

On the HPC/HPDA/AI Competences in Bulgaria

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Abstract. EU member states and the European commission realized the importance of High Performance Computing (HPC) and its applications in High-Performance Data Analytics (HPDA) and Artificial Intelligence (AI) and provided substantial funding for buying hardware and developing the national competences in the area. The EuroCC project (<https://www.eurocc-access.eu/>) supported the establishment of National Competence Centres in HPC/HPDA/AI, which serve as a focus point for access to expertise and know-how in the area and foster the European collaboration in the area. Bulgaria tries to maintain a leading position in the area of HPC in the region and thus it is important to collect and analyse information about the available competences in the field, the demand from the research community and the private sector, and to map ways for future development. The paper gives an overview on the current competences in HPC, HPDA and AI in Bulgaria and provides information about the plans for future development.

Keywords: EuroCC, HPC, HPDA, AI, EuroHPC JU.

1 Introduction

The National Competence Centre of Bulgaria (NCC Bulgaria, <https://cmp.eurocc-bulgaria.bg/>) in the area of High-Performance Computing (HPC), High-Performance Data Analytics (HPDA) and Artificial Intelligence (AI) has been built within the Horizon 2020 project **EuroCC** (*National Competence Centres in the framework of EuroHPC*), Grant Agreement № 951732, H2020-JTI-EuroHPC-2019-2, 2020-2022 (<https://www.eurocc-access.eu/>), with the goal to enhance and develop the competences of the Bulgarian research community in this domain, while making full use of EuroHPC resources and leveraging the EuroCC partnership, in collaboration with the “sister” project CASTIEL (<https://www.eurocc-access.eu/about-us/the-projects/>). The NCC-Bulgaria is built by a consortium coordinated by the Institute of Information and Communication Technologies - BAS (IICT-BAS), www.iict.bas.bg, with members Sofia University “St. Kliment Ohridski” (SU, <https://uni-sofia.bg>), and University of National and World Economy (UNWE, <https://unwe.bg>). The three partners carry diverse

technical and scientific background in the area of HPC and ICT in general, thus covering the full spectrum of applications and users and ensuring achievement of the project objectives and aiming for longer-term sustainability.

The main objectives of the NCC Bulgaria are:

- Perform a comprehensive competence mapping, identify gaps and possible synergies and organize teams of experts in different areas.
- Facilitate the use of HPC/HPDA/AI applications, resources and tools by users from academia, industry and public administration.
- Streamline access to high-level scientific / technical expertise and consulting through HPC know-how, access to modern equipment, software and tools.
- Create a solid foundation for training by identifying requirements, synergies and gaps, facilitating skills development and building HPC/HPDA/AI teams.
- Raise awareness of the benefits of HPC for potential industry users, including SMEs.
- Technology transfer activities at national level.



Fig. 1. Supercomputer Avitohol at ICT-BAS.

The ultimate goal of the EuroCC project is to provide access to a coordinated, structured and sustainable high level of expertise in HPC and related technologies (HPDA/AI) across Europe. This goal requires a detailed planning of work and deep analysis of the current state of HPC/HPDA/AI usage and necessities of the various stakeholders in the country, taking into account not only academia but also industry and especially SMEs and also the public administration. The National Competence Centre Bulgaria started by developing a roadmap, which contains a comprehensive work plan for the first year and a vision what has to be achieved by the end of the project. Four comprehensive online studies were conducted in Bulgaria, contacting more than 150 active HPC users, more than 100 research organizations involved in the Large Research Infrastructures, and more than 200 private companies. These studies enabled the focusing of the efforts in training and dissemination (Bulgarian NCC LinkedIn, <https://www.linkedin.com/>

company/eurocc-bulgaria; Bulgarian NCC Twitter, https://twitter.com/EuroCC_Bulgaria; EuroCC-Bulgaria event, <https://events.iict.bas.bg/category/2/>) towards the most important and fruitful directions. A mapping of the available competencies in HPC/HPDA/AI was produced, which identified the existing gaps in the knowledge and skills of stakeholders and the interest and needs of the industry. Effective collaboration with industry associations/clusters has also started. The joined efforts of the partners in the centre in technology watch and dissemination of technical information are facilitated through a knowledge-based platform and tools. A collaborative platform for networking and dissemination for the NCC team and their partners working in HPC and related technologies was developed, successfully tested, and publicly presented. In this way, the foundation for successful utilization and expansion of the NCC's competences has been laid out. Teams capable of supporting the preparation or assessment of innovative HPC/HPDA/AI projects at European and national level, including industry participation, were formed and achieved their first successes. Thus, we have a good foundation for the extensive work with research, industrial and public sectors for the uptake of HPC/HPDA/AI technologies in Bulgaria.

In this paper we briefly describe the project result focusing on the competences and competence mapping developed within the project.

2 Achievements and Lessons Learned in 2021-2022

The NCC Bulgaria is a natural focus point providing HPC expertise/consultations/services to researchers, SMEs and public sector. Expanding the scope of HPC with HPDA and AI was a very successful approach of the EuroCC project. We benefited from the common approach, guidance and help from EuroCC and CASTIEL and from the connection and exchange with other NCCs, for example through the access to the roadmaps of the other NCCs.

The main project results during the first year and a half include:

- Development and implementation of a Roadmap for successful work in the field of HPC/HPDA/AI.
- Analysis of the existing competencies in Bulgaria in the three areas - HPC, HPDA, AI, identification of gaps and shortcomings and development of measures to overcome them.
- Development and maintenance of a web portal (EuroCC project website: <https://www.eurocc-access.eu/>), providing a constant, high quality information flow to all participants and stakeholders.
- Development of innovative methods for technology transfer. Development of strategies for cooperation with business.
- Promoting HPC, HPDA, AI throughout society with a focus on industry and the public sector.
- Facilitating access to scientific and technical expertise, awareness raising and cooperation. Development of training programs.

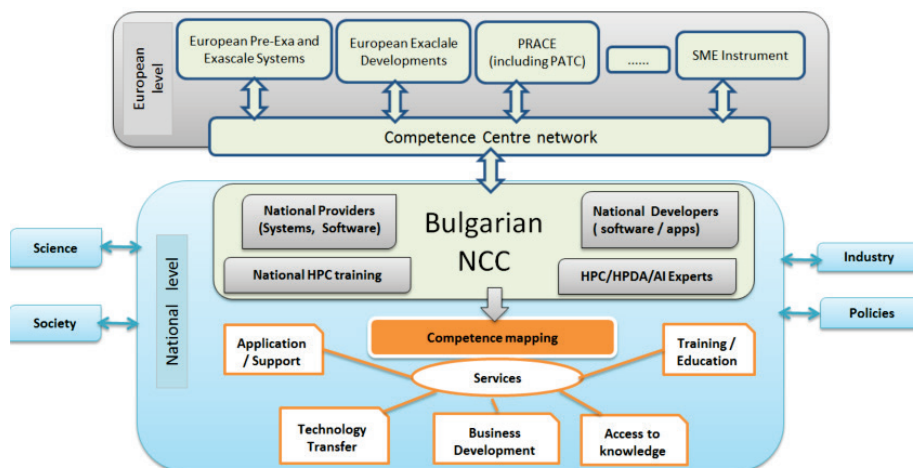


Fig. 2. Sustainability of the Bulgarian NCC and embedding in the national and European level

Establishing working relationships with the other NCCs, the project office and CASTIEL has been instrumental in introducing good practices and following innovative approaches to further develop our NCCs. Most of the online events, organized by the project, included group discussions, while more focused twinning activities were also undertaken between pairs of NCCs.

3 Competence Mapping

Competences are an important pillar for a successful implementation of the European HPC (EuroHPC Joint Undertaking, https://eurohpc-ju.europa.eu/index_en) strategy. Due to the different strategies of the EuroHPC member states, the competence levels have naturally grown at different speeds and with different focuses.

In Bulgaria, the competence mapping task successfully identified the main strong areas of expertise of the NCC and their correspondence with the needs of researchers and industry. An initial competence mapping for the NCC-Bulgaria using the template of EuroCC/CASTIEL was performed and shared with EuroCC and CASTIEL partners. Then, a methodology for fine-grained mapping was developed and executed. A list of key contacts from academic user communities and industry (both users and providers of HPC/HPDA/AI services) was compiled and face-to-face or online interviews were performed, gathering information about the most necessary competences in the country for the needs of academia (mainly contacting senior researchers from the main established user communities) and industry (mainly CTOs or leading developers, in some cases CEOs).

Furthermore, the competences of the NCC partners in several main areas (as provided by EuroCC/CASTIEL) were assessed in detail, producing comprehensive coverage of the areas, and providing numerical measures for several competences in

each of these. The strengths and weaknesses of the NCC and areas of potential fruitful collaboration with the other NCCs through mentoring, twinning, and other joint activities were identified and shared. The NCC has expertise in using HPC/HPDA/AI on diverse hardware, using state-of-the-art software and services, and utilizing different models for collaboration with industry, academia and public bodies, e.g., municipalities.

The team of NCC Bulgaria has substantial expertise along the whole lifecycle of an HPC application development, starting with feasibility evaluation, optimisation and testing, software design where required, etc. Skills that are important for industrial applications are also widely available, as cost awareness, contract preparation, expertise in applying for EU projects, etc.

As a result of the series of studies, some areas which were less covered were determined, for example, Quantum Computing, and measures were taken to increase our capabilities in these areas. The results of our work have been presented at various national events as well as the events organized by EuroCC and CASTIEL. The team leaders corresponding to each of the available competences have been identified and a process for offering access to the teams has been decided.

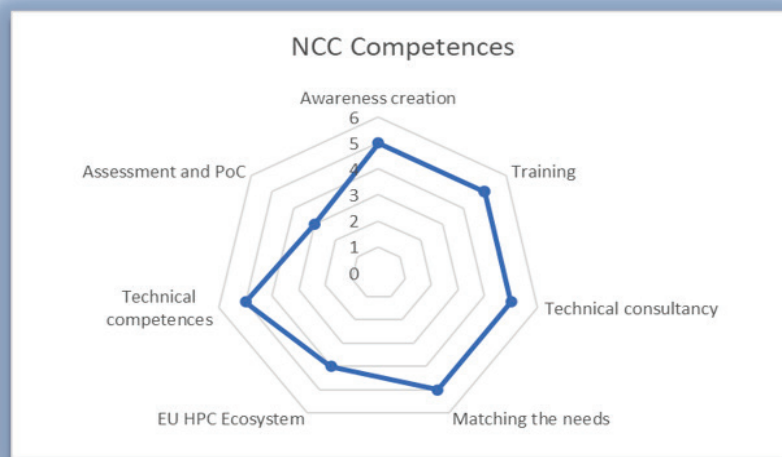


Fig. 3. NCC Bulgaria Competences

Achieved results include detailed mapping of the available competences at the NCC, assessment of strong areas and areas that need improvement, identification of topics for collaboration, feedback to training and collaboration with industry, presentation of the tasks' results at national and international level. The presentation of the results of the competence mapping and their analysis at the national Workshop "Competencies and Good Practices in HPC/HPDA/AI", 15th July 2021 were widely discussed and assessed as insightful.

Figure 3 shows our quantitative assessment of the competences of NCC Bulgaria in the main categories. The more detailed assessment at the fine level of competences will be used to assist in the twinning, mentoring, and training programme development, as well as to provide points of contacts for the strong areas of the NCC. Our findings were disseminated within the project in the pitching events, organized by CASTIEL, and were taken into account in the planning for future collaboration. One of the areas of technical expertise where it was determined that more expertise is needed, was Quantum Computing, and measures were taken to increase our capabilities in these areas, including participation in trainings and workshops.

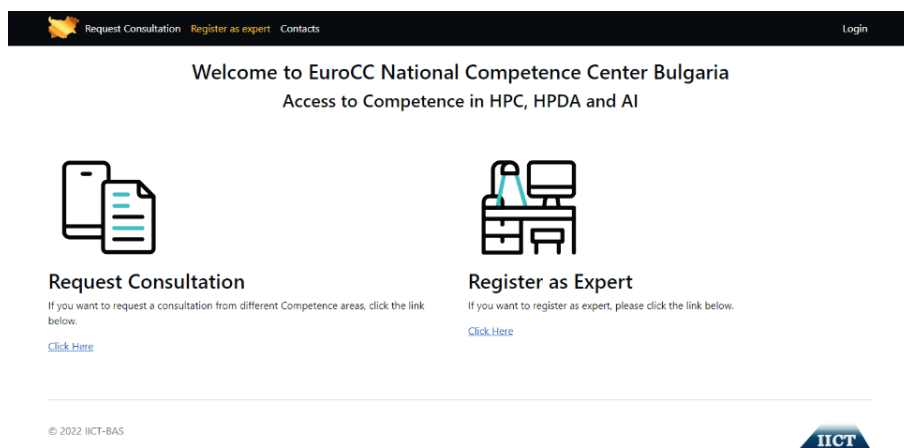


Fig. 4. System for requesting specific competences or for registering as an expert (home page)

An online system for requesting specific competences or for registering as an expert (see Fig. 4) is made available at NCC Bulgaria online system for requesting competences (<https://cmp.eurocc-bulgaria.bg/>), which enables direct contact of interested parties from the research community or private enterprises with experts with the necessary knowledge. It is important to understand that many of the competences are related to the early stages of HPC adoption, so our experts can help during the preparation of a project proposal or during assessment of viability or cost/benefit analysis of a project. Potential users of HPC/HPDA/AI can request online experts with specific expertise, corresponding to the phase of their (potential or ongoing) HPC usage problem. Experts from the partners have already indicated their fields and levels of expertise, so that the NCC team can forward the requests appropriately. The system allows also outside experts to indicate their fields of expertise (see Fig. 5), so that further collaborations are enabled. Our intention is to interface the system with a similar one at the level of EuroCC, so that we can offer consultations to partners when they do not have appropriate expertise to serve the particular request.

The screenshot shows a web application interface for expert registration. A modal window is open, titled "Please choose your level for the following competences". The modal is divided into three sections: "Awareness creation", "Training", and "Expert technical consultancy". Each section contains a list of competences with four radio button options: "None", "Intermediate", "Advanced", and "Expert".

Competence	None	Intermediate	Advanced	Expert
Awareness creation				
Production of marketing materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organisation of events	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Media and social media presence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Production of movies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interviews, TV presence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Training				
Introductory training organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advanced training organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Expert technical consultancy				
Feasibility evaluation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Optimisation and testing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Software design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Platform specific optimisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cost awareness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Benchmarking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Fig. 5. Expert registration page

4 Conclusions and Plans for Future Work

In summary, we have achieved the following results:

- Strengthening the HPC network through coordination on national level
- Deeper understanding of the users' needs and problems; organizing various follow-up activities
- Improving collaboration with industry, contacts with industry associations/clusters
- Competence mapping and fitting in the European HPC ecosystem
- Virtual meetings and workshops have replaced face-to-face meetings due to Covid-19 pandemic situation

Overall the competences available in the Bulgarian NCC span a wide range and cover all the important areas of supporting HPC-related projects, as they were defined within EuroCC. The constant discussions and the issued guidelines have been instrumental in achieving cohesive organization of the NCC, better fitting within the overall European ecosystem. As Bulgaria has substantial investment in supercomputing hardware, it is important to continue the development of HPC-related competences and to make them available to the research community and the private sector, as they are important national capital.

The current project ends on the 31 of December 2022. Our future plans are to continue our work within the next project phase, EuroCC2. The main goal of the second phase of the EuroCC is to continue the establishment of a network of National Centres of Competence (NCC) in the most efficient way, while continuing to address the differences in the maturity of HPC deployment in Europe. The NCC Bulgaria will focus

to create and maintain a comprehensive portfolio of services to streamline access to scientific/technical expertise and consulting and facilitate access to advanced HPC equipment, competences, software codes and tools.

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