Towards a European Distributed Experimentation Capability

Mick Priestley – MBDA UK

Ben Walker – MBDA UK

Antonella Spanó – MBDA Italy

Francois Monjanel – MBDA France

MBDA (UK) Limited
Six Hills Way
Stevenage
Hertfordshire
SG1 2DA
+44 (0)1438 752581

mick.priestley@mbda.co.uk

ABSTRACT

Distributed modeling and simulation capabilities have become a key element of experimentation, supporting transformation, Simulation Based Acquisition and Networked Enabled Capability. For some time, MBDA Missile Systems has had experimentation facilities in the UK, France and Italy. In the UK, the company has a Distributed Experimentation Capability consisting of a high bandwidth network linking the Simulation Centre at Stevenage, the System Integration Facility at Bristol and the Trials Facility at Bedford.

Over the last two years, a multinational team, part of the Synthetic Environments Centre of Excellence within the company, has been established. Its primary objective is to create a company wide European Distributed Experimentation Capability, linking the facilities in the UK, to Châtillon in France and La Spezia in Italy. Different link technologies are being evaluated, including internal company networks and the Internet. As part of this evaluation, a Test-Bed infrastructure was established in the UK and distributed to France and Italy for the integration of French and Italian simulations. An interim milestone was a co-located experiment held at the end of 2005. However, the capability continues to be developed to achieve the distributed networking capability. Extensive use is being made of Collaborative Working Environments including: an SE Web on the company's Intranet and an always-on video conferencing.

This paper outlines the challenges of creating such a distributed capability covering: working across national boundaries, export controls, distributed teams, the network technologies and the benefits of sharing a common toolset and approach.

1 INTRODUCTION

Distributed modeling and simulation capabilities have become a key element in the experimentation that supports transformation, Simulation Based Acquisition (SBA) and Networked Enabled Capability (NEC). SBA is part of the new procurement process, which considers the use of simulations throughout the CADMID lifecycle and its use of simulation in the Concept and Assessment phases of a program is well

Priestley, M.; Walker, B.; Spanó, A.; Monjanel, F. (2006) Towards a European Distributed Experimentation Capability. In *Transforming Training and Experimentation through Modelling and Simulation* (pp. 14-1 – 14-10). Meeting Proceedings RTO-MP-MSG-045, Paper 14. Neuilly-sur-Seine, France: RTO. Available from: http://www.rto.nato.int/abstracts.asp.

understood. Synthetic Environments (SE) also supports NEC by allowing users and engineers to explore the information exchange across systems and thus enable Rapid Prototyping.

SE's play an important role because they provide the capability to link models and simulations together and enable the interoperability. SE's also provide the additional benefit of being able to visualize the emergent, simulated battle-space, which give a better understanding of the complex interactions between systems. This is indeed a highly valuable commodity especially when we are able to place customers or users in-the-loop.

MBDA Missile Systems has for some time made use of simulation based experimentation facilities in the UK, France and Italy. Over the last two years, a multinational team, part of the Synthetic Environments Centre of Excellence (SECE) based within the company, has been formed. Its goal is to establish a collaborative working practice and infrastructure which will enable the international partnerships within the company to make use of SE to support SBA and NEC.

2 COLLABORATIVE WORKING

2.1 Three Ways to Simulate

It is the inevitable fact that within a newly formed multinational company there will exist, for a time, distinctive patterns, practices and working culture.

In the UK the SE Team has been using a common SE-based approach since 1995 [1]. They have developed a set of core software libraries to provide a middleware layer between applications using the DIS and HLA protocols. The middleware layer provides a foundation for a mature SE Toolset, which has been used extensively on many national and multinational projects. Federation development processes have been developed to support rapid prototyping and integration, together with Smart Prototyping Environments, that support the design, test and integration of complex systems using real and virtual equipment [2].

In the France there are many different uses for simulation. The SE Team has been predominantly focused on the development of Future Federated Training Systems and battle models, making use of SE-API to achieve DIS and HLA compliance. Through rapid prototyping techniques their future potential is to support joint training and system of systems components.

In Italy there are also many different uses for simulation. The SE Team makes extended use of Simulink as a model development and validation platform. The team is increasingly making use of Synthetic Environments within Air Defense and Command and Control simulations.

2.2 SE Centre of Excellence

The UK SE Team has been chosen to be the Centre of Excellence for Synthetic Environments across MBDA (SECE). Its objective is to provide co-ordination and leadership in SE's by:

- Sharing best practice;
- Enabling the sharing of a common SE Toolset;
- Encouraging the common use of SE-API;
- Consolidating research activities;

- Focusing the company's education strategy through the in-house Missile System University, providing standard SE briefs and distribution of user guides;

To forge collaborative working, the SECE is using a joint study with the UK, France and Italy SE Teams, using the following program of work:

- 2004 planning and component development;
- 2005 linked collocated simulations;
- 2006 distributed linked simulations;

2.3 Objectives

The primary objective of this program is to create a company wide European Distributed Experimentation Capability that links the facilities in Stevenage in the UK, to Châtillon in France and La Spezia in Italy.

The objective drives these additional goals:

- The development of a world class SE capability, providing MBDA with a unified and distributed SE Capability that can support multinational projects;
- The development of core competencies in: simulation open-standards, distributed simulation, and integration and exploration of the interoperability of constructive, virtual and real equipment;
- The development of a Common SE Toolset available across the UK, France and Italy;
- The development of a Common Test-Bed infrastructure and architecture and ensuring that the Test-Bed components available across the international company;
- The capture and dissemination of best practice;

2.4 Collaborative Working Environments

To support the efficacy of international working, extensive use is made of Collaborative Working Environments (CWEs). These create an approachable, use-friendly foundation on which to build the inter-team dialog and working practices. The established CWE includes a Euro SE Web hosted on the company Intranet and an always-on networking and video conferencing facility.

2.4.1 Euro SE Web

The Synthetic Environments International Web, or Euro SE Web, has become the single source of SE information across the company and is accessible from any standard desktop in all three nations, figure 1. The Euro SE Web hosts information on:

- The Common SE Toolset;
- The program of events within the SE community;
- The SE Centre of Excellence;
- The international Applied Research programs;

In addition, the service is bi-direction. Users are allowed to upload information, documents, help guides, software and toolset components onto the web. Users at any site can then download them for immediate use.

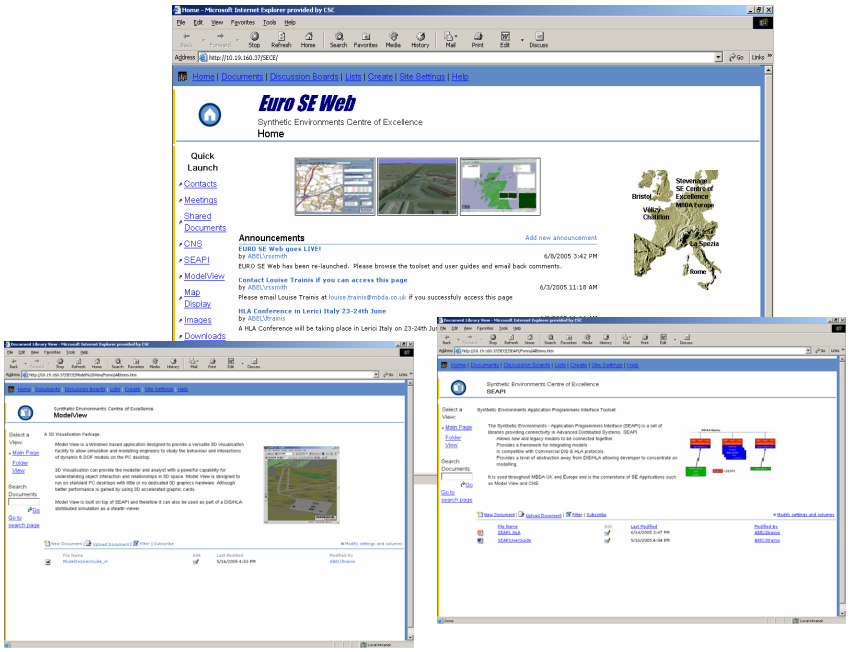

Figure 1: The Synthetic Environments International Web (Euro SE Web).

2.4.2 Always-on Networking and Video Conferencing Facilities

The approach to developing Synthetic Environments has always been to follow a familiar set of steps:

- Develop a common infrastructure;
- Develop components at national level, initially in isolation;
- Collocate for integration;

However, to support distributed working practices and "online integration" the SE Teams have constructed a set of dedicated infrastructure elements, namely a Wide-Area Network (WAN) and a video conferencing facility. The WAN between each site uses either ISDN or a bandwidth-share on the company's IWAN for exclusive use by the SE Teams. The direct network links dedicated to SE support a rapid integration timeframe. Developers are given remote computer access to allow remote software debugging, configuration checking or the latest software transfers.

The WAN can be considered always-on and supports the additional video conferencing facility between all three countries. There have been many benefits to these dedicated facilities. With the always-on video conferencing, the SE Teams can create an effective "virtual office". Cost savings through minimised travel are attained by a ready ability to conduct ad-hoc meetings and immediate access to local experts.

All these benefits give a faster integration cycle by providing, firstly, a faster and more agile response to changing requirements and experimental needs, and secondly by keeping team members informed.

2.5 Common Test Bed Infrastructure

As part of the joint program, a Common Test-Bed infrastructure was established in the UK and distributed to France and Italy for the integration of French and Italian simulations, figure 2. The Common Test-Bed defines three features: a common architecture, a common infrastructure and common components.

2.5.1 Common Architecture

The common architecture defines a baseline solution, which may be built upon and extended. The architecture also defines a road-map that can be exploited for re-use across project domains, while maintaining a consistency of approach. This supports rapid re-use and develops a common understanding between domains.

2.5.2 Common Infrastructure

The Common Test-Bed components are built upon the SE-API middleware and are, therefore, both DIS and HLA compliant. However, it is our practice to use HLA during experimentation whenever possible.

Consistency of the FOM within the Common Test-Bed is achieved amongst partners by using a single, inclusive "Common Operating Environment FOM". The FOM is based on RPR-FOM v1 with extensions to meet individual project needs and includes the Link 16 BOM proposed by SISO [5].

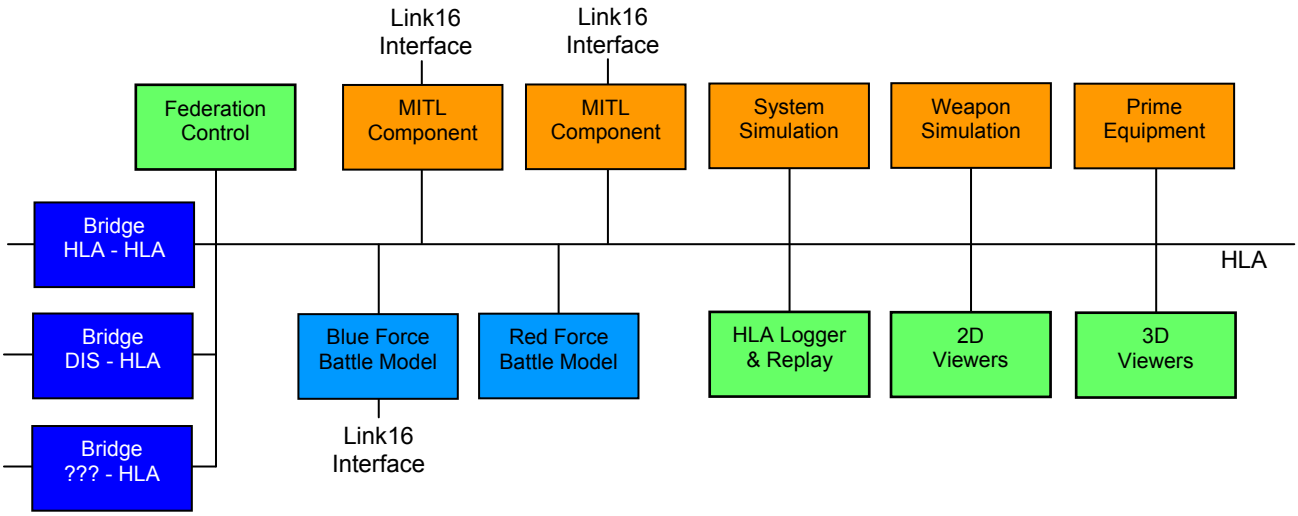

Figure 2: The Common Test-Bed Infrastructure.

2.5.3 Common Components

The common components of the Test-Bed cover a number of areas:

- Bridges to interface to any number of DIS and HLA federates and federations;
- Bridges to interface the SISO compliant Link 16 federation to the Link 16 SIMPLE NATO standard [6];
- Federation Control to manage the federation execution when all sites are in operation;
- Blue Force and Red Force battle models;
- Support and integration tools such as Logging and Replay, 2D and 3D god's-eye views;

2.6 Support to Users

Support to users of the Common Test-Bed technology is given in terms of workshops, user guides, video conferences and the SE Euro Web. The company as a whole is given support through participation in the Missile Systems University.

As an example of support to users, during the joint study, an interim demonstration was conducted to give the team an understanding of the philosophies and practices behind SE. The demonstration was in the form of a co-located experiment held at the end of 2005. It provided a basis to reinforce the Common Test-Bed and associated practices of work, the Collaborative Working Environment, common toolset, etc.

3 DISTRIBUTED CAPABILITY

In the UK, the company has a Distributed Experimentation Capability consisting of a high-bandwidth, secure network linking the Simulation Centre at Stevenage, the System Integration Facility at Bristol and the Trials Facility at Bedford.

For connections between the European sites, different link technologies are being evaluated, including guaranteed bandwidth on the internal company network (IWAN), ISDN and the Internet.

The need for low-latency connections with minimal timing jitter is well understood, especially when the links need to support real-time, fast maneuvering targets. The connections established by the SE Teams have proven to be adequate for their desired purposes. Table 1 shows the typical timings for the IWAN connections.

Between Sites	Mean turnaround time (msecs)	Variation (msecs)	Peak (msecs)
UK & France (Vélizy le Bois)	25	10	164
UK & Italy (Rome)	70	4	108
UK & Italy (La Spezia)	110	-	-

Table 1: Timing results for WAN Tests.

Since the initial co-located demonstration, several experiments and demonstrations have been conducted across the European WAN involving all three sites. A typical federation is shown in figure 3. The capability continues to be developed to achieve an even better distributed networking capability. The SE Teams believe the Collaborative Working Environment and distributed capability is unique across Europe and provides a world-class capability, figure 4.

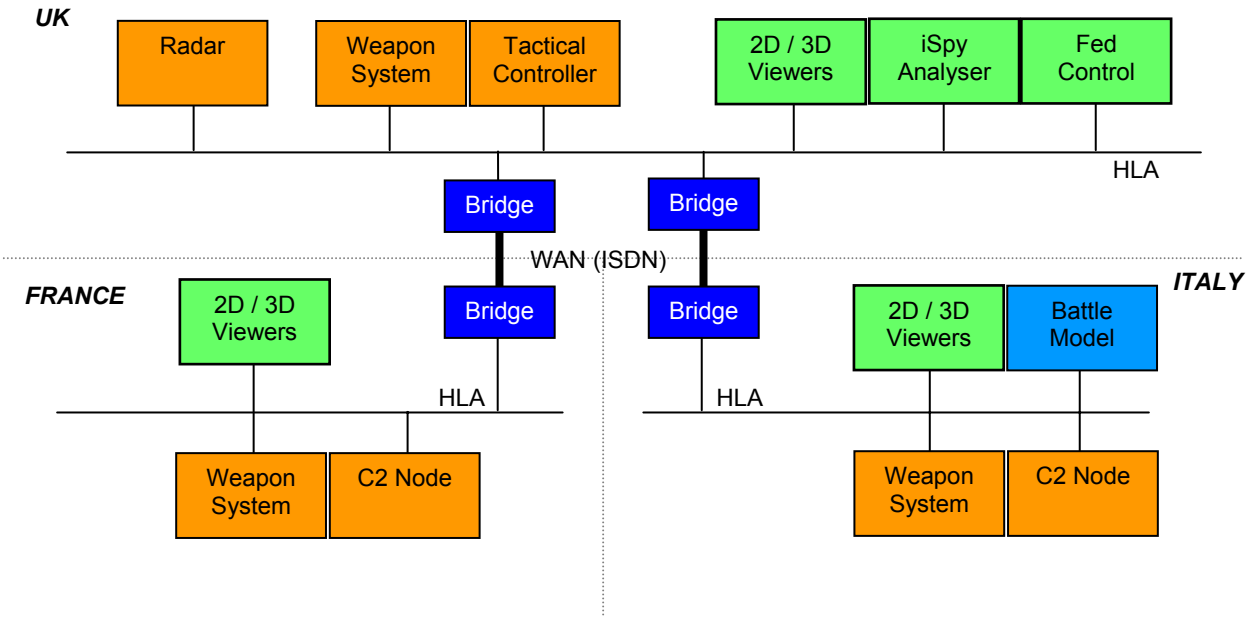

Figure 3: The Distributed Common Test-Bed.

4 WORKING PRACTICES

Working across national boundaries inevitably creates challenges: distributed teams, and their need to travel, have largely been mitigated through the Collaborative Working Environment; language and cultural differences are used as an opportunity to discover rather than hinder.

Export controls between nations can be challenging and the approach of the SE Teams has been to prepare insensitive tools, datasets, etc. to ease consent for their release.

Networking technology is relatively low risk due to the open standards being adopted internationally. The greatest challenge is the network latencies, especially when real-time simulations are involved, which include fast manoeuvring assets. This difficulty is reduced by the teams' readiness to share experience in this problem and solutions become readily available.

The practice of pooling tools to form a common toolset and aligning SE practice has been encouraged and the benefits of reuse and cooperation have been appreciated by the SE Teams and clearly demonstrated to the company.

5 CONCLUSIONS

The importance of SE to support the SBA process and the realization of NEC is appreciated by MBDA and an international capability has been sought. A programme of activities has been facilitated by the SE Centre of Excellence in partnership with teams across Europe.

The close co-operation of the teams has allowed them to pool their resources and experience to form:

- A common set of tools, models and simulations, for re-use;
- A common infrastructure through SE-API;

- A common set of working practices;
- The potential to link internally via IWAN and externally to other companies and facilities via ISDN

All of these are embedded within a Collaborative Working Environment for access by all members of the SE Teams.

The team believes that its approach has achieved the goals of:

- Cost savings and risk reduction to company programmes;
- The sharing of a common toolset;
- The sharing of best practice;
- A European Distributed Experimentation Capability to support MBDA activities.

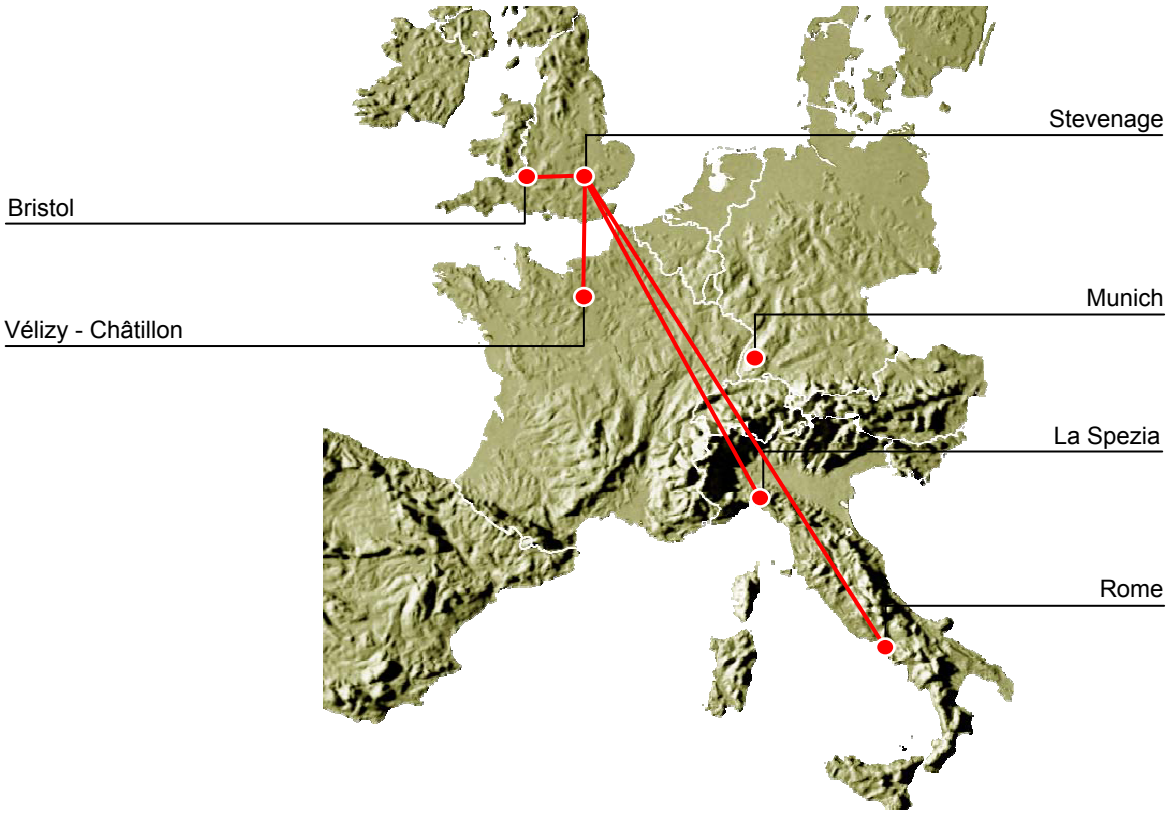

Figure 3: The MBDA Distributed Experimentation Capability.

6 REFERENCES

[1] R. Smith (2005). *SE-API – A Synthetic Environments Toolset*. HLA Conference 2005, Lerici, Italy.

[2] M.D.J. Priestley (2004). *Rapid SE Prototyping – A Key to Smart Integration*. SE National Advisory Committee (SENAC) Conference 2004, London, UK.

[3] L. Trainis (2005). *Distributed Integration for NEC*. SE National Advisory Committee (SENAC) Conference 2005, London UK.

[4] C. Rouget (2006). *Development and Evaluation of a Federated Link 16 Test-Bed*. Royal Aeronautical Society (REaS) Conference 2006, Boscombe Down, UK.

[5] Simulation Interoperability Standards Organization (SISO). *Link 16 Simulation Standard*. SISO-STD-002-V2.9.6

[6] North Atlantic Treaty Organization (NATO) Military Agency for Standardization (MAS) Standardization Agreement (STANAG). *Standard Interface for Multiple Platform Link Evaluation (SIMPLE)*. STANAG 5602.