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Abstract: This document describes Stockholm Public Safety Scenario.

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Table of Contents

List of Figures

List of Tables

Glossary

Acronym	Meaning
TS	Trafik Stockholm (Traffic Stockholm)
SSRC	The Greater Stockholm Command and Control Centre
RCSL	The Stockholm County Command and Control Centre
SL	Stor Stockholms Lokaltrafik (Greater Stockholm public transport)
LKC	Command and control centre of the Stockholm County Police Authority
VMA	Viktigt Meddelande till Allmänheten (Important Public Announcement)
MSB	Swedish Civil Contingencies Agency
SMHI	Swedish Meteorological and Hydrological Institute

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1. Introduction

This document describes the City of Stockholm's Safe City Scenario. The document is based on end-user requirements identified mainly at two workshops and group interviews with respondents and informants from two different fire and rescue services in Stockholm County. Secondary, data has been collected through official documents and open sources that include reports and articles, and from various government official statistics.

1.1 Purpose of the document

The document aims to describe the present situation in the City of Stockholm with respect to public safety systems in order to be able to identify needs and functions that are not covered by the current systems. The document also aims to describe on going initiatives and future ideas for the improvement of the current situation.

1.2 Scope and structure

The Safe City framework is designed to support public safety organizations to collect, share and analyse information. With better information management the organizations will be able to operate more efficiently and make better real-time decisions during the planning and management of events and crises.

Safe City is based on four main areas according to their functionality: Citizens Behaviour, Road Track Incident Management, Alerting Citizens and Ad-hoc networks.

2. Stockholm general overview

The *City of Stockholm* is Sweden's capital. It is located on the east coast of Sweden in the region recognized as the *Stockholm County*. The City of Stockholm hosts the Swedish government, the Swedish parliament and the official residence of the Swedish monarch as well as the Swedish Prime Minister.

The City of Stockholm was founded circa 1250 and has long been one of Sweden's cultural, media, political, and economic centres. Its strategic location on fourteen islands at the mouth of the lake Mälaren, by the Stockholm archipelago, has been historically important.

The Stockholm County is home to just over two million citizens, which is over one fifth of the Swedish population. It has a total area of 6488 km^2. The county consists of 26 municipalities, of which the City of Stockholm has the largest population with 847000 inhabitants, distributed over an area of 188 km^2 . The City of Stockholm is the most populated city in Sweden. It should be noted that in common language the term *Stockholm* refers not only to the City of Stockholm but also to the neighbouring municipalities (Lidingö, Vaxholm, Värmdö, Nacka, Solna, Danderyd, Järfälla, Sollentuna, Täby, Huddinge and Botkyrka). The actual City of Stockholm is subsequently referred to as the *downtown*.

Of the Stockholm population in 2004, 370,482 were men and 394,562 women. The average age is 39.8 years; 40.5% of the population is between 20 and 44 years. 309,480 people, or 40.4% of the population, over the age 15 were unmarried. 211,115 people, or 27.5% of the population, were married. 85,373, or 11.1% of the population, had been married but divorced. Approximately 37.5% of Stockholm's resident's are of an immigrant or non-Swedish background. The Stockholm suburbs are places with diverse cultural background. Some languages spoken in Greater Stockholm beside Swedish, Finnish and English due to large numbers of immigrants are Bosnian, Syriac, Arabic, Turkish, Kurdish, Persian, Spanish, Serbian and Croatian.

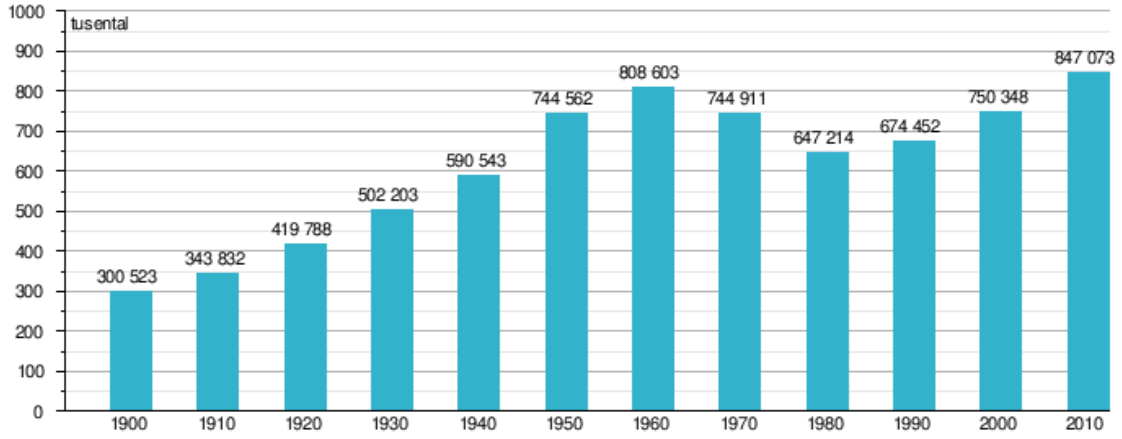

Figure 1. The population in thusends refers to the City of Stockholm from 1900 to 2010 with intervals of 10 years [18].

2.1 City and county areas

The City of Stockholm consists of fourteen districts (Figure 2). The main roads E4, E18 and E20 through Stockholm are further described in Section 2.6.1.4. The districts are no legal entities but administrative bodies of the municipal administration. The districts are run by district councils, which are responsible for primary schools, social services, and leisure and cultural activities. The district councils are not directly elected but appointed by the elected assembly of the City of Stockholm.

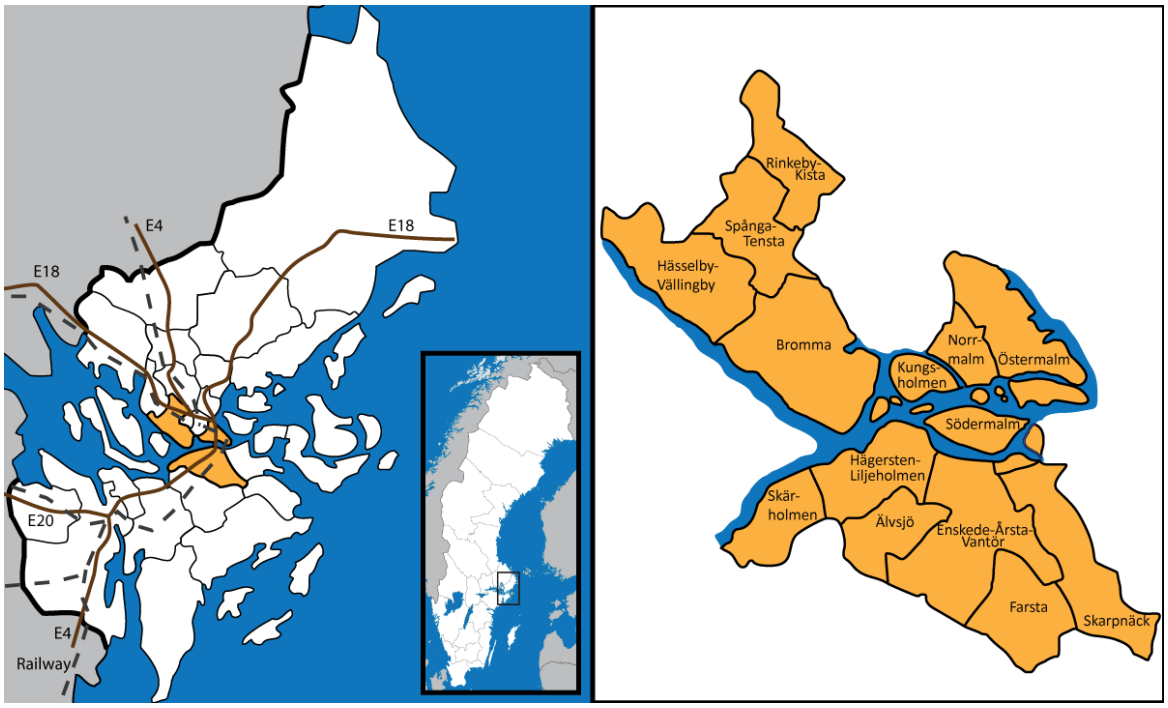

Figure 2. Stockholm County (to the left) with the City of Stockholm marked in orange colour (to the right).

There are several tourist areas in Stockholm. The old town “Gamla Stan” is one of the largest and best preserved medieval city centres in Europe, and one of the foremost attractions in Stockholm. This is where Stockholm was founded in 1252. All of Gamla Stan and the adjacent island of Riddarholmen are like a living pedestrian-friendly museum full of sights, attractions, restaurants, cafés, bars and places to shop. Other tourist areas that can be mentioned are “Skeppsholmen”, “Djurgården”, “Drottningholm” and Vaxholm. Another popular tourist and recreational area is the Stockholm archipelago extending from Stockholm city centre roughly 60 kilometres to the east. Many Stockholm citizens have summerhouses in the archipelago and visitor numbers swell in the warmer months, especially July. The landscape varies tremendously, from the more populated, thickly wooded inner archipelago to the bare, flat rocks of the central and outer islands.

Most of the downtown, commercial centre of Norrmalm resulted from a massive 'renewal' campaign in the 1960s, in which nearly all of the district's older buildings were torn down in favour of boxy office space. The area continues to develop today, this time decidedly for the better, with renovated shopping centres, new designer boutiques and ultramodern hotels under construction on its western border. Aside from all the hotels and shopping opportunities, Norrmalm is also known for its restaurants,

nightclubs and some key museums and sights. Vasastaden is more residential and has some pretty pubs, restaurants and antique shops.

Kista Science Park is a vibrant cluster of ICT industries with more than 20 000 people involved in developing next generation 4G mobile telecommunications and Informations and Communications solutions. Kista hosts departments of both Royal Institute of Technology and Stockholm University (formerly jointly known as "the IT University"). Because of its ICT industries, Kista became referred to as Sweden's Silicon Valley in the 1980s. Besides shopping in the city centre many shopping malls/centres have also been established in the surroundings residential areas, as for example "KISTA Galleria". The main locations of the city areas are shown in Figure 3. The different land types in the Stockholm County are illustrated in Figure 4. As can be seen Stockholm is spread across many islands, thus either tunnels, bridges or ferries are needed to be used for the transport system.

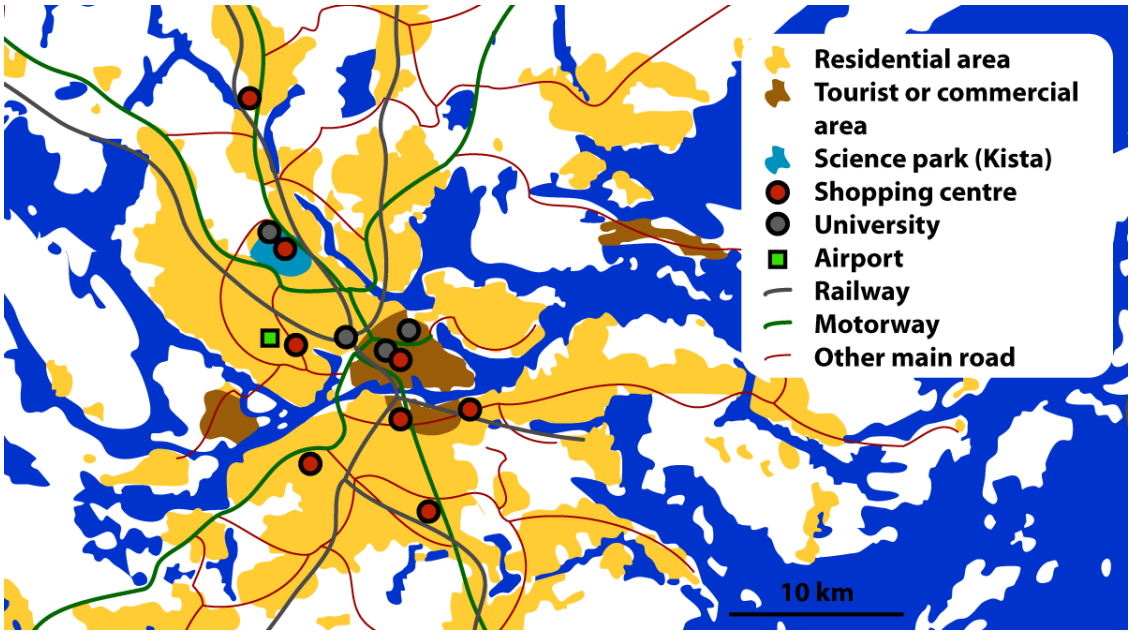

Figure 3. Different areas in the Stockholm County.

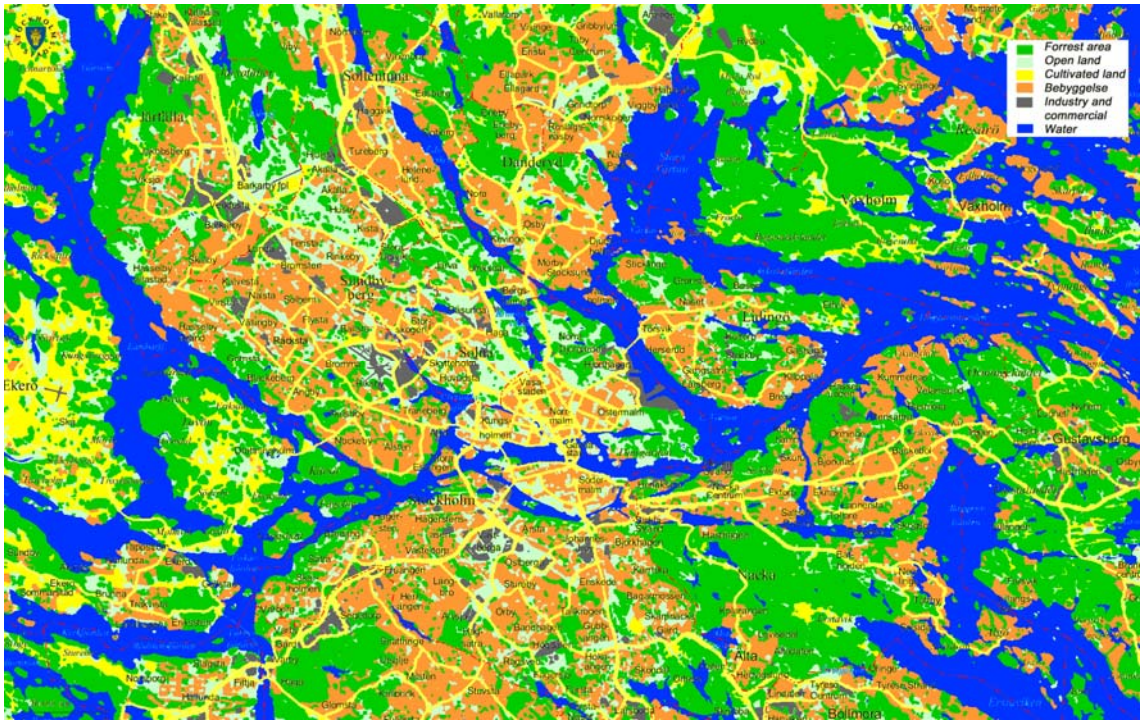

Figure 4. Land types in the Stockholm County [21].

2.2 Climate

Stockholm was in 2010 awarded as Europes Geen Capital. Some of the reasons for the award was [18]

- measures taken towards reducing noise pollution,
- a protection plan setting new standards for cleaner water,
- an innovative integrated waste system and that
- 95 % of the population live less than 300 meters from green areas.

The climate in the region is relatively mild considering its latitude, mainly due to the influence of the warm Gulf Stream. The average daytime temperature vary between 13°C and 22°C in the summer and from -5°C to 1°C in the winter. The annual precipitation is 539mm.

The average temperature in Sweden has risen by 1.0 °C since the early 90's which are considered by Swedish Meteorological and Hydrological Institute to be a very high increase in such a short time. The winter of 2007/2008 was the warmest since continuous observations was made, i.e. 150 year. The winters since 2008 on the other hand have been clearly colder and snowier than normal. Climatic fluctuations give an unpredictable environment for safety work in the county. During planning and preparation for safety work, regards have to be taken to floods as well as extreme cold (Figure 5, Figure 6) [15].

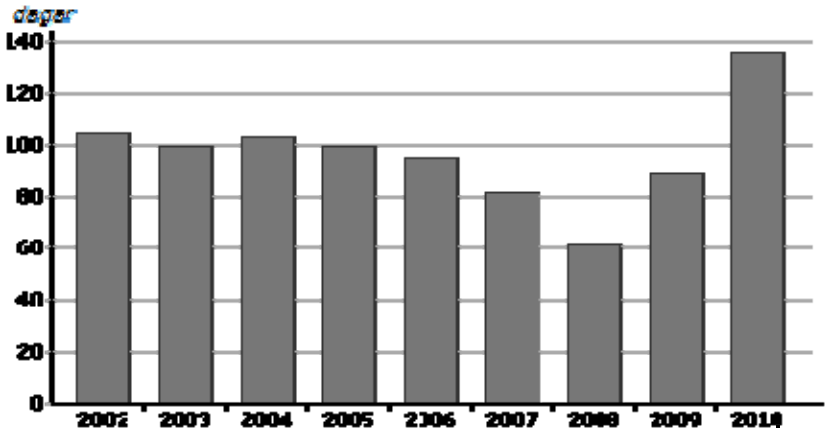

Figure 5. Number of frost days in Stockholm County. A frost day is defined as a day when the minimum temperature is below 0.0°C [23].

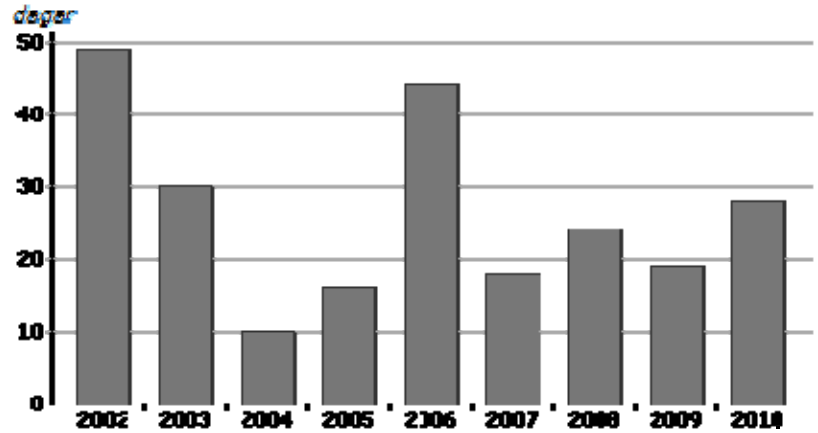

Figure 6. Number of summer days in Stockholm County. A summer day is defined as a day when the maximum temperature is over 25.0 ° C [24].

2.3 Religion

Since the 16th century the Swedish population has been predominantly Lutheran. In 2000 the state church was partly separated from the state [20]. As of 2010, about 70% of the Swedish population is members of the Church of Sweden, compared to over 95% in 1970, and 83% in 2000.

2.4 Culture and education

The City of Stockholm was in 1998 awarded as Europan Capital of Culture and is, with 24 colleges and universities, a centre for higher education. Research and higher education in the sciences was established already in the 18th century with the *Karolinska Institutet* in medicine and the *Royal Institute of Technology* and *Stockholm University* in science. The Stockholm School of Economics is one of Northern Europe's leading business schools and among the most prominent within the area of art is Swedish National Academy of Mime and Acting, Royal University College of Fine Arts and Royal College of Music. Also the Swedish defence college as well as Military Academy Karlberg is seated in the area.

2.5 Major events and leisure locations

Regularly there are several events going on in the City of Stockholm. For instance *Culture Night Stockholm* is a unique evening when Stockholm's broad cultural life comes together to offer an evening of celebration, culture, socializing and meetings. Around the city are museums, theaters, galleries, cinemas and a host of other cultural organizers open until late night. *Sweden's National Day*, 6th of June, is celebrated in Stockholm with programs around the entire city. A highlight is the citizenship ceremony at City Hall where people, living in Stockholm, who have become Swedish citizens during the year are welcomed. *Stockholm's Culture Festival* moves the culture to the city's streets and squares. The festival has free admission and offers locals a multitude of exhibits, entertainment venues, restaurants, markets and venues. Cultural festival conducted in cooperation with the city's cultural life, business and other partners, both national and international.
Stockholm county and the City of Stockholm is home to several elite sport clubs (football and hockey).There are also annual sporting events, such as the Stockholm Marathon, DN-galan and Lidingöloppet, the world's largest cross country running race.

2.6 Critical infrastructures

This chapter describes transportation systems, public health and command and control centres in the Stockholm County.

2.6.1 Transportation systems

The Stockholm County has an extensive network of roads and railways. Due to the Countys geographical characteristics tunnels and bridges are a critical part of the road and railway infrastructure. The roads and tunnels link the central parts of the City of Stockholm with the mainland and other islands in the county.

2.6.1.1 *Public transport*

Stockholm has a well-developed multimodal public transport system with a strong competitive position as compared to private transportation.

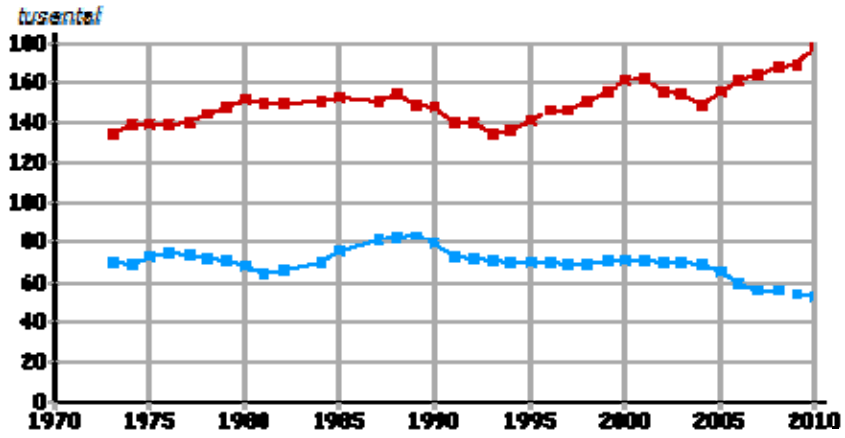

Figure 7. The number of public transport in thousands of users (in red), as compared to private car users (in blue), to the inner city during the morning peak period between the hours 06-09 [22].

The public transport system is administrated by the Stockholm Public Transport (SL), while it is operated by a number of contracted commercial providers. The public transport system consists of metro, railway, bus and ferry services. The metro system is the main transportation system in the City of Stockholm and the central parts of the county. It is a 106 km long underground and surface railway system. The metro is complemented with a commuter train system and a light-rail system in the suburban and rural parts of the county. Local and express bus services as well as ferry services are provided through out the county.

2.6.1.2 *Railway transport*

The Stockholm Central Station is an important transportation hub for all long-distance railway transports. Gods and passenger traffic from three different directions, south, west and north, meets in this hub. The traffic passing through the Stockholm Central Station is currently at the maximum capacity, which leads to frequent delays and disturbances in the long-distance and commuter railway services.

2.6.1.3 *Air transport*

In the Stockholm County there are two international airports, the Arlanda airport and the Bromma airport. The Arlanda airport is, with 18 million passengers, the biggest airport in Sweden. The airport also acts a hub for the Scandinavian Airlines. It is located about 40 km north of Stockholm. The Bromma airport is a minor airport located close to the Stockholm's city centre, with 200 thousands passengers (Table 1, Table 2) .

Swedavia is a state-owned company with roughly 2,500 employees and revenue of SEK 4.5 billion that owns and operates 11 airports in Sweden, among them is Arlanda and Bromma Airport. Environmental concern is integral to Swedavia's entire operations. Swedavia works actively with the emissions sources they can influence themselves but also with other environmental initiatives and in 2006, Swedavia became the first major climate-neutral company in Sweden.

Emissions from Swedavia's own operations have been reduced by more than half in just a few years. The work continues to further reduce these emissions, and the ultimate goal is to eliminate them completely. This will take time, and in the meantime the remaining emissions will be carbon-offset in line with the principles of the Kyoto Protocol by supporting projects in other countries. The majority of the travelers are business people. The list show more statistical information about Swedavia travellers:

- 65% men, 35% women
- Majority aged between 30 and 49
- 75% business travellers
- 59% hold a leading position in top or middle management
- 29% travel more than 10 times a year
- 60% earn between SEK 450 800,000
- Travellers spend on average 90 minutes at the airport

	Flights	Passengers
Foreign, total	67 427	13 915 978
Europe	62 885	12 142 674
The world	4 542	1 773 304
Domestic, total	34 821	4 328 927
Total	102 248	18 244 905

Table 1. Statistics about flights and passengers at Arlanda airport 2010 [30].

	Flights	Passengers
Foreign, total	290	21 935
Europe	287	21 925
The world	3	10
Domestic, total	1 946	191 221
Total	2 236	213 156

Table 2. Statistics about flights and passengers at Bromma airport 2010 [30].

2.6.1.4 Roads

The Stockholm County is, besides being an important railway transportation hub, also an important hub for road transportation. A number of main road meet in the outskirts of the City of Stockholm, for instance, the E4 motorway connecting southern Sweden with the north, the E20 motorway connecting Stockholm with Gothenburg and the Swedish west coast, and the E18 motorway, which is the road link between Stockholm and Oslo, see Figure 2. The E4 motorway and in specific the part passing though the City of Stockholm is the busiest road in the entire Sweden with an average of 160 000 vehicles/day (figure for 2007). The geography of the Stockholm County and the City of Stockholm influences how the road network is shaped, something which leads to concentration of a large part of road traffic in the region to a limited number of roads.

2.6.1.5 Water transport

The Stockholm County is characteristic for its archipelago and a system of rivers and lakes. Moreover a large part of the City of Stockholm is spread across a number of islands. Therefore a variety of ports and harbours can be found in the City of Stockholm and the Stockholm County. There are three major harbours in the county located in Nynäshamn, Norrtälje and the City of Stockholm. These harbours offer international regular and irregular ferry services for passenger and goods transports to various destinations around the Baltic Sea.

2.6.2 Public health

The Stockholm County Council is responsible for public health and health services in the county. It organizes health care in the county, and has one region hospital, Karolinska University Hospital , that serves the nation with specialist knowledge. There are nine regional hospitals in Sweden. They deal with rare and complex illnesses and injuries. The regional hospitals are also known in Swedish as University Hospitals because they operate closely with the medical colleges on education and research. The county has several additional public and private hospitals and a modern emergency medical service [31].

2.6.3 Command and control centres

The county has a complex environment with many underground structures, densely settled areas, heavy traffic on road, rail, sea and air, rural areas, large archipelago, harbours, old culture settlements and industry areas. This conjures collaboration between the command and control centres as well as with other organizations and agencies such as police, ambulance, county, maritime authorities and the military during emergencies.

In the Stockholm County there are five core public safety agencies:

- Police service – Stockholm County Police Authority.
- Fire and rescue service – four agencies operate in the county, The Greater Stockholm Fire Brigade, The Attunda Fire and Rescue Service, The Södertörn Fire and Rescue Service, and The Norrtälje Fire and Rescue Service.

- Emergency medical service – Stockholm County Council is the responsible agency administrates the service. The service is provided by four contracted commercial providers, Falck, Sirius, Samariten, AISAB.
- 112 emergency call services – SOS Alarm Sweden that is a publicly owned company responsible for 112-services in Sweden.
- Coast guard service – Swedish Coast Guard. The service is provided by the organisational unit Region East.

There are additional organizations and services, which play a key role in emergencies concerning public transports and transport systems in general:

- Road transports – Trafik Stockholm (TS), Swedish Transport Administration
- Railway transports – Swedish Transport Administration
- Sea transports – Swedish Maritime Administration
- Air transports – Swedish Transport Agency
- Public transports –SL

Furthermore, the Stockholm County Administrative Board and the 26 municipal administrations in the county are also involved in emergency response situations through their crisis management functions.

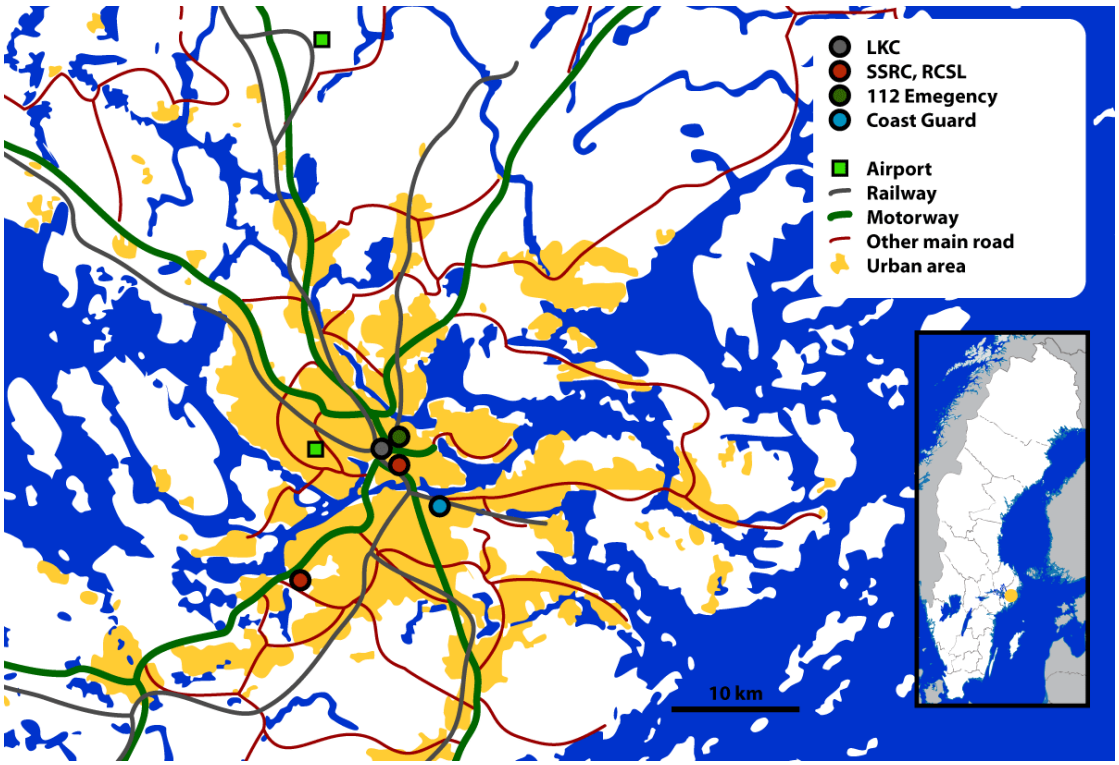

Figure 8. The approximate location of the command and control centres of the public safety agencies in the county.

The public safety agencies are coordinated by a number of command and control centres. How many and which command and control centres are involved depends on the nature of the emergency. The list detailed in this section summarise the most significant command centres, whereas the next section, *Communication Infrastructures*, describe the used communication technology.

2.6.3.1 Police command and control centre

The Stockholm County Police Authority manages their operational activities from their countywide command and control centre (LKC). LKC is staffed by one on-duty officer and a number of operators.

2.6.3.2 Fire and rescue command and control centres

There are two fire and rescue command and control centres in the county, (1) The Greater Stockholm Command and Control Centre (SSRC), and (2) The Stockholm County Command and Control Centre (RCSL**)**.

SSRC manages emergencies in ten municipalities. The command and control centre handles about 16000 emergencies per year. There are always six alarm operators and a chief of staff in place at the centre. SSRC also support municipalities with intelligence, such as weather and infrastructure (electricity, water, telecommunications and road networks) disruption warnings [6].

RCSL manage emergencies in sixten municipalities. RCSL handles about 10,000 emergencies per year. There are at least two alarm operators and a chief of staff in place at the centre. RCSL also support municipal services during night time with alarm operator that mainly manages CCTV, burglar alarms and municipal alarms [7].

2.6.3.3 112 emergency call centre

The Stockholm County is served by one 112 emergency call centre managed by SOS Alarm Sweden, a publicly owned company. The centre receives 112 and other emergency calls, coordinates resources (ambulances) of the emergency medical service, provides other emergency related services, and operates systems for public alerts and warnings [9].

2.6.3.4 Coast guard command and control centre

The Coast Guard´s Command and Control Centre Region East coordinate the Coast Guard's resources in the county and the other neighbouring counties.

2.6.3.5 Command centres related to transportation

The following command and control centres are involved in managing transports and transport systems in the Stockholm County:

- Stockholm Transport Safety Centre operates surveillance systems and coordinates security guards in the public transport system, as well as provides assistance to travellers/commuters.
- Stockholm Transport Dispatch Centre is responsible for operating the public transport systems in the county. The Railway System Dispatch Centre operates the railway system in the county and the rest of Sweden.
- The Road Network Dispatch Centre is managed by Trafik Stockholm and responsible for operating the road network in the county. The centre operates a system of cameras and sensors to monitor the road network system.

2.6.4 Command and control vehicles

The public safety agencies in the Stockholm County have also command and control vehicles, which can support on-site commanders during on-going emergencies. These vehicles are so called command and control vans equipped with a variety of communication systems and equipment. They can, if necessary, provide functions and services of a command and control centre at the incident site. In the Stockholm

County there are three such command and control vans at the fire and rescue services and one at the Stockholm County Police authority.

2.7 Communication infrastructures

The following information and communication infrastructure is currently available for the public safety agencies in the Stockholm County.

2.7.1 Public ICT Infrastructures

Public ICT infrastructure in the Stockholm County consists of a variety of information and communication systems. Many of these systems are also are used by the public safety agencies.

2.7.1.1 *GSM, 3G, 4G – Digital mobile phone and data systems*

There are three physical GSM networks available in Sweden. The operators of these networks are Telia, Tele2, and Telenor. There are also about 20 virtual GSM network services provided through these three physical networks. Concerning 3G there are two physical networks available. Each network is operated jointly by two operators (Telia and Tele2 and Telenor and Hi3G). In total there are eight virtual 3G network services provided through these two networks. There are also two physical 4G networks. The operators of these networks are Telia (one network) and Tele2 and Telenor (second network). These two networks are currently covering parts of the Stockholm County. The GSM and 3G networks have coverage in the tunnels throughout the Stockholm County.

Examples of public safety users of these systems are the police force, fire and rescue services, Coast Guard and emergency medical services.

2.7.1.2 *Wi-Fi hotspots*

There are currently several Wi-Fi hotspot providers in the county. These providers are, for example, Telia, Skype, Clue and The Cloud. There are several hundred Wi-Fi hotspots available through these operators. These hotspots are located primarily in the Stockholm downtown, metro, commuter train and railway stations, airports, public places, sport grounds, highway services and hotels.

Examples of public safety users of these systems are the fire and rescue services.

2.7.1.3 *Web services*

There are several commercial web services providing online and offline aerial, orthographical and video data. Examples of such services are the Swedish Eniro and hitta.se and the Google Earth and Google Maps.

Examples of public safety users of these systems are the fire and rescue services and crisis management functions at the regional and local administrations.

2.7.2 Private ICT Infrastructures

The public safety agencies have access to a variety of wireless communication systems. The following systems, also recognized as professional communication systems, are in use today.

2.7.2.1 *Rakel - Digital trunked radio system*

Rakel is the name of the Swedish nationwide TETRA-based digital radio system. Rakel is a dedicated public safety communication network available for all the public safety agencies. The services of the

system have been launched during the period of 2006-2010. The system provides services, which are common for TETRA solutions such as a group call, push-to-talk function, priority mechanism, encrypted communication, direct-mode operation (DMO), and short data services (SDS). For instance Rakel users can create group calls locally, regionally and nationally.

Examples of public safety users of these systems are the police force, fire and rescue services, emergency medical services, coast guard, government authorities, and crisis management functions at the regional and local administrations.

2.7.2.2 S-70M, S-80, E-80 - Analogue radio systems

S-70M, S-80 and E-80 are nationwide analogue radio systems for public safety agencies. These systems have been used for many years by the core public safety agencies. The most common systems are S-70M, operating at frequency 79 MHz, and S-80, operating at 380 MHz. These systems allow the users to coordinate with a large number of other users across organizational boundaries, for example, between the emergency medical services, fire and rescue services and police forces. The S-70M and S-80 radio systems support group calls and the transmission of short status messages (from mobile units to command and control centres). The E-80 radio system is used by the police forces and provides encrypted voice communication.

Examples of public safety users of these systems are the police force, fire and rescue services, emergency medical services, coast guard and SOS Alarm.

2.7.2.3 GSM-R

There is one GSM-R network, called MobiSIR. MobiSIR is operated by the Swedish Transport Administration and is dedicated for coordination of railway transports.

Examples of public safety users of these systems are the Swedish Transport Administration

2.7.2.4 Minicall – Analogue paging system

Minicall is a commercial paging service. The system covers approximately 99 % of Sweden and uses frequency bands between 160 and 170 MHz. The Minicall user terminals can receive messages from telephones or via email, SMS and a web interface.

Examples of public safety users of these systems are the fire and rescue services, crisis management functions at the regional municipal administrations and SOS Alarm.

2.7.2.5 Mobitex and Mobitex Combi - Digital mobile data service

Mobitex is a packet-switched, narrowband system for wireless transmission of data. The system is provided on a commercial basis. The radio transmission is on the frequencies from 80 to 400 MHz. Mobitex Combi is a commercial system that makes Mobitex services available for mobile devices via GSM (GPRS, EDGE) or 3G.

Examples of public safety users of these systems are the emergency medical services.

3. Public safety characterization

This chapter describes applications identified by the end users as useful in order to enhance public safety, both in their everyday work as well as in major emergency events. The characterization is divided into four different areas: Citizens behaviour, Road track incidents management, Alerting citizens, Ad-hoc networks and Situation awereness.

3.1 Area A: Citizens behaviour

3.1.1 Stockholm public transport surveillance system

Today security cameras are located on all subway stations, in all buses, in most subway cars and in the latest deliveries of commuter trains (Figure 9). With the cameras the security centre can monitor what happens in real time and the main purpose is to increase the security of passengers and staff. The purpose is also to support daily operation, to facilitate evacuation and rescue, and to detect and secure evidence of crime and vandalism. The system can analyze images and notice Stockholm Transport Safety Centre, which immediately can stop the traffic, if someone enters the track, but also notice on people moving at the stations at night. The network is operated by the Stockholm Transport Safety Centre [2, 3].

3.1.1.1 Application and infrastructure deployment

Figure 9. There are security cameras at every Stockholm metro station [19].

3.1.1.2 *Application requirements*

The system is designed based on the following requirements:

- Give notices if someone enters the track or other movement is recognised on the stations at night.
- Facilitate the identification of persons suspected of vandalism and other crimes.
- Facilitate evacuation and rescue operations through real-time information.
- The police should be able to ask for recorded material from the system.

3.2 Area B: Road track incidents management

Capability of situational awareness among the public safety agencies can be supported by real time sharing of surveillance data on the road network system, and is relevant with respect to the SafeCity focus area *Road Track Incidents Management*. The Road Network Dispatch Centres can forward, both on pull and push basis, video streams from their cameras to other command and control centres in the county.

For example, The Stockholm County command and control centre, which coordinates resources of the Attunda Fire and Rescue Service, can request video streams from locations, where emergency response operations take place, or from roads that the dispatched resources are driving on to incident areas. Additional capability to support situational awareness is through real time video streaming and video messaging from incident areas to command and control centres as well as to different command and control functions. Some fire and rescue services support their situational awareness in this way. If necessary they may share these data even with other public safety agencies.

3.2.1 Cameras for traffic monitoring

There is a fixed network of cameras, queue warning systems and road weather stations deployed throughout the Stockholm County. In an embedded system this network covers the public transport systems and the road network system in the county. The network is operated by Traffic Stockholm via the Road Network Dispatch Centre (road network system). The information is sent via the Swedish Transport/Road Administration's private communication platform (a broadband network for data, video and audio communications). The system include five of the county's most important tunnels with their extensive variety of embedded systems such as control, security, telecommunications and traffic systems. All systems in the tunnels are communicating with each other and also with Traffic Stockholm via the communication platform.

The embedded system is usable for road users in order to plan their journey via message signs located above the carriageway that is updated manually by Traffic Stockholm based on the systems information. Signs on the road to reduce speed and/or changing lanes in heavy traffic or accident are controlled automatically from Traffic Stockholm.

The system also monitors traffic signals out of order and alerts the control centre automatically. The sensors for measuring temperature, wind speed and humidity, and cameras that follow the changes in road conditions gives, in cooperation with SMHI, information on how and where weather conditions affect road conditions and the traffic [4].

The Swedish Road Administarions (SRA) broadband General Communication Platform (GCP) is used for the communication (Figure 11). Local systems, traffic cameras, control systems and sensors that automatically send an alarm in the event of traffic disruptions use GCP. The GCP primarily utilizes fibre

cable for the communications. The SRA's fibre network is continually being extended and upgraded. Across longer distances, such as in certain tunnels, a radio link can be used instead. Rented links are also in use in the GCP network. For each section of a road or a tunnel, a local ring is built with several different independent communication routes to the traffic management centre. These local rings are joined to form a global communication ring. The structure is chosen to offer a high level of accessibility, so that the communication is reliable. GCP is monitored around the clock by equipment that checks routers and switches. In the event of a fault, an alarm is sent to the traffic management centre [15].

3.2.1.1 *Application and infrastructure deployment*

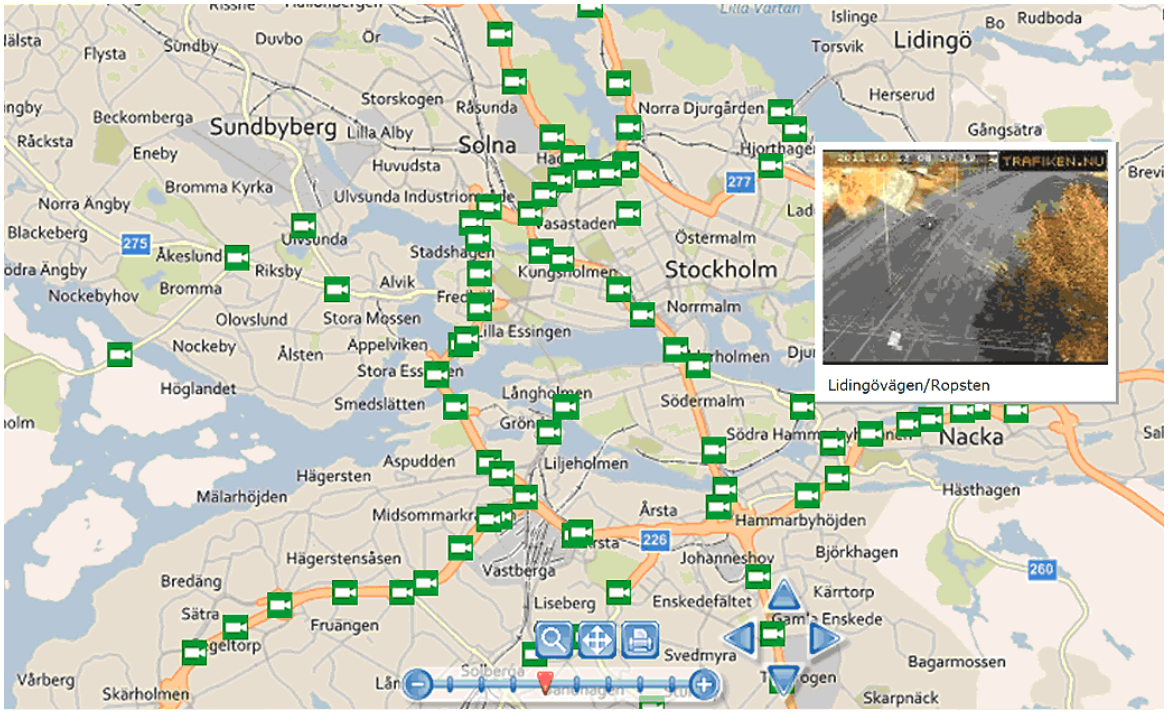

Figure 10. Public available web site for traffic monitoring [25].

3.2.1.2 *Application requirements*

The system is designed based on the following requirements:

- Be able to give information for cooperation with authorities, media and the public.
- Control and monitor of traffic equipment such as barriers, signs and cameras.
- Manage and control of roadside assistance.
- Handle alarms from technical equipment and manage the service group.
- Serve as support to operators in their work

3.2.1.3 System architecture

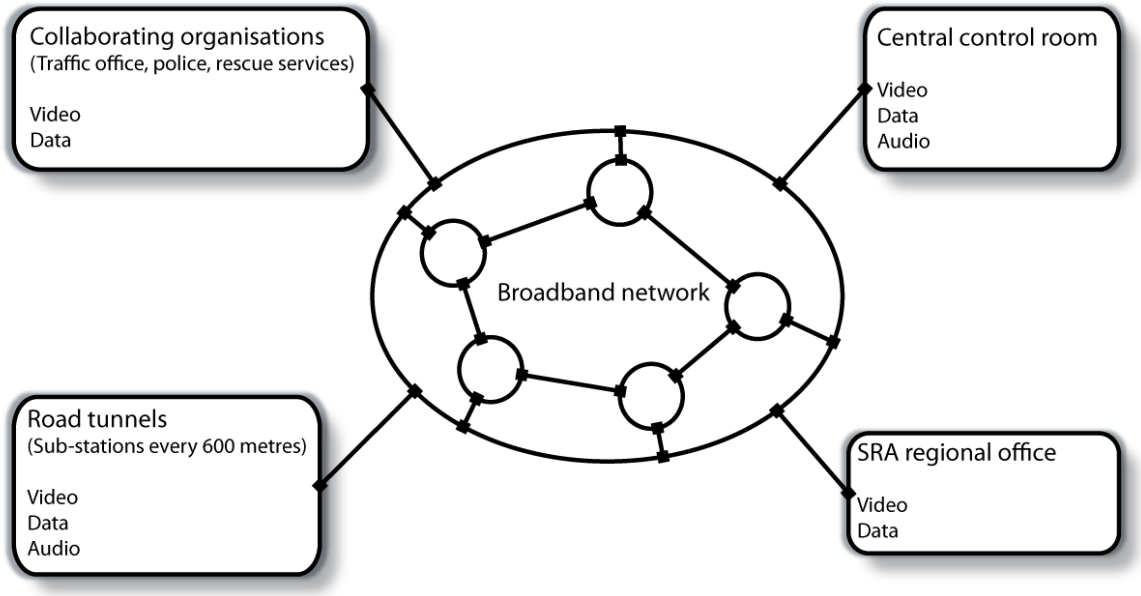

Figure 11. System architecture of the broadband General Communication Platform (GCP) network

3.2.1.4 Use case and actuation proceedings

The network is operated by Traffic Stockholm via the Road Network Dispatch Centre and by the Stockholm Transport Safety Centre. The centre can share their surveillance data with other emergency organisations like the police or fire and rescue upon a request from them.

3.3 Area D: Alerting citizens

There are nationwide systems and procedures for broadcasting urgent emergency alerts and warnings. According to these procedures commanding officers from the public safety agencies in the Stockholm County can issue orders to broadcast alerts and warnings.

3.3.1 Emergency alert – VMA system

Sweden has a nationwide public warning system for broadcasting emergency alerts and warnings (VMA). VMA systems are administrated by the Swedish Civil Contingencies Agency. [10,11]

There are two types of messages that can be broadcasted, *VMA warning messages* that are broadcasted in case of an immediate danger in order to protect life, environment or property and *VMA information messages* that are broadcasted in situations when there could be a danger for life, environment or property. Currently the following alerting capabilities are available to broadcast *VMA warning and information messages* in the Stockholm County:

- Sirens: Outdoor alerts and warnings in all built-up areas with populations of more than 1000 inhabitants. There are about 4500 sirens across Sweden connected to a nationwide radio-based control system. The sirens are only used to broadcast VMA warning messages.
- TV and radio: VMA messages can be broadcasted on major public and commercial TV stations, as well as all public and commercial radio stations. The VMA warning messages have a higher priority than regular broadcast. All broadcast is interrupted immediately and the VMA warning

messages announced. The VMA information messages on the other hand have a lower priority and the TV and radio stations can decide if they want to broadcast these messages information.

- Internet: National emergency information web- and twitter-page called “Krisinformation.se” contains all VMA warning and information messages broadcasted in Sweden [12].

- Mobile public address systems (vehicles): All police and fire and rescue service vehicles that are equipped with blue lights and sirens are also equipped with a public address system (voice broadcast). Usually it is the police that handle this kind of information broadcasting.

All alerting capabilities, sirens, TV and radio, RDS and Internet, are regularly tested first Monday every third month. The number of access points from which VMA messages can be broadcasted is limited to 112 emergency centres and municipal fire and rescue services. The Swedish Civil Contingencies Agency supplies these organizations with terminals to control the sirens. The fire and rescue services can only control sirens within their jurisdiction, whereas the 112 emergency call centres (eighteen in the country) can operate sirens all over Sweden. Alerts and warnings broadcasted via other systems, e.g. TV and radio, can only be issued via the 112 emergency call centres.

There are specific procedures for each type of VMA messages [13, 14]. For the *VMA warning message* the following C2 functions and organizations can issue an order to broadcast:

- Emergency response incident commander (according to the Act 2003:778). Depending on the type of emergency the following organizations have the responsibility to assign an incident commander to manage a specific response operation:
- Municipal fire and rescue services in the Stockholm County, The Greater Stockholm Fire Brigade, The Attunda Fire and Rescue Service, The Södertörn Fire and Rescue Service, and The Norrtälje Fire and Rescue Service (land-based fire and rescue operations).
- Stockholm County Administrative Board (land-based fire and rescue operations).
- Stockholm County Police Authority (land-based search and rescue operations).
- Swedish Coast Guard (environmental protection operations).
- Swedish Maritime Administration (sea-based fire and rescue operations, and sea- and air-based search and rescue operations).
- Police commanding officer (according to the Act 1984:387) from the Stockholm County Police Authority or The National Police Board.
- Disease control medical officer (according to the Act 2004:168) from the Stockholm County Council.
- On-duty officer from the 112 emergency call centre in Stockholm.
- Selected facilities where accidents may lead to severe danger for life, environment and property, for instance chemical production and storage facilities, or dams. The Stockholm County Administrative Board identifies and selects such facilities.

For the *VMA information message* the following organizations can issue an order to broadcast an information message in extraordinary situations (according to the Act 2006:941, 2006:544 and other related laws):

- Organizations and C2 functions with the right to issue VMA warning messages (see above).
- The government and the government office.
- Selected national government authorities, about 40 authorities with crisis management responsibility and an on-duty emergency officer.

- Municipal administrations in the Stockholm County.

The following organizations can issue an order to broadcast a *VMA information message* in case of serious service disturbances:

- Communication networks, about 15 operators with own networks.
- Power distribution, a national authority Swedish National Grid.

3.3.1.1 *Application requirements*

The system is designed based on the following requirements:

- Be able to broadcast in the precise geographical area of the incident.
- Alert in order to order to protect life, environment or property during incidents.

3.3.1.2 *System architecture*

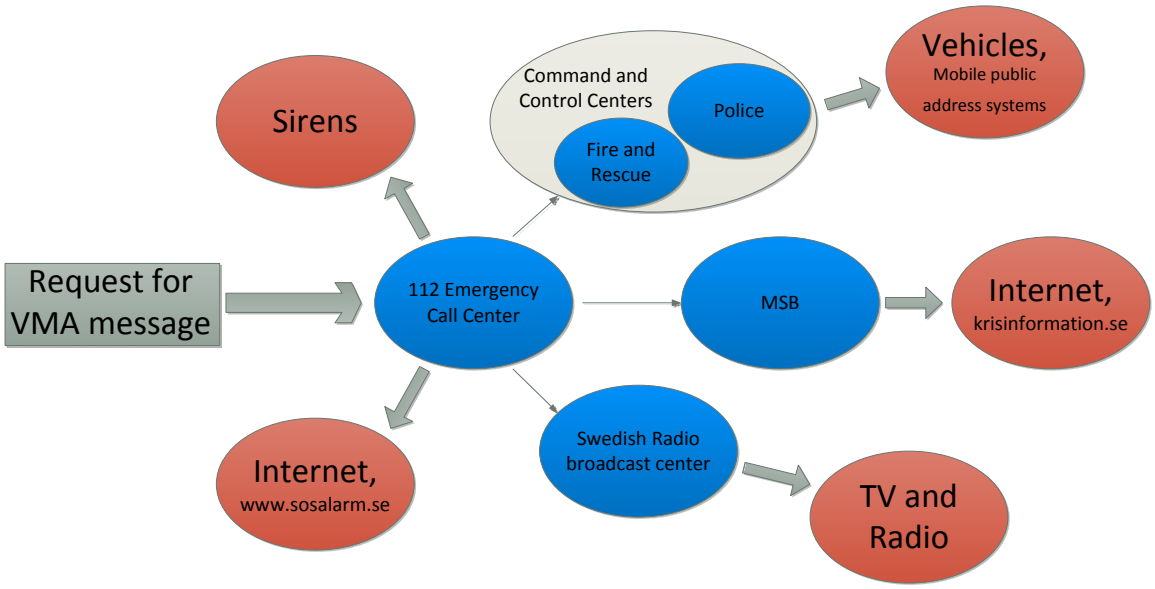

Figure 12. The VMA system architecture

3.3.1.3 *Use case and actuation proceedings*

The 112 Emergency call centres receives a request for a VMA message. If the message concerns the applications SOS Alarm is in charge of, that is sirens and internet, then the emergency call centre manage the message themselves. If the message needs to be executed by other applications, then the emergency call centre will notify the appropriate authority, which in turn conveys the message according to procedure (Figure 12).

3.4 Area E: Ad-hoc networks

Thanks to the availability of multiple GSM, 3G and 4G cellular networks, TETRA as well as several hundreds of Wi-Fi hotspots in the Stockholm County, and specifically in the Stockholm downtown, robust and flexible communication setups can be established in incident areas. On-scene commanders and command and control vehicles from the public safety agencies commonly have subscriptions to multiple communication networks.

For example, commanding officers in command and control vehicles from the Attunda Fire and Rescue Service can theoretically connect (a) to Wi-Fi hotspots through WLAN interfaces of laptops in their

vehicles, (b) to a 3G network through 3G-modems plugged into the laptops, or (c) to 3G networks through their smart phones. These devices can also theoretically be interconnected for instance through the Bluetooth or WLAN interfaces. However, ad hoc networks in terms of temporarily and easily deployable networks that can be brought to the incident site to improve connectivity, coverage and capacity is not used today but is of interest in the future [Annex A]

3.5 Area F: Situational awareness

3.5.1 LiveResponse

Live Response is a commercial service, which allows on scene commanders to share steramed video, messages and notes, via wireless communication, with other actors and command centres. Live Response combines a web service for the receiving commanders with wireless communication to the sending commander's mobile devices (smart phones, in-vehicle computers) or cameras. LiveResponse share streamed video, messages and notes. It gives GPS positions for the sending device. Subscribers and users of the service can share situational awareness data in real time with other organisations through a password protected web interface where the company behind LiveResponse, Ideaviate AB, supply the service [Annex A, 1, 15].

3.5.1.1 *Application requirements*

The system is designed based on the following requirements:

- Be able to record and send events from mobile phones.
- Play video both live and subsequently via a password protected web interface.
- Show GPS position of the recording device on a map via a password protected web interface.
- Allow for taking and sharing notes via a password protected web interface.

3.5.1.2 *System architecture*

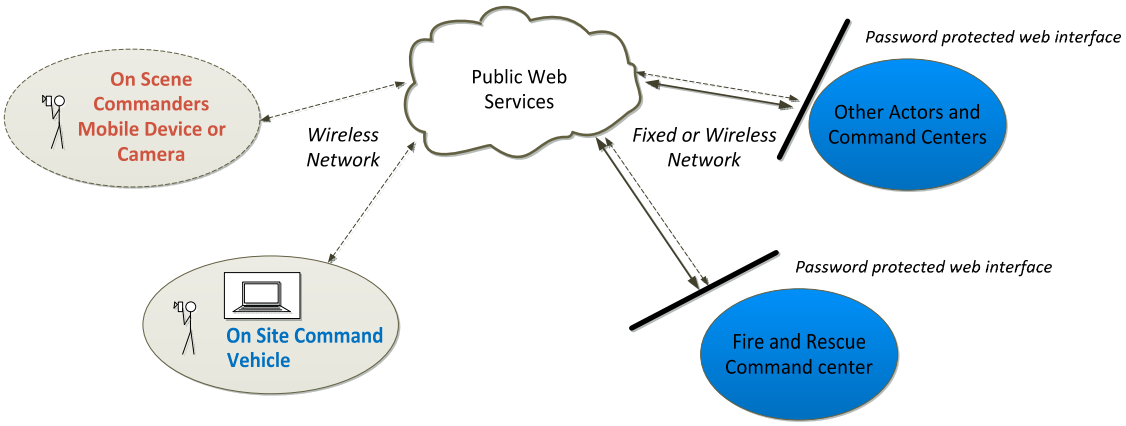

Figure 13. The Live Response system architecture

3.5.1.3 *Use case and actuation proceedings*

Situational awareness is currently promoted in the Stockholm County Fire and Rescue Services through *LiveResponse*, where on-scene incident commanders from for instance the Södertörn Fire and Rescue Service can stream or send video reports to RCSL, the Stockholm County command and control centre, or to other commanding officers in nearby Fire and Rescue Services.

The on-scene incident commander can use his mobile phone or a web camera that is connected to an in vehicle computer. The video, messages and GPS positions are sent via 3G, 4G or Wifi. The receiving command centre need a computer with internet connection, 3G, 4G or Wifi and password as well as an internet address to the service that manage the videos, messages and GPS positions from the scene.

4. Social, Ethical and Legal implications

The described capabilities available today in the Stockholm County show that there currently exists infrastructure and services, which build upon the idea of smart cities and contain some of the features of the SafeCity concept. The use of the infrastructure and services as well as their further development is not influenced as much by technological constraints as it is restrained by Swedish laws and regulations. Laws regulating this area are for instance *Public camera surveillance act*, *Civil protection act*, *Public access to information and secrecy act*, *Personal data act*, *The Police act*, and *Act on road tunnel safety*. With respect to surveillance and gathering of personal data these laws and regulations are rather strict in the European context. They must be considered for future capabilities.

The *Act on road tunnel safety* (in Swedish: *Lag om säkerhet i vägtunnlar (2006:418)*) regulates the safety of tunnels longer than 500 m. Regulated areas relevant with respect to the SafeCity focus area are the paragraphs of surveillance and communications systems within the tunnels.

4.1 Monitoring public and private areas

For camera installation and surveillance of cameras directed at places where the public has access the Public camera surveillance act (in Swedish: *Lagen om allmän kameraövervakning (1998:150)*) is the most important regulator. It is the Stockholm County Administrative Board that grants permission and supervise the use of cameras in the Stockholm County.

Regarding camera surveillance data the *Personal data act* (in Swedish *personuppgiftslagen (1998:204)*) and the *Public access to information and secrecy act* (in Swedish *offentlighets- och sekretesslagen (2009:400)*) are the two main restraining laws. The Government Data Inspection Board supervises the enforcement of the *Personal data* act and the *Public access to information and secrecy act* regulate government agencies management of official documents, also with regards to secrecy and the protection of personal information or financial circumstances.

For instance, Stockholm County Administrative Board has approved camera surveillance of all Stockholm Public Transport buses, and of the Stockholm metro. The permit means that the Stockholm Transport Safety Centre may store surveillance material in more than 30 days, but in practice it is rarely stored longer than 3 days.

4.1.1 The public camera surveillance act

Permission is required for surveillance of public places. Strict private places as own apartments, own gardens, or office spaces without public access do not require permissions. However, surveillance of public transport and stations and travel centre do require permission. The act also regulate recording of sounds. Ease dropping and recording of sound require permissions, but there are some exceptions; for example in bank offices when there are a suspicion of crime.

As a general rule, camera surveillance is only permitted if the aim is to deter from crime (security), expose crime and if a crime has occurred to determine the events and the identity of personal involved. Picture and sound material should be destroyed as soon as possible but cannot be stored more than a month without a special permission. Also, the public need to be informed about the surveillance by signs.

In the process to decide on to grant permission the county administrative board assesses the need for the camera surveillance towards private integrity.

4.1.2 The personal data act

Main purpose of the act is that people shall be protected against the violation of their personal integrity by processing of personal data. The *Personal data act* lists certain fundamental requirements concerning the processing of personal data. These demands include, inter alia, that personal data may only be processed for specific, explicitly stated and justified purposes.

Personal data may, if the fundamental requirements are satisfied, in principle, only be processed if the registered person gives his or her consent. However, there are several exceptions to this rule, for example, if it is necessary:

- in the exercise of official powers
- when a work task of public importance is to be performed
- in order to enable the controller of public data to fulfil a legal obligation
- in order that a contract with the registered person may be performed.

Particularly stringent rules apply to the processing of sensitive personal data – e.g. concerning political views or health. These rules also apply to the transfer of personal data to other countries. Also, the registered person is entitled to information concerning processing of personal data that concerns him/her. The processing of personal data shall be notified to the Data Inspection Board. However, this does not apply if the person who is responsible for the processing has appointed a personal data representative. A person who contravenes the Personal data act may be liable to pay damages or be sentenced to a criminal penalty.

4.1.3 Public access to information and secrecy act

This act contains regulations for how authorities and other agencies need to manage registration, disclosure and other types of handling of public documents. The act also contains the rules on confidentiality in the public sector, and rules on the disclosure of public documents.

5. Challenges in Public Safety

5.1 Current limitations and gaps

Considering end user comments it can be noticed that the problems usually detected is connected to the large number of decision-support systems they use. Some end users have more than 20 passwords [Annex A] for systems they need to connect to in order to do their work. This is time consuming but doable during ordinary work, but a severe hinder in emergency events, when time is scarce, the risk high and cognitive workload high. It should be noted that many decision-support systems are specific for single public safety agencies, i.e. one fire and rescue service can have completely different decision-support systems than the other fire and rescue services as well as other public safety agencies. This multitude of decision-support and communication systems hinders collaboration among the public safety agencies and the agencies work continuously to mitigate these hinders and to reduce the numbers of systems. The technological constraints, with regards to many systems, in current applications lay in their inability to enhance organisational collaboration as they are not integrated with each other [Annex A].

5.2 On-going innovative initiatives

The broadcast of alerts and warnings in the Stockholm County is based on sirens, radio and TV. In 2013, these capabilities will be complemented by the possibility to broadcast messages to mobile devices through the Cell Broadcast.

5.3 Ideas for the future

Capabilities for enhancing the Public Safety would be (1) Service availability estimation, (2) Support for airborne communication relay platforms, (3) Cold vehicles alert, (4) Dangerous traffic congestion alert (5) Automatic emergency data log function and (6) Situation awareness picture for search team replacement.

Service availability estimation involves mobile actors benefiting from predictions of available services at present location and time, including estimations how the service availability will change. In particular, early warning about communication disruptions will guide mobile actors on what can be expected in terms of cloud applications/services. That the service availability varies is due to the changing network conditions because of bad links, overload, power supply etc.

Support for airborne communication relay platforms for ad hoc networks can substantially increase coverage and bandwidth at certain locations. Moreover, airborne platforms could use cameras for increased situation awareness [Annex A].

Estimate the need for evacuation of people from cold vehicles in traffic jams under cold winter conditions. After a time in a traffic jam, there is a high risk of vehicles running out of fuel so that people can not keep warm any more. Old people and children must be evacuated from the road. Also vehicles have to be removed from the road. This can be achieved by using information from temperature, infra-red and video sensors, as well as using statistical prediction models for the risk of cold vehicles in a traffic jam on a certain road section [Annex A].

Dangerous traffic congestion alerts could be given to travellers via on-road information on travel-time prediction and alternative direction guidance based on traffic information. In well time sent alerting

messages to GPS navigators, cellular networks and internet when there is a risk for dangerous traffic jams in the city, for example under cold winter conditions, could give travellers possibility to make change rout, refuel or pause decisions before they are trapped in the traffic congestion.

An automatic emergency data log function would give the organisations capability to, during real emergencies, log data from their technical systems in order to be able to, in hindsight, evaluate events that took part during the emergency from a learning perspective.

Situation awareness picture for search team replacement; aimed for first responders when they are searching in accident or fire areas, (dark, dust, smoke). A search team needs to know positions and directions within the incident area. These data need to be logged so that a replace team fast can take over, i.e., the replace team need to know what places that already have been covered and how and where to continue the search [Annex A].

5.4 Future characterization

There are plans to improve the road and train communication infrastructure in Stockholm, and main projects are “Norra Länken” and Stockholm City Line. Also, plans are made for a motorway linking southern and northern Stockholm resulting in a new route for the European highway E4 past Stockholm, it is called the E4 Stockholm Bypass. Since much of the traffic in these infrastructure projects, both road and train traffic will take place underground in tunnels, tunnel safety is a main concern. Notice that Sweden has an act on road tunnel safety mentioned in Chapter 4

Norra länken is a route of national interest through its connection to Värtahamnen and Frihamnen, Sweden’s most important seaports for cargo and passenger traffic to the Baltic States, Finland and Russia. Norra länken is planned to be operational 2015 [26]. The project Stockholm bypass is planned to be ready 2020.

The City Line is a 6 km-long commuter train tunnel running between “Tomteboda” and Stockholm South, with two new stations at Odenplan and T-Centralen. The City Line is planned to be operational 2017 and it will roughly double the capacity for rail traffic through Stockholm [27].

It can be mentioned that for the Stockholm Bypass 18 km of total 21 km will be in tunnels and all the tunnels will be provided with sensors, surveillance cameras, and traffic control systems. In fact, the Stockholm Bypass will contain one of the longest road tunnels in city environments in the world; the main tunnel will be 16.5 km long [28].

Applications: Many road tunnel safety applications already exist and will be further developed to increase road tunnel safety further [26-28]. The following are some applications that are planned to be available in the Stockholm Bypass tunnels.

Traffic surveillance system, the traffic in the tunnels will be monitored by cameras. By the use of steerable guidance signs, traffic can be diverted in case of traffic jams and obstacles on the road. With the help of booms, the entire tunnel system, or parts of it, can be turned off for maintenance work or in the case of an accident. There are also controllable information panels with text messages to users.

Figure 14. Illustration of infrastructure projects with many long tunnel parts needing new safety applications.

Still standing vehicles will be detected by cameras so that first responders can be directed to the site and other vehicles redirected by variable message signs. Moreover, a number of security systems will be activated in case of fire. Smoke and fire will be detected by the sensors. The traffic control centre can monitor the development of the fire and activate the fixed fire fighting system accordingly.

Communication support; tunnels are equipped with antenna systems and equipment for the retransmission of radio and mobile telephony. Particular important is that communication works for first responders. Police, fire and ambulance will have full coverage with their radio systems in the tunnels. The supporting communication systems will be powered by batteries as a backup and therefore work even when the power fails.

Air monitoring: fans are placed in the tunnels and polluted air is sent out through ventilation towers. For the fans to function optimally they are steered by an advanced measurement system that records pollution levels, visibility and air velocity.

In order to facilitate cooperation Stockholm region's public safety actors like traffic Stockholm, SOS Alarm and parts of the Fire department, responsible for crises managements and rescue operations plan to concentrate their resources in a common function – a collaboration centre called "Samverkanscentralen Stockholm". A new building will be erected in "Kungsholmen" which will include the Collaboration Centre and it is estimated to be ready 2014 [29].

There are also two large arena building projects ongoing. These arenas can be used for different type of events, for example soccer/football. Creating a pleasant, safe and secure environment as for the visitors is a main concern. For example, fire safety is accomplished by sprinklers, fire alarms and easy accessible escape routes and the arenas will be equipped with modern and advanced camera technology.

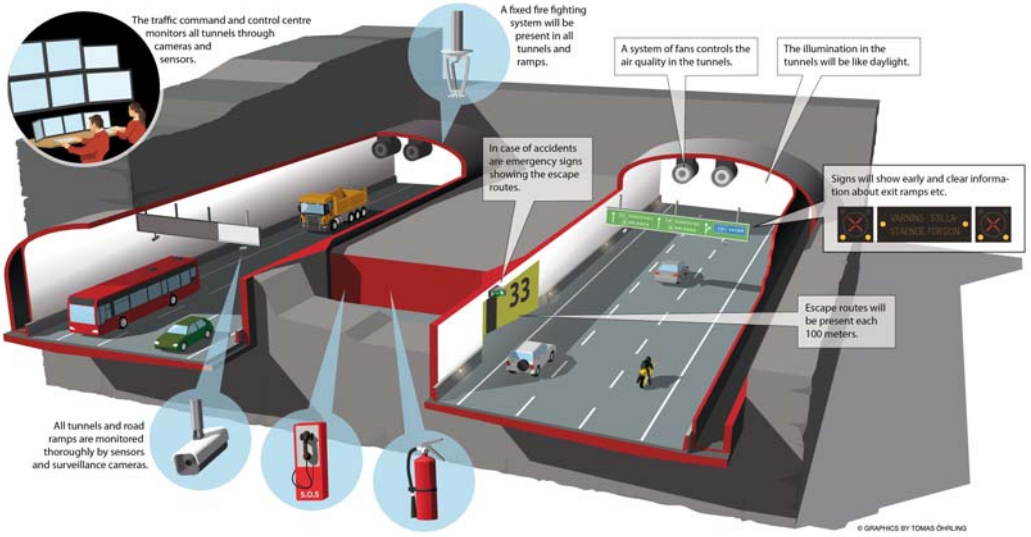

Figure 15. Illustration of public safety applications planned for E4 Stockholm Bypass [28].

5.5 Stockholm use case

The Stockholm use case will be based on a scenario, which is developed in cooperation with the Attunda Fire and Rescue Service and the Södertörn Fire and Rescue Service. The current capabilities in the Stockholm County are based on the county's geographic and organizational limitations. The geography is characterized by waterways, tunnels and bridges in combination with a fluctuating climate. The public safety setting in the county is characterized by a large number of public safety agencies. The geography and public safety setting is the basis for the scenario. The scenarios that public safety agencies, private organizations and citizens must be prepared for are many and complex. A scenario of such complexity is a bomb attack on a train in the tunnel under the Arlanda airport, which takes place during a stormy winter afternoon.

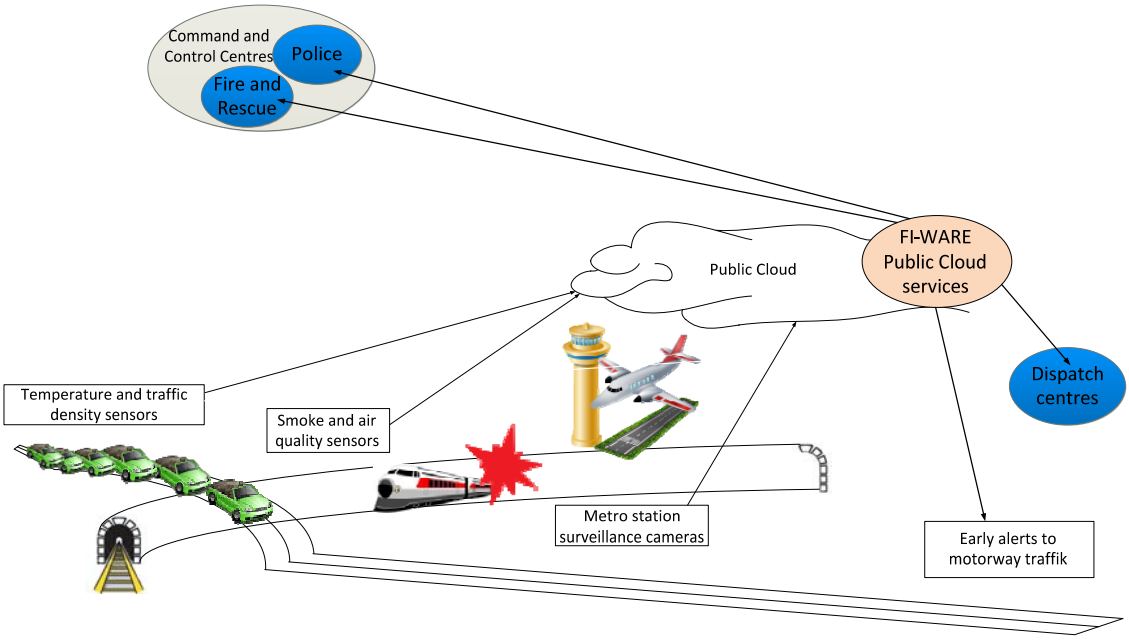

Figure 16. Illustration of Stockholm use case.

In such an event the fire and rescue services, police force and emergency medical services will be deployed The derailment of train causes serious disturbances of public transport and a total stop at the motorway and railway traffic in northern and central parts of the county. Traffic management and security are other essential elements of the response.

Examples of support that SafeCity can provide in such a scenario are data fusion for situation awareness and sensor information and improved communication capacity. Temperature and traffic density sensors would with appropriate data fusion capability provide for early traffic alerts and awareness information to dispatch centres. Smoke and air quality sensors would give early alerts and awareness information to fire and rescue services (Figure 16).

Annex A – Minutes of personal interviews

Workshop with Södertörn Fire and Rescue Service 2011-05-23

Södertörn Fire and Rescue Service gave a demonstration of the command centre and command vehicles. They demonstrated and described the commercial application LiveResponse. This is a tool for real-time sharing of streamed video, messages and notes together with GPS positions from mobile devices on the incident site sent to a web site. This web site is accessible from the command centre. They also use traffic surveillance cameras to get a picture of the present traffic conditions in Stockolm and to estimate the scale of accidents. The traffic surveillance cameras are also available at a public web site, see for example:

- http://www.trafiken.nu/sv/Stockholm/trafiklaget/
- http://www.trafiken.nu/sv/Stockholm/trafiklaget/Kameror/Innerstan/.

One conclusion from this workshop is that coordination between authorities is essential for incident management. Moreover, too many systems need to be used and one obstacle are logging in to and knowing how to use all these systems. It is not uncommon that a user needs passwords to more than 20 different systems. As a general comment, for new and more sophisticated applications to be valuable, in particular in the field (e.g., at mobile command centres) they need to be easy to use (user friendly) and reliable; otherwise rescue personal will go back to and use the older well-tried methods they know by experience will work.

Workshop with Attunda Fire and Rescue Service 2011-05-23

A demonstration of the ambulance and fire brigade vehicles was performed. It was obvious that many handheld communication and other devices had to be carried around by the personal. Therefore, for the future, integrating all communication devices into one multi-waveform radio would be beneficial. Another problem is that the integrity of ambulance patients limits what can be communicated between the ambulance and other public safety organisations. As an example they mentioned that before the new radio system RAKEL (TETRA) was in use, the fire brigade had access to ambulance position coordinates and could use this to faster navigate to the incident place. With RAKEL it is possible to encrypt such information, and due to the integrity of the patient in the ambulance, this information is not available to the fire brigade any more.

When discussing particular problems during winter conditions the following was mentioned. During severe traffic jams with long traffic stops under cold winter conditions, there is a high risk of vehicles running out of fuel so that people can not keep warm any more. People must then be evacuated from the vehicles and the vehicles need to be transported away. This requires a lot of extra resources and there is a need for early warning of this situation.

A risk by relying on public cellular communication systems is that the network can be overloaded during larger incidents when many users need to communicate at the same time. An issue that was raised was therefore whether it would be possible to give first responders priority in these systems.

Reliable and robust communication is essential and there is always a need for better capacity and connectivity. Ad hoc networks was discussed as a mean to improve the communication capabilities by providing connectivity at difficult places, or places without coverage, and to increase capacity

Using an UAV for situation awareness, and perhaps also communication, was mentioned as an interesting option but perhaps difficult to manage due to practical aspects such as handling the UAV equipment and getting permission for flying and video recording.

Team replacement may take time; therefore an application like the situation awareness picture for search team replacement was suggested for saving time.

The Stockholm Scenario for SafeCity was discussed. Attunda Fire and Rescue Service is positive to coordinate a large exercise together with the SafeCity Stockholm PoC. The scenario will be based on a derailment of an express train in a tunnel as the main incident. The scenario will be placed in the operational area of The Attunda Fire and Rescue Service, that is the northern part of the Stockholm County. The main incident will be followed by serious disturbances in the public transport systems and the road and railway traffic in the northern and central parts of the county. A detailed list of incidents, the storyline and other features of the scenario will be further developed.

Attunda expressed an interest in exchanging experience between first responders in other countries.

Annex B – Questionnaire

FP7-285556 SafeCity Project

SafeCity Questionnaire

LiveResponse and Situational awareness for Fire and Rescue services

Deliverable Type:	**CO**
Nature of the Deliverable:	**O**
Date:	
Interviewer Partner:	
Editors:	**FOI**

***Deliverable Type:** *PU= Public, RE= Restricted to a group specified by the Consortium, PP= Restricted to other program participants (including the Commission services), CO= Confidential, only for members of the Consortium (including the Commission services)*

**** Nature of the Deliverable:** *P= Prototype, R= Report, S= Specification, T= Tool, O= Other*

Abstract: This is the SafeCity questionnaire for end-users data collection.

It is really important to identify and characterize **existing applications or systems** that provide Public Safety members of similar functionalities belonging to any of the 4 areas presented. Please, identify exiting applications related to the different areas. For **each application** please respond the following questions:

STATE OF THE ART			
SUBJECT	**Q NR**	**QUESTION**	**ANSWER**
APPLICATION CHARACTERIZATION	Q1.	Indicate brief description of the application. In which situations/operations do you use this application? You could support your inputs with references to case scenarios and/or past incidents.	LiveResponse; A system allowing on scene commanders to share video, picture, messages with other commanding functions and command centres of the Attunda Fire & Rescue Service as well as other collaborating actors.
	Q2.	In which **SafeCity area** (A, B, C or D) do you frame this application?	Mostly A, but also partly B, C, D.
	Q3.	**Actuation procedure** followed during the utilization of this application.	A signal from a mobile device or camera is sent to the command centre by wireless communication as a first step.
	Q4.	Related to your organization operations, indicate key **requirements** of this application. Paying special attention on ICT needs (e.g. Band Width, rate (bps), latency, QoS, data storage requirements, trained/supervising personnel, energy costs, etc).	N/A
	Q5.	Which concrete sensors does your organization use for this application? What is the purpose of each of them? What is the format of the output data? Are these standardized with respect to fusion processes?	Camera, GPS, smart phones to record videos, take pictures and generate messages.
	Q6.	Is this an **automated process**? If so, up to which level? Does this include definition of data tags?	No, the first step is manual with the on scene commander as the operator.
	Q7.	What kind of type and data are being forwarded to the	N/A

STATE OF THE ART			
SUBJECT	**Q NR**	**QUESTION**	**ANSWER**
		citizens, regarding the original sensors outputs?	
	Q8.	How interrelated are the different families of sensors that you apply? How interoperable are the different technologies? How can one support/ complement the other? How can one affect the others in case of malfunction	GPS provides a position of where the picture/video has been taken as well as of the sending device.
	Q9.	**Advantages** of the use of this application.	Any on scene commander with appropriate equipment and the LiveResponse application installed send a video/picture/message to the command centre.
	Q10.	**Gaps** detected (e.g. additional info, inefficiencies, etc). Could you categorize such limitations as being a result of: ▪ current ICT development ▪ current integration lacks (interoperability issues) ▪ not full awareness of crisis situation requirements (advanced changes) ▪ Information management and network complexity	Dependability on the coverage of public wireless communication systems. Without such coverage no video/pictures/message can be sent without delay.
	Q11.	Would you see such **limitations** being corrected/refined via supported/back-up technology?	Better wireless coverage and capacity in certain situation and places, primarily rural areas (islands).
	Q12.	**Infrastructure** involved in this application (e.g. data bases, wired fibber connections, wireless standards, etc), private or public networks. Main constrains imposed by this infrastructure (e.g.data losses, network coverage, different networks	Wireless communication infrastructure and the Internet.

STATE OF THE ART			
SUBJECT	**Q NR**	**QUESTION**	**ANSWER**
		interpretabilities, data security, etc.)	
	Q13.	Is it Internet-based application? Does it use any internet connection?	Yes, it does.
	Q14.	Which information security policies do you use within this application?	Password protected WEB interface.
	Q15.	Which ethical, social and legal policies do your organization satisfies in order to make use of this application (e.g. considering sensitive data)? How does this affect your data formats and permissions?	Only authorized personnel can access the data that have been created and are stored on the server.

Please include the following answers regarding each specific area:

STATE OF THE ART			
AREA	**Q NR.**	**QUESTION**	**ANSWER**
AREA A: SITUATIONAL AWARENESS	Q16.	What social policies do you apply (e.g. regarding social division)?	N/A
	Q17.	Does your organization have different data sources (e.g. criminal data base)? In that case, please list them.	No dedicated databases, only public/open sources
AREA B: AD-HOC NETWORK	Q18.	Which communication networks are currently used between different bodies and among members of the same body (PMR, Radio TETRA, TETRAPOL, UHF, Radio, Satellite links, GSM/GPRS/UMTS, WiFi, WiMax, etc)?	GSM/GPRS/UMTS, Wifi, VHF. Tetra-based system is currently under implementation in the region.

STATE OF THE ART			
AREA	**Q NR.**	**QUESTION**	**ANSWER**
	Q19.	Does your current communication network satisfy all the needs you require to perform an efficient work when a special event or an emergency happen? Have you ever deploy portable base stations to improve covertures or capacity of the cellular network you are using? How effective is this approach (coverage, data quality, etc)? How efficient is this approach (cost/ benefit ratio)?	So far no such supporting communication technology have been used.
AREA C: ALERTING CITIZENS	Q20.	Which kind of incidents or situations do you consider important to be alerted of?	In particular when live is at risk, but also when environment and property are at risk.
	Q21.	How do you think it would be the best way to alert citizen about these incidents?	Having possibility to use many ways/systems for redundancy; Mobile phones, TV/radio, sirens, signs, Internet etc. For minor disturbances mobile public address systems can be good, for very serious accident all systems could be used
	Q22.	What social implications do you see arising (division, mass panic, etc) and which policies do you define in order to deal with these situations?	Sweden has a nationwide public warning system (VMA). with specific procedures how and when to alert citizen to avoid causing unnecessary mass panic.
AREA D: COMMAND CENTRE TECHNOLOGIES	Q23.	At which level(s) of your organization, control centre technologies are used? If several levels of your organization use control centre technologies could you precise information managed at each level of the organization? And relation between/role of each level of the organization?	One command and control center is used.
	Q24.	What anomalous situations do you consider important to be alerted of in the Command Post (Citizen Behaviour,	Anything that would require actions of first responder and other public safety agencies.

STATE OF THE ART			
AREA	**Q NR.**	**QUESTION**	**ANSWER**
		suspicious objects…)?	
	Q25.	What management direction do you follow regarding data fusion, distribution and overall coordination of the related processes? Mention if applicable, learned-by-experience lessons upon gradually moving to more efficient architectures.	ICT is to large extent outsourced and contracted on service-basis.

Beyond the state of the art			
AREA A Situational awareness	**Q Nr.**	**QUESTION**	**ANSWER**
Video Analytics Application	Q26.	What are the demands you pose on the operation **Video Analytics Application** (1= very important, 2=important, 3=less important, 4=unimportant) If possible, establish also some parameters related to each technical requirement:	▪ Orphan objects detection, intrusion detection, facial detection, face recognition: o [3] Distance o [3] Application environment (indoor, outdoor,…) o [3] Kind of object to be detected o [3] Cross check detection with Criminal Data Bases ▪ Anomalous pattern detection: o [3] Persons o [3] Objects ▪ Tracking of: o [1] Persons o [2] Objects ▪ [2] Speed in data processing once it has been collected ▪ [2] Working autonomy ▪ [1] Cost of maintenance (sensors maintenance and operation, data storage facilities, etc.) ▪ [1] Confidentiality

Beyond the state of the art			
AREA A Situational awareness	**Q Nr.**	**QUESTION**	**ANSWER**
			▪ [1] Requirements to configure and operate ▪ [3] Justification of algorithms in defining suspicious and anomalous behaviors. How do you define suspicious and anomalous behaviours ▪ Operating o [2] On demand o [3] Continuously ▪ [2] Interconnection with other sensors (triggering inputs / outputs). If so, specify what type of sensor/output would you find necessary? What would be a suitable shared data format?
	Q27.	Which characteristics do you consider important to define exact profile (Location, Time, Behaviour…)	
	Q28.	Evaluate how useful Video Analytics application could be to your specific organization (1= very important, 2= important, 3= less important, 4= unimportant)	2
	Q29.	In your opinion, what are the challenges to integrate this application into your activities performed during prevention and preparedness phases? (connectivity, trained personnel, additional data processing, etc)?	
	Q30.	Which scenarios you consider that would be applicable to	To understand citizen behaviour, if a situation is

Beyond the state of the art			
AREA A Situational awareness	**Q Nr.**	**QUESTION**	**ANSWER**
		Video Analytics application? Please refer to potential as well as past incidents applicable	threatening
	Q31.	Given your existing experience, what social, ethical and legal implications would you see to arise? What respective policies could your organization apply in each case?	
Real time Positioning for Decision support Application	Q32.	What are the demands you pose on the operation **Real-Time Positioning for Decision Support Application** (1= very important, 2=important, 3=less important, 4=unimportant) If possible, establish also some parameters related to each technical requirement:	▪ [ ] Distance: …… ▪ [ ] Application environment ▪ [ ] Working autonomy: …… ▪ [1] Cost of maintenance: …… ▪ [1] Reliability: …… ▪ [1] Confidentiality ▪ [1] Requirements to configure and operate: ……
	Q33.	Which scenarios you consider that would be applicable to Real-Time Positioning for Decision Support application? Please refer to potential as well as past incidents applicable	To keep track of all people inside buildings (and tunnels etc); search/first responder personal as well other people

Beyond the state of the art			
AREA A Situational awareness	**Q Nr.**	**QUESTION**	**ANSWER**
	Q34.	Please precise for scenarios you describe at which operational level location information is relevant (on a local PDA, on a mobile Control Command vehicle screen, on a global city control room screen? Other?) ▪ What kinds of vehicles are interesting to locate/track? In which situation? ▪ In which situation is it interesting to locate and/or track a specific person? ▪ When tracking information is not available anymore (vehicle/person goes out of the scope of cameras), would it be interesting to have some information for decision support such as re-apparition zone of the person/vehicle? ▪ What kinds of events are interesting to locate? In which situation?	In particular at low level, so first responders now where to search after persons, and to know where first responders already searched.
	Q35.	Evaluate how useful Real time Positioning for decision support application application could be to your specific organization (1= very important, 2= important, 3= less important, 4= unimportant)	1
	Q36.	In your opinion, what are the challenges to integrate this application into your activities performed during	

Beyond the state of the art			
AREA A Situational awareness	**Q Nr.**	**QUESTION**	**ANSWER**
		prevention and preparedness phases?	
	Q37.	Given your existing experience, what social, ethical and legal implications would you see to arise? What respective policies could your organization apply in each case?	
Road Track and environmental sensors application	Q38.	What are the demands you pose on the operation of SafeCity **Road track & environmental sensors application** (1= very important, 2= important, 3= less important, 4= unimportant) If possible, establish also some parameters related to each technical requirement:	▪ [3] Detect unusual traffic patterns ▪ [1] Identification of incident ▪ [3] Sense critical environmental changes ▪ [3] Monitoring of structural health of bridges and buildings ▪ [1] Monitoring of inhospitable/dangerous environments ▪ Weather station o [3] Temperature o [3] Weather conditions o [3] Weather forecast ▪ Road General condition o [1] Ice o [2] Snow

Beyond the state of the art			
AREA A Situational awareness	**Q Nr.**	**QUESTION**	**ANSWER**
			o [2] Rain ▪ Events and occasions o [3] Holidays and vacation periods o [3] Tourist seasons (visitors not aware with the area) o [3] Grand seasonal events ▪ Speed in data processing once it has been collected ▪ [1] Reliability ▪ [1] Confidentiality
	Q39.	Please specify what kind of information your organization would require to receive from the respective technology, in order to foresee such risks. Please refer to appropriate case scenarios, where possible.	If there will be risk for an dangerous traffic congestion, in particular in winter time. When will vehicles start to run out of fuel. Will emergency vehicles be able to pass?
	Q40.	Evaluate how useful Road Track and environmental sensors application could be to your specific organization (1= very important, 2= important, 3= less important, 4= unimportant)	2
	Q41.	In your opinion, what are the challenges to integrate this application into your activities performed during prevention and preparedness phases?	

Beyond the state of the art			
AREA A Situational awareness	**Q Nr.**	**QUESTION**	**ANSWER**
Intelligent transportation system	Q42.	Would you consider an intelligent transportation system to be an important part of the city's infrastructure? Which parameters do you consider the most important? (1= very important, 2= important, 3= less important, 4= unimportant)	▪ [3] Automatic activation of breaking systems or fuel control. ▪ [3] Maintain driver and passenger comfort and safety through the use of sensors for airbags control and seatbelt pre-tensioning. ▪ [3] Use of sensors for fatigue and mood monitoring to ensure safe driving ▪ [3] Use of a broad city-wide distributed sensor network to indicate traffic flows, administer tolls or provide continually updated destination routing feedback to individual vehicles. ▪ [3] Use of global and local information, combining GPS information with cellular networks

Beyond the state of the art			
AREA B: Ad-hoc Networks	**Q Nr.**	**QUESTION**	**ANSWER**
Ad-hoc Network application	Q43.	What are the demands you pose on the operation of SafeCity **Ad-hoc Network application** (1= very important, 2= important, 3= less important, 4= unimportant) If possible, establish also some parameters related to each	▪ [1] Characteristic of devices: weight, size, robustness, accuracy, etc ▪ [1] Node time deploy

Beyond the state of the art			
AREA B: Ad-hoc Networks	**Q Nr.**	**QUESTION**	**ANSWER**
		technical requirement:	▪ [ ] Kind of data ▪ [ ] BW ▪ [1] Reliability ▪ [ ] Supporting data storage on the field ▪ [2] Allowing sensors intercommunications in the field (in such case, please reference families of sensors of which you would consider necessary/important to be integrated on a defacto basis
	Q44.	Evaluate how useful Road Track and environmental sensors application could be to your specific organization (1= very important, 2= important, 3= less important, 4= unimportant) In your opinion, what are the challenges to integrate this application into your activities performed during prevention and preparedness phases?	
	Q45.	Which scenarios you consider that would be applicable to Ad-hoc Network application?	When existing communication infrastructure is not function properly (good enough), for example destroyed, overloaded, lack of coverage.

Beyond the state of the art

AREA C: Alerting Citizens	Q Nr.	QUESTION	ANSWER
Alerting Citizens applications	Q46.	Which applications do you consider useful to be part of your daily operation? Including in each case: ▪ Which requirements/demands would you have regarding to this application? ▪ Evaluate how useful this application could be to your specific organization (1= very important, 2= important, 3= less important, 4= unimportant) ▪ In your opinion, what are the challenges to integrate this application into your activities performed during prevention and preparedness phases?	Be able to alert only citizens who are affected of an incident in an efficient way to avoid sending out unnecessary alerts, perhaps by using mobile phones.

Beyond the state of the art			
AREA D: Command Centre Technologies	**Q Nr.**	**QUESTION**	**ANSWER**
Decision Support System application	Q47.	What are the demands you pose on the operation of SafeCity **Decision Support System** (1= very important, 2= important, 3= less important, 4= unimportant). If possible, establish also some parameters related to each technical requirement.	▪ [ ] Working autonomy: ..... ▪ [ ] Facilitate to configure and operate: ..... ▪ [1] Reliability: ..... ▪ [ ] Work distribution and decentralization: .....
	Q48.	Evaluate how useful Decision Support System application could be to your specific organization (1= very important,	The main problem today, is the large number of such system in use. Integrating them into one with just one

		2= important, 3= less important, 4= unimportant) In your opinion, what are the challenges to integrate this application into your activities performed during prevention and preparedness phases?	unified user interface would be excellent but probably an unrealistic vision. But if the number of systems could be limited it would be beneficial.

Please indicate if you considered any other application that might not adjust to the previous areas, including:

Beyond the state of the art			
AREA D: Others	**Q Nr.**	**QUESTION**	**ANSWER**
Other applications	Q49.	Which applications do you consider useful to be part of your daily operation? Including in each case: ▪ Which requirements/demands would you have regarding to this application? ▪ Evaluate how useful this application could be to your specific organization (1= very important, 2= important, 3= less important, 4= unimportant) ▪ In your opinion, what are the challenges to integrate this application into your activities performed during prevention and preparedness phases?	
Ubiquitous Sensor Network	Q50.	Would you consider important the existence of a Ubiquitous Sensor Network (USN), a term which is used to describe a network of intelligent sensors (including people with their mobile phones) that could appear everywhere? A USN can be used to provide an intelligent information infrastructure to support a multitude of different	An interesting idea to get an better situational awareness picture over an incident area and the surroundings

		applications (utility infrastructure, buildings, roads, rails, vehicles, goods, people…) ▪ Which requirements/demands would you have regarding to this vision? ▪ Evaluate how useful this application could be to your specific organization (1= very important, 2= important, 3= less important, 4= unimportant) ▪ In your opinion, what are the challenges to integrate this application into your activities performed during prevention and preparedness phases	