Identifying and Supporting Information Needs in Mass Casualty Incidents – an Interdisciplinary Approach

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ABSTRACT

In mass casualty incidents (MCIs) different authorities and organizations with safety responsibilities (BOS) act in highly dynamic situations. BOS operating in MCI-scenarios have a large demand of different information. SpeedUp, a German government-funded research project, wants to support this information demand. From an IT-perspective, our basic concept is to model available resources (e.g., sources of information and communicative devices) as services and flexibly combine them to the information demand of the BOS. To achieve this, we have to know which kind of information is needed by whom and explore the structures, tasks and roles of the BOS involved. In this paper we employed an interdisciplinary and user - centered approach. It is the result of a close cooperation of two research groups: one from the Intercultural Business Communication (IWK) and one from the chair of computer sciences. While the IWK focused on identifying information needs via expert interviews and observations, the computer scientists were looking at the possibilities for technical support of these needs. Only both disciplines together can achieve viable solutions.

Keywords

Semantic services, mass casualty incidents, information gathering and propagation.

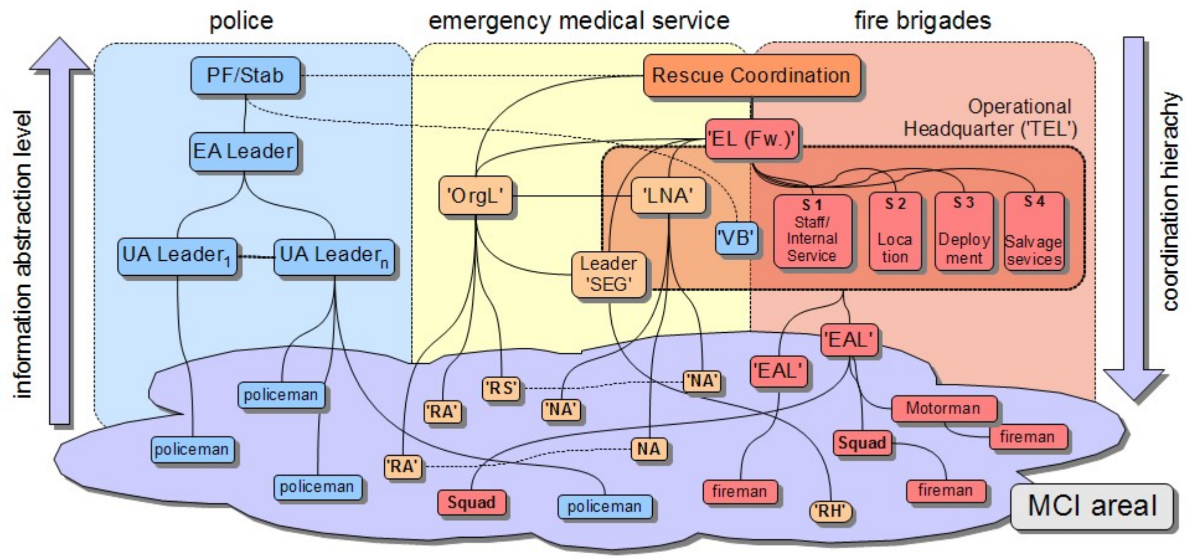
INTRODUCTION

In *mass casualty incidents* (MCI) police, medical services, and fire brigades (together often referred to as authorities and organizations with safety responsibilities; in German *Behörden und Organisationen mit Sicherheitsaufgaben* or short: BOS) need to cooperate in order to handle the situation. The main challenge is to efficiently assign the scarce resources available, e.g., to make sure that the most severely injured victims are treated first. The basis for a successful management of such situations is the availability of sufficient information. In contrast to smaller scenarios, rescue personal has little experience and no routine in managing MCIs. Consider as a first example a collision of two cars. Here, roles and tasks of all involved forces of the BOS are clear based on their abilities and the different organizational structures: fire fighters will gather information about the location, police officers will collect legally confidential data of injured persons and emergency medical personnel will do the pre-hospital care of patients and in addition transport to a hospital. This small example shows already the wide variety of roles, performed by all participants, and the need to share

Reviewing Statement: This full paper has been fully double-blind peer reviewed for clarity, relevance, significance, validity and originality.

information within a single organization as well as among different BOS. Both the number and the variety of roles and the necessary information flow become considerably more complex when bigger disasters occur. At the same time the ratio between needed and available resources deteriorates. While for some such disasters (e.g., a fire in a football stadium), rather detailed emergency plans can be developed beforehand, that help overcome the ensuing chaos, there are also numerous disasters, where this is not the case. Consider, e.g., traffic accidents. These disasters can occur anywhere and can vary widely in severity. Depending on the exact location, access to the accident site will differ, as will the number, experience, and equipment of available emergency personnel. Often, only limited information about the incident will be available in the beginning. More information about the situation will become known over time only.

Consider, e.g., a traffic accident on a motorway with a number of injured people. In handling this situation, at least fire fighters, first aid personnel, and police will be involved and special intra-organizational management structures will be established. For example, in large scenarios the police use a Special Organizational Structure ("Besondere Aufbauorganisation" — *BAO*), while the fire brigades and emergency medical services establish a Technical Operation Management ("Technische Einsatzleitung" — *TEL*), respectively an organizational medical leader (*OrgL*) and a leading emergency doctor (*LNA*). To successfully handle the situation, these different organizational entities need to cooperate (see Figure 1). Thus, communication and the exchange of information within the individual organizations but also across organizational boundaries are needed despite the complex organizational structures and despite the lack of routine and experience.



EA Leader – leader of an operational area; ***UA Leader*** – subsection leader; ***EL*** – local operation manager; ***S 1- S4*** – functional areas; ***OrgL*** - Organizational Medical Leader; ***LNA*** - Leading Emergency Doctor; ***RH*** – Emergency Medical Technician; ***RA*** – Paramedic; ***RS*** - Emergency Medical Technician; ***NA*** – Emergency Doctor; ***EAL*** – leader of an operational area; ***VB*** – liaison officer; ***PF (Polizeifuehrer)/Stab*** – commander of police/ Crisis Management Group (CMG).

Figure 1. The graphic shows BOS in the MCI scenario and sketch out parts of their management structure and units.

We are looking at these problems in the context of the SpeedUp project[1] which is focused on MCIs in Germany, and thus on the specific regulations in Germany. These differ slightly between the sixteen German federal states. It is therefore important to develop a solution that can handle these differences. Also, the BOS have different organizational structures, tasks, and cultural characteristics. Each local region applies its own special structures of organization. An important goal of SpeedUp therefore is to develop a generic framework for an information management system practicable for all forces involved in handling the scenario. Within this framework, offered functionality will be wrapped as services. These services will be semantically described to allow for their on-the-fly automatic assignment at run time.

The present paper presents a user-focused analysis of interaction and contents of communication for the emergency forces. The resulting classification is used as a basis for the identification of useful services to be offered by the framework.

[1] http://www.speedup-projekt.de/

In the following section, the results of the analysis done by the Intercultural Business Communication (IWK) concerning the roles, tasks and content of communication and information of the forces involved in an MCI scenario are summarized. Afterwards the role of services in an information management system for an MCI scenario will be discussed, followed by the classification of the information needs and its modeling as semantic services. Based on this, a technical overview of the semantic service description is given. Thereafter, we provide an overview of the related work and conclude.

CONTENTS OF INFORMATION AND INFORMATION FLOW OF AUTHORITIES AND ORGANIZATIONS WITH SAFETY RESPONSIBILITIES IN MCI SCENARIOS

If, in SpeedUp, we wish to develop a generic framework for an information management system practicable for all crucial forces involved in handling a scenario, we need to analyze what is happening in a MCI scenario. Who is involved, who communicates with whom and through what? Consider the example in the introduction (traffic accident on a motorway): BOS (police, fire brigades, medical services) will meet on-site and they will have to coordinate their tasks. If we want to understand what is actually going on in our example we need to examine more closely the following topics: what roles and tasks exist (intra-organizational) for the forces involved in an MCI? What information regarding the overall situation do the forces need in different command structures? Where does this information come from?

To access these questions we conducted interviews with forces of three BOS (police, fire brigades, and emergency medical services). To collect data we used the structured, semi-standardized expert interview. We chose this method over a narrative interviews to ensure all topics of interest were covered (Gläser and Laudel, 2006). The interviews were based on a manual. The manual was geared to the research questions of the project (BOS acting in an MCI and their intra-organizational communication). After that we transcribed the interviews using the software program "F4"[2]. It eases the transcription of spoken words trough a downshift of the frame rate. Then, we analyzed the transcribed interviews with a qualitative approach. The focus of the analysis was on verbal aspects, not on non-verbal aspects of the interview. The analysis of the interviews was referred to the central question onto the communication characteristics and contents of communication. The analysis was based on the qualitative content analysis according to Mayring (2008). This method is especially suitable to extract social issues out of the data (Gläser and Laudel, 2006). The states of the interviewees were phrased with own words in a first step. Based on the question regarding the characteristics of communication of BOS and the content of this communication, a grid pattern was created and applied to the interview-material. Afterwards recurring categories were identified and summarized. The frequencies of the categories pointed out the relevance of the issues. In a final step the categories were abstracted to formulate assumptions about the intra-organizational communication of BOS and the contents of this communication. In doing so, we identified so called "sources" and "sinks" of information.

Also, we observed the characteristics of communication of fire brigades and emergency medical services in MCI exercises. In those exercises, we were non-participant observers. We could video-tape the exercises and interpret the data together with our observation entries. Thus, we could enrich our interview data. In the following we summarize the findings of our analysis (interviews and observation) for police, fire brigade, and emergency medical services. You can also find most of the roles we describe here in Figure 1. Our findings apply to the BOS-structures in Germany. Hence, they cannot directly be assigned to authorities and organizations with safety responsibilities in other countries. While we assume that the categories of information needs will apply widely, the concrete information flows will probably differ among countries. To the best of our knowledge no research for other countries exists that explored the concrete information needs of BOS, and that we could compare our results to.

Police

In our example, an MCI on a motorway (see introduction), the police represent one of the BOS who will have to handle the situation. The main contents of information communicated within the police-forces in an MCI are: cause of loss, involved subjects and the impact of the damage. The police will have to give most of the information through technical devices like radio communication and telephone into a background crisis management group (CMG[3]) to develop a detailed operational picture of the situation right away. The inferior

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[2] http://www.audiotranskription.de/f4.htm

[3] Labeled PF/Stab in Figure 1 according to the German terminology.

command structures of the CMG (leaders of different operational areas and leaders of the subsections) will simultaneously receive and disseminate information among the CMG (see Figure 1). A lot of information is already collected and saved on-site. As a primary source of information we identified the leaders of the operational areas and leaders of the subsections, who disseminate information into the CMG with its commander of police according to their tasks in the special organizational structure. Based on the specific, task-related operational areas there are contact persons in the CMG which receive certain information. For example, personal data is transmitted via the operational area "identification of persons" and traffic through the operational area "barriers" into the CMG. Hence, the CMG has the most relevant position inside the special organizational structure of the police. At the same time, the CMG is a source of information for the police forces (for example regarding logistics). Also, the CMG is an important source for external inquiries (for example from a ministry, family members or the press). So, the CMG also generates information that is not collected on-site (for example about missing persons or advice regarding the cause of the incident given by residents) – this information is given to the accordant operational areas and effects the contents of information the forces communicate on-site. To summarize, we identified a homogeneous, task-related picture of the contents of information and the information flow.

Fire Brigades

Further, forces of the fire brigades will have certain tasks and roles in an MCI and there will be certain contents of information they communicate on-site. We identified the central position of the local operation manager in the information network of the fire brigades. The local operation manager, or respectively the technical operation management (see Figure 1), can be seen as the largest information sink and a central intersection for the informational flow. While the forces of the inferior command structures (like leaders of the operational areas, platoon leaders, group leaders) merely have to pass the information, the local operation manager has to evaluate the information he receives. He processes a multiplicity of information (for example regarding the number of fire brigade forces) and also has to make decisions. At the same time he needs to react to a large amount of information and to monitor it (for example he gives feedback to instructions, requests for additional demands, status information of the forces). Firefighters, group leaders and leaders of the operational areas can be seen as a primary source of information for the local operation manager. A big part of the content of all communicated information is located in an area of conflict between the management of the forces, the categorization of an operational picture and the number of persons affected. For fire brigades, there may be more than one source of information in relation to a certain category. For example, information regarding the location (formation of smoke, sight, moving and not moving barriers) can have multiple sources. Therefore, the contents of information communicated may overlap, be inconsistent or subjective. Otherwise, there are specific contents of information that can be allocated to a constant informational source (for example the position of a specific firefighter or measuring results). To summarize, we identified a heterogeneous, mission-specific picture of the contents of information and the information flow, which is especially designed for the desires of the local operation manager.

Emergency medical services

In a final step, in our example which contained a large amount of injured persons, we had to consider the contents of information and the information flow, tasks and rolls of the emergency medical services. The tasks of emergency medical services consist of the pre-hospital care of patients and the transport of the patients to a hospital. For an MCI scenario we identified the central position of the leading medical doctor and the organizational medical leader in the information network of the emergency medical services. Organizational medical leader and leading medical doctor lead the subordinate forces and are responsible for the best possible care of the patients. The subordinate forces (see below) forward information to the organizational medical leader and the leading medical doctor. The leading medical doctor evaluates the operational picture; delegate´s medical tasks, arranges the priority of the treatment and the evacuation of the patients on-site and is also an advisor for medical questions. The organizational medical leader is responsible for the organization of the operating resources (like vehicles), the forces on-site and the assembly areas. Also, he is documenting the operating sequences. Hence, the organizational medical leader and the leading medical doctor form the biggest sink of information. Emergency doctors, paramedics, and emergency medical technicians, the subordinate roles, act as the source of information for the organizational medical leader and the leading medical doctor. The subordinate forces are the source of a variety of different information (for example the progress of the care of the patients on-site, the condition of the patients, needed logistics). Additionally, the organizational medical leader and the leading medical doctor use the rescue coordination center as a source of information (for example for information on the on-site area or the additional demand of forces).

To summarize, we identified a heterogeneous, mission-specific picture of the contents of information and the information flow, which is especially designed for the desires of the organizational medical leader and leading medical doctor.

In this section we discussed such research questions as: who communicates with whom in a MCI scenario? What are the contents of the information that is communicated by the BOS? The preceding (intra-organizational) picture for police, fire brigades and emergency medical services emerged. A large scale of communicated information on-site (and also by the relevant CMG or technical operation management), tasks, and roles were discovered. Based on this work, which is described in detail in twelve IWK – project memos, we classified information needs and identified means to meet them with the technical infrastructure by modeling them as services.

ROLE OF SERVICES IN MCI SCENARIOS

To obtain a correct and complete picture of the situation in an MCI information needs to be gathered and propagated according to its relevance for different tasks and roles. Additionally resources able to support the fulfillment of certain tasks need to be allocated. This is difficult due to the dynamic situation: it is not known in advance who will be there and which resources will be available. In SpeedUp, we aim at providing BOS personnel with IT-support for these tasks. We propose to use a service oriented architecture (SOA) to realize this support platform. SOA is modern architecture paradigm for distributed systems popular because of the relative ease with which it allows to seamlessly integrate heterogeneous resources and to cope with dynamically changing IT environments (Papazoglou, 2008). Offered functionality is encapsulated as services. Services are described and published (and thus made discoverable) and can be accesses with standard protocols via a standardized interface. In our system different resources offered, e.g., communication media or vehicles, will be modeled as service offers. Their internal logic is hidden behind an interface. Information and resource needs on the other hand, will be modeled as service requests. In order to allow for runtime assignment of service offers to service requests, we propose to use an extension of classical SOAs, namely the usage of semantic service descriptions. These are machine-processable descriptions of the functionality offered respectively desired. These descriptions enable an automatic assignment of suitable service offers to service requests. This task is performed by software components called matchmakers. The big advantage is that in any given situation appropriate services can be found without the need for human involvement. This enhances tremendously the flexibility and robustness of the framework: In case a service is no longer available, performs badly or is not adequate in a certain situation, another service offer can be chosen without affecting the overall behavior.

In order to match a service request with a service offer, it is necessary to have a (central or distributed) service repository in which currently available services are published by the service providers. Service requests have the possibility to search in the repository for services providing a certain functionality. In order to do this automatically at run time, a common service description language is necessary that is used to describe the offered as well as the requested services and can be automatically and efficiently compared. An explanation of the selected description language and its matchmaker will be provided in Section “Semantic Service Description”.

However, first of all, we need to identify and formalize the functionality of the resources in MCI scenarios in order to define appropriate services.

IDENTIFICATION AND FORMALISATION OF SERVICES

An important issue for the feasibility and ultimately the success of our proposed solution is the modeling and formalization of required and offered functionality as services. Only, if it is possibly to adequately model the domain of emergency management in terms of services, will our solution be useful. Once we succeed in encapsulating functionality as a service, and succeed in describing it in a machine - processable way, we can build on the work done by the semantic services community over the last few years. The main motivation for that work was the vision to support automatic, dynamic allocation of resources at runtime. Thus, modeling functionality as services will be the basis for flexible support of the changing situation at hand.

Even without a thorough analysis of the domain, it is quite obvious, that from the point of view of the people involved — regardless of their position in the organization — there are two big blocks of functionality required: On the one hand, there is a strong need to obtain information on all levels of the organization. The exact nature of this information depends on the role of the respective person, but everyone involved needs some type of information. On the other hand, there is a need for services which can be used to achieve specific effects at the place of incident. Among these, services which are responsible for resource allocation play a key role. Again, the exact type of resource differs for different roles and therefore requires special consideration. Basically all tasks involved in emergency management can be regarded as instances of one of these two types. In the remainder of this section, we will take a closer look at these tasks and will discuss how they can be modeled in terms of services.

Information Gathering

We analyzed numerous expert interviews and observations with respect to the information flow within and among the BOS (see Section 2). Based on this analysis, information needs can be classified along three dimensions. In the remainder of this section we will use examples based on firefighters' work. However, the classification is the same for the other BOS.

i) Requester of the information: different types of information will be requested by firefighters in different roles, e.g., the command center, the local operation manager, a group leader, or a firefighter will have different information needs. Additionally, there are external requesters of information, either people from other rescue organizations, politicians, or the press.

ii) Type of information: With respect to this dimension, project memos from IWK distinguish the following classes:

- affected persons (e. g., number, severity of injuries, and location),
- rescue personnel (e. g., number, status, communication channels, and assignment to vehicles and other equipment),
- rescue resources (e. g., number and type of vehicles and other equipment),
- assessment of the situation (e. g., type of event, location, infrastructure, and weather),
- hazardous substances (e. g., properties, amount, characteristics, category, and diffusion); this can be regarded as a subclass of the situation assessment; it is listed separately due to its great importance,

iii) Source of information: In an emergency setting, possible information sources are

- people (e. g., emergency personnel of the own and other organizations, and lay people),
- databases or other information systems owned either by the own organization or another one, and
- data obtained from sensors under the control of the own organization (e. g., oxygen sensors carried by firefighters) or others (e. g., temperature sensors that happen to be installed in a building).

Quite obviously, information needs are very heterogeneous with respect to all three dimensions. In order to find a unifying way to handle all information needs, as mentioned above, we propose to adopt a service-oriented architecture: We will model the different types of information providers and the type of information they can provide as service offers and accordingly information needs as service requests. For a number of reasons, this is not quite as easy as it sounds: Firstly, it requires considerable effort to obtain an at least somewhat complete picture of the domain, possible information needs and providers. Luckily, we can build here on the work done by IWK. Secondly, it is not trivial to decide on an appropriate level of granularity for each service that on the one hand will minimize modeling effort, and that on the other hand will allow for at least semi-automatic service matching. While there is considerable know-how in the semantic services community on how to model information services provided by databases or other technical information systems, matters become more complicated when trying to model sensors (is a single sensor a service? an entire sensor network?) or people. For the latter, it is hard to efficiently capture the kind of information they can provide. In our ongoing work, we are addressing these issues.

A second problem arises from the fact that often, the level of granularity will differ between information offers and information requests. For instance, a local operation manager might request to "*obtain information about the number of victims*". In order to actually obtain this information, requests may need to be send to different group leaders. This in turn encompasses the establishment of some communication channel. Appropriate service offers might be described as *send message m via sms to person p* or *establish radio connection to person p*. Thus, a major challenge in SpeedUp for service modeling is to find ways to automatically map offers and requests on these different layers of abstraction.

Resource Allocation

Similarly to information needs, the needs for resource allocation can be classified along a number of dimensions. Again, different requesters will have different needs. The main distinction will, however, be the type of resource that is requested. Possible types are people with different capabilities, own equipment with different capabilities, equipment owned by others with different capabilities.

From the point of view of a requester, often, there will be no need to assign a specific piece of equipment or person. Rather, it will be sufficient to obtain any equipment or person that meets certain criteria. For instance, an emergency doctor may order that a severely injured person is transported to a hospital. He may not be interested in choosing the concrete emergency vehicle that will transport the victim. He may also not be interested in choosing the concrete hospital. On the other hand, however, there may be situations where he wants to choose a specific vehicle or a specific hospital. Thus, a flexible solution is needed here that allows for formulating requests with different levels of detail.

Again, in our opinion, a service-oriented architecture is an appropriate metaphor to achieve the required flexibility. All of the resources — both humans and equipment — can be described as services offering a specific functionality with specific characteristics.

Similar to the information services described in the previous section, it is not trivial to decide on the level of granularity for services: Should, e. g., a single ambulance be described as a service, or should we rather offer a generic ambulance service that administers several vehicles. In case, where each vehicle, hospital, etc. is presented as individual services, we directly deal with concrete resources and can perform the appropriate requests to them. The main disadvantage of such approach is the lack of flexibility: If you need to add a new function you will need to correct each single service. Moreover, the service descriptions will need to contain dynamic attributes (representing for instance availability or current location of an ambulance) which are not easy realizable due to state-of-the-art for description languages. If each type of resource (transport, hospitals, etc.) will be described as a single service, all the interaction will occur at the highest level of abstraction and a direct access to the low level (by the concrete resources) will be hidden in the implementation. Thus, to the outside world of the service it is not needed to know exactly what kinds of resources are currently available (for example, *ambulanceA01* or *ambulanceA02*) but it is important to know that this resource is available (for example, *ambulanceXXX*) and thereby count it in for resource allocation.

Hence, both possibilities have advantages and disadvantages: Modeling, e. g., single ambulances requires a high modeling effort, poses problems with respect to the dynamic parts of service descriptions (how do you keep information about an ambulance’s current location up to date?), but, on the other hand, it allows for fine-grained matching. Also, similar to the information services described above, requests and offers will often be on different levels of granularity.

SEMANTIC SERVICE DESCRIPTION

In order to fully exploit the potential of service oriented architectures for dynamic allocation of services to fulfill given tasks, service offers and requests need to be described in a machine-processable, i. e., semantic way. A matcher for service descriptions generally has two tasks: First and foremost it has to determine if - and how well - an offer description fits a given request description e.g. using matching algorithms. But if service offers are configurable (and usually they are) it also has to find an optimal configuration (Kuester et al., 2007). An automatic and powerful matchmaker enables the dynamic runtime allocation of resources needed for the execution of tasks, thereby allowing for adjustment to currently available and most suitable resources. The result of the matchmaker should be reliable and sufficient enough to automatically invoke the found service. Therefore, e.g. all necessary parameters to invoke the service need to be determined by the matchmaker as well.

For information and resource descriptions, we use the DIANE Service Description language (DSD) and its matchmaker (Kuester et al., 2007) to provide such descriptions and to automatically match service requests and offers in order to find the most appropriate offer for a given request. The language is not based on one of the existing ontology or logic languages such as the often used description logic or f-logic, but uses an ontology language and a reasoning mechanism that is specialized for service discovery: the DIANE Elements (DE). Service offers are described as sets of required preconditions and achieved effects. By the introduction of variables, DSD allows to seamlessly integrate the descriptions of which functionality is provided and what the message flow should look like (i.e., which inputs a service expects and which outputs it is able to produce). DSD descriptions of both offers and requests are basically directed graphs. The matchmaker traverses the request graph and tries to find and configure matching offers by implementing a subset test. This powerful and efficient matchmaker is at the heart of the accompanying semantic service middleware that supports the whole process of service matching, selection, and automatic invocation.

In the following, an example of DSD for SpeedUp is given. It is depicted in the graphical representation for this language (called *g-dsd*).

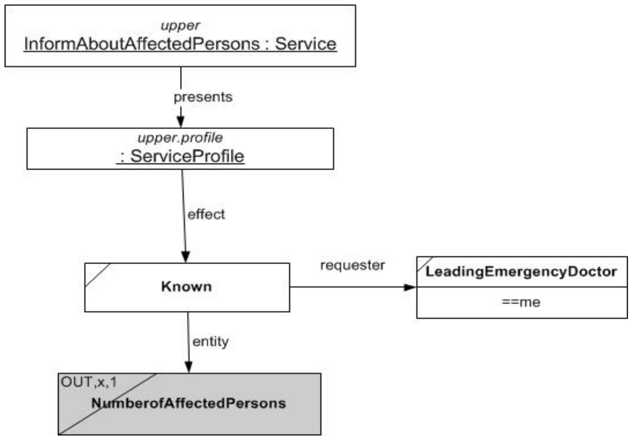

Figure 2. High-Level Service Request "*InformAboutAffectedPersons*"

Figure 2 shows a generic service request that asks for a service that has the effect that the requester, a leading emergency doctor, knows about the number of affected persons. The requester does not care how this information will be obtained: options might include a database query, an e-mail or sms to the organizational medical leader or a request to CMG. At the same time, Figure 3 illustrates a service offer that allows transmitting a text message. The description tells that the effect of the service execution will be that text message (*TextMessage* is an input parameter of the service) will be send only if it *.doc* or *.pdf* formats and only if their filename is known.

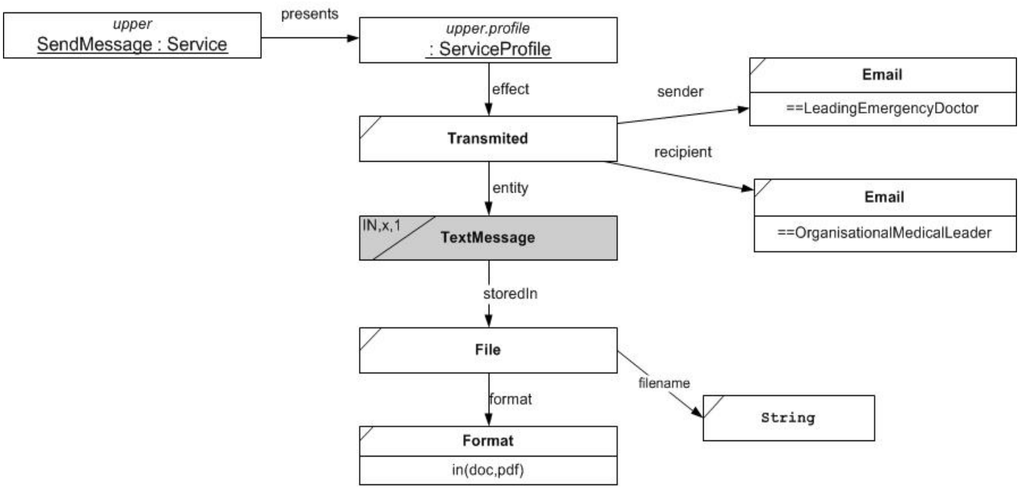

Figure 3. Low-Level Service Offer "*SendMessage*"

Obviously, the request in Figure 2 does not directly fit to the service offer in Figure 3 (and even the best logical reasoner could not derive a match unless provided with extensive additional information). On the other hand, at least for a human, it is quite obvious, that the service in Figure 3 could be used to obtain information about the number of victims. While a requester will typically ask something like «*inform about number of affected persons*» in general, a service provider will offer very specifically to «*transmit a message from leading emergency doctor to organizational medical leader*». The problem is that the descriptions are on different semantic levels and on different levels of abstraction. In order to bridge these differences in an abstraction layer, we introduce the concept of virtual services.

A virtual service is a service that is not directly implemented but relies on other, more specific services to achieve the functionality it promises. On the one hand, it is presented as a service with a service offer. This virtual service communicates with the planner for correctly scheduling currently available suitable services and it is presented as an operator specified by pre- and postconditions (Krueger et al. 2010). Internally, instead of an implementation, it contains possibly context-dependent service requests which can be mapped to appropriate concrete service providers at runtime. The evaluation of the context can be either hardcoded, e.g., by storing a list of associated service requests and the respective context in which they are suitable, or can be realized via an adapted matchmaking process. This approach is more powerful than the commonly used late binding approach: Like the latter, it allows hiding some of the dynamics and uncertainty of the rescue situation. But, in contrast to late binding, it also allows to bridge different levels of granularity.

RELATED WORK

The basis for a successful management of an MCI is the availability of adequate information. At the best of our knowledge, there is a lack of studies which quest the information needs of BOS in major incidents like MCI´s. Hofinger et al. (2010) investigated requirements for shared situation assessment in major incidents. They found that an unhindered and constant flow of information is the basis of a shared operating picture of all organizations involved in coping with the incident. The possibility to verify sources of information was found to be important as well.

While basically every paper written on IT-support for MCIs claims that such support is needed, few substantiate this claim. Mostly, anecdotal evidence is provided. Often, the argumentation focuses on the "obvious" advantages of ICT-solutions, without taking the user perspective into account. Additionally, there are studies that investigate the acceptance of ICT technology for MCIs by emergency personnel (e.g., Sharoda et al., 2008). While this is certainly a better basis for further work than just anecdotal evidence, we believe that conducting such studies without a prior thorough analysis of the current information flows and communication patterns falls short. To the best of our knowledge, no systematic study like the one summarized in this paper that analyses in detail how organisations communicate and which information flows exist (and may need to be supported by ICT-based solutions) has been conducted so far. We fear that this lack of thorough, user-centric requirements analysis results in poor acceptance of developed solutions, thus making it difficult for research prototypes like SHARE (Konstantopoulos et al., 2009), CoSAR-TS (Tate et al., 2004), MobiKat (Danowski, 2007), the *Emergency Management System* (Rausch et al., 2009), or SIADEX (Asuncion et al., 2004) to find their way into real-life usage.

With respect to using semantic services for dynamic resource allocation, there exists a plethora of description languages and matchers, e.g. OWL-S[4] or WSMO4[5]. Contrary to DSD both approaches do not differentiate between a description of an offered and a requested service and rely on ontologies and heavy-weight logics (like description logics or frame logics). Thus, when searching for a service in dynamic and unreliable environments, it would be difficult to describe what should happen in cases where, e. g., information is missing or not fully matching. Like DSD none of them can handle the different levels of granularity of requests and offers without extensions. Existing approaches (e.g., Klusch and Gerber, 2006) to using semantic services in the emergency domain circumvent this problem by manually breaking down requests to the appropriate level of abstraction.

CONCLUSION

Major incidents like MCIs ask for an effective intra and also for inter-organizational communication and cooperation of BOS. Such cooperation is, at the moment, achieved by orally (face-to-face) or technically (radio channel, telephone) exchanged information. In the present paper we provide a user-focused intra-organizational analysis of interaction and contents of communication of BOS acting in MCI´s in Germany. A large scale of communicated information on-site, as well as tasks and roles were quested. Information needs of BOS can be classified along three dimensions: requester of the information, type of information and source of information. This classification is used as a basis for the identification of useful services to be offered by the framework. We have also shown that this is not easy to gather, identify, and formalize information and to allocate available resources from the technical point of view. Finally, a semantic service technology was suggested as possibility for technical support of these information needs and resource allocations.

This framework is being developed in close cooperation with our partners from different rescue organizations and will be tested in real-life situations. This close cooperation among users and scientists from different disciplines is an absolute necessity for the development of useful systems, that one day may help to save life.

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[4] OWL-S Working Group (http://www.daml.org/services/owl-s/)

[5] Web Service Modeling Ontology (http://www.wsmo.org/)

ACKNOWLEDGMENTS

The SpeedUp project is funded within the Federal Government's program Research for Civil Security (call "rescue and protection of people") by the German Federal Ministry of Education and Research. (http://www.speedup.uni-jena.de).

We would like to thank the numerous interview partners and organizations that allowed us to take part in different MCI exercises.

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