beAWARE

Enhancing decision support and management services in extreme weather climate events

700475

D6.3

Outdoor Location Services

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Abstract

This deliverable reflects the work performed in task T6.3 dedicated to design and develop an outdoor location solution as part of the beAWARE platform. The interoperability with third-party applications, as well as Radio Access Networks was taken into account. The solution allows to synchronize and coordinate the work of various field entities and Public Safety Answering Point (PSAP) users, in conjunction with additional cross-platform services. The main goal of this document is to describe the requirements, conventions, and specifications of each component of the beAWARE platform and the integration of the components to produce a holistic end-to-end solution. Additionally, several operational scenarios that have been implemented are also described, in order to demonstrate the compliance of the

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platform with the fundamental requirement to provide robust location management services.

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EXECUTIVE SUMMARY

This dual (confidential and public) deliverable presents the Outdoor Location Management Solution (LMS) Prototype. The LMS is a fundamental layer in the beAWARE architecture, allowing the generation, sharing, and management of position and location information across the beAWARE platform.

This dual deliverable has two variants: a public variant – D6.3, and a confidential variant – D6.7. The structure of both deliverables is identical, but the content of two confidential sections appears only in D6.7.

In the public part of this dual deliverable, we begin with an introduction and overview of location management and its centrality to the beAWARE platform as an emergency management solution. We analyze the operational stakeholders' needs for location management, and specify system requirements and capabilities for location management. We also review the publicly-available conventions, protocols, and standards acquired and applied during the project in the domains of position, location, and time. Standardization of data formats and exchange mechanisms helps ensure a common language among parties and interoperability across the board, which is critical for the successful implementation and deployment of end-to-end processes. The notion that beAWARE implements common and best practices and conventions is important for external stakeholders and is therefore public.

Following the understanding of the operational requirements and conventions, we describe the capabilities and functionalities of the LMS demonstrator in its current version, including the enabled functional end-to-end processes, and the role each module in the beAWARE platform has. This introduction is also open to the public, as it provides an overview of the current capabilities of our LMS prototype, without getting into the implementation details.

In the confidential part of this deliverable, we explain the LMS architecture, including the functions and features required from each beAWARE module to ensure the flow of information including position and location data. We elaborate and analyze the functional flows across the platform in order to ensure the end-to-end realization of the requirements. We also specify the communication and data exchange protocols that enable these features. Besides, in the next confidential section we present the results of the LMS prototype development effort.

We conclude with a discussion on the impact of the LMS, summary of the obtained results, and future extensions, in accordance with the beAWARE platform development roadmap.

ABBREVIATIONS AND ACRONYMS

alt	altitude
API	Application Programming Interface
ASR	Automatic Speech Recognition
CA	City Authority
CAP	Common Alert Protocol
CDR	Central Data Repository
CRCL	Crisis Classification
CSV	Comma-Separated Values
DB	Database
FR	First Responder
GIS	Geographic Information System
GPS	Global Positioning Satellite
HQ	Headquarters
HTM(L)	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
ID	identifier
IoT	Internet of Things
IP	Internet Protocol
IM	Incident Manager
JSON	JavaScript Object Notation
KBS	Knowledge-Base Services
lat	latitude
LMS	Location Management Solution/ Services
long	longitude
MRG	Multilanguage Report Generation
MSB	Message Bus
MTA	Multilanguage Text Analysis
ODI	Open Data Interface
PCI	Peripheral Component Interconnect
PoR	Place of Relief
POS	Position
PSAP	Public Safety Answering Point
Pub/Sub	Publish—Subscribe
REST	Representational state transfer
SDK	Software Development Kit
SDS	Scenario Demonstration Site
SMA	Social Media Analytics
SoS	System of Systems
SQL	Structured Query Language
TCP	Transmission Control Protocol
TL	Team Leader
TR	Technical Requirement
UDP	User Datagram Protocol
UI	User Interface
UR	User Requirement
URI	Uniform Resource Identifier

URL	Uniform Resource Locator
USB	Universal Serial Bus
WFS	Weather Forecast Services
WP	Work Package
XML	Extensible Markup Language
XSD	XML Schema Definition

PARTNER ACRONYMS

AAWA	AUTORITÀ DI BACINO DEI FIUMI ISONZO TAGLIAMENTO LIVENZA PIAVE BRENTA BACCHIGLIONE
CERTH	CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS
FBBR	FREDERIKSSUND-HALSNÆS: FIRE- & RESCUE SERVICE
FMI	FINNISH METEOROLOGICAL INSTITUTE
HRT	HELLENIC RESCUE TEAM
IBM	IBM ISRAEL - SCIENCE & TECHNOLOGY LTD.
IOSB	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.
MSIL	MOTOROLA SOLUTIONS ISRAEL LTD
PLV	AYUNTAMIENTO DE VALENCIA
UPF	UNIVERSITAT POMPEU FABRA

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1 INTRODUCTION [PUBLIC]

1.1 Scope

This document is a description of the Outdoor Location Solution prototype demonstrator, which is part of the First Prototype of the beAWARE platform (P1), due M18 (June, 2018).

1.2 "beAWARE"

The beAWARE Project is an EU-funded collaboration (#700475) of partners from several countries in Europe to deliver a prototype disaster management system for extreme weather conditions. The Project is focused on Flood, Forest Fire, and Heatwave scenarios, and is intended for deployment and testing of these scenarios in Vicenza (Italy), Valencia (Spain), and Thessaloniki (Greece), respectively. The end users are the Alto Adriatico Water Authority (AAWA), Valencia Local Police (PLV), and Hellenic Rescue Team (HRT), respectively. In addition, the Frederiksborg Fire Department (Frederiksborg Brand OG Redning, FBBR) contributed to the operational requirements for the Fire scenario.

The technical partners involved in the project include: Centre for Research and Technology – Hellas (CERTH), who is also the coordinator of the project; Motorola Solutions Israel (MSIL), who is also the technical manager of the project; IBM Israel Haifa Research Labs (IBM); Finnish Meteorological Institute (FMI); Fraunhofer Institute for Optronics, System Technologies and Image Exploitation (IOSB); and Universitat Pompeu Fabra (UPF).

The beAWARE system is an end-to-end solution for collecting information from multiple data sources – such as end users, social networks, sensors, and data providers – analyzing it, predicting and assessing emergencies, alerting the public, and managing first responders' activities.

1.3 The need for Outdoor Location Services

During an emergency, the precise positioning of various operational entities is critical for enabling effective and efficient management of mitigation and response activities. This includes positions of incidents, first responder teams, critical assets and infrastructure, public alerts, etc. Outdoor location services require a holistic framework

to ensure the existence and integration of robust and reliable location management mechanisms across the emergency management platform.

Various references in the literature have also emphasized the importance of location management and map-based displays in Emergency Management Systems and Centres, in order to provide a common situation picture, enhance situational awareness, and allow action and interaction in a timely manner (Dusse et al., 2016; Morin, Jenvald, & Thorstensson, 2000).

1.4 Outline

This document is structured as follows:

- Section 2 discusses Location Management Requirements [Public].
- Section 3 discusses Standards and Conventions [Public].
- Section 4 introduces the Location Management Solution Prototype Demonstrator [Public].
- Section 5 introduces the Location Management Solution Architecture [Confidential].
- Section 6 introduces the intermediate results achieved up to date of this deliverable. [Confidential].
- Section 7 concludes this report.

2 LOCATION MANAGEMENT REQUIREMENTS [PUBLIC]

2.1 Scope

In this section we review and analyze the requirements for location management in the beAWARE platform.

2.2 Stakeholder Roles

The operational stakeholders of the beAWARE platform can be categorized into two main groups: Headquarters (HQ) and FIELD. The roles of beAWARE HQ stakeholders are summarized in Table 2-1. These roles are supported by the Public Safety Answering Point (PSAP) application. The FIELD roles are summarized in Table 2-2. These roles are supported by the beAWARE mobile app.

Table 2-1. Primary beAWARE HQ Stakeholder Roles (beAWARE, 2017a, 2017b)

Stakeholder	Associated Roles and responsibilities	Primary Interface
CITY AUTHORITY	Receives emergency metrics; Issues Early Warning / Public Alerts; Oversees Emergency Management Operation	PSAP
INCIDENT MANAGER	Receives incident reports; Manages incidents	PSAP
OPERATIONS MANAGER	Receives incident handling requests; Receives team reports; assigns tasks to first responder teams;	PSAP

Table 2-2. Primary beAWARE FIELD Stakeholder Roles (beAWARE, 2017a, 2017b)

Stakeholder	Associated Roles and responsibilities	Primary Interface
CITIZEN	Provides incident reports; Posts social media updates; Receives public alerts	Mobile App, Social Media
FIRST RESPONDER	Reports status; receives tasks; reports progress	Mobile App

2.3 User Requirements for Location Management

The beAWARE end users defined various operational and functional requirements, in order to support the roles, responsibilities, and activities of human agents during the occurrence of a scenario (flood, fire, or heatwave). The complete list of initial User

Requirements is defined in Deliverable D2.1 (beAWARE, 2017a), which was published in M6.

Several user requirements concern the location of first responder teams, public assets, and various field reports (such as incidents and observations).

For the purpose of this report, the initial user requirements provided by beAWARE partners are considered as a general reference for an overall understanding of user needs, expectations, intentions, and constraints with respect to the location management framework. The possible impact of each user requirement on location management has been analyzed throughout the course of the project and the architecting of the framework. The results of the multiple teleconferences and emails exchange discussions are summarized in the following sections. The impact is specified in the right column in each of the user requirements tables below.

User requirements whose impact resembles that of previously analyzed user requirements refer to the original user requirements from which the impact was derived. The goal was to minimize multiple definitions of the same impact, and to consolidate use cases as derived from various user requirements. For example, providing a suitable mechanism for localizing public alerts from the control center to the citizens is the same for all the user requirements that refer to generating public alerts, regardless of the type of hazard they intend to warn about, the specificity of the applicable location or area, and the content of the alert.

We emphasize that the impacts derived from the user requirements are still oriented as much as possible to the problem domain, and are mostly interoperability-driven, so that they reflect operational needs for location management as means to support interactions among operational users, e.g. to allow task assignment by the control center operators to teams of first responders.

Below we summarize the analysis of LMS requirements derived from the user requirements defined for the Flood, Fire, and Heatwave scenarios. Each LMS requirements is identified by the tag "LMS_XXX" where XXX is a serial number. A summary of all 24 LMS requirements is listed in Table 2-3. The scenarios whose user requirements participate in each LMS requirement. For each LMS requirement, we collected all the user requirements that have an impact that necessitates the LMS requirement. This coverage is shown in Table 2-4.

As the analysis shows, out of 24 identified LMS requirements, 8 requirements (33%) concern a single scenario, 6 (24%) requirements concern two scenarios, and 10 requirements (43%) concern all three scenarios. This means that the LMS

requirements, which are system-level requirements, generalize the problems faced in each scenario, and attempt to find generic solutions that can be applied in multiple cases. Moroever, It should be noted that some of the requirements that do not apply to all three scenarios have the potential to become relevant and applicable in other scenarios, provided that suitable data sources or operational concepts are employed by the operational stakeholders of those scenarios. For example, sensor data acquisition can clearly pertain to the Valencia case, provided that smoke sensors are deployed, and that the data is made accessible to the beAWARE platform.

Table 2-3. Location Management Requirements – Summary

Req ID	Location Management Requirement	Scenarios
LMS_001	Display an event map to authorities as part of PSAP; Display events on map	**FL** **FR** **HW**
LMS_002	Display flood-related position-based metrics on the map	**FL** FR **HW**
LMS_003	Display position-specific public alerts on the map	**FL** **FR** **HW**
LMS_004	Display incident reports from citizens on the map	**FL** **FR** **HW**
LMS_005	Display task reports from first responders on the map	**FL** **FR** **HW**
LMS_006	Display sensor and device positions on the map	**FL** **FR** **HW**
LMS_007	Transfer citizen report position data to authorities	**FL** FR **HW**
LMS_008	Transfer team status and position report to authorities	**FL** **FR** **HW**
LMS_009	Display water level index/ flood warning/ flood alert on the map	**FL** FR **HW**
LMS_010	Display elements at risk (assets, infrast., people, etc.) on the map	**FL** **FR** **HW**
LMS_011	Display real-time disaster area on the map	**FL** **FR** **HW**
LMS_012	Display tasks on the map	**FL** **FR** **HW**
LMS_013	Display sensor measurement-based alerts on the map	FL FR HW
LMS_014	Generate tasks from incidents on the map	**FL** FR **HW**
LMS_015	Display teams on the map	**FL** FR **HW**
LMS_016	Display weather layers on the map	**FL** **FR** **HW**
LMS_017	Enable flexible map event filtering for display	**FL** **FR** HW
LMS_018	Display impact grid on top of the map	**FL** **FR** **HW**
LMS_019	Display traffic data on the map	**FL** **FR** **HW**
LMS_020	Display predicted incidents on the map	**FL** **FR** **HW**
LMS_021	Display infrastructure status on the map	**FL** **FR** **HW**
LMS_022	Display incident report certainty on the map	**FL** **FR** **HW**
LMS_023	Display overall crisis map	**FL** **FR** **HW**
LMS_024	Display places of interest on the map	**FL** **FR** **HW**

Table 2-4. Location Management Requirements Coverage of User Requirements (beAWARE, 2017a)

Req ID	Location Management Requirement	Scenarios
LMS_001	**Display an event map to authorities as part of PSAP; Display events on map**	**FL FR HW**
Supported User Requirements		
UR_101 Type of visualization	Display information to authorities in a web-gis platform (citizen and first responders reports by calls, apps, social media)	
UR_109 Localize tweets	Provide authorities with the ability to localize Twitter messages concerning a flood event	
UR_322 Information for incident status from Social Media	Provide information to the authorities regarding potential risks in case there is a situation in the city (eg car accident, etc.) gathered from social media	
UR_323 Information for Hospital Status from Social Media	Provide information to the authorities regarding overcrowded hospitals and places offered to the public with a/c, gathered from social media	
UR_327 Send emergency reports	Allow citizens to send text, images and video messages from their mobile phone (for the different operative systems) and from their social media account to the authority.	
UR_332 Localize tweets	Provide authorities with the ability to localize Twitter messages	
UR_341 Twitter analysis and warning	Allow authorities/first responders to be warned by Twitter messages concerning traffic jam, availability of places of relief, potential hazards or people in danger	
Req ID	**Location Management Requirement**	**Scenarios**
LMS_002	**Display flood-related position-based metrics on the map**	**FL FR HW**
Supported User Requirements		
UR_102 Map of the AMICO Flood EWS results	Display reliable and trustful flood forecasts, potential dangerous situations and the forecasted level of risk to the authorities, based on the results of the EarlyWarning System AMICO (improved with the assimilation of Satellite data (snow cover, soil moisture, etc.) and Meteorological forecasts data with a finer spatial resolution provided by FMI)	

Req ID	Location Management Requirement	Scenarios
LMS_003	Display position-specific public alerts on the map	FL FR HW

Supported User Requirements	
UR_103 Flood warnings	Provide authorities/citizens with automatic warnings on river levels overtopping some predefined alert thresholds, based on forecast results
UR_116 Warning people approaching flood areas	Provide authorities with the ability to warn people in danger with warning messages, when they are approaching a flooded area
UR_125 Traffic warnings	Provide authorities with the ability to send warnings to citizens in order to avoid interferences inside the area involved by civil protection activities
UR_131 Traffic warnings	Provide authorities with the ability to send warnings to citizens in order to avoid a certain area that is jammed with traffic
UR_209 Electronic traffic panels	Display authorities/first responders to display in electronic traffic panels useful information and evacuation instructions in case.
UR_212 Traffic warnings	Sending warnings to citizens in order to avoid interferences inside the area.
UR_213 Recommendations	Sending recommendations to citizens.
UR_214 Warnings	Sending warnings of pre-emergency alerts to citizens by authorities
UR_215 Evacuation orders	Ordering evacuations of citizens at risk.
UR_312 Warning citizens	Provide citizens with warnings through the beAWARE app, of an imminent heatwave and a list of proactive measures and how to reduce its effects
UR_325 Suggested places for relief	Provide information to citizens regarding the suggested places for relief through an app.
UR_336 Traffic warnings	Provide authorities with the ability to send warnings to citizens in order to avoid a certain area that is jammed with traffic
UR_338 Warnings	Allow authorities to send warnings of pre-emergency alerts to citizens.
UR_339 Evacuation orders	Allow authorities to order evacuations of citizens at risk.

Req ID	Location Management Requirement	Scenarios
LMS_004	Display incident reports from citizens on the map	FL FR HW

Supported User Requirements	
UR_104 Send/receive emergency reports	Allow citizens to send text, images, audio and video messages from their mobile phones (for the different operative systems) and from their social media account to the authority during bad weather conditions when the GPS signal is low.
UR_113 Detect element at risk from calls	Provide authorities with the ability to detect the number of element at risk and the degree of emergency from emergency calls
UR_210 Mobile application	Enable citizens to communicate a fire alert, detected neglects or other risk situations and even send visual data through a mobile application.
UR_221 Geolocalization of telephone calls	To geolocalize a mobile phone citizen call by sending a request permission message to the citizen, who would accept to be tracked temporarily.
UR_222 Filter of the emergency messages	Transfer emergency calls by writing (only minor emergencies or only information call). The aim is to save operator time and avoid losing emergency calls
UR_207 Aerial images	Display authorities/first responders to visualize aerial images of the smoke and the trajectory flames. It will provide information about the extension and the damages (kind of damages, and so on), the tracking of the fire, vehicles and people around the spot, in order to find out possible suspects or victims. Furthermore, if these aerial images provide thermal information it can be used for looking over the fire perimeter once it has been extinguished, in order to locate sleeper fire and avoid possible reproduction.

Req ID	Location Management Requirement	Scenarios
LMS_005	Display task reports from first responders on the map	FL FR HW

Supported User Requirements	
UR_105 Send task reports	Allow First Responders to send reports about their assignments from their mobile phone to local authorities
UR_110 Localize calls	Provide authorities with the ability to localize Phone Calls to an emergency number concerning a flood event
UR_216 Internal sharing of information	Sharing data (images, videos, geolocation, reports) regarding the forest fire among authorities & first responders
UR_328 Send task reports	Allow First Responders to send reports about their assignments from their mobile phone to local authority
UR_333 Localize calls	Provide authorities with the ability to localize Phone Calls to an emergency number concerning citizens who are trapped
UR_337 Location of vehicles and personnel involved	Allow authorities/first responders to visualize GPS location and/or real time footage of vehicles and personnel on the incident site. Transmitted to an online map where the coordination centres can follow both the development of the incident, and the location and amount of resources. The online map will also provide the possibility of interacting with the police and other agencies involved
UR_342 Coordination and communication between different resources	Provide communication between authorities and first responders, in order to improve their coordination.

Req ID	Location Management Requirement	Scenarios
LMS_006	Display sensor and device positions on the map	FL FR HW

Supported User Requirements	
UR_106 Visualize video cameras	Display streamed video from video cameras to the authorities/citizens
UR_208 Access to road traffic cameras	Allow authorities/first responders to have access to the cameras located at CV-500 (La Devesa main road) and CV-5010. Although there are already installed cameras, they are managed and visualized by autonomic resources.
UR_329 Visualize video cameras	Display streamed video from video cameras to the authorities/citizens

Req ID	Location Management Requirement	Scenarios
LMS_007	Transfer citizen report position data to authorities	FL FR HW

Supported User Requirements	
UR_107 Localize video, audio and images	Provide authorities with the ability to localize videos, audio and images sent by citizens from their mobile phones
UR_330 Localize video and images	Provide authorities with the ability to localize videos and images sent by citizens from their mobile phones

Req ID	Location Management Requirement	Scenarios
LMS_008	Transfer team status and position report to authorities	FL FR HW

Supported User Requirements	
UR_108 Localize task status	Provide authorities with the ability to localize first responders reports regarding the status of their assigned tasks
UR_211 Location of vehicles and personnel involved	Display authorities/first responders to visualize GPS location and/or real time footage of vehicles and personnel on the incident site. Transmitted to an online map where the coordination centres can follow both the development of the incident and the location and amount of resources. The online map will also provide the possibility of interacting with the police and other agencies involved
UR_313 First responders status	Provide to the authorities the current status and location of all first responders when they are performing their tasks
UR_219 Coordination and communication between different resources	Provide communication between authorities and first responders, in order to improve their coordination.
UR_331 Localize task status	Provide authorities with the ability to detect the location of first responders

Req ID	Location Management Requirement	Scenarios
LMS_009	Display water level index/ flood warning/ flood alert on the map	FL FR HW

Supported User Requirements	
UR_111 Detect flooded elements from video	Provide authorities with the ability to detect and count flooded elements (e.g. cars and people inside the river)from video and images sent from mobile phones and social media
UR_114 Detect water depth and velocity	Provide authorities with the ability to detect water depth and water velocity from video and images sent by the mobile app and social media
UR_121 Detect rainfall volume and duration	Provide authorities with the ability to detect rainfall volume and duration from videos (fixed and mobile cameras, social media and the mobile app)
UR_123 Detect embankment exceeding	Provide authorities with the ability to detect from video, automatically (fixed and mobile cameras, social media and mobile app) , if a river embankment is overtopping and/o breaking

Req ID	Location Management Requirement	Scenarios
LMS_010	Display elements at risk (assets, infrastructure, people, etc.) on the map	FL FR HW

Supported User Requirements	
UR_112 Detect elements at risk from reports	Provide authorities with the ability to detect the number of elements at risk and the degree of emergency from text sent by the mobile app or social media
UR_201 Detection of people and goods in danger	Display information authorities/first responders to detect people, cars and buildings in danger.
UR_217 Twitter analysis and warning	Warning authorities/first responders about Twitter messages concerning the forest fire event.

Req ID	Location Management Requirement	Scenarios
LMS_011	Display real-time disaster area on the map	FL FR HW

Supported User Requirements	
UR_115 Real time flood mapping	Display flooded areas in real time to authorities/citizens
UR_220 Improvement of the signal for telephones and emergency communication	Provide authorities/first responders with an accurate coverage of telephone mobile lines and emergency communication due to there is currently a lack of signal in some spots of the area.
UR_317 Areas with power outage	Display to the authorities the areas where there is a power outage.
UR_321 Affected area	Provide the authorities with a prediction of the affected area

Req ID	Location Management Requirement	Scenarios
LMS_012	Display tasks on the map	FL FR HW

Supported User Requirements	
UR_117 Manage assignments in case of new emergencies	Provide authorities with the ability to manage first responder assignments
UR_334 Manage assignments in case of new emergencies	Provide authorities with the ability to manage first responder assignments
UR_340 Internal sharing of information	Allow authorities and first responders to share data (images, videos, geolocation, reports)

Req ID	Location Management Requirement	Scenarios
LMS_013	**Display sensor measurement-based alerts on the map**	FL FR HW

Supported User Requirements	
UR_118 River overtopping	Provide authorities/citizens with the ability to know if the river level is overtopping predefined alert thresholds
UR_122 Rainfall warnings	Provide authorities/citizens with the ability to know in real time if the rainfall intensity is overtopping predefined alert thresholds
UR_124 Embankment warnings	Provide authorities/citizens with the ability to know in real time if a river embankment is overtopping and/or breaking; the comprehensive and reliable real-time information about the situation, especially the breach enlargement and discharge, the spatial and temporal development of the inundation and the damages
UR_306 Number of people affected	Provide the authorities with an estimation of the people that might be affected from the phenomenon and in which areas
UR_307 Power needs	Provide the authorities with an estimation on the power needs during a heatwave based on its foreseen progression
UR_318 Trapped citizens	Allow authorities to know if there are people trapped (e.g. in an elevator) and display where
UR_319 Trapped elders at home	Allow authorities to know if there are elder people trapped in houses without an A/C and display where

Req ID	Location Management Requirement	Scenarios
LMS_014	**Generate tasks from incidents on the map**	**FL** FR **HW**

Supported User Requirements	
UR_119 Manage assignments based on river level overtopping	Provide authorities the ability to assign task to first responder teams related to the overtopping of predefined river level thresholds
UR_314 Assign tasks to first responders	Allow authorities to assign additional tasks to those first responders who are available or even instruct those who are able to assist other responders

Req ID	Location Management Requirement	Scenarios
LMS_015	**Display teams on the map**	**FL** FR **HW**

Supported User Requirements	
UR_120 Map of rescue teams and task evaluation	Display to authorities the location in time of first responder teams in all the municipality and provide the ability to evaluate in real time the execution of the assigned tasks with a global visualization of the activities performed
UR_335 Map of rescue teams and task evaluation	Display to authorities the movements of first responder teams in all the municipality and provide the ability to evaluate in real time the execution of the assigned tasks with a global visualization of the activities performed

Req ID	Location Management Requirement	Scenarios
LMS_016	Display weather layers on the map	FL FR HW

Supported User Requirements	
UR_126 Map of Satellite data and weather forecasts	Display updated satellite images and weather forecasts.
UR_206 Specific weather data	Provide authorities/first responders and citizens with specific weather data of the Devesa place, as it has a specific microclimate that might be different from other places.
UR_301 Real time weather forecast	Provide the authorities with real time weather forecast in relation to the progression of the heatwave phenomenon

Req ID	Location Management Requirement	Scenarios
LMS_017	Enable flexible map event filtering for display	FL FR HW

Supported User Requirements	
UR_127 Filters	Provide advanced filters in the data management platform (visualize and list information selected by filters/query)
UR_225 Quick search of events and applicants	Data storage, in order to improve indexation of information relative to events and applicants

Req ID	Location Management Requirement	Scenarios
LMS_018	Display impact grid on top of the map	FL FR HW

Supported User Requirements	
UR_128 Evaluation of the level of risk	Provide authorities with the ability to evaluate the forecasted level of risks (based on all the available dataset)
UR_202 Detection of critical aspects	Provide authorities/first responders with information in order to detect the following kind of situation, process, material or condition that can cause a wildfire or intensify its damaging impacts: drought, air temp. and weather aspects, fuel accumulation spots, crowds, etc.
UR_203 Study of the smoke behaviour	Provide authorities/first responders with information on the smoke behavior (vertical/inclined, column, smoke color…).
UR_204 Identification of the fuel being burned	Provide information to authorities/first responders to know the type of fuel being burned by the colour and the shape of the smoke
UR_205 Analysis of advancing fire	Provide authorities/first responders with an analysis of the advancing fire (flame progression, height and length).
UR_218 Automatic detection system	Having an automatic detection system of the forest fire, which is connected to firefighters and police officers
UR_223 Automatic selection of the level of emergency	This can be done with the operator's supervision. The aim is to save time and avoid losing emergency calls
UR_302 Automatic warning	beAWARE system to generate and provide the authorities with an automatic warning when an imminent heatwave phenomenon is forecasted
UR_303 Risk assessment for a forest fire	Provide the authorities with a risk assessment regarding the probability of a forest fire to occur during or in the upcoming period after a heatwave. The relevant authorities will have an assessment of a fire risk based on the weather forecast during a heatwave and especially during the following days
UR_304 Heatwave intensity	Provide the authorities with a risk assessment regarding the intensity of the phenomenon in the city.

Req ID	Location Management Requirement	Scenarios
LMS_019	Display traffic data on the map	FL FR HW

Supported User Requirements	
UR_130 Traffic Status	Display to the authorities the current traffic situation so that they can decide where to direct the first responders or inform them of which routes to avoid
UR_315 Traffic Status	Display to the authorities to monitor the current traffic situation so that they can decide where to direct the first responders or inform them which routes to avoid
UR_324 Information for existing situation in the from Social Media	Provide information to the authorities regarding existing traffic conditions all over the city grid gathered from social media

Req ID	Location Management Requirement	Scenarios
LMS_020	Display predicted incidents on the map	FL FR HW

Supported User Requirements	
UR_305 Possible locations for incidents	Display to the authorities visual information about possible locations in the city (or outside the city) where a situation that will require rescue team intervention is more likely to develop (for example, based on past experience, traffic jam and/or accidents will be more likely to occur at a main street intersection/ public park/ entrance to hospitals or banks… etc.). In such cases a decision might be made to send rescue teams in advance to shorten response time if/when an incident occurs

Req ID	Location Management Requirement	Scenarios
LMS_021	Display infrastructure status on the map	FL FR HW

Supported User Requirements	
UR_308 Infrastructure overload	Provide the authorities with an estimation of damage/overload to the city's infrastructure (phone lines, electricity, water, etc)

Req ID	Location Management Requirement	Scenarios
LMS_022	Display incident report certainty on the map	FL FR HW

Supported User Requirements	
UR_309 False Alarms	Provide to the authorities with a procedure to confirm necessity of rescue teams so they are not sent needlessly to one place instead of somewhere else where they are needed more urgently, therefore the ability to handle false alarms.

Req ID	Location Management Requirement	Scenarios
LMS_023	Display overall crisis map	FL FR HW

Supported User Requirements	
UR_310 City-wide overview of the event	Provide the authorities with a city-wide overview of the event – allow decision making authorities an overall view of all incidents handled at any point in time/ see where all rescue teams are located in real-time to allow them to make informed decisions regarding who to send where… etc

Req ID	Location Management Requirement	Scenarios
LMS_024	Display places of interest on the map	FL FR HW

Supported User Requirements	
UR_316 Capacity of relief places	Show the authorities the current state of the available capacity of all relief places provided to the public
UR_320 Hospital availability	Show the authorities the current availability of the hospitals.

3 STANDARDS AND CONVENTIONS [PUBLIC]

3.1 Overview

In order to ensure interoperability and standardization across the platform, as well as a common language, several conventional guidelines were adopted by the beAWARE consortium for the representation of positions and locations. There are various standards for conventional representation of geographical locations, such as (International Organization for Standardization (ISO), 2009; OGC, 2011) and for time representation (International Organization for Standardization, 2016). In general, we have tried to ensure compliance with ISO standards.

3.2 Definitions

duration	difference in time measurement units (e.g. days, hours, seconds, milliseconds, etc.) between the point-in-time in which an event begins and the point-in-time in which the event ends
elapsed time	difference in time measurement units (e.g. days, hours, seconds, milliseconds, etc.) between two instants
event	occurrence of something of interest which takes place in space and/or time
instant	relatively-short specific point in time identified by a high-precision timestamp (typically in the order of 1 second or shorter) in which or during which an event of interest occurred, or will occur
interval	difference, in time measurement units (e.g. days, hours, seconds, milliseconds, etc.), or distance units (e.g. meters, miles, etc.) between two consecutive events in a series of events in time or space
latitude	decimal value in degrees above (positive) or below (negative) the equator for a position on the surface of the earth, applicable in the range of [-90°,+90°], where -90° or 90°S (S stands for "South") is the latitude of the geographic South Pole and +90° or 90°N (N stands for "North") is the latitude of the geographic North Pole
location	place of reference for an object or event, typically introduced as a **position**, an address (e.g. "15 Memorial Dr., Rochester, NY, USA"), a meaningful name (e.g. "Piazza San Marco" in Venice) or an informative or relative description (e.g. "50 meters from the road" or "in the second room to the left of the corridor")
indoor location	location within a building, relative to the outline of the building (e.g., "in the middle of the third room to the left of the main corridor")
outdoor location	location on the earth, (e.g., "73 Charlotte St., London, England, UK" or "Jaffa Gate, Jerusalem, Israel")
virtual location	location (of a file or computer resource) in a computer system, e.g. a Uniform Resource Locator (URL), an IP address, a directory path ("C:\documents\myDoc2.txt"), etc.
longitude	decimal value in degrees west (positive) or east (negative) of the **IERS Reference Meridian (IRM)** (also known as the ***Greenwich Meridian***,

	which passes from the northern pole to the southern pole through Greenwich, Englad, UK) for a position on the surface of the earth, applicable in the range of [-180°,+180°]
perimeter	two-dimensional continuous line (e.g., polygon, circle, ellipse, etc.) forming the boundary of a location
polygon	cyclic series of positions, which constitutes vertices, with straight lines stretching between each two consecutive vertices, and a closing straight line stretching from the last vertice to the first vertice
position	precise point on the surface of the earth, specified by its latitude and longitude, according to the standard Geographic Coordinate System (GCS), based on the World Geodetic System standard WGS-84 (National Geospatial-Intelligence Agency, 1984)

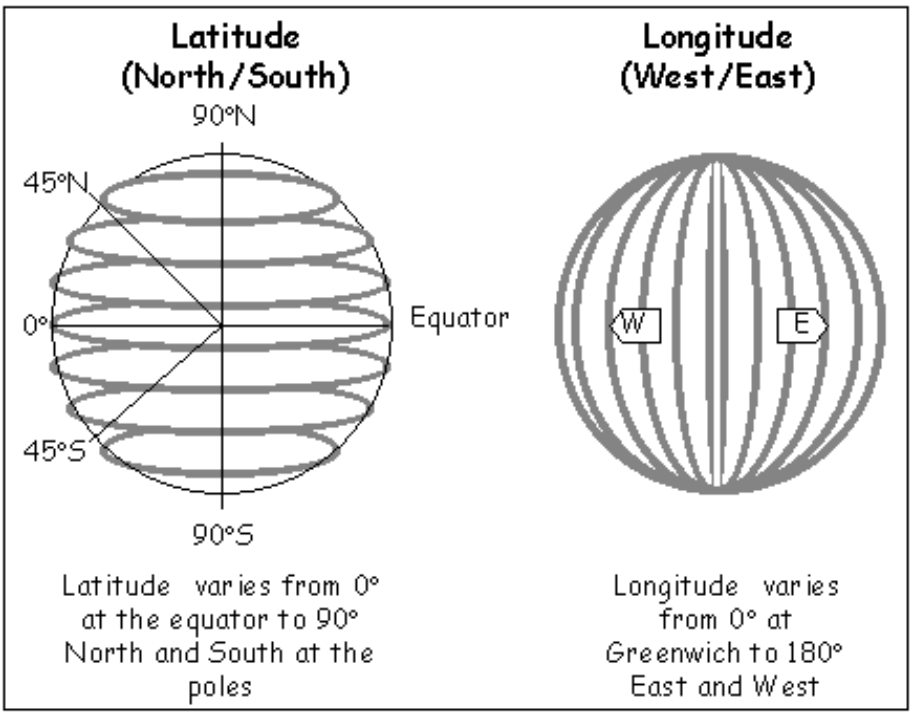

Figure 3-1. Latitude and Longitude of Positions on the Surface of the Earth

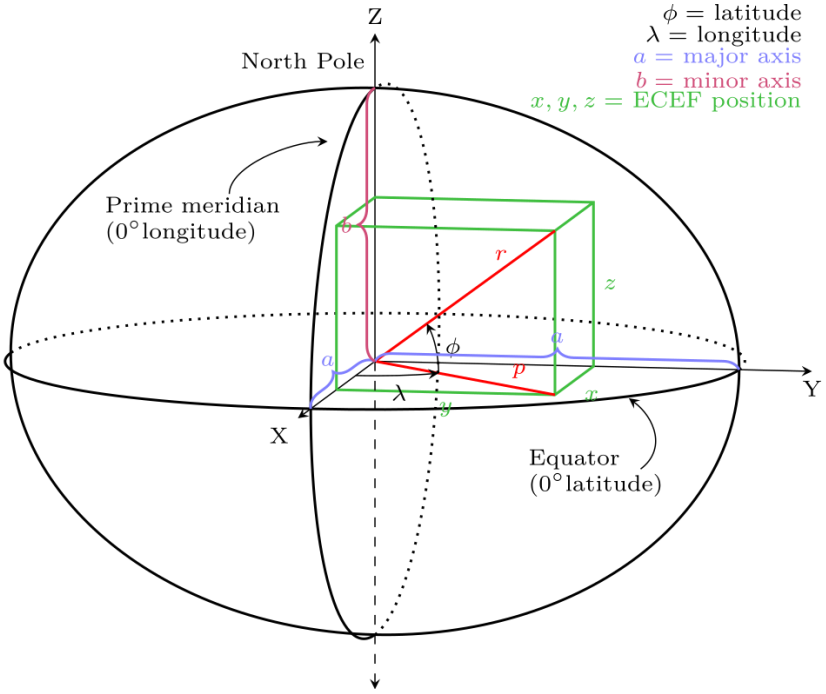

Figure 3-2. Latitude and longitude of an arbitrary position on the surface of the earth

Source: *https://en.wikipedia.org/wiki/Geographic_coordinate_system#/media/File:ECEF.svg*

3.3 Usage Conventions

3.3.1 Position Specification

The beAWARE platform supports the specification of **positions** in its current version. A position shall preferably be specified as a typed data structure, e.g., as shown in the examples in Figure 3-3 below. A vector representation of a position, e.g. P(lat, long) shall always specify the latitude value first, and the longitude value second, according to international standards. **Latitude and Longitude are both mandatory.**

Latitude and Longitude must be specified with at least 5 digits after the decimal point (and preferably 6 or 7), allowing a precision of ~1m. The circumference of the earth is about 40,074 km, hence the distance between each two consequent meridians with an integer longitude on the equator, i.e. the aperture of one longitudinal degree, is ~111,317 m. Hence each milli-degree (0.001°) is ~111 m, so 0.00001° is ~1.11 m.

A reference to a position shall always be accompanied by a timestamp, which indicates the point in time in which the object was recorded at the specific position. Time specification conventions are described below.

JSON full text labels

```
"position": {
      "latitude": 40.689231 ,
      "longitude": -74.04450
}
```

JSON short text labels

```
"pos": {
      "lat": 40.689231 ,
      "long": -74.04450
}
```

Vector Representation Pos1(lat,long)

```
Pos1.set(40.689231,-74.04450);
Pos2 = Pos1.get() ➔
 Pos2:(40.689231,-74.04450)
```

XML short text labels

```
<pos>
 <lat>40.689231</lat>
 <long>-74.04450</long>
</pos>
```

Figure 3-3. Position Representation Data Structure Examples

3.3.2 Location Specification

The beAWARE platform will support the specification of **outdoor locations** in future versions. In the current version, beAWARE supports only the association of positions with a specific geographical district of interest. Currently the system supports three operational geographical districts:

District	Central Position	Radius	Southwestern Corner	Northeastern Corner
Thessaloniki	Aristotelous Square (40.63242,22.94097)	40km	Aiginio (40.49823,22.53968)	Lagyna (40.72437,23.00358)
Vicenza	Parco Querini (45.55394,11.54809)	25km	San Bonifacio (45.40919,11.27854)	Rosà (45.72137,11.76414)
Valencia	Plaça de l'Ajuntament (39.46979,-0.37636)	35km	L'Alcúdia (39.17871,-0.52565)	Port de Sagunt (39.66284,-0.22954)

Any entity or event report in the beAWARE platform is associated with exactly one district. This practice allows filtering and routing of information according to its relevance.

A location shall be specified as a combination of position(s) and location identifier(s). Location identifier can be a textual name or description, a physical building or room address, Global Location Number (GLN) (GS1, 2013), Intelligent Mail Barcode (IMB) (Riley, 2008) etc.

A location that consists of more than one position requires the designation of the meaning of each position, as well as an overarching meaning of all positions together. For instance, a list of five positions can represent the perimeter of the location.

Alternatively, a single position can constitute the center of the location, accompanied by a radius, which determines a circular perimeter for the location.

A vector representation of a position, e.g. P(lat, long) shall always specify the latitude value first, and the longitude value second, according to international standards.

Location Object – JSON full text labels

```
"location": {
 "name": "Statue of Liberty",
 "description": "The famous statue granted by France to the United
States of America in 1886",
 "address:" {
  "addressLine1":"1 Statue Rd.",
  "addressLine2":"Liberty Island",
  "city": "New York City",
  "state": "NY",
  "country": "United States",
  "zipcode": "10004",
  "phone": " 1-212-363-3180",
  "locationIdentifier" : "10004-1000-01",
  "locationIdentifierType": "IMB"
 },
 "positions":[
 {
  "positionId": "0";
  "positionName": "center";
  "position": {
   "latitude": 40.689231 ,
   "longitude": -74.04450
  }
 },
 {
  "positionId": "1";
  "positionName": "northwest";
  "position": {
   "latitude": 40.691082,
   "longitude": -74.047228
  }
 },
 {
  "positionId": "4";
  "positionName": "southeast";
  "position": {
   "latitude": 40. 688611,
   "longitude": -74. 043499
  }
 }
 ]
}
```

Figure 3-4. Location Representation Data Structure Example

3.3.3 Time Specification

3.3.3.1 Conventional Timestamp Formatting

Any timestamp in the beAWARE platform shall be specified according to the ISO-8601 convention (International Organization for Standardization, 2016), i.e., in the following string-based format:

```
"YYYY-MM-DDThh:mm:ssZ"
```

where:

the element	stands for
`YYYY`	the Gregorian year in four digits [0000-9999]
`MM`	the Gregorian month in two digits [01-12]
`DD`	the Gregorian day of the month in two digits [01-LD] (LD stands for "last day" and varies according to the year and month
`T`	a character separating the date portion from time portion
`hh`	the hour of the day in 24 hours format, two digits [00-23]
`mm`	the minute of the hour in two digits [00-59]
`ss`	the second of the minute in two digits [00-59]
`Z`	a character designating that the time is in the UTC timezone

As noted, **all the timestamps in the beAWARE platform shall be communicated and stored in the UTC timezone**. For presentation to a user, the UI logic may include a conversion to the local time, as follows:

```
DisplayTime(UserID) = utcTimeStamp + utcOffset(UserID)
```

where:

the element	stands for
`DisplayTime`	the time that is displayed to a specific user

UserID	the unique identifier of the user
utcTimeStamp	the time of the event as stored in UTC
utcOffset	the time offset of the user from UTC. For instance, the winter-time offset of a user who is located in Helsinki from UTC is +2h.

For acquisition of time from a user or device, the UI/DI logic has to include a conversion to the global time, as follows:

EventTime = UserTime(UserID) – utcOffset (UserID)

where:

the element	stands for
EventTime	The time that is communicated or stored for the event
UserID	The unique identifier of the user
UserTime	The local time provided by the user or device
utcOffset	The time offset of the user from UTC. For instance, the summer-time (daylight saving) offset of a user who is located in New York from UTC is -4h.

3.3.3.2 Event Start and Relevance Time Specification

Any event must have at least one timestamp to mark its **start**. In addition, any event has a **relevance** timestamp, which is either recorded in the event as its **last update**, or derived as the time in which the update arrives. Typically, the reference time for each event is defined as follows:

Event.RefTimeUTC = max (Event.LastUpdateUTC, Event.StartTimeUTC)

where:

the element	stands for
Event	the object representing the event

RefTimeUTC	the attribute of the event marking its reference time
LastUpdateUTC	the time in the UTC timezone of the last update for the event
StartTimeUTC	the time in the UTC timezone in which the event originally started

3.3.3.3 Event Age Specification

The age of an event is the elapsed time from the start time until the current time. It should typically be used for prioritization or filtering of events according to their time in the system. In some cases, the age of the last update, commonly known as "Freshness", is more meaningful and usable than the age of the event from its creation. Typically, the age and freshness of an event are defined as follows:

```
Event.Age() = NowUTC() - Event.StartTimeUTC
Event.Freshness() = NowUTC() – Event.LastUpdateUTC
```

where:

the element	stands for
Event	the object representing the event
Age()	a method of the event that returns the elapsed time from its start until the current time
Freshness()	a method of the event marking the elapsed time from its last update until the current time
RefTimeUTC	the attribute of the event marking its reference time
LastUpdateUTC	the time in the UTC timezone of the last update for the event
StartTimeUTC	the time in the UTC timezone in which the event originally started
NowUTC()	a function that returns the current time in the UTC timezone

3.3.3.4 Event End and Expiration Time Specification

An event may have an additional timestamp to mark its **end**. In case an event has no specified end timestamp, the system shall assign a default end timestamp to the event,

according to the **default duration** of the **event type**. Since events may have multiple updates, in the absence of an end timestamp, the end timestamp shall be calculated as

```
Event.EndTimeUTC = Event.RefTimeUTC + DefaultDuration(Event.EventType)
```

where:

the element	stands for
`Event`	the object representing the event
`EndTimeUTC`	the attribute of the event marking its end
`RefTimeUTC`	the attribute of the event marking its reference time in UTC
`DefaultDuration`	a function that returns the default duration for each event type
`EventType`	the type of the event

In addition, for the purpose of compliance with performance conventions and data protection regulations, events shall also have an **expiration time**, after which they will be logically or physically deleted or removed from the storage, processing, or display, according to relevance for each application and each module in the beAWARE platform. The expiration is typically longer than the duration of the event, such that it allows the event to remain in the system for a while even after it is officially ended (for purposes of analysis, logging, debriefing, etc.)

Any event can have an explicit expiration time attribute. In case an event has no specified expiration timestamp, the system shall assign a default expiration timestamp to the event, according to the **default expiration** of the **event type**. Since events may have multiple updates, in the absence of an expiration timestamp, the expiration timestamp shall be calculated as

```
Event.EndTimeUTC = Event.RefTimeUTC + DefaultExpiration(Event.EventType)
```

where:

the element	stands for
`Event`	the object representing the event
`ExpirationTimeUTC`	the attribute of the event marking its expiration

`RefTimeUTC`	the attribute of the event marking its reference time in UTC
`DefaultExpiration`	a function that returns the default expiration duration for each event type
`EventType`	the type of the event

Typically, the following default durations and expirations apply:

Event	Default Duration	Default Expiration
`Incident`	12h	72h
`Team Report`	1h	72h
`Alert`	24h	72h
`Place-of-Relief Report`	6h	72h
`Observation`	6h	72h
`Forecast`	6h	72h

3.4 Ethics and Privacy

The beAWARE consortium is well-aware of the need to ensure the privacy of participants in field trials and demonstrations. The beAWARE policy and commitments related to ethics and privacy are described in (beAWARE, 2017d), from which we have derived the following fundamental principles to guide our work.

3.4.1 Informed Consent

All individual participants of beAWARE field trials, demonstrations, scenario validation sessions, and so on, will provide an informed consent for participation.

3.4.2 Simulated Scenarios

The validation processes will be based on synthetic scenarios of emergency situations, so no actual personal data collection and processing will be performed.

3.4.3 De-Identification of Personal and Behavioral Data

The social networking behavioral data will be de-identified.

3.4.4 Discommunication of Personal Data

Personal details of human originators of social media or mobile app reports are not being communicated among modules of the platform.

4 LOCATION MANAGEMENT SOLUTION PROTOTYPE DEMONSTRATOR [PUBLIC]

4.1 Overview

In this section we present the contents of the LMS demonstrator. This presentation includes listing the features provided by each module in the beAWARE platform that contributes to location-based capabilities. In addition, we specify and explain the system use cases demonstrated by the LMS or whose system-level demonstrated is enabled or supported by LMS capabilities.

4.2 Covered LMS Requirements

The current LMS Prototype covers part of the requirements defined for the LMS. This is due to various considerations related to gradual progress in the development process. The requirements covered by the current LMS Prototype are listed in Table 4-1. The scope of coverage varies for each requirement, as the intention was to reach a basic demonstration level for as many requirements as possible.

Table 4-1. Location Management Requirements Covered by the LMS Prototype

Req ID	Location Management Requirement	Scope of Coverage
LMS_001	Display an event map to authorities as part of PSAP;	Full
LMS_002	Display flood-related position-based metrics on the map	Without level distinction
LMS_003	Display position-specific public alerts on the map	To citizens
LMS_004	Display incident reports from citizens on the map	Without type distinction
LMS_006	Display sensor and device positions on the map	Measurement-Based
LMS_007	Transfer citizen report position data to authorities	Full
LMS_008	Transfer team status and position report to authorities	Position Only
LMS_015	Display teams on the map	Without type distinction
LMS_017	Enable flexible map event filtering for display	Full
LMS_024	Display places of interest on the map	Places of Relief only

4.3 Components and Demonstrated Capabilities

4.3.1 Weather Forecast Services (WFS)

- Provides weather data for all three Scenario Demonstration Sites (SDS).
- Provides Fire Weather Index for Valencia SDS.
- Provides Heatwave Weather Index for Thessaloniki SDS.

4.3.2 Flood Prediction Services (AMICO)

- Provides weather station and river sensor data for Vicenza SDS.

4.3.3 Sensor Analytics (SENSAN)

- Retrieves, stores and provides weather data and crisis index data for all SDSs.

4.3.4 Crisis Classification Services (CRCL)

- Calculates risk index values and crisis forecast values for all three SDSs.

4.3.5 Social Media Analyzer (SMA)

- Collects tweets from Twitter.

4.3.6 Mobile Application (APP)

- Receives incident reports from citizens.
- Provides public alerts to citizens.
- Reports first responders positions.

4.3.7 Knowledge Base Services (KBS)

- Clusters incident reports from citizen and social media.
- Sends incident reports to PSAP
- Sends places of relief to PSAP for Thessaloniki SDS.

4.3.8 Public Safety Answering Point (PSAP)

- Displays metrics on the map.
- Displays teams on the map.
- Displays incidents on the map.
- Sends public alerts from a fixed list of texts.

4.3.9 Message Hub (MSB)

- Publishes messages from producers.
- Relays messages to their consumers according to their topics.

4.3.10 Logger

- Sends initialization message to KBS.

4.4 Demonstrated Use Cases

4.4.1 Overview

The LMS prototype supports several operational use-cases that are demonstrated as part of beAWARE's First Prototype (P1). A summary of the demonstrated use-cases in each operational scenario is presented in Table 4-2. A detailed description of the demonstrated use-cases is provided in the following subsections.

Table 4-2. beAWARE P1 Demonstrated Use Cases Supported by the LMS

Use Cases	Flood	Fire	Heatwave
Crisis Classification	YES	YES	YES
Early Warning Generation	YES	YES	
Relief Management			YES
Incident Management	YES	YES	YES
Response Management	YES		

4.4.2 Crisis Classification

This use-case includes the generation and presentation of several position-based metrics, following the **Metric Flow**. This use case is demonstrated in all three operational scenarios. The goal is to demonstrate the capability to visualize position-based metrics on the event map, thus providing a picture of the situation.

At this stage, we visualize the positions of the measurements in a dedicated map layer (which allows for fast and easy filtering of other entities such as teams and incidents). Currently no further separation or distinction of metrics is provided. Future versions will include the distinction of specific metrics by suitable icons, as well as the use of different colors for measurement values. These distinctions will allow decision makers to understand the situation and prioritize their response.

A list of the data streams generated by the CRCL service and displayed by the PSAP is provided in Table 4-3.

Table 4-3. Crisis Classification Data Streams Supported by the LMS Prototype Demo

SCN	Metric	Structure	Locations
Flood	Predicted Flood Crisis Level	1 data series for each river section group (total of 6 groups) + 1 value for Total Overall Crisis Level per forecast, every 6 hours for next 54 hours	6 river section group centers around Vicenza + 1 Vicenza city center
	Predicted Water Level Measurement	1 measurement per river section per forecast: maximum in next 54 hours	60 Bacchiglione and Retrone river sections around Vicenza
	Predicted Water Level Category	1 measurement per river section per forecast: category of maximum level in next 54 hours	60 Bacchiglione and Retrone river sections around Vicenza
	Observed Flood Crisis Level	1 measurement which aggregates all the OCL of Weather Stations per forecast	
	Observed Water Level Measurement	1 measurement per Weather Station per sample	3 weather stations in Vicenza
	Observed Water Level Category	1 measurement per Weather Station per sample	3 weather stations in Vicenza
Fire	Predicted Fire Crisis Level	1 measurement which aggregates the FWI values per period (9 days)	1 Valencia City Center
	Predicted Fire Weather Index	1 data series for each point of interest (total 9), 1 measurement per day per position	9 (3x3) grid positions over Valencia / La-Devesa area
Heatwave	Predicted HeatWave Crisis Level	1 value for the region per forecast	1 in Thessaloniki center
	Predicted HeatWave Discomfort Index	1 data series for each point of interest (total 6), 1 measurement per day per position	6 selected positions around Thessaloniki region

4.4.3 Relief Management

This use-case includes the generation and presentation of several **dummy incidents**, based on the location of predefined places of relief (PoRs). The incidents are generated as initial anchors for future reports from the area of the PoR, such that the future

reports will get clustered with the initial anchor reports and enrich them with information.

In addition, a dedicated filtered event list shows only the incidents marking the PoRs. This filter can also be applied to the event map such that only the PoRs can be visualized on the map.

As part of this demo, two PoR-reflective incidents are generated for two designated PoRs in the Thessaloniki district. The PoRs are stored in the KB. This use case is only demonstrated for the heatwave scenario.

4.4.4 Early Warning Generation

This use-case includes the generation of several **public alerts**, which are intended to provide early warning and precautionary information to the citizens, as a result of the assessment by decision makers before the emergency, based on the crisis classification index. This use case is demonstrated in all three scenarios.

As part of this demo, public alerts are generated for the whole city as a general notice. In addition, public alerts for specific places are generated for specific incident locations around the city.

4.4.5 Incidents Management

This use-case includes the generation of multiple incident reports from the mobile application. Incident reports that are sufficiently close (e.g., within a distance of less than 500 m from each other) get clustered and considered as the same incident report. This allows the PSAP operators to accrue information about the same incident from multiple data sources, rather than treat each report as an incident of its own. This use case is demonstrated in all the scenarios.

In addition to reports from the mobile app, we also demonstrate the acquisition and analysis of reports from the Twitter mobile application. These reports are also converted into incident reports that get clustered into pre-existing incident entities, based on the tweet's position. The posted text also enriches the information about the incident. No personal information shall be transferred by the SMA service to the KBS or PSAP.

Incidents are visualized to the PSAP operator on the event map in a dedicated Incidents layer, which allows easy and fast filtering of incident events and the exclusion of other entities such as teams or measurement. Each incident event has additional data including textual details, precise position, and media attachments.

Currently all the incidents share the same icon for incidents. In future versions incidents will be distinguished with specific icons according to category, severity, and status.

4.4.6 Response Management

This use-case includes the registration of several teams, with different roles and positions, who are scattered around the city. The team's position is reported by the mobile application to the PSAP. Teams are visualized to the PSAP operator on the event map in a dedicated Teams layer, which allows quick and easy filtering of team positions, which is especially useful to the Operations Manager.

Currently all the teams share the same icon. In future versions teams will have distinguished icons according to category (role) and status. In addition, team position management will enable task assignment to teams in the field as part of the response effort.

5 LOCATION MANAGEMENT SOLUTION ARCHITECTURE [CONFIDENTIAL]

The content of this section is only available in the confidential counterpart of this deliverable – D6.7.

6 RESULTS [CONFIDENTIAL]

The content of this section is only available in the confidential counterpart of this deliverable – D6.7.

7 CONCLUSION [PUBLIC]

This document has presented the beAWARE Location Management Solution (LMS) cross-platform prototype demonstrator. Location management is a critical capability in emergency management. Therefore, it has been a primary effort supported by almost all the partners in the consortium to ensure the end-to-end capability of displaying entities and events on the map to the decision makers and field users alike, in order to enhance their situational awareness and geospatial understanding of the emerging situation.

We started with identifying the user requirements which are relevant for location management in all three operational scenarios.

It became apparent very early in the architecting and high-level design process that the system architecture must rely on a robust and extensible LMS infrastructure, including platform-crossing position, location, and time conventions, end-to-end position-based entity and event flows, and spatio-temporal reasoning and clustering of events.

In addition, each subsystem and module has been designed to deliver capabilities and features to support location and position management as appropriate and relevant for each module according to its role in the platform. This also includes considerations for enhanced performance and flexibility.

We then explained and introduced how the current version of the LMS supports and enables location services and location-based operations. It is clear that halfway through the beAWARE project, only part of the capability is delivered and demonstrated, and additional work is required and intended to continue during the second half of the project.

This document marks the outcome of the intensive work of all technical partners as part of task T6.3 – Outdoor Location Solution – with continuous feedback from end-users, in order to ensure the facilitation of a robust location management capability, and the intelligent and efficient utilization of spatiotemporal data and technology by the modules developed by the partners. During the project it became increasingly critical to ensure the commonality and standardization of spatiotemporal data, govern the definition of new data topics and ensure compliance across the board, especially for the seamless exchange and manipulation of spatiotemporal information while preserving a common semantic language.

Another critical impact of the LMS prototype was the capability to demonstrate preliminary presentation modes to end user representatives in order to collect

feedback, ideas, and needs. Only the actual visualization of location-based entities and events helped clarify, for instance, how users would prefer to see various events on the map, how they would want to layer and filter events, and how they would want to analyze location-related information and interact with it.

One of the major advantages of the LMS is its interoperability – which is both endogenous and exogenous. The LMS is architected and implemented such that components can seamlessly interact with other 3rd-Party location management services and applications. Furthermore, the beAWARE platform as a whole can support interactions with external platforms and systems. This is due to two major architectural principles: a) standardization and conventionality of position, location, and time formats; and b) robust interconnectivity and data exchange architecture allowing flexible addition of location data producers and consumers. This capability allows, for example, adding other mobile applications as incident providers. Moreover, we can integrate and interact with external Radio Access Networks (RAN) and Virtual Private Networks (VPN) – both of which are core capabilities of public safety and emergency management agencies – for receiving and monitoring team positions based on mobile devices that are not on the public internet.

Further extensions of the LMS include the completion of location management capabilities to support the operational requirements for incident and workforce management, reasoning, and decision support, as well as additional and richer functionality around the existing capabilities.

Future extensions of the framework include complete support for all spatiotemporal entities and events, including infrastructure assets, tasks, and other events. Additional enhancements may include differentiation of service levels according to the criticality and frequency of various topics, as well as the extension of spatiotemporal construct representation and utilization (e.g., polygons and polylines).

8 REFERENCES

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