

Towards Effective Bulgarian Competence Centre in High Performance Computing – Service Portfolio and Competences

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Abstract. Three years ago a new European initiative started: establishing a network of Centres of Competence in HPC in the European countries through the project EuroCC (2020-2022) in its second phase EuroCC2 (2023-2025). The goal is to accelerate the improvement of national and thus European capabilities in the area of HPC+ technologies, where HPC+ means High Performance Computing (HPC) and HPC application in HPDA and AI. In order to form an effective National Competence Centre in HPC+ technologies, we performed extensive competence mapping and now devise an extensive service portfolio, open to users from academia, public administration and industry. In this paper we present our analysis of the situation in Bulgaria as well as our approaches to make NCC and effective focus point for those that can benefit from use of HPC+ technology in their research or business.

Keywords: EuroCC2, HPC+, HPDA, AI.

1 Introduction

High performance computing (HPC) is the ability to process data and perform complex calculations at high speeds (Sterling, Brodowicz, & Anderson, 2017). HPC plays a pivotal role in stimulating Europe's economic growth allowing industry and academia to develop world-class products, services and inventions. Three years ago a new initiative for establishing a network of Centres of Competence in HPC in the European countries started with EuroCC project (Karaivanova, Atanassov, & Gurov, 2022). Now the second phase of this initiative, EuroCC2, started with mission 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 (EuroCC ACCESS, n.d.). The main task of the project is to support national centers in setting up their individual operational frameworks, while accessing and making the most of the experience and expertise currently available at national and European level.

Although Bulgarian industry in general is not among the most developed in Europe, we have a long tradition in using supercomputers and developing parallel algorithms. One of the first Blue Gene/P supercomputers was deployed in Sofia in September 2008. The Avitohol supercomputer (Avitohol supercomputer, n.d.) is operated by IICT since 2015.

At present, the Bulgarian HPC facilities include also the petascale system Discoverer (operational since 2021 at Sofia Tech Park, position 91 in TOP500 list) (Discoverer system, n.d.), as well as multiple other HPC clusters at the NCC partners, including servers with powerful GPU cards (Nvidia V100), servers with large amount of RAM (3TB per server), as well as data storage and processing systems capable of handling Petabytes of data.

Another advantage of the Bulgarian NCC is the long track record of successful EU projects, including both infrastructure projects as well as purely research-oriented projects, leadership and participation in high-profile national programmes as well as projects with industry/SMEs. Multiple partners in EuroCC reported lack of experience in negotiating and managing contracts for use of both HPC equipment and technical expertise. Fortunately, IICT has extensive experience in negotiating and then managing such contracts with diverse industrial players, from SMEs to huge companies (telecoms).

Even before the start of the EuroCC project, we noted the obvious synergies within the NCC, with the slightly different focus of the partners, especially with regard to HPDA and AI, and with the already functioning collaboration in the main areas of research related to HPC. As the EuroCC project in partnership with CASTIEL offered multiple opportunities for twinning and mentoring, NCC Bulgaria has been able to benefit from training and expertise provided by other NCCs and currently has capable and sizable team, able to handle both small and large projects needing diverse expertise.

Our core teams provide generic e-infrastructure services, training, user support, etc., with the main user groups being from climatology, life sciences and computational physics. Several collaborative activities for joint research or consultancy with SMEs using HPC have been successfully carried out.

As the three partners in the National Competence Centre on HPC+ technologies in Bulgaria (IICT, SU and UNWE), through their projects funded by the Operational Program “Science and Education for Smart Growth” operate a significant amount of newly acquired equipment with HPC capabilities and substantially bigger data capacity, now is the perfect timing to perform the activities planned in this project in order to prepare academia, industry and society as a whole for the new level of HPC in Bulgaria.

2 Competence Centre in Bulgaria

The National Competence Centre in Bulgaria (EuroCC-Bulgaria website, n.d.) is built within EuroCC project by a consortium, consisting of: Institute of Information and Communication Technologies (IICT) - leading organization) (Institute of Information and Communication Technologies (IICT), n.d.), Sofia University (SU) (Sofia University “St. Kliment Ohridski” (SU), n.d.) and University of National and World

Economy (UNWE) (University of National and World Economy (UNWE), n.d.). The three partners in NCC Bulgaria, IICT, SU and UNWE, are coordinators of large infrastructural projects in the area of ICT. These projects are mostly oriented towards acquisition of infrastructure and thus are the ideal complement to the activities funded by the EuroCC project.

The goals of the NCC Bulgaria are:

- Establish NCC Bulgaria as the focus point for current and potential users of HPC from SMEs, academia and public administrations.
- Create and maintain a comprehensive portfolio of services to streamline access to scientific/technical expertise and consulting and facilitate access to advanced equipment, competences, software codes and tools.
- Establish stable foundation for local and national training, through identification of requirements, synergies and gaps, facilitating skills development and team-building in the area of HPC.
- Raise awareness and outreach on the benefits of HPC+ technologies and the available services of the NCC to potential user communities, including SMEs.
- Successful execution of industrial pilots within the framework of the NCC Bulgaria, with analysis of the lessons learned and best practices.
- Collaborate and exchange knowledge with the other NCCs, CoEs and related national initiatives and projects.

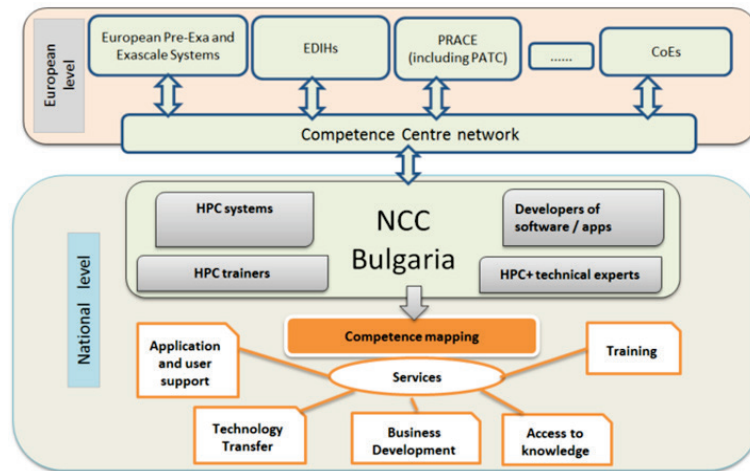


Fig. 1. Updated structure of the Bulgarian NCC and embedding in the national and European level.

The governance structure of the NCC is shown in (Fig. 1), where one can see its task-oriented organization. The functional organization of the NCC Bulgaria is shown on (Fig. 2).

To achieve the goals of the NCC Bulgaria, it is important to connect the activities of the Competence Centre to the already existing and prospective national and international activities to benefit from the potential synergies. The HPC competence map for

Bulgaria shall be continuously upgraded to ensure a clear picture on available competences. The interactions with industry will be continuously monitored and analysed in order to improve the processes and increase the overall impact.

The Competence Centre will be collaborating in a better way with researchers, public administration and industry in the HPC+ area, exposing a comprehensive portfolio of services. Following the developed methodology for knowledge transfer, the consultancy work will be supported by streamlined procedures and templates and its progress will be monitored and evaluated. Potential users could gain ideas and learn from the good practices and success stories, and will be directed to appropriate consultants from the teams formed. Various dissemination activities will contribute to further HPC awareness in Bulgaria. Regular dissemination and marketing events will be organized to integrate the HPC+ stakeholders in Bulgaria and to complement the knowledge available in the NCC.

3 Analysis of Competences and Current Service Portfolio

The competence mapping task built upon the information collected about the available expertise at NCC Bulgaria, studying more in detail the capabilities and necessities of the whole Bulgarian landscape of, on the one hand, providers of HPC/HPDA/AI expertise and services, and on the other hand, current or potential users of these technologies. An online tool for requesting access to expertise has been deployed, providing direct access to NCC experts for interested parties. The tool is designed that way, that also experts, who are not affiliated with NCC Bulgaria, can enter their information there. This enables additional interaction capabilities of experts and SMEs/industries.

The NCC is well positioned with teams formed along the key competence areas. One important weakness in the overall NCC positioning was identified in the Quantum Computing area, but after active participation in training and capacity building, we have now a capable team with diverse expertise in the area. Some underrepresented areas in terms of use of HPC, like social sciences/humanities, were specifically targeted and certain success in attracting actual users has been achieved.

Two main types of industry contacts were identified as key to improve our position – software development companies and system integrators, and meetings with these were held to explore possibilities for collaboration.

As the NCC consists of partners only from Sofia, we collected information about the HPC expertise and interest in the technology from universities in other cities.

Information about our competence mapping has been contributed to the competence mapping at EuroCC ACCESS (EuroCC ACCESS, n.d.). As the working group from EuroCC/CASTIEL updated their classification of competences, we also adjusted our groupings.

Our careful evaluation of the usage of HPC/HPDA/AI competences in projects and success stories is the basis for the forming of a full-fledged portfolio of NCC services. The results of our work were presented at national events as well as in the events organized by EuroCC/CASTIEL. Notable case is the fruitful series of workshops with colleagues from NCC UK, where significant areas for future collaboration were identified.

Achieved results include detailed, fine grained mapping of competences, with the NCC competences accessible to interested parties at national and European level, measures to improve certain weak points and exploitation of our strong points in successful project proposals. Results of the task were presented at national and international level, including a research paper. The competences of the team we used as a basis during the formation of our portfolio of services. Some of these services were outlined for a centrally maintained by EuroCC list of services and their market prices:

- HPC+ Training – introductory/intermediate.
- HPC+ Training – advanced/specialized.
- HPC+ Technical consultations – code optimisation/benchmarking/profiling/bottleneck analysis, etc.
- HPC+ Technology consultation – advice on use of technologies, acquiring or access to hardware, investing opportunities, project preparation, etc.
- Software design and development for Proof of Concept using HPC+.

Again at the request of the project management we prepared packages comprising of several services, logically intertwined and priced accordingly:

- Package 1:
 - HPC+ Training – advanced/specialized.
 - HPC+ Technical consultations – code optimization / benchmarking / profiling / bottleneck analysis, etc.
 - Software design and development for Proof of Concept using HPC+
- Package 2:
 - HPC+ Training – introductory/intermediate
 - HPC+ Technology consultations – advice on use of technologies, acquiring or access to hardware, investing opportunities, project preparation, etc.

4 Development of the Service Portfolio

The services outlined in the previous chapter are just a starting point, as they only cover areas that are of direct interest to the EuroCC collaboration. It is obvious that important services were left out. For example, the NCC partners already offer direct access to hardware (at market prices) for SMEs/industry. Our experience from previous successful projects shows, that such access by itself is rarely enough to attract the interest of SMEs. They can see the benefit of working with the NCC mostly when they require the technical expertise of the NCC experts in HPC+, or when their problem requires knowledge in adjacent areas in applied mathematics/ computer science. That is why we plan to provide an easy-to-use interface for the companies to request specific expertise and start and manage the appropriate type of project, not strictly limited to Proof-of-Concept.

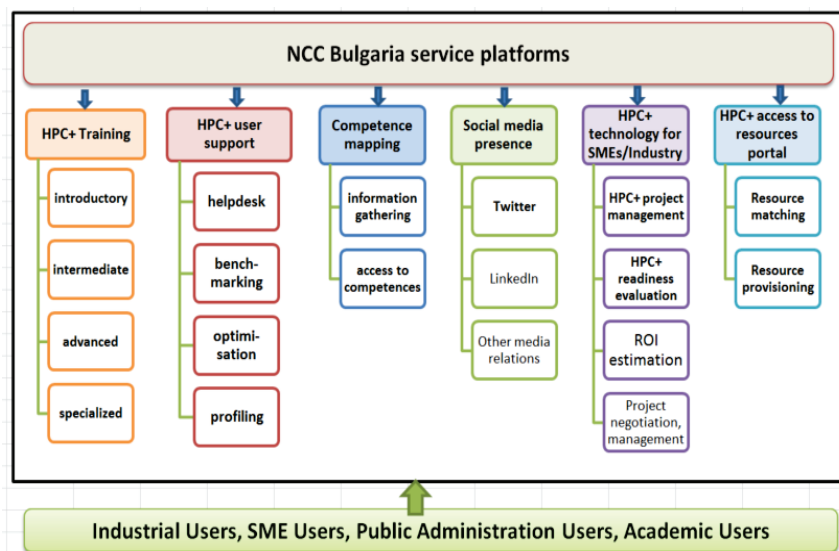


Fig. 2. Functional organization of NCC Bulgaria.

The estimation of the suitability of using HPC for the particular problem and the expected Return on Investment will also be accommodated. The feedback of the users of the services will also be collected in a standardized way, allowing us to adjust the service offerings. Significant interest in the use of virtualized or containerized (cloud) HPC services was observed and respective tools and software are in the process of being deployed. More information about the typical problems and approaches to solve them can be obtained from (Abraham, Paul, Khan, & Butt, 2020).

5 Lessons Learned

Throughout its first few years of existence, the Bulgarian NCC has identified the biggest challenges for the successful project implementation as follows:

- Overcoming fragmentation by organizing a strong human network with agile highly focused teams that can solve challenging industrial or societal problems through use of HPC+ technologies, with a lightweight administrative structure.
- Lowering the administrative and technical burden to use of HPC in order to attract more diverse user groups from academia, industry and public administration.
- Ensuring sustainable development of HPC user communities especially engagement of industry.

Some specifics of the Bulgarian IT landscape and overall economic situation that hinder the effective use of HPC that we have observed:

- SMEs in our country are interested in very short term return on investment, while introducing HPC+ in their work requires substantial change in their

organization. Even if the concrete topic with substantial ROI is found it likely requires substantial investment to move from PoC to a complete product or process.

- SMEs believe that the process of making use of HPC+ technologies through collaboration with the NCC is cumbersome and bureaucratic and do not even start initial discussions while our process is relatively streamlined.
- The big industry companies, especially those with foreign ownership, have an established vetting process for their suppliers, which means that even if our services are to be provided free of charge to them, we still have to pass through a lengthy bureaucratic process.
- The public administration usually only prepares tenders for public procurements and does little technical work directly, which makes it difficult for us to introduce our services.

Regardless of these challenges and problems, we have established an agile structure of the NCC and we have already achieved substantial progress in collaboration with our target user communities, thus we believe that the NCC will reach its full potential.

6 Conclusions

The work of the NCC Bulgaria is based on the team expertise in the field, experience and good collaboration with the already existing and prospective national and international activities to benefit from synergies. The high levels of expertise of the teams behind the NCC supports its good positioning in this ecosystem. The HPC+ competences and services for Bulgaria will be continuously upgraded to ensure good matching with the constantly evolving technologies in the space.

With the maturing of the NCC more and more of its capabilities will become exposed through web-based interfaces, lowering the threshold for access to HPC+ technologies for researchers, public administration and industry. The consultancy work will be accompanied by useful and user-friendly materials, procedures and templates. Potential users could gain ideas and learn from collected HPC good practices, an upcoming HPC handbook, and address appropriate experts from available repository. Networking activities will contribute to further HPC awareness in Bulgaria and improve the position of Bulgarian companies and research teams in the European research ecosystem.

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