



Joint Investment Programme on Innovative Concepts and Emerging Technologies

Progress Report

1. Project	2. Acronym	3. Payment Milestone
A-1133-RT-GC	METAFORE	PM 01

4. Author, Contact Information, Signature

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Noain, Spain, May 5th 2011. Sign

A handwritten signature in blue ink, appearing to read "Jose Antonio Marcotegui".

5. Releasable Summary

During the first six months of the project, we have prepared a review of the main results achieved in metamaterials as a rapidly expanding new technology with a main emphasis in the applications, many of them with clear relevance to defence. Extreme parameter media have been reviewed because its unconventional properties and potential antenna applications. Also, cloaking by it could be used in the future for reducing or shaping radar cross section. Similar phenomena are observed for acoustical waves, which are clearly relevant for sonar and other naval applications. The extension of these concepts to shorter wavelengths, from the terahertz up to infrared, and visible wavelengths, has been discussed too. The most recent advances in metamaterial technology are discussed, and particularly, the related with the possibilities of control in metamaterial structures and those where superconductors and more futuristic ideas are introduced.

In order to identify the possible applications of metamaterials in military systems, we have analysed several sources of information as they are research projects having defense purposes with some disclosed information, the scan and analysis of patent applications having potential relation with applications of metamaterials to defense systems and also some research papers. In this way, we have identified a broad list of topics where metamaterials could improve some of the today's limitations of defense systems and give us some paths for future evolution of such systems.

This work presents firstly the period of time comprised from now up to the next 10 years and a probable geographic localization of the developments, and later a forecast up to 20 years. Also a description of the areas of expertise by countries is given. Note that, up to now, the usefulness of metamaterials is still under discussion due to the existence of cases where they have succeeded and other situations where conventional technologies have not been surpassed. RF, microwave, millimetre wave, terahertz, infrared, optical and acoustic metamaterials have been analysed giving a time scale of probable developments. The introduction of gain and controllable structures have been discussed and placed in the time axis. Much more sophisticated technologies employing metamaterials have been placed into the second half of the ten years time period due to the needed fabrication methods advances to reach such devices.

The assessment of the impact of this technology in future military systems is given under the basis of a review of some open documents from world wide web. Finally, unknown new capabilities have been identified from the available open information.



6. Reporting Period Characterisation

Summarize:

- **Project Objectives** – general [and for the reporting period (Progress Report only)]:

To give forecasts relevant to military systems on the performance of Metamaterials technology and how it is likely to evolve. These forecasts are divided in two, first, from today and ten years ahead, and finally, from ten years ahead to 20 years ahead. Also, an assessment of how performance parameters of the studied systems are likely to develop in topics like detection distance or RCS reduction. Information regarding the probable geographic localisation of the leader of a certain development is expected. Also, an assessment of the impact of the forecasted technology developments on the future performance of military systems and we will identify any unknown new capabilities. This has been the work done during the first 6 months of the Metafore project.

For the next 6 months, it is expected to do an identification of areas where civilian technology development will not be sufficient for the needs of the military use. To identify the sub-areas of the technology under investigation that needs development on European (Ministry of Defence) funds, from today and ten years ahead. The reasons why civilian technology has low possibilities to accomplish the current and projected military needs, like restrictions on export from the United States or European industrial capacity, without the support of a military investment.

Finally, an Establishment of Roadmaps for European Investments will be performed. To propose which projects are needed to undertake in order to secure a lead on selected metamaterial based technologies. In this way, we will detail the European investments for the development of the metamaterials field in the selected R&T Goal over the coming ten years. These roadmaps will describe how associated technologies can be matured and become ready for insertion in system development. As possible, we will provide cost estimations, in spite of the level of uncertainty we are dealing.

- **Achievements;**

We have performed several forecasts on the performance of Metamaterials technology relevant to military systems and how it is likely to evolve. First, they are done from today and ten years ahead, and second, from ten years ahead to 20 years ahead. We prepared an assessment of how performance parameters of these systems will develop in topics like detection distance or RCS reduction, etc. The estimated geographic localisation of the leaders of a certain development is given. An assessment has been done on the impact of these forecasted developments on the future performance of military systems and the identification of any unknown new capabilities.

- **Deliverables and Work** – work carried out and contractual deliverables – detailed listing in sections and respectively;



A written report on the first 6 months Management and another written report on Technology Forecast which includes: State-of-the-art in metamaterials, science and technology, identified metamaterials applications in military systems, the forecast up to 10 years and those from 10 years up to 20 years, and its probable geographic localisation, an assessment of the impact on future military systems, and the identified unknown new capabilities are delivered.

- **Consortium** – changes to consortium, changes in responsibilities, contributions by consortium members etc.; N/A
- **Project Schedule and Status** (Progress Report only) – including updated charts and calendars (attach); clarify changes and impact on the planned milestones, if any, and highlight especially changes along the critical path]; The work plan time schedule is on time.
- **Risk management** (Progress Report only) – major risks to the project and actions to mitigate them]; N/A
- **Open Issues** from previous assessments (if any) and brief description of how they have been taken up by the consortium (details in section) – detailed list in section ; N/A
- **Dissemination and Networking** – comments and information on inside and outside activities in the project / the reporting period, such as project meetings, conference contributions (attach / deliver), actual co-operation or co-operation opportunities with other projects pr programmes etc. Several teleconferences have been maintained in order to discuss the work flow along this six months period. Also, we had a meeting in Paris last April 3rd

A detailed technical annex is included in the documentation.



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7. Work Packages Progress

i. No	ii. Participant(s)	iii. Work	iv. Start	v. End	vi. Deliverable(s)	vii. Progress %	viii. Issue(s)
1	1, 2, 3, 4	T1.1 Project management	November 2010	25 th May 2011	Report	100	None
2	1, 2, 3, 4	T2.1, T2.2, T2.3, T2.4, T2.5, T2.6, T2.7	November 2010	25 th May 2011	Reports	100	None



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8. Status of Contractual Deliverables

i. No	ii. Title	iii. Nature	iv. Lead	v. Dissemination	vi. Milestone	vii. Status	viii. Date	Status	ix. Issue(s)
1	D1,1 Project Management written	Report	1	Information	PM01	100	May 5 th 2011	1	None
2	D2,1 Technology forecast written	Report	3	Information	PM01	100	May 5 th 2011	1	None



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9. Periodical Work and Cost Breakdown

i. No.	ii. Short Name	iii. Work	iv. Work Cost	v. Contracting Cost	vi. Consumables Cost	vii. Investments Cost	viii. Other Costs	ix. Total Cost	x. Issue(s)
1	TAFCCO	144	38.547,88 €	0,00 €	0,00 €	0,00 €	7.700,00 €	46.247,88 €	None
2	FHR	164	42.081,09 €	0,00 €	0,00 €	0,00 €	8.480,00 €	50.561,09 €	None
3	UPNA	86	22.971,61 €	0,00 €	0,00 €	0,00 €	4.590,00 €	27.561,61 €	None
4	CNRS Supelec	86	22.664,30 €	0,00 €	0,00 €	0,00 €	4.590,00 €	27.254,30 €	None



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10. Overall Cost Breakdown

i. No.	ii. Short Name	iii. Total Cost, last projection	iv. Total Cost, actual	v. Total Cost, new projection	vi. Issue(s)
1	TAFCO	38.547,88 €	46.247,88 €	92.495,76 €	None
2	FHR	42.081,09 €	50.561,09 €	101.122,18 €	None
3	UPNA	22.971,61 €	27.561,61 €	55.123,22 €	None
4	CNRS Supelec	22.664,30 €	27.254,30 €	54.508,60 €	None



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II. Issue(s)

i. No.	ii. Issue Description	iii. Situation & Way Ahead	iv. Related Documentation
N/A	N/A	N/A	N/A



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12. Attachments

i. No.	ii. Title	iii. Purpose / Reference
1	Progress Report	ICET_A1133RTGC_METAFORÉ_PM01_Progress_Report
2	Invoice Cover Sheet	ICET_A1133RTGC_METAFORÉ_PM01_Invoice_Cover_Sheet
3	Progress Assessment Report	ICET_A1133RTGC_METAFORÉ_PM01_Progress_Assessment_Report
4	Management Report	ICET_A1133RTGC_METAFORÉ_PM01_Management_Report
5	Technical Report	ICET_A1133RTGC_METAFORÉ_PM01_Technical_Report