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European Module for Crisis Management A Crisis Room on the field

Design of a ready-to-deploy mobile module for Crisis Management

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Abstract

In the context of crisis management, new technologies are employed to enable the crisis managers exploiting better the flow of information. The presence of decision makers near the crisis locations helps the process of coordination, scaling from a tactical to a strategic level.

Providing promptly a shelter and a proper place to arrange a coordination centre is a challenging task, which requires a solution agile, flexible and sustainable. In order to coordinate the efforts of different entities involved in the crisis management, the solution must also provide interoperability usually achieved by modularity.

In this report this concept will be further described together with past and present implementations.

On the basis of past experiences and using consolidated technologies, the report will then provide a design of a mobile crisis room to be implemented in 2016.

At the end of the report new technologies will be introduced to evaluate their possible impact on future implementation of similar solutions.

1 Introduction

In this section the concept of mobile operational centres will be introduced together with the needs it can meet and the first implementations illustrated.

1.1 Concept and key features

Headquartered in Brussels with a global network of field offices, the European Commission's Humanitarian aid and Civil Protection department (ECHO) ensures rapid and effective delivery of EU relief assistance through its two main instruments: humanitarian aid and civil protection. When a country is hit by a disaster which overwhelms its response capacity, in fact, European countries can provide assistance via the EU Civil Protection Mechanism. The Mechanism was established in 2001 to foster cooperation among national civil protection authorities across Europe. It enables a more rapid and effective response to emergencies by coordinating the delivery of civil protection teams and assets to the affected country and population.

Coordination is a challenging task, that is difficult to implement when the actors involved cannot be physically together, exchanging and consolidating information. The communication technologies provide improved solutions to allow the cooperation of many actors, but there are still cultural gaps which slow down this approach. Anyway, a physical place to gather information is usually needed, also to gather expertise or special equipment needed on the field.

The Emergency Response and Coordination Centre is the 24/7 operational hub of the Mechanism and coordinates the delivery of civil protection assistance to disaster stricken countries such as relief items, expertise, intervention teams and specific equipment. It replaces the previous Monitoring Information Centre (MIC) which in the past developed solutions to deploy part of its functionalities where mostly needed. The first implementation was, for instance, MIC-in-the-box, a set of ICT tools kept operational and ready to be taken by the MIC officers to easily deploy where needed. A further development of this concept, MIC-in-a-pocket, implemented a PDA (Personal Digital Assistant) based software enabling to produce geo-referenced field reports and publish them immediately on the Web.

In order to face large scale disasters and to organize better the cooperation of the many actors involved, it is advisable the presence of a physical place to gather the actors and to moderate the flows of information into a common operational picture.

A solution to deploy a Control and Coordination facility easily and promptly all around the world would also help the outbreak assistance teams of the European Centre for Disease Prevention and Control (ECDC), whose expertise may include epidemiology, clinical medicine, public health, infection control, etc. ECDC ensures the immediate availability of the necessary material for field missions, including state of the art communication material, as well as medical or protective material.

Relocating the decisional process next to the need avoids relying heavily upon the communication means. It brings together all the actors involved, but allows as well that the first actor arriving can start performing and establishing the post. In case the procedures require to pass later the control position to another actor, this won't move the location of the post, it will just alter its internal organization.

A typical example is an event requiring the joint intervention of local police, fire brigade and sanitary personnel. Usually, a natural disaster will be under the fire brigade control. The first actor arriving on the place best suited to establish a control post will set it up. When the fire brigade personnel will arrive, it will take charge of the situation, but the position will be the same.

In the same way, either the ERCC or another actor of the EU Civil Protection Mechanism could reach the emergency location to start implementing a crisis management centre to be later merged into a coordinated structure of the Mechanism.

The assets required by a mobile command and control solution will vary on the basis of its specific tasks, but it is possible to determine some common needs:

- Self-containment
- Communication and interoperability
- Sustainability

1.2 Self-containment

The mobile unit must provide energy for all its apparatus, including those for the comfort of its operators.

Batteries can provide energy, but cannot last for long and cannot be too many, because of the weight. An additional source of power is therefore needed. Not always the power grid will be available during the events, but it is the perfect solution when present. In a critical situation though, its behaviour is not predictable and electrical safeties must be employed to prevent overcharging the mobile unit's system. An engine based power generator will be anyway necessary to ensure full-time availability of energy. Renewable sources of energy are advised, since solar panels or wind turbines can be installed on the roof, but they cannot guarantee a 24/7 delivery of power, still adding complexity and maintenance requirements.

The energy is required to operate the equipment, including lights and signals, communications, computers and cameras; but also to provide heat and air conditioning for the comfort of the operators. Mobile equipment will also require charging batteries, using the energy provided by the unit.

The mobile unit is then required to provide all the necessary means to establish a post, including shelters to enlarge the operational workspace and all the first intervention aids to help the population or endangered operators: CPR equipment, stretches, first aid kits, blankets and spare garments, but also what is necessary to confine a space, like barricade tapes or retractable belt barriers.

1.3 Communication and interoperability

While the paradigm of crisis management evolved from the military organizations and the civil protections developed, the operators involved on the site of intervention created a

Trading Zone, where the actors share and give meaning to information to synchronize their actions (Boersma, May 2014) (Wolbers & Boersma, December 2013).

This requires the solutions adopted to allow the maximum interoperability. The best way to achieve that is the use of common standards, where they can be applied. A certain effort is still required at national level to provide all involved corps with interoperable technology. Some member states already promoted the use of intercommunication standards (e.g. decreto 17 giugno 2008, Ministero dell'Interno, Italia), thus implementing leopard spotted integrations of the emergency services. Promotions of these standards will lead in the future to use them on the whole territory and possibly cross-borders.

At supranational level, the level reached at the moment is quite low. Cross-borders exercises and activities pointed out this problem in the past, leading to small projects, carried on case by case by the different corps, in the frame of an ongoing European effort started in 1985 along with the Schengen agreement. Various regions of common interest have been identified, like the alpine region (including the Alps, their foothills and plains, part of the Mediterranean coast and of the basins of Danube, Po, Adige, Rhone and Rhine) and sustained in the frame of INTERREG projects.

Interoperability and exchange of information require reliable means of communication and a common understanding, based on a common lexicon or the means to combine the differences in a consistent way.

The telecommunications infrastructures are improving and benefit from the Digital Agenda for Europe (COMMISSION), which explicitly refers to Interoperability and standards in section 2.2.

The use of one single common language is utopic: the operators have to interface with the population in its native language (even two or three at the same time, e.g. Cataluña) and in crisis conditions there is no need of an additional strain caused by the translation. The technology to transform formalized information from one language to another is available and widespread and the alerting solutions already benefit from it (e.g. CAP).

The military background of many operators in civil protections led many to ask for standardization agreements similar to others adopted by military forces (e.g. NATO Standardization Office). Harmonised standards are not developed in the field, but many are requested to be developed in the frame of Horizon 2020, like those regarding eHealth.

1.4 Sustainability

A mobile unit as a self-contained system requires to be maintained in full efficiency: its components must be available on the market at reasonable prices and in a free market condition. Proprietary solutions are not consistent with the requirements of a system, that can be freely deployed in foreign countries inside and outside the European continent. The key components should therefore foresee a lifespan of several years, while the additional components should be chosen depending on their cost/lifespan ratio. Refurbishing the unit after a field mission has to require a slight fraction of the cost of the unit, and must be possible in a reasonable time. If this means that it is required stocking consumables and spare parts, this also has to be a negligible investment, if compared to the overall cost of the solution.

Well established technologies or de facto standards are to be preferred, even if requiring additional expenses including software licences.

Standard Operating Procedures (SOPs) have to be developed and maintained to keep the unit fully operational while deployed and when recovered. The personnel will follow them and routinely will check the readiness of the unit.

A key component of sustainability is the coherency of the working environment within a mobile unit with the day-by-day working conditions of its operators. This means that the same equipment and ICT solutions should be used for both; or at least they have to adopt the same conventions and use philosophy, thus providing a common context to the operator, who will always be able to refer to the same working conditions, since he needs to operate exactly as he does in his office.

1.5 History

The second World War was a conflict where the fast movements of troops and resources created vast fields of operations: the battlefields, which were extremely confined only 25 years before, extended for tens or hundreds of kilometres.

There was no way to arrange a command post in a building, when finding a suitable location could depend by a last minute change of fortune. The lack of inhabited regions in northern Africa led Sir Bernard Montgomery to elaborate a travelling command post, basically a cabin mounted on the rear of a lorry. Originally built for Italian General Annibale Bergonzoli, the caravan was captured in 1941 near Benghazi and split in two compartments: forward there was a toilet and a wash basin, and in the rear were map lockers, a collapsible map table and a bed-settee.

This solution, later deployed in Tunisia, Sicily, Italy and Normandy, provided a more refined solution than usual armoured vehicles such as those used by his German counterpart, Edwin Rommel, since it already presented the concepts expressed so far: this was the first solution providing inside the working environment instead of just bringing the material to establish an on-the-field command post. It was so successful, that General Montgomery adopted other two caravans to implement his mobile headquarters, and many other of his colleagues followed his example.

In Figure 1 it is clearly visible the extension of the unit with other mobile units to create a larger space.

In Figure 2 the interior is used as a working environment: the wall of the cabin is used to arrange maps to georeference the strategy.

In Figure 3 the personnel needs some time to rest: the unit must provide the means and comforts for it.

Later, many other military forces provided themselves with other solutions. The armoured versions were preferred: using tracks they were all terrain solutions; but they were slower, offered less space and were not applicable to civil uses.

Figure 1 Alan Brooke, Winston Churchill, and Bernard Montgomery at Montgomery's mobile headquarters in Normandy, France, 12 Jun 1944

Figure 2 King George VI listens as Field Marshal Sir Bernard Montgomery outlines his future strategy at his mobile headquarters in Holland, 13 October 1944

Figure 3 General Montgomery with his puppies "Hitler" and "Rommel" at his mobile headquarters in Normandy, 6 July 1944

2 State of the art

In this section, some mobile units are presented. Far from being exhaustive, this presentation allows spotting the common principles shared by the implementations of the generic model.

2.1 Special Technical Unit Guidance/Communication

The special technical unit Guidance/ Communication (FGr FK) in particular serves the purpose of guiding THW units and applies the communicational tasks necessary for guiding THW action forces and communicating to the public utility provider. It may also support the incident command of the requesting agency in setting up a functional communications network for the affected area. The mobile control centre, consisting of a lorry with a trailer, can be designed as a large integrated office with modern technical equipment.

Individual divisions of the Technical Unit Guidance/Communication can be tactically separated and used for variety of especially supportive tasks. The Technical Unit may also support other units or auxiliary forces with telecommunications. As an addition, the THW provides four wide-area squads to enlarge telecommunication hubs and data linkage and for establishing and maintaining autonomous telecommunication facilities.

Characteristic equipment

- Versatile mobile relays stations with 2m/4m cables
- Mobile stations equipment
- Building equipment for cable boxes and remote cable boxes
- Mobile telecommunications systems (analogue, ISDN, GSM and DECT)
- Field-ready telecommunications systems for dial and common battery use
- Management assistance

Special equipment

- Directional radio or wireless switched network
- Satellite communications

Vehicles

- Guiding Emergency Vehicle, 1t cargo load, estate car, 1+5 seats
- Management/communications cars, 3t cargo load, box body, 1+5 seats
- Trailer, management and situation, 2t cargo load, special body, foldout, tandem truck
- Telecommunications car, 3t cargo load, 1+6 seats, platform/conversion kit, terrain ready

Wide-area squad

- 5-car vehicle, terrain-ready, 4x4 drive, 1+3 seats
- Special vehicle for setting up pylons, 3 trucks, special body, telecommunications pylon 30 m
- Trailer, 2t cargo load, tandem truck

Figure 4 The components of the THW Special Technical Unit

Figure 5 The THW Special Technical Unit deployed

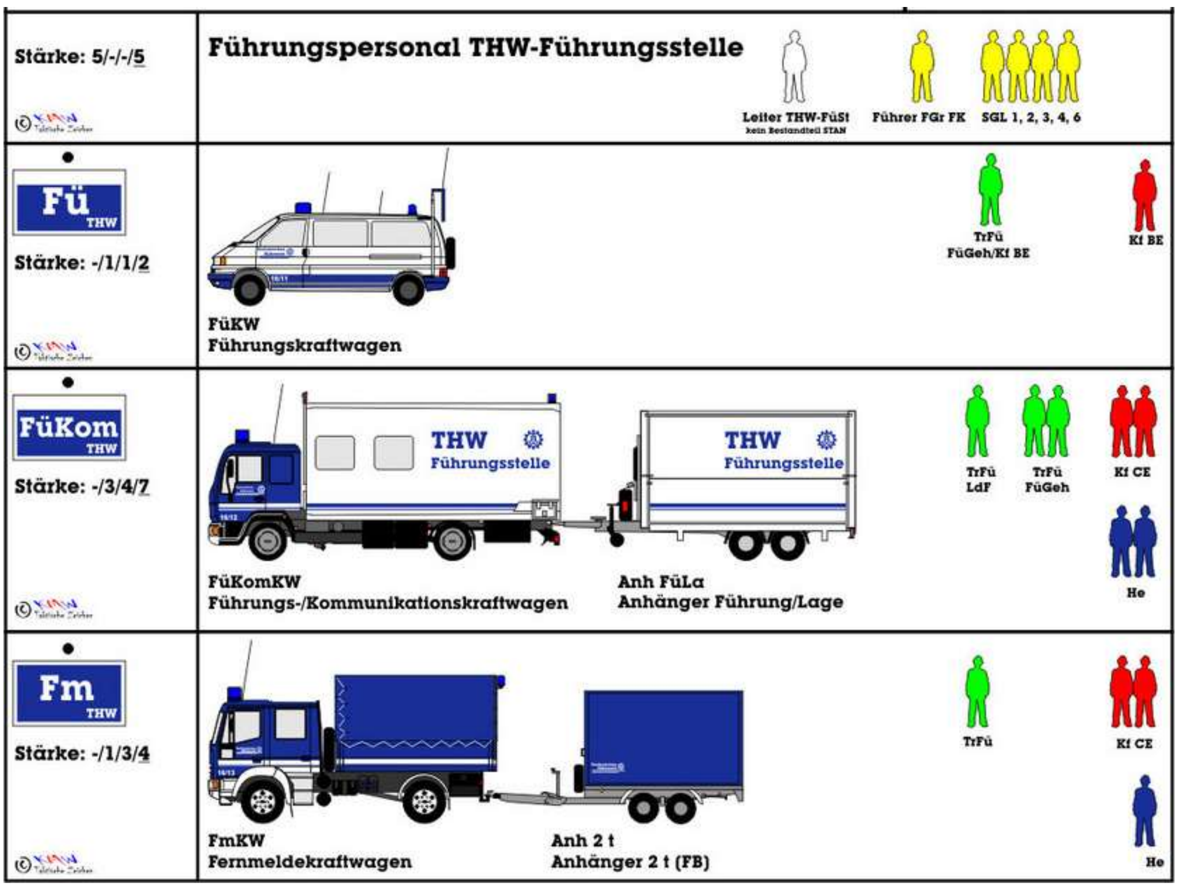

Figure 6 Manning of the THW Special Technical Unit

Figure 7 Operations in the THW Special Technical Unit

The unit aims specifically at restoring the communication means in the area affected, thus acting as a concentration hub for the flow of information. Notified by the operators about the situation, it can easily help in building a COP.

Self-containment	Self-propelled, power batteries in trailers
Communication and interoperability	Designed specifically to establish communications
Sustainability	Designed internally, built locally

2.2 MDA National Mobile Command and Control Vehicle

Figure 8 MDA National Mobile Command and Control Vehicle

The vehicle was invented, built and programmed to act as a special MDA command post. It is mounted on a Dutch DAF truck chassis and was built in England and equipped with advanced technologies from Israel.

The 16m long vehicle is 4m high and weighs 32 tons. It is supported by a generator truck and fuel tank which holds over 900l of diesel fuel.

Figure 9 Inside the MDA National Mobile Command and Control Vehicle

The command centre includes a huge boardroom which is completely separate from the operational stations. The centre is equipped with technology, aerials and dishes to keep communication channels open

Among other things, the truck is equipped with advanced cameras that rise 19m high and includes a conference room.

Construction, which took four years, was commissioned after the 2009 Carmel fire disaster, during which the MDA encountered challenges with regard to communications and coordination of rescue efforts.

Self-containment	Self-propelled, power generator
Communication and interoperability	Reliable multi-standard communications
Sustainability	Built abroad, but equipped in house

2.3 UCL – Italian Fire Brigade

In order to comply with a 2006 policy of Italian Presidency of the Ministries Council, which created the position of the Technical Rescue Director (DTS, Direttore Tecnico del Soccorso), the Italian Fire Brigade developed the Local Command Unit (UCL - Unità di Comando Locale) to support this position’s activities and to ease the coordination with the other organizations.

The UCL is a mobile station for control and coordination, which is essential for the management of interventions that require the use of significant resources in terms of means and operators of the Italian Fire Brigade (CNVVF). It is also used to bring together teams of CNVVF with representatives of other agencies and other organizations involved in the management of interventions in more complex scenarios. The UCL can be considered an extension of the operating rooms of CNVVF, as it is integrated with the systems of telecommunications and data transmission.

In the search for missing persons, for the possible presence in the field of a large number of agencies and organizations, the UCL is the natural point of contact between them, since it provides information about the area, allowing the planning and subsequent management of relief operations. When the use of technology and systems TAS (Topography Applied to Rescue) is needed, the UCL can be indispensable for the activities of search and rescue of missing people (SAR - Search And Rescue).

In the ordinary configuration the fire brigade UCL has radio communication systems and telephones to contact other agencies and central commands, it also provides the data processing and cartography.

A considerable number of UCLs from different Fire Brigade commands has been used for months in the relief efforts following the earthquake of April 6, 2009 in Aquila.

Figure 10 UCL - Internal and external arrangement

Figure 11 ICT equipment: radio links and servers

Self-containment	Self-propelled, power batteries that can be charged by the vehicle engine
Communication and interoperability	Reliable multi-standard communications integrated with the other operating rooms, including same software and data formats Designed to interoperate with similar vehicles of Police and Red Cross
Sustainability	Built locally, internally designed, retail equipment

2.4 UCA – Milan Local Police

This vehicle is used primarily as an Advanced Command Unit (UCA – Unità di Comando Avanzato), in order to manage events during emergencies or other situations out of the ordinary, such as severe car accidents, seismic events, floods and the like. As ordinary use, it will perform surveillance on the roads for heavy traffic and during the weekends (to avoid weekends nights' accidents).

After an in-house built prototype, the Local Police Command requested through a tender the implementation of two new vehicles.

These units will be able to connect to the network of many thousands of cameras displaced in the metropolitan area of Milan and to provide additional cameras itself, including those mounted on a mast on top of the unit.

The unit is provided with all the means to act as a control unit and a first aid facility. It has lights and power units, medical provisions including a back safe stretcher and a CPR device, technical complements including mobile barriers and a LED panel to signal the population about the nature of the event.

The unit is also provided with a workstation, a notebook and a printer and all are connected through various means with the Internet and the Local Police network.

The UCA is compliant with similar units from the Fire Brigade and the Italian Red Cross, in order to interoperate and create a joint command post.

Figure 12 The Advanced Command Unit deployed for the Seveso flood, 2014

Figure 13 Advanced Command Unit interior

Self-containment	Self-propelled, power batteries that can be charged by the vehicle engine
Communication and interoperability	Reliable multi-standard communications integrated with the other operating rooms and the CCTV systems Designed to interoperate with similar vehicles of Fire Brigade and Red Cross
Sustainability	Built locally, internally designed, retail equipment

2.5 Irvine Police Department Mobile Command & Control Vehicle

In February 2008, the Irvine, California Police department commissioned orange county's first command and control vehicle. The primary objectives for the vehicle include helping at major traffic collisions, aircraft crashes, hazardous material spills, major crime scenes, crimes in progress, natural disasters, and as a resource for police outreach at community events.

The 45-foot (13.7 metres) vehicle, manufactured by Renegade Specialty Vehicles, Bristol, Indiana, required seamless integration of voice, data, and video communications to enable incident commanders to coordinate tremendous resources at the scene of an event.

The Irvine Police department selected CompView as the integrator for the mobile command vehicle because of CompView's experience in design and installation of command and control systems along with their status as a GSA (U.S. General Services Administration) contractor.

The final plan for the vehicle included the ability to capture live video feeds and record video for future viewing, access the internet, and receive broadcast television signals. Within the vehicle, there are four technology enabled areas;

1. The communication and dispatch areas equipped with multiple 22-inch-wide displays for accessing the internet and receiving police report data.

2. The conference room - outfitted with a large display that serves as both a media display and an interactive whiteboard for highlighting tactics.

3. The outside workstation - for accessing media reports.

4. The galley - for housing radio reception and audio visual equipment as well as a communication area with viewing monitors.

Figure 14 Conference room

Figure 15 Outside Workstation

Figure 16 Touch control panel

The communication room has two dispatch stations and two communication stations. The dispatch stations have a computer and three monitors to view news casts, internet sites, and video as well as a microphone, a police communication radio and telephone. The communication stations are similarly equipped with two display monitors to view news casts, video, or the internet as well as radio dispatching equipment and a telephone.

In the conference room, a Pn340 SMART Board for flat-panel displays, allows Incident commanders to simply touch the display to control computer applications, write in digital ink and save notes. The large 40” display is secured to the vehicle with a Premier Mount PCM

MS2 wall mount. This universal mount was selected for its ease of installation and high safety standards.

Integrated into the wall of the conference room is an AMX MVP-8400 8.4” Wireless Touch Panel which provides Incident commanders with easy one-touch routing and control over all of the audio visual systems. The touch panel features a security system that requires the user to enter a pass code to release the touch panel from the docking station. Once the touch panel display is released from the wall mount it becomes a wireless touch panel providing the Incident commander with the flexibility to use the device anywhere inside or outside the vehicle.

The outside workstation is located on the same side as the entrance into the vehicle and is revealed when the door to the workstation is folded down. This area holds a 32” Samsung HDTV selected for its thin design and crisp images. The workstation also holds a phone and dispatch radio. This space enables emergency staff to gather around to view the latest news of the event and receive directions.

The galley is located in the centre of the vehicle and holds the heart of the audio visual system in two built-in equipment racks. One rack contains the radio communication equipment, network components and off-air helicopter decoders. The second equipment rack contains the audio visual equipment routers and decoders. The routers system is capable of routing RGBHV from eight interfaced operators, dual screen computers, and conference centre Pc’s, component video from satellite receivers, and video sources along with stereo audio to all areas of the vehicle, both internal and external. Access to the Orange County MESH video network is made possible by MPEg4 decoders with network bandwidth friendly requirements and capability to provide real-time video from the wireless MESH network. The galley also contains two more communication stations with small overhead monitors for viewing live video feeds from cameras outside the vehicle.

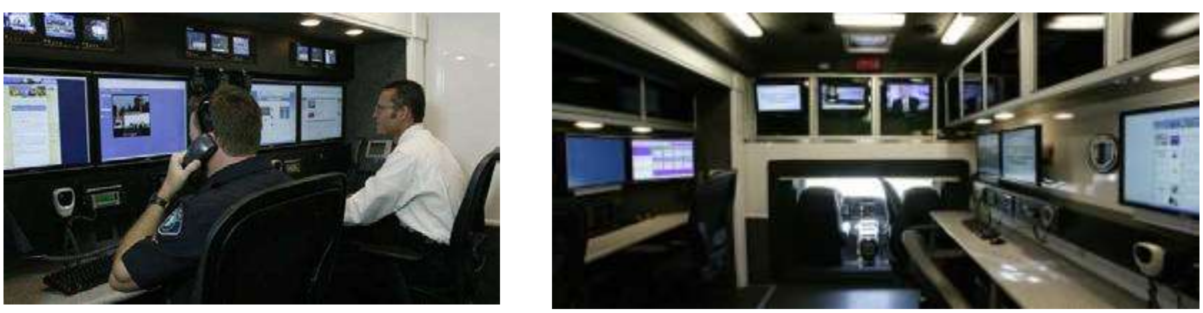

Figure 17 The galley

Figure 18 Irvine Police Department Mobile Command & Control Vehicle

Self-containment	Self-propelled, power batteries that can be charged by the vehicle engine
Communication and interoperability	Reliable multi-standard communications integrated with the other operating rooms, including same software and data formats Designed to interoperate with similar vehicles of Police and Red Cross
Sustainability	Built locally, internally designed, retail equipment

3 Implementation design

The specific needs of a Mobile Crisis Management Unit for a fast deployment all over the world in support of the crisis management effort are anyway different from the examples illustrated so far.

This section will present a design of a possible implementation of such a unit and the description of the chosen solutions.

Referring to the same table used so far, the solution will rate like this:

Self-containment	Not self-propelled, power batteries that can be charged by different means
Communication and interoperability	Reliable multi-standard communications integrated with the other operating rooms, including same software and data formats Designed to interoperate with similar equipment
Sustainability	Built using international standards, easy to replace components

3.1 External structure

The common trait of the implementations listed in the previous sections is autonomy: they are all vehicles provided with additional equipment to implement a working environment for crisis managers.

Using a vehicle allows the mobile unit deploy itself where needed and to benefit from the locomotion engine; nevertheless, all the solutions come from the exigence of an entity operating on its territory with well-defined requirements and operated by drivers used to the topology and the roads.

Developing a mobile unit for a wider use, including a rapid deployment abroad with different traffic rules and sometimes even fuel composition, would benefit from detaching the locomotion component from the unit itself. A unit that is delivered on the territory in order to be carried on the right spot by a local vehicle has several advantages:

- A smaller size will comply better with the needs of the carrier
- On the destination site it will be more probable to find the right transport
- The crew operating the transport will be local, therefore better trained for moving on the territory

Using a standard sizing for the unit means that it will be straight-forward loading it on the transport provided by the selected carrier and sending it where needed. On the destination site a standard mean of transport will also be easy to be arranged.

For this development, the ISO container 20’ long

- provides enough space for the equipment and the operators as well
- is a very consolidated mean of transport
- is already available on the market as a basis for this use

A ISO container 20’ long provides

- a length of 5.898 m
- a width of 2.352 m
- a height of 2.394 m

thus providing approximately 14 m^2 area and 33 m^3 volume. Such dimensions are the minimum requirements for three operators working full time in normal conditions, for this reason the design will use a flexible solution, that provides some additional space.

Some easily deployable containerized offices in fact allows providing more space by collapsing one or two of the longer walls: this doubles or triples the working space, thus providing room for meeting tables or a projector.

The time required by this operation is usually below 30 minutes: therefore, the total preparation of the mobile unit would be immediate, once arrived at the destination.

Solutions which can provide both this flexibility and the capability to store inside them the equipment must be preferred: there is no sense in having a container, which is not used to contain the related material when not used.

An alternative is, therefore, the capability to open the long walls in the middle to create a contained space or a connection with a similar unit.

In the following pictures the concept is made clear showing, for instance, the solution by SEABOX Inc., New Jersey.

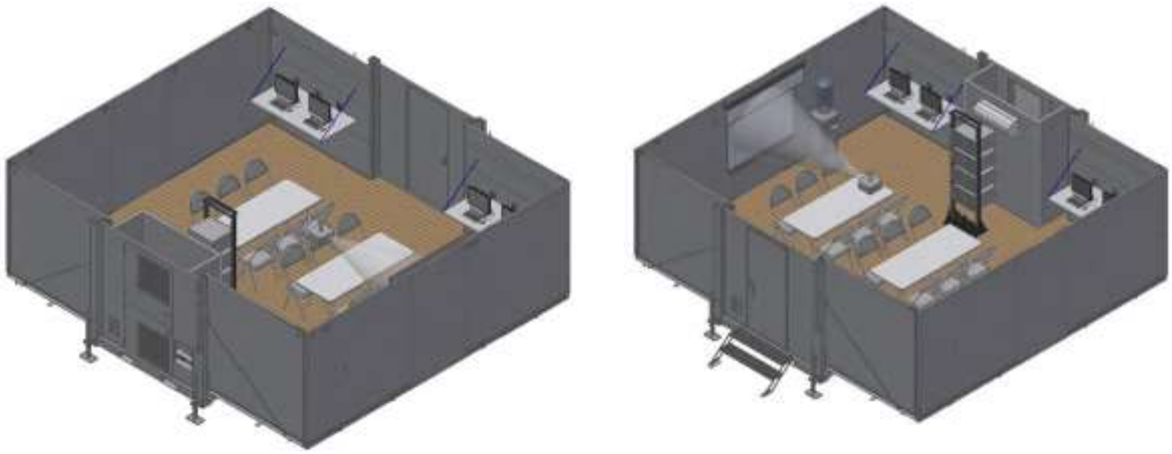

Figure 19 Different perspectives of the mobile shelter

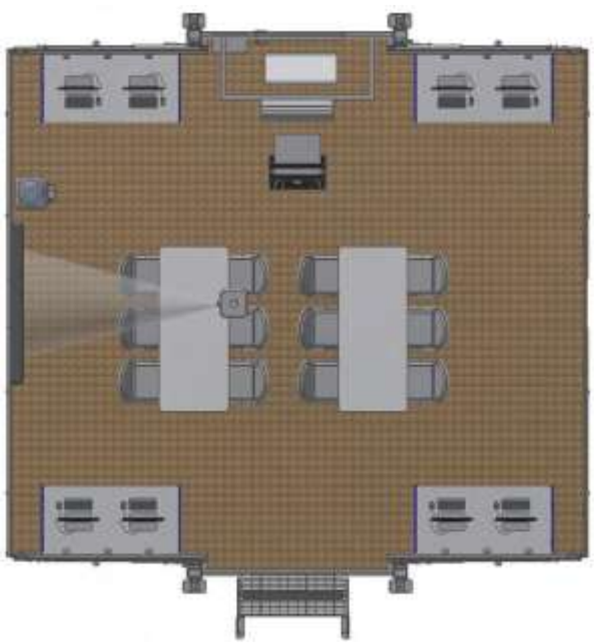

Figure 20 The mobile shelter floorplan

Figure 21 The mobile shelter deployment

3.2 Internal organization and features

The interior of the Mobile Crisis Room will be divided in two main areas: a meeting and planning area and a monitoring and coordination area.

In the first area, the crisis managers can evaluate the situation with the additional information analysts and operators provided: the mobile unit will be provided with all the means (data and software) to evaluate the situation and provide a COP.

This work will be done in the second area, where workstations will be available to handle the flow of information and to aggregate into it the data available locally and online. Information coming from the field will also be ingested and fed into the COP.

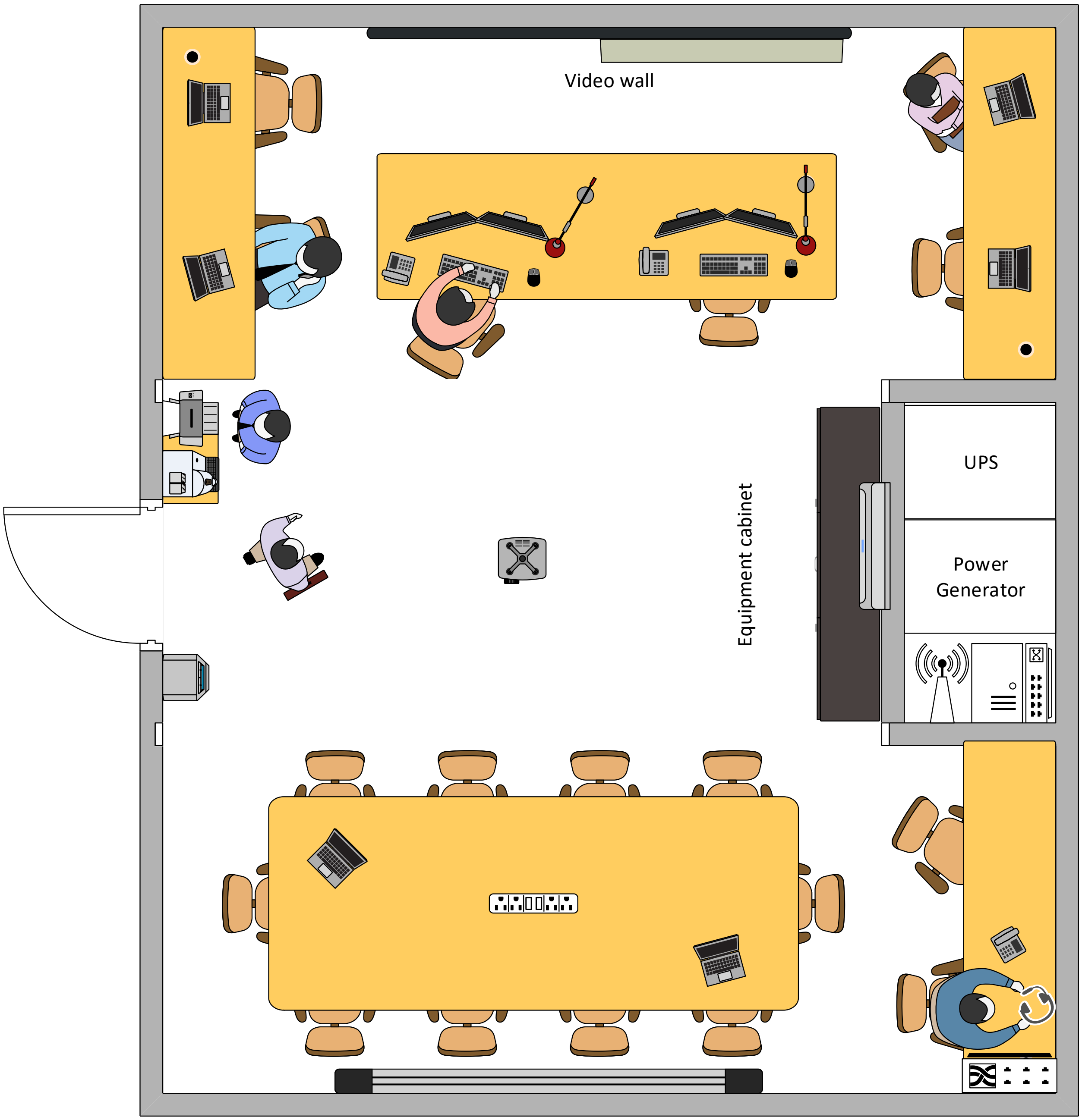

Figure 22 Example of internal organization

Two workstations will be provided, completed by big displays, in order to work easily with GIS and other graphic software. The contents created there will be available on a local network and published on a video-wall (around 2 ½ square meters).

Additional workstations will be implemented using rugged laptops.

The mobile unit will be equipped with a WiFi hotspot, capable to provide both a local network and access to the Internet through various means:

- Cable connect with existing LAN infrastructure
- Access to the DSL connection
- Mobile network access (UMTS/HSDPA/HSUPA and GSM/GPRS/EDGE)
- Satellite connection

This device should also allow to connect normal phones both through the mobile network and accessing the cable based telecommunication network.

The workstations (fixed and mobile) will be therefore connected between themselves and with the servers deployed in the unit. The servers will be virtual machines deployed into a cluster-in-a-box system, a small redundant server, capable to host several virtual servers and the necessary storage. This system will be installed in the small area hosting the power generator and the UPS, in order to confine the noise generating devices.

Next to the meeting area, the telecommunication systems will allow coordinating the operations. All common means of communication will be available like phone, radio and the Internet based services.

Where possible, the unit will receive video streams from the cameras deployed on the territory; but other means should be available to get promptly images of the interested areas. Recently, retail market UAVs developed to reduce costs and complexity still providing easy to use devices with a valuable payload. Users can easily pilot small copters to dangerous areas and get pictures: probably, these will not be fit for precise mapping, but up to the task of providing a better knowledge of the situation. At least one of this device should be present ready to fly and acquire images of the struck area.

3.3 Power source

The mobile unit requires to be self-contained and to provide itself with an autonomous power source.

Given the description in previous section, it is possible to estimate the power consumed by the equipment.

Equipment	Quantity	Power/Unit	Peak power
Workstation	2	125 W	250 W
Laptop	4	50 W	200 W
Server	1	2 000 W	2 000 W
Video-wall	1	900 W	900 W
Air Conditioning	1	3 500 W	3 500 W
Lamps	6	15 W	90 W
Telecommunications	1	1 500 W	1 500 W
Miscellaneous	1	500 W	500 W

(Battery chargers, ...)	
	8 940 W

Over-estimating the usual consumption at 75% of the peak power required by the equipment, the power source must be able to provide at least 6.7 kW.

3.4 Diesel power generator

The mobile unit will therefore be provided with a 10 kVA diesel generator, which will deliver 8 kW. The typical three-cylinders engine based generator consumes less than 2 litres of fuel per hour: a 50 litres tank will allow about a day of power generation.

Special cases can dampen the engine sound below 50 dB, thus allowing housing the generator in the container, as long as the air inlet and outlet are connected outside.

Such a device weighs around 400 kilograms.

3.5 Uninterruptable power source

In order to stabilize the electrical power, to provide the time required by the power generator to kick in and to let the work start as soon as possible, the Mobile Unit will be also provided with an UPS. A rack mounted UPS with a single battery pack can provide the required 7 kW of power for 15 minutes. This is more than enough to cope with a power failure: the power generator can be started in a few minutes; in order to start the equipment while deploying the unit, additional battery packs can provide the required power.

Such a device weighs around 70 kilograms, more or less like each battery pack.

Together, these devices require less than two cubic meters and can be easily installed in the same space devoted to the server. Anyway, this means that on one end, the unit will have a considerable weight. Steps have to be taken in order to balance it: this will avoid straining its structure and will let it be handled more easily by fork lifts.

3.6 List of materials

In this section, there will be a possible list of materials to be deployed and integrated into the Mobile Command and Control Unit. A cost estimation of the material will be necessary in the design phase of the tender for the implementation of this functional design. The material will be divided in categories:

- Infrastructure
- Information and communication technology
- Intervention support

Infrastructure	
Material	**Quantity**

Containerized office unit (includes air conditioning)	1
Diesel generator of electric power	1
UPS	1
Furniture (table, desks, chairs, cabinets)	

In order to be transported as a normal container, the material inside it have to be secured by latches or safety belts. The mobile unit must not be used during transports, whatever the mean used (aircraft, lorry, boat, …).

Information and communication technology	
Material	**Quantity**
High-profile PC	2
High resolution display	4
Rugged laptop	4
Cluster-in-a-box	1
Radio-link	1
Satellite link	1
High performance WiFi switch modem/router	2
Laser colour printer	1
Frameless monitor (42”)	4
Video wall controller	1
Phone	2

The unit must be able to provide the user a safe working environment and the means to take care of small accidents.

Intervention support	
Material	**Quantity**
Tools to prepare the deployment area (shovel, axe, mace)	3
Red-white barricade tape or retractable belt barriers to limit the area	10 to 50 meters
First aid kit	2
CPR device	1

Blankets	6
Protection helmets	6
Safety glasses	6
Fire extinguisher	2
Rechargeable flashlight	3
Water jerry can	2

3.7 Maintenance and sustainability

In order to be effective, the crew of the mobile unit must recognize it as a familiar work environment: therefore, working in it must be as similar as possible to the daily work experience of the operators. The software and hardware must be the same, and all the procedures common to these two environment must be identical and identically applied.

In case of reduced activity of the unit, the crew must perform regular exercises in it: all procedures specific to the on-the-field activities of the unit must be familiar as the daily activities in common with the usual working environment.

SOPs must be shared with the resident crisis rooms as much as possible.

For the specific task of maintaining the facility, there will be three level of SOPs:

- Inventory
- Efficiency
- Proficiency

At inventory level, a SOP must be performed to assess the quantity of material present in the unit and to refurbish it in case it was used. It has to applied every time the unit is recovered after use.

At efficiency level, the material and the devices in the unit will be tested. Materials must be present as requested by the full capacity list and of the necessary quality: overdue material must be replaced, all batteries must be at full charge (and periodically undergo a discharge/recharge cycle), laser printer toner refills installed. All software must be updated. The SOP has to be applied on a regular basis and before sending the unit to be deployed elsewhere.

At proficiency level, the unit must be powered up and used as deployed on the field. All the devices must be used in simulations or exercises.

All communication devices will be tested in communication with a resident Crisis Room facility.

All software must be checked using a set of tests and performing a set of procedures, which will include:

- Data ingestion

- COP production and delivery (sent by different means and in different formats)
- Handouts print

4 Future developments

New technologies in ICT are continuously developed and it is straightforward applying them to the Crisis Management, as long as they provide additional capabilities to the system without requiring a massive reorganization of the procedures: the improvements of mobile telephone network to send and receive data are automatically exploited by the systems as soon as available.

Others are the technological innovations that can improve the Crisis Management activities in a new way, maybe reducing the costs or the risks in terms of materials or human lives.

4.1 Sensors and Internet-of-Things

It has been demonstrated the benefit an unmanned vehicle can provide in emergency situations, eventually the UAV were investigated in a specific workshop (Rester, Spruyt, De Groeve, Van Damme, & Ali, 2013).

Providing those with the Mobile Command and Control Unit will allow immediate investigation of the crisis area and the capability to have a prompt knowledge of it even in hazardous conditions; but with more advanced solutions it will be possible to take georeferenced pictures in order to produce detailed land maps or even 3D models of the area.

Other uses of UAVs include the implementation of a limited WAN: this requires the use of several vehicles, given the reduction of autonomy caused by an intense activity of radio based transmissions; therefore, other viable solutions adopted hot-air balloons to fly.

The unit will not require a large array of sensors, trying to cope with all the possible requirements, just a few kits for fast assessing the quality of air and water will be sufficient. It is in fact better trying to have it connected easily with the network of sensors the territory can provide: an effort is necessary to provide it with the means to interface easily with other systems, including softwares to translate data formats.

The recent developments in IoT for instance is providing the capability to create low cost sensors easily deployed on all territories. Large grids of this kind of sensors will be soon available: the mobile unit must be able to integrate easily with them and to use their data. This means also that the unit will be IPv6 enabled.

4.2 New usage paradigms

The crisis management activities are benefitting from new technologies, as soon as they mature enough to be reliable on the field. Now it is possible to have large visualization areas near the disaster site. This kind of devices already proved to be very effective (Rester, Judmaier, De Groeve, & Annunziato, 2013), but using them in such a specific task requires both specific software and hardware solutions. The usage of a device on the field requires the hardware shifting from the common usage paradigm, where the devices are installed in very controlled environments, to a platform, that can easily undergo to power shortage and physical strains. On the other hand, in such a condition, where the command and control activity is so close to the field, a dynamic and prompt acquisition of information is a key point and the controlling software of these devices is very often not up to the task: custom implementations are required to face the new requirements.

On the other hand, mobile computing progress is providing new devices, which can deliver big computational and displaying power for long time at cheap costs. These devices can be wearable and complement the user experience of the reality with additional data, allowing the users to benefit from the real elements, automatically fed into the system, that can ingest the real objects near the users into its reality representation.

In the scenarios that can be developed from these premises, the real space where the crisis management will occur becomes secondary: the users will find more natural interacting with digital information, that will become part of the space surrounding them, including the remote interaction and collaboration. The best part of the required hardware will be used naturally by the unit crew, who will need less and less frequently to interact with the information systems by using keyboards and mice. Every flat surface or even empty space will be available to be used as a video wall. The only needs will be a backend server and a WiFi powerful enough to handle all the traffic with it.

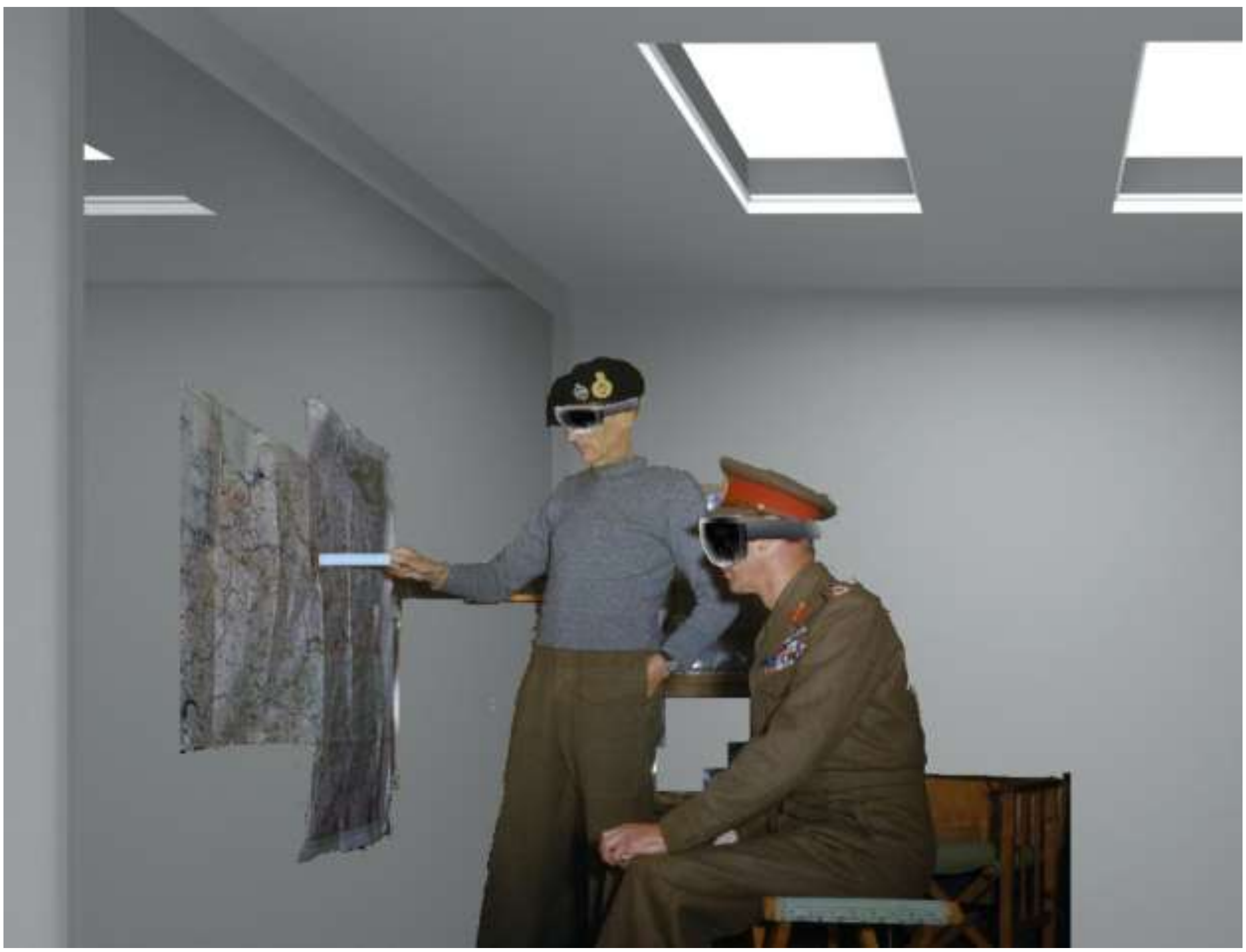

Figure 23 Fictional briefing: the users look at maps created in augmented reality, the pointer itself is virtual

Conclusion

In order to provide a crisis management facility as close as possible to the location of the generating phenomenon, the design of Mobile Command and Control Unit requires both simplicity and flexibility. This can be achieved by learning from existing experiences, introducing the concept of an easy to deploy self-contained unit without its own locomotion means, but easy to transfer and deploy all around the world.

The solution described can be used to develop the design of a tender to ask the market to implement such a facility. The use and maintenance of the unit will then require a periodic use of it, even if no real need is present. Other than exercises, a list of checking procedures will maintain it up to date and fully operational and ready for immediate use.

The use of new technology will make it more effective and maybe will introduce some simplification.

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List of abbreviations and definitions

SOP	Standard Operating Procedure
COP	Common Operational Picture
LAN	Local Area Network
WAN	Wide Area Network
IoT	Internet of Things

List of figures

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