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Abstract: This document describes Madrid City Council Public Safety Scenario.

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Glossary

Acronym	Meaning
3G	Third Generation
ADSL	Asymmetric Digital Subscriber Line
AENA	Spanish Airports and Air Navigation – Aeropuertos Españoles y Navegación Aérea
AEPD	Spanish Data Protection Authority – Agencia Española de Protección de Datos
CCTV	Closed Circuit Television
CISEM	The integrated Security and Emergency Center of Madrid
CISEVI	Integrated Video Signal Centre
DAI	Incidents Automatic Detection – Detección Automática de Incidentes
DGT	Spanish Traffic General Direction
e-commerce	electronic commerce
EMT	Madrid's Municipal Transport Corporation - Empresa Municipal de Transportes
EPA	Spanish Active Population Survey – Encuesta de Población Activa
ERU	Universal Remote Station – Estación Remota Univeral
EU	European Union
FO	Optical Fiber
EPAFTTH	Spanish Active Population SurveyFiber To The Home
GDP	Gross Domestic Product
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
ICT	Information and communications technology
INE	Spanish Statistic National Institute – Instituto Nacional de Estadística
INTECO	Spanish National Institute of TIC – Instituto Nacional de las Tecnologías de Comunicación
ITS	Intelligent Traffic System
LOPD	Organic Law for Data Protection
M-30	Main Bypass of Madrid
MCC	Madrid City Council
PBX	Private Branch Exchange
PCPMN	Priority Communications on Public Mobile Networks
PDA	Personal Digital Assistant
PTZ	Pan-Tilt-Zoom
QoS	Quality of Service
RDSI	Integrated Services Digital Network – Red Digital de Servicios Integrados

RTC	Switched Telephone Network – Red Telefónica Conmutada
TETRA	Terrestrial Trunked Radio
UMTS	Universal Mobile Telecommunications System
VSAT	Very Small Aperture Terminal

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[11]	http://www.renfe.com/viajeros/cercanias/index.html
[12]	Municipal Transport Corporation Annual Report, 2009. http://www.emtmadrid.es/web_emt_babel/files/55/55ebb532-d3b0-48ac-bf4c-421a692631a2.pdf
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1. Introduction

One of the key points of the SafeCity project is to define accurately end user requirements in order to obtain optimum benefits from the project implementation. In this case the collection of information regarding already existing systems is crucial. Moreover, needs and functionalities not yet implemented in safety and security fields must be identified.

1.1 Purpose of the document

This document describes Madrid Public Safety state of the art. One of the key points of the SafeCity project is to define accurately enduser requirements in order to obtain optimum benefits from the project implementation. The day to day experience of Madrid Council in security and emergency issues makes it ideal to lead this task in the city of Madrid. In fact Madrid is pioneer in technological solutions applied to the city security and emergencies management. Thus the use of technologies applied to the security and emergency services is one of the strategic action lines of Madrid City Council developed from 2004 working for a more secure Madrid (*Madrid Seguro* project) [1]. Indeed one of the focus points was to apply the latest technologies available or work in innovative ones to achieve the best results in the emergencies and security field.

1.2 Scope and structure

Madrid City Council has made a big effort investing in technology in order to provide a better service in safety and security in the city of Madrid. The scope of this report is to identify the current situation of Madrid in terms of available ICT infrastructures, normative, operations, capabilities, etc. and Public Safety. The information is classified by functionality areas, described in detail and provided as first step of basic enablers and requirements definition. In addition, issues like social and ethics have been taken in consideration.

This report describes the current systems used by Madrid Police Department, regarding video surveillance among others, and as all systems they can be improved. Chapter 5 identifies some current limitations and gaps but also some ongoing innovative initiatives and ideas for the future.

2. MCC general overview

2.1 Population and economy. General figures.

Madrid is the capital and largest city of Spain with 3.273.043 inhabitants [2]. In terms of population Madrid ranks the second largest city of the European Union behind Berlin. The City of Madrid has the 51.2% of the population of the Region of Madrid as a whole, which, with 6.45 million inhabitants, represents the third largest metropolitan area in Europe after Île-de-France and Greater London. The city spans a total of 604.3 km² and is divided administratively into 21 districts [3]. Madrid population density is 5.334,77 hab/km².

Madrid is located in the middle of Spain and Manzanares River goes through the city.. As capital city of Spain, Madrid is seat of government and residence of the Spanish monarch, as well as the political center of Spain. The current mayor is Alberto Ruiz-Gallardón who is an active member of the People's Party (Partido Popular). He was elected in the last local elections on the 22nd of May 2011, becoming this one on his third mandate. The City Council consists of 57 members, one of them being the Mayor who presides over the Council. The Plenary of the Council is the body of political representation of the citizens in the municipal government. Some of its attributions are: fiscal matters, the election and deposition of the Mayor, the approval and modification of decrees and regulations, the approval of budgets, the agreements related to the limits and alteration of the municipal term, the services management, the participation in supramunicipal organizations, etc. Nowadays, mayoral team consists of the Mayor, the Vice-Mayor and 7 Delegates; all of them form The Board of Delegates (the Municipal Executive Committee) [6].

Madrid's population has increased over recent years due mainly to the considerable inflow of foreigners. The foreign citizens currently are 16.92% of the city's total population (557,117 on the 1st January 2011), in deep contrast to the 2.8% reported in 1999 [7].

Gross Domestic Product (GDP) for the City of Madrid in 2009 was estimated at 128,211 million euro, representing 67.8% of total GDP for the Region of Madrid as a whole, and 12.2% of total Spanish GDP, placing it considerably above the relative weighting of the population in each of these two areas. Industry (mainly graphics, energy, chemicals, transport and electronics) contributes 7.4% of total production, while construction accounts for 7.9%. The services sector contributes with 84.7% to the total economic activity. The most notable of these services are corporate services, followed by transport and communications, property and financial services. These four groups generate 51% of gross value added for Madrid's economy and 62% of gross value added for the services sector [8].

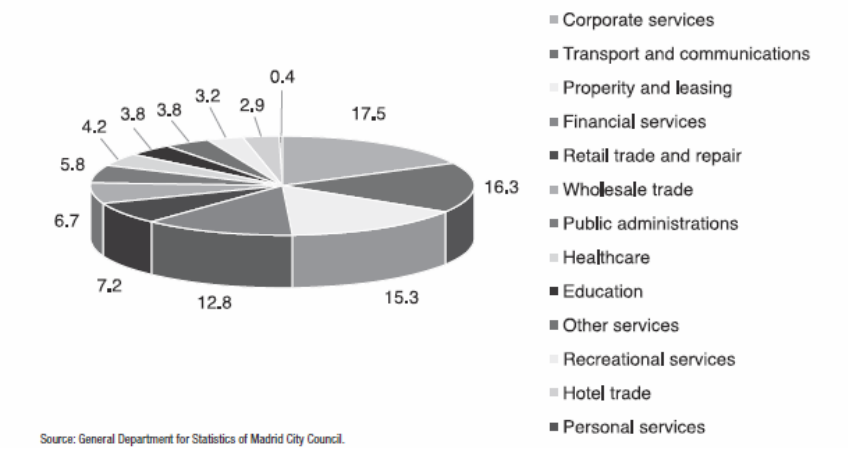


Figure 1. Madrid Economy by sectors

Tourism is especially important in Madrid City, providing employment to a large part of its population in the retail trade, hotel and transport sectors and the leisure industry. Overall figures for 2009 recorded 7.2 million visitors and 13.7 million overnight stays [3].

GDP per capita for Madrid, measured both in nominal terms and in terms of purchasing power parity, is at the head of Spain. As regards purchasing power, the city stood at 75% above the Spanish average for 2009 and 80% above the average for the 27 member states of the European Union [3].

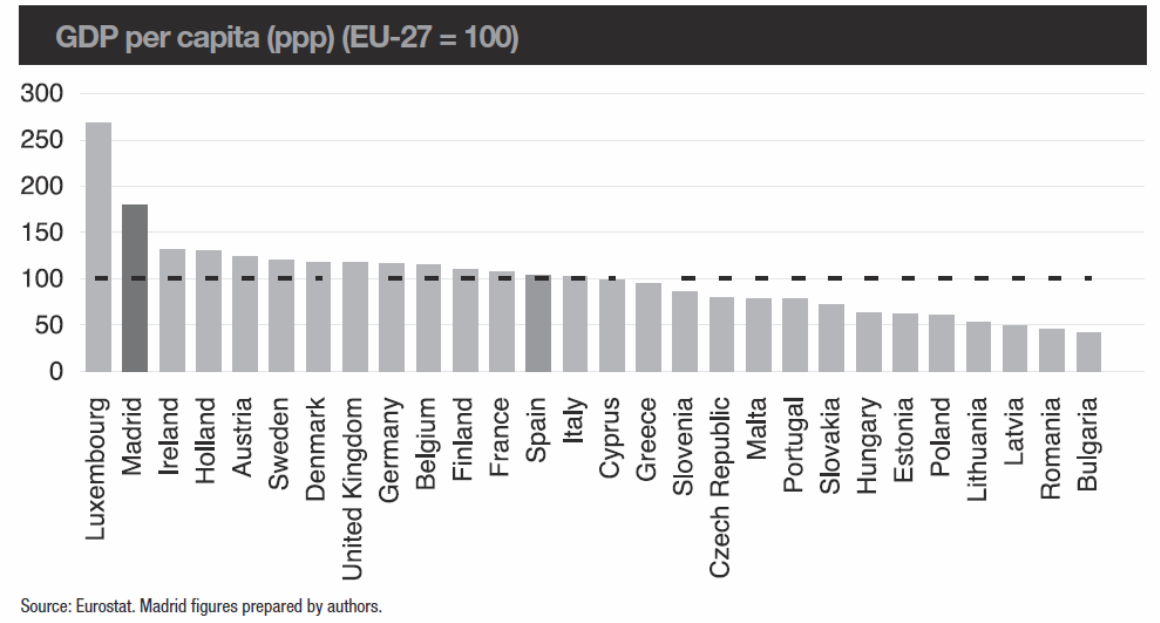


Figure 2. GDP per capita per Madrid EU comparison

According to EPA data (Spanish Active Population Survey, third quarter 2010, INE) 62.5 % of population older than 16 years was active. The sector that employs most Madrid citizens is services, in line with the

hefty weighting of this sector within the city's economy. The number of workers employed in this particular sector stands at 86.1% of total workers. In contrast, 7.9% of Madrid citizens work in industry and 5.8% in construction. The unemployment rate is 15.6 % of the economically active population [3].

2.2 City areas

Madrid, the capital city of Spain, is politically organized with a division in 21 districts (distritos), which are further subdivided into 128 wards (barrios). All districts are governed by an organ named Junta Municipal de Distrito, which are part of the City Council.

Administrative Division of Madrid		
Districts and Wards (last arrangement of 1988)		
	Districts	**Wards**
1	Centro	Palacio, Embajadores, Cortes, Justicia, Universidad, Sol.
2	Arganzuela	Imperial, Las Acacias, La Chopera, Legazpi, Las Delicias, Palos de Moguer, Atocha.
3	Retiro	Pacífico, Adelfas, Estrella, Ibiza, Jerónimos, Niño Jesús.
4	Salamanca	Recoletos, Goya, Fuente del Berro, Guindalera, Lista, Castellana.
5	Chamartín	El Viso, Prosperidad, Ciudad Jardín, Hispanoamérica, Nueva España, Castilla.
6	Tetuán	Bellas Vistas, Cuatro Caminos, Castillejos, Almenara, Valdeacederas, Berruguete.
7	Chamberí	Gaztambide, Arapiles, Trafalgar, Almagro, Vallehermoso, Ríos Rosas.
8	Fuencarral-El Pardo	El Pardo, Fuentelarreina, Peñagrande, Barrio del Pilar, La Paz, Valverde, Mirasierra, El Goloso.
9	Moncloa-Aravaca	Casa de Campo, Argüelles, Ciudad Universitaria, Valdezarza, Valdemarín, El Plantío, Aravaca.
10	Latina	Los Cármenes, Puerta del Ángel, Lucero, Aluche, Las Águilas, Campamento, Cuatro Vientos.
11	Carabanchel	Comillas, Opañel, San Isidro, Vista Alegre, Puerta Bonita, Buenavista, Abrantes.
12	Usera	Orcasitas, Orcasur, San Fermín, Almendrales, Moscardó, Zofío, Pradolongo.
13	Puente de Vallecas	Entrevías, San Diego, Palomeras Bajas, Palomeras Sureste, Portazgo, Numancia.
14	Moratalaz	Pavones, Horcajo, Marroquina, Media Legua, Fontarrón, Vinateros.

15	Ciudad Lineal	Ventas, Pueblo Nuevo, Quintana, Concepción, San Pascual, San Juan Bautista, Colina, Atalaya, Costillares.
16	Hortaleza	Palomas, Valdefuentes, Canillas, Pinar del Rey, Apóstol Santiago, Piovera, Sanchinarro.
17	Villaverde	San Andrés, San Cristóbal, Butarque, Los Rosales, Los Ángeles.
18	Villa de Vallecas	Casco Histórico de Vallecas, Santa Eugenia.
19	Vicálvaro	Casco Histórico de Vicálvaro, Ambroz.
20	San Blas	Simancas, Hellín, Amposta, Arcos, Rosas, Rejas, Canillejas, Salvador.
21	Barajas	Alameda de Osuna, Aeropuerto, Casco Histórico de Barajas, Timón, Corralejos.

Table 1 Districts of Madrid

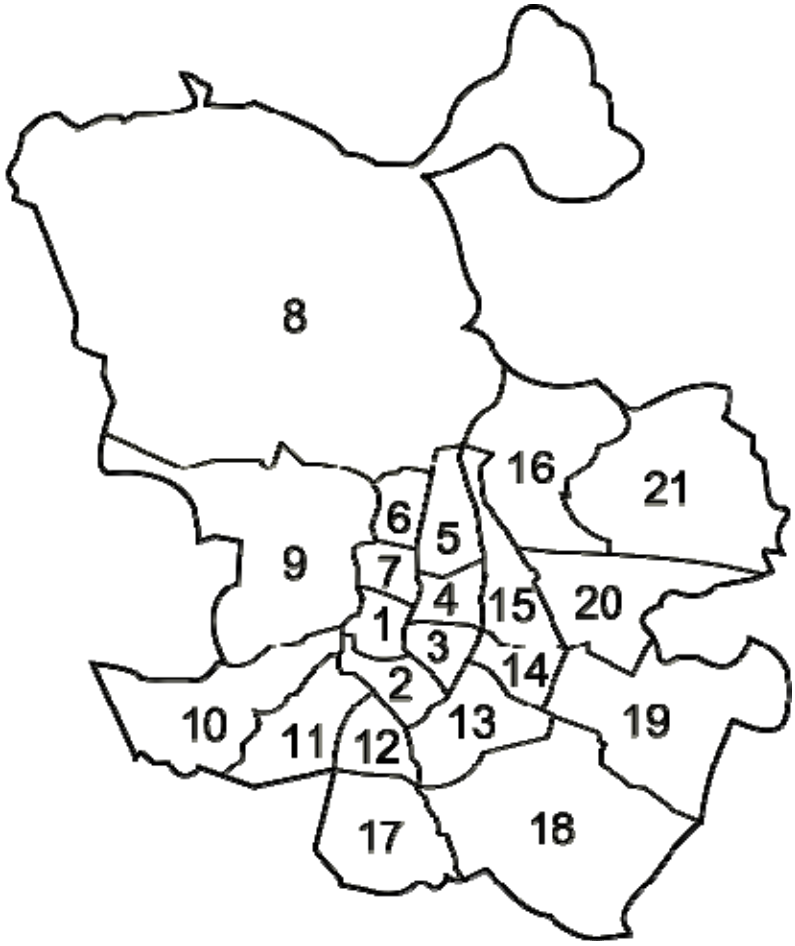


Figure 3. Administrative Division of Madrid

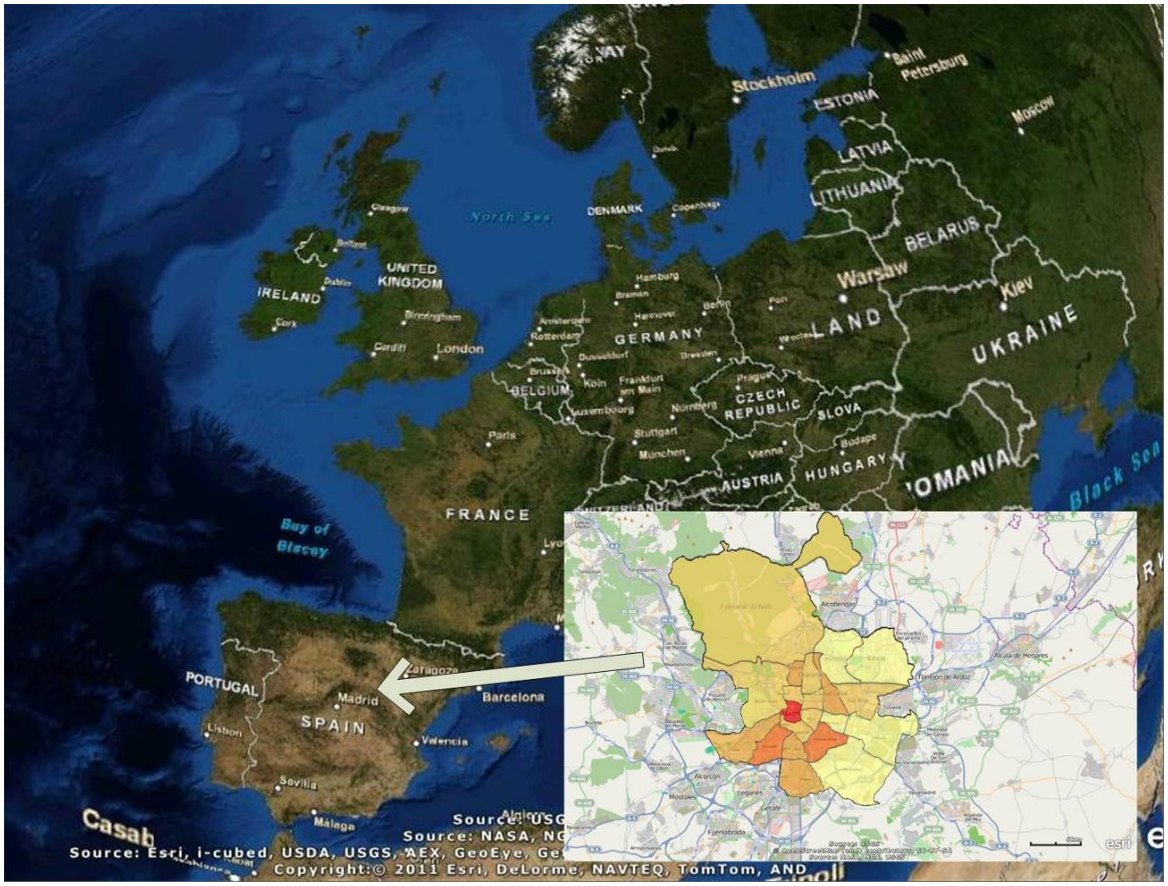


Figure 4. Criminality rate. 2003/2009

A very important result is what citizens perceive. In this case citizens feel much safer year by year in Madrid. Every year The Security Observatory of the city launches a survey to measure how Madrid citizens feel about security and safety.

2.3 Climate

The Madrid region features a Continental Mediterranean climate with cold winters in winter due to altitude (650m over the sea level), including sporadic snowfalls and minimum temperatures often below freezing. Summer tends to be hot with temperatures that consistently surpass 30 °C (86 °F) in July and August and rarely above 40 °C (104 °F). Due to Madrid's altitude and dry climate, diurnal ranges are often significant during the summer. Precipitation is concentrated in the autumn and spring. It is particularly sparse during the summer, taking the form of one or two showers and/or thunderstorms.

2.4 Religion

There is not available information about religious beliefs related to Madrid City. The only accessible information covers the whole territory of Spain and is dated in 2009. According to this survey carried

out by the Centre for Sociological Research of Spain, a 76% of Spanish habitants consider themselves Catholics, a 13% are unbelievers, a 7.3% atheists and a 2.1% of the habitants follows other religion [9].

2.5 Culture and Education

There are 631 state schools in Madrid, 572 private schools and 438 grant aided schools. There are 39 public libraries run by the City Hall and 55 municipal sport facilities.

There are 15 universities in the Region of Madrid; 7 of them are State Universities. In Madrid City Council there are the following Centers: Universidad Complutense and Universidad Politécnica, both state universities and Universidad CEU San Pablo and Universidad Pontificia de Comillas, private ones.

2.6 Major Events and leisure locations

Madrid is one of the most active cities of Europe from the point of view of events and happenings. Regarding football stadiums, Santiago Bernabeu Stadium holds national league football matches almost every week and also European Champions League matches. The stadium has 77,500 seats. During 2009-10 season, there were more than 447 events and only 27 of them were football matches, the rest were concerts, institutional and commercial happenings, among others. There is also another big football stadium, Vicente Calderon Stadium with 54.851 seats.

Madrid also has the Magic Box. It is a multifunctional center designed to carry out sporting events, shows, conventions, presentations... The extension of this facility is 103,365 squared meters. There are 3 big covered tennis courts with a capacity for 12,000, 3,500 and 2,500 spectators. There are also 11 indoor courts, 5 of them with seats and 6 for training. Right now it is used for the tennis competition of Madrid Masters and the matches of Real Madrid Basketball team.

Another representative place of Madrid is Las Ventas Bullring. It has 23,798 seats. The main bullfights are held on May during San Isidro festivities, Madrid Patron Saint. Las Ventas is also used for music concerts and other events during the whole year.

Regarding Madrid Sports events, one that has to be pointed out is Madrid Marathon, which represents one of the most important athletic happening of Spain. During 2011 edition, there were more than 250,000 participants. The other public athletic event that is carried out in Madrid is the San Silvestre Vallecana, a 10 Km race with the participation 0f 34,000 runners.

Many other events are celebrated in Madrid during the year. For instance, on the 16-21 of August 2011 was held the World Youth Day with the participation of nearly 2.000.000 people.

2.7 Information Society

In the following tables there are included the most relevant figures regarding Information Society, dealing with enterprises and citizens in Madrid City Council.

Information Society - Enterprises [4]	**%**
Use of the PC in enterprises. (Percentage over the overall enterprises)	91,4%
Enterprises connected to Internet. (Percentage over the overall enterprises)	97,5%

Type of Internet Connection	
ADSL	92,29%
Fiber Optics	5,02%
Satellite	1,02%
RTC	
RDSI	0,3%
Laptop card connection	2,1%
Mobile Internet – PDA	0,7%
Mobile Broad Band	0,6%
Enterprises with corporative web	56,4%
Use of e-commerce by enterprises	50,4%
Enterprises using on-line payment methods – buys	30,2%
Enterprises using on-line payment methods – sales	3,7%
Enterprises using on-line marketing	14%
Enterprises using electronic signature	45,8%

Table 2 ICT use by enterprises

Information Society – Enterprises [4]		
Investment in ICT by enterprises		
Amount invested	**Madrid City Council**	**Spain**
0 €	12.3%	16.3%
< 1,000 €	17.1%	17.3%
1,000 € < 2,999 €	15.1%	20.9%
3,000 € < 5,999 €	13.1%	13.7%
6,000 € < 29,999 €	11.3%	10.4%
30,000 € < 100,000 €	4.1%	2.5%
> 100,000 €	0.8%	0.7%
No replay	26.2%	18.2%

Table 3 ICT investment by enterprises

Information Society – Enterprises [5]	**Number of enterprises**
Enterprises advised by Madrid City Council regarding ICT issues (2004-2010)	58,961 enterprises
Enterprises trained in ICT by Madrid City Council (2004-2010)	19,128 enterprises
Enterprises participating in on-line activities managed by Madrid City Council (2004-2010)	96,261 enterprises

Table 4 Madrid City Council promotion of ICT activities for enterprises

Information Society – Households [5]	**Data**
Households with Personal Computer	72%
Household with Internet access	63,9%
Households with broadband (ADSL, Red de cable, etc.)	61,8%
Households with phone fixed line	90,1%
Households with mobile phone line	95,5%
Internet use by citizens during the last 3 months	70,9%
Citizens who has use Internet for buying purposes in the last 3 months	36,3%
Number of ICT training rooms of Madrid City Council	34
Madrid Public spots with Internet access	163

Table 5 ICT use by citizens

2.8 Criminality

Crime in Madrid is at the lowest levels of the last decade. Crime in Madrid has decreased 13 points in the last seven years and nearly 3% during 2010. The best results occurred in faults (less serious criminal offenses and without imprisonment) with a decrease of 9.6%. Crimes reported a decrease of 3.5%. The theft of vehicles fell by 22%, pulling 17.11% and 11.76% a robbery.

The chart below shows that during 2010 Madrid Police Department managed 725.000 incidents. Most of incidents came from 092 calls (direct phone to the Police Services of Madrid); 31% from 112 (regional phone to manage emergencies) and the rest from other agencies that phone directly like Metro, the bus system and so on. In order to manage Madrid security, the Police Department of Madrid has 7000 policemen and 600 vehicles. All the incidents reported by the citizens are managed by the Command and Control Center CISEM where there are 200 policeman working.

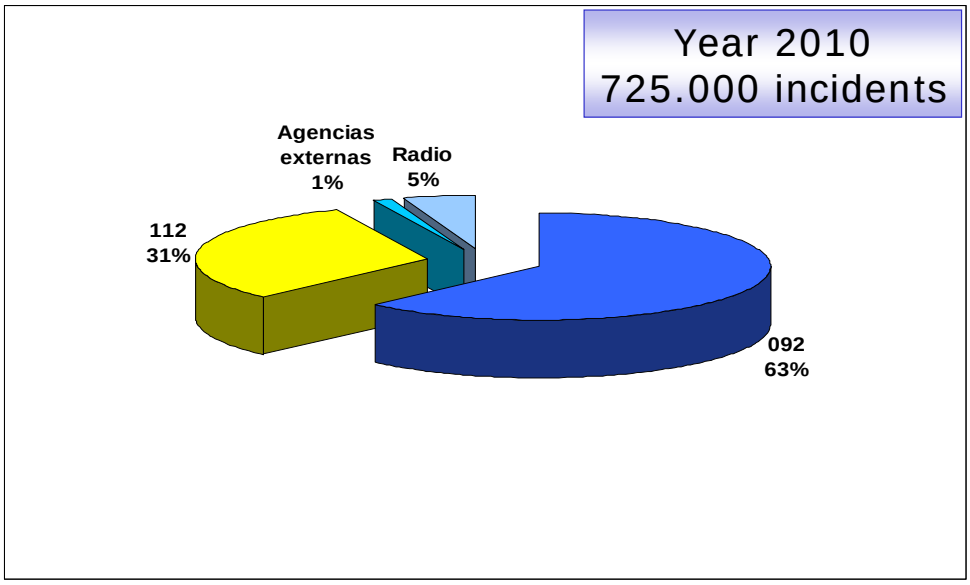


Figure 5. Incidents per year. 2011

The next figure shows the decrease of the percentage of the criminality from 2003/2009 for MCC meanwhile the results are not as positive for Madrid Region and for the Rest of Spain where the results is the increase of this ratio. There has been many strategies carried out by Madrid City Council in order to achieve this results (as part of the Strategic Plan Madrid Seguro [1]), the technological ones have been one of them, and they have contributes to the final results

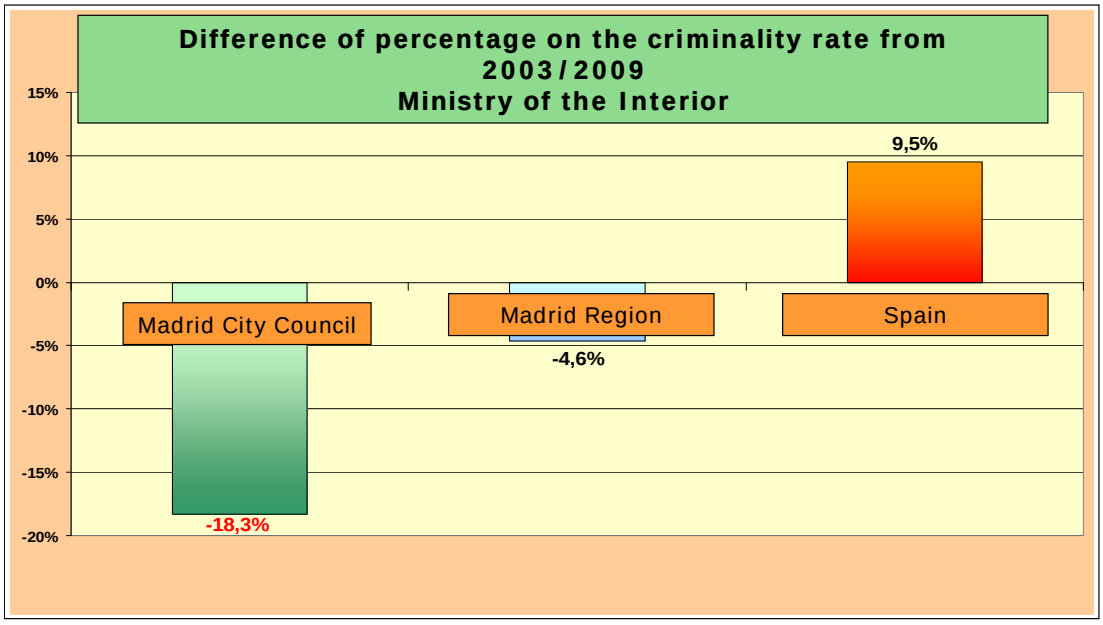


Figure 6. Criminality rate. 2003/2009

A very important result is what citizens perceived. In this case citizens feel much safer year by year in Madrid. Every year The Security Observatory of the city launches a survey to measure how Madrid citizens feel about security and safety.

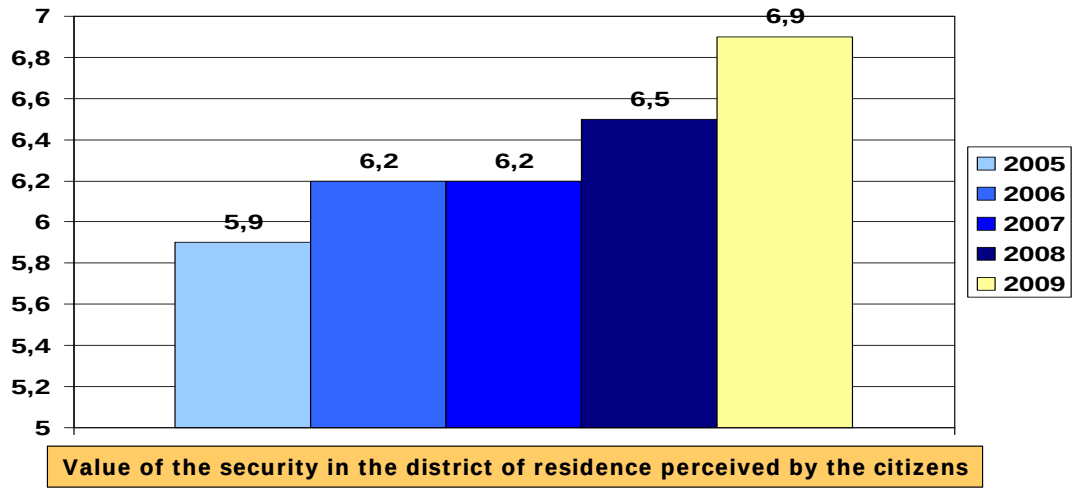


Figure 7. Security in Madrid districts

Another value to take into account is the effectiveness of Madrid Police. In this case as the graph below shows Madrid Police is very effective and arrives in a short period of time to the incidents. This rate is very representative and is one of the compromises of Madrid Police Department. The goal is to arrive to 80 % of critical incidents in less than 8 minutes, which is nearly achieved.

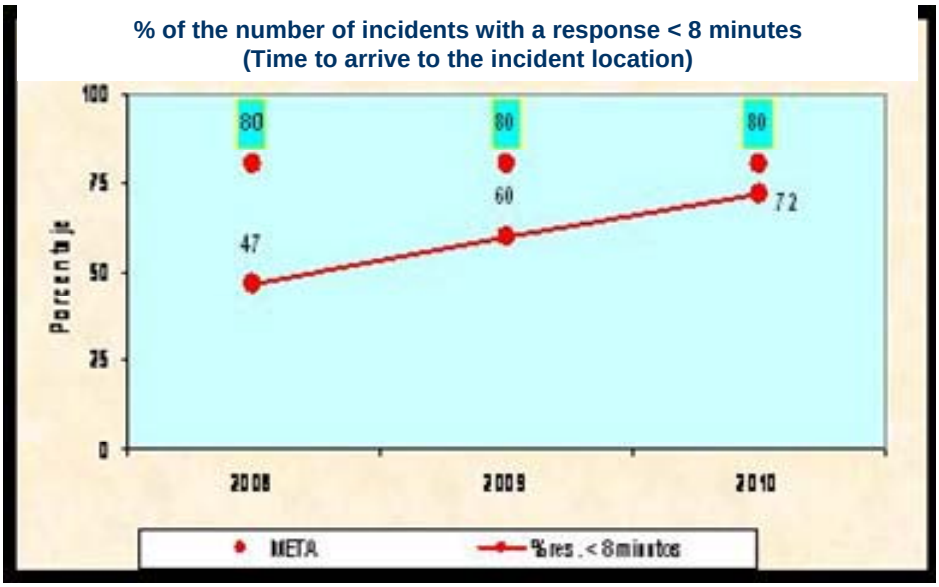


Figure 8. % of Incidents with fast response

In relation with video surveillance and criminality rate, the chart bellows is a proof of how the demand of police intervention has decreased in areas with street video surveillance. These types of systems are installed in specific risky areas of Madrid. Right now there are 118 cameras in the street and probably this number will increase during 2011.

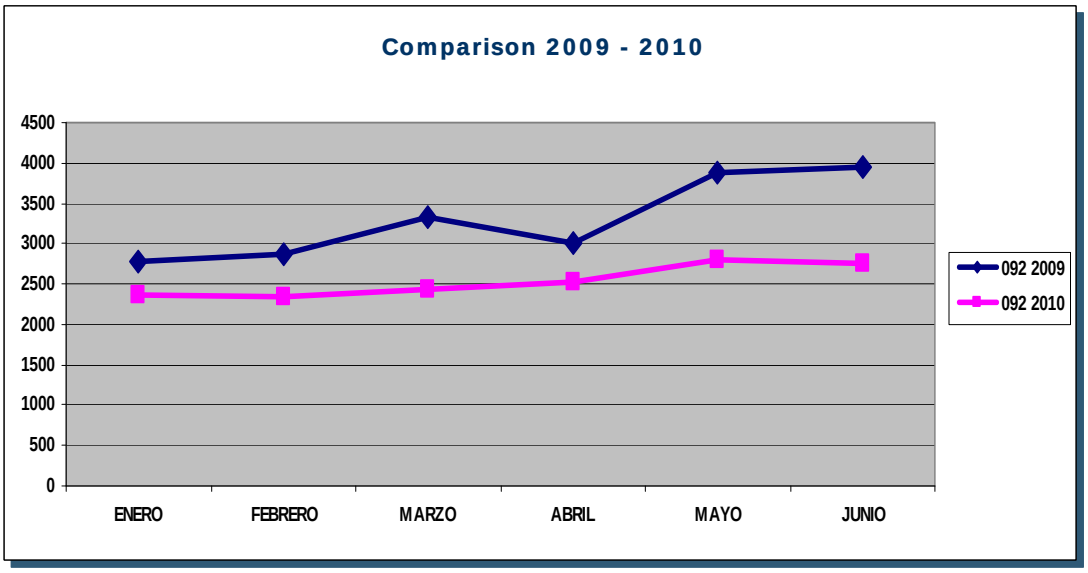


Figure 9. Incidents before (2009) and after (2010) surveillance systems installation

2.9 Critical Infrastructures

In this point are described Madrid City Council critical infrastructures, dealing with safety issues, regarding transportation systems (airports, railway network, harbours, train/metro stations, tunnels), and security services facilities (Command centres), etc.

2.9.1 Transportation infrastructures

One of Madrid's greatest assets is its network of transport infrastructures, which effortlessly connect the city with regional, national and international locations. As regards the latter, the Madrid Underground plays a pivotal role by covering vast areas of the city and even stretching beyond. Over the last twelve years, underground network has expanded by nearly 250% and by 22% in the last two years alone to span a total of 293 kilometres, making it the second largest in Europe with only the London Underground lying ahead. The number of passengers that used Madrid Underground in 2010 was 627 millions [10].

Partnering the metro we have the commuter rail service, which boasting about 339 kilometres of track among ten different lines, some of which operate as frequently as the underground, provides connections between Madrid and its metropolitan area, and between Madrid and the rest of the neighbour regions. Main rail terminals are Atocha in the south and Chamartín in the north [11].

This railway network is ably supported by an impressive and ever-expanding network of city buses. The overall length of the bus network of Madrid's Municipal Transport Corporation (Empresa Municipal de Transportes, or EMT) at year close 2009, when 426 million passengers were transported, stood at 3,690 kilometres, using 216 different bus lines. These routes are serviced by a growing fleet of over 2,000 vehicles [12].

A key driving force behind effective transport within a city is its intermodal transfer facilities, enabling travellers to change from one means of transport to another. Madrid currently features 28 modern transfer facilities that allow travellers to change between the different modes of transport at strategic points, including each of the main entry points into the city. The transfer facilities with the biggest amount of travellers are listed bellow:

- Avenida de América: 167.720 travelers per day
- Moncloa: 287.081 travelers per day
- Plaza de Castilla: 179,645 travelers per day
- Plaza Elíptica: los 86.487 travelers per day
- Príncipe Pío: 198.807 travelers per day

Madrid enhances its public transport network with a fully modernised and extensive road network, which not only connects the city with the rest of the region, but also with Spain and, from there on, the rest of Europe. Over the last ten years alone, the network of major roads has experienced a 44% leap to bring its combined total length to over 964 kilometres, representing 29% of an expansive 3,381-km network for the entire region. Madrid is the most important hub of Spain's motorway network and is surrounded by four orbital motorways: M30, M40, M45 and M50. M30 circles the central districts and is the inner ring motorway of Madrid. Significant portions of M30 runs underground, the tunnels are close to 40km in length and support traffic of 300000 cars per day and they have 3 to 6 lanes in each direction. In the south by-pass there are close to 10 km of continuous tunnels [14]. M40 is a ring motorway which borders Madrid at a mean distance of 10.07 kilometres and it has a total length of 63.3 km. M45 is a partial ring around the city serving the metropolitan area of Madrid. It was built to help alleviate the congestion of the M40 from the southern to the north-eastern, runs between the M40 and

the M50 where the two ring motorways are more separated. M50 is the outer of the Madrid orbital motorways and has a total length of 85 km. It services mainly the metropolitan area at a mean distance of 13.5 km.

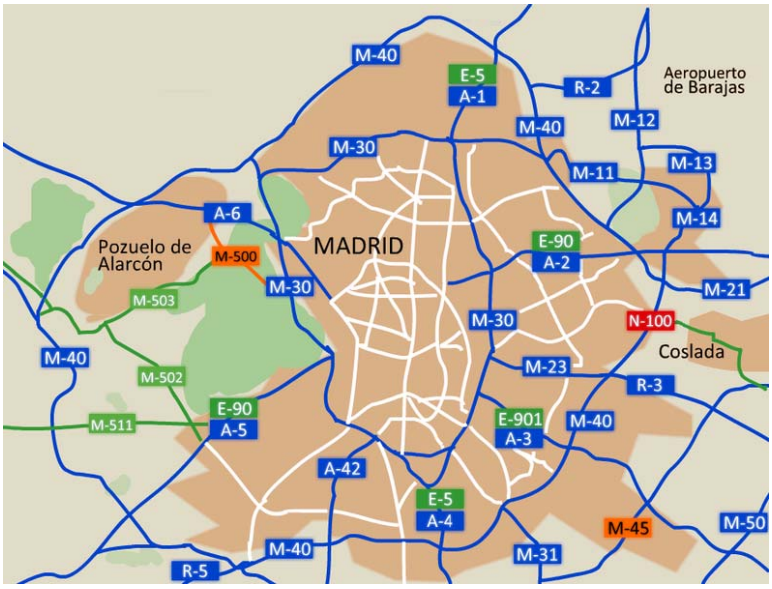


Figure 10. Madrid bypasses

Yet one of the main pillars underpinning Madrid's connections with the rest of Spain and abroad is the high-speed rail network. Three new lines were brought into service in 2008, drastically cutting travel times with cities such as Barcelona and Malaga. AVE high-speed trains link Atocha station to Seville, Málaga, Córdoba, Ciudad Real and Toledo in the south and to Cuenca, Albacete, Valencia, Zaragoza, Lleida, Tarragona and Barcelona in the east. AVE trains also arrive from Valladolid in the north. The overall goal is to have all important provincial cities be no more than 4 hours away from Madrid, and no more than 6 hours away from Barcelona. This gradual process will eventually connect Madrid with the major cities on the Mediterranean routes, as well as Lisbon and Paris, to name but a few. Madrid now ranks alongside Tokyo and Paris as one of the world's three largest high-speed railway hubs [13].

Nevertheless, the main mode of transport linking Madrid with the international community remains its airport - Barajas. Barajas is one of the world's largest airports with a potential capacity of 70 million passengers a year, having recently completed extension work to increase its existing worldwide connections to 222, more than 80% of which are located abroad. During 2010 more than 49 million passengers used its facilities, more than 136,000 a day [15].

2.9.2 Command and Control Centers

Madrid, as the capital of Spain, is the center of administrative issues. Thus, there are different levels of Command and Control Center which manage various aspects of the public services. Regarding Madrid City Council, the list detailed ahead takes into account the most significant Command and Control Centers.

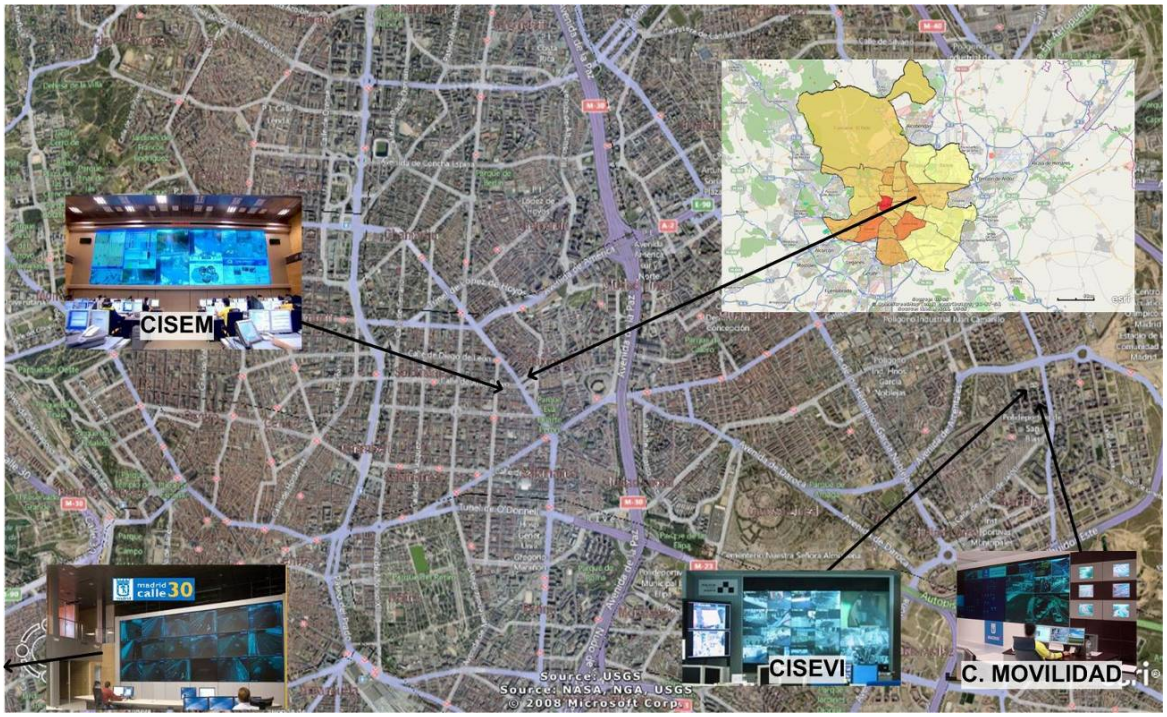


Figure 11. Main Control centers location

2.9.2.1 CISEM - The integrated Security and Emergency Center of Madrid

In the aftermath of the 2004 train bombings, the city of Madrid recognized the need for greater coordination among its first responders, even when the response to the attack was a complete success. The solution included the construction of an entirely new emergency response headquarters and the design and implementation of an IT system that would support the center's response capabilities. The result was CISEM (Integrated Security and Emergency Center of Madrid), an advanced emergency command & control center, which integrates information, systems, and people. The system enables seamless coordination among emergency response teams, while also giving emergency managers the understanding and insight required to better assess needs, prioritize and coordinate actions, and proactively deploy assets to address, and potentially prevent, multiple, complex incidents. The mission was ambitious, but clear-cut: reduce emergency response time, integrate information, standardize procedures and protocols, provide seamless coordination and planning, enable shared use of resources, optimize information management and promote prevention through better planning.

It is an advanced emergency command & control center, which integrates information, systems, and people for managing emergencies and security of the City of Madrid. CISEM (coordinates the various services involved with disaster or major event risk for incidents of emergency management in critical infrastructure in the city of Madrid, offering security and unified treatment of emergencies. CISEM was launched on January 16, 2007.

CISEM integrates several agencies:

- Fire fighters.
- Police department.
- Health assistance services (SAMUR – Civil protection agent).

- Traffic department.

The need, therefore, was not only for top-down coordination, but also for the ability to capture and integrate information to give managers the understanding and insight required to quickly make the right decisions. Information from first responders, the public, video surveillance, traffic control and other sources is fed into the CISEM system. CISEM integrates information, people, processes and systems to enable better coordination and situational awareness for first responders. A holistic, real-time view of incidents gives commanders an understanding of how complex emergencies affect the city as a whole, enabling them to more rapidly and effectively assess and respond to incidents, and thus better protect the public.

Past events have also taught the city that more than one major incident can happen simultaneously, and that emergency assets may be needed in more than one place. And, without a clear overall picture, it was nearly impossible for emergency managers and first responders to tell if there is an important pattern emerging. Improving the city's response capabilities would require a comprehensive view of real-time events, as well as the ability to respond to unpredictable situations with greater agility.

A key aspect of the solution was integration (of information, systems, data sources, and people) across emergency response agencies, as well as external organizations, such as Madrid 112, the city's emergency hotline, the video surveillance center, and the M30 Control Centre. For example, CISEM is connected to the optical fiber ring used by the M-30 Control Centre, but they cannot manipulate the systems (cameras, sensors, etc.) since only the M-30 Control Centre is in charge of the communication and surveillance systems. Therefore, the CISEM receives the incident point and define the action plan.

CISEM now coordinates all of the different resources, from the police to the fire brigade. In addition to responding to emergencies more quickly and effectively, CISEM can also efficiently manage large public gatherings or other events where it is necessary to have police units and ambulances on standby, for example, football matches.

In other hand the existence of specialized sensors (sound, environmental, traffic…) could collect information that real time treated can aware for threats and alarms. These improvements combined with advance analysis of the internal and external information available for the security and emergency bodies can prevent and help to solve risk situations.

Because each of the first responder agencies had its own communication technology, a common mobile infrastructure had to be deployed.

The implementation of CISEM pursues the achievement of various objectives which are as follows: to reduce the response times of Security and Emergency Corps, to obtain a single view of the incidents that affect all bodies (Fire fighters, Police Department, Health Services and Traffic Agents) to promote coordination of the Corps and boost the overall response of the Security and Emergency Services, increasing the quality and efficiency of the services for the citizens. This is achieve by using the capabilities of information technology to approximate the security and emergency management to the public, improve the operational management and exploitation of information (reports, statistics, balanced scorecard, risk mapping, geo-referencing) for decision making, facilitate the planning of services to bring out preventive policies in the field of security and emergencies.

2.9.2.2 CISEVI – Integrated Video Signal Centre

This center is integrated with CISEM and is becoming a key tool for the security services. The centralized video system receives video information from several sources:

- Traffic cameras;
- M30 cameras (the big inner belt in Madrid, which is run by another agency);
- Police District Offices and Security main buildings CCTV
- Video surveillance system in main or significant places (Plaza Mayor, Montera street, Ballesta, Lavapiés …);
- Fixed cameras in Police vehicles

CISEVI manages more than 2,000 video images. Among the advantages of the system should be highlighted the centralization of all available video signals by the Municipal Police of Madrid in one center and the possibility of having an overview of all images available on request. It is possible to reduce the response time in the incidents detection, since CISEVI is integrated in CISEM and visualize the image of the cameras (in case there is any available) close by the incident. CISEVI ha a dual function, acting as backup centre of CISEM.

2.9.2.3 Mobility Traffic Center

This Center manages form a single platform more that 8,000 traffic sensor located in the City of Madrid.

2.9.2.4 Environmental Control Center

This centre manages the information coming from the sensors to assess the quality of air.

2.9.2.5 M-30 Control Centre

M-30 Control Centre is located in the south area of Madrid, concretely in Méndez Álvaro Street. Apart from this Main Control Centre, there is a Mobility Centre which carries out the functions of M30 traffic control and support in case of collapse of the Main Centre.

Figure 12. M-30 Control Centre facilities

The management and control architecture of the tunnels is based on a pyramidal structure. The control hierarchy of the system has four levels, from Field level to Control Centre level. Each level has a local logic which ensures the performance of the system.

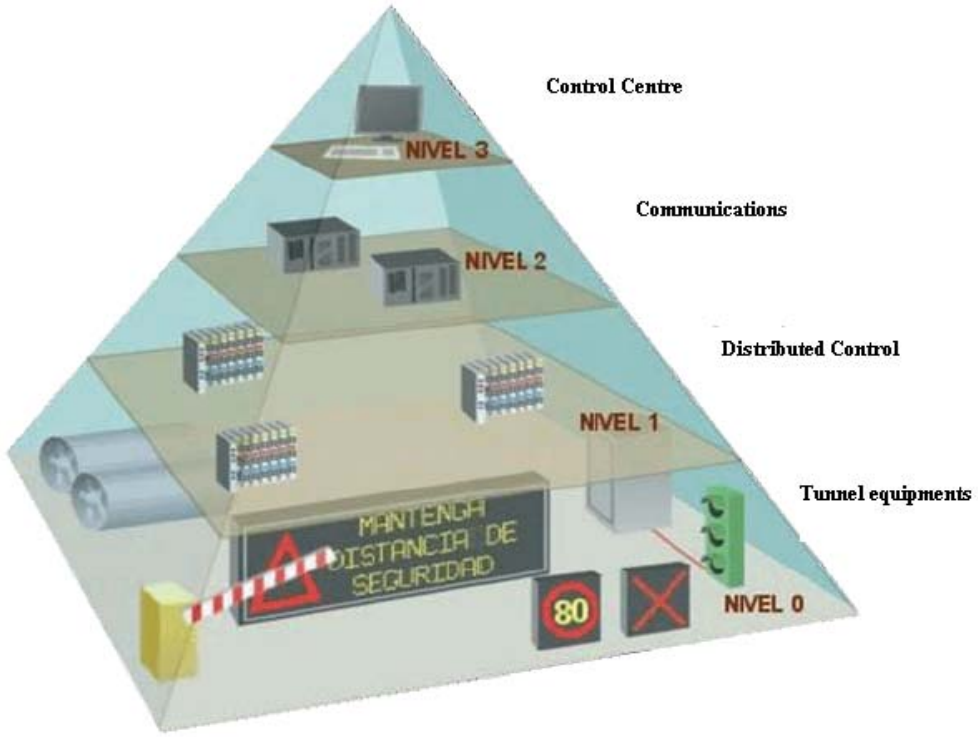


Figure 13. M-30 Control architecture

Currently, the M30 Control Centre has a surveillance system installed along the tunnels of this ring road in Madrid called M30. The tunnels are 40km in length and support traffic of 300000 cars per day. This system is made up of several subsystems described briefly bellow:

- Technical rooms are inside the tunnels. There are 36 technical rooms where the images are analysed. The technical room storage capacity is 9Tb.
- DAI (Incidents Automatic Detection) is inside technical rooms. The images of these cameras are slowed down to 25fps to be analysed by this system.
- ERU (Universal Remote Station) is inside technical rooms. These stations enable to automate some systems. Currently just ventilation system is automatic except when a fire occurs.
- UCDT (Tunnel Distributed Control Unit) is along the tunnel to control video cameras, sensors, etc.
- ITS (Intelligent Traffic System) processes traffic data and some sensors like environmental sensors (CO, NO and opacity sensors).
- 690 Video cameras are distributed along the tunnels. The video cameras can detect the following incidents: a car stopped on a lane, a pedestrian in the tunnel, a car driving in the opposite direction, and smoke.

Each incident activates an alarm (although the incidents are detected automatically by sensors, actually the alarms are activated manually). There are 7 alarms per minute in peak hour and 1 alarm per minute in off-peak hour.

The video cameras efficiency is 80%.

- 5 Power stations provide the electricity supply.
- Alert system to citizens via radio, electronic noticeboards or public address system.

The following figure shows a high level diagram of the communications between the different systems of the M30:

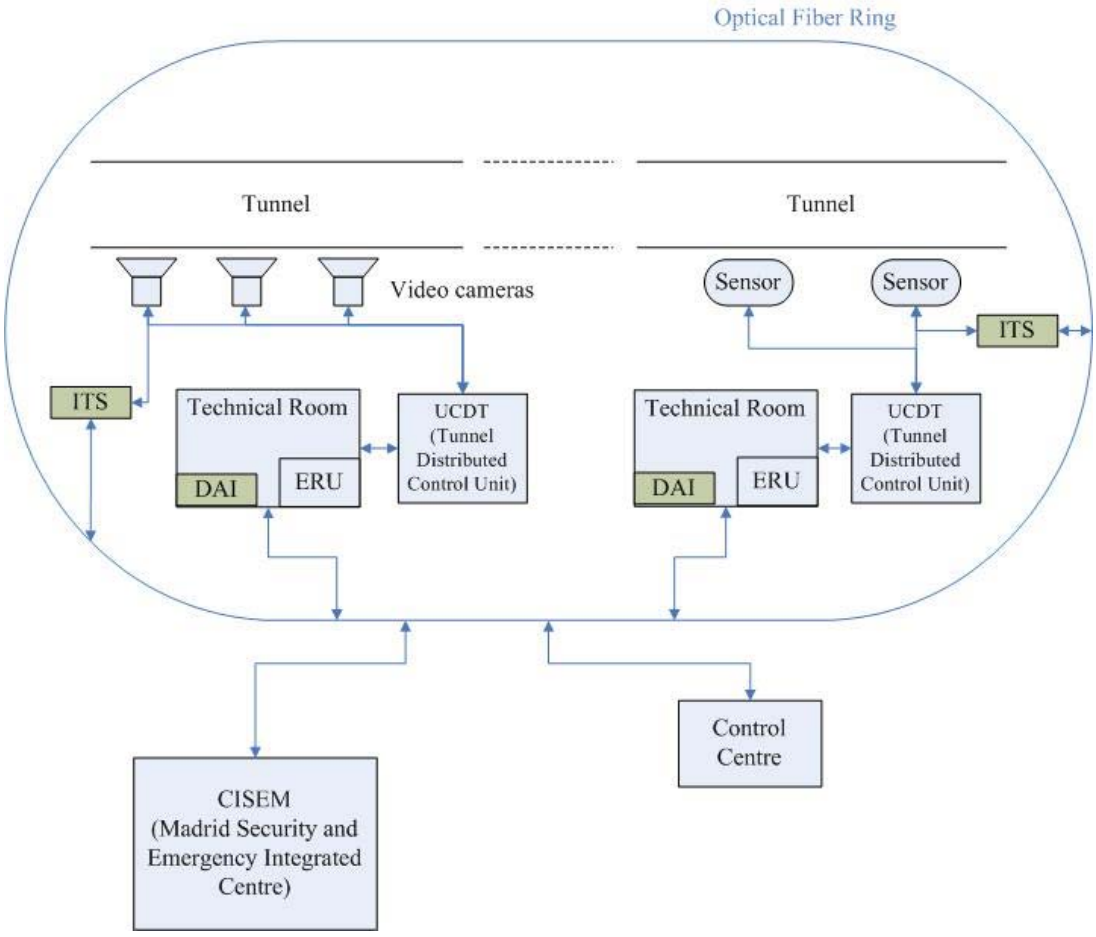


Figure 14. M-30 communication diagram between systems

2.9.2.6 Service Facilities Control Center

The Service Facilities Control Center takes care of controlling and monitoring 15 traffic tunnels, 100 km of galleries of service and 90% of the public lighting network (except M-30, Madrid Rio and some specific tunnels which have specific control centers).

2.10 Communication Infrastructures

This point aims at describing the information and communication technology (ICT) of the city of Madrid with particular regard to the infrastructure around telecommunications and Internet provision. The research covers public infrastructures that provide network connectivity and private infrastructures used exclusively Madrid City Council for providing different kind of services.

2.10.1 Public ICT Infrastructures

This section describes ICT infrastructure available in Madrid which provides network connection to the general public.

The information available regarding the coverage and type of public ICT infrastructures for 2010 is as follows [16]:

- **Fixed Networks**
  - Coverage: Information not published. Operators determine the growth of their network by the existing demand.
  - Broadband technology access
    - 79% ADSL (xDSL)
    - 20% cable
    - 1% others (LMDS, optical fiber)
  - Ultra-speed broadband technology (> 30 Mbps)
    - Cable. DOCSIS 3. Available in 53% of ONO network.
    - Optical Fiber. FTTH. Available on 37% of Telefónica network.
  - Coverage:
    - 90% ADSL
    - 53% cable
    - 37% FTTH (Telefónica only)
- **Mobile Networks**
  - Coverage 99%.
  - 3.5 G Technology (Download Speed: between 7 and 14 Mbps).
  - 4.085 base stations
    - 1.806 GSM/GPRS stations
    - 2.279 UMTS stations
  - Investment in network is needed due to the increasing demand of mobile Internet services through Smartphones.

The following table shows the list of the public operators who offer their communications services in Madrid, divided by the type of service offered:

Telecommunications services for the broad public (households and enterprises) managing proprietary infrastructure
TELEFÓNICA DE ESPAÑA SAU
ONO (CABLEUROPA S.A.U)
FRANCE TELECOM ESPAÑA S.A
JAZZ TELECOM S.A.U
VODAFONE ESPAÑA

Telecommunications services for the enterprises
BT ESPAÑA COMPAÑÍA DE SERVICIOS GLOBALES DE TELECOMUNICACIONES S.A.U
COLT TECHNOLOGY SERVICES S.A.U
Fiber Optics rental
CITYNET S.A
CORREOS TELECOM S.A
RENFE-OPERADORA
IBERDROLA S.A
GAS NATURAL FENOSA TELECOMUNICACIONES
Mobile services for the broad public (households and enterprises). 2G and 3G technology
TELEFÓNICA DE ESPAÑA
VODAFONE ESPAÑA
FRANCE TELECOM ESPAÑA
XFERA MÓVILES
Wireless radio service LMDS/WIMAX
NEO-SKY 2002
IBERBANDA

Table 6 Public Communications operators in Madrid

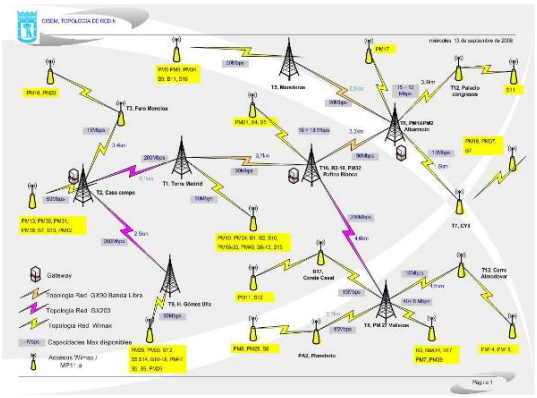
Regarding the coverage there is no available information for the fix network coverage. The existing operators improve their network, depending on the demand. The mobile network coverage reaches 100% in the whole territory of Madrid.

2.10.2 Private ICT Infrastructures

The Madrid Police Department has a main office in each of the 21 districts of the city, as well as another operational buildings distributed along the City territory. All of them are connected by the Madrid City Council Network, a private optical fiber ring which belongs and is managed by the IAM agency of the city council.

This backbone network fulfill the transmission services of data, voice and video, between all the city council, using a double fiber optic ring with a minimum throughput of 10 Gbps for each ring. For some isolated buildings the connection to the backbone is made using lines contracted to the communications public suppliers.

Backhaul

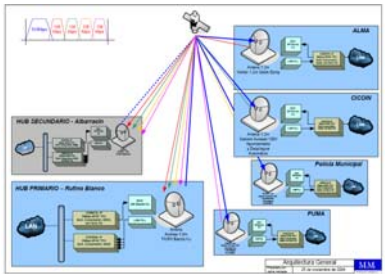


Wireless network

It is also available a wireless network that connects only the main buildings of the security and emergency services. This wireless network is based in WIMAX and has 7 main backhauls and 50 gateways

base stations, with GX90 (up to 45Mbps) and GX200 (up to 100Mbps) network equipments. It is connected to the municipality backbone through the backhauls. It is used right now as a back up network for the main one. This network allows transmission with QoS of data and video, and is designed to backup the main data network, although it is always in ACTIVE mode, the clients terminals can connect through Wifi or Wimax hotspots.

It is also available a satellite network, with two hubs, that allows the four command vehicles to communicate with the main and backup CISEM, in case the mobile 3G network is down, and there is not any MCC wifi/wimax hotspot available. The satellite network has a throughput of 2Mbps, and allows the transmission of voice, data and even Video at low resolution.



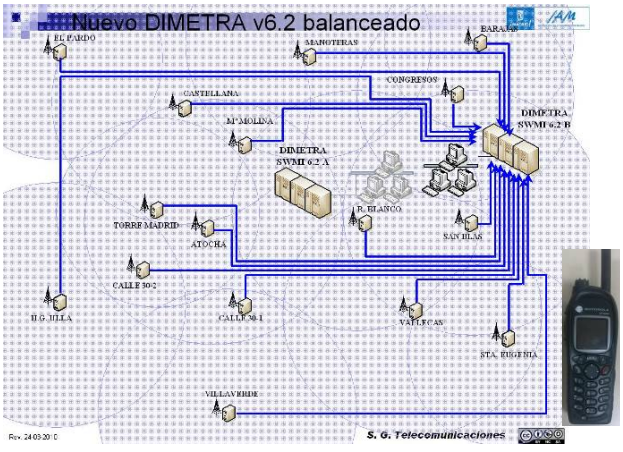
Main figures:

- More that 70 security and emergency offices connected
- 8 Gbps through the FO backbone network
- 100 Mbps through the backup wireless network
- 2 Mbps through the Satellite Network
- 7 Mbps through the 3G public network

The police cars are equipped with a computer and a camera. To transmit the data and video, they use 3G public mobile communications, managed by the IAM agency.

Madrid City Council Radio Network

As any other Police in the world, Madrid Police Department makes an intensive use of mobile two-way transceiver radio systems, for voice communication between all the police resources. This radio network belongs and is managed by the IAM agency. It is based on TETRA (Terrestrial Trunked Radio) standard, which is specifically designed for use by the security and emergency services (police forces, fire departments, and ambulance), train transport services and the military.



The main users of the MCC radio network are the following agencies or services:

- metropolitan police
- fire brigades
- city medical and civil protection services
- traffic services

There are about 3.000 terminals, 2.200 of them used by police, of which 1.700 are portable and 500 mobile.

The MCC Tetra radio network main characteristics are:

- 16 BTS
- 2 switches
- band ~400 MHZ
- 4 frequencies by BTS (15 traffic channels and 1 control channel)

The main use of this network is voice, and small messages (SDS). It do not permit to transmit video or big amounts of data, because of its narrowband.

M-30 Control Network

M-30 Control Centre has a private fixed network based on optical fiber. The optical fiber ring installed to connect the different systems and centres has a capacity of 16Gbps; this enables to support 700000 signals.

Besides, there is a UHF channel, but this is being replaced by a digital channel. This communication via radio is used to contact with the M-30 intervention units and the different state bodies which have to operate in the tunnels in case of incident.

M-30 IP Communication Network has been designed as a mixed topology. It consists of 2 main nodes located in the two Centres and 9 rings of access level; each ring is connected to both main nodes to assure the redundancy.

The equipment of the communication network is:

- 2 Main Nodes Gigabit
- 36 Access Nodes Gigabit
- 329 Ethernet Nodes of field network

The two Control Centres (main nodes) are connected each other to enable the communication between applications and the transference of data.

There are two types of nodes in each ring of access level:

- Level 3 Nodes have more capacity than Level 2 Nodes and connect the rings to the main nodes. These nodes are located in the technical rooms.
- Level 2 Nodes take over extending the network along the tunnels, providing control and service systems with access points.

A logical structure has been defined over this physical topology. It is based on services and separates the data traffic of each system (VLANs per services), so if a service has a problem, this one will not affect the other services.

Apart from this, M-30 Control Centre is connected to CISEM, DGT (Spanish Traffic General Direction), Control Centre of Urban Tunnels and Mobility Centre to share information and facilitate the management of incidences.

The following figure shows the communication architecture described above:

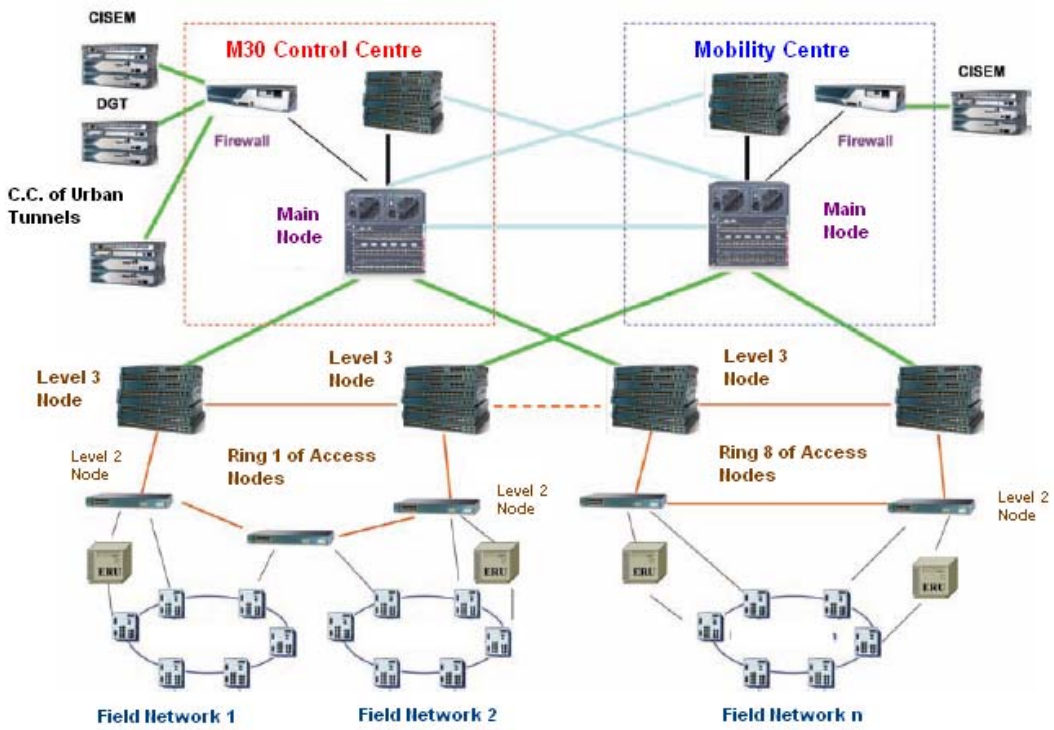


Figure 15. M-30 System Architecture

3. Public Safety Characterization

The Public Safety Characterization describes the current state of the art of the key systems that enable Public Safety capabilities in the city of Madrid. The characterization will be classified into different functionalities areas.

3.1 Area A: Citizens Behavior

For Madrid City Council, the main application used regarding citizens behaviours is the video surveillance system, which is managed by the Integrated Video Signal Center (CISEVI) which integrates images of the City Council facilities, the traffic cameras and the street surveillance in Madrid specific areas. This center is integrated with CISEM and is becoming a key tool for the security services.

There are 3 specifics point which are going ton be detailed: the video surveillance platform of CISEVI, the patrol cameras system for capturing image and license plates recognition and the 3D model of Plaza Mayor, an specific area covered by the street surveillance cameras.

3.1.1 Video Surveillance Platform

3.1.1.1 General Description

The Video Surveillance Platform is the core of CISEVI (Integrated Video Signal Center). The main goal of the system is the centralization of all available video signals by the Municipal Police of Madrid in one center and the possibility of having an overview of all images available on request.

The centralized video system receives video information from several sources:

- Traffic cameras;
- M30 cameras (the big inner belt in Madrid);
- Video surveillance system in main or significant places with historical and commercial interest (Plaza Mayor, Montera street, Ballesta, Lavapiés …);
- Main security building and Police District offices;
- Fixed cameras in Police vehicles.

The main system elements are the following:

- Type of Sensors: fix cameras and domo cameras. Most of them are digital cameras.
- Number of sensors: nearly 2,300. Madrid Police Department manages directly 35% of them. The rest come form other agencies: M-30 and Traffic Services.
- Access network Elements: fixed and ad-hoc deployment of communication infrastructure. In some specific installations, private wireless networks are being used. All the communication systems are private infrastructures.
- Core network Elements: private fiber optic connections and private routers.
- City infrastructure involved: streets (main areas with tourist and commercial interest) and main buildings related to the Security Division of Madrid City Council. Need of power supply for each camera.

Some specific features regarding the centralized video system are listed below:

- Possibility of publishing selected images on a videowall
- Possibility of viewing the images on the operator's screen
- Possibility of automatic recording and recording on demand
- Ability to associate the recorded imaged to the incidents happened
- Ability to play back recorded images from any operator station
- Record search capabilities
- The images can be displayed in the main center CISEM and in the back-up center CISEVI
- A centralized system has been developed to integrate under the same interface different vendors cameras. The police operator can access them in a transparent way.

3.1.1.2 Application and infrastructure deployment

In the following maps, it is possible to locate the video surveillance areas in the city of Madrid.

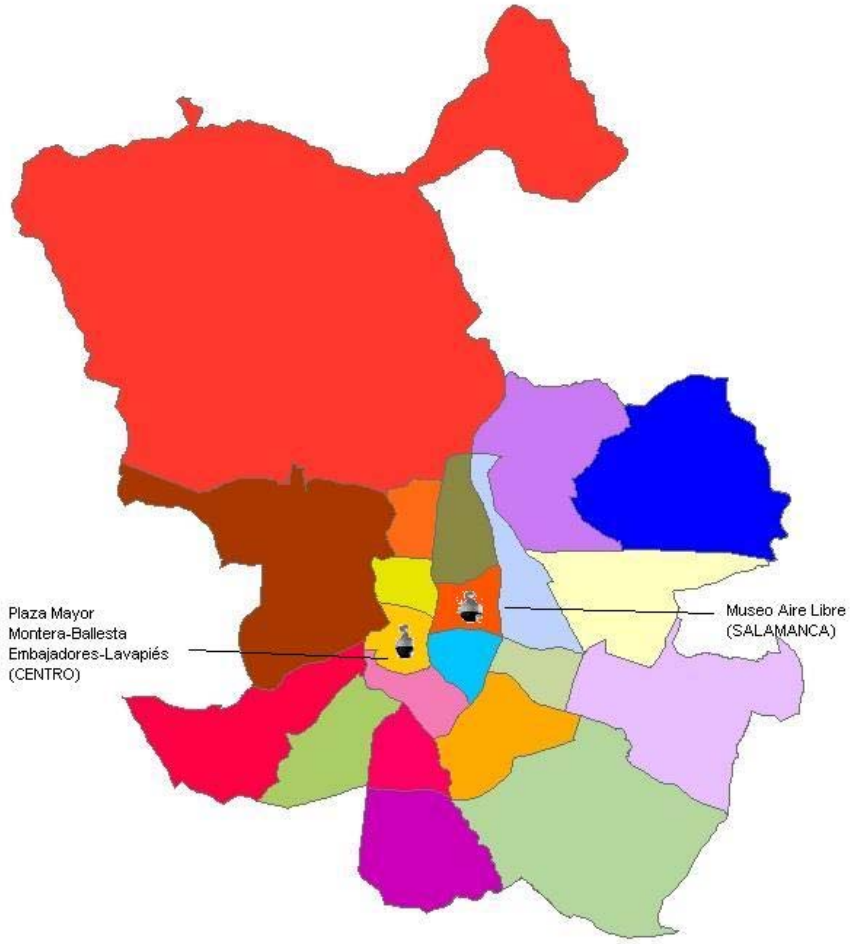


Figure 16. Video Surveillance areas in Madrid

Figure 17. Plaza Mayor and Montera Video Surveillance in Sol Ward - Centro District

Figure 18. Ballesta Video Surveillance in Universidad Ward - Centro District

Figure 19. Lavapiés Video Surveillance in Embajadores Ward – Centro District

Figure 20. Museo al Aire Libre Video Surveillance in Castellana Ward – Salamanca District

3.1.1.3 *Application Requirements*

- The cameras installed in the streets transmit information via cable to a digital recorder situated nearby and connected to the private network, or via radio to the nearest place with connection to the private network (200 – 300 m).
- The deployed cameras in each area have one or more video recorders, depending on the number of cameras.
- Recording is made in the local recorder.
- The video stream is requested on demand.
- These centralize recorders keep up to 7 days of video, which is compliant to Spanish data protection law unless there is a police/court request.
- The current bandwidth needed for each camera is 2Mbps.
- The use of private networks is required, according to performance (QoS) and security (privacy).
- The cameras used must have masking capabilities
- User permissions need to be implemented
- Encryption is used for wireless networks

3.1.1.4 *System Architecture*

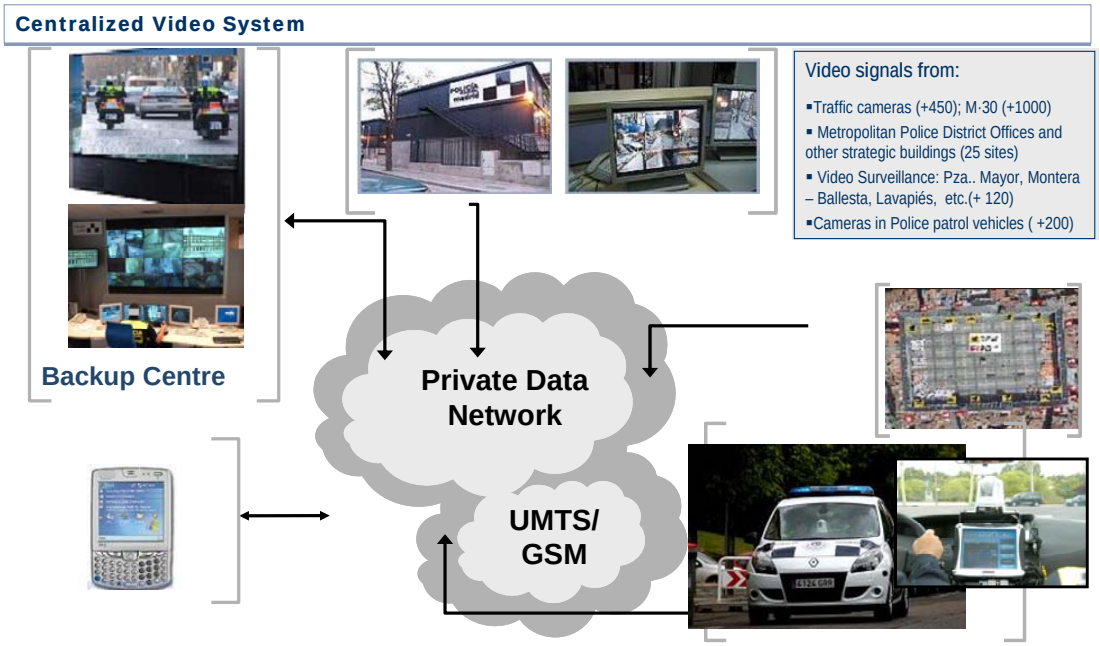


Figure 21. Video Surveillance System Architecture

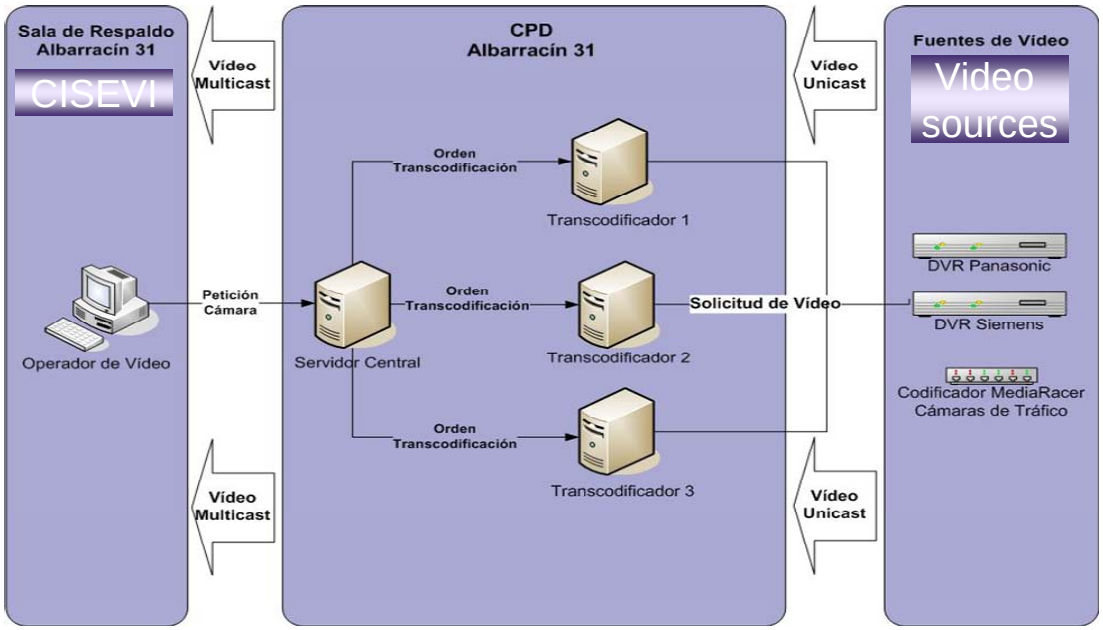


Figure 22. Video Surveillance Platform System Architecture

3.1.1.5 Use case & Actuation Proceedings

There are 4 police operators in charge of visualizing the cameras. Each police operator can visualize and control any camera. They can either watch the images on the videowall or in their own desk screens. The images are chosen on demand by the police operator (planned services required or incidents manually alerted by CISEM). No video analytics is made by the system.

A specific system as the 3D model of Plaza Mayor is deployed to make an automatic round trip by the watching scene to facilitate police operator duty.

3.1.2 Cameras installed in patrol vehicles

3.1.2.1 General Description

All the vehicles, from police cars to ambulances to fire engines, are equipped with mobile wireless computers or PDAs that are connected to CISEM. The mobile infrastructure is critical; it provides true interoperability among the various agencies and also enables a two-way interchange of information—which gives managers vital, on-the-scene input that helps them develop a better understanding of what is happening in the field.

The cameras in police vehicles integrated system for video transmission and number plates capture integrates two technologies using the same equipment, obtaining an important cost saving and simplifying the user interface. It is an innovative system that leads Madrid Police Force to become pioneer in this filed. The system is installed in 200 patrols.

The system applies mobility technologies for city security, trough the use of cameras and TabletPC in police vehicles, providing the wide range of functionalities that these elements can offer.

The system has two usages. One of them is the automatic capture of car number plates using OCR (Optical Character Recognition). This information is verified online and enables the Madrid Police Force to recover stolen vehicles among other issues. The other use of the system is online video transmission on demand and in real time, from the camera car to a Video Control Centre where the police operators manages these video images with the rest of video images received of the city of Madrid.

One of the key points of this project is to implement mobile police units, for making easier the police job, placing the police units near the citizenship that asks for protection where is needed. The use of mobility technologies applied to the police services is one of the strategic action lines developed from 2004 working for a more secure Madrid.

The design criteria for the system are the following:

- Existent reusability of the equipment, which produces costs savings. The equipment as said is used by two different systems: the automatic car number plate capture system and the video surveillance system.
- Offer a secure, stable, solid and ergonomic solution due to the big amount of vehicles and the big number and rotation of policemen (day, evening and night schedule shift).
- Process performance increase by on-line accesses to number plate data bases.
- System acceptation among the users since it is a tool for making easier the police job and provides more security for the policemen. The designed system is friendly user oriented. When the system is installed in the vehicles there is a practical session for the use of the system to the policemen in charge of the vehicle.

3.1.2.2 Application Requirements

Requirements of the License Plate Recognition Application:

- Automatic positioning of the camera
- License Plate Detection
- Reading of digits and letters
- Picture recording, license plate information and GPS location data
- Sending license plate number to the competent service (per protocol set). Identification of suspected license is made by a centralized system. No by local checking in the patrol TabletPC.
- In case of license is in Blacklist an alarm is sent
- Display warning on map for vehicle recovery
- Bandwidth required: 40 - 100 Kbps

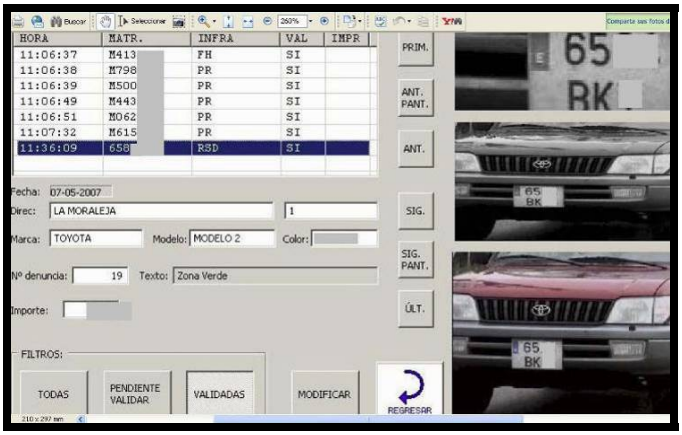


Figure 23. License plate recognition application interface (I)

Figure 24. License Plate Recognition Application interface (II)

Requirements of the video transmission application:

- Capability of sending Video IP via UMTS from the TabletPC to CISEVI: On request of the police in the vehicle, on request of CISEVI
- Possibility to record both the images in CISEVI.
- User menu interface with the camera display, camera control and monitoring system parameters
- Integration with CISEVI by deploying a specific menu with the following features:
  - Check connection status vehicles from CISEVI
  - Motion Picture
  - Recording
  - Camera Control
  - Alert delivery request from vehicle
  - Display both on the video wall, and on the police operator screen.
- Bandwidth required: 384 - 512 Kbps
- The entire recording system meets the requirements of the Data Protection Law.

Figure 25. Video provided by a patrol visualized on Video Wall - CISEVI

3.1.2.3 *System Architecture*

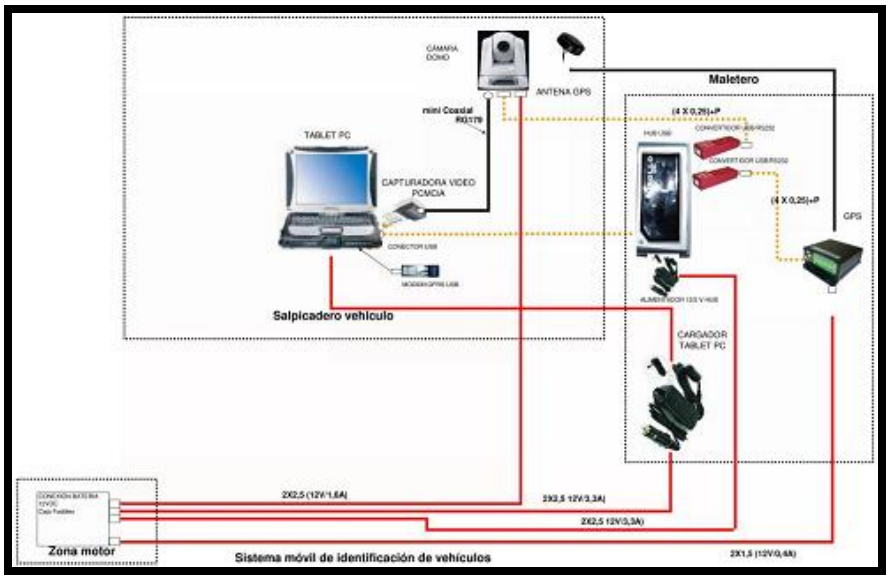


Figure 26. Cameras in police patrols architecture

3.1.2.4 *Use case & Actuation Proceedings*

Madrid Police Department uses the patrol vehicles on a day by day basis. The system allows capturing the license plate of parked or moving vehicles and to check on real time the license plate number information. This procedure is an automatic one. This method enables stolen vehicle recovery, among other police actions. The system is complemented with the possibility of sending images to CISEVI if any incident happened o special planed service is scheduled.

Benefits and outcomes of the applications installed:

- Economic: reusability of the equipment installed, which produces costs savings.
- Stakeholder satisfaction: system acceptation among the users since it is a tool for making easier the police job and provides more security for the policemen.
- Prestige / Image: Madrid Police Force modernization by applying IT technologies to police service.

- Process performance: Increases the processes agility by online accesses to number plate data bases.

The results obtained during 2010 shows the success of the system. The system has captured 404,646 number plates; 1,693 of them were stolen number plates. The police recovered 90 vehicles and 750 stolen documentations.

3.1.3 Plaza Mayor 3D model

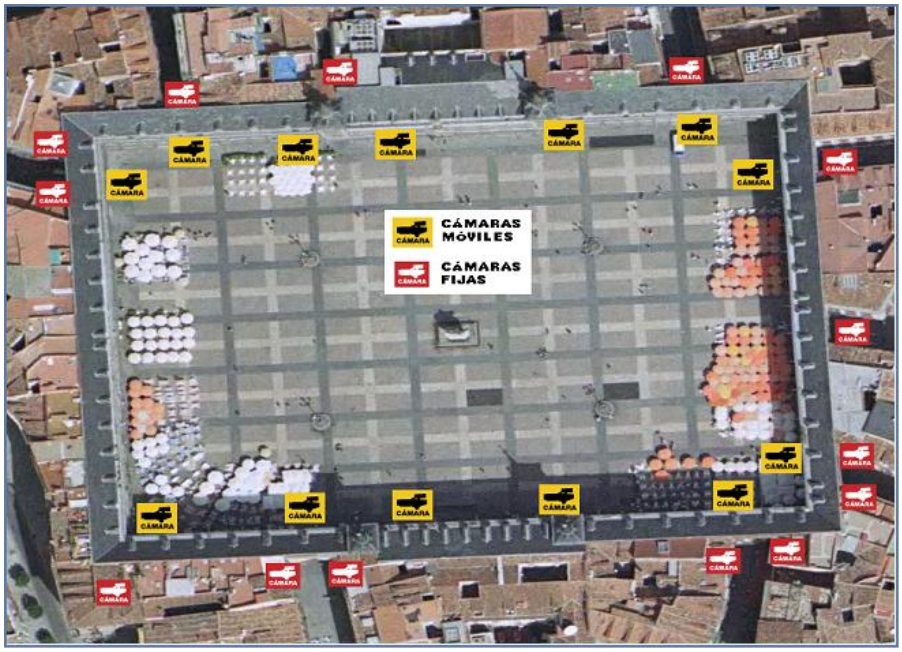
In order to make easier the video surveillance for the police operator a 3D system has been built for the emblematic area of Madrid Plaza Mayor.

The 3D model of the view of Plaza Mayor is combined with the video images provided by the cameras located in the Square.

3.1.3.1 Application Requirements

- 12 fixed cameras and 16 domes
- Type of Sensors: fix cameras and domo cameras. The cameras are analog cameras. Need of one codec for each camera
- Number of sensors: 12 fixed cameras and 16 domes.
- The video stream of each camera has to be sent to the 3D system.
- The current bandwidth needed for each camera is 2Mbps.
- The use of private networks is required, according to performance (QoS) and security (privacy).
- The cameras used must have masking capabilities
- Access network Elements: Fiber Optic Ring has been deployed. Connection to the corporative network of Madrid City Council. All the communication systems are private infrastructures.
- Core network Elements: private fiber optic connections and private routers.
- City infrastructure involved: Plaza Mayor Square. Need of power supply for each camera.

3.1.3.2 *System Architecture*



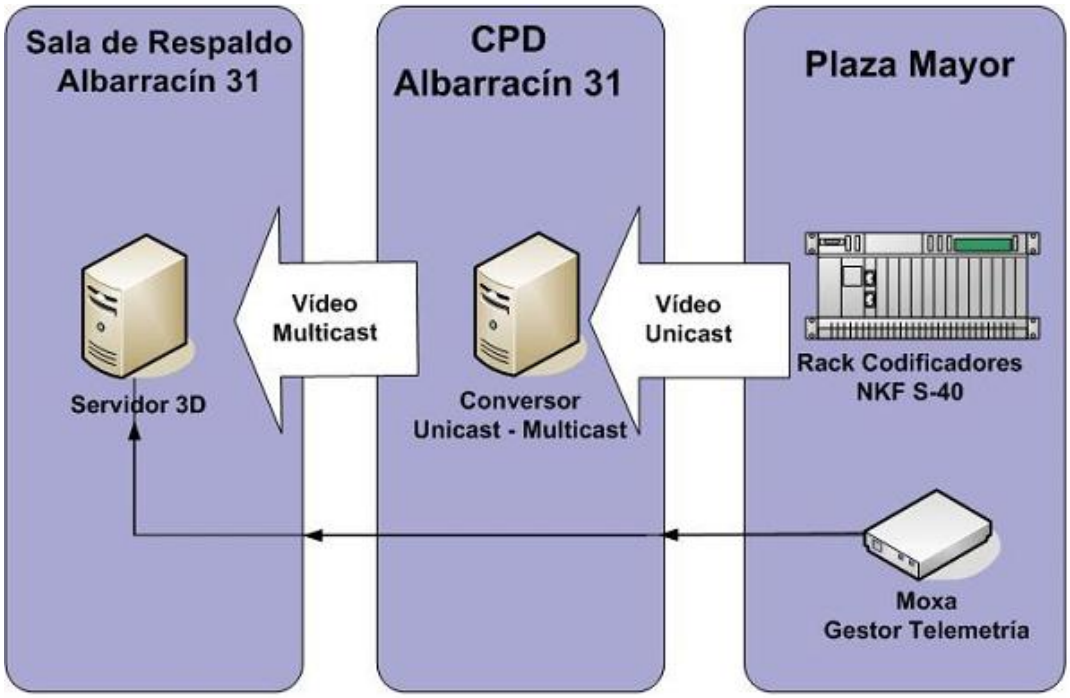


Figure 27. 3D Model system architecture

3.1.3.3 *Use case & Actuation Proceedings*

The police operator uses either the Centralized Video System or the 3D model system to visualize cameras in Plaza Mayor. Both systems have the same information, though the 3D model system helps the operator to localize easily the camera of interest. It is also available for the operator the possibility of following a pre-programmed guard tour by the cameras images integrated in the 3d model of Plaza Mayor.

3.2 Area B: Road Track Incidents Management

3.2.1 Road incidents management in M-30 tunnels

3.2.1.1 *General Description*

M-30 Control Centre has 690 Video cameras which are distributed along the tunnels. This system of cameras enables the monitoring of vehicles and pedestrians behaviour in tunnels.

The video cameras can detect the following incidents: a car stopped on a lane, a pedestrian in the tunnel, a car driving in the opposite direction, and smoke. In this case, the presence of a pedestrian within the tunnels is considered an incident since the pedestrian access to the tunnels is not authorized.

The cameras are connected to a fixed optical fiber ring and they are processed by the DAI system (Incidents Automatic Detection). Once an incident is detected, the human factor intervenes to launch an actuation procedure, so the intervention units are notified via radio.

Figure 28. M30 tunnels control software

3.2.1.2 *Application and infrastructure deployment*

This application is deployed along the coverage area controlled by M-30 Control Centre. M-30 Control Centre manages the net of tunnels (see in red in figure 17) as if it was just one, though it is divided in several stretches:

- Junction between A-3 and M-30

- South By-Pass – North Tunnel
- South By-Pass – South Tunnel
- Connection between C/Embajadores and M-30
- Tunnel from Av. Portugal to Gta. San Vicente
- Stretch from Av. Portugal to M-30
- Stretch from Marqués de Monistrol to Puente de Segovia
- Stretch from Puente de Segovia to Puente San Isidro
- Stretch from Puente San Isidro to Puente de Praga
- Stretch from Puente de Praga to South junction

M-30 Control Centre should be able to manage North project (see in blue in figure 17) in the near future:

- North By-Pass
- Connection between North By-Pass and A-1

Figure 29. M-30 applications coverage area

3.2.1.3 Application Requirements

The optical fiber ring installed to connect the different systems and centres has a BW of 16Gbps; this enables to support 700000 signals.

Apart from this, the images of the videos cameras are slowed down to 25fps to be analysed by the DAI system. However, the images are stored in real quality during three days, for this the technical rooms have a storage capacity of 9Tb.

The video cameras efficiency is 80%.

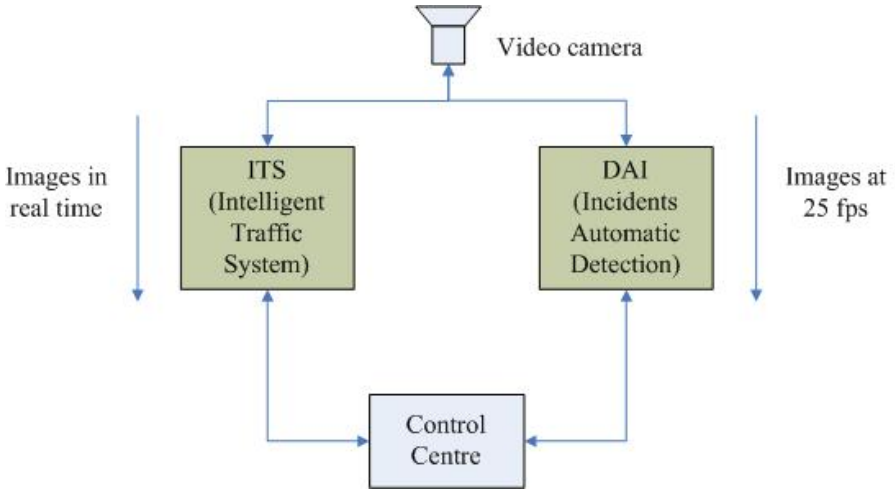


Figure 30. Images processing in M-30 Control Centre

3.2.1.4 System Architecture

The M-30 system general architecture is described in the point 2.10.2 (M-30 Control Network).The following figure describes the part of the ICT system which enables this application:

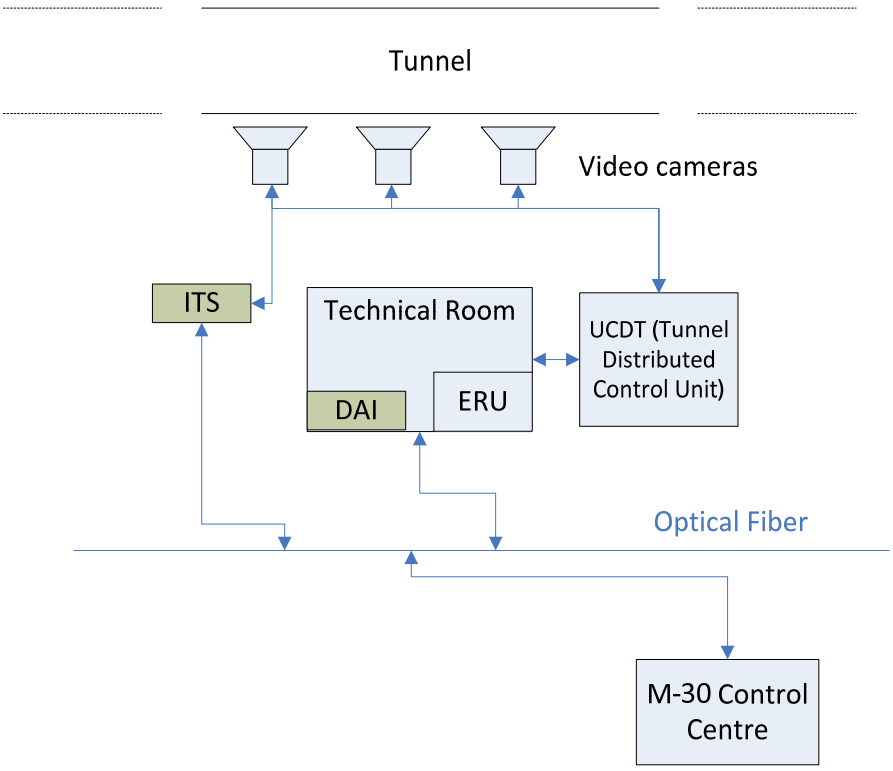


Figure 31. Road incidents management system architecture

3.2.2 Number plates tracking by M-30 Control Centre

3.2.2.1 General Description

This application enables to control the traffic using a number plates detection system and to track suspicious vehicles.

The cameras used have an efficiency of 20%.

This system uses the M-30 optical fiber private network to connect the cameras with the Control Centre. The vehicle tracking is managed from the Control Centre by an operator and the police is notified using a phone.

3.2.2.2 Application and infrastructure deployment

This application is deployed along the coverage area controlled by M-30 Control Centre. This area is described in the point 3.2.1.2.

3.2.2.3 Application Requirements

The M-30 number plate detection system should have access to the data base of stolen vehicles number plates to enable the identification of suspicious vehicles.

3.2.3 Calculation of access points in case of incident in M-30 tunnels

3.2.3.1 General Description

This application enables to calculate the nearest and available access points to an incident using a data base of the access points situated on a map. The doors which communicate the road with the auxiliary

tunnels, which are used by emergency bodies in case of incident, are equipped with sensors to know if they are blocked and also the video cameras can be used to detect blocked accesses. This information is transmitted using the M-30 private optical fiber network.

All this is currently processed manually to identify the best access points, so the intervention units can improve the response time. The intervention units are informed via radio.

3.2.3.2 Application and infrastructure deployment

This application is deployed along the coverage area controlled by M-30 Control Centre. This area is described in the point 3.2.1.2.

3.2.3.3 Application Requirements

The M-30 tunnels 3D model could be used to determinate more efficiently the best route that will be used by emergency bodies to access to the incident area, and also to have a better knowledge of the situational awareness.

3.2.4 Traffic lights control

3.2.4.1 General Description

This system is consisted of electromagnetic sensors on the road. The vehicles pass over the electromagnetic sensors, so the system can calculate the traffic density. Depending on the traffic density near a crossroads, the traffic lights change to a red or green light.

3.2.4.2 Application and infrastructure deployment

This application is deployed along the coverage area controlled by M-30 Control Centre. This area is described in the point 3.2.1.2.

3.3 Area C: Environmental Monitoring

3.3.1 Environmental monitoring in Madrid

Madrid City Council monitors air quality in the municipality through the 27 stations in the Network Automatic Air Quality Monitoring of the City of Madrid, designed entirely to protect human health. This network offers complete information that provides high reliability to the recorded values.

The air quality index is intended to be the tool that allows to the service in charge to inform in a clear, direct and fast way about the quality of air in the city of Madrid and effectively guarantee the right of all citizens to have access to environmental information.

The assessment of data from Stations Surveillance Network is made through the air quality index, which is a dimensionless value calculated from the values recorded in the measurement stations, taking into account the limit values established by European law, and the national laws of the following contaminants:

- sulfur dioxide (SO 2)
- nitrogen dioxide (NO 2)
- ozone (O 3)
- carbon monoxide (CO)

- PM 10 particles

The public enterprise Canal de Isabel II is in charge of the quality of the water consumed by the citizens, and depends of the regional administration. Nevertheless, Madrid City Council has the responsibility of control the water of the river that passes through Madrid, which is The Manzanares River, with a total length of 30 Km in the municipality of Madrid. There are a total of 7 stations that control the water quality among other issues related to the river management. The parameters controlled are:

- PH
- dissolved oxygen
- conductivity
- temperature

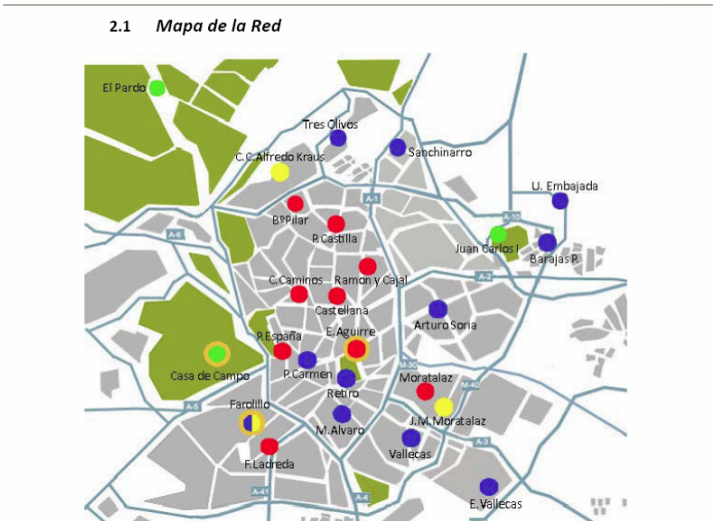


Figure 32. Air Quality Monitoring Stations

3.3.2 Environmental monitoring in M-30 tunnels

3.3.2.1 General Description

The M-30 tunnels have an environmental sensors network which is managed by the M-30 Control Centre.

There are different types of sensors: temperature sensors, smoke sensors (the smoke can also be monitored using the video cameras), C0 and C02 level sensors, etc.

The information of these sensors is processed by the ITS (Intelligent Traffic System) and stored in the technical rooms. The information already processed is managed in the M-30 Control Centre.

Currently, only the ventilation system, which depends on the CO and CO levels, the temperature and the rest of environmental sensors, is automatic. The rest of the systems require the human intervention.

3.3.2.2 Application and infrastructure deployment

This application is deployed along the coverage area controlled by M-30 Control Centre. This area is described in the point 3.2.1.2.

3.3.2.3 *Application Requirements*

Currently, the alarms are activated manually, but they should be activated automatically and so their processing would be more efficient.

3.3.2.4 *System Architecture*

The M-30 system general architecture is described in the point 2.10.2 (M-30 Control Network).The following figure describes the part of the ICT system which enables this application:

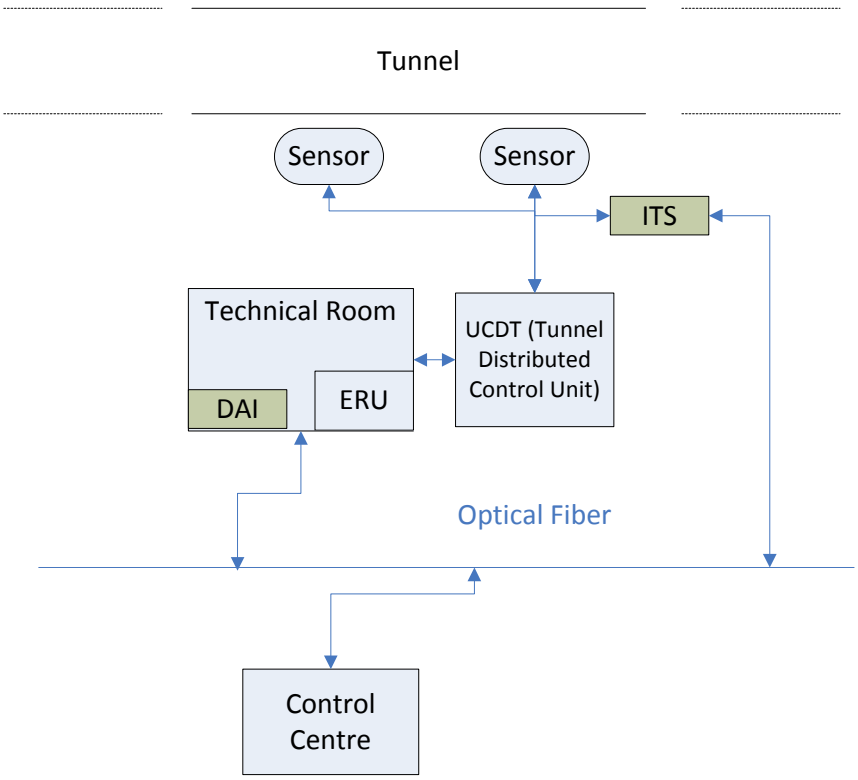


Figure 33. Environmental monitoring system architecture

3.4 Area D: Alerting Citizens

3.4.1 Alerting citizens in the M-30 tunnels

3.4.1.1 *General Description*

The M-30 Control Centre has an alerting citizens system which consists of electronic noticeboards and a public address system in the tunnels distributed along the tunnels. Besides, citizens can be alerted via radio.

The electronic noticeboards and public address system is connected with M-30 Control Centre using the private optical fiber ring.

This application can be used to control the traffic, for example, blocking a lane using electronic noticeboards due to an accident in this lane; to inform a cyclist that he must leave the tunnels, etc.

3.4.1.2 *Application and infrastructure deployment*

This application is deployed along the coverage area controlled by M-30 Control Centre. This area is

described in the point 3.2.1.2.

3.5 Area E: Ad-hoc networks

3.5.1 Mobile Command Center

The Mobile Command Center ha been designed to have a Command and Control Center as close as possible to the emergency or event, allowing:

- Real-time access to data and central systems.
- Ensuring communications in emergency situations (saturation / drop networks)
- Coordination of all site resources across the crisis room of Mobile Command Center.
- Increased perception of safety and closeness of the police to citizens.

3.5.1.1 *Application Requirements*

The main capability of the Mobile Command Center is to provide any communication means in case of emergency.

The Mobile Command Center has various communications systems that allow function autonomously with a philosophy 24x7.

Data communications systems

- External communications with automatic routing
  - VSAT satellite (512Kbps)
  - Broad Band Wireless
  - 3G communications
- In/Out communication panel for external connections
- Internal network: LAN connections, Wi-Fi and Bluetooth

Voice communications to interact with the security forces, CISEM and resources mobilized.

- PBX Phone System with 6 terminals and (4 fixed and 2 mobile) with the possibility of IP communications, GSM, Inmarsat and Iridium (total support of voice).
- TETRA Communications System. DMO Gateway expand coverage
- Terminals inside the cab and inside trailer
  - Mobile terminals
  - User profiles, support for recording
  - Direct Call Video-conferencing to remote Inmarsat

The different equipment inside the vehicle enables communications using the available network: public or private one; wireless or satellite. Once the systems are connected, connectivity is guaranteed for any equipment belonging to the network in the Mobile Command Center.

3.5.1.2 *System Architecture*

Figure 34. Mobile Command Center main features

3.5.1.3 Use case & Actuation Proceedings

The Mobile Command Center is use for planned services scheduled in advance, as demonstrations, football matches or any major event. In case of emergency the Mobile Command Center can provide communications towards CISEM and CISEVI and between other first responders Mobile Command Center (Health Services and Fire Fighters)

4. Social, Ethical and Legal implications

The information regarding social, ethical and legal implications have been extracted form the Video surveillance and personal data protection guide, from de Information Security Observatory - INTECO, depending of the Ministry of Industry [17].

Video surveillance comprises any activity that means installing a fixed or mobile recording camera, with the aim of ensuring the security of a building or individuals, ensuring that workers comply with their work obligations or being of usefulness in diverse areas.

A video surveillance system is made up of a device that takes a picture (e.g. a camera), one that displays (e.g. screen) and one that stores (e.g. hard disk). In order to use the captured image immediately or at a later date it has to be transferred to the display device and to the storage device respectively.

The chief aim of video surveillance is to capture and/or process images to guarantee the security of property and individuals. Video surveillance can be carried out for the following purposes:

- For security purposes of individuals and property. This purpose includes capturing images to control public safety, road safety, sporting events, access to private areas, etc.
- For use in business settings for work-control purposes. In this case, cameras are used to provide employers with information regarding employee compliance with obligations and duties. This verification method does have its limitations and cannot be carried out in a manner that threatens the employees' rights to privacy.
- Other purposes. The increase in popularity of these systems has prompted their use in other fields such as tourism promotion, research, behavioral studies, etc.

The use of images containing identifiable people in the various fields of activity has a series of legal implications. Firstly, anonymous people have the specific right to not be filmed in public places (nor private ones obviously) unless the filming is covered by the fundamental right to freedom of expression (article 20 of the Spanish Constitution), which includes image rights with the economic element preventing commercial exploitation without the individual's permission.

This principle is based on the fact that capturing an image of a recognisable person constitutes personal data and must, therefore, be treated in compliance with relevant data protection laws.

Nevertheless, video recordings of the street and of passers-by, is allowed in certain cases for security reasons.

The right to one's privacy, honour and self- image is guaranteed under section 18.1 of the Spanish Constitution and established by Organic Law 1/1982, of 5 May on Civil Protection of the Right to Honour, Personal and Family Privacy and Image. If a person is identifiable or could easily be identified from an image, this is considered personal data. Data protection principles must be applied to the field of video surveillance whenever technical means are used to record, capture, process, store and broadcast images of identifiable individuals, be it live or pre-recorded.

This obligation is not applicable in the following situations:

- When filming in personal or family surroundings, for example family celebrations, providing the setting remains personal. Internet broadcasting of personal or family recordings would mean going beyond these limits.
- When performing informative tasks carried out by media professionals based on article 20 of the Constitution for freedom of information.

Any organization that installs a video surveillance system to capture or process images in which identifiable people may appear, must abide by some general principles of conduct in accordance with data protection laws and the Spanish Data Protection Authority's (AEPD) Circulars and Resolutions.

The following principles are defined:

- Quality. Images obtained must be suitable, relevant and never excessive with regards to the purpose for the installation of cameras.
- Proportionality. The controller must give the sought objective much thought and the possible effects on the individuals involved, to ensure that there is no other less invasive method to fulfill the same purpose.
- Purpose. The purposes sought must be clearly defined in the processing of personal data.

Video Surveillance for Public Safety

Video surveillance carried out by the Law Enforcement Authorities aims at guaranteeing public safety, as well as preventing crime and offences related to public safety.

1) Video surveillance system and processing controller: the Autonomous Regions are authorized to regulate and allow the Law Enforcement Agencies to use video cameras in this case as well as take custody of the recordings and control image access.

2) Applicable regulation:

• Organic Law 4/1997 of 4 August specifically regulates the installation of video cameras and recordings carried out by the Law Enforcement Authorities.

• The Organic Law for Data Protection (LOPD) and Instruction 1/2006.

3) Obligations of the controllers:

• Organic Law 4/1997 stipulates:

− Authorization for the installation of fixed and mobile cameras.

− Provide Public Administrations, Judges and Courts with the images captured.

− Offences and fines related to the development of police activity.

• The LOPD and instruction 1/2006 complement the above, noting: − General data protection obligations according to the general obligations of the video surveillance system controller10.

− Creation of files by means of general regulations published in a daily journal.

Madrid City Council has official authorization from the competent administration (Madrid Government Delegation) for the areas that are going to be covered by SafeCity project (5 cameras of 200 aprox. installed and authorized for video surveillance in Madrid).

Video Surveillance for Road safety

The object of this type of system is to control, regulate, monitor and discipline traffic, as well road safety.

1) Video surveillance system and processing controller: Public Administrations authorized to regulate traffic and enable the installation and use of video cameras.

2) Applicable regulation:

- Organic Law 4/1997 of 4 August in its eighth additional law considers the controller to be the person in charge of carrying out the installation and use of video cameras and any other means to capture and reproduce images for the control, regulation, monitoring and discipline of traffic.
- Law 18/1989 of 25 July for Motor Vehicle Traffic and Road Safety, approved by Royal Decree Legislation 339/1990 of 2 March in its Title I, refers to the authorities with the power for carrying out and coordinating motor vehicle traffic and road safety issues.
- The LOPD and Instruction 1/2006.

3) Obligations of the controllers:

- Organic Law 4/1997 stipulates:
  - Authorization for the installation of fixed and mobile cameras.
  - Identification of public roads.
  - Measures that guarantee the availability, confidentiality and integrity of the images.
  - The body in charge of the custody and processing.
  - Provide Public Administrations, Judges and Courts with the images captured.
- The LOPD and instruction 1/2006 complement the above, noting: − General data protection obligations according to the general obligations of the video surveillance system controller.
  - Creation of files by means of general regulations published in a daily journal.

5. Challenges in Public Safety

5.1 Current Limitations and Gaps

The Madrid Police Department has detected the following problems and technological constraints in current systems and applications.

CCTV systems

With the increasing number of surveillance cameras, there is not enough police officers to watch all the real time images, so it is needed some new capabilities to automate the process, and this can be done only with video analytics. But the most of the surveillance cameras of the MCC are Dome PTZ, and that is a problem for analytic software, that is unable to detect anything when the camera is moving. Even with fixed cameras, the number of false alarms is too high, shadows and swaying trees confuse it. A new generation of analytic is needed, with more capabilities.

Downtown, between the old streets and buildings, it is not very easy to install security cameras and sensors, and transmit the information to the right place.

Mobile communications

The police cars use 3G public mobile communications to transmit data and video, but 3G do not have QoS, neither guaranty it is going to work when there is a crowd of people using their cellular and smart phones, and that is what happens in any great emergency or important public event.

Ad-hoc communications

In some locations where the Madrid Police officers have to work, for a variety of reasons there is not any network available, so they have to rely in the voice radio system, to send and receive any type of information and orders.

Security Applications

Police need to keep them working in any location, in a secure way, with faster response possible, and with all the available information in just one place. Nowadays people have started to use the web 2.0 intensively, and information from the social networks has become a must, now the polices officers recollect data about security issues around the city by hand, and try to predict what is going to happen.

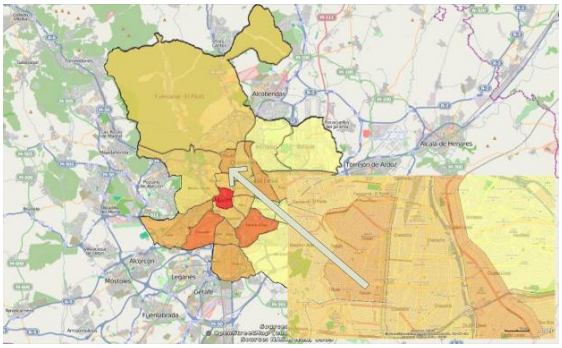
Data collected from the different sources not always is as complete, accurate and meaningful as needed.

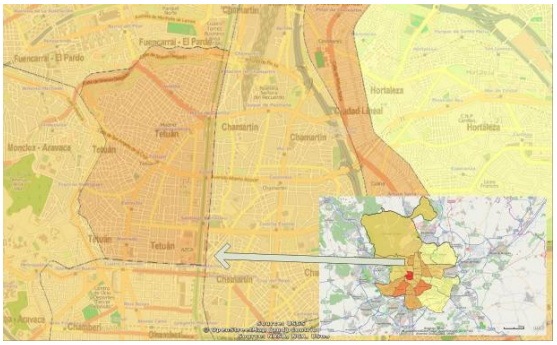
5.2 On-going innovative Initiatives

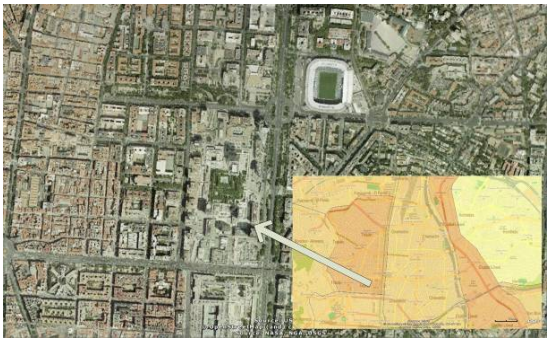
Madrid Police Department has been and is involved in various Spanish and EU projects to improve safety through the use of the information and communications technology. Some of the activities performed in these projects are described below:

- Improve data communication in crisis situations for security and emergency bodies, using Priority Communications on Public Mobile Networks (PCPMN), new private data networks (LTE, wimax<>wifi, etc.), or ad-hoc systems.

- Implement video surveillance in new areas of Madrid City, as the AZCA business centre.







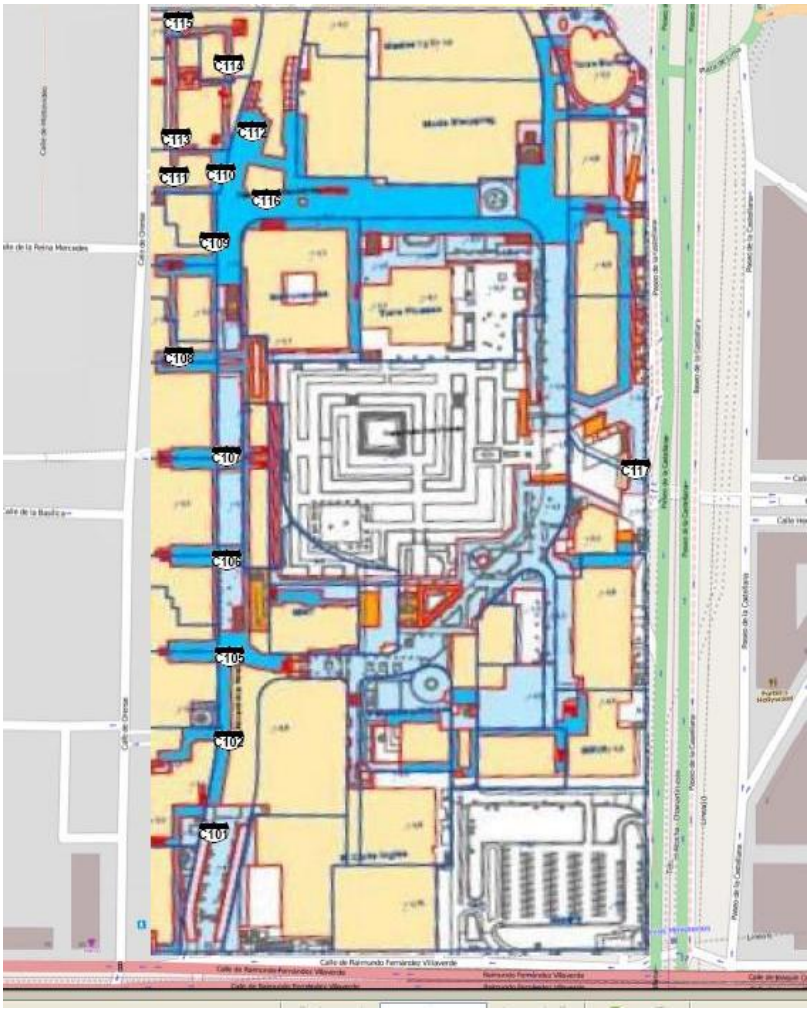


Figure 35. Draft of the AZCA CCTV surveillance system

- Install an improved video analytic systems, with at least 99,9% of accuracy.

Figure 36. Detection of objects

- Design the integration and automatic transmission of incident data and video from other public and private agencies, as of Metro, EMT, Barajas Airport, National Police, etc., to CISEM.

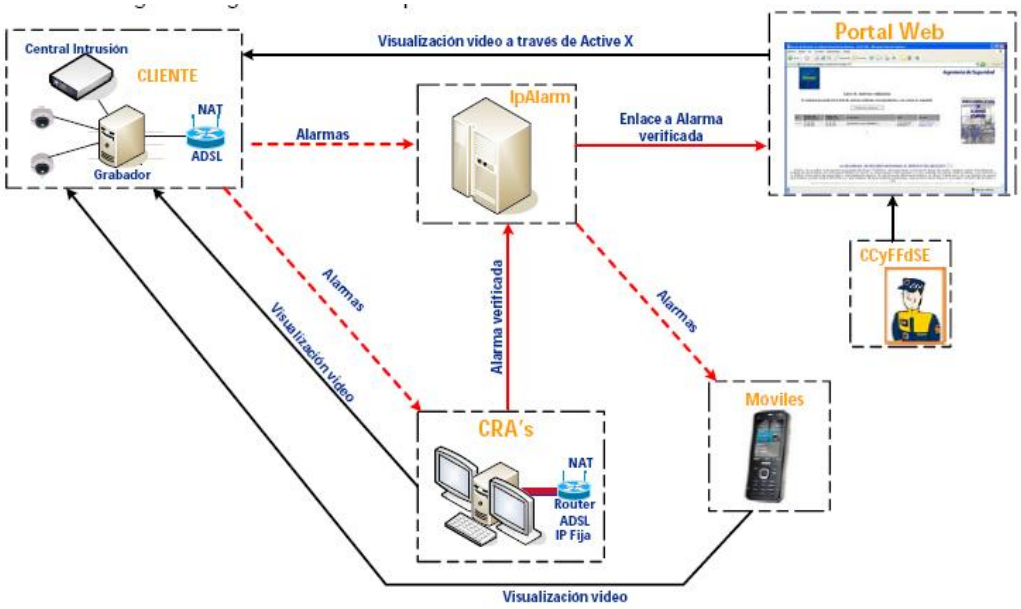


Figure 37. Draft design of transmission of incident and the video related

- Define the technology to improve the iPOL system, adding new data sources, as more external databases, and social networks as facebook, twitter, tuenti, etc.

- Create a "predictive system", that with the information that iPOL manages, will allow to know what will probably happen.

5.3 Ideas for the future

Once CISEM provides answer to issues related to integration and coordination, it is time to give one more step and focus on the response of some technological requirements which are not fulfilled yet.

One of them is to integrate and analyse automatically information from the social networks.

More over, during emergencies like the March 11th terrorist attack, citizens overload private mobile data networks. Police and other first responders in the scene need high capacity wireless communication networks in the public areas of the city, with guarantied QoS, in order to send and receive critical data and CCTV images, so a deployable ad-hoc network is a need in that specific situations.

Other real need in the cities is the management and analysis of a great number of cameras to provide automatic detection of certain kind of patrons that can lead to an emergency situation for the city. In this area, coordination and standardization of the vendors' solutions is required. The video analytics software must be able to improve:

- Use of PTZ and panoramic cameras.

- Motion detection.

- Auto tracking motion.

- Object recognition.
- Detection of: Loitering, street fight, person fall, etc.
- Counting of people.
- Face recognition.
- 3D models.
- Detection of Type, model and colour of vehicle.

Priority Communications on Public Mobile Networks (PCPMN) during crisis situations for security and emergency agencies, and QoS for communications to/from police cars, is demanded.

Availability to permanently deploy public network access points in Street and other locations, in an easy way.

Apart from this, specific innovative applications could be implemented to enhance the public safety in the M-30 tunnels and other areas of Madrid. The following applications would be managed by the M-30 Control Centre:

- A tunnels 3D model is being developed. In the future, this could open a lot of possibilities to have a better situational awareness in case of incidents in the tunnels.
- A vehicles tracking system could be implemented in Madrid City using the existing cameras in the tunnels. However, there is a problem to implement this system outside the tunnels since the Incidents Automatic Detection system is not available due to the outdoor lighting is variable.
- A digital communication system is being implemented; therefore the first response plan could be launched using messages. This would enable to store and control the reaction time.
- A communication system shared between the different emergency bodies would enable to share information such as stolen number plates facilitating the suspicious vehicles tracking.
- An automatic route calculation system could be implemented if the incident location is known. This would facilitate the access to the emergency bodies.
- Access to databases with sensitive information, for example, stolen vehicles number plates database. The information security has to be taken into account.

In conclusion, the current communication system between emergency bodies, police, local authorities, etc. should migrate to the following model:

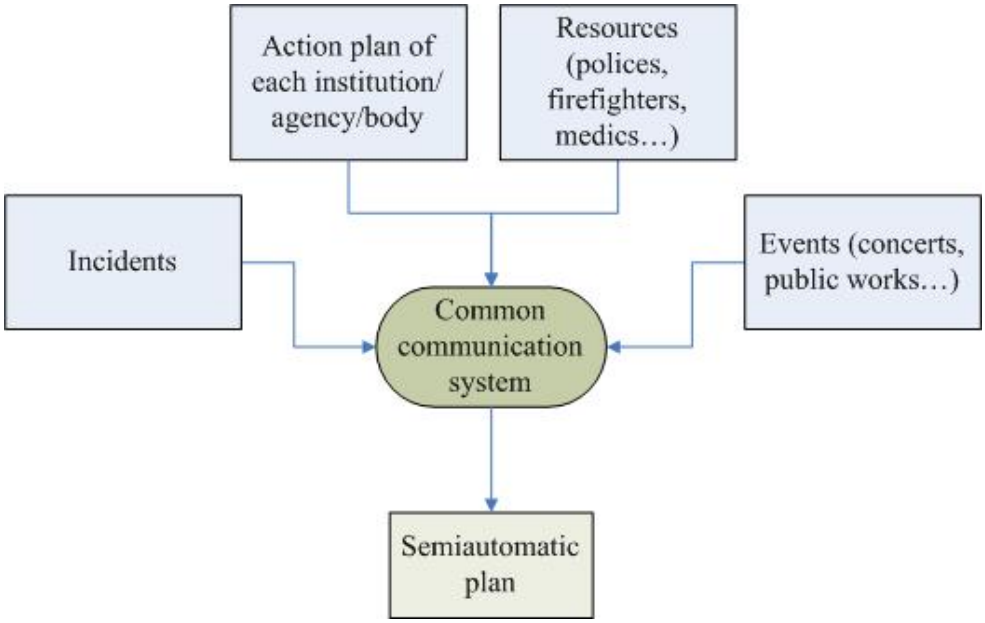


Figure 38. Concept of future communication system

5.4 Future Characterization

Regarding video surveillance in Madrid City, as it was already stated; new projects will be planned in the field of intelligent video surveillance in the sense of incorporating those kinds of systems to the surveillance platform already installed.

The surveillance areas are not likely to increase in the following years. Just the AZCA area in Tetuán District could be one of the new areas to incorporate to the system.

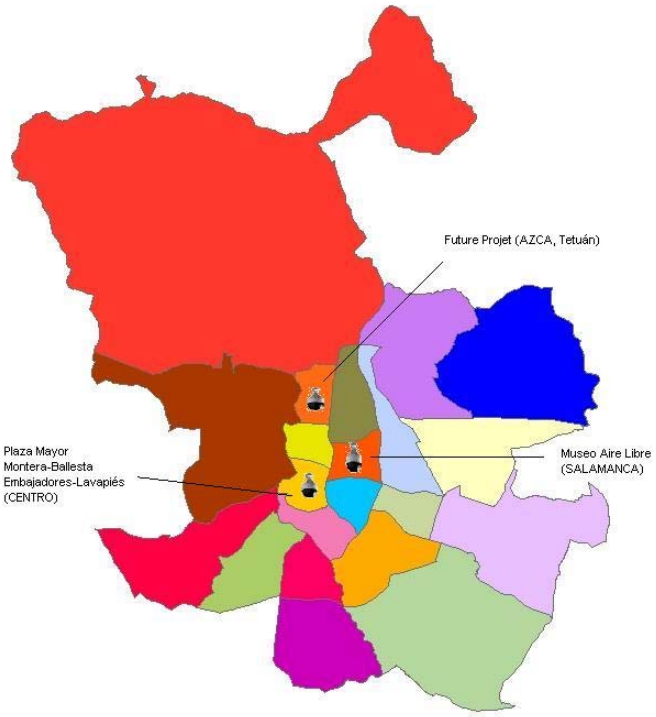


Figure 39. Future Video Surveillance areas in Madrid: AZCA incorporation

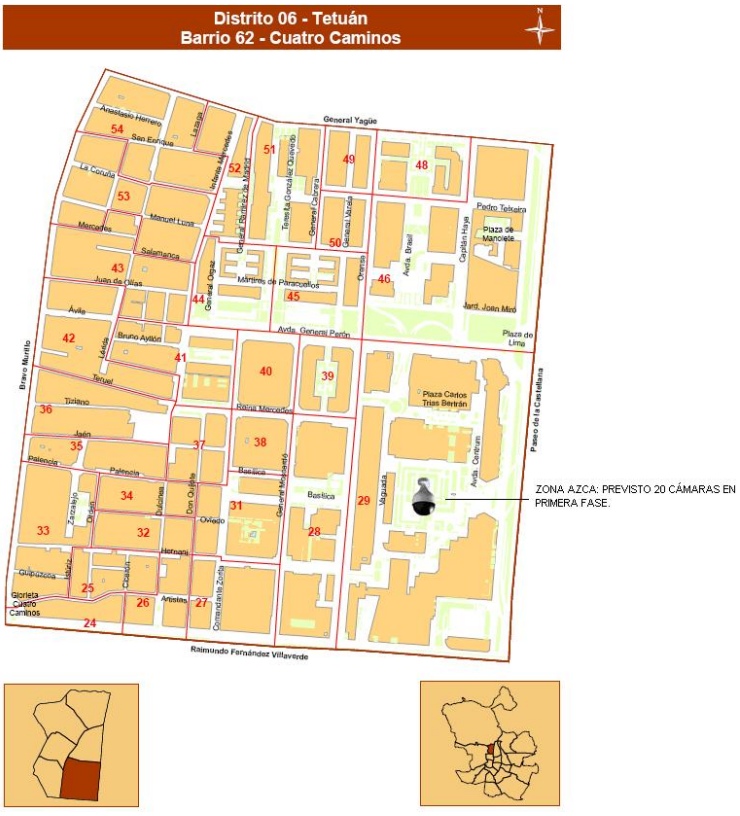


Figure 40. AZCA Video Surveillance in Cuatro Caminos Ward – Tetúan District

Apart from this, the applications controlled by M-30 Control Centre could be implemented in the future projects of M-30 expansion in the North area of the City.

These projects are:

- North By-Pass (in yellow and orange)
- Connection between North By-Pass and A-1 (in red)

Figure 41. Possible expansion of M-30 applications

6. References and Citations

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Annex A – SafeCity End User Questionnaire MCC Single Incident Police incidents

FP7-285556 SafeCity Project

SafeCity Questionnaire

MCC Single Incident Police incidents

Deliverable Type:	**CO**
Nature of the Deliverable:	**O**
Date:	**26th of July, 2011**
Interviewer Partner:	**Madrid City Council**
Editors:	**Sara Gutiérrez**

***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.

Annex B – SafeCity End User Questionnaire MCC Centralized Video System

FP7-285556 SafeCity Project

SafeCity Questionnaire

MCC Centralized Video System

Deliverable Type:	**CO**
Nature of the Deliverable:	**O**
Date:	**26th of July, 2011**
Interviewer Partner:	**Madrid City Council**
Editors:	**Sara Gutierrez**

***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.

Annex C – SafeCity End User Questionnaire MCC OCR System

FP7-285556 SafeCity Project

SafeCity Questionnaire

MCC OCR System

Deliverable Type:	**CO**
Nature of the Deliverable:	**O**
Date:	**26th of July, 2011**
Interviewer Partner:	**Madrid City Council**
Editors:	**Sara Gutiérrez**

***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.

Annex D – SafeCity End User Questionnaire MCC Traffic Control System

FP7-285556 SafeCity Project

SafeCity Questionnaire

MCC Traffic Control System

Deliverable Type:	**CO**
Nature of the Deliverable:	**O**
Date:	**26th of July, 2011**
Interviewer Partner:	**Madrid City Council**
Editors:	**Sara Gutiérrez**

***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.