APPEL A PROJETS EQUIPEX / CALL FOR PROPOSALS

2010

DIGISCOPE

SCIENTIFIC SUBMISSION FORM B

Acronyme du projet/ Acronym of the project	**DIGISCOPE**	
Titre du projet en français	Infrastructure haute performance pour la visualisation interactive et collaborative	
Project title in English	High performance infrastructure for interactive and collaborative visualization	
Coordinateur du projet/Coordinator of the project	Nom / Name : Michel Beaudouin-Lafon Etablissement / Institution : Université Paris-Sud XI Laboratoire / laboratory : LRI Numéro d'unité/unit number : UMR8623	
Aide demandée/ Requested funding	Tranche 1/Phase 1 6 204 999 €	Tranche 2/Phase 2 925 600 €
Champs disciplinaires / disciplinary field	☐ Santé, bien-être, alimentation et biotechnologies / health, well-being, nutrition and biotechnologies ☐ Urgence environnementale et écotechnologies / environnemental urgency, ecotechnologies X Information, communication et nanotechnologies / information, communication and nantechnologies ☐ Sciences humaines et sociales / social sciences ☐ Autre champ disciplinaire / other disciplinary scope	
Domaines scientifiques/ scientific area	Interaction, Visualization, Collaboration	

Affiliation(s) du partenaire coordinateur de projet/ Organization of the coordinating partner

Laboratoire(s)/Etablissement(s) Laboratory/Institution(s)	Numéro(s) d'unité/ Unit number	Tutelle(s) /Research organization reference
Fondation de Coopération Scientifique Digiteo – Triangle de la Physique		

Affiliations des partenaires au projet/Organization of the partner(s)

Laboratoire(s)/Etablissement(s) Laboratory/Institution(s)	Numéro(s) d'unité/ Unit number	Tutelle(s)/Research organization reference
LRI	UMR8623	Univ. Paris-Sud & CNRS
LIMSI	UPR3251	CNRS
INRIA Saclay		INRIA
LIST		CEA
LTCI	UMR5141	Institut Telecom & CNRS

MAS, EM2C and MSSMAT	MAS: EA 4037, EM2C: UPR288, MSSMAT: UMR8579	Ecole Centrale & CNRS
OVSQ (LATMOS + REEDS + Master M2S)	LATMOS: UPR8190, REEDS: EA4256	UVSQ & CNRS
Institut Farman	Farman: FR3311; CMLA: UMR8536, LMT: UMR8535, LSV: UMR8643, LURPA: EA1385, SATIE: UMR8029	ENS Cachan & CNRS
Maison de la Simulation		CEA & CNRS
Entreprise(s) / company	**Secteur(s) d'activité/activity field**	**Effectif/ Staff size**

SUMMARY

While the massive increase in computational power has made it possible to routinely manage extremely large and complex data sets and computations, the ability of human users to deal with them has been trailing behind. Given the types of problems that are addressed today by scientists, engineers and other users, it is critical that human intelligence and computing power complement each other through rich interaction (between humans and computers) and collaboration (among humans using computers). Whether it is about testing hypotheses, detecting unexpected patterns or supporting creativity, to name a few, neither humans nor computers alone suffice. Novel tools, both hardware and software, are necessary to address these challenges.

The graphical user interface (GUI), invented over 30 years ago, has clearly reached its limits and cannot adequately deal with the size and complexity of today's problems. This reduces our collective ability to explore, understand, modify and control complex data and computations. Although researchers have been exploring alternatives to traditional GUIs, such as large display areas (boards, tables and walls), immersive devices (virtual and augmented reality) and novel interaction devices and techniques, few are in active use by potential target users.

One reason is that this type of research requires multidisciplinary teams with expertise in computer science, psychology, and engineering, with lengthy iterative cycles to create and validate novel solutions. In addtion, the hardware platforms necessary to exploit these novel interaction techniques is only available to a handful of users, typically a few research labs and corporations. Finally, these platforms each use ad hoc software specific to that platform, making it impossible to transfer skills and interoperate software over multiple platforms.

The goal of the DIGISCOPE project is to support advanced interactive visualisation and analysis of complex data sets and computation by deploying a large, interconnected hardware and software infrastructure. DIGISCOPE will consist of a collection of hardware platforms, each with different characteristics addressing specific needs, connected so as to maximize the potential for collaboration among both local and distant users. Partners will conduct research in interactive and collaborative visualization, in order to develop and deploy software tools that interoperate across the various platforms, and will make these tools available to a wide range of users for their own projects. DIGISCOPE addresses a major theme of the Digiteo research cluster and the forthcoming Digiteo proposal for a *Laboratoire d'Excellence*. Because of its multidisciplinary aspect, DIGISCOPE will have a structuring role in the Saclay Campus.

The targeted uses of DIGISCOPE cover six areas. The first two will focus on the enabling technologies necessary for the equipment to reach its full potential:

- Research in interaction, visualization and collaboration; and
- Research in interactive and collaborative modeling and simulation of large and complex phenomena and systems.

The remaining four uses will demonstrate the value of the platform for a variety of application areas:

- Scientific discovery;
- Design, engineering and manufacturing;
- Decision-support systems, including crisis management; and

- Education and training.

DIGISCOPE will build upon the existing platforms already developed by some of the partners. These platforms will be extended and complemented by additional platforms from the remaining partners. Previously stand-alone platforms will be interconnected to each other, as well as to nearby high-performance computing facilities via high-speed networks. By the end of the project, DIGISCOPE will consist of nine interconnected nodes that combine large immersive environments, 3D display devices and various display walls and interactive surfaces. In addition to the hardware, DIGISCOPE will include software that will allow users to easily deploy applications across the individual nodes, supporting remote collaboration and taking advantage of the unique characteristics of each node.

DIGISCOPE will make it possible to tackle new problems that could not be addressed before due to limitations in existing platforms and lack of shared expertise across domains. An example of an open problem is remote asymmetric collaboration, in which the parties use different visualisation and interaction methods, from an immersive room on one side and a wall-sized display on the other. Another open problem is the development of large-scale interactive simulations, in which the user wants to see the results as they are being computed and dynamically change the parameters of the simulation to see their effects.

DIGISCOPE will also make it possible to reach new users and contribute to faster deployment of these technologies to a greater audience. In particular, some of the nodes will be dedicated almost exclusively to outside users who will rent them for their own research, teaching or commercial purposes. The targeted users are typically research labs from other disciplines and medium-size companies that cannot afford such equipment but can greatly benefit from using it for specific projects, as well as larger companies and government organizations that want to assess the technology before acquiring their own.

Overall, DIGISCOPE will have an impact at the scientific, technical, economic and environmental levels. At the scientific level, it will allow computer science researchers to study fundamental aspects of interaction, visualization and collaboration for large data sets as well as interactive modeling and simulation. It will also enable other scientific disciplines to conduct their research with a state-of-the-art instrument, fostering multidisciplinary collaborations. At the technical level, the project will design, develop and assess novel solutions, both hardware and software, allowing the partners to develop unique expertise. At the economic level, it will make these advanced technologies accessible to a large number of users in different disciplines and will foster technology transfer to industry partners. At the environmental level, DIGISCOPE will demonstrate new working environments that facilitate remote collaboration without the cost of distant travel.

The results of the project will include scientific dissemination of the research results through publications in conferences and journals as well as technology transfer. The latter will include software licenses and know-how of the developed technologies, which could lead to start-ups or existing companies selling these technologies. Finally, although individual platforms exist elsewhere, primarily in North America, DIGISCOPE will be the first to interconnect these heterogeneous platforms, providing a flagship project that attracts international attention and a world-wide leadership position.

1. SCIENTIFIC ENVIRONMENT AND POSITIONING OF THE EQUIPEMENT PROJECT

The computing power available today is opening new doors for science, industry and society: Massive amounts of data, such as those generated by scientific instruments, sensor networks or business processes, can now be analyzed, mined and searched. Precise models of complex objects, from molecules to automobiles and aircraft, can be created, explored and manipulated. Massive simulations of complex physical, biological or meteorological phenomena can be run with high temporal and spatial resolutions.

These data processing, modeling and simulation applications are vital for making new scientific discoveries as well as creating the products and services that will shape our future. However sheer computing power alone is not sufficient for these applications to achieve their potential. The ability of human users to easily control, analyze and understand the massive amounts of data that they manipulate is also critical for success. The key is to create an efficient coupling between the motor, perceptual and cognitive skills of humans and the storage and computational capabilities of computers.

The main goal of DIGISCOPE is thus to provide users with more effective *interaction* with massive data and complex processes, better *visualization* of the current state and final result of large computations and improved *collaboration* among people performing these tasks.

Over the past two decades, researchers have been developing tools for scientific visualization of physical phenomena, information visualization of abstract data, interactive modeling of 3D objects, interaction with large display surfaces, and collaboration across time and space using mediaspaces and shared environments. However, it is only recently that these areas have started to converge, with the goal of creating integrated environments that can be used outside of laboratory settings.

One strand necessary for this convergence is *Data Visualization* (Post et al., 2002). Data visualization is the emerging scientific field that combines scientific visualization (Friendly, 2008), the visual representation of three dimensional phenomena (architectural, meteorological, medical, biological, etc.), and information visualization, the visual representation of large-scale collections of abstract quantities (Bederson & Shneiderman, 2003; Friendly, 2008). To deal with the large amounts of data to display and understand, data visualization researchers and practitioners have created rooms with high resolution displays, e.g. Johnson et al. (2006), Mavris et al. (2005), Semeraro et al (2004), that allow more data to be visualized and explored by multiple researchers. Another approach advocates the use of distributed computing, to share visualization data among multiple researchers, e.g. Brodie et al (2004), COVISE[1], in different geographical locations. Even so, few researchers address the problem of managing large-display visualization for multiple researchers in a room, with shared distributed visualization.

A second strand of this convergence is *Collaborative Virtual Environments* (CVEs), which extend immersive virtual reality systems to support collaboration through shared environments. Benford et al (1994) conducted early work on a spatial interaction model that captures the social dimensions that are relevant to such environments. Broll (1995) analyzed

[1] http://www.hlrs.de/organization/av/vis/covise

existing models of CVEs and proposed a method to control concurrent interactions. Margery et al (1999) identified three levels of collaborative interaction: perceive each other (through avatars) and communicate (level 1); individually manipulate objects in the scene (level 2); and collaboratively manipulate objects in the scene (level 3). Typically, level 3 requires the definition of rules for access control and combining users' actions (Margery et al, 1999; Pinho et al, 2002).

While CVEs address remote collaboration in virtual environments, co-located interaction and collaboration have also been addressed in large immersive environments such as Workbenches and CAVEs (CAVE Automatic Virtual Environment). A major problem is how to provide each user with the proper 3D perception of the surrounding scene. Fröhlich et al. (2005) showed that the active separation of users through shutter glasses and the passive separation for binocular perception through circular polarisation were the most promising approaches. These ideas have been turned into products, e.g., by BARCO, Infitec and RealID, that support two simultaneous users with individual exact stereoscopy. Solutions with additional users are being studied, e.g. in the IMVIS european project (Blach et al., 2008). Another important issue is providing accurate audio feedback, e.g. with ambisonic systems that can provide each user with the proper spatialized audio feed.

A third strand of the convergence between interaction, visualization and collaboration is recent work on large interactive surfaces, including walls and tables. Interaction with multi-touch tables has been studied mostly from the perspective of co-located collaboration, e.g. (Dietz et al, 2001; Isenberg, 2010) and the affordances of touch-based interaction (Forlines et al., 2007; Shen et al, 2006; Terrenghi et al 2007). Some studies involved real users, e.g., Wigdor et al. (2006), Wobbrock et al. (2009), to demonstrate the value of these technologies. In contrast, large displays, have usually been studied from the perspective of sharing information in public spaces (e.g. H. Brignull and Y. Rogers, 2003; Peltonen et al. 2007) and the problems they raise for interaction, including task as simple as pointing (Vogel and Balakrishnan, 2005). Since most large displays use low-resolution projection systems, direct interaction with the displayed data was not an issue. However, the advent of ultra high-resolution large wall displays, made of tiled LCD screens, has demonstrated the potential for co-located collaboration (Isenberg et al., 2010), data visualization and exploration (Ball and North 2005), and direct interaction mostly using a stylus (e.g., Guimbretière et al. 2001; Forlines et al. 2006). Nevertheless, most such large displays, such as the 70-screen HiPerWall[2], do not support direct interaction and instead use a traditional mouse. Two decades ago, Mark Weiser (Weiser, 1991; 1994) predicted the advent of *ubiquitous computing*, which combines display and interaction surfaces where information can be freely transferred from one device to another. His vision has been a major motivating force behind this research, and though far from being realized, the proofs of concept such as those described above, are paving the way to creating real-world ubiquitous computing environments.

The final strand concerns research in *mediaspaces* and *mediated communication* conducted in the early nineties at Xerox PARC, Univ. Toronto, Bellcore and Rank Xerox EuroPARC (Harrison, 2009). This research explored how permanent audio-video links could be used to create a sense of shared space and a natural medium for peripheral awareness, informal communication and social encounters. Some of the results of this work have been incorporated in high-end commercial telepresence videoconferencing systems (Finn et al, 1997). Such systems however are designed for a standard meeting format where participants sit around a table. Little work has been conducted to date to apply the findings from

[2] http://hiperwall.com

mediaspace research to collaborative tasks other than meetings, in particular the collaborative visualization activities targeted by DIGISCOPE.

DIGISCOPE will build upon existing research, incorporating and advancing the state-of-the-art in the various technologies, and by combining them as appropriate. The partners include leaders in these fields and will use their expertise to develop a software infrastructure that can be deployed across the various nodes. When mature, this infrastructure will be made available to other research groups, primarily as open source software.

The goal of DIGISCOPE is not only to provide a highly advanced infrastructure for researchers in interaction, visualization and collaboration to develop and test their ideas. It will also make these advanced technologies available to end-users and co-develop with them the best solutions to their problems. DIGISCOPE will benefit greatly from the local environment of the Saclay Campus, with its high concentration of world-class scientists and corporate research labs and will target four primary application areas:

- Scientific discovery,
- Design, engineering and manufacturing,
- Decision-support systems, including crisis management,
- Education and training.

Scientists from all scientific disciplines now have access to world-class computational power, both at the national level with the GENCI infrastructure and at the European level with the PRACE project. Major scientific advances are expected from using these supercomputers to compute large simulations and mine large data sets. Industry also uses massive computing facilities to create complex models and large simulations, with the goal of designing, engineering and manufacturing new products more efficiently. In both cases, simulations can run for days, producing vast amounts of data and requiring multiple types of expertise, with appropriate forms of interaction, visualization and collaboration tools for end users (Trottenberg and La Poutré, 2010). In particular, users require post-hoc visualizations to help them understand the results of these simulations and the ability to control simulations in real-time, i.e. to assess progress through visual tools and interactively control the parameters. *Interactive Simulation* requires research into new types of progressive algorithms and has extensive applications in both scientific research and for industry.

Industry is exploring how to reduce design, engineering and manufacturing costs by integrating Virtual Reality (VR) into Product Lifecycle Management (PLM). For example, virtual prototyping has been succesfully applied to Computer Aided Design (CAD) (Deisinger et al., 2000) and virtual 3d mock-ups can reduce design time and facilitate decision making. VR offers several intuitive and multimodal interaction techniques that enhance the sensation of immersion and improve the perception of 3D scenes, e.g. for project review and automobile design (Dai et al., 1996; Bullinger et al., 1999). VR-CAD integration is another active research area that seeks to operate more directly on the semantics of CAD objects (CAD Special issue, 2010). Another major challenge is how to support the collaborative nature of product lifecycle management (Shyamsundar et al., 2002), in both co-located and remote immersive work sessions (Li et al., 2005), using both mesh-oriented (Chu et al., 2008) and native CAD data approaches (Jing et al., 2009). Successfully integrating VR and CVE technologies into real-world industrial settings requires multi-disciplinary expertise, including specific understanding of the organization and project life cycle management as well as in immersive technologies and computer-supported collaborative work.

Today's corporate decision-support systems must handle ever-increasing quantities of data to help answer complex and diverse questions using multiple types of analysis. Even more challenging are decision-support systems used for emergency response to large crises, adding a time-critical element to an already complex problem. The field of *Visual Analytics* (Ward et al., 2010) addresses these issues by combining visualization with interaction to provide users with tools and techniques "*to synthesize information and derive insight from massive, dynamic, ambiguous, and often conflicting data; detect the expected and discover the unexpected; provide timely, defensible, and understandable assessments; and communicate assessment effectively for action.*"[3]. Large interactive surfaces and the ability to easily communicate and share data with local as well as distant collaborators is critical for this new generation of decision-support systems, e.g., the European coordination action VisMaster[4]. In North America, significant public funding is being invested in emergency response systems, fueled by security concerns in the aftermath of Sept. 11. However, the applications are much broader, and include business intelligence, market analysis, command and control centers, disaster response.

Finally, education and training, while traditionally slow to pick up technological innovations, is finally waking up to the use of interactive simulations, advanced visualizations and collaborative tools for teaching. In recent years, the availability of easy-to-use digital tabletops, interactive boards and, in particular, mobile devices (iPads, TabletPCs, etc) has led to an increased interest in using such devices for education, e.g., India's iProf tablet[5]. Novel software and hardware technology has also been combined to instrument classrooms for remote education, such as ePresence[6] and LiveSpaces[7], and to allow collocated collaborators to share interactive surfaces outside of educational use, such as Smart Classroom[8]. Nevertheless, few educators have attempted to combine shared surfaces (digital tables, whiteboards and walls) in both local and remote classroom settings.

In summary, DIGISCOPE addresses the exploding need for advanced technology supporting interactive and collaborative visualization of complex systems, both locally and at a distance. At the national and international level, DIGISCOPE will provide a unique, world-class platform for addressing major challenges in science, industry and education. DIGISCOPE takes advantage of the confluence of internationally recognized research groups in interaction, visualization and collaboration, as well as in modelling and simulation on the Saclay Campus benefits from the unique environment on the plateau, with world-class scientific and corporate research labs, educational institutions, and large companies and SMEs each with complex, pressing needs that will both take advantage of the resources offered by DIGISCOPE and spur the partners to innovative solutions.

2. TECHNICAL AND SCIENTIFIC DESCRIPTION OF THE ACTIVITIES

DIGISCOPE is a high performance infrastructure designed to support the interactive and collaborative visualization of large data sets and complex systems. Nine individual nodes will feature different advanced display, interaction and collaboration capabilities to address a diverse range of user needs. The DIGISCOPE nodes will be interconnected via a high-

[3] http://www.infovis-wiki.net/index.php/Visual_Analytics
[4] http://www.vismaster.eu
[5] http://www.iprofindia.com
[6] http://www.epresence.tv
[7] http://freshmeat.net/projects/livespaces
[8] http://pi.cs.tsinghua.edu.cn

bandwidth network and also linked to high-performance computing facilities such as Teratec. Together, these nodes will form the DIGISCOPE infrastructure and provide the world's most advanced system for real-time collaboration across heterogeneous platforms.

2.1. ORIGINALITY AND INNOVATIVE FEATURE OF THE EQUIPEMENT PROJECT

DIGISCOPE will provide a unique set of platforms to a wide range of users from the Plateau de Saclay Campus and beyond. As such, it is a structuring component for the academic institutions of the Saclay Campus but also for the many industrial actors of the area, including SMEs.

DIGISCOPE is unique because of the type and performance of each platform, the number of platforms, their ability to support collaborative work and their availability to outside users. This will enable research and teaching activities, multidisciplinary collaborations and rich interactions with industry that no other facility can provide today for the targeted applications.

First, DIGISCOPE will provide unique research facilities for the computer science groups working on interaction, visualization and collaboration. There is no other example in the world of such a concentration of state-of-the-art equipment to study, develop and test advanced interaction, visualization and collaboration techniques. This is particularly important for collaboration: without the close vicinity among some of the nodes it is simply not possible to properly study remote collaboration scenarios and develop appropriate solutions.

DIGISCOPE will also foster collaborative research among the partners on modeling and simulation. New algorithms such as Reduced-Order Modeling now support a very condensed representation of mechanical systems including design variables, control variables and environmental parameters. This could be used in collaborative Visualization environments for direct manipulation, real-time simulation, online analysis, haptic manipulation of high-fidelity virtual systems with real-time feedback and dynamic evolution.

Second, DIGISCOPE will facilitate multidisciplinary scientific collaborations. The nature of the equipment and the availability of multiple nodes will make it easy for scientists from different disciplines or specialties to get together, confront their data, test new hypotheses, etc. We are confident that DIGISCOPE will enable new forms of multidisciplinary work because of the unique affordances of the interactive technologies that will be made available to a large and diverse audience.

Third, DIGISCOPE provides a unique opportunity for industry to use research prototypes for their own needs, whether it is analyzing large datasets or conducting computer-assisted engineering (See the letters of support from industry in appendix 6.5). This will be particularly facilitated by the two competitivity clusters in ICT in the greater Paris area, Systematic and Cap Digital, which gather hundreds of companies, large and small. In return, this will also provide researchers with unique access to case studies from industry. In this way, DIGISICOPE will greatly contribute to a better integration between research and innovation in a number of domains.

The technologies developed for DIGISCOPE itself may lead to technology transfer. There is no doubt that large-scale interactive visualization will become mainstream when the cost of equipment drops, as witnessed by, e.g., the interactive whiteboards that start replacing traditional ones in meeting rooms and classrooms. DIGISCOPE may enable a start-up or an existing company to bring this technology to market.

Fourth, DIGISCOPE will be a tremendous asset for education and training. It will be used for interactive classrooms with collocated as well as remote students, enabling a range of distributed activities such as collaborative projects, classroom polls, interactive simulations or concurrent simulations. This interactive aspect is especially important in the engineering sciences, where most material requires high-resolution, dynamic visual representations: 3D models, multidimensional simulation results, equation plot diagrams, etc. Furthermore, it will provide an attractive setup for students to present their work to industrial partners and other private or public investors that may bring further financing to research and teaching institutions.

Finally, DIGISCOPE will become the center of a larger network of similar platforms by providing the interoperating glue for interconnecting the many similar platforms that exist or are being created in France and worldwide. The advantage of DIGISCOPE over other projects is its critical mass in terms of number and diversity of platforms and its integration of collaboration facilities. This will make the Saclay Campus an international landmark in collaborative data visualization.

2.2. DESCRIPTION OF THE PROJECT

2.2.1 SCIENTIFIC PROGRAMME

The goal of DIGISCOPE is to provide the partners as well as external users with a state-of-the-art infrastructure for collaboratively visualizing and interacting with complex data and computations. This will be achieved by:

- Joining the forces of the partners and interacting closely with final users, both in academia and industry;
- Creating a unique set of platforms that push the limit of technology and anticipate its evolution in order to test novel solutions in real settings;
- Making these platforms available to end users in order to quickly iterate new ideas and designs and create a virtuous circle to foster technology transfer;
- Developing a software infrastructure that will support a wide range of configurations, potentially resulting in a standardization effort to increase the interoperability of such platforms worldwide.

DIGISCOPE will build on a rich body of work and the experience of the partners in the areas of interaction, visualization, collaboration, modeling and simulation to create a new generation of environments. Indeed, while there is a long history of research in those areas, the technology is far from being mature. CAVEs and large interactive walls are still very much research prototypes that are seldom used for actual, real-world projects. Even companies that have invested in such equipment are far from using it to its full potential.

The DIGISCOPE partners have been active for a long time in these domains (see the description of the partners for details and the annex for a list of publications): LRI, INRIA-Saclay (In Situ and AVIZ teams) and LTCI in human-computer interaction, information

visualization and computer-supported cooperative work; CEA-LIST and LIMSI in virtual reality and immersive environments; MAS and EM2C at Ecole Centrale Paris and CMLA and LMT at ENS Cachan in modeling and simulation; CEA and LATMOS (OVSQ-UVSQ) in simulations of scientific phenomena. The partners also bring expertise in networking and security (LTCI) and in the use of new technologies for information and communication by actors from different communities and cultures (UVSQ REEDS).

By creating a series of platforms over a period of three years, the partners will be able to take advantage of their expertise and complementarity to combine well-known solutions and innovative ideas. In particular, by using the platforms for their own needs and making them available to external users early on, they will be able to learn from their own experience as well as users' feedback.

This project is timely: while research on virtual reality and immersive environments has traditionally benefited from public funding, in recent years government funding has ramped up significantly to also support research in data visualization and visual analytics. For example, in the United States, the *National Science Foundation* (NSF) and the *Department of Homeland Security* have created the *National Visualization and Analytics Center* (NVAC) and are funding the FODAVA[9] program (*Foundations of Data and Visual Analytics*). FODAVA is led by Georgia Tech and has eight partner universities including Stanford University, University of Illinois at Urbana-Champaign, and Cornell University. In the UK, the *Visual Analytics Consortium* (UKVAC) is a similar initiative, gathering five universities. While the European Union has not issued specific calls in that area yet, it is funding the coordinated action VisMaster[10] whose goal is to define a roadmap for visual analytics research and set the stage for follow-up actions.

Research in interactive visualization for modeling and simulation is also very active. It has become a regular topic at simulation conferences, e.g. Coupled Problems[11]. It is a research topic at institutions such as *Oakridge National Research Labs* (ONRL[12]) with the 20-year old VizLab or at NASA with the *Jet Propulsion Laboratory* visualization facilities[13]. Yet the combination of interaction and collaboration with simulation and modeling is still fairly new. While the Collaborative Visualization Environment[14] at Georgia Tech's *Aerospace System Design Laboratory* is an exception, there is a growing need to provide not only better visualization tools, but also better tools to interact with and collaborate about simulation results.

Scientific objectives

The scientific program of DIGISCOPE is organized in six main themes. The first two focus on the enabling technologies that will make DIGISCOPE a unique instrument:

- Research in interaction, visualization and collaboration;
- Research in interactive and collaborative modeling and simulation of large and complex phenomena and systems.

The other four will demonstrate the value of the equipment in a variety of application areas:

- Scientific discovery;

[9] http://nvac.pnl.gov/nsf.stm
[10] http://www.vismaster.eu
[11] http://congress.cimne.com/coupled2011/frontal/default.asp
[12] http://www.ornl.gov/info/ornlreview/v30n3-4/scien.htm
[13] http://sc.jpl.nasa.gov/visualization.html
[14] http://www.asdl.gatech.edu/index.php?option=com_content&task=view&id=62&Itemid=131

- Design, engineering and manufacturing;
- Decision-support systems, including crisis management;
- Education and training.

For each of them, we identify the main objectives of the project and illustrate each of them with a short scenario. Some of these scenarios are expanded in the Appendix. Each theme lists the partners that are primarily involved in it. This shows the rich web of collaborations among the partners, but the lists are by no means limitative: every partner will be welcome to participate, if only as an observer, in each theme.

Interaction, visualization and collaboration (LRI, INRIA, LTCI, CEA, LIMSI)

Large interactive walls as well as immersive environments can only be adopted by a wide range of users if they are as easy to use as personal computers. Because the interaction context is very different from that of a desktop computer, new interaction languages must be created that build on human skills. DIGISCOPE will advance the state-of-the-art in existing work in human-computer interaction, virtual reality, visualization and computer-supported cooperative work to provide novel techniques for interacting with and sharing complex content on large displays.

Scenario: Rafael wants to compare the results of his latest experiment with that of his colleagues. He brings the laptop with his results in one of the DIGISCOPE nodes. Using his bare hand, he points at the data on his laptop and swipes it to the wall display. Shortly after one of his colleague shows up on the telepresence screen while another enters the room. The remote user has a larger wall and uses a remote control to interact with it. Together, they spend the next hour confronting their results on the two wall displays using natural gestures.

Modeling and simulation (ECP, Institut Farman, UVSQ, M. Simulation, CEA-LIST, LIMSI)

The move towards interactive simulations is a critical step to save time (and money) and to empower users with interactive tools to steer simulations, explore the results and try alternatives, possibly in parallel. Interactive simulations are also critical in immersive environments, especially for haptic rendering, to allow a human user to experience a physical phenomenon. DIGISCOPE will explore and test new approaches to run and control on-line simulation in interactive time and to improve the quality of interaction in immersive environments.

Scenario: Paul, a mathematician, has developed a new optimization model to approximate a complex system that combines airflow, temperature, air-quality and pressure models in a closed system. He enters a DIGISCOPE node, connects remotely to a simulation center and starts a new instance of the simulation. Data starts arriving from the simulation center and is immediately visualized on the large wall. Paul immediately detects an unexpected correlation between airflow and temperature that he did not foresee. He brings a visual representation of his model on the interactive table to verify its correctness, and then invites John, an expert physicist in airflow. Using the interactive wall they look and explore the data together and decide that they need a second opinion so they send their model to Anna at a different DIGISCOPE center. Anna receives the model and identifies an issue with one mathematical equation. Through the telepresence system she shows Paul and John the problem with the model on the table and the problematic data on the large wall. Paul redefines the model, sends it to the simulation center and restarts the simulation. The newly updated results appear at both sites and all participants agree that the new simulation model seems correct. They decide to run an offline, more precise simulation to verify it.

Scenario: For a long time, Amelie has dreamt of working in a space station. This is now almost possible thanks to an immersive DIGISCOPE node. Inside the system, her motions are tracked and used to pilot an avatar that moves in micro-gravity conditions within a virtual model of the International Space Station. All the contacts between her avatar and the ISS walls are managed by interactive simulation and the stereoscopic display matches what she would see in the virtual situation. At the same time, in a different DIGISCOPE node, an wall display provides a general view of the ISS environment on which experts may analyze Amelie's activity.

Scientific discovery (Maison de la Simulation, UVSQ, LRI)

Visualization has always been a critical aspect of science and the right image or the right diagram is often the key to scientific insight and discovery. Now that most sciences rely on computers to either analyze data collected in the field or to run simulations of natural phenomena, the role of visualization is even more important. DIGISCOPE will work closely with scientists from the Saclay Campus to provide them with proper tools to display, share and explore scientific data.

Scenario: A recent study found the first evidence of an effective HIV vaccine, but only when two different, unrelated vaccines were combined. The surprising findings run counter to current scientific understanding and requires an urgent meeting of scientists from diverse domains, including geneticists, cellular biologists, biochemists, bioinformaticians, physicians and epidemiologists. DIGISCOPE offers them a common environment in which experts can present their own data, in their own formats, and interactively visualize and explore the relationships among them. By linking different types of large-scale interactive displays, experts from around France can compare and contrast each other's data and begin to understand this very complex phenomenon.

Design, engineering and manufacturing (LIMSI, CEA)

The cost-efficient design of new objects is a competitive advantage for many companies. The increased computerization of all aspects of product design, from early sketches to manufacturing of the final product, requires advanced tools to realistically render the object and simulate its use as well as control all the steps of the design and manufacturing chain. DIGISCOPE will emphasize multimodal input and output and the use of haptics to improve the state-of-the-art in digital design, engineering and manufacturing.

Scenario: Several designers are collaborating to prepare the first drafts of a new product for a large audience with the help of a group of potential end-users. They are in various locations and have access to DIGISCOPE nodes. Using the sharing facilities of DIGISCOPE they can go through the whole drafting process: Sketching, Part design, Styling, and User' validation. Those in an immersive room can even experience the haptic feedback of touching the object.

Decision-support systems (INRIA, ECP, Institut Farman)

The availability of on-line information for many aspects of human activity has changed the face of decision-support systems. Whether it is for running a business day-to-day or in response to an emergency situation, the key to better decisions is the ability to combine overview and details, to cross data from multiple sources, and to collaborate more freely while keeping some information confidential. DIGISCOPE will create advanced information visualization techniques and conduct case studies with experts in crisis management to develop more appropriate tools.

Scenario: Crisis management often involves experts from different fields that have to collaborate both simultaneously and successively, sharing data and results while they may be located in different places. The proposed scenario starts with the explosion of a chemical bomb in an urban area, and describes how experts may initially anticipate the situation, before planning and performing a robotised remedial intervention. It shows the benefit of using a collaborative network featuring heterogeneous interaction and computing means to increase the efficiency of decision-making, intervention preparation and staff training.

Scenario: See the VisMaster video showcasing a scenario in epidemiology at http://www.youtube.com/watch?v=5i3xbitEVfs

Education and training (ECP, UVSQ, Institut Farman)

Interactive technologies are slowly changing the world of education. Interactive whiteboards slowly permeate classrooms around the world, but are still limited when it comes to interaction by the students themselves, especially when they are at a distance. Whether at school, at the graduate level or for continuing education, the ability to annotate contents, to run simulations, to work collaboratively in the same room or at a distance can significantly help students learn better and faster and teachers transmit their knowledge more effectively. DIGISCOPE will make it possible to experiment advanced learning tools and assess the benefits of interactive and collaborative visualization for teaching. DIGISCOPE nodes will be used to teach advanced scientific visualization in two HPC oriented Masters (M2S and MIHPS) that are co-organized by DIGISCOPE members (ECP, UVSQ, ENS Cachan, CEA).

Scenario: Student projects conducted in collaboration with industrial partners are an essential aspect of engineering schooling. During these projects, a group of students attempts to solve a problem or explore an area of interest provided by the industrial partner. These projects are often open-ended and visionary. Using a DIGISCOPE node, students can attract industrial partners through a collection of presentations and mockups on multiple surfaces. They can then use DIGISCOPE to develop and experiment with new ideas using cutting edge technology. Finally they can use the node to present their results to the industrial partners.

Work program

The DIGISCOPE work program consists of five tracks:

1. Hardware installation;
2. Software development;
3. Internal projects;

4. External projects;
5. Dissemination.

The first two will take place during the installation of the various nodes (first three years). The last three will take place from the time a node is functional until the end of the project.

Track 1: Hardware installation

Due to the constraints on the availability of new buildings, but also in order to equalize the workload on the project participants and to transfer the experience gained from one node to the next, the hardware will be installed over a period of 3 years, as follows:

Year 2011	*Year 2012*	*Year 2013*
Telepresence infrastructure FabLab; Node at Ecole Centrale Paris Node at LTCI; Node at LIMSI (EVE extension)	Node at LRI and INRIA Saclay Node at CEA LIST Node at Maison de la Simulation	Node at UVSQ/OVSQ Node at Institut Farman.

The staff working on the hardware installation will work as a team, rotating from site to site as needed in order to maximize exchanges and build up expertise.

Track 2: Software development

In parallel with the hardware installation, software development will take place over the first three years and will continue on as needed for the rest of the project. The software development team will work as a group and will be collocated at least the first year of the project. As nodes get installed it will become more efficient to distribute the team, but regular meetings, the use of teleconferencing tools and the team-building effect of the first year will ensure that the software development effort stays coherent.

The DIGISCOPE software will build on existing software from the participants. It will provide a set of basic functionalities such as displaying contents from multiple sources, managing the display with windows/layers/portals, supporting distributed rendering of content for tiled walls, sharing content across nodes and managing user input in a unified way. On top of this basic layer, a higher-level toolkit will support standard interaction tasks, e.g., pointing, navigation, manipulation, visualization and sharing.

The goal is to produce successive releases of the DIGISCOPE software early on so that it can be quickly used for real work, and a first stable version by the end of year 2. At this point, the software will be open-sourced as much as possible to encourage dissemination and adoption by other platforms outside DIGISCOPE. Components that cannot be open sourced, such as the physical interactive simulation software components required for haptic interaction, will be made freely available to all partners and to academic institutions for research purposes.

Track 3: Internal projects

As the nodes get installed and the software deployed, the DIGISCOPE Program Committee will issue calls for internal collaborative projects and monitor the use of the various nodes. It will ensure that the different scientific objectives are addressed by the various projects and that the nodes are used the majority of the time for collaborative projects.

Track 4: External projects

As the nodes get sufficiently robust to be used by people outside the project, the Program Committee will seek external users from both industry and academia to build up the Users Group. It will encourage collaborations involving internal and external partners as well as use by external partners alone. It will make sure that the tools get improved as the project gains experience from such outside use. It will also use this input to assess the potential for technology transfer.

Track 5: Dissemination

During the whole project, a number of actions will be undertaken to make it visible to the scientific community, the partner institutions, the funding bodies and the public at large. A web site will present DIGISCOPE, its progress and its results. Demonstrations will be organized including at public events such as the annual *Fête de la Science*. An annual DIGISCOPE Forum, which will move from node to node each year, will include scientific tracks and presentations targeting a wider audience, with the specific goal of growing the Users Group.

Expected results

The expected results of DIGISCOPE are the following:

- A unique set of hardware platforms for interaction, visualization and collaboration featuring diverse trade-offs in terms of size and resolution of the displays, interaction technology, etc. and supporting remote collaboration across heterogeneous systems;
- Open-sourced software featuring
  - a scalable architecture for sharing large visualizations across multiple nodes and real-time compositing of multiple sources;
  - a flexible toolkit that supports a wide range of input devices for specific tasks such as pointing, navigation, manipulation;
- A set of novel interaction, visualization and collaboration techniques validated through real-world applications;
- A set of modeling and simulation techniques that scale up and support real-time interaction;
- A number of case studies drawn from outside users from academia and industry, and hopefully a number of scientific result or industrial advances that would not have been possible without DIGISCOPE;
- A flow of Master and PhD-level students who will have taken courses using DIGISCOPE followed and defended a DIGISCOPE-based innovation project in collaboration both with academic partners and/or sponsoring companies;
- Ideally, technology transfer to a start-up or an existing company, and interoperability with a larger network of outside nodes.

2.2.2 STRUCTURE AND BUILDING OF THE EQUIPMENT

DIGISCOPE is a distributed infrastructures consisting of nine nodes each featuring state-of-the-art interactive visualization technology and high-end telepresence technology for remote collaboration. The nodes are located in the greater Paris area, mostly on the Saclay Campus (see figure 1 below).

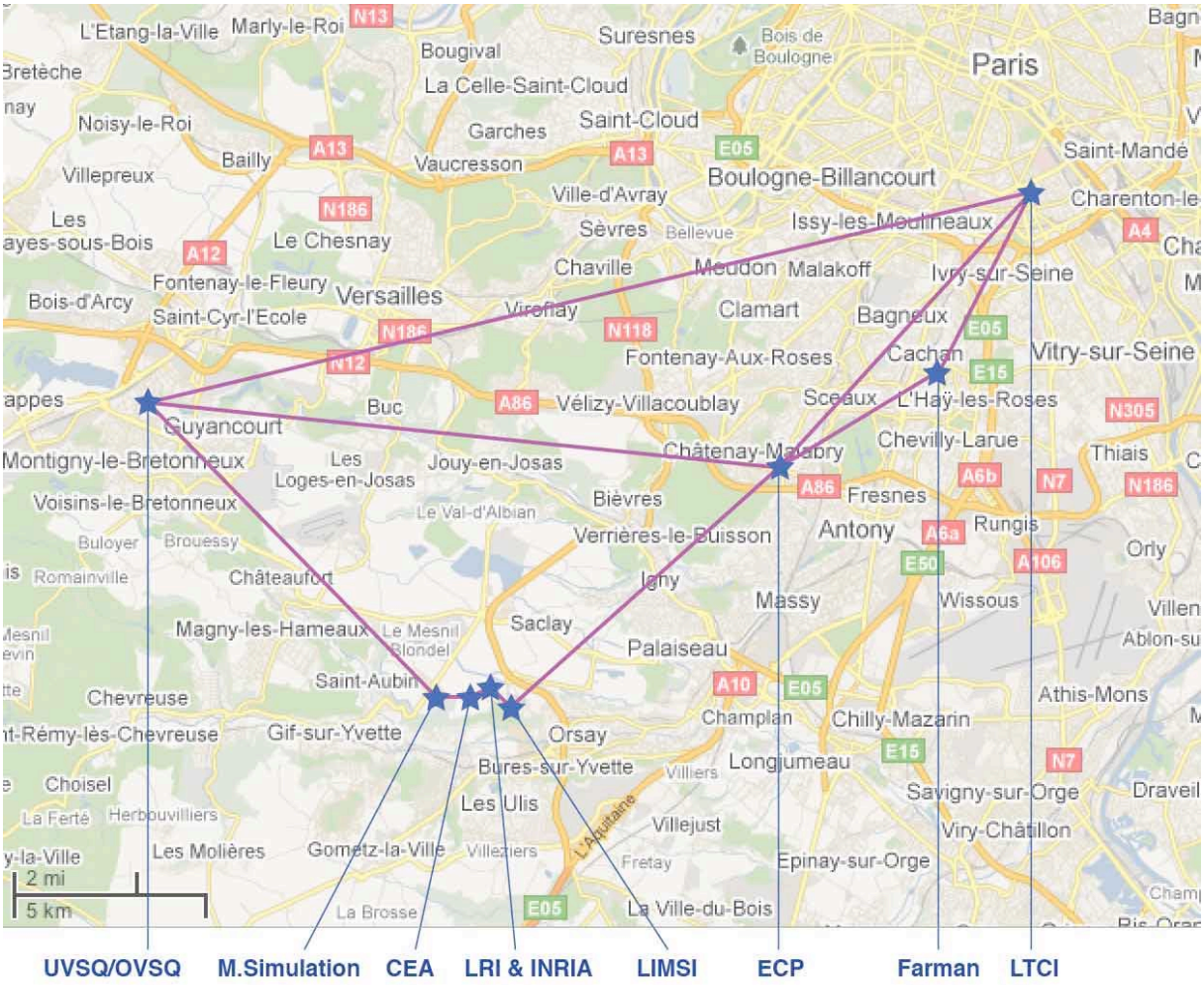

Fig.1: Location of the nine DIGITEO nodes (two nodes are installed at the LRI & INRIA site).

Four main types of interactive visualization rooms are featured in DIGISCOPE, representing the state-of-the-art in visualization technology.

Virtual reality rooms (Fig. 2) provide an immersive experience by projecting information on multiple walls around the user(s) as well as on the floor and by using multimodal input (gesture, voice) as well as multimodal output (visual, audio, haptics). Full immersion is achieved by providing a 3D stereoscopic display consistent with the user's position. Current system can support up to two such users.

Large power walls (Fig. 3) use a single, large display surface by combining multiple projectors with invisible seams between the projected images. As with VR rooms, 3D stereoscopic display is supported but it is usually not tied to the position of the user so that a larger number of users can be accommodated than in VR rooms. Since users stand a few feet away from the display, interaction is achieved through remote control devices, such as laser pointers to designate objects and hand-held devices to manipulate them.

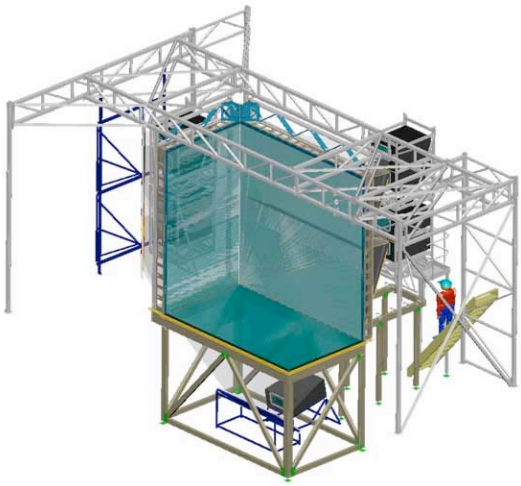

Fig. 2: Virtual reality room (EVE room)

Fig. 3: 3D power wall (source: BARCO)

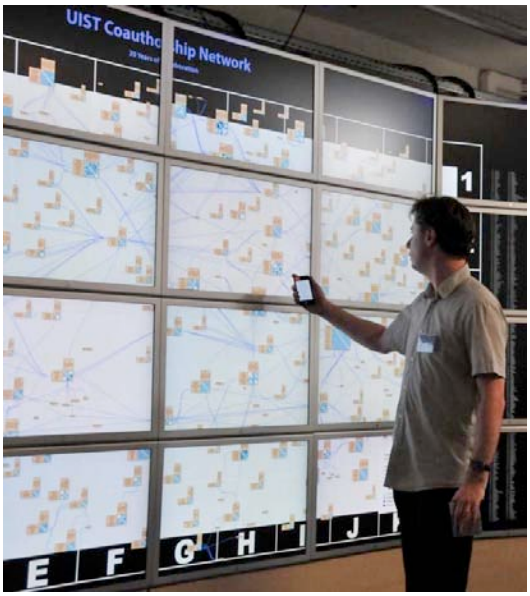

Fig. 4: Ultra-high resolution wall (WILD)

Fig. 5: Large multitouch surface (source: MultiTouch)

Ultra-high resolution walls (Fig. 4) are made of a mosaic of LCD screens. The linear resolution of such walls is two to five times higher than projection-based systems, making them particularly useful for high-density information visualization. Unfortunately current LCD technology requires that the borders are visible, although screens with ultrathin borders are becoming available. Because such walls can display high-density content, users walk back and forth to switch between overview and detail. This affects the types of interaction and collaborative behavior when compared with VR rooms and power walls.

Large multitouch surfaces (Fig. 5) consist of one or more display surfaces that can detect multiple simultaneous contact points by users' hands and fingers, as with the now popular iPhones and iPads. Early systems combined projection and camera-based touch detection, while newer ones work with flat displays, including LCD screens. Multitouch surfaces work

well for horizontal surfaces (tables), but can now scale to wall size. The affordances of direct interaction using one's hands leads to natural forms of interaction and collaboration, especially when managing documents, graphs and other displays that users are accustomed to manipulate on their computers.

While some convergence is taking place between these different technologies, such as higher-resolution and multitouch capabilities for projection-based systems, it requires trade-offs, e.g. in terms of resolution or number and accuracy of simultaneous touch points. More importantly, some activities are better supported by some types of rooms. For example, immersive technology is very useful to experience haptic feedback and provide haptic input, while multitouch surfaces are very effective for sifting through large numbers of documents; Power walls work well for scientific visualization, while ultra-high resolution walls are better for complex information visualization. This is why DIGISCOPE will deploy each of these technologies rather than picking a single one or trying to unify them.

Moreover, in order to support remote collaboration in both homogeneous and heterogeneous situations, i.e. across rooms of the same vs. different type, DIGISCOPE will feature at least two rooms of each type. Each DIGISCOPE node will focus on a set of activities and applications. However the project will be managed so that each participant must collaborate with other members

Finally, the equipment will include specific software developed by the project during the installation phase. This dedicated software will provide the necessary glue between the nodes so that applications can be run on nodes with different display and interaction capabilities with only a change of configuration. It will also provide collaboration features to allow users to share content at a distance and interact remotely.

- *Element 1: Telepresence equipment and FabLab*

The telepresence equipment will include a video network backbone and terminal equipment in each DIGISCOPE node. It will provide HD quality video links between multiple sites (multi-point conferencing) and will be based on industry standards for interoperability. It will use the high-speed network infrastructure available to all the partners, including the national Renater2 network and the Saphir and Rubis networks in the Saclay Campus area.

DIGISCOPE will also features a shared fabrication lab (FabLab), equipped with 3D printer, laser cutter and circuit board printer. This will make it possible to create dedicated devices for interaction as needed by the various projects.

Both the telepresence equipment and the FabLab are new. They will be installed at the main DIGISCOPE location: first in the PCRI building and then in the adjacent Digiteo-Moulon building when it is completed.

- *Element 2: Two ultra high-resolution walls at LRI & INRIA Saclay*

LRI, INRIA Saclay and LIMSI-CNRS have installed a first ultra-high resolution wall called WILD[15]. With 32 30-inch monitors, it has an overall resolution of 131 million pixels for a physical size of 5m50 x 1m80. WILD also features a multitouch table and a VICON motion tracking system for gesture-based interaction. WILD will become a DIGISCOPE node by

[15] http://insitu.lri.fr/Projects/WILD

adding a telepresence terminal when the wall is moved from the current LRI building to the PCRI building.

A second node will be installed in the Digiteo-Moulon building, adjacent to the PCRI building. It will be a similar ultra-high resolution wall and telepresence terminal called WILDER. WILDER will use the best technology available at the time, in particular to reduce screen bezels and to improve gesture tracking. While the current WILD wall will be primarily used for research in human-computer interaction, the new WILDER wall will be primarily targeted at external users.

- *Element 3: Immersive VR room at LIMSI-CNRS*

LIMSI-CNRS has installed a large immersive virtual reality room called EVE in a new building. EVE currently features two walls and a floor, and is reconfigurable to provide either dual stereoscopic single-height display or single stereoscopic double-height display.

EVE will be extended by adding a third wall that can be rotated to either "close the box" or extend the back wall, providing a variety of configurations. Audio, haptic and tracking facilities will also be added to improve the multimodal experience, as well as a telepresence terminal. This node will focus on multimodal input and output to support co-located as well as remote collaboration tasks involving complex 3D objects.

- *Element 4: Immersive VR at CEA-LIST*

The CEA-LIST node will be a new immersive virtual reality room in the Digiteo-Moulon building. The room will have two sides with a very high-resolution area (sub-millimeter pixels) in the front screen, several haptic devices, an accurate tracking device and a telepresence terminal. The haptic devices will include classic 6D arms as well as more exploratory devices: vibro-tactile actuators integrated in a suit and an exoskeleton for the upper body. This node will focus on collocated haptic interaction (typically, feeling a contact exactly where the user – and the other people – see it) in an immersive environment for co-located and remote collaboration tasks.

- *Element 5: Large multitouch surfaces LTCI*

The LTCI node will consist of a collection of reconfigurable multitouch surfaces made up of "cubes" and a telepresence terminal. It will be installed in the show room of the new lab space at Place d'Italie in central Paris. Each cube combines a display and multitouch surface. The purpose of this equipment is to experiment with several configurations of multitouch surfaces for collaborative work, e.g. multiple walls, wall + table, and even remote settings by moving some cubes to a different room or to the main LTCI building.

The ability to quickly change configuration will provide a perfect test bed for the software developed by DIGISCOPE, in particular its ability to support a variety of input/output configurations. It will also make it easy to better understand the differences between multitouch interaction on a vertical vs. horizontal display.

- *Element 6: Dual multitouch visualization wall at ECP*

The node at Ecole Centrale Paris will include a multitouch wall (where rendering will be done by a dedicated server), using the same technology as the LTCI node and a telepresence terminal. Moreover it will include a second setup where rendering will be done in a distributed fashion, similar to the LRI and INRIA Saclay setup. The dual setup will provide

flexibility both in terms of hardware and software. The modular nature of each of the visualization cells will support easy reconfiguration of the screen (used as a wall, or part of it as a table). The dual visualization setup will also allow it to run both (i) dedicated high-end visualization applications on a distributed visualization setup, as well as (ii) traditional software on the single server setup. The entire wall will be connected to the ECP computational mesocentre through appropriate network infrastructure and will act as a means to visualize the computational and simulation results.

Together with the DIGISCOPE node at UVSQ and in collaboration with Institut Farman, the ECP node will concentrate on applications for interactive simulations and for teaching. Furthermore, the multi-touch aspect of the visualization cells will provide a testbed for new visualization and interaction techniques using touch, or remotely using a motion capture system.

- *Element 7: Large multitouch wall at UVSQ*

The UVSQ node will feature a large wall based on the same or similar technology as that of ECP and LTCI and a telepresence terminal. It will be installed in an existing 80m^2 room at the UVSQ observatory. UVSQ will focus on large simulations of phenomena such as plasmas, and on the applications of DIGISCOPE to teaching, in collaboration with ECP and Institut Farman.

- *Element 8: Large 3D wall at Institut Farman*

The Institut Farman node will be a constellation of devices made up of a main decision center with a telepresence terminal and two remote satellites. The main decision center will be a large 3D power wall installed in the Institute's future building at ENS Cachan while the satellites will be hosted in the laboratories of the Institute. The wall will be based on stereoscopic 3D projectors with the best technology available at the time (a few very high resolution projectors or a larger number of stackable projection-based display cubes). A motion tracking system will be used to support interaction with the wall. The two satellites will consist each of a very high-resolution 56" display with standard input devices and a videoconferencing terminal compatible with the telepresence system.

This node will focus on applications to decision-making and interactive simulation. In particular the satellites will make it possible to experiment with collaborative methodologies for remote decision-support in a variety of contexts.

- *Element 9: Large 3D wall at Maison de la Simulation*

The node at Maison de la Simulation will be a large 3D power wall and telepresence terminal installed in the CEA facilities at Orme des Merisiers, close to the PCRI, Digiteo-Moulon and LIMSI buildings. The large wall will use projection technology and feature a 3D motion capture system for interaction. The wall will be connected to the high-performance computing facilities of Teratec[16] and the TGCC[17] (*Très Grand Centre de Calcul* or Very Large Computing Center) installed at CEA in Bruyères-le-Chatel, about 20km away. TGCC is the home to one of the top high-performance computers in the world. In order to handle the very large datasets produced by some of the simulations run on Teratec and TGCC, a local cluster will compute the visualizations for the power wall.

[16] http://www.teratec.eu
[17] http://www.teratec.eu/gb/technopole/tgcc.html

This node will focus on interactive visualization for large simulations in scientific fields. It will have a key role in connecting DIGISCOPE with the large number of top-notch research laboratories of the Saclay Campus, in particular in natural and life sciences.

2.2.3 TECHNICAL ENVIRONNEMENT

All infrastructures for installing the DIGISCOPE nodes are already in place or are being built. Dedicated rooms either already exist, are being built or will be made available by the hosting institution. The partners will also provide the necessary personnel for running and maintaining the equipment.

Telepresence and FabLab

Both the PCRI and Digiteo-Moulon buildings have machine rooms large enough to host the backbone of the telepresence system. Technical staff from Universté Paris-Sud, CNRS, INRIA and CEA in these buildings will provide the necessary technical support.

Sufficient space is available in the Digiteo-Moulon building for the FabLab. It will be hosted in the PCRI building until that space is available. According to the needs of the partners, part of the FabLab may be installed in the LTCI space in Paris. LTCI and INRIA will provide technical support for the FabLab with two part-time engineers.

LRI and INRIA Saclay – WILD and WILDER ultra-high resolution walls

The new PCRI building will host WILD in a dedicated 60m^2 room. A dedicated 80m^2 room also exists in the Digiteo-Moulon building for WILDER. The building is under construction with a delivery date in late 2011. The room will require minor adaptations for air-conditioning.

Université Paris-Sud will provide a half-time engineer for the duration of the project, while INRIA will provide two half-time engineers.

LIMSI-CNRS – EVE immersive virtual reality room

A new building was created next to LIMSI to host EVE. The platform was designed from the ground up to include the articulated third wall and all the extensions described above. Therefore the infrastructure is already present for DIGISCOPE.

To support the installation of the extension of EVE and the dedicated software developments required for its connection to the others platforms during the first three years, LIMSI will 18 man-months from its current staff (including 3 man-months of management) and man-months from its future PhD students. To support the research and end-user developments in the extension of EVE during 7 more years, LIMSI will provide 42 man-months from its current staff (including 7 man-months for management) and 28 man-months from its future PhD students.

CEA-LIST – Immersive virtual reality room

The Digiteo-Moulon building was specifically designed to host two virtual reality equipments, one of which with under-the-floor projection. It is planned to be delivered in early 2012 and integration of the Digiscope immersive and collocated haptics VR node will start immediately thereafter. This node is specified according to the known caracteristics of the building and its installation should not raise unreasonnable difficulties, taking into

account the previous experience of CEA-LIST with its Fontenay-aux-Roses VR systems and the close link maintained with LIMSI and its EVE room. Additionally, a number of equipments (Virtuose arms, Inca system, tracking system, computer architecture ...) will be moved from Fontenay to the Moulon site in order to create a complete setup from the start.

Based on its experience with existing VR systems in Fontenay-aux-Roses , CEA will provide a full-time engineer to support the equipment (management, maintenance, upgrades, integration of new devices ...).

LTCI – Large multitouch surfaces

The large multitouch display surfaces will be mainly hosted in the new showroom of LTCI-Institut Télécom/Télécom ParisTech which is located in its "Place d'Italie" expansion. The building has been completely renovated in 2010 and it is equipped with air conditioning and appropriate network cabling. Taking advantage of the flexibility of the "Multitouch Cells" (the equipment we plan to obtain) we will consider different configurations depending on our emerging needs and the experiments we want to perform. Hence, while most cells will be permanently installed in the showroom to provide a large interactive wall display, a few cells will be either used as interactive tabletops or small wall displays in other buildings in order to experiment with various collaboration patterns.

LTCI plans to hire a research engineer (half-time) for operating and maintaining the multitouch display system. In addition, LTCI will be strongly involved in the development of the FabLab (1 research engineer in electronics and 1 technical engineer, at least 3 months each). Finally, several PhD and post-doc students will use the equipment. They will participate in the development of complementary software components and will occasionally help other people exploit the system.

Ecole Centrale – Large dual interactive visualization wall

The DIGISCOPE node will be installed in a dedicated room located in the Dumas Building (Research Labs) at the Ecole Centrale Paris. The room already exists, and will need some minor adaptations for proper air-conditioning, power supply and network connections.

ECP will hire a Research Engineer, on a half-time basis, for operating and maintaining the whole visualization system. In addition, ECP will allocate about 6% of the Mesocentre Research Engineer to take care of the connection of the Digiscope room with other ECP high-performance computing facilities, including the Mesocentre.

UVSQ/OVSQ – Large multitouch wall

The UVSQ/OVSQ display wall will be hosted in a 80m^2 blind room already available in the Guyancourt campus of the UVSQ observatory (OVSQ), where the UVSQ research teams are located. The room needs to be air-conditioned. The equipment will be operated in close coordination with ECP and ENS-Cachan for the educational applications. A full-time engineer will be appointed by UVSQ to manage the equipment (hardware and software).

Institut Farman – Large 3D display wall

The main equipment or Decision Center will be installed in the forthcoming high-technology Farman Institute building, scheduled for the end of 2012. This new building will host the multidisciplinary teams of the partner laboratories. The building will include a large theater for conference meetings, offices, high-performance computing facilities and smaller meeting

rooms. A 70m^2 room is already scheduled to host the Decision Center, which will also be linked to the video facilities of the main Theater.

While the Decision Center will be installed in early 2013, it will be possible to install the two satellites (Quad HD LCD screens with Barco's smart networking XDS suites) earlier in the existing laboratories.

ENS Cachan will hire a full-time Research Engineer for operating and maintaining the complete visualization system. The Research Engineer's mission will include monitoring the reliability of the system and defining use policies under security rules. Finally, the engineer will take care of the connection with third-party equipments such as remote connection with other DIGISCOPE nodes but also connection with high-performance computing facilities in the Farman building and at other local laboratories.

Maison de la Simulation – Large 3D display wall

The 3D wall at Maison de la Simulation will be hosted in a dedicated 130 m^2 room that will be available by the fall of 2011. In this room it will be possible to use the wall both in small working teams and with a larger audience for teaching or public outreach. The room will be located in the open part of the CEA/Saclay center, and therefore will be easily accessible to researcher from outside the Maison de la Simulation. A 40 m^2 technical room adjacent to the wall will host the graphic computers and storage that will be necessary to power the wall.

CEA will provide two part-time engineers to operate the platform, to develop proper visualization software and to provide users with adequate support. This work will be done in close collaboration with engineers working at the CCRT and TGCC (national and European supercomputing infrastructures located at CEA in Bruyères-le-Chatel). The objective is to provide the Saclay community with a state-of-the-art visualization platform tightly connected to the large computing infrastructure. An important mid-term objective is to implement deported visualization between the supercomputing center and the Maison de la Simulation. An upgrade of the network infrastructure is underway that will make this connection more efficient by the time the wall is installed.

3. DISSEMINATION AND EXPLOITATION OF RESULTS

The progress and results of DIGISCOPE will be shared with the scientific community, with industry and with society at large through a number of channels and events. The phased nature of the project, with some equipment installed early and some installed later on, will ensure that the project can take advantage of the latest technology while sustaining novelty and producing new results steadily. This will also ensure that feedback from early users will be taken into account as the new nodes are created.

The scientific impact of the project will increase the international visibility of the participating research groups. The goal is to be a worldwide reference for research in interaction, visualization and collaboration for modeling and simulation of complex systems. This in turn will attract researchers, including Ph.D. students, post-docs, junior and senior faculty to join the project or come for shorter visits. This visibility will of course benefit the hosting labs and partner institutions and, in fine, the Saclay Campus at large.

Publications and public events

The research groups involved in the project will publish their results in the top conferences and journals in their respective fields, such as:

- Interaction/Visualization/Collaboration:
  - Conferences: ACM CHI, ACM UIST, IEEE InfoViz, ACM CSCW, AVI, INTERACT, …
  - Journals: ACM Trans. on CHI, HCI Journal, Jal CSCW, …
- Virtual reality:
  - Conferences: ACM Siggraph, IEEE VR, ACM ISMAR, ACM VRST, IEEE 3DUI, EGVE, EuroHaptics, …
  - Journals: Presence, VR, Int. Jal. of VR, Jal of VR and Broadcasting, …
- Modeling and Simulation:
  - Conferences: ECCOMAS, SIAM, ICCMS, AIAA, MSV, ICMSC, MSV, …
  - Journals: CAF, JCP, CMAME, IJNAM, IJNME, JAIM, ESAIM, IJCES, …

The consortium will also seek publications in high-profile scientific venues such as *Communications of the ACM*, *IEEE Computer*, or *Science*.

Beyond scientific publications, the partners will also publicize the results of DIGISCOPE in magazines that reach a wider audience, such as *MIT Tech Review*, *WIRED*, *Scientific American*, *La Recherche*. DIGISCOPE will also have a strong web presence and will be presented at public events such as the French annual Science Fair (*Fête de la Science*). This will allow the partners to showcase their results in many areas, including those that do not use DIGISCOPE directly but more as a medium. An annual *DIGISCOPE Forum* will provide an opportunity to present the project to companies, government agencies and the press. This could be the occasion to commission works by designers and artists to demonstrate other, unexpected uses of the advanced technologies explored in the project.

Technology transfer

A significant output of the project will be the software developed to run the various nodes. The preferred model for this software will be to open-source it when it is mature enough in order to encourage its adoption by other similar platforms outside DIGISCOPE. Following the example of the X Window System in the early 80s (Scheifler & Gettys, 1986), a liberal license will not preclude companies from adapting the software to a specific platform and sell the resulting improved version, as long as the modified version maintains interoperability with the open source version. Interoperability will be sought by publishing the key protocols, data formats and APIs and seeking some form of standardization – either de facto if the system gets adopted widely or through some standardizing body.

Some of the technologies developed in the project may result in patents, especially if they involve hardware. The goal here is to facilitate technology transfer with start-ups and existing companies, which typically require a patent portfolio to secure a competitive advantage. This however must not stifle innovation and progress of the project. The main measure of success of DIGISCOPE will be the variety of uses of the equipment and a growing demand by academic and industry users to access it and, in the long run, to buy their own.

4. PROJECT MANAGEMENT

4.1. MANAGEMENT

4.1.1 RELEVANT EXPERIENCE OF THE PROJECT COORDINATOR

Michel Beaudouin-Lafon is Professor of Computer Science « *Classe exceptionnelle* » at Université Paris-Sud and is spending a year as visiting professor at Stanford University. He was director of LRI, the laboratory for computer science joint between Université Paris-Sud and CNRS, from 2002 to 2009. With close to 300 faculty, staff and Ph.D. students, LRI is one of the leading French labs and a founding member of Digiteo.

Michel has worked in human-computer interaction (HCI) for over 20 years and was elected to the ACM SIGCHI Academy in 2006. His research interests include fundamental aspects of interaction, engineering of interactive systems, computer-supported cooperative work and novel interaction techniques. His current research is conducted in the In Situ group, a joint lab between LRI and INRIA. He has advised twenty Ph.D. students, twelve of whom have continued a research career. He is on the editorial board of three international journals (ACM TOCHI, IJHCS, JCSCW) and has sat on many program committees (especially ACM CHI, ACM UIST, ACM CSCW, INTERACT, AVI). He as chaired the ACM CHI and ACM UIST program committees and has chaired the ACM UIST and E-CSCW conferences. He is a member of the European Research Council (ERC) evaluation panel for Advanced Grants and has conducted numerous expertise both nationally and internationally. He founded AFIHM, the Francophone association for human-computer interaction, and was a member of the ACM Council and the ACM Publications Board from 2002 to 2008.

Michel has managed a dozen collaborative projects at the national and European levels. Recent ones include the InterLiving European project, which developed communication technologies for families, the INDIGO RNTL project and the iStar ANR project, which studied tools and architectures for advanced interactive systems, the Micromegas ACI project, which focused on the managements of massive familiar data, and the WILD Digiteo project, a unique platform featuring a 131 million pixel display for studying interaction with massive visualizations.

Selected publications

Selected among 130 publications including 2 books, 8 edited books or journal special issues, 18 book chapters, 7 journal articles, 41 articles in top international conferences.

1. T. Baudel & M. Beaudouin-Lafon, "CHARADE: Remote Control of Objects Using Free-Hand Gestures", *Communications of the ACM*, Vol 36, n° 7, July 1993, pp 28-35.
2. M. Beaudouin-Lafon (editor), *Computer-Supported Co-operative Work*, Trends in Software 7, John Wiley & Sons, 1999.
3. M. Beaudouin-Lafon, "Instrumental Interaction: an Interaction Model for Designing Post-WIMP User Interfaces", in *Proc. ACM Human Factors in Computing Systems* (CHI 2000), ACM Press, 2000, pp 446-453.
4. M. Beaudouin-Lafon & W.E. Mackay, "Prototyping Tools and Techniques", *Human Computer Interaction Handbook*, J.A. Jacko and A. Sears (eds), Lawrence Erlbaum Associates, 2002, pp 1006-1031.
5. Y. Guiard & M. Beaudouin-Lafon, "Target acquisition in multiscale electronic worlds", *International Journal of Human Computer Studies* (IJHCS), Elsevier, 61(6):875-905, Dec. 2004.

6. M. Beaudouin-Lafon, "Human-Computer Interaction", *Interactive Computation: The New Paradigm*, D. Goldin, S. Smolka, P. Wegner (eds), Springer, 2006, pp 227-254.
7. W. Mackay, C. Appert, M. Beaudouin-Lafon, O. Chapuis, Y. Du, J-D. Fekete, Y. Guiard, "Touchstone: Exploratory Design of Experiments", Proc. *ACM Human Factors in Computing Systems* (CHI'07), ACM Press, 2007, p 1425-1434.
8. C. Appert et M. Beaudouin-Lafon, "SwingStates: adding state machines to Java and the Swing toolkit". *Software: Practice and Experience*, 38(11):1149-1182.

4.1.2 COORDINATION MODALITIES

DIGISCOPE will be managed by an executive and operational structure organized as follows:

- A Steering Committee;
- A Program Committee;
- A Support and Development Committee;
- An Advisory Board;
- A Users Group;

The *Steering Committee* will have one member per partner institution. It will meet two to four times a year for strategic decisions, including budget allocation and validation of the work program proposed by the Program Committee. It will be chaired by the DIGISCOPE President.

The *Program Committee* will have one member per partner laboratory or research group (depending on their sizes). It will meet every six weeks to two months to oversee the activities. The Program Committee will issue an open call for projects, which can include internal as well as external partners. It will assess and select the proposals, present them to the Steering Committee, and monitor those that will be selected. The goal is to encourage projects that involve at least two DIGISCOPE partners or a DIGISCOPE partner and an external partner, and that require the collaborative use of two or more DIGISCOPE nodes. Of course, projects involving a single partner and/or a single node will also be considered. The goal is that collaborative projects and multi-node projects will represent, in the long run, more than 60% of the time of use of the equipment.

The *Support and Development Committee* will have one member per DIGISCOPE node. It will meet every month to report on progress on the development tasks, to ensure proper coordination and resource sharing among the nodes, and to report any operational problem. It will also be responsible for managing the reservations of the nodes. It will report to the Program Committee.

The *Advisory Board* will be an international group of 6 to 12 prestigious academic and industry representatives. It will meet once a year to visit the project, assess it and provide advice to the Steering Committee.

The *Users Group* will gather all the internal and external users of DIGISCOPE. It will be open to academic institutions as well as corporations and companies. By joining the Users Group, a participant will be able to join projects and to access the equipment. External members will have to either pay for access or to commit to provide DIGISCOPE with some resources such as manpower, datasets, software licenses, etc. The Program Committee will decide of the

conditions for access. A preliminary analysis of the cost-of-use leads to a rental price in the 1000€ - 2000€ range per half-day. In the long run, the goal is that the nodes are used by external partners at least 30% of the time. A number of industry partners, including Orange Labs, Microsoft, Dassault Aviation and Teratec have already expressed their interest in joining the DIGISCOP Users Group: their letters of support are included in Appendix 6.5.

4.2. COLLABORATION ORGANIZATION

4.2.1 PARTNERS DESCRIPTION , RELEVANCE AND COMPLEMENTARITY

FCS Digiteo-Triangle de la Physique

The « Fondation de Coopération Scientifique Digiteo-triangle de la Physique » is the legal entity for two research networks, Digiteo and Triangle de la Physique, created by nine research and education institutions of the Saclay area with the support of the government in 2007. This Foundation is going to be expanded to include all the institutions involved in the creation of the Saclay Campus (with the name "Paris-Saclay foundation").

The Digiteo network is dedicated to software intensive systems and the main themes of the scientific program include

- Interactions, visualization and virtual reality,
- Decision and control systems,
- Sensing systems,
- Computing systems,
- Modelling and simulation,
- Software: models, safety and security, data and knowledge engineering.

The aim of the network is to strengthen the scientific potential of the Saclay area by organizing joint actions: selected joint research projects, chairs, and fellowships. It also organizes a specific innovation scheme through "maturation projects" to accelerate the transfer from research to market. All the DIGISCOPE partners are founding or associate members of Digiteo, which is therefore the natural framework to organize DIGISCOPE.

LRI / Université Paris-Sud

LRI (Laboratoire de Recherche en Informatique) is the Laboratory for Computer Science at Université Paris-Sud, joint with CNRS. LRI consists of 300 people, including 100 faculty and 125 PhD students. It is organized in twelve research groups, eight of which are joint with INRIA Saclay – Île-de-France. The research themes addressed by LRI cover a wide spectrum of computer science ranging from fundamental to applied research: algorithms, complexity, quantum computing, graph theory, combinatorial optimization, clusters and grids, software engineering, programming, human-computer interaction, databases, inference systems, data mining, machine learning, bioinformatics.

InSitu (http://insitu.lri.fr) is a joint research group between LRI and INRIA Saclay, specializing in human-computer interaction. Its research themes include the study of novel interaction techniques, multidisciplinary design methods, and engineering of interactive systems. InSitu has a worldwide visibility, with many publications in the top conferences (CHI, UIST) and several members very active in the evaluation and management of research at the international level. InSitu spearheaded the WILD project, which will become one of the

DIGISCOPE nodes. It will bring to the project its expertise in pointing and navigation methods for large displays, participatory design techniques for working with extreme users, and advanced user interface toolkits such as Metisse for windowing, ZVTM for zoomable interfaces and Substance for multi-surface interaction.

LIMSI-CNRS

LIMSI is a CNRS laboratory (UPR 3251) associated with Paris-6 and Paris-11 (Paris-Sud0 Universities. The laboratory accommodates approximately 120 permanent personnel (researchers, professors and assistant professors, engineers, technicians) and about sixty PhD candidates. It undertakes multidisciplinary research in Mechanical and Chemical Engineering and in Sciences and Technologies for Information and Communication.

The research activities of LIMSI in Virtual and Augmented Reality (V&AR) is supported by the **VENISE** group (http://www.limsi.fr/venise) whose mains topics are: (i) Distributed architectures and cluster solutions for V&AR systems; (ii) Multimodal interaction in Virtual Environments, to combine 3D tracking with speech and gesture recognition processes, as well as to supervise the distribution of information on several modalities conveyed through Visual, Haptic and 3D audio channels; (iii) Advanced researches on sensory-motor rendering channels, with Photo realistic visual rendering, Haptic interaction and 3D audio expertises; (iv) Matching Real and Virtual worlds, to develop new paradigms and algorithms for Augmented Reality, Augmented Virtuality, and Mixed Reality applications; (v) Paradigms and metaphors for navigation control and collaborative interactions in Virtual Environments.

VENISE is or has been involved in numerous projects. At the regional level, it leads the DIGITEO project "SIMCoD" on Collaborative and Multimodal Immersive Virtual Environments (partners: CEA-LIST and IEF-Univ. Paris-Sud). At the national level, it was a partner in the RNTL "Perf-RV" platform and the ANR-RNTL "Perf-RV2" project, which led to a collaboration with PSA Peugeot Citroën. VENISE was the leader of the ANR-ARA "CoRSAIRe" project (partners: IRCAM, EBGM, Univ. Paris-Descartes and Haption SA) on immersive and multi-sensory exploration of large scientific data sets (from CFD and Bioinformatics applications). VENISE is a partner in the ANR-White Program "EVEILS" on designing Virtual Spaces for Scientific Exploration and Education. At the international level, it was the lead partner for several CNRS labs in the European Network of Excellence INTUITION (vIrtual reality aNd virTUal environments applIcaTIONs for future workspaces) funded by FP6. Finally, VENISE is a founding member of AFRV and EuroVR, the national and European associations for the promotion of Virtual and Augmented Reality.

Beyond VENISE, three other LIMSI groups are involved in DIGISCOPE for their respective expertises, namely: (i) the **AA** group for its research in 3D audio rendering, (ii) the **AMI** group for its research in "Virtual Humans", (iii) the **CPU** group for its research in Ergonomics for collaborative tasks.

INRIA-Saclay

INRIA (Institut National de Recherche en Informatique et en Automatique, National Institute for Research in Computer Science and Control) is a French national research institution focusing on computer science, control theory and applied mathematics. INRIA has 204 research teams distributed across 8 research centers. The two INRIA research teams involved in DIGISCOPE are In Situ and Aviz, from the Saclay - Île de France research center. In Situ is also a team of Université Paris-Sud and has been presented in the section above.

Aviz (http://www.aviz.fr) is a multidisciplinary research team of about 10 people that seeks to improve analysis and visualization of large, complex datasets by studying new interactive visualization methods and tools. The overall goal of this research is to support human abilities to perceive, understand, and act on abstract information, in order to gain competitive advantage from the exponential growth of information and the increase in its availability. Aviz is a leading research team in the domain of interactive information visualization, with regular publications to the top international conferences in the domain (IEEE Infovis, ACM CHI) and a continuous involvement in their organization.

CEA-LIST

The CEA LIST Institute focuses on R&D programs for digital systems. Located on the Saclay Campus, LIST gathers over 650 researchers, engineers and technicians on topics with high economic and societal significance: Interactive Systems (including Virtual Reality or VR), Embedded Systems, and Sensors and Signal Processing. Its activities range from concepts to pre-industrial prototypes according to technology roadmaps shared with its industrial partners. The LIST VR team designs and develops software components dedicated to the interactive simulation of physical phenomena, often involving virtual humans, and always answering industrial needs. The addressed topics are:

- Interactive mechanical simulation of rigid bodies, multi-bidy systems and deformable objects (collision detection and numerical solver), as well as simulation of other physical phenomena, such as fluid mechanics;
- Motion-captured controlled and/or autonomous virtual manikins featuring realistic behaviors and interacting with their environment;
- Interaction (vision, sound, haptics, metaphors, etc.) with a special emphasis on collaborative work (exemplified in the SIMCOD project with LIMSI).

CEA LIST mainly targets transport, security, energy and construction domains through applications dealing with virtual prototyping, human factor validation, preparation of intervention scenarios (urban areas, nuclear or Seveso plants, …) and training.

LTCI – Institut Télécom / Télécom ParisTech

Institut Télécom/Télécom ParisTech is one of France's leading centers of higher education and research in the field of Information Technologies. The LTCI research lab has more than 150 full-time staff members (full professors, associate and assistant professors), 30 full-time researchers from CNRS and 300 PhD students. LTCI research fields include computer science and networks, digital communications, electronics, signal and image processing, economics and social sciences.

The DIGISCOPE equipment will be extremely useful to several research teams at LTCI:

- INFRES/IC2, which works on novel interaction techniques and principles (with a focus on touch-sensitive surfaces and novel physical devices), information visualization, decision-support systems and crisis management (which require large-scale interactive data mining methods) – see http://www.telecom-paristech.fr/~via;
- ESS/HSS, a Social Sciences team working on telepresence videoconferencing and remote collaborative design;
- TSI/TII, which works in geometric modeling, virtual reality and image synthesis. DIGISCOPE will be used, in particular, for image processing and understanding of huge volume of data such as medical images, satellite images and 3D objects and meshes;

- TSI/MM, which works on real-time embodied conversational agents in collaboration with LIMSI.

Finally, LCTI is part of three joint laboratories with industrial partners with direct interest in DIGISCOPE: WHIST (with Orange Labs), BILAB (with EDF R&D) and UBIMEDIA (with Alcatel-Lucent Bell Labs).

Ecole Centrale Paris (ECP)

Ecole Centrale de Paris (ECP), founded in 1829, is one of France's premier Engineering Grandes Ecoles. ECP, in conjunction with Supelec, undertakes rapid development of both research and education activities in modeling and simulation of complex systems. Advanced interactive and collaborative visualization is a key aspect of this work, especially as multi-disciplinary research and collaborative engineering and design becomes pervasive. This can only be undertaken in a close network with top research facilities such as the Saclay Campus. ECP is particularly interested in DIGISCOPE for educational projects and activities to channel engineers, Master or PhD students into advanced visualization, in close connection with industrial and academic partners. It is also interested in using this advanced visualization/interaction infrastructure to create a collaborative network around modeling, simulation and industrial design research projects.

Associated ECP departments and labs include:

- Maths, TISA/Computer Science, Industrial Engineering, M2S Master, for education;
- MAS, EM2C, MSS-MAT, LGI Labs for research (~ 300 people);
- Supelec E3S research team;
- Space plasma physics and physics of planetary atmospheres: 25 scientists open to an international community, including collaborative projects using virtuality concepts with Japanese laboratories.

The MAS Lab at ECP mainly deals with mathematical and computing tools and methods for the analysis, design and exploitation of complex systems. It is structured around projects, including Scientific Engineering and Visualization, Information Processing and Information Systems.

MSSMAT and EM2S Labs are both co-affiliated with CNRS and ECP. Research at MSSMAT is focused on multi-scale advanced structural and soil mechanics and material science. Research at EM2C tackles energy science in multi-physics and multi-scale experimental and numerical approaches around combustion, out-of-equilibrium plasmas and transfer physics.

Université Versailles Saint-Quentin (UVSQ)

The participation of UVSQ in DIGISCOPE will be federated by the Observatory of the Versailles-Saint Quentin University (OVSQ) on its Guyancourt campus. The OVSQ hosts 4 laboratories : LATMOS (Laboratoire ATmosphere, Milieux, Observations Spatiales), LSCE (Laboratoire des Sciences du Climat et de l'Environnement), REEDS (Recherches en Economie-Ecologie, Eco-innovation et Ingénierie du Développement Soutenable) and IFREA (Institut Français des Recherches et des Etudes Arctiques), gathering more than 400 scientists, engineers, administration staff, PhD students, post-docs and visiting scientists. LATMOS (UMR 8190), UVSQ/CNRS, (144 permanent staff, 27 PhD students) and REEDS (EA 4456), UVSQ/IRD (35 permanent staff, 25 PhD students) are the partners Laboratories in DIGISCOPE.

LATMOS is a key laboratory, in France, for the observation of Atmospheric processes for the Earth and planets. Beside a strong instrumental and observational activity using ground, airborne and spatial instruments, it develops a significant activity in modeling in three major fields: modeling of mesoscale atmospheric processes, modeling of the interaction between the solar wind and planetary atmospheres and exospheres, modeling of plasma processes that develop in the solar system.

REEDS is dedicated to research on socio-economic and ecological systems. It studies their dynamics, their changes and their interactions, taking into account the societal processes involved in making choices and taking decisions. For the past ten years, REEDS has conducted research in the field of new multimedia interfaces for scientists, decision makers, industry and citizens, and on the use of NTIC as new efficient tools for exchanges between stakeholders in sustainable development, learning and education. Sophisticated visual representations using wall displays and remote collaboration enabled by a network of such walls are key tools for these studies.

Twenty-five years ago, LATMOS and Ecole Polytechnique started an interdisciplinary Masters on mathematical methods for simulation and applications in physics (MMSAP). It still exists today under the name "Master for Modeling and simulation" (M2S). It is led by both UVSQ and INSTN – National Institute for Nuclear Science and Technology, in partnership with ECP, ENS-Cachan and ENSTA.

The involvement of OVSQ in DIGISCOPE will consist in three areas:

- Education, through the M2S Masters, for training graduate students with the most advanced facilities for the analysis of simulations;
- New techniques for the simulation of space plasmas (LATMOS);
- The use of TIC by communities for learning, training, analyzing and deliberating (REEDS).

Institut Farman / ENS Cachan

The École Normale Supérieure de Cachan is a prestigious public institution of higher education and research founded in 1912. The **Farman Institute** was founded in December 2006 by combining the expertise of five research laboratories on the campus of the ENS Cachan in the field of modeling, simulation and validation of complex systems. Research conducted by our laboratories, often in cooperation with common industrial partners, model, control and optimize complex physical systems and software using complementary tools of analysis.

The Farman Institute initiates and supports multidisciplinary research projects for a fixed term, which address issues at scientific and technological interfaces of complex systems. This multidisciplinary collaboration aims specifically to provide a comprehensive and unified approach to some technological barriers identified by our industrial and institutional partners. Laboratories five of the Farman Institute are:

- Centre de Mathématiques et de Leurs Applications (CMLA), UMR CNRS 8536.
- Laboratoire de Mécanique et de Technologie (LMT), UMR CNRS 8535,
- Laboratoire Spécification et Vérification (LSV), UMR CNRS 8643,
- Laboratoire Universitaire de Recherche en Production Automatisée (LURPA), EA 1385,
- Laboratoire Systèmes et Applications des Technologies de l'Information et de l'Energie (SATIE), UMR CNRS 8029.

CMLA will be the lead laboratory in DIGISCOPE. It brings together 35 researchers, 30 PhD students, 12 postdocs or research lecturers, 7 technical and administrative staff. The specificity of the CMLA lies in the multidisciplinarity of its members and in the effective aspect of the work done in an industrial context. Modeling and numerical simulation play a role at least as important as mathematical analysis. Any new phenomenon of nature, technology or mind, is an opportunity for the CMLA's researchers to develop mathematical models, then to simulate on a computer and finally to achieve a practical application. The mathematical techniques developed and used come from many areas: PDEs, probabilities and statistics of course, but also from classical analysis, geometry, algorithmics, and so on. The policy of the CMLA is to conduct high-level theoretical research while remaining close to the needs of industry without hesitating to explore the complexity of phenomena and to move away from academic models. Two major research themes emerge in the CMLA. The first one is the scientific computation for partial differential equations used in physics and in fluid mechanics and the other one is the processing and analysis of signals and images.

Maison de la Simulation

With the fast spreading of large computing centers at both the national and European levels, the French research community now has access to a world leading computing infrastructure. Such an infrastructure should foster major advances in both fundamental research and technology. Nevertheless, in order to meet these goals, it is necessary to develop applications software adapted to a very high degree of parallelism. These high-end applications can only be developed by gathering multidisciplinary teams, composed of HPC engineers, software and application specialists. For this reason, the Maison de la Simulation was created under the joint impulsion of CEA and CNRS. Its main goal is to promote the efficient use by the scientific community of the available computing infrastructure. For that purpose, the Maison de la Simulation is developing along three main axes:

- A multidisciplinary research centre dedicated to numerical simulation;
- A service and expertise centre open to the scientific community;
- A nerve centre for education and scientific animation.

With the power of supercomputers increasing exponentially, the simulation of complex systems at higher spatial and temporal resolution produces very large and complex datasets. The analysis, exploration and proper understanding of these datasets is a major issue. Visualization tools should transform complex datasets into readily understandable images; they should also allow easy exploration and the discovery of regions of particular physical interest. For this purpose, stereoscopic display and multi-windowing, which allow visualizing simultaneously several physical properties of the same region, are particularly useful especially if they can be used in a collaborative manner.

The members of Maison de la Simulation have a long experience in scientific visualization. They have developed high performance visualization tools, especially for stereoscopic vision. These tools have been used by many scientists and have contributed to numerous publications. One of their stereoscopic movies was shown for 6 months at two science museums in Paris, *Palais de la Découverte* and *Cité des Sciences*. The laboratories working with the Maison de la Simulation that will benefit from the visualization platform span a wide range of scientific areas: Climate science, Material science, Astrophysics, Plasmas physics and fusion science.

Added value of the partnership

DIGISCOPE requires multi-disciplinary expertise in each of three research areas: *human-computer interaction* (including visualization and computer-supported cooperative work), *virtual reality*, and *modeling and simulation*. The partners in the project are internationally recognized experts in these areas and have a long history of collaboration, both as active participants in the Digiteo research network and through diverse research and teaching activities over the past decade.

InSitu, AVIZ and LIMSI created the WILD display wall, which will become one of the DIGISCOPE nodes, and started a new Masters in Human-Computer Interaction at Université Paris-Sud. LIMSI and AVIZ are collaborating through the Digiteo Chair created for Tobias Isenberg on the topic of scientific visualization. AVIZ was created as a spin-off of InSitu and the groups share interests in information visualization and advanced interaction techniques. AVIZ collaborates with ECP on information visualization. InSitu, AVIZ and LTCI have exchanged several Ph.D. students and post-docs and share a common interest in advanced interaction techniques, information visualization and engineering of interactive systems. LIMSI and CEA-LIST have participated in a number of collaborative projects, in particular SimCOD (2007-2011), which deals with collaborative virtual environments. LTCI and LIMSI collaborate on virtual humans and embodied conversational agents. The on-going CSDL (Complex Systems Design Lab - Pôle System@tic) project involves a tight multi-year collaboration between ECP, ENS Cachan, UVSQ and INRIA as well as many other Saclay-based companies and academics in visualization and high-performance computing of large industrial modeling & simulation. LISMI and EM2C have a long-standing collaboration in computational fluid dynamics and related modeling and design. UVSQ, ECP and ENS Cachan participate in the M2S Masters on modeling and simulation.

The creation of nine separate nodes will enable the partners to take advantage of their specific expertise as they explore how best to develop specific techniques for individual users of their nodes. They will be able to compare and contrast their 'lessons learned' with those of the other partners, who will find alternative solutions to related problems. However, the primary added value of the partnership will be the combined expertise of the partners, who have already demonstrated their ability to work together productively on multi-disciplinary research projects: DIGISCOPE will enable them to reach the critical mass necessary for true innovation and breakthroughs. The large number of nodes will offer a sufficiently large infrastructure to create network effects, providing early exposure to the key challenges inherent in distributing highly interactive, high-performance, large-scale visualization.

The telepresence infrastructure will be both a research topic in its own right and a major tool for helping the partners to work more closely together, offering more rapid feedback loops and high levels of inter-group interaction. DIGISCOPE will provide a productive environment in which partners and users will find it natural to meet and work at a distance: the goal is for DIGISCOPE to become embedded in the fabric of their everyday work. This highlights another important advantage of the partnership, i.e. the collaboration between the designers and developers of the DIGISCOPE technology with users of these technologies. For example, researchers who specialize in visualization and computer-supported cooperative work require complex, real-world examples that push the boundaries of the field. At the same time, scientists and those in industry who produce and analyze large datasets will benefit from the advanced interaction and visualization techniques that the former can offer. By working together over time, each will provide the other added input

and incentives to create better methods for exploring simulation data and interacting with the data in real-time.

The collective portfolio of application domains, including computational fluid dynamics, biomedical imaging, industrial design, and mechanical simulation will provide a rich set of case studies for all partners. The extensive network of collaborators of the partners, in both academia and industry, will also provide access to "extreme" users who push the limits of technology and are motivated by the problem they are trying to solve rather than the technology that may solve it. This will lead to innovative use of technology and a source of innovation in the design process.

4.2.2 QUALIFICATION, ROLE AND INVOLVEMENT OF INDIVIDUAL PARTNERS

Partenaire/ Partner	Nom/Surname	Prénom/First name	Poste/Position	Discipline/Domain	Organisme de rattachement /Organization	Rôle dans le projet / Contribution in the project
LRI / Université Paris-Sud						
LRI	BEAUDOUIN-LAFON	Michel	Professor	Human-computer interaction, computer-supported cooperative work	Université Paris-Sud	Project manager
LRI	HUOT	Stéphane	Maître de Conférences	Human-computer interaction, mobile interaction	Université Paris-Sud	Node manager for WILD
LRI	CHAPUIS	Olivier	Chargé de Recherche	Human-computer interaction,	CNRS	Interaaction techniques and distributed windowing
LIMSI-CNRS						
LIMSI	BOURDOT	Patrick	Researcher, head of the VENISE group	Virtual & Augmented Reality, Multimodal, sensory-motor & col-laborative immersion	CNRS	Virtual Reality / Product Life-Cycle Managament applications
LIMSI	KATZ	Brian	Researcher, AA group	3D audio	CNRS	3D audio rendering
LIMSI	MARTIN	Jean-Claude	Professor, AMI group	Multimodal user interfaces, Virtual Humans	Université Paris Sud	Multimodal interaction, Conversational agents
LIMSI	DARSES	Françoise	Professor, head of the CPU group	Ergonomics	Université Paris-Sud	Ergonomics
CEA-LIST						
LIST	CHODORGE	Laurent	Lab manager	Virtual Reality	CEA	Management of the CEA-LIST node
LIST	ANDRIOT	Claude	Senior Researcher	Virtual Reality	CEA	Scientific management
INRIA Saclay						
INRIA	MACKAY	Wendy	Senior Researcher, head of InSitu group	Human-computer interaction	INRIA	Participatory design, Mediated communication

INRIA	PIETRIGA	Emmanuel	Researcher	Human-computer interaction	INRIA	Node manager for WILDER
INRIA	TSANDILAS	Fanis	Researcher	Human-computer interaction	INRIA	Interaction techniques
INRIA	FEKETE	Jean-Daniel	Senior Researcher, head of AVIZ group	Visual Analytics, Information visualization, Human-computer interaction	INRIA	Fab Lab, Visual Analytics and InfoViz systems
INRIA	DRAGICEVIC	Pierre	Researcher	Visual Analytics, Information visualization, Human-computer interaction	INRIA	Fab Lab, Visual Analytics and InfoViz systems
INRIA	ISENBERG	Petra	Researcher	Visual Analytics, Information visualization, Human-computer interaction	INRIA	collaborative Information Visualization systems
LTCI - Institut Télécom / Télécom ParisTech						
LTCI	LECOLINET	Eric	Assistant Professor	HCI, Interaction techniques, Information visualization	Institut Telecom (INFRES / IC2)	Coordinator for LTCI, Interactive techniques for large displays, FabLab
LTCI	ROSSI	Fabrice	Professor	Decision-support systems, business intelligence, data mining	Institut Telecom (INFRES / IC2)	Large-scale interactive data mining methods
LTCI	DETIENNE	Francoise	Researcher director	Psychology, Egonomics, CSCW	CNRS (SES / SHS)	Mediated collaboration in realistic contexts
LTCI	BLOCH	Isabelle	Professor, head of the TII team	Image processing & understanding, medical imaging	Institut Telecom (TSI / TII)	Understanding of medical images
LTCI	PELACHAUD	Catherine	Researcher DR CNRS	Embodied Conversational Agent, Affective Computing	CNRS (TSI / MM)	Interactions with real-time embodied conversational agents
Ecole Centrale de Paris						
ECP	DEROCQUIGNY	Etienne	Professor, Director MAS Lab	Risk and uncertainty modeling, model-based design and decision-making	ECP/MAS	Coordinator for Ecole Centrale
ECP	BEZERIANOS	Anastasia	Assistant Professor	Interaction and visualization design / large datasets & display	ECP/MAS	Pilot of use cases on education, Model-based design hub
ECP	PARAGIOS	Nikos	Professor	Vision, biomedical imaging	ECP/MAS	Pilot of use case on computer-assisted surgery
ECP	GICQUEL	Olivier	Professor, Department Head "Energy"	Combustion and advanced multi-physical CFD	ECP/EM2C	Pilot of use case on visualization for 3D combustion design
ECP	AUBIN	Véronique	Professor	Material science	ECP/ MSSMAT	Pilot of use-case on 3D visualization of fatigue crack

						simulation
Université Versailles Saint-Quentin/OVSQ						
OVSQ	LEMBERGE	Bertrand	Research Director	Plasma physics, numerical simulation.	UVSQ/OVSQ /LATMOS	UVSQ coordinator, Virtual Reality in space plasma physics.
OVSQ	BOUKHEDDADEN	Kamel	Professor	Spijntronics	UVSQ-GEMAC	M2S co-manager for UVSQ (physics)
OVSQ	HORSIN	Thierry	Assistant Professor	Scientific computering, nulerical analysis.	UVSQ laboratory of mathematics	M2S co-manager for UVSQ (mathematics)
OVSQ	O'CONNOR	Martin	Professor	Soclai Sciences on communication and cognitive sciences.	UVSQ/OVSQ /REEDS	New medias for decision making
Institut Farman / ENS Cachan						
Institut Farman	DE VUYST	Florian	Professor	Numerical Analysis Scientific Computing Reduced order models	ENS – CMLA	Coordinator, Real time simulation & visualization, data-model fusion
Institut Farman	MOREL	Jean-Michel	Professor	Image Processing (ERC "Twelve Labour" Grant)	ENS –CMLA	Image processing applications
Institut Farman	REY	Christian	Professor, Director of the Farman Institute	Computational Mechanics, Fast solvers, Reduced-order models	ENS – LMT	Cordination with HPC facilities and HPC projects
Institut Farman	LABOURDETTE	Christophe	Research engineer	Numerical simulation, software engineering	ENS – CMLA	R&D, specific code development
Institut Farman	VAYATIS	Nicolas	Professor	Statistics, data mining, complex systems	ENS – CMLA	Data exploration, interactive data analysis, dashboard
Maison de la Simulation						
Maison de la Simulation	AUDIT	Edouard	Professor	Astrophysics/HPC	CEA-DSM	Coordinator for the Maison de la Simulation
Maison de la Simulation	POMARÈDE	Daniel	engineer	Visualisation	CEA-DSM	Visualisation software development
Maison de la Simulation	THOORIS	Bruno	engineer	Visualisation / HPC	CEA-DSM	User support

5. FINANCIAL ASSESSMENT

The total cost of DIGISCOPE is evaluated at 12.4 M€ for the initial investment, which is spread over three years, and 10 M€ for operating the equipment over the next seven years. The funding we are asking from EQUIPEX is 50% of the investment (6.2 M€) and 10% of the operating cost (1 M€).

Maintenance costs are kept to a minimum. Full maintenance of the equipment over the whole period would cost a lot more than the initial investment. Instead, we include a 3-year

warranty in the acquisition cost, when possible, and provision 100k€ per year after this initial period to cover maintenance costs, to be funded by EQUIPEX. This provision will be used to repair or replace equipment as they fail. Some partners will cover recurring maintenance costs for the equipment they consider critical, for a total amount of 1M€. Note that this strategy takes advantage of the inherent redundancy in the project: with 9 nodes and at least 2 nodes of each type, it is easy to use a different node in case of equipment failure until it is fixed.

Manpower is a significant part of the investment cost. This manpower will be used to create the software running the equipment. Indeed, while we can use off-the-shelf hardware, we need dedicated software to get the full potential of the equipment. 339 man-months are budgeted for this development effort, i.e. 9.4 man-years for each of the three years of the initial development. We are asking EQUIPEX to fund 108 man-months of this effort, i.e. about 30%.

Manpower for operating the equipment will be provided by the partners. Each of them has committed resources to that end for a total of 730 man-months, including management of the project, maintenance and operation of the equipment, and additional software development. This represents 8.7 man-years for each year of the seven years of exploitation, or close to a full-time person for each node.

The other costs of the project include a small budget for travel, mostly to visit sites outside DIGISCOPE and communicate about the project, some consumables, and some off-the-shelf software, for a total of about 500k€, i.e. less than 2.5 % of the total cost.

The rest of this section describes the individual elements of the equipment in more detail. Quotes obtained from vendors are included in the appendix. Note that the prices reported in the rest of this section include VAT (19.6%), while most quotes do not. Note also that because of the limit set on the overall size of this document, we could not include all the quotes we have received. They are available upon request through ANR.

- *Elément 1/ Element 1 : Telepresence equipment and FabLab*

Two components of DIGISCOPE will be available to all the partners: a telepresence system interconnecting all the nodes, and a fabrication lab (FabLab) to create dedicated devices.

Telepresence

In order to support remote collaboration among DIGISCOPE nodes, a high-performance telepresence system will be deployed. Dedicated digital audio/video servers, codecs, and multiplexers will be deployed at the main location of the equipment (Digiteo-Moulon building) and each node will have a terminal (65" flat display with HD camera and audio system – see fig. 6). This will allow users of two or more DIGISCOPE nodes to hear and see each other while sharing data on their respective visualization surfaces. It will also be possible to display these video feeds on the shared surface itself, and to experiment with even more immersive forms of telepresence. The telepresence system and collaboration facilities will use the high-speed networks already installed on the Plateau de Saclay and available to the partners. Note that each of the nodes described below includes a telepresence terminal even though it is not explicitly mentioned in the descriptions.

Fig. 6: telepresence terminal (Polycom)

Price estimates for the telepresence system were given by Tandberg and COMIRIS (see quotes in the appendix). Tandberg is a major supplier of telepresence systems (and now a subsidiary of CISCO) and COMIRIS specializes in installing telepresence systems in large organizations. Both insist that accurate pricing can only be done after visiting each facility in order to take into account the installation costs. These estimates lead us to allocate about 370k€ for the infrastructure and 770k€ for the terminals, to be funded by EQUIPEX.

FabLab

DIGISCOPE will feature a fabrication lab (FabLab) accessible to all the partners. It will provide the necessary facilities to create new hardware for interaction devices.

Originally invented in the Media Lab at MIT, Fab Labs (short for Fabrication Laboratory) are small-scale workshops meant to build computed-enhanced devices such as new types of input devices for interaction[18]. A Fab Lab provides all the support tools and machines to the researchers and students to rapidly build these devices and test different variations. This includes the electric, electronic and mechanical parts as well as the physical materials, either hard such as plastic or soft such as fabric.

There are currently two Fab Labs in France, one in Paris (usinette.org) and one in Toulouse (Artilect Fab Lab). Netherlands has four Fab Labs. United Kingdom, Island, Norway, Spain, each have one or two each[19]. Fab Labs used in the field of Human-Computer Interaction typically feature a 3D printer, a laser cutter and a circuit-board plotter, in addition to the tools commonly available in a standard electronic workshop. The DIGISCOPE FabLab is priced at 107k€ based on the estimates received from several vendors (see the appendix for the most expensive machines: 3D printer, circuit printer).

Detailed List of Equipment

The Fab Lab will be hosted in a 30m^2 room located at the PCRI building on the Saclay Campus and will be later moved to the Digiteo-Moulon building. The equipement will consist in:

- Building Machines

[18] See http://fab.cba.mit.edu/about/charter/ for a charter
[19] Source: http://fr.wikipedia.org/wiki/Fab_lab

  - 3D Printer: a machine that produces objects from a computer model by extruding small beads of thermoplastic material to form layers as the material hardens immediately after extrusion. A 3D printer is typically used for rapid prototyping and proof-of-concept modeling.
  - Laser Cutter: a machine that cuts 2-dimensional shapes from most non-metals and is also able to engrave and etch metals and glass. Typically used for rapidly creating parts and device casings.
  - PCB Mill: for plotting electronic circuits.
  - Embroidering Machine: for embroidering electronic circuits into fabrics (e.g., in wearable computing).
- Tools
  - Multi-channel laboratory power supply
  - Oscilloscope
  - Soldering station
  - An SMT (surface-mounted technology) pick and place table
  - An SMT oven
  - Electronic toolset
- Supply
  - assortment of passive and active components (resistors, capacitors, transistors, ICs, wires, LEDs)
  - Soldering supplies
  - Circuit board supplies
  - Arduino boards
- Furniture
  - Modular workshop

- *Elément 2/ Element 2 : Two ultra high-resolution walls at LRI & INRIA Saclay*

The WILD platform already installed at LRI will be moved to the new PCRI building by the end of 2010. WILD consists of a 130 million pixel wall (32 monitors with a resolution of 2560 x 1600, 30" diagonal for a total size of 5m50 x 1m80), an 18-computer visualization cluster running custom software, a VICON motion tracking system and an interactive multitouch table. To date, it is the largest ultra-high resolution *interactive* wall in the world and represents a 320k€ investment. WILD will be turned into a DIGISCOPE node by adding a videoconferencing system. This node will be dedicated to research in interaction and visualization in local as well as remote collaboration settings.

A second node, WILDER, will feature similar technology. It will be installed in the Digiteo Moulon building, next to the PCRI building. This building is currently under construction and will open in early 2012. This node will be dedicated to external users from both academia and industry. Its proximity with WILD will make it easy to transfer the research results to real users and applications. In addition, the proximity with the immersive CEA LIST node (see below), which will be in the same building, will make it ideal for testing collaborative scenarios across heterogeneous equipment. We estimate WILDER at 340k€ based on the cost of WILD, to be funded by EQUIPEX.

LRI will provide the equivalent of a half-time person for software development and operation of the platforms over the 10 years of the project, plus the management of the overall project and the WILD node. INRIA will provide two half-time persons for the whole duration of the project, plus management of the WILDER node.

Fig. 7 : the WILD wall display.

- *Elément 3/ Element 3 : Immersive VR room at LIMSI*

The existing EVE platform (Fig. 2) installed at LIMSI will be extended. EVE is a unique reconfigurable immersive Virtual Environment featuring multi-stereoscopy (2 sets of users) and accurate 3D sound rendering and acoustics (see Fig.). Not including the building, the existing infrastructure costs 1.1M€.

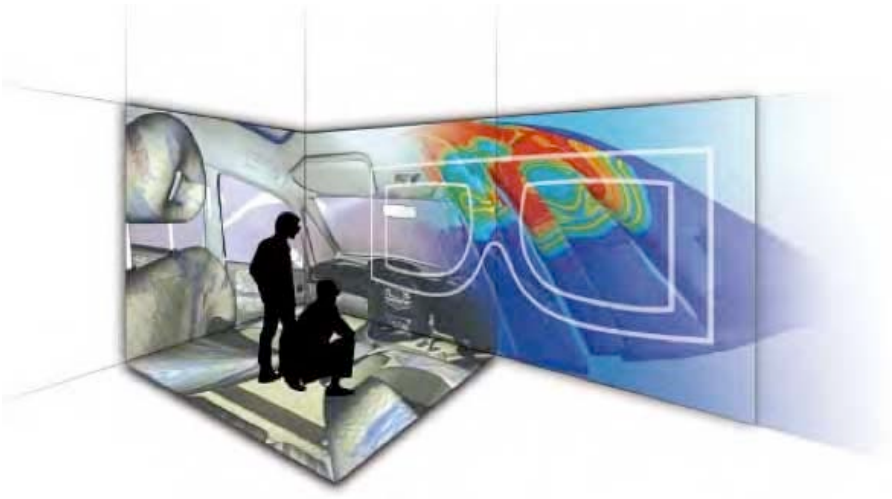

Fig. 8: Artist view of the EVE extension, here with the new wall in the flat configuration (BARCO)

It will be extended as follows (Fig. 8):

- A mobile screen (2.7m x 4.7 m) will be added to provide a more complete immersion in the CAVE-like system by "closing the box", as well as a large (7.5m wide) front screen by rotating this right side in the same plane as the existing frontal projection. Two DLP HD projectors providing double stereoscopy will power this new screen. The quote from BARCO for this system is 368k€ (see appendix);
- An extension of the haptic facilities of EVE, including: a second 6 DoF arm, an update of the existing one to put the two of them in the same position for two-handed force

feedback, and a mobile structure to move them easly within EVE system. The quote from HAPTION for this system, including software, is 332k€ (see appendix);
- Multi-user 3D audio facilities to improve the current audio installation: extra loudspeakers, and two sets of high-fidelity binaural headphones. The quote is 13k€ (available upon request).

Altogether, the cost of the EVE extension is 722k€, to be funded by EQUIPEX. LIMSI, on the other hand, will commit a total of 87 man-month to the project.

These equipments will allow a set of research project, such as:

1. Distant immersive collaborations between the EVE system of the CNRS-LIMSI (a reconfigurable and multi-sensorymotor Virtual Environment) and the CAVE-like system planned by CEA-LIST (see below);
2. Thanks to the double stereoscopy, comparing co-located immersive collaborations with distant ones with or without immersions;
3. Studying the role of haptics for collaboration:
    a. Bimanual interactions with other remote haptic facilities (cf. CEA node), or with none-immersive remotes facilities using pseudo-haptic paradigms (other DIGISCOPE nodes),
    b. Co-located haptic collaborative interactions with two users in the same immersive system.
4. Studying the add edvalue of 3D audio immersion for collaborative tasks:
    a. The extra loudspeakers will provide accurate sound rendering within the very large working space of EVE,
    b. The high-fidelity binaural headphones will support co-located as well as distant immersive collaborations.

- *Elément 4/ Element 4 : Immersive VR at CEA-LIST*

Synchronising haptic with vision and (to a lesser extent) sound, both spatially and temporally, is a difficult issue when dealing with a complex 3D environment. In particular, allowing a user to feel, see and hear a contact at exactly the same location and time is a crucial problem referred to as *collocated haptics*. If not properly addressed, it may spoil the benefits of haptic feedback, including all the currently considered ways of implementing it with low-cost tactile devices and/or haptic metaphors. The collocated haptic problem is also encountered, often in a more acute way, in synchronous collaborative work for both collocated and remote collaboration conditions: indeed, each user must consistently feel, see and hear what the others are doing, e.g., colliding with an object he is holding. At the moment, industrial VR applications feature good quality immersive display systems, and they often feature efficient dedicated haptic devices as well. But the combination of immersive displays and versatile haptics with accurate co-localisation is still missing.

CEA-LIST works on virtual prototyping and training applications, where the role of haptics is critical. The goal with this DIGISCOPE node is to support collocated haptics for collaborative heterogeneous interaction with a goal of millimeter accuracy. This requires:

- VR equipment conveying to the user the feeling of being immersed in the virtual environment (typically, to be able to touch the virtual objects). Since HMD (Helmet Mounted Display) technology is not mature enough to support working sessions of a reasonable duration (more than 30 minutes), stereoscopic projection display on several screens is required; 2 screens (front and floor) are an absolute minimum.

- A working area with dimensions matching the requirements for collocated collaborative work (for at least 3 users) and virtual environments of the size of a car interior, a part of an airplane fuselage or a factory working station. For these purposes, a reasonable specification is 4 m x 3 m x 3 m (width x length x height).
- High-resolution display with pixels of less than one millimeter size, at least for the front screen.
- Very accurate tracking of the human user positions, to know where they are and what they are doing. While the requirement is clearly for position tracking with sub-millimeter accuracy, no commercial product currently exists that matches this specification. This critical point thus justifies a significant effort to obtain the best possible performance.

The haptic devices will include state-of-the-art systems that are currently available at CEA-List (Virtuose 6D haptic arm and Inca 6D Spidar system), as well as two more exploratory devices:

- Low-cost vibro-tactile actuators integrated in a VR suit. Associated with accurate motion tracking and relevant visual and/or audio metaphors, these techniques may support efficient interactions for virtual tasks featuring assembling, manipulatiom and disassembling operations.
- An exoskeleton system addressing the user upper body (Fig. 9). It has the capability to generate haptic feedback for the user's arm and thus allows to simulate assembling and manipulation tasks with a very high level of realism. This system is based on the Able 5-DOF exoskeleton and a 4-axis carrier that extends the working area to the available immersive space.

Fig. 9: 5-ais exosquelton prototype (HAPTION)

CEA-LIST will contribute 610k€ for the funding of this node, including the haptic arms and the tracking system. The funding required from DIGISCOPE includes a 2-face immersive

visualization system with millimeter resolution on part of the front screen (771k€) and an exoskeleton + mobile carrier haptic system (200k€, see quotations in the appendix). The visualization system is based on a commercial product, but we expect at the time of purchase to switch to 4K projectors that should be available by then. Regarding the exoskeleton, the quotation covers the construction of a system that has been already designed for its most demanding components. CEA-LIST will contribute a total of 108 man-months to the project (24 for the development phase and 84 for the operational phase).

- *Elément 5/ Element 5 : Large multitouch surfaces at LTCI*

A large multitouch display wall will be installed in the new showroom of LTCI in its "Place d'Italie" expansion. This wall will consist of tiled "Multitouch Cell" displays (Fig. 10). MultiTouch Cells technology provides true multitouch capability for creating scalable display arrays. Each cell is a 46" multitouch-enabled HD LCD screen with a resolution of 1920x1080 pixel. Cells can be placed in horizontally, vertically or in any intermediate position, and can be combined to create larger screens. This technology is interesting because it is modular and reconfigurable, making it easy to use combinations of cells as parts of a multi-touch wall or table. Hence, while most cells will be permanently installed in the LTCI showroom to provide a large interactive wall display, we also plan to use some cells as interactive tabletops or small wall displays in other buildings in order to experiment with various collaboration patterns. This technology will also be used at ECP and UVSQ, thus allowing the partners to share expertise.

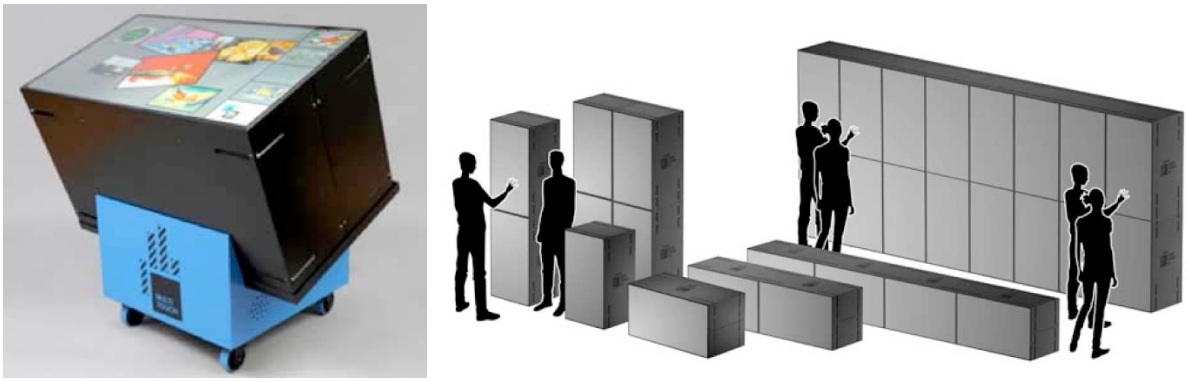

Fig. 10: Cell concept (MultiTouch)

The LTCI node will consist of:

- A configurable high-resolution display wall made of 12 multitouch 46" Cells (204k€, see quote in the appendix, which includes the tracking, visualization and applications servers needed to run the equipment);
- A VICON motion tracking system (84k€, see quote for the LRI WILD system);
- A compute server for visualization applications (24k€, see quote in the appendix).

Moreover LTCI will provide 40k€ worth of equipment:

- Air conditioning and appropriate networking infrastructure;
- An interactive tabletop, a touch-sensitive plasma display, an interactive whiteboard with a video projector;
- Various interactive devices such as smartphones, tablets, interactive remotes, etc.

LTCI will provide a half-time research engineer (half-time) for operating and maintaining the multitouch display system and a part-time research engineer in electronics and a part-time technical engineer (at least 3 monts / year each). The latter will help operate the FabLab.

- *Elément 6/ Element 6 : Dual multitouch wall at ECP*

ECP incorporates many labs and takes part in diverse projects that have different visualization and interaction needs. Similarly to LTCI, ECP requires a flexible interactive visualization platform for visualizing and interacting with data both using traditional visualization software, as well as dedicated in house software. To that end, it will set up a dual visualization system, one based on a high bandwidth distributed visualization (several high-end PCs driving 2 screens each) running dedicated in-house software, and one dedicated server visualization machine running traditional applications. This ECP node will also act as a platform for visualizing the results of intensive computations and simulations done on the ECP computational mesocentre.

High-resolution display wall (EQUIPEX funding):

- High-resolution multi-touch setup of 16 HD multi-touch surfaces, modular in configuration (265k€, see quote in the appendix);
- Frame for the screens;
- A dual visualization setup (10k€ for the computers plus $6 for the video switches):
  - setup for all 16 screens driven by a dedicated server (similar to LTCI), with an additional server driving 4 cells separately in order to support configurations with a secondary wall or a table;
  - distributed visualization setup similar to that driving the LRI WILD wall: 8 high-end machines driving two cells each;
- Motion-capture system (36€ for an OptiTrak system, quote available upon request);
- Air-conditioning (30k€, estimate);
- Power and networking infrastructure and installation of the show room (40k€, estimate).

The node will also feature the following equipment provided by ECP for a total of 200k€:

- 2 HD projectors
- Multi-touch surface (from MS France)
- Digital whiteboard
- Various devices (Logitec Air Mice, Nintendo Wii, iPads and iPodTouch, Tablet PC)

It will be connected with the existing Meso-centre for scientific computing: 860-core SGI machine with CPU/GPU processors.

Ecole Centrale Paris will secure a half-time computer engineer to support the node.

- *Elément 7/ Element 7 : Large multitouch wall at UVSQ*

The UVSQ node will feature the same type of equipment as LTCI and ECP, in a 12-cell configuration. This node will be used mainly for teaching applications, especially for the M2S Master joint with other DIGISCOPE partners, and for visualization of plasma simulations. EQUIPEX funding for the wall is estimated at 334k€, while UVSQ will provide 50k€ worth of equipment and a half-time engineer for support.

- *Elément 8/ Element 8 : Large 3D wall at Institut Farman*

For ENS Cachan, DIGISCOPE is an opportunity to equip the Farman Institute main building and partner research labs with top-notch technology for cooperative scientific visualization. The Institut Farman node will feature a constellation composed of a main decision center and a set of peripheral screens installed in the various labs (Fig. 11). Such a visualization constellation will allow Institut Farman to connect to the DIGISCOPE partners for research networking purposes but also for proof-of-concept of remote decision-support collaborative methodologies.

Main decision Center. A large screen decision center will be set up at the Farman's Institute. It will be composed of a four-channel stereoscopic projection system (see Figure 2). The room will allow for important project technical reviews, collaborative meetings, multimedia conferences, demonstration to students, etc.

Distributed Office equipment. It will be made of a 56'' 8 Mpixel LCD screen (see figure 3.). A XDS suite will allow for smart networking, remote connection to the main decision center and remote equipment from the DIGISCOPE partners. An LCD screen will be provided to each Farman Institute's lab : CMLA, LMT, LSV, LURPA, SATIE.

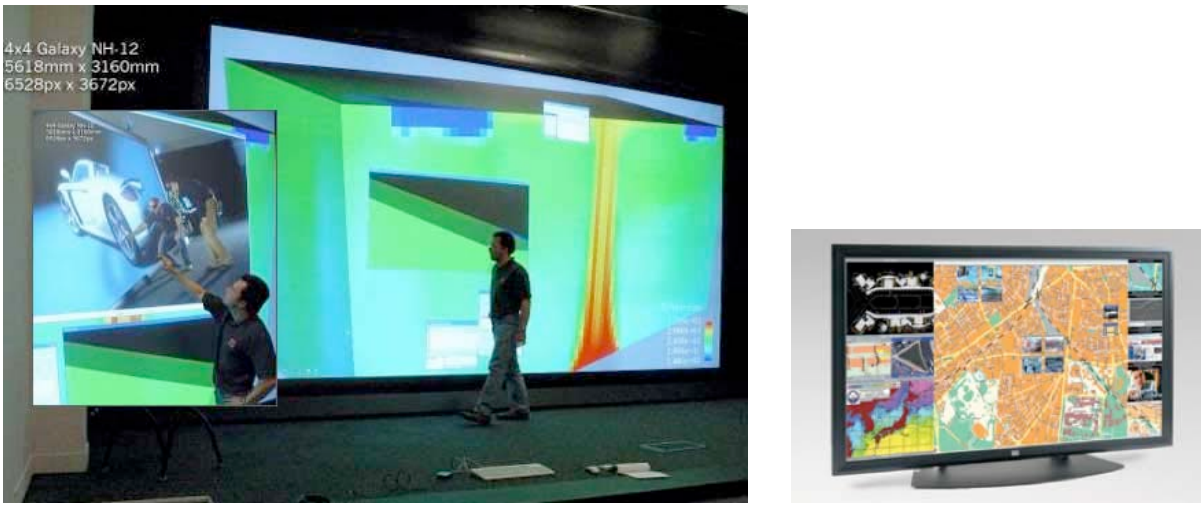

Fig. 11: The main decision center (on the left) and the peripheral screens (on the right) constituting the constellation

The estimate from BARCO for this constellation is available in the appendix. EQUIPEX funding is expected to cover part of the projection system (543k€) and two terminals (84k€). Institut Farman will provide the other part of the projection system and remaining terminals (520 k€). It will also allocate one and a half person for the maintenance and operation of the node.

- *Elément 9/ Element 9 : Large 3D wall at Maison de la Simulation*

The node at Maison de la Simulation will be equipped with a large stereoscopic wall using the same technology as the one at Institut Farman (see above for a detailed description) but with two projectors instead of four. This size is well adapted to the room that will host it. The stereoscopic capability as well as the possibility to support multi-windowing while retaining a good resolution are the most important features for scientific visualization. The wall will be used both in small working groups in order to explore and analyze large datasets and for

presentation and teaching to a wider audience, in local as well as remote collaborative settings.

The wall will be coupled to a powerful graphic cluster with a large shared memory. This hardware is necessary to properly handle the very large datasets produced by large computing center. For example, it will be possible to load and visualize simultaneously between 5 and 10 scalar fields of a large magneto-hydro-dynamic simulation. In addition, this equipment will be coupled to the CCRT/TGCC computing centers and deported visualization tools will be deployed by the CEA engineer. These tools will also be of interest for collaborative work within the Digiscope project.

The BARCO quotation for the dual-projection system is 543k€ (see appendix) and the graphics cluster is estimated at 100 k€ (see appendix). We expect this equipment to be funded by EQUIPEX, while Maison de la Simulation will take care of the installation of the room and of providing the storage facility for the simulation data (350€). CEA will provide two part-time engineers to support the infrastructure and participate in the software development effort.

6. APPENDICES

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6.3. ESTIMATES FOR THE EQUIPEMENT

The following estimates are provided here. Because of size limitations, only the most important estimates are included. The full list is available upon request to ANR.

Telepresence equipment:
- Tandberg
- COMIRIS

FabLab: 3D printer and circuit printer
- HP
- APPC

Univ. Paris-Sud & INRIA: ultra-high resolution wall display and VICON tracking system
- France Systèmes
- Biometrics

LIMSI: extension to the EVE immersive VR room
- BARCO
- HAPTION

CEA-LIST: immersive VR room with advanced haptic devices
- BARCO
- HAPTION

LTC, ECP and UVSQ: multitouch cells and small cluster for LTCI
- MultiTouch Ltd (12-cell and 16-cell configurations)
- DataSwift

Institut Farman & Maison de la Simulation: 3D power wall, with satellites for Institut Farman
- BARCO

Maison de la Simulation: cluster for processing simulation data
- Serviware

Telepresence

TANDBERG

Client Final	Univ Paris Sud
Partenaire	A définir
Date	9/14/10

Part Number	Product Name	Price List	Qté	Total (Ht)	
INFRASTRUCTURE					
VCS					28,050 €
1163401	TANDBERG Video Communication Server Control Application - 10 non-traversal network calls.	16,900 €	1	16,900 €	
1163401V26	TANDBERG Video Communication Server Control Application - 10 non-traversal network calls 1 Year Constant Care Core Standard Service	1,300 €	1	1,300 €	
1163401V27	TANDBERG Video Communication Server Control Application - 10 non-traversal network calls 1 Year Constant Care Core Advanced Service	1,890 €	1	1,890 €	
1163401V27-3	TANDBERG Video Communication Server Control Application - 10 non-traversal network calls 3 Year Constant Care Core Advanced Service	4,725 €	1	4,725 €	
116341X20	TANDBERG Video Communication Server - additional 20 non-traversal network calls (purchased with item # 1163401 , 1163402 or B116350X300)	11,800 €	1	11,800 €	
116341X20V27-3	TANDBERG Video Communication Server - additional 20 non-traversal network calls 3 Year Constant Care Core Advanced Service	1,625 €	1	1,625 €	
113703V60	Video Communication Server installation, configuration and knowledge transfer	4,800 €	1	4,800 €	
TMS					22,175 €
1158001	TMS Server appliance (preinstalled with TANDBERG Management Suite and Scheduler - 25 system license	13,900 €	1	13,900 €	
1158001V27	TMS Server appliance 1 Year Constant Care Core Advanced Service	1,390 €	1	1,390 €	
1158001V27-3	TMS Server appliance 3 Year Constant Care Core Advanced Service	3,475 €	1	3,475 €	
113600V03	TMS installation and configuration up to 25 systems, and knowledge transfer	4,800 €	1	4,800 €	
MSE					52,950 €
198000B2	MSE-8000-B2 Media Services Engine chassis bundle- 10 slot chassis- 1 MSE 8050 Supervisor blade- 2 MSE 8010 Fan trays- 1 MSE 8026 Dual power shelves including AC/DC rectifier modules	36,600 €	1	36,600 €	
198000B2V27	MSE-8000-B2 Media Services Engine chassis bundle 1 Year Constant Care Core Advanced Service	3,660 €	1	3,660 €	
198000B2V27-3	MSE-8000-B2 Media Services Engine chassis bundle 3 Year Constant Care Core Advanced Service	9,150 €	1	9,150 €	
113703V74	MSE 8000 installation, configuration and knowledge transfer (includes 1 blade install. Additional media blade installation charged separately)	7,200 €	1	7,200 €	
GATEWAY					30,250 €
198321	TANDBERG Codian MSE-8321 ISDN gateway blade - up to 8 PRIs	15,800 €	1	15,800 €	
198321V27	TANDBERG Codian MSE-8321 ISDN gateway blade - up to 8 PRIs 1 Year Constant Care Core Advanced Service	1,580 €	1	1,580 €	
198321V27-3	TANDBERG Codian MSE-8321 ISDN gateway blade - up to 8 PRIs 3 Year Constant Care Core Advanced Service	3,950 €	1	3,950 €	
193241PL	TANDBERG Codian ISDN GW-3241-PL 1 Additional PRI port license	8,400 €	1	8,400 €	
193241PLV27-3	TANDBERG Codian ISDN GW-3241-PL 1 Additional PRI port license 3 Year Constant Care Core Advanced Service	2,100 €	1	2,100 €	
113703V73	MSE 8321 ISDN gateway blade install, Configuration and knowledge transfer				
TELEPRESENCE SERVER					150,270 €
198710	MSE-8710 Telepresence Server blade - up to 16 Telepresence Screens	75,000 €	1	75,000 €	
198710V27	MSE-8710 Telepresence Server blade - up to 16 Telepresence Screens 1 Year Constant Care Core Advanced Service	7,500 €	1	7,500 €	
198710V27-3	MSE-8710 Telepresence Server blade - up to 16 Telepresence Screens 3 Year Constant Care Core Advanced Service	18,750 €	1	18,750 €	
198710SL	MSE-8710-SL 1 Telepresence Server screen license	8,000 €	16	128,000 €	
113703V85	Telepresence Server 8710 Blade Install	3,520 €	1	3,520 €	
SOLUTION DESIGN					24,000 €
113600V20	Video Architect	2,400 €	10	24,000 €	
Total Infrastructure					307,695 €
TERMINAL					
PROFILE 65 Pouces Single					81455
120050	TANDBERG Profile 65" - 65" Full HD LCD with Codec C60 including NPP option and PrecisionHD 1080p Camera - Note: Choice of wall mount or floor standing must be specified	€55,300	1	€55,300	
120050V07D	TANDBERG Profile 65" - 65" Full HD LCD with Codec C60 including NPP option and PrecisionHD 1080p Camera - Domestic On-site Installation	€5,800	1	€5,800	
120050V27	TANDBERG Profile 65" - 65" Full HD LCD with Codec C60 including NPP option and PrecisionHD 1080p Camera - 1 Year Constant Care Core Advanced Service	€6,970	1	€6,970	
120050V27-3	TANDBERG Profile 65" - 65" Full HD LCD with Codec C60 including NPP option and PrecisionHD 1080p Camera - 3 Year Constant Care Core Advanced Service	€17,425	1	€17,425	
117641MS	TANDBERG Profile 65" with C60 MultiSite (MS)	€5,370	1	€5,370	
117641PR	TANDBERG Profile 65" Premium Resolution (PR)(1080p/UXGA) option	€3,360	1	€3,360	
120048	TANDBERG Profile 65" single and dual Floor Stand kit (two kits needed for dual)	€0	1	€0	
120049	TANDBERG Profile 65" single and dual Wall Mount Kit (two kits required for dual)	€0	1	€0	
Total terminaux			8		651,640 €

PROPOSITION POLYCOM				
DESIGNATION	PPI	VENTE	QTE	TOTAL
HDX Executive Collection 8000-1080 2ET. HDX 8000-1080 (see 7200-23160-107), HDX Executive Collection stand with integrated 120v/270w audio and 2-50" 1080p plasma displays, EagleEye 1080 camera mount, cable bundle,cntry=026 (Maintenance Contract Required)	34 319,00	28 370,37	8,00	226 962,99
INSTALLATION		1 200,00	8,00	9 600,00
MAINTENANCE 3 ANS - PACK PLATINUM		7 333,33	8,00	58 666,67
SERVICES POLYCOM		5 273,33	8,00	42 186,67
TOTAL HT				337 416,32
TOTAL TTC				403 549,92
HDX 8000-1080: HDX 8000 HD codec, EagleEye1080 camera&license, HDX mic array, P+C, PPCIP, PoC, French rmt. Cables: 2 Component video (DVI-to-3xRCA), audio (RCA-RCA), LAN, Eur pwr. Cntry code 26. PAL (Maintenance Contract Required)	15 499	12 812,51	8,00	102 500,05
Moniteur LCD Full HD 65" enceintes intégrées -		5 066,67	16,00	81 066,67
SUPPORT MURAL ECRAN + CODEC		314,67	16,00	5 034,67
INSTALLATION		600,00	24,00	14 400,00
MAINTENANCE 3 ANS - PACK PLATINUM		3 000,00	8,00	24 000,00
SERVICES POLYCOM		1 866,67	8,00	14 933,33
TOTAL				241 934,72
TOTAL TTC				289 353,93
RMX 4000 20 HD/80 CIF resource configured & licensed system, IP only, equipped with MPM+80 Media Processing Module, Software upgradable to 20HD/80CIF, AC Power (Not Available in Country Codes: 14, 16, 41) (Maintenance Contract Required)	146 000		1,00	120 693,33
Implementation service, RMX 4000 20 HD/80 CIF base IP system	11 995		1,00	9 915,87
Premier Plus, Three Year, RMX 4000 20 HD/80 CIF base IP system	64 000		1,00	52 906,67
TOTAL				183 515,87
TOTAL TTC				219 484,98
Converged Management Application (CMA 5000) + 500 Devices includes Appliance, Gatekeeper, Conference Monitoring, Scheduling (Web, Outlook, Lotus), Device Mgmt; automatic software update , provisioning , support for CMAD. (Maintenance Contract Required)	40 000			33 066,67
INSTALLATION				3 000,00
MAINTENANCE 3 ANS - PACK PLATINUM				7 000,00
SERVICES POLYCOM				9 333,33
TOTAL				52 400,00
TOTAL TTC				62 670,40
VBP 5300-ST10 Firewall/ NAT traversal unit with H.460 support for medium to large enterprise locations. This model includes 2 x 10/100/1000 Ethernet interfaces, 1 x 10/100 Ethernet with capacity of 10meg-select power cord (Maintenance Contract Required)	10 960			9 060,27
INSTALLATION				2 000,00
MAINTENANCE 3 ANS - PACK PLATINUM				2 333,33
SERVICES POLYCOM				1 920,00
TOTAL				15 313,60
TOTAL TTC				18 315,07

PROPOSITION TANDBERG				
TANDBERG Profile 65" Dual - Dual 65" Full HD LCD with Codec C90 including NPP option and PrecisionHD 1080p Camera - Note: Choice of wall mount or floor standing must be specified	87 200,00	75 573,33	8,00	604 586,67
INSTALLATION		1 200,00	8,00	9 600,00
MAINTENANCE 3 ANS - PACK PLATINUM		19 333,33	8,00	154 666,67
SERVICES TAA		8 466,67	24,00	203 200,00
TOTAL				972 053,33
TOTAL TTC				1 162 575,79
TANDBERGIntegrator Package C90- includes Codec C90, PrecisionHD 1080p camera, 2 HDMI cables, 2 table microphones. Natural Presenter Package (NPP) is included.	31 800,00	27 560,00	8,00	220 480,00
Moniteur LCD Full HD 65" enceintes intégrées -		5 066,67	16,00	81 066,67
SUPPORT MURAL ECRAN + CODEC		314,67	16,00	5 034,67
INSTALLATION		1 200,00	24,00	28 800,00
MAINTENANCE 3 ANS - PACK PLATINUM		5 250,00	8,00	42 000,00
SERVICES TANDBERG		1 940,00	24,00	46 560,00
TOTAL				423 941,33
TOTAL TTC				507 033,83
MSE-8000-B2 Media Services Engine chassis bundle- 10 slot chassis- 1 MSE 8050 Supervisor blade- 2 MSE 8010 Fan trays- 1 MSE 8026 Dual power shelves including AC/DC rectifier modules	36 600,00	29 280,00	1,00	29 280,00
MSE-8710 Telepresence Server blade - up to 16 Telepresence Screens	75 000,00	60 000,00	1,00	60 000,00
MSE-8710-SL 1 Telepresence Server screen license	8 000,00	6 400,00	16,00	102 400,00
INSTALLATION		5 000,00	1,00	5 000,00
MAINTENANCE 3 ANS - PACK PLATINUM		35 000,00	1,00	35 000,00
SERVICES TAA		25 000,00	1,00	25 000,00
TOTAL				256 680,00
TOTAL TTC				306 989,28
TANDBERG Video Communication Server Control Application - 10 non-traversal network calls.	16 900,00	13 520,00	1,00	13 520,00
TANDBERG Video Communication Server - additional 20 non-traversal network calls (purchased with item # 1163401 , 1163402 or B116350X300)	11 800,00	9 440,00	2,00	18 880,00
INSTALLATION		746,67	1,00	746,67
MAINTENANCE 3 ANS - PACK PLATINUM		1 666,67	1,00	1 666,67
SERVICES TAA		9 200,00	1,00	9 200,00
TOTAL				44 013,33
TOTAL TTC				52 639,95
TMS Server appliance (preinstalled with TANDBERG Management Suite and Scheduler - 25 system license		11 120,00	1,00	11 120,00
INSTALLATION		1 506,67	1,00	1 506,67
MAINTENANCE 3 ANS - PACK PLATINUM		6 253,33	1,00	6 253,33
SERVICES TAA		1 130,67	3,00	3 392,00
TOTAL				22 272,00
TOTAL TTC				26 637,31

FabLab: 3D printer and crcuit printer

Offre de prix enEuros

Offre N° OP103 606
vendredi 10 septembre 2010

TVA: FR57440222099

Coordonnées Banquaires:
Crédit Lyonnais- Fontenay-le -Comte:
N°: 30002 08958 0000070451C 07
IBAN : FR34 3000 2089 5800 00070451 C07
B.I.C. / SWIFT : CRLYFRPP

INRIA
Attn: Pierre Dragicevic
Bât 490, Université Paris-Sud

91405 ORSAY
FRANCE

Affaire suivie par :
Olivier RIETSCH

Ref: ProtoMat S62

Remise applicable uniquement sur quantité.

Référence	Désignation	Qté	P.U. BrutHT	%	P.U.HT Remisé	Total Remisé
115788	LPKF ProtoMat S62 (Broche 10 000 à 62 000 tr/mn, logiciel CircuitCAM et BOARDMASTER, Surface de travail 230 X305mm, Changement d'outil automatique 10 positions,meuble accoustique et éclairage du pied)	1,00	16 924,77			16 924,77
114647	Système d'aspiration avec Auto Switch [ProtoMat S62; ProConduct]	1,00	1 040,09			1 040,09
115693	Table à vide [ProtoMat S62]	1,00	1 313,25			1 313,25
113495	Petit microscope à main X60, gradué et réticulé en mm, avec éclairage.	1,00	390,08			390,08
116698	Système pour ajustement des outils	1,00	853,09			853,09
122157	Kit de consommables pour LPKF S62 avec table à vide.	1,00	998,07			998,07
115789	Système de positionnement par caméra [ProtoMat S62]	1,00	3 424,96			3 424,96

(Les articles dont la quantité est nulle sont proposés en option, la quantité 1 représentant notre meilleur choix)
Qté minimum de cde Possibilité de panachage selon le Fabricant. Nous consulter.
La photo est donnée à titre indicatif et ne saurait engager la responsabilité d'APPC.)

APPC 62 rue du Petit Logis, Route de Pissotte 85200 SERIGNE Tél: 02 28 13 90 45 Fax: 02 28 13 90 46
SARL au capital de 33 285€ SIRET 440 222 099 APE 4690Z
www.appc.fr info@appc.fr

Offre enEuros

vendredi 10 septembre 2010

Offre N° OP103 606

INRIA
Attn: Pierre Dragicevic

Ref: ProtoMat S62

Remise applicable uniquement sur quantité.

Référence	Désignation	Qté	P.U. BrutHT	%	P.U.HT Remisé	Total Remisé
113421	Brosse antistatique courte [ProtoMat S62]	1,00	37,82			37,82
INSTAL	Installation, Mise en route et Formation - France métropolitaine	1,00	1 877,95			1 877,95

Poids total : 91,000
Nombre d'articles : 1,00

(Les articles dont la quantité est nulle sont proposés en option, la quantité 1 représentant notre meilleur choix)
Qté minimum de cde Possibilité de panachage selon le Fabricant. Nous consulter.
La photo est donnée à titre indicatif et ne saurait engager la responsabilité d'APPC.)

Nous nous réservons la propriété des matériels vendus et livrés conformément à la loi N° 80335 du 12 mai 1980 jusqu'au paiement intégral du produit.

Validité de l'offre: 30Jours ***Minimum de commande : 150€HT***
APPC est un Organisme de Formation Agréé sous le N° 52-85-01253-85
Auprès du Prefet de la Région Pays de la Loire

Nos prix s'entendent hors taxes, départ SERIGNE, livraison en sus.
Conditions de réglement: Mandatement à 35 jours

Total brut HT : 26 860,08
Remise : %

Net € HT : 26 860,08

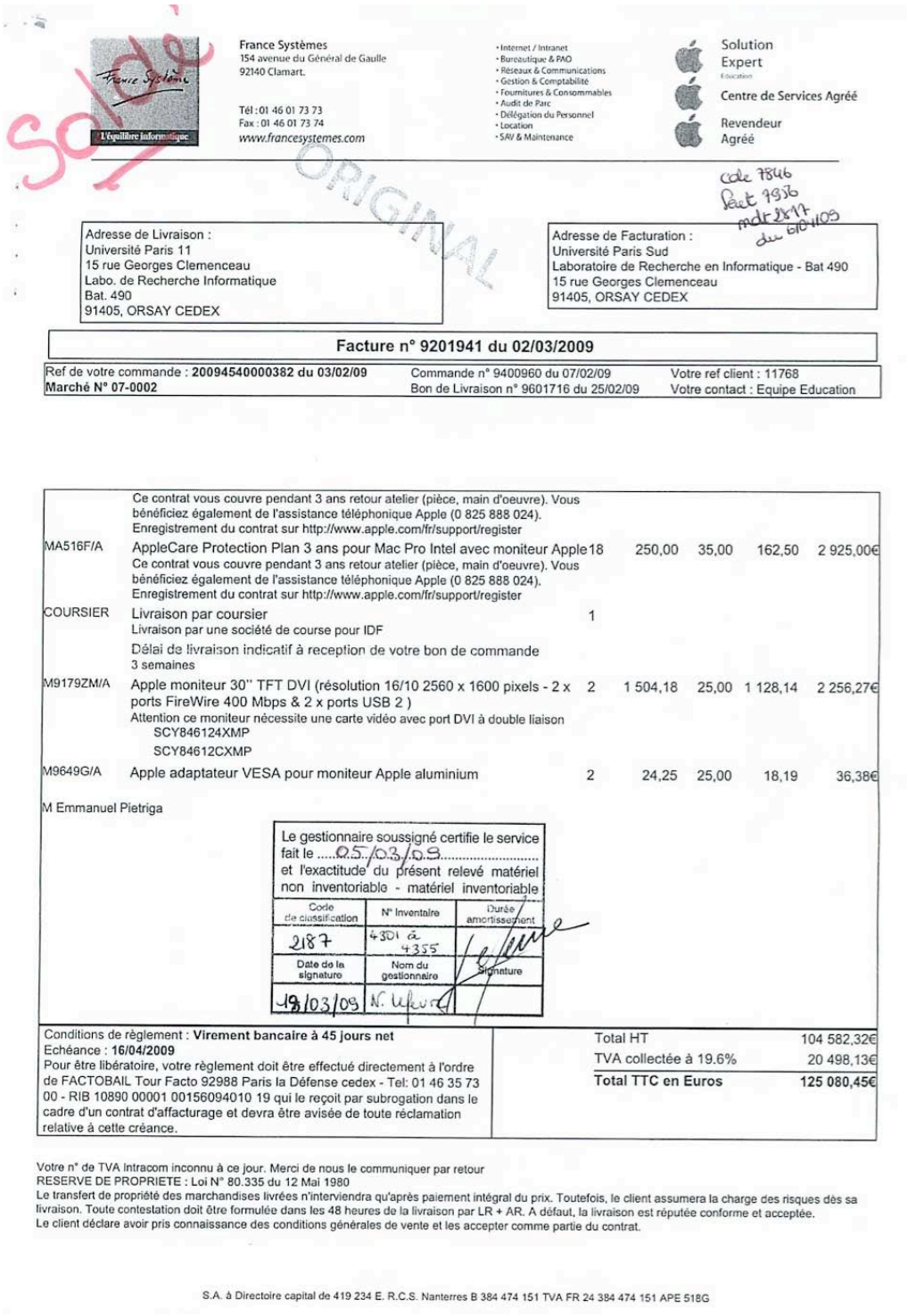
€TTC

En passant commande aujourd'hui, vous pouvez être livré le : 08/10/2010 (Délai moyen constaté)
Pour info: Frais de port Emballage & UPS Standard 135,00€HT
Le montant des frais de port est donné à titre indicatif, et ne constitue pas un engagement de notre part.

Les Conditions Générales de Vente disponibles sur notre site sont réputées connues par l'acheteur. Toute commande implique de la part de l'acheteur l'acceptation des dites conditions.

APPC 62 rue du Petit Logis, Route de Pissotte 85200 SERIGNE Tél: 02 28 13 90 45 Fax: 02 28 13 90 46
SARL au capital de 33 285€ SIRET 440 222 099 APE 4690Z
www.appc.fr info@appc.fr

Univ. Paris-Sud & INRIA: ultra-high resolution wall display and VICON tracking system



France Systèmes
154 avenue du Général de Gaulle
92140 Clamart.

Tél : 01 46 01 73 73
Fax : 01 46 01 73 74
www.francesystemes.com

• Internet / Intranet
• Bureautique & PAO
• Réseaux & Communications
• Gestion & Comptabilité
• Fournitures & Consommables
• Audit de Parc
• Délégation du Personnel
• Location
• SAV & Maintenance

Solution Expert
Centre de Services Agréé
Revendeur Agréé

SOLDE
ORIGINAL

code 7846
fact 9936
mdt 2817
du 6/04/09

Adresse de Livraison :
Université Paris 11
15 rue Georges Clemenceau
Labo. de Recherche Informatique
Bat. 490
91405, ORSAY CEDEX

Adresse de Facturation :
Université Paris Sud
Laboratoire de Recherche en Informatique - Bat 490
15 rue Georges Clemenceau
91405, ORSAY CEDEX

Facture n° 9201941 du 02/03/2009

Ref de votre commande : **20094540000382 du 03/02/09**	Commande n° 9400960 du 07/02/09	Votre ref client : 11768
Marché N° 07-0002	Bon de Livraison n° 9601716 du 25/02/09	Votre contact : Equipe Education

	Ce contrat vous couvre pendant 3 ans retour atelier (pièce, main d'oeuvre). Vous bénéficiez également de l'assistance téléphonique Apple (0 825 888 024). Enregistrement du contrat sur http://www.apple.com/fr/support/register					
MA516F/A	AppleCare Protection Plan 3 ans pour Mac Pro Intel avec moniteur Apple Ce contrat vous couvre pendant 3 ans retour atelier (pièce, main d'oeuvre). Vous bénéficiez également de l'assistance téléphonique Apple (0 825 888 024). Enregistrement du contrat sur http://www.apple.com/fr/support/register	18	250,00	35,00	162,50	2 925,00€
COURSIER	Livraison par coursier Livraison par une société de course pour IDF	1				
	Délai de livraison indicatif à reception de votre bon de commande 3 semaines					
M9179ZM/A	Apple moniteur 30'' TFT DVI (résolution 16/10 2560 x 1600 pixels - 2 x ports FireWire 400 Mbps & 2 x ports USB 2) Attention ce moniteur nécessite une carte vidéo avec port DVI à double liaison SCY846124XMP SCY84612CXMP	2	1 504,18	25,00	1 128,14	2 256,27€
M9649G/A	Apple adaptateur VESA pour moniteur Apple aluminium	2	24,25	25,00	18,19	36,38€

M Emmanuel Pietriga

Le gestionnaire soussigné certifie le service fait le ....05/03/09.....
et l'exactitude du présent relevé matériel non inventoriable - matériel inventoriable

Code de classification	N° Inventaire	Durée amortissement
2187	4301 à 4355	
Date de la signature	Nom du gestionnaire	Signature
19/03/09	N. Ufeur	

Conditions de règlement : **Virement bancaire à 45 jours net**
Echéance : **16/04/2009**
Pour être libératoire, votre règlement doit être effectué directement à l'ordre de FACTOBAIL Tour Facto 92988 Paris la Défense cedex - Tel: 01 46 35 73 00 - RIB 10890 00001 00156094010 19 qui le reçoit par subrogation dans le cadre d'un contrat d'affacturage et devra être avisée de toute réclamation relative à cette créance.

Total HT	104 582,32€
TVA collectée à 19.6%	20 498,13€
Total TTC en Euros	**125 080,45€**

Votre n° de TVA Intracom inconnu à ce jour. Merci de nous le communiquer par retour
RESERVE DE PROPRIETE : Loi N° 80.335 du 12 Mai 1980
Le transfert de propriété des marchandises livrées n'interviendra qu'après paiement intégral du prix. Toutefois, le client assumera la charge des risques dès sa livraison. Toute contestation doit être formulée dans les 48 heures de la livraison par LR + AR. A défaut, la livraison est réputée conforme et acceptée.
Le client déclare avoir pris connaissance des conditions générales de vente et les accepter comme partie du contrat.

S.A. à Directoire capital de 419 234 E. R.C.S. Nanterres B 384 474 151 TVA FR 24 384 474 151 APE 518G

BIOMETRICS

Biometrics France

Parc Club - Orsay Université
28, rue Jean Rostand
91893 ORSAY Cedex . France

Téléphone 01 60 19 34 35
Télécopie 01 60 19 35 27

n/ref. EML

Le 20 novembre 2008

Monsieur le Directeur de l'INRIA
Domaine de Voluceau – Rocquencourt
BP 105
78163 LE CHESNAY CEDEX

Concerne le Marché N° 3/2008 pour la fourniture de l'infrastructure matérielle de capture de mouvements pour la réalisation d'un mur d'images intéractifs - INRIA

OFFRE DE PRIX

- validité : 4 mois
- délai de livraison: 2 semaines

Système d'Analyse Tridimensionnelle du Mouvement
VICON T10/8

Référence	Désignation	Qté
MXT10	Caméras numériques T10 Vicon (voir descriptif document joint) Caméras 1 Million de pixels (1120x896) Fréquence maximale à pleine résolution : 250 Hz, Tracking 2D au sein de la caméra. Transmission caméra-GIGANET en Gigabit Ethernet. Strobes superpuissants.	8
GIGANET	Unité Mx_GigaNet Vicon permettant la connexion de 10 caméras T10	1
Nexus	Logiciel d'acquisition et de traitement des données en temps réel 2 licences Utilisateurs	1
Dyna_Cal	Système de calibration statique et dynamique	1
SUP_CAMERAS	Supports caméras	6
Trépieds	Trépieds	4
Têtes3D	Têtes 3D Manfrotto 804RC2	8
Kit_Marqueurs	Kit de marqueurs de 14 mm de diamètre – Quantité : 30	1
PC	Processeur : **Intel Core 2 Quad Q9450 (2.66GHz)**, RAM : **2 Go - Disque Dur de 500 Go 7200 tours/mn -** Carte vidéo : **Nvidia GeForce 8800 GT, 512 Mo -** Graveur DVD+/-RW - **Carte réseau Gigabit - Ecran plat 22 pouces -** Système d'exploitation Windows XP Pro SP2 - Microsoft Office Basique – **Garantie pour le PC : 3 ans sur site**	1

Montant HT	91 370,00
Remise exceptionnelle	- 21 370,00
Montant HT remise déduite	70 000,00
TVA 19.60%	13 720,00
Montant TTC	83 720,00

E.M. LAASSEL

- Installation et formation des utilisateurs sur site comprise : 2 jours
- Support technique permanent par téléphone , fax, e-mail, VOS (Vicon On-line Support)
- Système Vicon garanti 1an , pièces, main-d'oeuvre et déplacements.
- Mise à niveau gratuite des logiciels pendant l'année de garantie.
- Transport et assurance compris.

Biometrics France • SAS • Capital Social 40.000 € • RCS Evry B 343 940 292 • Siret 343 940 292 00067 • Code APE 514N

LIMSI: extension to the EVE immersive VR room

5 OFFRE DE PRIX BUDGETAIRE

Notre offre de prix est une estimation budgétaire, qui devra faire l'objet d'une discussion détaillée.

Tranche conditionnelle n°1 : Structure, ECrans, miroirs, Projecteurs	
Ensemble Ecran, miroirs, structure et projecteur suivant le descriptif des livrables au § 2.4	315 000,00 €
Modification au SOL pour la DOUBLE STEREOSCOPIE	
Ensemble Double stéréoscopie au sol , suivant le descriptif des livrables au § 3.3	300 000,00 €
Maintenance sur 10 ANS	
Contrat PREMIUM PLUS suivant descriptif §4.2 pour 8 projecteurs	916 000,00 €
Contrat PREMIUM PLUS suivant descriptif §4.2 pour 7 projecteurs	801 500,00 €
TOTAL DU PROJET pour 8 projecteurs	1 531 000,00 €
TOTAL DU PROJET pour 7 projecteurs	1 416 500,00 €

Les prix sont des prix Hors Taxes.
La TVA applicable est de 19,6% à ce jour.

5.1 EXCLUSIONS

Cette proposition ne comprend pas les éléments suivants :

- Fourniture de l'alimentation électrique 220V + Terre
- Téléphone
- Réseau informatique
- Ordinateur et Générateur d'images nécessaires
- Modification du faux plafond ou du faux plancher, si nécessaire
- Les contraintes d'environnement : air conditionné, peinture, tapisserie…
- Les modifications éventuelles à la construction accueillant le système
- Les modifications éventuelles à l'éclairage ambient
- Les moniteurs
- Le mobilier (Tables, chaises, armoires, etc.…), à l'exception de ceux mentionnés.
- Evacuation des projecteurs existants et des matériels associés ;
- Evacuation des emballages ;

BARCO N.V.
DEPARTEMENT BP & S
Noordlaan 5
B8520 KUURNE – Belgique
Tél : 00 8000 227 2603 – Fax : 00 32 56 36 84 86

ARTICLE 9. : Montant de l'offre

Le tableau suivant présente le prix de la solution complète, avant et après remise.

Produits	Prix Unitaire HT	Qté	Prix Total HT
Matériel			
Lot 1 : Virtuose 6D35-45	85 000,00 €	1	85 000,00 €
Lot 2 : Support fixe Virtuose	15 000,00 €	1	15 000,00 €
Total Lot 1 et 2			**100 000,00 €**
Logiciel			
Lot 3 : IPSI + IPP Core + IPP Human	16 500,00 €	1	16 500,00 €
Total Lot 3			**16 500,00 €**
Mise à jour du bras Existant			
Inversion du bras	3 100,00 €	1	3 100,00 €
Changement d'alimentation pour atténuer le bruit	3 000,00 €	1	3 000,00 €
Support Virtuose 6D35-45	15 000,00 €	1	15 000,00 €
Total Mise à jour			**21 100,00 €**
Structure mobile 2 bras			
Structure mobile 2 bras, prix indicatif	100 000,00 €	1	100 000,00 €
Total Structure mobile			**100 000,00 €**
Mise à niveau des bases de contrôleur			
Intégration du contrôleur dans la base du bras, prix indicatif	20 000,00 €	2	40 000,00 €
Total Changement base			**40 000,00 €**

ARTICLE 10. : Délai de livraison

10.1 : Le délai indicatif maximum de livraison est de 4 (mois) mois.

10.2 : Le délai de livraison court à compter de la date de signature du contrat par les Parties ou l'acceptation expresse de la commande par HAPTION. En tout état de cause, les engagements d'HAPTION relatifs aux délais s'entendent sous réserve du respect par le CLIENT de ses propres obligations, notamment en ce qui concerne le règlement des acomptes prévus dans le contrat.

10.3 : En cas de force majeure, les délais d'exécution prévus dans le contrat sont prolongés de la durée desdits évènements et de leurs conséquences. Toutefois, si par suite d'un événement de force majeure, l'exécution du contrat devient impossible dans un délai raisonnable, chacune des parties peut se dégager de ses obligations par lettre recommandée avec avis de réception entraînant de plein droit, sans formalités judiciaires ni indemnités, la résiliation du contrat.

ARTICLE 11. : Conditions de paiement

HAPTION – Atelier relais, Route de Laval, 53210 SOULGE SUR OUETTE – France
☎ 02 43 64 51 20 ✉ 02 43 64 51 21 ✉ pierre.vercruysse@haption.com

CEA-LIST: immersive VR room with advanced haptic devices

11/09/2010

Opportunity Name: DIGITEO

Worksheet Title: Scénario 1: système 2 faces avec insert très haute résolution sur l'écran principal
rétro projection pour les 2 écrans avec écran de verre
- espace de travail collaboratif XDS

Currency: EUR

Line Item No	Description	List price	Extended w/ discount
	Services	66 666,67	66 666,67
	Stereo	5 800,00	4 350,00
	Projector Body+ lenses	334 020,00	250 515,00
	MISCELLANOUS	103 362,00	77 521,50
	XDS écran principal	50 500,00	25 250,00
	Total glass screens + certification	233 558,00	109 168,50
	Structure	115 250,00	111 437,50
	Totals:	909 156,67	644 909,17
	MC Priority for 1->3 years	54 549,40	54 549,40
	Tracking	58 100,00	43 575,00
	Totals:	1 021 806,07	743 033,57
	Mutualisation projet Equipex Digiscope	-100 000,00	-100 000,00
	FINAL Totals:	921 806,07	643 033,57

Interface Haptique

LOT 1 : FOURNITURE D'UNE INTERFACE HAPTIQUE EXOSQUELETTE ABLE

Le lot 1 concerne la fourniture d'une interface haptique Exosquelette ABLE. Cet exosquelette peut être proposé, pour le bras droit, selon plusieurs configurations :

Version 4 axes : Exosquelette pour l'épaule et le coude

Version 5 axes : Exosquelette pour l'épaule, le coude ainsi qu'un mouvement de pronossupination au niveau du poignet

Version 7 axes : Exosquelette pour l'épaule, le coude ainsi trois mouvements au niveau du poignet

Dans le cadre de cette offre. la version 5 axes est retenue

LOT 2 : SUPPORT MOTORISE

L'exosquelette ABLE est également compatible avec une utilisation sur un support motorisé.

Le support mobile est un système en cours de développement, la première démonstration aura lieu en septembre 2010. Ce système permet de supporter un exosquelette dans un grand champ de travail, les spécifications techniques du produit sont en cours de finalisation.

ARTICLE 9. : Montant de l'offre

Le tableau suivant présente le prix de la solution complète. avant et après remise.

Produits	Prix Unitaire HT	Qté	Prix Total HT
Lot 1 : Exosquelette ABLE			
- version 5 axes	90 000,00 €	1	90 000,00 €
Lot 2 : Structure mobile, prix indicatif	77 000,00 €	1	77 000,00 €
Total			**167 000,00 €**

Référence de la proposition : HAP/10/P760CEA2 ver0
Date de la proposition : 15 juillet 2010

LTC, ECP and UVSQ: multitouch cells
12-cell configuration:

QUOTATION / ORDER CONFIRMATION

MULTITOUCH LTD
Kiviaidankatu 2 B
00210 Helsinki
Finland
info@multitouch.fi
www.multitouch.fi
Reg.nr. FI2126814-5

Date: 10.9.2010
OA Number 20100910-PM2

Customer name and address:
École Centrale Paris, MAS laboratory
Bat. Dumas, office C414
Grande Voie des Vignes
F-92 295 CHÂTENAY-MALABRY
France
Attention: Anastasia Bezerianos

Shipping address (if different):

Customer Reference: Email on September 8th , anastasia.bezerianos@ecp.fr
Validity: This quotation is valid until **September 30, 2010.**
Terms of Payment: 14 days net
Payment due: 100% on order and before shipment
Estimated delivery: 5-8 days from order and prepayment

Code	Description	Quantity	Unit Price €	VAT %	VAT €	Cost
MT465	MultiTouch Cell 46" Full HD LCD High Brightness	12	10 500,00	0 %	0,00	126 000,00
MT46XW2	MultiTouch Cell 46" Extended Warranty, 2nd Year	12	800,00	0 %	0,00	9 600,00
MT46XW3	MultiTouch Cell 46" Extended Warranty, 3rd Year	12	1 100,00	0 %	0,00	13 200,00
MTCSSDKB	MultiTouch Cornerstone SDK Academic	1	0,00	0 %	0,00	0,00
MTPCLT8	MultiTouch Linux Tracking PC for up to 8 displays	2	2 000,00	0 %	0,00	4 000,00
MTPCLA8	MultiTouch Linux Application PC for up to 8 displays	2	4 000,00	0 %	0,00	8 000,00
MTPCL4	MultiTouch Linux PC for up to 4 displays	1	2 400,00	0 %	0,00	2 400,00
MTPCW1	MultiTouch PC Windows 7 upgrade	1	500,00	0 %	0,00	500,00
MTST10	MultiTouch Support Ticket Set 10	1	1 000,00	0 %	0,00	1 000,00
MT46PK	Packaging for 46"	12	200,00	0 %	0,00	2 400,00
MTSHIP	Shipping, DDU, Economy Express to France	1	3 650,00	0 %	0,00	3 650,00
			Total € (VAT 0%)			**170 750,00**

Notices:
1. All prices are in euros.
2. Client is responsible for local customs and taxes.
3. Cells include Cornerstone runtime software and demo applications
4. Cornerstone SDK Academic license is for non-commercial academic use only.

Attachments:
1. Multitouch Cell 46" LCD technical descriptions
2. MultiTouch Ltd General and Limited Warranty Statement

We order the above products, and accept the attached MultiTouch CornerStone software license, and the applicable open-source licenses for third-party software (LGPL, Apache Software License).

Please sign and send via email of fax to number +358 9 8565 7328.
Customer signature, title, date, location

16-cell configuration:

QUOTATION / ORDER CONFIRMATION

MULTITOUCH LTD
Kivialdankatu 2 B
00210 Helsinki
Finland
info@multitouch.fi
www.multitouch.fi
Reg.nr. FI2126814-5

Date: 10.9.2010
OA Number 20100910-PM1

Customer name and address:
École Centrale Paris, MAS laboratory
Bat. Dumas, office C414
Grande Voie des Vignes
F-92 295 CHÂTENAY-MALABRY
France
Attention: Anastasia Bezerianos

Shipping address (if different):

Customer Reference: Email on September 8th , anastasia.bezerianos@ecp.fr
Validity: This quotation is valid until **September 30, 2010.**
Terms of Payment: 14 days net
Payment due: 100% on order and before shipment
Estimated delivery: 5-8 days from order and prepayment

Code	Description	Quantity	Unit Price €	VAT %	VAT €	Cost
MT465	MultiTouch Cell 46" Full HD LCD High Brightness	16	10 500,00	0 %	0,00	168 000,00
MT46XW2	MultiTouch Cell 46" Extended Warranty, 2nd Year	16	800,00	0 %	0,00	12 800,00
MT46XW3	MultiTouch Cell 46" Extended Warranty, 3rd Year	16	1 100,00	0 %	0,00	17 600,00
MTCSSDKB	MultiTouch Cornerstone SDK Academic	1	0,00	0 %	0,00	0,00
MTPCLT8	MultiTouch Linux Tracking PC for up to 8 displays	2	2 000,00	0 %	0,00	4 000,00
MTPCLA8	MultiTouch Linux Application PC for up to 8 displays	2	4 000,00	0 %	0,00	8 000,00
MTPCL4	MultiTouch Linux PC for up to 4 displays	1	2 400,00	0 %	0,00	2 400,00
MTPCW1	MultiTouch PC Windows 7 upgrade	1	500,00	0 %	0,00	500,00
MTST10	MultiTouch Support Ticket Set 10	1	1 000,00	0 %	0,00	1 000,00
MT46PK	Packaging for 46"	16	200,00	0 %	0,00	3 200,00
MTSHIP	Shipping, DDU, Economy Express to France	1	4 200,00	0 %	0,00	4 200,00
			Total € (VAT 0%)			**221 700,00**

Notices:
1. All prices are in euros.
2. Client is responsible for local customs and taxes.
3. Cells include Cornerstone runtime software and demo applications
4. Cornerstone SDK Academic license is for non-commercial academic use only.

Attachments:
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Please sign and send via email of fax to number +358 9 8565 7328.
Customer signature, title, date, location

Small cluster for LTCI :

DataSwift

Infonet Services

EDF R&D
A l'attention de Mr Bruno Jacquin

A Nanterre, le 01/06/2010

Thierry PAILOT
tp@dataswift.fr
Tél : 01 46 24 19 06
Fax : 01 46 24 03 68

Devis 100601-1 EDF

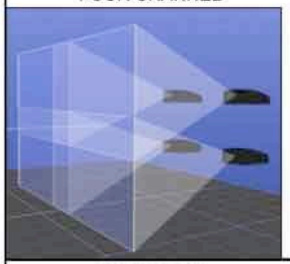
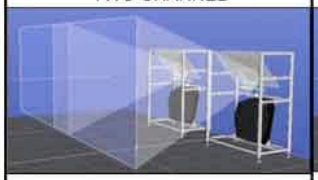
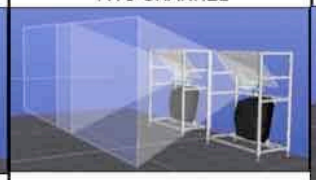
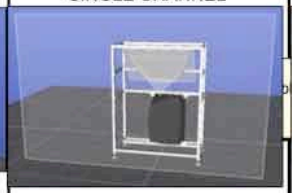
Prototype EDF R&D

Qté	Désignation	Prix Nets (Euros HT) Prix unitaire	Prix total
	Nœuds de calcul		
5	**Serveur Cloe.D1G-T8230-SA**	3 720,00 €	18 600,00 €
	Carte mère TYAN S8230WGM4NR-LE - Dual Socket AMD G34		
	2 Processeurs AMD Opteron 6134 (octocore - 2,3Ghz - HT3+ 6.4Ghz - 12Mo de cache L3)		
	32 Go de mémoire DDR3 Ecc reg 1333MHz (8*4Go) - quad-channel		
	Controleur LSI 2008 SAS/SATA II - 4 Ports - support materiel Raid 0/1/1E		
	4 disques durs SATA - 1To - 7200rpm - 16Mo de cache - en Raid 0 sur controleur LSI		
	Contrôleur graphique Aspeed AST2050		
	4 contrôleurs réseau Gigabit Ethernet Cuivre intégrés - Intel		
	Controleur IPMI 2.0 et KVM sur IP - Aspeed AST2050		
	Châssis rackable 19" - hauteur 1U - 4 cages de disques Hotswap		
	Alimentation 110-240 VAC EPS 1U 500W - rendement certifié 80Plus		
	Rails de montage pour serveur 1U		
	Serveurs validés sous OS Linux CentOS 5.5 x64		
	Validé et testé pendant 48 heures en atelier		
	Validation en atelier de Debian Lenny (noyau recompilé si necessaire) et Ubuntu 10.04		
	Serveur Garantie 3 ans pièces et main d'œuvre retour atelier - Frais de transport Aller/Retour inclus		
	Connectique		
15	Cable réseau Gigabit - longueur 2m - pour réseau Gigabit et IPMI	3,00 €	45,00 €
1	Switch Réseau Gigabit - Netgear GS724 - 24 ports - manageable niveau 2 - garantie à vie Netgear	275,00 €	275,00 €
1	Prise multiple - 1U rackable - 9 prises UTE Type C13	45,00 €	45,00 €
	Installation sur site des matériels (forfait)		
1	Montage et installation de l'ensemble du matériel - prestation niveau 1	750,00 €	750,00 €
	Installation et tests des connexions réseau - prestation niveau 1		
	Livraison		
1	Livraison de l'ensemble des serveurs	100,00 €	100,00 €
	SOMME DES SOUS TOTAUX	Total € HT	19 815,00 €
		TVA 19,6%	3 883,74 €
		Total € TTC	23 698,74 €

Délai de validité de l'offre : 5 semaines
Délai de livraison : 4 à 5 semaines

15. Budgetary Estimate

Following table gives a budgetary proposal for all solutions described in chater 3.

MAIN DECISION CENTER		OTHER RESEARCH CENTER		DISTRIBUTED OFFICE EQUIPMENT
FOUR CHANNEL	TWO CHANNEL	TWO CHANNEL	SINGLE CHANNEL	
				
699 500,00 €	454 500,00 €	454 500,00 €	282 500,00 €	35 000,00 €

It includes all the installation costs performed on a dedicated site in France (excluded DOM-TOM)

Is not included :

- Supply of power
- Finishing between the screen and the room infrastructure
- False ceiling or false floor modification
- Any modification or addition to the main building structure
- Removal of existing projection equipment and associated items
- Removal and disposal of packaging material
- Installation of cables not provided by Barco
- Installation of cabling baskets or computer floor to cover cablir
- Configuration of signal sources or resolutions

Maison de la Simulation: cluster for processing simulation data

Synthèse	*Prix public total En € H.T.*	*Prix de vente total € H.T.*
1 x 2 x Bullx S6030: 8 x X7560 (8c - 2.26GHz - 6.4GB/s), 1024 Go RAM, 2 x 500GB SATA 1 x Quadroplex 2200 S4 (comprenant 4 cartes graphiques FX5800)	**164 950.00**	**79 850,00**

TOTAL TTC 95 500.06 €

Délai de livraison :.....**3 à 4 semaines date de réception de votre commande.**
Conditions de règlement :.....**30 jours fin de mois.**
Validité de l'offre : .....**2 mois .**

INFORMATION :

Le contrat de Service SERVIWARE, vous permet d'accéder :

- ✓ ***A un support informatique personnalisé,***
- ✓ ***A différents services « à la carte »***

Comme des interventions ponctuelles :
Urgence, Installation de nouveaux matériels……
Des missions pour du développement, de la méthodologie, du support applicatif……..

Pour une étude personnalisée, vous pouvez contacter votre commercial.

RESERVE DE PROPRIETE :
Le transfert de propriété du matériel vendu est subordonné au paiement intégral du prix à l'échéance par l'acheteur. Toutefois, l'acheteur assume dès la livraison les risques du matériel vendu et notamment les risques de perte et de dommage. L'acheteur ne peut jusqu'à complet paiement, ni transférer de droit, ni transformer ce dernier, ni l'incorporer à un autre produit.
Dans le cas où le paiement n'interviendrait pas dans le délai prévu, le vendeur se réserve le droit de reprendre la chose livrée et si bon lui semble, de résoudre le contrat.
LOCATION :
Tout dépassement dans le temps du contrat initial de location impliquera la facturation mensuelle totale du mois entamé. Le vendeur se réserve le droit de facturer toute détérioration constatée ou tout produit manquant au retour du matériel loué au locataire Le client locataire s'engage à utiliser le matériel loué dans des conditions normales d'utilisation et s'engage à le préserver de toute détérioration éventuelle et du vol.

Toutes nos offres de prix s'entendent en F HT. ou en € H.T.
Nos prix pouvant être revus à la hausse si le prix d'achat auprès du fournisseur venait à augmenter de plus de 3%.

6.4. SCENARIOS AND USE CASES

The following sample scenarios and use cases illustrate the types of applications targeted by DIGISCOPE, from shorter to longer term. They expand on the short scenarios listed in section 2.2.1.

Scenario: Collaborative model-based design hub

Robert, a mathematician working on the CSDL System@tic project recently developed a new optimisation model for solving constrains related to physical simulations that combine air-flow models, temperature models, air-quality and pressure models in a closed system. While running some optimisation tests in the scientific computing Meso-centre, he finds some correlations between air-flow and temperature that he did not foresee. Wanting to understand his results, he invites John, who is an expert in air-flow to the ECP DIGISCOPE node.

Using a wireless keyboard, Robert loads onto the digital table 3 different optimisation results and their parameters in the form of scatterplots. By using gestures on the table, he rearranges the scatterplots in order of the number of imposed constraints. John finds it a bit hard to understand the abstract scatterplot representation so he uses one of the iPads to load onto the digital wall the 3D simulation results that show combined views of air-flow, temperature etc. Both Robert and John approach the digital wall to view and compare the 3 different results. Each using a Wii-mote (or direct touch), they manipulate the 3D views, by rotating them and zooming-in to get a better understanding of the data. John thinks the results look ok, but he asks Robert to verify the relationships and mathematical constraints he uses in his air-flow and temperature simulation. Robert goes to the digital whiteboard and writes a set of equations that are immediately recognized and digitally plotted on the whiteboard. John verifies the air-flow equations and drag-and-drops the temperature equations and findings to his iPad and emails them to Ian, a colleague of his at Dassault who is an expert on simulations of airplane cabin conditions.

Ian receives the email while in a brainstorming session with other colleagues in another DIGISCOPE node. Noticing that the new simulation model seems to give unexpected results in a domain that is of interest to them, he informs his colleagues and they decide to connect via teleconferencing to the ECP DIGISCOPE node. Half of the digital wall in both sites is taken up by a remote video view of the other room, and the other half by a shared working space. At ECP, Robert and John rearrange and scale the windows of the 3D models on the wall and drag-and-drop the scatterplots from the table to the wall to share them with their remote colleagues.

Ian has been joind by Marc in the other DIGISCOPE node. Marc indicates which parameters to change in the simulations using telepointers, so as to create a system that is close to their domain of expertise. Robert re-runs the optimisation algorithm on a (approximate) reduced simulation model and the results appear at both sites. Ian and Marc verify that the optimisation results are realistic for their domain within the acceptable margin of error. They also send a request to the scientific computing Meso-center to run a full simulation with the new optimisation parameters for verification purposes. Since Robert's optimisation model is faster than their in-house model, Robert uses his iPad to email them a version of it. Robert and John then close the connection to other DIGISCOPE node and continue their discussion about how to further test the model.

Scenario: Determine why two new HIV vaccines work only when combined

Finding an effective HIV vaccine has proven elusive: vaccines that seemed promising in the lab have systematically failed to provide clinical results in the field. However, a recent double-blind field study in Southeast Asia produced astonishing results. The study tested two vaccines, organized into four groups: no vaccine, vaccine A, vaccine B, and both vaccines A and B together. Neither vaccine alone, nor the conrol condition, reduced HIV infection rates. However, when the two vaccines were combined, HIV rates dropped by 30%. This was completely unexpected and none of the scientists have an explanation.

The Biology departement at the University of Paris-Sud offered to host an emergency working session, with participants from local institutions, including Digiteo, the Institute Pasteur and INRA, as well as experts from around the world, with experience in the specific vaccines and different types of biology, including geneticists, cellular biologists, biochemists, epidemiologists, bioinformaticians as well as physicians and public health officials associated with the field trials.

The meeting begins at 13:00 in France, with several people participating remotely, from MIT in Boston. Most of the participants arrive with their own hard drives and laptops (Mac, Linux and various versions of Windows). The 'wet' biologists also bring their paper laboratory notebooks and one brings a set of gels, the results of a recent experiment. They have a wide variety of different forms of data, including images, data tables, spreadsheets with dosage levels, experimental protocolas, scripts and alogrithms for running specific analyses, models of specific molecules and results of relevant genetic analyses, as well as published research articles. Some of this data is highly confidential and cannot be viewed by the others. Other information can only be reviewed under non-disclosure agreements. Still other data and results can be shared, with varying levels of protection, within the confines of the group. In addition, the group has access to a large number of on-line databases and research libraries.

Our host, Thierry, has identified a series of research articles from Nature, Science and JAMA and displays the abstracts, so everyone can see. He then moves them into a small pile in the lower right-hand corner of the wall. As the meeting progresses, people add additional articles and documents to the pile, which can be printed or leaved through at any point in the meeting. Thierry begins the session by showing an extremely large 3d model of the molecule of the active ingredient in vaccine A, written in pymol and displayed at very high resolution. He wants to demonstrate how this molecule prevents the 'docking' of the HIV virus with normal cells. George has a different type of model of vaccine B. Thierry shrinks his molecule and George displays his model next to Thierry's. They work together to see how the two molecules interact with each other, in the presence of normal cells.

This raises a question at the genetic level. Ivan displays the results of his research on gene therapy on chimpanzies, in which vaccine A proved to be effective in the laboratory. However, the corresponding mouse studies were inconclusive and he wonders whether this particular gene has an unusual incidence within this particular population. He diplsays 1000 gene sequences, aligned in multiple columns on the display wall and rearranges them to highligh particular patterns. Manuela is an expert on the origins and early evolution of the HIV virus first traced in the green monkey in Africa. She has developed a software visualisation tool that allows her to compare different gene sequences in different animals and humans and highlight differences, with about 10,000 nodes. George has a different approach, and shows the results of a comparative analysis he did by hand, over a period of

three days, which identified two unexpected relationships. Jun contributes a new algorithm that builds upon these two relationships and generates a new visualisation. He writes down the algorithm on paper, and projects it onto the wall. They ask Ann, participating at a distance from MIT, if she can run several additional analyses and display them when she is finished.

Sun Lee has been working with her colleagues in Vietnam and has the results of two recent epidemediological studies of HIV incidence rates in each of the villages where the two vaccines were tested. She appeals to Jimmy, who describes how the study was conducted, the details of the experimental protocol and the statistical analysis assumptions. Jason has brought a geneological map that shows the genetic lineage of this part of the country and Victoria begins exploring several on-line databases to see if she can answer his question. She diplays the top 40 results of her search in a series of windows on the wall. Jason updates his map accordingly.

Scenario: Emergency crisis management

A building in the southern suburbs of Paris is partly destroyed by an explosion and the emergency services arrived on the scene detect an abnormal radioactive environment. It quickly appears that the building housed radiating material that was dispersed in the atmosphere, mingling with the dust generated by the partial collapse of the construction. The retained hypothesis is that of a terrorist attack using a "dirty bomb" prepared in a cellar. In such a highly urbanized area, the detection of a CBRN agent triggers the activation of the "yellow plan": sending a reconnaissance team dressed in protective clothing, defining the danger areas and establishing a decontamination line. Very quickly, the physical communications between Paris where the crisis management operational centre is located and the south of the Ile-de-France are completely paralyzed, all traffic in the region is seriously disturbed and the crisis management centre must essentially work with the staff already on-site. The first measurements made in the field and the current meteorological situation point to a complex situation where it will be difficult to predict the evolution of the contamination. It follows that the original definition of the threatened areas is liberally done, inducing an additional inconvenience for the Civil Security teams.

Soon after the bombing, the crisis management centre (CMC) is networked with a Météo France centre (MFC) and a CEA centre staffed with experts in propagation of particles and toxic agents (PEC). These three centres each have one image wall, audio-visual links and tools for collaborative work on high definition images and 3D models. A ground model of the region of the bombing feeds the geographic information system shared by the three centres. Upon the establishment of connections, the CMC provides the other two centres with the latest information. In a constant dialogue with the experts who reconstruct the local weather conditions from the T0 of the attack, the PEC compares the results of fast simulations with actual observations. Within hours, the conditions of the attack (force of the initial explosion, contaminating particle characteristics ...) are relatively well determined. The PEC is then capable of anticipating the upcoming situation and at T0+12 hours a refined demarcation of danger areas is sent to the CMC. This is made possible by the quality of ongoing exchanges between the PEC and the CMC. In parallel, heavy computation means are mobilised to refine the working hypotheses and finer mapping is available at T0+24. Subsequently, the two centres of expertise continue to monitor the situation and issue the CMC with situation projections and local risk assessments. During this period of consolidation, direct connections are established between the PEC and the CBRN experts in

the field who can now communicate and receive information, opinions and assumptions from their laptops.

When the situation is under control, a large-scale intervention is decided with human and robotics means to confine the source of the contamination. A general scenario is first defined by a team at CMC. It is then simulated in a training centre for NRBC intervention (TCI). The execution of certain demanding steps is solved through collaborative exchanges with the PEC and a Virtual Reality Centre (VRC) where difficult actions are rehearsed in immersive conditions. The same procedures are used to prepare each player to the mission that awaits him. This training continues in the hours preceding the operation with laptops to access simulation tools and discuss the points remaining unclear. The operation is finally carried out under the control of the CMC, but with the full support of the remote centres of expertise (PEC, TCI and VRC) through mobile interfaces (standard iPhone) and the control stations of the robotised devices. This "remote collaboration" of the expert centres enables everyone to work under the best conditions, surrounded by the people with who he must establish the richest communication (the experts of his own domain), working on familiar hardware and software tools, benefiting from intuitive means of communication with experts from other domains or with the Civil Security teams, and without cluttering the operational centres already overburdened.

The above scenario involves a simple and robust management of confidential information. This is crucial because critical information must only get out under the control of the CMC ; on the other hand, exchanges between the CMC and centres of expertise should not be encumbered by a continual questioning of the opportunity to share certain information. It goes without saying that securing adequate means of communication is a prerequisite.

Scenario: Preliminary design of consumer products

Several designers are remotely or co-locally collaborating to prepare the first drafts of a new product geared to a large audience with the help of a group of potential end-users. Most of them are in different locations and are working within different facilities. The whole drafting process is split into 4 steps: Sketching, Part design, Styling, and Users' validation.

Sketching: Using simple drawing tools and table the graphic production of a first designer is captured by a video camera system. Another one is collaborating with him via a standard PC tablet. Their respective graphic production is partially analysed by advanced software to determine the type of drawing representation, to reconstruct some parametric shapes, as possible guides for next designing tasks, to recover colours and lighting information for esthetical needs on the future product. Furthermore, both can use see-trough devices, which provide visual feedback on the results of this analysis process, to help them correct the numerical draft of their work, and to introduce additional information on the objects they are designing (geometric references, cinematic information provided by other designers which are collaborating with them, text annotations and so on).

Part design: a CAD engineer is editing a numerical model of the above manual draft, partly from video images of the manual draft that his colleagues have provided, partly from the structured information already found by the analysis procedures previously described. One of his tasks is to dialog with the above designers, to remove any incompleteness or inconsistency that blocks the analysis process, or to eliminate the possible topological and physical mistakes delivered by this automatic system. This engineer uses a large immersive environment, with multiple stereoscopies to have a co-located collaborative interaction with

a set of experts (ergonomics, mechanics, electronics, manufacturing…). All may access to the drafted product and utilise a set of Haptic facilities to refine with there gestures moulding shapes or to select and apply virtual machining tools.

Styling: Using these CAD models, another team of designers is investigating colours and esthetical issues. Some tangible prototypes are produced by a stereo-lithography system based on the numerical drafts. Once again AR devices are used, but this time for simulating colours and texturing on the tangible prototypes. In addition, the latter are haptically augmented in such a way that haptic texturing investigations can be done by this team, to define and choose tactile features of materials which will have to compose the future object.

Users' validation: Last but not least, the visual and haptic AR interfaces used by the designers are also available to study the users' acceptance of the future products. Several tangible prototypes with specific geometrical shapes are ergonomically tested, while colour and haptic features found during the previous collaborative design process are evaluated. This time, the goal is to collect the quality preferences of the potential clients on these different possible products to refine the design of the future product.

Use-case: Advanced visualization for collaborative model-based design

Design of complex industrial systems involved in aeronautical, automotive or power industries now involves multi-scale simulation and optimization operated in distant collaborative processes as the underlying industrial supply chains now spread worldwide. A common challenge facing both researchers and industrial partners in the field is the large amount of data that need to be visualized from simulations and mathematical models: both scientific data (e.g. 3D models of airflow in airplane cabins) and abstract data (e.g. scatter-plots of simulation parameters and optimisation results); as pioneered for years within Georgia Tech's ASSL (Aerospace Systems Design Lab, www.asdl.gatech.edu) as well as in the large on-going CSDL (Complex Systems Design Lab) System@tic project, multi-scale design along the V-cycle additionally involves back-and-forth interaction with coarse-to-fine models; each model typically powered by High Performance Computing, the interactive visualization approach requires advanced coupling with a meta-modelling machine learning strategy to optimize computing power. Powered by an already-funded 1000-core méso-centre, the ECP node linked with other DIGISCOPE nodes will act as a platform for both researchers and industrial partners to interact with their data and complex models at very high resolution, compare different data views concurrently on the large number of displays (scientific vs. abstract), discuss with their colleagues their findings (both collocated and remote), and be able to explore in their multi-scale datasets and numerical design in an interactive and collaborative manner. Finally, it will act as one of many connected scientific collaboration hubs of other partners in the project (e.g. other DIGISCOPE nodes), promoting research on how to conduct scientific visualization and collaboration between distributed teams.

Use-case: Monitoring and training of computer-assisted surgery:

Surgical operations are complex procedure requiring the use of exhaustive hardware and software infrastructure. Training of new physicians to operate in such a complex and highly stressful setting is far from being trivial. This is usually achieved through observations of the operating room. Such a solution inherits numerous limitations. First, the viewpoint of the physician drastically improves the visual training component, since it can provide limited access to the process. Second, the natural presence of the training physician can be also problematic on top of the important number of acting operators in the OR room. Recently,

we have witnessed an enormous progress made on the acquisition of high-resolution video-streams using smaller and smaller devices that are also available for wireless infrastructure , as well constant increase of the bandwidth setting. This use case aims to use research progress made in the field of visual computing for advanced visualization and training. In particular, prior to the surgery, a 3D model of the operating room is recovered by simply explore research advances in computational stereo, as well as geometry. This model is constructed off-line. During surgery, live video streams are mapped to the 3D model. This is fairly simple if the cameras are static, but it can be done for pan-en-tilt cameras as well with dynamics registration to the model. This mapping provides a continuous 3D model of the operation room. Interaction with such an environment, given the obtained 3D model can happen at various scales. One can first put artificial viewpoints anywhere in the room and create views that would have been observed if there were a camera at this position. Furthermore, one can manipulate existing cameras through advance visual display and interfacing. The video streams recorded during the operation can be stored and the same operation can be done off-line, producing virtual views towards better understanding the process.

6.5. LETTERS OF ENDORSEMENT

The following institutions and companies have sent letters of endorsement for DIGISCOPE, showing the strong support for the project:

- FCS (Foundation in charge of the Paris-Saclay Campus);
- CNRS;
- ENS Cachan;
- Institut Telecom;
- Université Versailles Saint-Quentin;
- INRETS (research institute on transportation and safety);
- MOVEO (competitivity cluster on transportation);
- Teratec (association for high-performance computing);
- Microsoft France / Microsoft Research;
- Orange Labs;
- MEDIT (pharmaceutical screening);
- Dassault Aviation.

digiteo

Campus Paris-Saclay

Le Président

TRIANGLE DE LA PHYSIQUE

N/Réf : FCS-DT-SG/10-727

Saint-Aubin, September 14th, 2010

Position of the Foundation in charge of the "Campus Paris-Saclay" on major research equipments

In 2008, 19 research organizations or higher education establishments decided to create a campus located in the Plateau of Saclay. Seven among them will join the campus in the next years. This campus is already home to approximately 9 500 research staff involved in research and/or education and 17 000 students and delivers about 1 300 PhDs per year (in 2020 12 000 research staff and 27 000 students are expected). We intend:

- to promote scientific excellence, interdisciplinary, original research topics,
- foster the link between knowledge production and impact on economy,
- to be one of the most attractive place for researcher, students and companies.

The French programme "Investissements d'avenir" is a significant opportunity for us to accelerate this process. Indeed it provides tools to organize transverse programmes combining various skills and to support the emergence of novel ideas. More specifically, through the "equipment of excellence" call, large infrastructures related to these transverse programmes could be funded.

The 19 research organizations (including the seven which should join the campus in the next years) selected collectively the equipments which are of highest relevance for their collective goal. From 59 projects internally submitted by the researchers[1], 13 have been selected by a board of scientific directors:

- ✓ **CILEX**: Structuring a large community in an emerging field (Petawatt science).
- ✓ **C2M**: Mobilization of a large chemist community for health, environment, and information technology.
- ✓ **CASD**: Development of the interface between hard science, economics and social sciences. Synergy with the move of the main partner to the campus.
- ✓ **COGIS**: Interface between particle physics, astrophysics, and information technology.
- ✓ **DIGISCOPE**: Focusing a large community on a program on massive data, advanced interface for research and education.
- ✓ **Innov-Xes**: Large transverse program on embedded computers; related to the project of Institute of Technological Research).
- ✓ **MATMECA**: Collective effort of a world class research and education pole in the field of engineering.
- ✓ **METAGENEL**: Emergence of metagenomics based exploration of bacteria cell crosstalk with relevance to nutrition and human health.
- ✓ **MORPHOSCOPE**: Interface between optics and biology (morphogenesis).

[1] *Physics and nanosciences 23, health –food science -biology 12, information science and technology and engineering science 14 ,environmental science 3, chemistry 3, social science and humanities 1, others 3.*

Fondation de coopération scientifique Digiteo Triangle de la Physique
Les Algorithmes - Bâtiment Euripide
Route de l'Orme aux Merisiers - RD 128 - 91190 Saint Aubin
SIRET : 498 096 627 00027
Tél : (01) 69 33 21 66

- ✓ **PACEC**: Structuring a large community in the field of climate science. Synergy with other projects campus like our project of institute "climate-air-energy".
- ✓ **RAPSODY**: Interface between biology, ecology, and complex system science.
- ✓ **TEMPOS**: Organizing a large community with world class instrumentation in the field of nanosciences. Synergy with a large project of nanosciences center.
- ✓ **THOMX:** Development of an innovating tunable X ray source for medical science, applied physics, social science (cultural heritage) as well as in technology and industry.

The selection of these 13 projects (reduction by a factor 4,5) has been made using the following criteria:

- Scientific excellence of involved teams,
- Coherence with the following priorities (biology and health, food, information technology, environment and energy, high power laser),
- Synergy with other initiatives going on like arrival of research and education establishments, projects of "laboratory of excellence",
- Potential for creating economical value (in particular link with our project of Technological Research Institute (IRT)),
- Transformation and organisation of research communities,
- Initiatives at the frontier of disciplines (rendered possible by the synergy between various research organizations).

The Foundation which is managing the Paris-Saclay campus supports strongly these projects which would have a strong effect on the organization and the societal impact of our research.

Paul Vialle
President
FCS Digiteo – Triangle de la Physique

Monsieur Paul VIALLE

Président de la Fondation de coopération scientifique

Les Algorithmes- Bâtiment Euripide

Route de l'Orme des merisiers

RD128

91190 Saint-Aubin

Paris, le 08 septembre 2010

cnrs

www.cnrs.fr

Campus Gérard Mégie
3, rue Michel-Ange
75794 Paris cedex 16

01 44 96 40 00
01 44 96 49 13

Objet : Lettre de soutien pour les dossiers EQUIPEX des investissements d'avenir

Monsieur le Président,

Nous vous remercions de nous avoir transmis les dossiers de candidature aux Equipex en préparation au sein de votre établissement. Nous les avons analysés avec attention en nous appuyant sur notre connaissance d'ensemble des différents champs scientifiques, en tenant compte de notre implication sur chaque site ainsi que des ressources mobilisables. Nous pourrions ainsi apporter un soutien à l'opération suivante :

- DIGISCOPE, Infrastructure haute performance pour la visualisation interactive et collaborative

A l'issue du processus de sélection, nous serons disponibles pour participer aux négociations de consortium qui permettront de préciser les engagements des différents partenaires.

Nous vous prions de croire, Monsieur le Président, en notre parfaite considération.

Le Directeur scientifique référent
Pierre Guillon

Le Directeur de l'INS2I
Philippe Baptiste

Dépasser les frontières
Advancing the frontiers

ENS CACHAN

Le directeur

Tél. : +33 1 47 40 53 10 / 53 02 - Fax : +33 1 47 40 28 88

e-mail : jean-yves.merindol@ens-cachan.fr

September, Tuesday 14th, 2010

Letter of support

As the Director of Ecole Normale Supérieure de Cachan, I give my full support to the DIGISCOPE project which is submitted to the « Equipement d'Excellence » national call.

We will provide all necessary human and financial ressources, as described in the project.

The equipment associated to the DIGISCOPE project will contribute to the development of the scientific cluster in Saclay in which ENS Cachan is fully involved. It will be key element of our multidisciplinary research federation, the « Institut Farman » this institute adresses fundamental issues which are associated to practical engineering problems, in strong connexion with industry.

Jean-Yves Merindol
Director of ENS Cachan

La Spirale, 1957 - Germaine Richier

ÉCOLE NORMALE SUPÉRIEURE DE CACHAN
61, avenue du Président Wilson 94235 Cachan Cedex - France - Tél. : +33 1 47 40 20 00 - http://www.ens-cachan.fr

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Siret : 180 092 025 00014
APE : 85422
www.institut-telecom.fr

Paris,
Le 13 septembre 2010

Expression de soutien à l'Equipement d'Excellence DIGISCOPE

Le projet DIGISCOPE (Interaction pour des données massives) sera déposé par Michel Beaudouin-Lafon (LRI Saclay) au titre d'un consortium de laboratoires sous l'égide de la FCS de Saclay en réponse à l'appel à Equipements d'Excellence le 15 septembre 2010.

L'Institut Télécom apporte un soutien total à ce projet auquel participe très activement les laboratoires de recherche de son école Télécom ParisTech. DIGISCOPE proposera de déployer une infrastructure répartie de plateformes pour l'interaction collaborative avec des données et des calculs massifs. Dans ce projet, l'Institut Télécom participera de façon déterminante à 3 composantes :

- Tout d'abord pour développer des solutions innovantes d'assistance à l'interprète humain dans ses tâches cognitives supérieures (Télécom ParisTech saura en particulier mettre à profit ses compétences pluridisciplinaires exploitant au mieux ses ressources tant en informatique qu'en Sciences Humaines et Sociales : psychologie, ergonomie, ...)
- Puis pour faire partager son expérience théorique et pratique dans les problématiques d'interconnexion sécurisée à très haut débit,
- Enfin pour contribuer aux expérimentations en vraie grandeur à travers ses applications : réalité virtuelle, modélisation tridimensionnelle, fouille de données en imagerie cérébrale et en imagerie satellitaire.

Ces travaux, menés conjointement avec le CEA, le CNRS, l'INRIA et plusieurs acteurs académiques de Paris Centre et du Plateau de Saclay, constitueront une plateforme de grande valeur pour tester et expérimenter les nouveaux dispositifs d'affichage, d'interaction et d'échanges entre centres distants.

Jean-Claude Jeanneret
Administrateur Général

TELECOM PARISTECH
TELECOM BRETAGNE
TELECOM & MANAGEMENT SUDPARIS
TELECOM ECOLE DE MANAGEMENT
TELECOM SUDPARIS
TELECOM LILLE1
EURECOM

UNIVERSITÉ DE VERSAILLES SAINT-QUENTIN-EN-YVELINES

LA PRESIDENCE

Versailles, le 14 septembre 2010

La Présidente de l'Université de Versailles Saint-Quentin-en-Yvelines

Affaire suivie par :
Monique Cohen
Tél. 01 39 25 78 14
Fax. 01 39 25 78 01
Mél. : service.recherche@admin.uvsq.fr
Réf : SF/MC/HC/DREDVal-10/304

à

Agence Nationale de la Recherche
Programme Investissements d'avenir
EQUIPEX 2010
212, rue de Bercy
75012 Paris

Subject: Letter of support for the DIGISCOPE Project

The DIGISCOPE project is submitted to the « Equipement d'excellence » national call within the framework of the System@tic « pole de compétitivité », of which University of Versailles Saint-Quentin-en-Yvelines (UVSQ) is a partner.

This equipment will be a key element for the education as well as research programs of UVSQ:

The « Simulation and Modelisation » master degree which is managed by UVSQ, together with INSTN-CEA, has close partnership with ENS Cachan, Ecole Centrale and ENSTA, and this equipment will allow coordinated education programs with those institutions, which will host similar equipments. As regards research, this equipment will favor work about the use of information and communication technologies by actors of cognitive and social sciences as performed in the REEDS laboratory. It will also permit the development of new methods to analyse the outputs of simulation studies, involving solar system plasmas and planetary atmospheres. The recent building hosting the observatory (OVSQ) if perfectly adapted for this equipment,

As the president of UVSQ, I give my full support to the DIGISCOPE project, and UVSQ will contribute to the running of the equipment by allocating one engineer to support the project.

UNIVERSITE DE VERSAILLES - ST-QUENTIN-EN-Y.

Sylvie FAUCHEUX
Professeur des Universités

INRETS
Institut national de recherche sur les transports et leur sécurité

GRETIA

14/09/2010

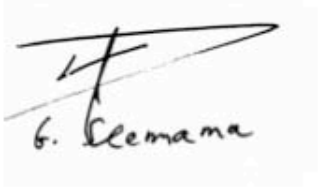
Pour faire savoir à qui de droit

En tant que Directeur du laboratoire GRETIA de Génie des Réseaux de Transport et d'Informatique Avancée de l'INRETS, je déclare tout mon intérêt pour le projet d'équipement d'excellence, intitulé DIGISCOPE de calcul, de visualisation et de stockage des données, porté par le "Centre de Mathématiques et de leurs Applications" CMLA de l'ENS-CACHAN.

D'une part, nous pouvons mentionner une collaboration fructueuse ces dernières années avec le professeur Florian De Vuyst du CMLA sur le thème des fouilles de données spatio-temporelles.

D'autre part, le GRETIA est lui-même porteur d'un projet CLAIRE-SITI d'un équipement référentiel pour l'Intermodalité dans le transport qui s'appuiera sur le site pilote du département de la Seine Saint Denis. Ce dernier devra se confronter à des problèmes complexes de traitement dynamique de données, de stockage et de visualisation multi-dimensionnelle pour lequel l'équipement DIGISCOPE pourrait apporter des réponses. En retour, CLAIRE-SITI servirait de base expérimentale à DIGISCOPE.

Pour toutes ses raisons, je soutiens très fortement le projet DIGISCOPE qui permettra de contribuer à la résolution de problèmes complexes et pour ce qui nous concerne, à des progrès dans la gestion du transport.



Etablissement public à caractère scientifique et technologique
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Tél : +33 (0)1 45 92 55 00 - Fax +33 (0)1 45 92 55 01
SIRET INRETS BRON 180 060 022 00092 - APE 7219 Z
http://www.inrets.fr

mov'eo

Pôle de compétitivité

Des automobiles & moyens de transports avancés sûrs pour l'Homme et son environnement

Affaire suivie par : Nicolas DATTEZ
Tél : 06 10 27 53 57
Email : nicolas.dattez@pole-moveo.org

BEAUDOIN-LAFON Michel
LRI Bâtiment 490
Université Paris Sud
91405 ORSAY

Satory le 14 septembre 2010

Objet : projet « DIGISCOPE»

Je soussigné, Gérard-Marie MARTIN Pilote du DAS SME de Mov'eo (Domaine d'Activités Stratégiques « Systèmes Mécatroniques pour l'Electrification du véhicule »), atteste que le projet d'EQUIPEX DIGISCOPE est en cours d'examen au sein du comité de pilotage du DAS SME dans le cadre du processus de labellisation Mov'eo.

Le comité confirme que les équipements proposés dans ce projet sont en cohérence avec les thématiques stratégiques développées dans Mov'eo. Il est donc « Recevable » selon la procédure de labellisation du pôle.

Le projet étant en cours d'accompagnement, d'évaluation et d'expertise, cette attestation ne constitue pas à ce stade un soutien officiel de la part du Pôle. La seule expression de soutien d'un projet par Mov'eo étant la labellisation.

Bien cordialement
Gérard-Marie MARTIN

Bruyères-le-Châtel, 14 septembre 2010

A propos du projet DIGISCOPE,

La visualisation interactive et collaborative de très grands ensembles de données et de systèmes complexes constitue un élément clef de l'exploitation des résultats fournit par le calcul à très haute performances. Ainsi l'importance pour Teratec et de ses membres de ce domaine a été récemment démontrée. Lors du forum Teratec qui s'est tenu en Juin dernier une session particulière a été consacrée à la visualisation et a rassemblé plus de 200 spécialistes français et étrangers.

Dans ce contexte nous attendons que le projet DIGISCOPE nous aide à comprendre et prendre en compte les nouvelles orientations et activités de la visualisation et nous faisons confiance aux membres du projet et en son directeur Michel Beaudoin Lafon pour y parvenir.

Pour ces raisons nous soutenons pleinement le projet DIGISCOPE et nous souhaitons qu'il reçoive le financement demandé

Gérard Roucairol

Président de Teratec

Association TER@TEC
Siège Social : "Zone d'activité TER@TEC" - Domaine du Grand Rué
91680 BRUYERES LE CHATEL - Tél. : 01.69.26.61.76 - Fax : 01.69.26.43.04

Association régie par la loi du 1er juillet 1901 modifiée et le décret du 16 août 1901

Microsoft
39, Quai du Président Roosevelt
92130 Issy-les-Moulineaux

Téléphone : 0 825 827 829*
Télécopie : +33 1 57 75 77 00
Web : www.microsoft.com/france/

Microsoft

Nathalie Wright
Directrice de la division Secteur Public
Microsoft France
39 quai du Président Roosevelt
92130 Issy-les-Moulineaux

Paris, le 9 septembre 2010

A

Comité d'évaluation
Appel à Projet Equipex

Je soussigné, Nathalie Wright, Directrice de la division Secteur Public au sein de la société Microsoft France, vous confirme par la présente que Microsoft France apporte son soutien de principe à la proposition DIGISCOPE coordonnée par le Professeur Michel Beaudouin-Lafon en réponse à l'appel à projet EQUIPEX.

Microsoft s'intéresse en effet au développement des technologies d'interactions naturelles, à la recherche de nouvelles techniques de visualisation et de manipulation de très grands volumes de données ou de systèmes complexes, ainsi qu'à l'exploration des nouveaux scenarios de collaboration permis par ces technologies.

Cet intérêt est lié à une vague d'innovations technologiques (telles que Microsoft Surface, Windows Seven, Kinect, Windows HPC, Windows Azure) et à nos activités de Recherche et Développement, qui sous l'égide de Microsoft Research sont mises en œuvre en étroite collaboration avec la communauté scientifique internationale).

Nous estimons, à cet égard, que DIGISCOPE et les projets associés ouvriront sur de nouvelles opportunités d'innovation au service de scenarios particulièrement exigeants comme l'ingénierie ou le calcul haute performance. Nous sommes également intéressés par l'exploration du potentiel pédagogique du projet, en étroite collaboration avec ses partenaires académiques.

Dans ce cadre, nous souhaitons rappeler au Comité notre engagement existant auprès de plusieurs partenaires du projet, comme l'Ecole Centrale de Paris (mise en œuvre de projets pédagogiques autour de l'interaction de surfaces et du calcul haute performance) ou le LRI à l'université de Paris Sud (à travers le projet ReActivity du Centre de Recherche Commun INRIA-Microsoft Research à Orsay).

Pour toutes ces raisons, nous soutenons avec enthousiasme le projet DIGISCOPE et souhaitons que Microsoft deviennent un membre actif de son groupe d'utilisateurs (Users Group). Nous espérons, en conséquence que le Comité d'évaluation retiendra ce projet.

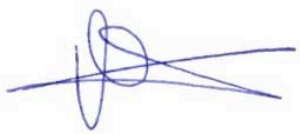
S.A.S. AU CAPITAL DE 4.240.000€ - RCS NANTERRE 327733184 - APE 511G - SIRET 32773318400516

* numéro indigo : 0,15€TTC / mn

Microsoft

Bien évidemment, notre implication matérielle ne pourra se réaliser qu'à réception des éléments concrétisant la création effective de l'infrastructure DIGISCOPE, des mécanismes de sa gouvernance et des premiers projets sélectionnés.

Je vous prie de croire, Mesdames, Messieurs les membres du Comité d'évaluation à l'expression de ma considération la meilleure,



Nathalie Wright
Directrice de la division Secteur Public

Issy les Moulineaux
10/09/10

Dr J Wiart
France Telecom Orange labs RD
38-40 Rue du General Leclerc
92794 Issy Moulineaux cedex 9, France
Phone: +33145295844
Fax +33145294534
Joe.wiart@orange-ftgroup.com

Michel Beaudouin-Lafon
Université Paris-Sud

Monsieur,

France Télécom-Orange est un des principaux opérateurs de télécommunications dans le monde.. Au 30 juin 2010, le Groupe comptait 182 millions de clients dans 32 pays, dont 123,1 millions de clients du mobile et 13,2 millions de clients ADSL dans le monde. Orange est le troisième opérateur mobile et le troisième fournisseur d'accès internet ADSL en Europe et l'un des leaders mondiaux des services de télécommunications aux entreprises multinationales.
Les Orange Labs constituent le réseau mondial d'innovation du Groupe France Télécom-Orange. Créés en 2006, ils regroupent 5 000 collaborateurs (chercheurs, marketeurs, ingénieurs) dans 18 pays sur 4 continents.. Le réseau international des Orange Labs concrétise l'ambition du groupe de donner un nouveau souffle à l'innovation pour en faire le moteur de sa transformation.
La R&D est la source principale d'innovation pour le groupe avec plus de 8500 brevets à son actif. Elle est composée de 3 800 chercheurs répartis dans 15 laboratoires sur trois continents (8 en France et 7 laboratoires répartis en Europe, Amérique et Asie).
Les réseaux de télécommunication utilisent de plus en plus des systèmes sans fils basés sur des ondes électromagnétiques.
Dans ce cadre nos actions de recherche s'intéressent aux interactions de ces ondes avec les personnes. Dans le cadre des collaborations nationales et internationales telles que celle mises en œuvre dans le projet ANR JST Fetus la visualisation de données est essentielle.
Compte tenu de la qualité de l'équipement DIGISCOPE et de sa capacité à répondre à des besoins de recherche et développement nous soutenons la mise en place de cet équipement et envisageons de s'inscrire comme utilisateur.

Je vous prie d'agréer, Monsieur, l'expression de mes salutations distinguées.

Dr J. Wiart

Orange Labs
Research & Development
38-40 rue du Général-Leclerc - 92794 Issy Moulineaux Cedex 9
phone : + 33 1 45 29 44 44

From : François Delfaud, CEO MEDIT SA
2 rue du Belvédère, 91120 Palaiseau, France
fdelfaud@medit.fr , tél : +33 1 6014 8743

Palaiseau Monday September 13th 2010,

We are pleased to endorse the DIGISCOPE project proposal led by Michel Beaudouin-Lafon.

While MEDIT SA develops a global chemo-proteomic software solution for pharmaceutical R&D in order to better select protein targets and to provide new drug candidate, it's clear that this segment market is actively looking for innovative solution to mine graphically several source of information simultaneously. And some of our customers are already using wall screen. MEDIT SA is by consequence definitely interested in interactive and collaborative visualization of large data sets and complex systems.

For example, we are already mining the 3D interaction surface between protein and ligand in the protein data bank (more than 67000 biostructural entries), our MED-SuMo/MED-Ligand application requires very large number of pixels to sort and classify all hits, including several chemical or protein based annotations.

In the Carriocas project (Systematic competitiveness cluster), we presented a complete "fragment based drug design" application on the EDF wall screen (4000x6000pixels), being able to browse simultaneously several MEDIT protocol in a real pharma case study.

Furthermore, we already explored in the SVIC preproposal (Surface de Visualisation Interactive Collaborative, labelled by the Systematic competitiveness cluster) different user cases to share multiple sources of information from different computer, a prototype has been developed.

We are enthusiastic about using DIGISCOPE and plan to become an active member of its Users Group. We expect DIGISCOPE to enable us to explore new applications for pharma industries which will give us a competitive advantage. For these reasons, we fully support the DIGISCOPE project and urge the committee to fund this proposal.

François Delfaud – MEDIT SA CEO

M.E.D.I.T. SA (**M**olecular **E**xtended **D**istribution in **I**nformation **T**echnology)
Capital de 248230€ - No Siret 448 815 142 00022 – Code APE 5829C
2 rue du Belvédère, 91120 Palaiseau – Tel: 01 60 14 87 43 – info@medit.fr
http://www.medit.fr

DASSAULT AVIATION

Saint-Cloud , le 14 SEP. 2010

DIRECTION GENERALE TECHNIQUE

UNIVERSITE PARIS XI

A l'attention de Monsieur BEAUDOUIN-LAFON

DGT/DPR/ESA 579278
MR/MFM

OBJET : Lettre de soutien à l'infrastructure haute performance pour la visualisation interactive et collaborative DIGISCOPE.

Monsieur,

Dassault Aviation est un véritable maître d'œuvre de systèmes. Ceux-ci demandent un savoir-faire essentiel en matière de coordination, de gestion de la compatibilité des systèmes intégrés et d'intégration, depuis la phase de conception jusqu'à celle de la production et du support. Il est nécessaire, dès les phases les plus amont du projet, de comprendre comment les exigences interagissent, quel est leur impact sur le dimensionnement, quels sont les choix possibles et leurs probabilités de succès associé…
La simulation numérique utilisée dans un environnement adéquat peut être utilisée pour l'aide à la décision en mettant les décideurs en situation d'explorer rapidement le comportement du système pour différents scénarios. Tous les résultats générés doivent enfin être synthétisés pour proposer une aide véritable à la décision en mettant en évidence les butées, les taux d'échanges entre les performances élémentaires et les performances globales afin de réaliser les bons compromis entre les spécifications ou les critères de design. Le risque associé aux décisions doit être quantifié pour gérer les marges de manière rationnelle. L'ambition est de plonger les décideurs dans l'espace de décision ou plus précisément dans l'espace des compromis afin de leur permettre de mieux appréhender ce qu'ils cherchent en leur fournissant immédiatement des éléments de réponse à leurs questions. Il est nécessaire de pouvoir réaliser cela en mode collaboratif pour que tous les acteurs puissent mesurer l'impact des interactions multiples et d'être capable de remonter l'analyse au niveau du système.

Tout cela nécessite de s'appuyer sur des méthodologies et outils à la mise au point desquels participe le projet CSDL du pôle System@tic auquel de nombreux membres de DIGISCOPE participent. Cette mutation va nécessiter la création de nouveaux métiers tant pour le développement des outils de conception que pour leur utilisation effective en conception et l'initiative DIGISCOPE permettra d'apporter un support aussi bien méthodologique que technologique sur le long terme.

L'excellence scientifique, la multidisciplinarité et la complémentarité des équipes participantes à DIGISCOPE permettront d'utiliser au mieux des infrastructures novatrices tant pour la résolution de problèmes scientifiques que pour des utilisations proches des applications industrielles.

J'apporte tout mon soutien à leur dossier.

Nous vous prions de croire, Monsieur, à l'assurance de notre considération distinguée.

Bruno STOUFFLET
Le Directeur de la Prospective
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