System story

Summary:
The goal is to develop a smart Firefighters Coordination System (FCS). The main objective of this system is to ensure that information is effectively spread among a team of firefighters and also is propagated from a firefighter to and from his/her officer in the field. This will let the officers have an up-to-date view of the condition of the firefighters and take strategic decisions to prevent harmful situations. At the same time, the system should optimize the use of resources such as battery life, shared communication medium, etc.

Firefighters in the field carry low-power devices with reliable sensors that are able to measure temperature, acceleration, and position. Every officer is leading a small group of firefighters (3-5 members). Officers carry tablets with dedicated applications for visualizing the data measured by the firefighters, e.g., for depicting the firefighters on a map of the operation area based on their measured positions, and for making a thermal map of the operation area based on the measured temperatures.

Requirements:
The general requirements for the FCS are:

1. Each GroupMember (GM) has to continuously use the available sensors to monitor his/her environment and condition. This involves:
   a. Monitoring his/her acceleration with an accelerometer attached to the GM’s protective equipment.
   b. Determining his/her position (see also req. 4 & 5).
   c. Monitoring the external temperature (see also req. 6 & 7).

2. The data acquired from the GMs’ sensors (temperature, acceleration, and position) has to be continuously propagated to appropriate Group Leader (GL).

3. Each GL has to continuously keep track of the condition of his group’s members (GM).
   a. Each GL has to continuously update a list of his/her GMs that are potentially at risk, according to the sensor data propagated to him from his/her GMs and a risk-assessment algorithm.

The situation-specific requirements of the FCS are:

4. If a GM is outdoors, he/she has to use the GPS device to monitor his/her position.

5. If a GM is indoors, he/she has to use the “indoors positioning system” (IPS) device to monitor his/her position (because satellite signals necessary for the GPS operation are not available inside buildings).

6. If a GM’s acceleration is equal to zero for the last 20 secs (which indicates that he/she is potentially unconscious), then the external temperature-monitoring rate is increased so that a new temperature measurement is obtained and sent to the GL every 20 secs (i.e. the temperature is measured more closely).

7. If a GM’s acceleration is not equal to zero for the last 20 secs, then the external temperature-monitoring rate is set so that a new temperature measurement is obtained and sent to the GL every 120 secs (i.e. the temperature is measured less closely).

8. When one or more GMs are at risk (as determined by the risk-assessment algorithm), then the list of firefighters at risk has to be propagated to all the GMs of the team.

Your task

Try to design a DEECo architecture for the firefighters coordination system as detailed as possible by mapping all requirements to processes and ensembles. Draw the final architecture by hand, together with as many sketches as needed (please hand over all your sketches together with the final design). Feel free to ask us questions on the FCS requirements and the rules of DEECo.