



Message from the Coordinator

The MAMMOET project **successfully finalized** all objectives and work plans during the third and final project period. There have been numerous events and achievements since the last issue of the MAMMOET newsletter. The project partners participated in various workshops, meetings and conferences dedicated to the dissemination of MAMMOET, as well as to support progress of the project. The main events were the technical meeting in Stockholm, Sweden in May 2016, the technical, General Assembly and Advisory Board meeting in Lund, Sweden in September 2016 and the Final Review Meeting in Lund, in February 2017. Partners were immersed in vivid discussions about the technical progress and further planning of MAMMOET beyond the project lifetime. It is with great pleasure to announce that the **objectives targeted in MAMMOET were reached and the project successfully ended in December 2016**. For a more detailed project overview, please visit our project website: www.mammoet-project.eu.

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MAMMOET Final Review Meeting



The MAMMOET consortium executed successfully the final review meeting on 2nd February 2017 in Lund.

The project fully achieved the objectives and technical goals for the period and even exceeded expectations and world records have been achieved. According to the reviewers and the EC the original objectives of the project are still relevant in the current, evolved market condition, and have been achieved within the time and resources available to the project.

Ultimately, MAMMOET delivers excellent potential for further exploitation of its results, both from scientific and commercial point of view.

Overview of MAMMOET most recent dissemination activities

15 peer-reviewed publications have been published within the third MAMMOET project year. Further MAMMOET partners participated in 9 conferences, workshops and other events. A highlight in year 3 was the **workshop on massive MIMO at ESSCIRC - ESSDERC 2016 in Lausanne, Switzerland on 12th September 2016**. In this workshop the public was introduced to the massive MIMO transmission concept. All presentations from the workshop are available on the official project website: <https://mammoet-project.eu/news/press-news>.

What is more:

- October 2016: The massive MIMO blog, an entry point to learn about massive MIMO technology, and a forum for expert commentary was launched and is available via the following link: <http://www.massive-mimo.net/>.
- November 2016: The Cambridge textbook [Fundamentals of massive MIMO](#), coauthored by a project member from LIU and a scientific advisor of MAMMOET was published

Start Date: 1 January 2014
End Date: 31 December 2016
Duration: 36 months
Project Reference: 619086
Project Costs: € 4.384.904
Project Funding: € 3.047.000

Consortium:
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Results & Deliverables

During the third project year the MAMMOET team worked on the following public RTD deliverables:

D2.7 Description of circuit design and test design of a novel lower efficient and flexible transmitter system for massive MIMO based transmission: Final report describing the newly developed transmitter circuits and the corresponding test results.

D3.3 Hardware-aware signal processing for massive MIMO systems: Selection and evaluation of hardware-aware signal processing strategies for massive MIMO, including per-antenna constant envelope precoding in the transmitter, improved channel acquisition schemes, and robust and efficient detectors in the receiver.

D4.2 Test-bed based assessment and proof of concept: This deliverable reports on the implementation and experiments carried out on the test-bed, and assesses the performance of the combined real-time processing solutions in realistic scenarios.

D4.4 Overall system validation and assessment: This deliverable validates all the project results at different levels: hardware measurement results were integrated into the link simulator and performance compared with proof-of-concept hardware and test-bed experiment results. An overall system power consumption analysis is reported.

MAMMOET Achievements

MAMMOET brought massive MIMO from an initial promising concept to a highly attractive technology for usage in broadband mobile networks:

- MAMMOET elaborated system concepts and approaches to provide an understanding of the statistical nature of the relevant channels and traffic and further additional channel measurements and validate already drawn conclusions in a broader range of scenarios.
- The project team provided flexible and effective signal processing through algorithms for distributed and scalable processing and hardware-friendly processing algorithms that allow trading some of the extra degrees of freedom that massive MIMO provides to achieve constant envelope signals to transmit from each of the antenna elements.
- Power-hungry hardware is made more efficient when the specific properties of massive MIMO are taken into account.
- MAMMOET proved overall innovative concepts and enabling hardware (HW) to create an attractive operational technology by bridging the gap between theoretical and conceptual massive MIMO.
- MAMMOET partners proposed solutions to standardisation bodies on 3GPP (3rd Generation Partnership Project) and reported the high potential of massive MIMO and promoted its use in future 3GPP standards.

MAMMOET Final results and their potential impact and use

MAMMOET **significantly increased the overall understanding, state-of-the art and confidence level of massive MIMO technology**. The **technical progress has been considerable on** both the overall system level and specific components of the technology: exploring the theoretical limits, realizing **efficient algorithms and hardware solutions** for the digital baseband as well as the analogue/RF front-end, **prototyping of components, and system-level validation** including experiments in the very large testbed.

Given the outstanding capacity and energy efficiency potential of this technology, the progress towards convincing proof of concept has stimulated the take up by standards. At the beginning of the project massive MIMO was probably mostly considered an interesting academic idea. Meanwhile, the technology has matured a lot and its value has been recognized and proven, amongst others by impressive demonstrations.

A clear consensus exists now that **massive MIMO is a key technology for 5G networks**. The MAMMOET project and its partners have been at the forefront of this impressive progress. We are confident that the results of the project will end up in 5G networks and (hardware) systems. Specifically, through a widespread dissemination of the project expertise and progress, both broad and in-depth knowledge of massive MIMO technology was raised.

Indeed exceptional dissemination results have continued to confirm the relevance of the project and its results, and the exceptional expertise of the consortium. The experts have taken up a large responsibility in sharing the knowledge, and engaged in numerous tutorials, workshops, and invited talks. **Particular project results can also be used beyond the massive MIMO focus**, as for example the channel characterization and the power efficient transmitters and power amplifiers.

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