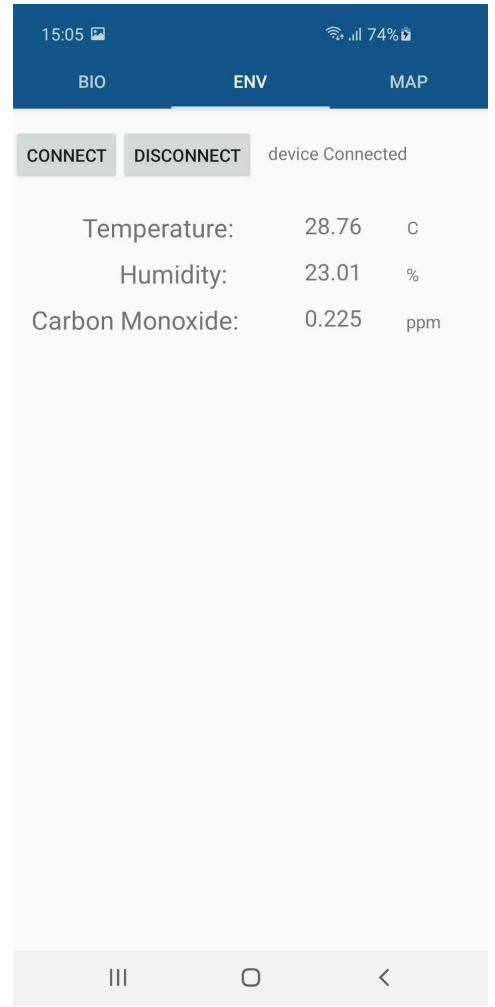




STF Application

- **ENV Tab**
  - Temperature ✓
  - Humidity ✓
  - CO ✓
- **BIO Tab**
  - Heart Rate ✓
  - ECG (Waveform) ✓
  - Respiration Rate (Waveform) & Breath Rate ✓
  - Estimated Core Temperature ✓
  - Acceleration ✓





Integration process / Testing

What follows

- Personalization of the STF set with each FR
- Implementation of rules that will trigger alerts
  - Personal Awareness
  - Situational Awareness
- Connection with Blockchain / DLT solution
  - Following GDPR rules

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