Towards a CBRN Crisis Management Training Capability at French Multiagency Level

Jean-Louis GOUGEAT – Jacques BONOT
SOGITEC
4 rue MONGE
92158 Suresnes, France

jlgougeat@sogitec.fr- jbonot@sogitec.fr

Key Words:
Crisis Management, CBRN, Multiagency, Terrorism, Asymmetric Warfare, Homeland Security, ANR, Simulation, VR

ABSTRACT:

The SAGECE project is co-sponsored by the French National Research Agency (ANR), the French MoD, and the project partners (Government, Industry, and Academia). It aims at defining, developing and evaluating an interactive simulation tool allowing to performing multiagency training exercises for crisis management related to CBRN terrorist attacks inside public facilities.

*This training capability addresses actors from the First Responders to the Operational Command Post at the "Département" Civilian Authority level ("*Préfet*"), representing the multiagency functional chains (Fire-fighters, Mobile Rescue Services, Police) and civilian operators. It will provide a realistic virtual world portraying the catastrophic situation, against which the various actors of the theatre will intervene, as players or exercise controllers. It will take into account complex terrain issues facing the First Responders as they are equipped with their NRBC protections, representing them by avatars moving in a Virtual Reality immersive environment.*

Due to the partners involved, the project goals are threefold: research, applicability, and creating contract opportunities. Thanks to the partners' contribution, the project will re-use related-projects' components, complement them with technological components developed for SAGECE, and demonstrate operational capability to meet requirements stated in particular by the Fire Fighter National Officers School, one of the project partners. In addition, this multiagency training capability will provide the possibility to assess the interoperability of each agency's procedures, and eventually to contribute to its improvement.

This paper aims at presenting in detail the objectives and implemented tools, as well as its current status by the end of the definition phase. It also aims at assessing the possibility to apply the capability and results of the project to a possible cross-border multinational training capability.

1.0 BACKGROUND

1.1 International Situation

Since the fall of the Iron Curtain and the collapse of the USSR, a major conflict in Central Europe is no longer the primary threat (though it has not completely disappeared, cf. the Georgia Crisis!) against which NATO nations have to prepare. On the military side, it has left room for a multitude of local asymmetric conflicts at various levels. These local conflicts sometimes have follow-ons related to civilian life, with terrorist attacks using an increasingly scaring panel of WMDs. As a consequence, Defence and Homeland security have common interests, and actions are undertaken to foster synergies between both domains.

1.2 French White Paper

Taking into account evolutions of the world since its previous 1994 version, The French White Paper on Defence and National Security highlights the need of continuity between “Internal security” and “External Security”. To be in line with this project, we will retain the highly risky combination of the continuously increasing densification of populations in urban areas, the increasing CBRN Technological and Industrial risks in these areas, and those of Terrorist threats.

In order to handle this situation, four challenges have been assigned to Government services: adapting MoD means within the context of Budget cuts, increasing co-operation between civilian and military forces and mutualising means to achieve common goals, improving readiness to crises management, and Resilience entailing necessary improvement at hiring, teaching and training personnel (possibly through outsourcing), and finally attractiveness of Defence and Security positions needed to ease recruitment and preservation of servants.

1.3 Genesis of SAGECE

In the Framework of a 2007 Call for Projects on “System Concepts and Tools for Global Security” of the French “*Agence Nationale pour la Recherche* (ANR)”, SOGITEC built a consortium around the Project SAGECE in the areas of “Crisis Management: Deployment and Protection of Involved Personnel” and “Protection of Closed and Open Infrastructures”. The goal of the proposed project was to improve the terrain actors’ intervention efficiency in a CBRN crisis situation by establishing a simulation-based multiagency exercise capability.

This project, particularly in line with the priorities of the White Paper (§ 1.2), was selected by the ANR with a 50% funding (the remaining 50 % being funded by partners) and launched in March 2008 ([2]).

2.0 PROJECT PERIMETER

2.1 Motivation

The decision to propose the project « Simulation for Crisis Management Improvement » (the French acronym SAGECE standing for « *Simulation pour l’Amélioration de la GEstion de CrisE* ») arises from the following twofold remarks:

- Good preparation of terrain actors from various Government departments (Fire Department, Police, Mobile and fixed emergency services) supposed to take part into emergency, disaster or crisis situations is mandatory in order to reach an appropriate level of efficiency;
- It is very difficult, sometimes impossible, during “Live” CBRN exercises, to / simulate specific risks occurring in such situations.

Even if the crisis exercise scenario stipulates the characteristics associated to on-site risks, these risks cannot be fully perceived and foreseen actors. Besides that, the number of actors involved in an exercise often leads to delays in the exercise process, and sometimes requires discontinuing the exercise in case of major synchronisation anomaly between decision level and action on “terrain”. This leads to lack of realism and mistakes in the course of action, difficult to assess and then to correct.

Moreover, some exercises performed to prepare for radiological and chemical attacks have demonstrated the heavy burden of taking over contaminated victims and the protection of rescue actors in the course of such an operation. It also proved the importance of education and training needs towards actors in charge of these processes ([4]).

2.2 Objectives

SAGECE proposes to design, develop and assess an interactive simulation tool allowing to performing multiagency training exercises for crisis management related to CBRN terrorist attacks within public facilities. The associated capability will allow:

- To educate / train terrain actors in a multiagency situation according to applicable doctrines and procedures; especially putting the emphasis on on co-ordination and interoperability issues between various Government departments;
- To analyse and experiment consistency between doctrines and procedures in order to foster their improvement and interoperability.

As shown on Figure 1 below, the project will cover:

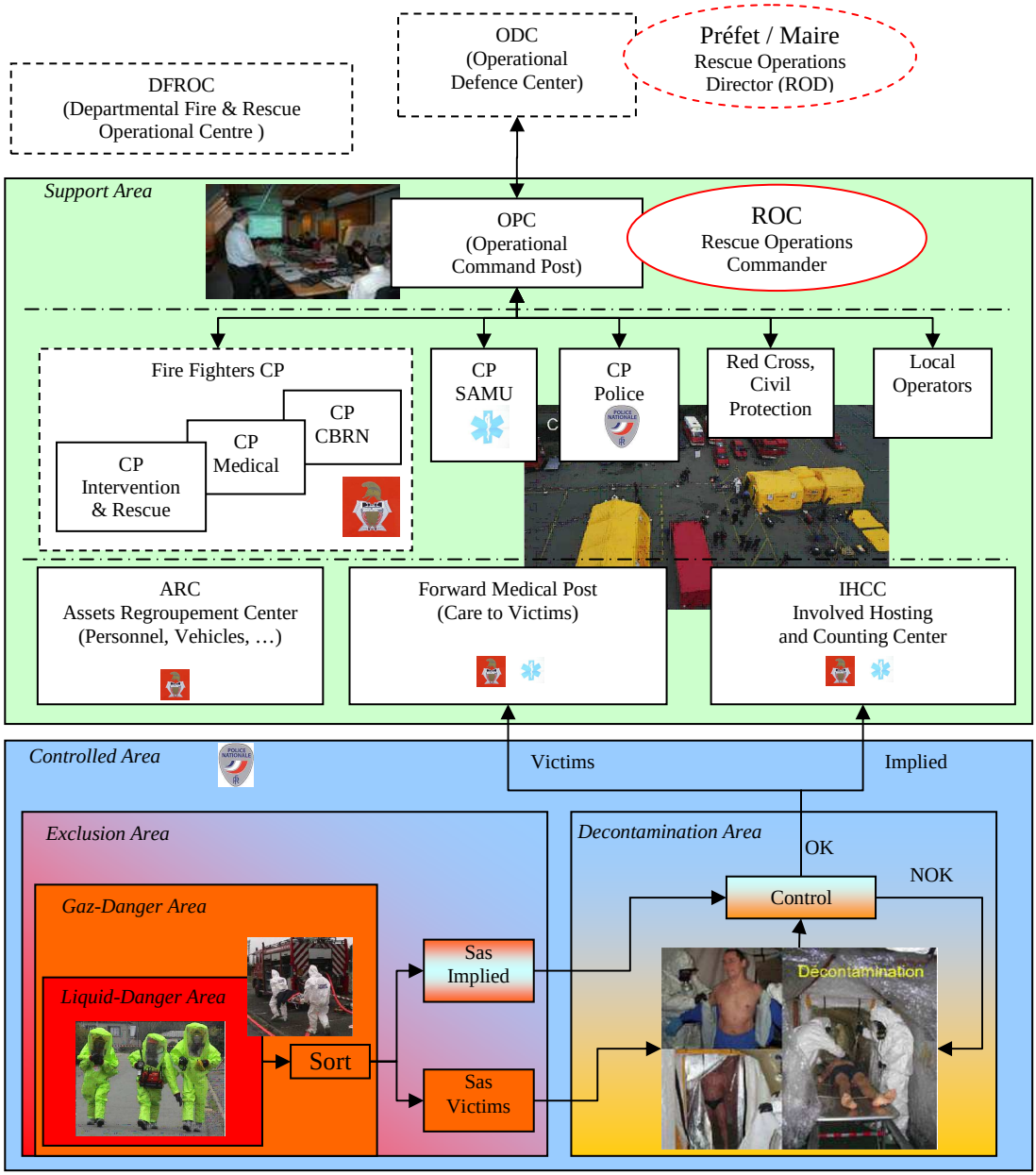

Figure 1:Project Perimeter

- **Progress of rescue operations** on the event site and immediate surroundings, namely the "Controlled Area" and its various sub areas : "Exclusion Area", "Decontamination Area"
- **Crisis situation** management at the various multiagency decision levels located in the « Support Area », from the Services Command Posts (Fire-Fighters, Mobile Rescue Units, Police, Civilian Operators, Non Governmental Organisations) to the Operational Command Post (OCP) Rescue Operations Commander (ROC).

The Strategic Decision Level with the Rescue Operations Director (ROD) will be considered as a controlling element.

3.0 PROJECT ORGANISATION

3.1 Project Partners

A consortium made up by SAGECE partners aggregates all competencies needed to achieve the project's objectives. It comprises:

- French Research bodies: Atomic Energy Commission (CEA List), Paris Descartes University, Compiègne University of Technology (UTC), Nuclear Safety Research Institute (IRSN) which are all major actors in scientific domains ((cf. § 3.4) relevant to the project (interactive and collaborative Virtual Reality, physical phenomena simulation, virtual mannequin, Human Behavior Modelling, CBRN risk experts) ;
- The French National Fire-Fighters Officers High School (ENSOSP) being a potential user for the targeted training capability as well as an expert for the statement of need;
- Industry partners from major groups (AREVA TA, EADS, SOGITEC) or small businesses (EMI) bringing to the project their expertise in developing similar tools for training of military personnel (including the ENSOSP by EMI) and the framework approach needed to ease the federation of heterogeneous components brought by the partners.

In addition, the whole SAGECE work will be monitored by a steering committee including members of governmental bodies pertaining to the crisis management domain (INHES, SAMU, DGA, DGGN, DGPN[1]) for consultation both on the statement of need and on the assessment phases for the positive outcome of the project.

3.2 Selected Approach

Consistently with the contract framework and the consortium composition, SAGECE's goals is threefold:

- 1- An <u>essential</u> goal for « research » coming from the orientation given by the ANR (funding half of the project) as well as those of Universities (Paris Descartes and UTC) and Laboratories (CEA List) partnering in the project.
- 2- An <u>important</u> goal for « applicability » coming in particular from ENSOSP interested by the Education/Training capability of SAGECE;
- 3- A <u>desirable</u> goal of "creating market opportunities" coming from the wish of industrial partners (and also ANR) to capitalize on the results of the project by setting up a crisis management training market, in line with the PPP planned in the White Paper.

[1] Institut des Hautes Etudes sur la Sécurité, Service d'Aide Médicale d'Urgence, Direction Générale pour l'Armement, Direction Générale de la Gendarmerie Nationale, Direction Générale de la Police Nationale

The approach selected for the project is thus to associate specific developments relevant to solving technological stumbling blocks together with the building of an operational demonstrator, the latter aiming at hosting the specific developments, the technological components made available by the partners, and eventually the components of existing or future projects.

3.3 Project Structure

Within this approach, the project is made up of 5 Work Packages, the responsibilities of which being split between the partners:

- **WP1**, co-ordinated by ENSOSP, addresses the statement of need for the project demonstrator, including an analysis of the training situation (practising issues, pedagogic objectives related to crisis management), leading to the identification of gaps, and an assessment plan for the demonstrator including a reference scenario whose action takes place in a public location;
- **WP2**, co-ordinated by CEA List, consists in defining the architecture of the demonstrator and the technological components to be built in order to fill the gaps identified in WP1;
- **WP3**, co-ordinated by EADS, consist in building the architecture and the technological components of the demonstrator defined in WP2;
- **WP4**, co-ordinated by SOGITEC, will allow to integrate and validate the demonstrator, and to perform its assessment based on the evaluation plan defined on WP1;
- **WP5**, performed by SOGITEC, comprises the co-ordination of the project, animation of the partners group and external communication.

The project was launched in March 2008 and spans over a 2-year period, according to the timetable below.

Months	3	6	9	12	15	18	21	24
WP1								
WP2								
WP3								
WP4								
WP5								

Figure 3 : Project Time Table

3.4 Selected technological stumbling blocks

According to the results of the preliminary analysis conducted, the primary technological stumbling blocks selected by ANR to be developed during the project are the following:

- Behaviour modelling of autonomous virtual characters facing such crisis situations;
- Interactive simulation of first aid procedures in situation of extreme emergency in accordance with physics phenomena;
- Taking into account the impact of attacks on actors;

- Representation of the exercise scene according to the requirements of various models ;
- Distributed simulation framework allowing to plug the models according to interface specifications and to run the federation;
- Generating the exercise's scene;
- Drawing the exercise's scenario

NB: Fine real time modelling of contaminating aerosol propagation proposed as an objective by CEA was not retained for SAGECE by ANR. Work performed in this area in other projects might be subsequently integrated into the demonstrator. For SAGECE, contaminating aerosol propagation will be integrated within the scenario according to an event-based principle.

3.5 Re-use of existing components

SAGECE will integrate several technological components from other projects related to Virtual Reality, Interactive Simulation or crisis domain to which the partners are actively participating :

- Immersive virtual reality tools (project PERF RV2)
- Piloted / Collaborative virtual mannequin (project PERF RV2)
- Virtual Character Behavior Management (project V3S) ;
- ISEN Scenario Engine (projects V3S and HESTIA);
- Rigid object collision simulation (project PERFRV1 – PERFRV2)
- Distant collaborative work within a same virtual environment ((project PERFRV2 – PART@GE)
- Macroscopic and microscopic human behaviour simulation in crisis situation (projects SECURVI – VIRTHUALIS – V3S)
- Distributed simulation and communication architectures (EMI, EADS, SOGITEC).

These components (owned by these projects' partners) as well as those developed during SAGECE will be integrated within the demonstrator and validated before being assessed during a crisis exercise based on the scenario developed during WP1.

3.6 Expected results

Besides the documentation resulting from all WP and the development and assessment of the demonstrator, the results expected by ANR and the other governmental departments as well as the project partners are in the following areas:

- Scientific, with advances in:
  - Human behavior modelling;
  - CBRN matters representation;
  - Multiagency complexity representation;
- Industrial, with:
  - Initialization of a market in the field of education / training to security;

- Accurate modelling components for Serious Games applications.

4.0 CURRENT STATUS

4.1 Introduction

At the time this document is released, the project is reaching the end of the 5th month of work. Progress is as follows:

- WP1: work related to the statement of need is being formalized.
- WP2: work related to the definition of the technological components has begun. Main tasks have been identified and the work will go on with availability of WP1 results to be achieved soon.

The following sections discuss the approach to solving the technological stumbling blocks and the selected perimeter for the demonstrator.

4.2 Approach to technological stumbling blocks

4.2.1 Behaviour modelling of autonomous virtual characters facing such type of crisis situation

During real-life rescue operations, the chemical risk being invisible, some actors might not notice it or conversely might be struck by fear. Rescue personnel must rescue the victims but the risk perception might change their objectives and their discernment ability. Victims might be affected by the situation and adopt unexpected behaviours.

In order to take this into account in the targeted training capability, a cognitive agent with autonomous decision ability will control each virtual character. Each agent will plan its activity according to its initial goals and to the current situation. UTC has selected different tools based on modelling of human decision process including errors in critical situations. They come from research in cognitive ergonomics and human reliability: COCOM model [Hollnagel, 2004] to describe human control modes, CLU [Amalberti, 2003] to describe adaptation made on the field for security reasons, OCC [Orthony, 1998] et OCEAN [Mc Crae, 1992] to generate fear, nervousness, courage behaviours.

Models will be based on analyses performed by Paris Descartes University in the following areas:

- Ergonomics analysis methods of activity to stick as much as possible to the terrain reality ;
- Knowledge in human factors on crisis situations;
- Expertise and Lessons learnt from relevant actors from the partners (input), corresponding modelling languages and the relevant interpretation systems (output).

4.2.2 Interactive simulation of first aid procedures in situation of extreme emergency

As from the knowledge of a CBRN accidental situation, rescue teams must put their protection equipments on, which heavily affect their normal intervention capabilities. It is also urgent to protect victims from exposition to pathogen agents as well as to limit propagation of those agents carried away by the victims.

In order to take this into account in the targeted training capability, CEA List will provide its Virtual Reality immersive assets to develop an interactive and collaborative simulation of the CRBN protection equipped avatars of terrain actors in charge of handling disabled victims. Various constraints associated with the use the protection equipment (mobility, visual perception, audio perception) will be simulated.

For immersion realism, the operator will wear his actual breathing protection device. To interact with his avatar, the operator will be equipped with a full body tracking system. Interactions will be fed back to the

operator either via vibro-tactile elements placed all over his body or through a load control device.

4.2.3 Consequences of attacks on actors

To represent pathogen agents consequences on characters, albeit consistent with the event-based representation principle selected for aerosol propagation, simple rules of exposition duration will be used to define health status of unprotected people:

- Contaminated but valid (able to move on their own);
- Contaminated and disabled (requires immediate care and transportation);
- Dead.

Every person having entered aerosol propagation area will be declared contaminated:

- External et internal contamination for people without protection;
- External contamination for people with protection.

4.2.4 Representation of the exercise scene

The scene where the various actors will be moving must integrate the following elements:

- A 3D full representation of the building (internal, external, openings, ways in & out) where the event occurred;
- A 3D full representation of rescue means (vehicles, Forward Medical Post, decontamination means, …) in the various intervention zones/areas;
- Representation and control of virtual characters with behavioural model within the scenario ;
- Representation of avatars and the means of control by actors of the crisis exercise ;

Representation of various Command Posts settled in the Support Zone will be based on actual shelters accessible to relevant role-playing personnel in the exercise.

To fulfil these requirements, simulation and VR interaction tools from the partners will be used as follows:

- EMI is providing their crisis situation training experience and tools to handle a significant part of simulation needs (basic internal/external continuous scene and characters needs);
- CEA List is providing their immersive assets and mannequin-based interactive simulation capabilities to address the project's specific needs for representation of rescue gesture constraints in extreme situation (wearing CBRN equipment).
- Paris Descartes is providing realism in the integration of ergonomics constraints by building the initial ergonomics specifications for the interactive tools user interfaces, and iterative assessment and evaluation of the tools with the users.

4.2.5 Generation of the exercise scene

The aim is at building the environment database where the actors are supposed to perform their mission, with a special concern on fidelity:

- by extraction from data sources from various origins (architecture, city maps, geographic, …) and using various formats, the whole supposedly poorly matching SAGECE needs;
- including data required to run SAGECE models and tools (visual data, pathdata for behavioural

models, …) and structuring these data to make real time processing more efficient;

- while reducing as much as possible manual generation, which is the main cost driver of the process (Artistic work may represent 70% of a Videogame development);
- Allowing subsequent use of the database, which requires using standards.

SOGITEC is providing their expertise in the area of terrain simulation database generation tools to define an appropriate generation tool and to produce the database needed by the scenario.

4.2.6 Distributed simulation framework

The aim is to define and develop an architecture framework allowing to assembling the various heterogeneous tools brought by the different partners in a consistent operable federation (the demonstrator). This Framework must address the static domain (initialization of federates),the dynamic domain (interaction in runtime), and semantic consistency.

Distributed simulation techniques will be applied, with the definition of a Federation Object Model, the use of an HLA interface protocol for local access (LAN) and/or SOA pour distant access (WAN). The demonstrator capability to evolve (new functionalities through coupling of new federates) will be preserved through special attention on the use of standards and documentation of architecture work.

EADS and SOGITEC will provide a solution based on their know-how in distributed simulation. Partners providing real time components (EMI, CEA-List and UTC) will participate to this endeavour and subsequently adapt their tools/interfaces to match the selected architecture principles.

4.2.7 Generation of the exercise scenario

The exercise scenario comprises a series of sequences (or vignettes), to be executed either conceptually (e.g. presentation of the initial or new situation to all actors), automatically (acceleration of time to skip uninteresting period), or in real time (interaction between actors and environment). Associated functions are:

- Initialization of the crisis situation (roles of the characters, scene configuration, behaviours);
- Cartography (2D/3D) of the pathogen agents (CBRN) dispersion. In the case of an evolutive situation, the scenario integrates a series of successive cartographies;
- Master Events List or Automated decision making conditions definition;
- Elementary animation scenarios for virtual characters or avatars (move, gesture, posture, action)
- High level co-ordination scenarios (area closure, balisage, assets deployment, run a mission-level character procedure);

Scenario generation will be derived from EMI's and CEA-List's (Automate engine) tools to be coupled with UTC's behaviour engine providing behaviour guidance.

Scenario content will be defined by IRSN, ENSOSP and AREVA-TA.

4.3 Functional perimeter of the Demonstrator

The demonstrator (see figure 2) will provide the networked actors of the exercise with a realistic and interactive virtual world portraying the crisis situation, within which automated virtual characters and avatars piloted by participating actors will interact. These avatars equipped with CBRN protection devices will co-operate to rescue the victims in the contaminated environment. Participants may also (for pedagogic purposes) visualize in the virtual environment a representation of the usually invisible physical

phenomena (cartography of pathogen agents dispersion).

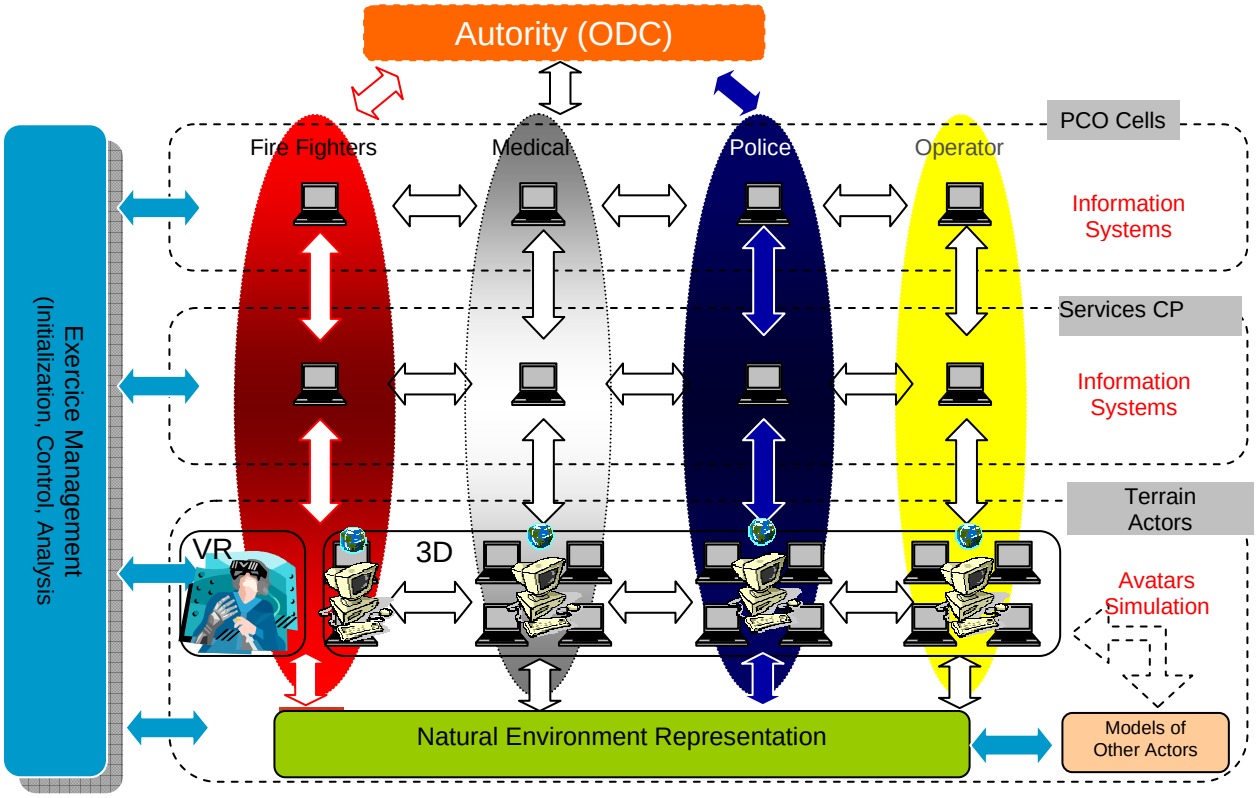

Figure 2 : Demonstrator Structure

Decision-making actors from the OCP (namely the ROC), from the various Services' CP, and the local Industry or Commercial operators, will be represented by real personnel (preferably from relevant organisms). They will be equipped with office computers figuring their operational information system, with following functions:

- Information display of operations' progress: texts, plans, photos, videos;
- transmission of orders & reports
- control of intervention protocols and procedures

Avatars in the 3D environment represent the Terrain actors from various services, allowing them to interact with the environment:

- Deployment of rescue assets ;
- Rescue operations toward victims ;
- Behaviour from victims and other people involved in the scenario;
- Time, Weather, Season conditions ;
- Events from the scenario.

CBRN specialised actors are represented by their avatar in a Virtual Reality immersive environment portraying in contaminated situation:

- Operation inside the building wearing individual CBRN protection devices
- Training to technical gestures in accordance with appropriate protocols.

Virtual automated actors will represent crowds and secondary characters.

5.0 FUTURE PLANS FOR SAGECE

5.1 Consolidation of works

SAGECE has a desirable goal (cf. § 3.2) of establishing a platform providing the conditions to develop a crisis management training market. The platform will provide training services to end-users as well as a means for new contributors to introduce their technology (taking care of IP),

The various components aggregated with the distributed collaborative architecture may then be re-used for other applications in the crisis management domain.

Work in this area may be performed according to various contractual frameworks:

- Funding by end-users interested in the training capability, possibly implementing upgrades to satisfy specific needs;
- ANR or European Programmes for Research on Security for developments related to new technologies aiming at improving fidelity, functionalities, performances, …

5.2 Contribution to multinational/coalition

The work done within SAGECE will allow focusing on the issues related to multi-agency co-operation because of doctrines and procedures defined independently in each service (Fire-fighters, mobile rescue services, Police). Setting up a training capability will provide the means to actually experience complex situations and to foster improved interoperability.

This multiagency issue may easily be transposed to the international context: it would aim at offering a capability for training and for doctrine confrontation to improve the capability to address cross-border crisis. As an example, the preparedness to a major crisis in the English Channel Tunnel, or in the Alps tunnels (Mont-Blanc, Fréjus) linking France to Italy, with language barriers on top of rescue procedures discrepancies is an interesting subject.

This work may in particular be put forward in a proposal as a response to a call within the European Project for Research on Security (or equivalent) allowing to merging efforts done is this domain in different countries.

6.0 SUMMARY

Fully in line with the policy stated in the “French White Paper on Defence and National Security”, SAGECE is a contribution to France’s Resilience improvement by targeting training of terrorist-based inside-public-facilities CBRN crisis management. This contribution is both technology-oriented (the project is co-sponsored by the French National Research Agency) and Capability-oriented (The partner ENSOSP is expecting a concrete application of the demonstrator). The project ranges from the Statement of Need to the setup of a Multiagency Training Capability for Personnel from CBRN First Responders immersed in a Virtual Reality environment to the Operational Command Post.

The 2-year-long project is in an early stage, with the coming to an end of the Work Package 1 comprising the statement of need, formalisation of training objectives, and definition of the evaluation scenario. This initial work will allow building the training capability based on a standardised framework integrating various technological components developed within the project or re-used from other projects from the

partners.

Subsequently, the consolidation of this initial platform to set up a permanent training capability will be undertaken. Besides a fully operational upgradable capability fitting French training needs, extension from a multiagency towards a multinational capability allowing taking into account cross boarder crisis management training will constitute a interesting challenge to be addressed in a multinational project team.

7.0 ACKNOWLEDGMENTS

The authors, as coordinators of the project, wish to thank the various partners for their contribution to the project and as such to this paper: M. François Murgadella (ANR), M. Philippe Cornu (UTT), Ms Celine Steinmetz (DGA), M. Xavier Augustin (AREVA TA), M. Philippe Morganti (CEA List), M. Didier Grignon and M. Stéphane Fournier (EADS), M. Eric Maranne and M. Emmanuel Vaucher (EMI), LCL Spies and CNE Bouchet (ENSOSP), M. Denis Winter (IRSN), M. Jean-Marie Burckard and Ms Céline Girard (Université Paris Descartes), Ms Domitile Lourdeaux (Université de Technologie de Compiègne), and Sylvie Rouillard (SOGITEC)

8.0 REFERENCES

[1] Défense et Sécurité Nationale – Le Livre Blanc.

[2] Agence Nationale de la Recherche – Université de Technologie de Troyes. Programme CSOSG 20007 - Convention Attributive d'aide n° ANR-07-SECU-005-01 à 09 relatives au Projet SAGECE

[3] Projet SAGECE – Fiche de Description Technique détaillée du projet (B)

[4] Contributions de la manifestation du 7 avril 2005 sur le risque NRBC associé à des actes malveillants de la Société Française de Radioprotection (SFRP) - http://www.sfrp.asso.fr

9.0 AUTHORS BIOGRAPHIES

Jacques Bonot is a Sales Manager at SOGITEC, in charge of Advanced Studies and R&T Projects. As such, he was the main actor for the creation of SAGECE and is keeping pace for the development. He has also contributed to the PART@GE project since the beginning.

Jean-Louis GOUGEAT holds a Licence and a Master in Electronics and Communications and an Engineering Degree in Telecommunications (1987). He has been a senior project manager at SOGITEC since 2001. He has 20 years of experience on R&D projects for the French MoD, and more specifically 12 years in simulation projects for training of military personnel, including company level training with Live simulation, Flight training with Virtual simulation and Command & Staff training with Constructive simulation, and. He also participated to the genesis of the NATO PATHFINDER programme. He is the coordinator for the SAGECE project.