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Adeptness – Design-Operation Continuum Methods for Testing and Deployment under Unforeseen Conditions for Cyber-Physical Systems of Systems



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<https://adeptness.eu/>

<https://www.linkedin.com/company/h2020-adeptness/>

https://twitter.com/adeptness_eu

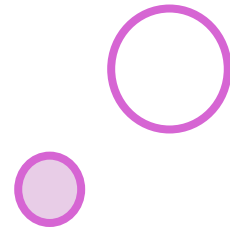


EDITORIAL

Welcome to the third and final issue of this Newsletter. Back in 2020, the project started focusing on the definition of the architecture and requirements. During 2021 and the first quarter of 2022, main research and development activities related to the project scope were carried out, eventually converging in the definition of the so-called Adeptness Framework.

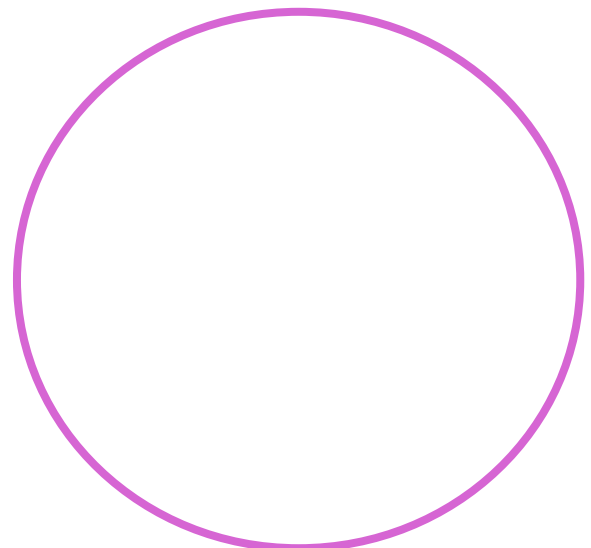
2022 (and the first quarter of 2023) has been the year where Adeptness Framework workflow was implemented in two industrial use cases aiming at validating its functionality and collecting valuable feedback. All the partners have been involved in the aforementioned use cases, namely. Elevator Use Case and Train Control Management System (TCMS) Use Case.

This newsletter intends to summarize these efforts and keep partners, associates and interested readers informed about the different activities carried out in connection with Adeptness. We hope that you enjoy this issue and we prompt you to provide us feedback and stay in touch through the webpage.



Mikel Garay

ULMA Embedded Solutions





Research and develop a workflow to speed-up the software release of CPSoS in operation while guaranteeing its reliability

PROJECT SUMMARY

Cyber-Physical Systems of Systems (CPSoS) are inherently complex. The lifecycle of these systems could last up to 30 years in sectors like aerospace, railway and elevation. In these systems, an increasing trend is to implement most of the functionalities through software. During the lifecycle of these systems, the software continuously evolves. The software of CPSoS evolves to

- fix bugs
- add new functionalities
- perform refactoring activities to improve its quality
- include some extensions to face unforeseen situations that are detected during operation
- cope with hardware obsolescence, etc.

80%

Reduction in time to recovery

60%

Reduction in bugs

80%

Reduction in deployment effort

2022 PROGRESS SUMMARY

WP1. REQUIREMENTS AND FRAMEWORK FOR DESIGN-OPERATION CONTINUUM OF CPSOS AND ETHIC CHECKING

WP2. RESEARCH AND DEVELOPMENT OF RELIABLE RE-COMMISSIONING METHODS FOR CPSOS

WP3. RESEARCH AND DEVELOPMENT OF RESILIENCE METHODS IN OPERATION FOR CPSOS

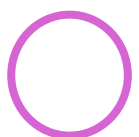
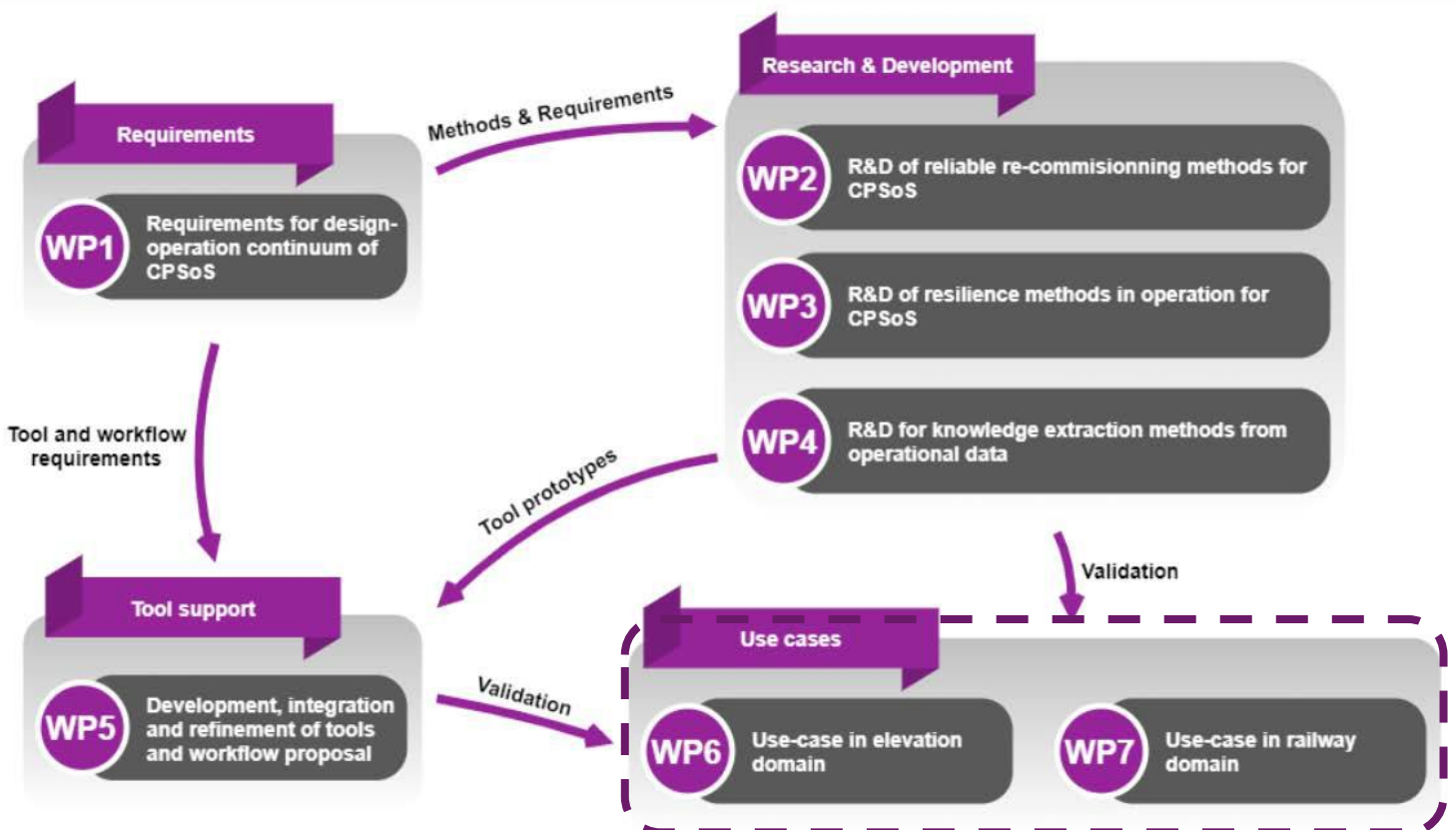
WP4. RESEARCH AND DEVELOPMENT FOR KNOWLEDGE EXTRACTION FROM OPERATIONAL DATA

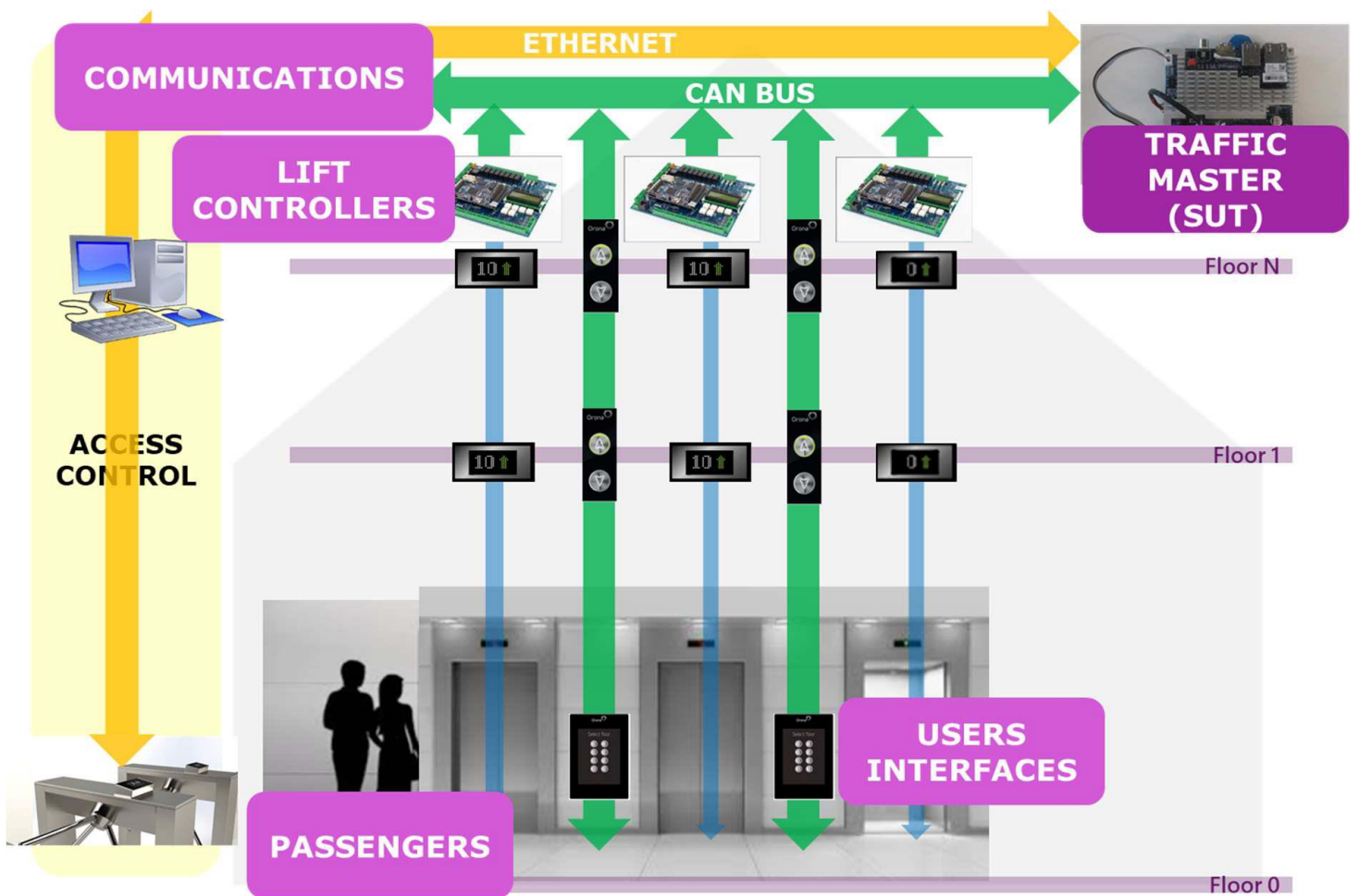
WP5. DEVELOPMENT, INTEGRATION AND REFINEMENT OF TOOLS AND WORKFLOW PROPOSAL

WP6. USE-CASE A – DESIGN-OPERATION CONTINUUM OF ELEVATORS CONTROL ALGORITHMS

WP7. USE-CASE B – TRAIN CONTROL MANAGEMENT SYSTEM LIFECYCLE VIRTUALIZATION

WP8. MANAGEMENT, DISSEMINATION, EXPLOITATION AND STANDARDIZATION





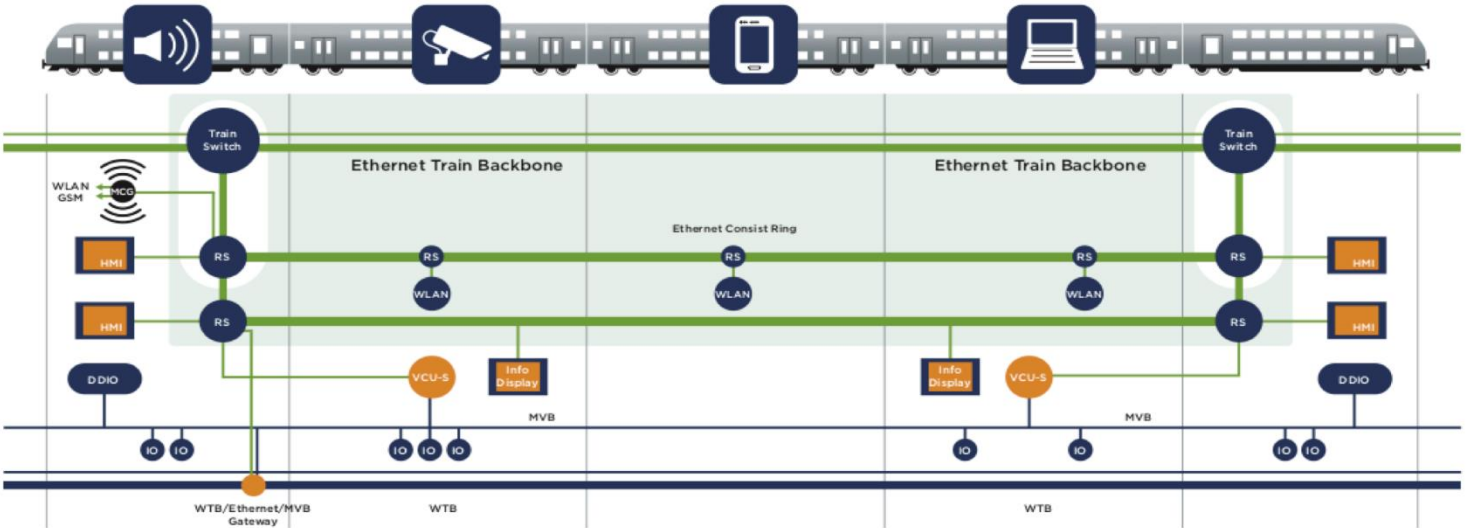
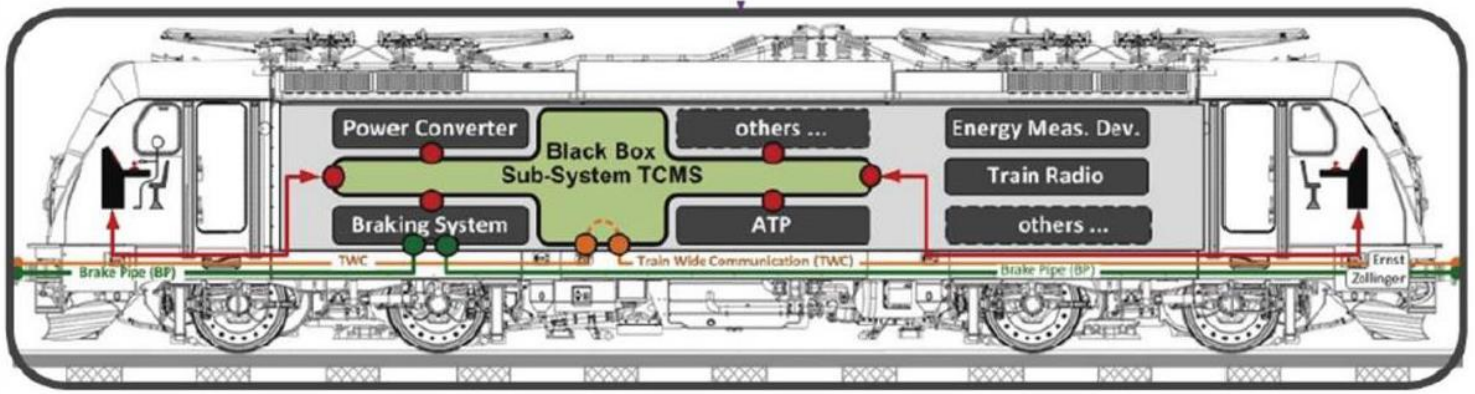
Elevator Use Case

An elevator is a Cyber-Physical Systems (CPS) comprising:

- Digital cyber technologies: processing units, software, communication buses, etc.
- Physical processes: elevator engine, mechanical doors, etc.

One critical unit of the CPS is its traffic master, which is the unit in charge of deciding, for each of the floor calls, which will be the elevator assigning that call. The traffic master encompasses information of many components of the CPS, such as, the status of each elevator cabin (e.g., the weight it is carrying, its direction, status of the doors, etc.). This component continuously evolves to incorporate new functionalities, correct bugs, deal with hardware obsolescence, etc.

During the last months of the Adeptness project, the evaluation of Adeptness toolchain and methods' evaluation in the Elevator Use Case has been successfully carried out.



TCMS Use Case

In Alstom's railway vehicle products for urban/suburban transport, mainlines, mining and airport ground transport systems, the Train Control and Management System is the core embedded intelligent system controlling and supervising all other onboard subsystems and functions, such as autonomous driving, door control, passenger protection, power converters, braking system, driver's communication radio, passenger information etc. TCMS supports train-to-ground (T2G) services for passenger infotainment, operation and maintenance.

TCMS comprises two dedicated communication network technologies (IEC61375), for meeting the high functional demands and dependability requirements of railway operators:

- Train Communication Network (TCN)
- Ethernet Consist Network (ECN)

The TCN/ECN network of a single train consists of ~100 communication nodes servicing ~10,000 input/output signals.

2022 Face to Face meetings

In 2022, Adeptness project entered its last year and face-to-face meetings' frequency intensified aiming at achieving a full and seamless integration of all Adeptness Framework components.

In June, Adeptness team met in Oslo and mainly focused on both TCMS and Orona use-cases' status and progress. The presence of NASA JPL as an advisory board member, provided a very valuable input for the market approach of the framework.

Close to the end of the year, Adeptness' partners met again, this time in Vienna, in order to discuss last steps of the project. The meeting hinged on the results of the use-cases that were about to be finished. In addition, the status of the standardization activities was also presented.



Oslo 06/28/2022



Vienna 11/30/2022

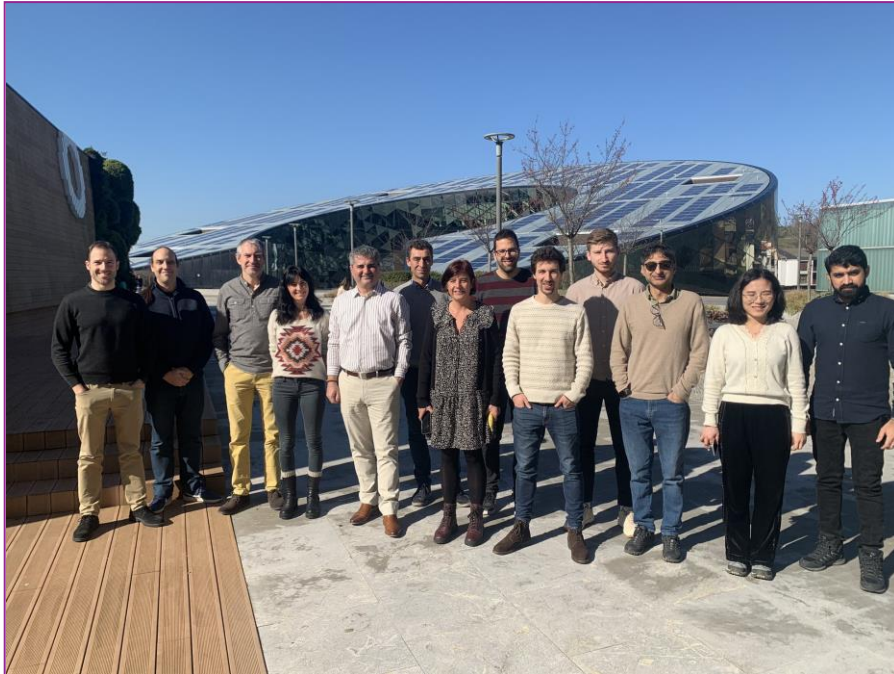


2023 Face to Face meetings

Once all the development and its corresponding practical application by means of use-cases were finished, the project entered its last phase in 2023.

Adeptness partners' met in San Sebastian in February for an Exploitation Workshop targeting the exploitation activities foreseen for Adeptness Framework as of the end project. In this regard, the potential roadmap for the framework was also discussed.

In March, Adeptness team met face-to-face in Västerås for the last time before the final review meeting. The meeting focused on the definition of the agenda for the final review meeting, including a first rehearsal of the presentation that will summarize all the work done during Adeptness project execution.



San Sebastian 10/02/2023

Västerås 09/03/2023



Brussels 09/06/2023



Final Review meeting

The Adeptness project, a collaborative endeavor fueled by innovation and ambition, has officially reached its successful conclusion with the final review meeting in June 2023. After years of dedicated work, meticulous planning, and unwavering commitment, the Adeptness project recently underwent its final review meeting, and we are elated to share that the results were nothing short of extraordinary. The project met all of its goals and objectives, demonstrating the exceptional aptitude and expertise of the entire team involved.

This momentous occasion marks a significant milestone for all of us, as it highlights the remarkable contributions made by our researchers, partners, and stakeholders.

As the project officially closes its doors, we want to express our heartfelt appreciation to everyone who played a role in its triumph. Your relentless commitment and ingenuity have left an indelible mark on the landscape of research and development, and your efforts will undoubtedly inspire future endeavors in this ever-evolving world of innovation.

13 publications

In 2022-23

Demo available at

<https://youtu.be/uoq9n9k4kgc>

PUBLICATIONS

Aldalur, I., Arrieta, A., Agirre, A., Sagardui, G., & Arratibel, M. (2023). A microservice-based framework for multi-level testing of cyber-physical systems. *Software Quality Journal*, 1-31.

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Xu, Q., Ali, S., & Yue, T. (2023). Digital Twin-based Anomaly Detection with Curriculum Learning in Cyber-physical Systems. *ACM Transactions on Software Engineering and Methodology*.

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Xu, Q., Ali, S., Yue, T., & Arratibel, M. (2022, November). Uncertainty-aware transfer learning to evolve digital twins for industrial elevators. In *Proceedings of the 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering* (pp. 1257-1268).



PUBLICATIONS

Han, L., Yue, T., Ali, S., Arrieta, A., & Arratibel, M. (2022, November). Are elevator software robust against uncertainties? results and experiences from an industrial case study. In Proceedings of the 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (pp. 1331-1342).

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Zafar, M. N., Afzal, W., & Enoiu, E. (2022, May). Evaluating system-level test generation for industrial software: A comparison between manual, combinatorial and model-based testing. In Proceedings of the 3rd ACM/IEEE International Conference on Automation of Software Test (pp. 148-159).

Strandberg, P. E., Afzal, W., & Sundmark, D. (2022). Software test results exploration and visualization with continuous integration and nightly testing. International Journal on Software Tools for Technology Transfer, 24(2), 261-285.

Gartziandia, A., Arrieta, A., Ayerdi, J., Illarramendi, M., Agirre, A., Sagardui, G., & Arratibel, M. (2022). Machine learning-based test oracles for performance testing of cyber-physical systems: An industrial case study on elevators dispatching algorithms. Journal of Software: Evolution and Process, 34(11), e2465.

13 publications

In 2022-23





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Adeptness



BOMBARDIER

