Communication Protocol for using Nontraditional Information Sources between First Responders and Citizens during Wildfires

Zoltán Balogh
Institute of Informatics, Slovak Academy of Sciences in Bratislava, Slovakia
balogh@savba.sk

Emil Gatial
Institute of Informatics, Slovak Academy of Sciences in Bratislava, Slovakia
emil.gatial@savba.sk

Sepideh Hassankhani-Dolatabadi
Institute of Informatics, Slovak Academy of Sciences in Bratislava, Slovakia
sepideh.ui@savba.sk

Štefan Dlugolinský
Institute of Informatics, Slovak Academy of Sciences in Bratislava, Slovakia
stefan.dlugolinsky@savba.sk

Marco Saltarella
Fincons SpA, Italy
marco.saltarella@finconsgroup.com

Marcello Paolo Scipioni
Fincons SpA, Italy
marcello.scipioni@finconsgroup.com

Dominika Grunwald
ITTI Sp. z o.o., Poland
dominika.grunwald@itti.com.pl

Marcin Przybyszewski
ITTI Sp. z o.o., Poland
mprzybysz@itti.com.pl

Andrea Majlingova
Technical University in Zvolen, Slovakia
majlingova@tuzvo.sk

Yvonne Brodrechtova
Technical University in Zvolen, Slovakia
brodrechtova@tuzvo.sk

Kayvan Yousefi Mojir
Swedish School of Library and Information Science, University of Borås, Sweden
kayvan.yousefi_mojir@hb.se

Nasrine Olson
Swedish School of Library and Information Science, University of Borås, Sweden
nasrine.olson@hb.se

Jelena Levak
RiniGARD, Croatia
jelena@rinigard.com

Krishna Chandramouli
Queen Mary University of London, United Kingdom
k.chandramouli@qmul.ac.uk

ABSTRACT

One of the biggest challenges faced during the wildfires is communication. A specific case represents the need to establish communication between first responders and the public. This paper presents a proposal for a generic protocol to ensure effective communication between fire fighters and many citizens at the incident site or in the surrounding area using nontraditional information sources such as a dedicated mobile app or social media. Specific challenges, concepts and technologies relevant to such communication are described specifically customized for forest fires and wildfires. The protocol itself is provided by proposing information flows between the involved actors. Moreover, several technologies including a Citizen Engagement Mobile App, an Edge Micro Data Center for forward command centers, a Mesh in the Sky communication infrastructure or a Dashboard integrating and displaying all the data in one place is shortly introduced. The presented paper is a work in progress.

Keywords

Communication Protocol, Wildfires, Forest Fires, Drones, Mesh in the Sky, Emergency Response, First Responders.

INTRODUCTION

When fighting wildfires, first responders are often battling flames over vast areas. In such situations, swiftly exchanging information between command centers (CC) and citizens located at the incident site or in the surrounding areas becomes crucial. In this article we consider two types of CCs: the main command center (MCC), which coordinates all operations across a country or a region, and the forward command center (FCC), which is deployed near the incident site. While firefighters at a scene are usually well equipped with radio devices for communication between each other the contact of the FCC with the citizens is still ensured indirectly through the MCC. Additionally, firefighters in the field often have limited access to high bandwidth network connections. A voice call or an eSMS message from a citizen is passed to an MCC using the emergency phone system (112 in Europe, 999 in the UK and 911 in the USA) where operators take care individually of each call and trigger further actions - usually deploy required forces and equipment. Information is typically disseminated to citizens through various means, such as mass media, Wireless Emergency Alert (WEA) messages, social media, automated phone calls, and dedicated mobile apps. However, the level of support for each of these communication channels often varies greatly across different countries and agencies. Often warnings, notifications, alerts or instructions (such as evacuation routes) reach the desired target audience late (Serna, 2020) or does not take into account the specific situation of the recipients (messages are not personalized or context-aware). In addition, it is often desirable to receive immediate feedback from a larger group of individuals impacted by the situation in the form of brief reports or confirmations.

During extensive wildfires, the *specific challenges* therefore are:

1. To provide technological means for firefighters at the scene (and at the FCC) to connect to a broadband data network and services in order to communicate with other CCs and with impacted people in the areas threatened by the fire.
2. To provide tools for a more direct communication between citizens and firefighters in the field through a specialized mobile app or social media platforms (nontraditional sources).
3. To aggregate information from point 2 on behalf of first responders in near real-time and displaying such information combined with information from other data (such as satellite data, fire spread models or IoT).

“The ability to incorporate information from multiple and nontraditional sources into incident command operations” was identified by IFAFRI[1] as the fourth of the 10 most urgent capability gaps for first responders (IFAFRI, 2020). Among others, crowdsourced information from mobile devices and social media information were identified as most frequently used nontraditional information sources. Information about an incident can be posted on social media platforms by witnesses even before first responders arrive to the incident site. Such information can potentially provide valuable preliminary insights (extracted from texts, photos, or videos) about the range, severity or type of the incident. Reliability and verifiability are the main concerns for social media sourced information though since the users or posts can be faked or falsely reported. The use of a specific social

[1] International Forum to Advance First Responder Innovation, https://www.internationalresponderforum.org/

media platform is varying based on the country, region or used language. For instance: while in the USA Twitter is never used by 58,2% of users (survey by GWI) in Slovakia it was never used by around 84% of responders (survey by Go4insight). On the other side Facebook is the most used social media platform in both in the US and in Slovakia. YouTube and Instagram are the 2nd and 3rd most frequently used platforms in Slovakia. Based on our analysis of posts from Slovakia, YouTube and Instagram are not used as frequently as Facebook to post near real-time information about incidents. The *main benefits of mobile applications* for emergency communication were summarized in (Repanovici, 2021): provide high-accuracy location of the caller, provide pre-set caller identity with additional information, can be used by people with communication disabilities or in silent emergency situations, can eliminate language barriers or accommodate the communication language and ability to easily access emergency services and request and send relevant information. In addition to these benefits, we see the following additional ones: to overcome language barriers, an app can accommodate the interface to a caller profile (child, teenager, adult, elderly, professional rescuer and ability to aggregate data from many callers (crowds or mass casualty incidents).

In this article a proposal for a generic protocol for dealing and processing information received from and published to a dedicated mobile app and social media is provided together with individual technological components making such protocol implementation possible. By a "protocol" in this context we mean a prescribed flow of data and information in a prescribed format, communicated between the main involved actors during an emergency event such as wildfire or forest fire. Specifically, the technological components further introduced in greater details are:

- *The Citizen Engagement Mobile App* (CEMA) - A dedicated mobile app with multiple modules which is used to engage citizens in the fight against forest fires. It also includes a module for receiving warnings and communicating with firefighters at the scene.
- *The Social Media Crawler* – A tool for processing and posting information to/from a social network.
- *The Edge Micro Data Centers* (EMDC) - is a specialized scalable computing device to be deployed at the edge on an FCC to provide seamless connection to other FCC in the area and to the MCC. The EMDC will be configured to provide network connectivity and to host local computing and data storage services.
- *Mesh in the Sky* - a wireless Software Defined Radio (SDR) communication link to ensure IP network connectivity. The devices providing connectivity can be mounted on multiple drones. Th IP connection is facilitated to Base stations. Mesh in the Sky is compatible with a wide range of sensors and external devices with sufficient throughput to ensure real time transmission of both the video and sensory data.
- *The Dashboard* – a UI integrating data from various services in a single portal.

The article has the following sections: the next section briefly discusses the state of the art in the use of mobile applications and social media by citizens during emergencies. The next section is devoted to the description of the proposed solution which includes the platform, the information sharing protocol flow and a simplified architecture comprising all the technological components. The next section describes the use of a mobile application and social media for sending messages, warnings or receiving feedback. The focus is on the use of mobile applications. As the evaluation we present preprepared message templates to be used during a pilot exercise – for this purpose we introduce two types of messages (Fire Report and Fire Warning) to be submitted, collected, and aggregated. We conclude with a final section devoted to future work.

STATE OF THE ART

Specifically, the Capability Gap 4 identified by IFAFRI refers to the need to collect, integrate, and validate data from multiple and nontraditional sources. More than 73% of all calls to the EU emergency phone number 112 were placed from a mobile phone. Smartphones are nowadays a ubiquitous tool for seeking and sharing information as well as for communicating using a great range of applications.

A significant milestone in the use of mobile applications occurred in 2011, when the Federal Emergency Management Agency (FEMA) released a mobile application that provides real-time alerts and information about disasters and emergencies. Similarly, the American Red Cross launched its first mobile app in 2012, which includes features such as emergency alerts and first aid information. Many other organizations and government agencies have developed mobile applications for emergency management and situational awareness, including state and local emergency management agencies, public safety agencies, and non-governmental organizations.

The potential of mobile application EscapeWildFire (Kamilaris, 2023) to assist people to escape wildfires in real-time by suggesting evacuation paths was considered in scenario for simulated wildfires in Cyprus and also the historic wildfire that occurred in Amarillo, Texas in 2011. This work also overviews the requirements and design on the mobile app for the specific domain of wildfires. The set of most relevant emergency notification mobile applications, specifically SafetyGPS, HelpBridge, Motorola Alert, EmergencyAlert, FEMA App, SignAlert, ELERTS and My112, were reviewed and analyzed (Romano, 2016) according to the shared data types and forms of communication with citizens. One of the conclusions states that people prefer to use multi-media to write a text or fill in the forms for notifying emergencies. In the scope of PEMEA project (Pemea, 2020), twelve mobile emergency applications are integrated to the communication framework defined by ETSI (TS 103 478) standard to provide citizens with fast and intuitive access to emergency services by providing improved communication channel. A comprehensive overview of the mobile crowdsensing technologies in emergency situations as well as research and development challenges were examined in the work (Cicek, 2023), finding that mobile applications and social media were mostly used for hazard/risk detection, evacuation/mapping, information exchange, situational awareness and data fusion. The requirements study (Majlingova et al., 2022) enlisted specific requirements for mobile application relevant to wildfire management. The following citizen requirements were identified: notification about the fire occurrence in citizens' vicinity; ability to notify the fire location to the fire and rescue service; ability to notify the forest management services on human negligence; and ability to report a suspect fire with geo-location information, photos, and a brief description.

THE PROPOSED SOLUTION

The presented work is being developed in scope of the SILVANUS project[2]. The project's main objective is to create a climate resilient forest management platform, called SILVANUS platform, to prevent and combat forest fires. The platform addresses three phases of the emergency management related to forest fires: A) Prevention and Preparedness, B) Detection and Response and C) Restoration and Adaptation. The innovation and the overall approach adopted for the development of the SILVANUS platform catering to the needs and demands of interdisciplinary stakeholders is presented in Figure 1.

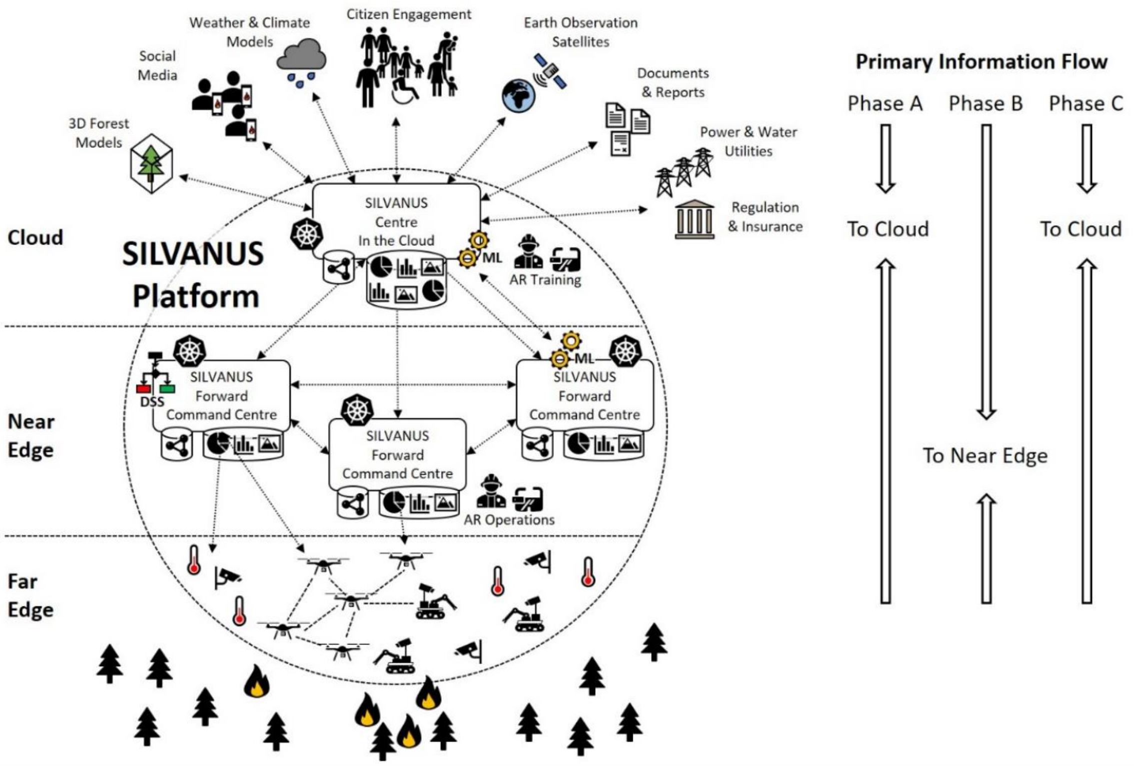

Figure 1. SILVANUS platform approach.

The challenge of continuously monitoring the forest infrastructure is achieved with the use of IoT devices and sensors (Far Edge). The information collected from such distributed sensor systems are then subsequently processed at both cloud platform and/or Near-Edge nodes deployed in individual FCCs. While Phase A and Phase C data collection, assessment and monitoring will take place in the Cloud, the need for (near-) real-time analysis

[2] SILVANUS Horizon 2020 Green Deal project https://silvanus-project.eu/

(such as spread of wildfire) will be continually analyzed at the Near-Edge computational infrastructure (EMDCs). The complexity of inherent data modelling and ingestion of complex stream of continuous and sparse data collected from various sources of end-devices will be processed within the platform.

The Information Sharing Protocol Flow

The overall approach of information sharing is based on the concept of information Polls, Channels and Templates proposed and described in (Balogh, 2016). Poll in the referenced context is a semi structured requests for information distributed in real-time to many subscribers - in our case Citizens. For subscribers the Poll request will be visualized either as an alert/warning message or as a simple reply from in a client (Mobile or Web App). In both cases the citizen will be able to submit a quick reply or initiate further communication. The setup of a Poll is based on a sequence of Template-based generated forms. In our case a Poll setup will be initiated by an operator from a command center (either MCC or FCC). The setup process determines when, what and to whom will be the Poll requests sent. Replies from Citizens (to Poll requests) will be aggregated, filtered, and visualized in a Dashboard. Citizens will need to subscribe to a specific information Channel to receive relevant notification – this process will be automatic through the Mobile App upon installation and will depend on several factor such as country of deployment, language, geographic location or options selected in the app. The schematic concept of the proposed solution is depicted in Figure 2.

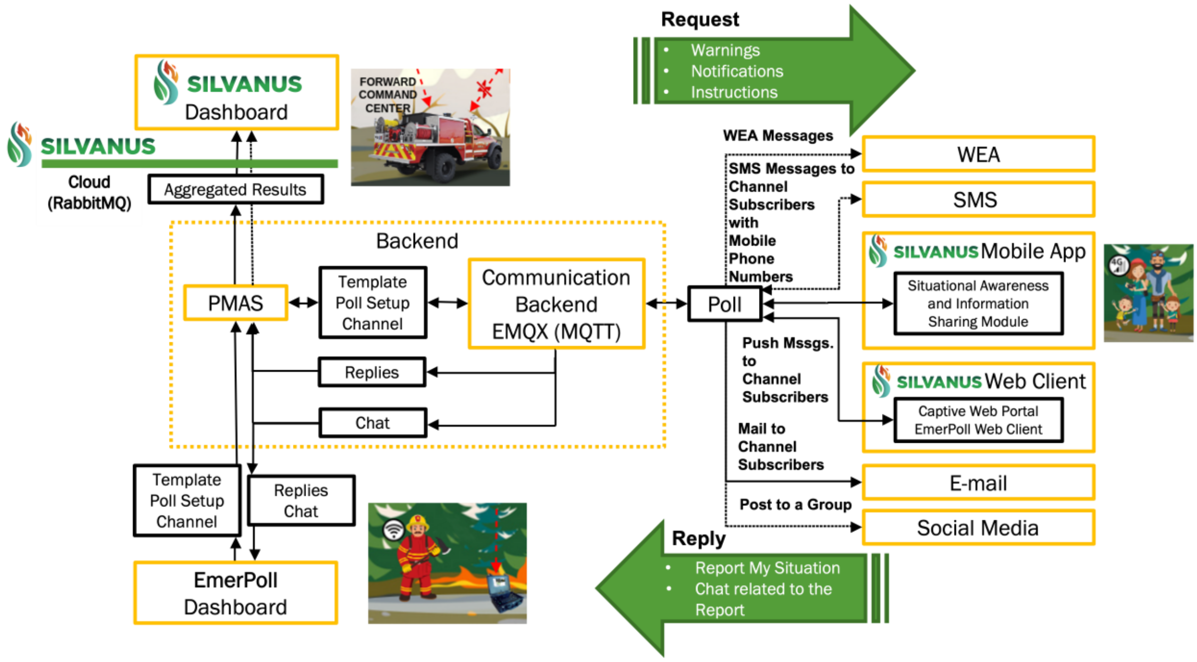

Figure 2. The Information Sharing Flow.

The schema above depicts that Poll requests can be delivered not only to the SILVANUS Mobile App, but also to a SILVANUS web client, e-mail addresses, or social media accounts (right side of the schema). In a case of short text messages (WEA or SMS) short links to either a web client or to an app installer with preconfigured setting can be provided. There are two Dashboards in the schema – the first one is the *EmerPoll Dashboard* – which is used to manage Polls (setup, start and send out Poll requests to citizens) and the second one the *SILVANUS Dashboard* - to receive aggregated results and visualize the timeline of generated Replies along with other available information from the SILVANUS platform.

The following table in Figure 3 depicts the flow of required steps to be taken on the side of the CEMA and on the side of the First responders (CC).

Citizen Frontend (Mobile App)	Information Sharing Protocol	CC Backend/Dashboard (Cloud, MCC)
1. Subscription - Manual - Automatic Geo	**Channel:** `sk.minv.hazz:Podpolanie`	
	Template: `zb:FireWarning` **Poll -** Request	1. Create Warning Poll 2. Send the warning to a Channel 3. Execute the Poll
2. Popup in the mobile app 3. Screen showing the Warning itself (fire shown as a polygon) 4. "Report My Situation" screen - Severity, Map, Note, Photo/Voice	Poll - Reply	4. Receive the Replies
	Poll – Aggregated Result	5. Aggregation of the Replies

Figure 3. The Information Sharing Protocol.

A common shared setup of a communication Channel and of a Poll Template must be ensured to interconnect the CC and the CEMA.

The Architecture

The SILVANUS Citizen Engagement Mobile App is one of the components allowing bi-directional communication between the citizens, and the fire responders and the rest of the rescue teams. In the concept of the SILVANUS platform, the EmerPoll architecture is based on exchanging Polls (described in the previous section), specifying the data format of requests and responses (visual representation, type definitions, flow of the questions and replies) using information Channels which implement the publish-subscribe messaging paradigm. The simplified architecture depicted in Figure 4 focuses on EmerPoll services integration into the overall SILVANUS architecture.

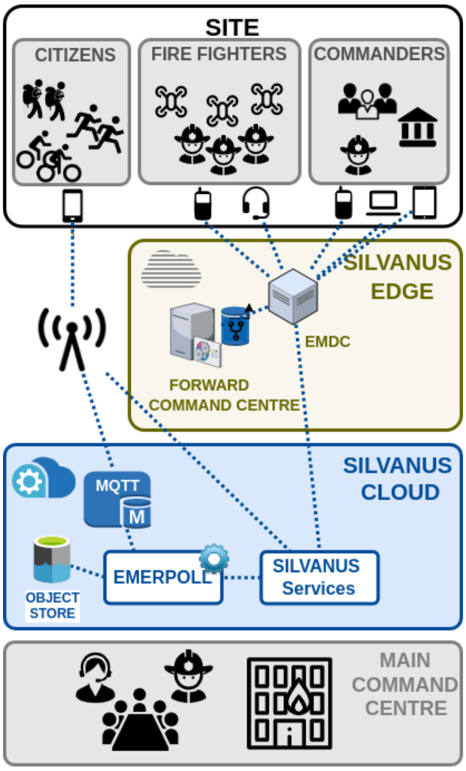

Figure 4. Simplified architecture comprising MCC, FCC, Cloud, Edge, Mesh in the Sky, Dashboard, Citizens, FF and the CEMA.

The EmerPoll is a stand-alone service that acquires information from many endpoints (i.e., mobile apps), aggregates them and pushes the aggregated information to the SILVANUS data repository where it is shared to with other SILVANUS components like the Main and Forward CC. On the other hand, several services developed in SILVANUS platform, especially evacuation routes and fire spread models, are relevant for the citizens, therefore the EmerPoll is about to register subscribe to RabbitMQ channels topics to acquire and propagate this information using EmerPoll channels to the mobile apps.

Citizen Engagement Mobile Application (CEMA)

The main trait of the CEMA design comes from the concept of polls and channels used in the EmerPoll system. The variability and dynamicity of the poll creation, management and re-use allows the app users to tailor the CEMA features to their needs, which helps to be adopted and expanded within the target user groups. This trait is the main enhancement compared to the reviewed mobile applications (Romano, 2016). For example, in case of the SILVANUS platform, the 'Fire Report' channel is used to report the fire location and its description, but the tourists will be able to create own channel 'Wild Animal Report' to share information about the dangerous animals.

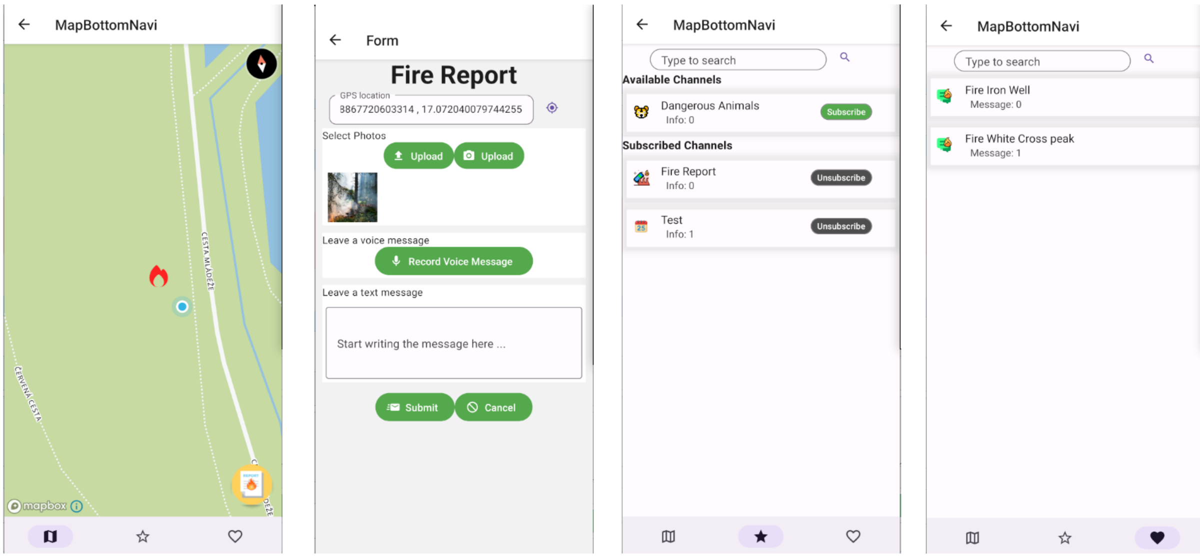

Figure 5: Screenshots of the CEMA for fire reporting and notification. The design of the CEMA contains (from the left) the interactive map, the user poll form, the channel management, and the message list.

The poll question format, visual representation and required response are defined in the poll templates which are dispatched through these channels. The core of the CEMA consists of four screens (depicted in Figure 5 from the left):

- *Interactive map* contains a vector base map layer designed to show in detail the most relevant points of interest and routes in the countryside. The map is also used the place markers to localize the events and also view relevant events populated by other users. The registered channels are depicted as the icons in the bottom of the map, that enable to place the markers and invoke the user poll. Registered channels also enable to display information relevant to the channel i.e., fire warning notifications are shown.
- User poll allows building the visual representation of the poll according to the 'poll template' (a JSON representation) and displayed a form or a set of forms in the app's screen. The poll may contain different data types, i.e., text, photo, audio and specific types like location, date, time, select box, option box, etc.
- *Channel management* is used to search, subscribe to and unsubscribe from the specific channels.
- *Message list* contains the list of messages sent by the user and received messages from different channels.

Citizen Engagement Framework

The SILVANUS citizen engagement framework was created to involve citizens in preventing and managing wildfires. It uses different methods, approaches, and tools to engage citizens in related activities, learning opportunities, decision-making processes, policy development, and defining public services. The goal is to increase citizen participation, improve awareness and knowledge, and promote better policies and services. The framework considers different target groups, engagement levels, timeframes, and available opportunities, and uses various modalities and channels like social media, public events, participatory activities, and a dedicated mobile app to engage citizens. Social media platforms like Twitter, LinkedIn, and YouTube are used, along with mass media channels such as press releases, newspapers, radio, and TV programs. Interactive citizen engagement activities include various participatory engagement activities and social campaigns.

For example, festivals and fairs offer citizens the opportunity to participate in interactive exhibits, demonstrations, and hands-on activities related to preventing and managing wildfires. Popular scientific conferences and workshops provide a platform for scientists and experts to share the latest research and knowledge about wildfires and prevention with citizens. Laddering events bring together citizens from diverse backgrounds to develop a shared understanding of the issue and identify collective solutions. Hackathons engage citizens in creating innovative and technological solutions by working together in teams to develop digital tools, applications, or other solutions that help prevent and respond to wildfires.

Social Media Crawler

There are legal and technical challenges for reading social media posts by third party applications (called "crawlers"). The legal conditions restrict or significantly limit access to the content generated by users. Concerning technical challenges there are application programming interfaces (APIs), such as FORT Pages API[9], which allow approved Facebook Research Partners to get data about public pages and public posts on public pages where steps have been taken to reduce the exposure of personal information. However, Facebook is not accepting new partner applications at the time of authoring this article. To fully exploit full capabilities of the API successful App Review process of the crawler application must be carried out by Facebook before it can access live data. In addition, the application must be put into "live mode" as well as installed into target groups by their administrators or it must gain explicit permissions from users and pages of which the crawler is reading posts.

The principle of the crawler integration and operation within the platform is depicted in Figure 6. Crawler is deployed as a server listening to real-time notifications of changes to specific objects in the Facebook Social Graph called webhooks. In particular, the crawler is subscribed to notifications on a new post shared in a group or posted by a page or a user, i.e., Page/feed and User/feed webhooks. The crawler is implemented in Python and uses facebook-sdk library for making Graph API requests and processing responses.

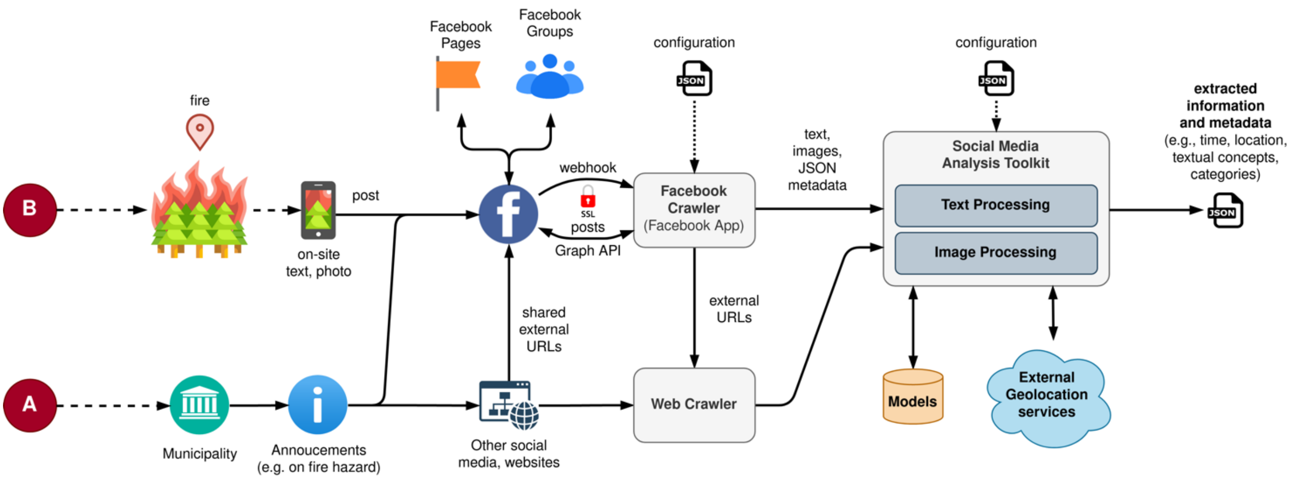

Figure 6. Facebook as a source of social media activity in the context of SILVANUS.

Prior to crawler operation, the crawler app must be either installed in the target Facebook groups by their administrators or the crawler must be explicitly allowed by pages or users to read their posts. The posts are decomposed into set of texts and images. The text analysis is based on the entity recognition matching the context of the message, location, date, author and URL referencing the original post. The images are sent to fire/smoke analyser based on the Keras deep learning library. The example of the Facebook post matching the fire context is shown in Figure 7.

Figure 7. Sample public post posted by a member of the city council for the Municipality of Nové Mesto, Bratislava.

SILVANUS Forward Command Center and Communication API

The SILVANUS Forward Command Center (FCC) will be deployed on an Edge Micro Data Center (EMDC) - specifically DELL's XR12. The FCC can provide reduced variants of cloud services (local machine learning algorithms such as such as fire detection, local decision support systems or edge data/object storage) and will host the components needed to enable the information flow shown in Figure 2. Specifically, the subsystems composing the SILVANUS platform will communicate among each other by means of different communication channels:

- a North-South API (N-S), allowing for communication between the Cloud platform and the Edge.
- an East-West API (E-W), allowing for communication between Edge within the same pilot site.

The communication in the N-S and E-W will follow a publish-subscribe pattern, which allow to decouple information producers from consumers. The architecture allows the output generated by a SILVANUS sub-module to become input of other sub-modules, which will act as subscribers: any other entities, such as other modules or FCC can subscribe to topics containing information generated by any producer. For instance, in the context of the scenario of this paper, the different FCCs can exchange the different warnings, notifications, instructions and user reports to allow a more efficient and coordinated emergency response.

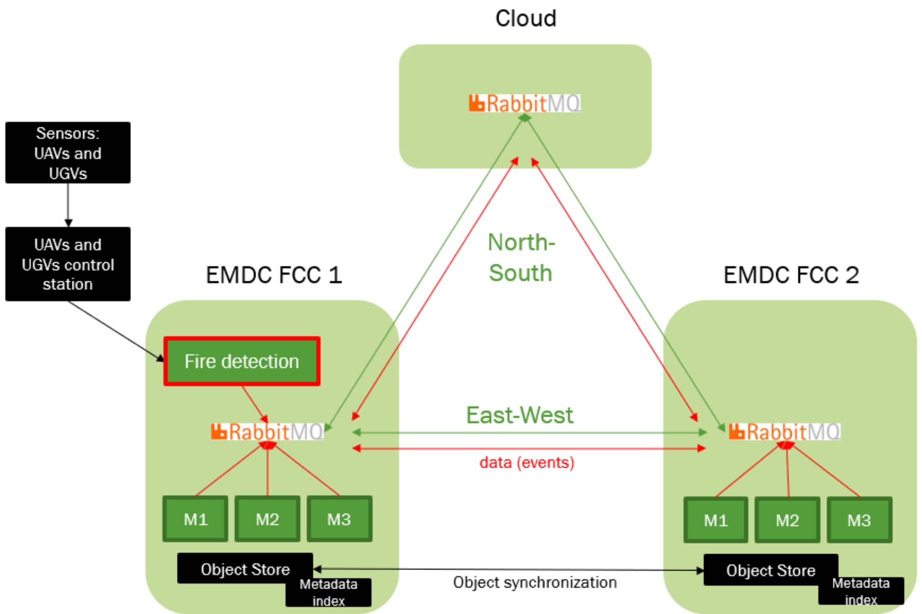

Figure 8. Communication API architecture.

Specifically, to implement the publish-subscribe pattern message brokers are employed, i.e., RabbitMQ so that the specific technologies used for the N-S and for the E-W is consistent within the overall Silvanus platform architecture.

In detail the E-W and N-S communication could be enabled by different means. One solution we explored is to connect the FCCs in a RabbitMQ cluster composition enabling a seamless E-W communication, whereas publisher and subscribers on each FCCs communicate as if they are connected to a single logical broker. The N-S communication between the FCCs cluster and the cloud, instead, is enabled by federating a remote exchange on the cloud RabbitMQ instance. In this case the federated exchange acts exactly like any AMQP exchange, with the main difference that is located on a remote broker. While this setup is quite easy to configure, however, has few constraints, specifically, regarding the clustering of the FCCs. Even if, most probably, the SILVANUS FCCs deployed in the same pilot site will run the same architecture and configuration, the cluster, forces the brokers on the FCCs to share the same data and state required for the operation of RabbitMQ (i.e., exchanges, virtual hosts, users, and permissions), which may reduce the customizability of the deployment in future. Moreover, a RabbitMQ cluster is designed for reliable LAN connections which may not be the case for some of the pilot sites of SILVANUS. Indeed, a connectivity issue on the E-W link may bring to a split-brain behavior (Bailis, 2014) which is quite undesirable for mission critical scenarios like the SILVANUS' one.

For these reasons we opt for both an E-W and N-S communication enabled by a federation of RabbitMQ exchanges. While it requires a more thoughtful configuration with respect to the topology of the different remote exchanges, this architecture (depicted in Figure 8) provides different benefits including:

- connectivity fault tolerance, which is highly desirable in our scenario, given the fact that, as said, SILVANUS FCCs may be deployed in remote sites with limited and with probable connectivity issues; specifically, the nodes will be interconnected to ensure that each FCC is able to reach the SILVANUS cloud, even if the internet connection is down, exploiting the network link with the other FCCs.
- scalability with an increasing connected node count, allowing to optimize the connections between the different brokers according to specific network topologies.
- network optimization, as messages may not be forwarded to a specific link if no subscribers interested in those messages are bound to the federated exchange.
- enabling the communication between different administrative domains (e.g., different SILVANUS pilot sites if needed)

Mesh in the Sky

For ensuring uninterrupted IP-based data connection a novel technology called "Mesh in the Sky" is being developed. The overall schema of the network connection and access as a basis for information sharing and exchange (when regular communication channels like cellular networks are not available/working) in a setting of a wildfire incident is depicted in the Figure 9. An FCC is responsible for deploying the "Mesh in the Sky" infrastructure using base stations and drones to establish internet connection only for the operational tasks of fire fighters. The *challenge addressed in respect to firefighters* is to ensure and maintain network connection using a swiftly deployable wireless communication infrastructure which will directly interface with the rest of the response units and provide technological tools to communicate with the citizens what are usually connected by cellular network at the incident site. The *targeted main challenge for citizens* is to enable easy, swift and seamless information sharing between first responders and citizens in the forest (tourist, runners or foresters) at the incident, place of the fire event or in the near vicinity of the scene.

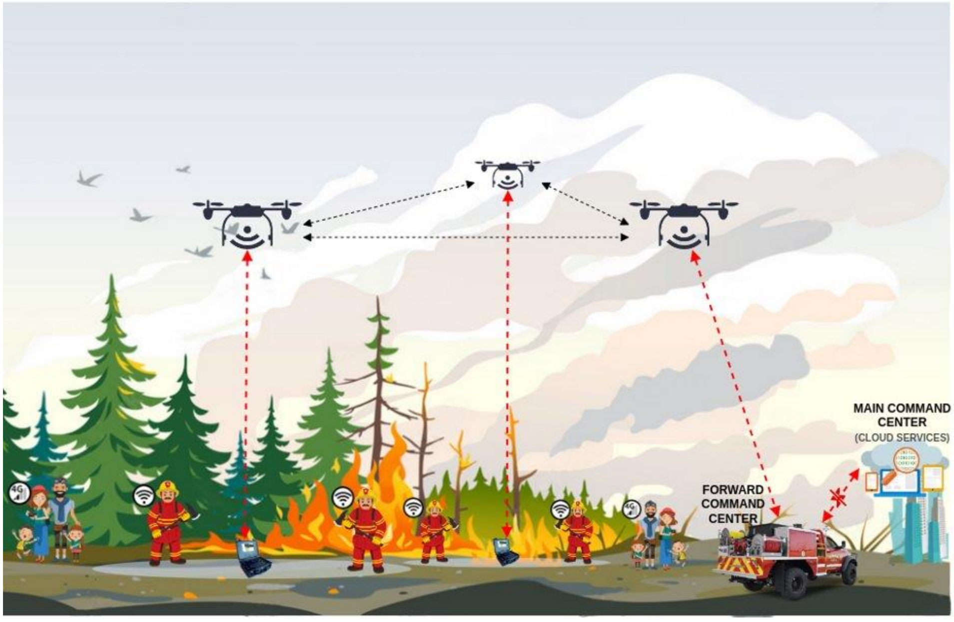

Figure 9. The High-Level Concept and main Actors.

In a telecommunication-less environment (where there is no mobile network coverage, due to smoke, etc.) UAVs will be deployed to establish a communication link – the "Mesh in the Sky". To address all the challenges associated with complex and diverse pilot scenarios, we propose to utilize Software Defined Radio (SDR) based ad-hoc broadband mesh communication from RINI, called RiniLink. The advantage of the Software Defined Radio is that it can be readily adapted to different communications environments. The RiniLink SDR offers, in a single device, a database of waveforms to meet different customers' needs in a wide range of wireless applications and uses. Thus, thanks to our proprietary software, the RiniLink SDR can be used in harsh environments and mobile applications.

The RiniLink SDRs can also be connected, on an ad-hoc basis, to form a network that lets each radio, automatically, connect to other RiniLinks; thus, creating a self-healing, mobile and dynamic IP mesh network. Each RiniLink automatically routes data around the wireless network and may easily be configured to operate without user intervention. This makes the system ideal for rapid deployment scenarios. A simplified version of the Wireless communication deployment is in Figure 10.

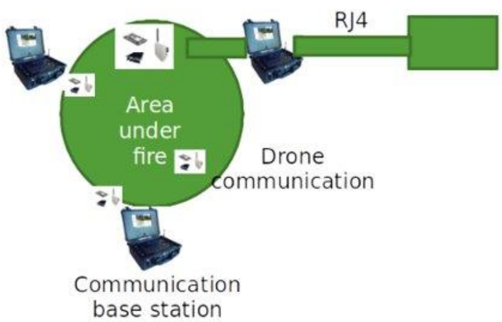

Figure 10. Simplified version of wireless communication deployment called Mesh in the Sky.

Mesh in the Sky communication will ensure the following interconnections:

- The IoT devices and the FCC.
- FCC and cloud command center.

The "Mesh in the Sky" will be IP based system, operating using NATO IST-118 recommendation 6. This recommendation is specifically developed for mesh communication in disadvantaged networks where ground infrastructure is poor or not available. It is a broadband mesh supporting up to 100 MB/s but with guaranteed connectivity of 20 MB/s at UAV ranges of 20 km from the Ground Station.

The Dashboard

One of the components of the SILVANUS platform is the Dashboard intended for fire respond and rescue teams. It is a web-based interface inside of which many backend services work to present data to facilitate the fire management process. The platform main view is a full screen map with different layers presenting fire incidents from many sources, including citizens. Those incidents are presented in a form of pinpoints, an example of this can be seen in Figure 11. The Dashboard uses the geographic database called Open Street Map and a Leaflet JavaScript library to make a map interactive.

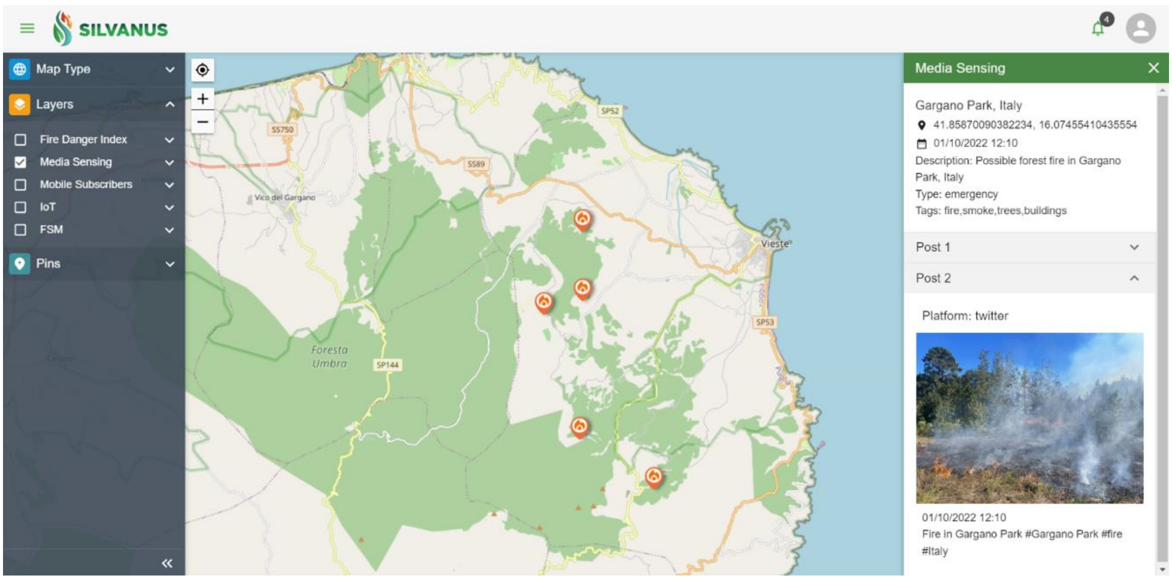

Figure 11. The Dashboard – Social Media Sensing layer.

The SILVANUS Dashboard has five layers, Social Media Sensing is one of them. The Dashboard receives aggregated data from the social media Crawler in a form of GeoJSON. Afterwards it visualizes the information in a form of a pinpoint and the notification. With that the user can view and analyze all the details including the exact location, type, the time it was added to the social media platform, tags and the content of the post. All pins can be filtered by date and time.

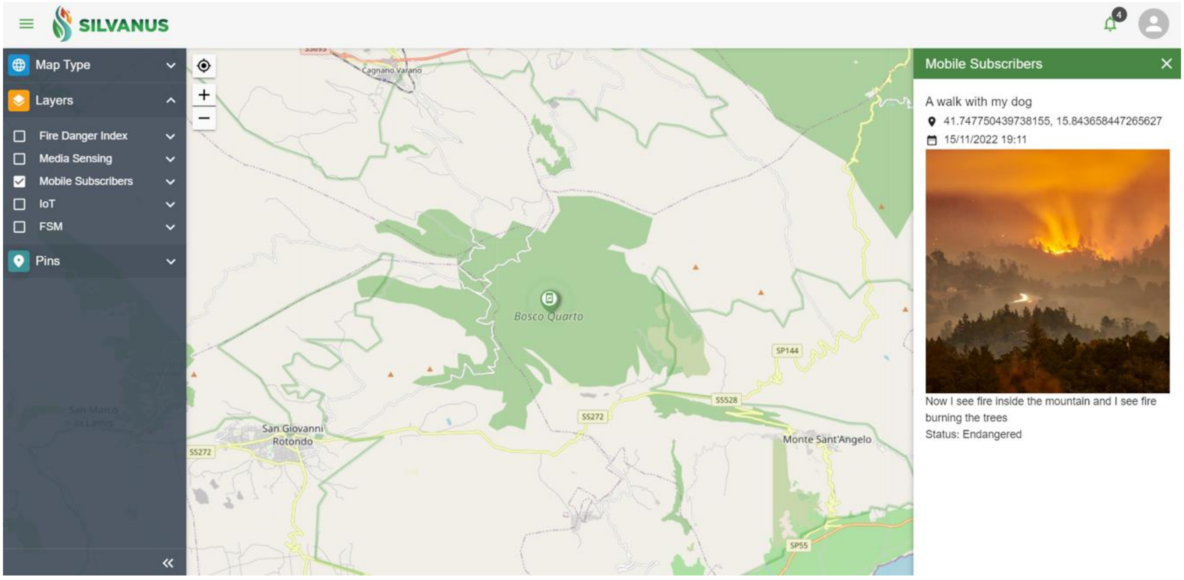

Figure 12. The Dashboard – Mobile Subscribers layer.

Another layer in which the citizen is engaged in notifying the fire service authorities is a Mobile Subscribers layer which is presented in Figure 12. After the citizen submits the report in the Mobile App with the description of the situation along with the photo, it will be forwarded as a GeoJSON file to the Dashboard. It will appear on the platform in a similar way as the Social Media Sensing layer. Furthermore, the user of the interface is able to turn on and off different layers at the same time. The other three layers to be depicted in the Figure 11 and 12 will represent the Fire Danger Index layer, IoT data from sensors (such as temperature, humidity) located in the forest and a layer generated by the Fire Spread Model services (FSM).

CONCLUSION AND FUTURE WORK

In this paper a proposal for a generic protocol for dealing and processing information received from and published to nontraditional information sources was proposed and presented together with individual technological components making such protocol implementation possible. The focus was given on the use of mobile devices through a specialized mobile app as well as using information from social media – namely Facebook as the most relevant and most frequently used platform in Slovakia. The communication protocol context is discussed in relation to management of forest fires.

Future work will include proceeding implementation and integration activities with other components of the SILVANUS platform. The multilingual version of CEMA connected with authentication and authorization services is planned for the next release. It is also planned to integrate the CEMA with SILVANUS platform services, such as the fire spread model and the evacuation routing service. SILVANUS Dashboard will be connected to other data sources like the Fire Danger Index, the IoT data sources and the Fire Spread Model (FSM) generating respective layers. Moreover, the SILVANUS services are planned to be containerized in order to be easily deployable in the Cloud and in the EMDCs.

The prototypes of herein presented technologies are planned to be demonstrated in scope of 12 pilot sites in 11 countries. The four main showcases to be demonstrated in 2023 are Croatia, Slovakia, Italy and Greece. While the technologies presented in this paper are generally applicable, many aspects need to be customized such as: geographic locations and positioning, language translations, legislative for citizen engagement, national regulations and procedures or legacy systems and their interfaces used by first responders. Each demonstration needs to be therefore adapted to the specific pilot’s requirements.

For instance, the demonstration of the presented technologies in the scope of the Slovak pilot will be aligned with the SILVANUS project phases, where majority of the technologies will be demonstrated in context of the Phase B. Fire localization by a forest camera system, demonstration of firefighters’ communication with citizens through the CEMA and social media monitoring, deployment of fire brigades and FCCs (with EMDCs) at the designated spot with simulated wildfire, coordination of the fire brigades with the MCC - are just some of the planned activities to be demonstrated during a full-day field exercise demonstration. Further activities will include the use of SILVANUS services to model the spread of fire, obtaining data from deployed IoT sensors, locating and monitoring the status of firefighters or using a swarm of drones to surveil the active fire. Since the Slovak pilot demonstration is planned for the end of Apr 2023 the preliminary results and lessons learned will be shared during the ISCRAM 2023 conference to be held at the end of May 2023.

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