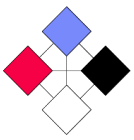
D1.4
2nd Annual Project Report



DAPHNE

Integrated Data Analysis Pipelines for Large-Scale Data Management, HPC, and Machine Learning

Version 1.5

PUBLIC

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Document Description

In D1.4 DAPHNE project team describe the progress made until project month 24 and here particularly the work done in project year 2 (M13/Dec 2021 – M24/Dec 2022). This report presents an overview of the type and purpose of the document, its revision history, the strategic objectives of DAPHNE project and the work carried out in project year 2 to reach these objectives. Then, a more detailed description concerning work done in the 2nd project year across all work packages (WPs) is provided. To round off, this report outlines year 2 project highlights and presents a brief outlook addressing the next steps.

D1.4 2nd Annual Project Report			
WP1 – Project Management			
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1 Introduction and Purpose of this Document

In D1.4 DAPHNE project team describes the progress made until project month 24, particularly the work done in project year 2 (M12/Dec 2021 – M24/Nov 2022) and even more specifically between M18/June 2022 – M24/Dec 2022, as the 1st Periodic Report has covered similar topics until M18.

First, this report refers to the structure and purpose of the document. Second, D1.4 outlines the main objectives in DAPHNE and what DAPHNE consortium has done to reach those targets. Third, this annual report presents an overview of achievements across the work packages 1 to 10, particularly addressing the work in the 2nd project year in section 4 pointing out to year 2 project highlights. Finally, an outlook is provided, and next steps are being addressed. The purpose of this document is therefore to provide an overview of DAPHNE project until M24, with an emphasis on updates of project year 2.

2 Strategic Objectives

This section shows the strategic objectives and the work of DAPHNE consortium towards these objectives in the 2nd project year.

2.1. Objective 1 System Architecture, APIs and DSL (WP2-4)

After an orientation phase including initial discussions and feasibility studies, the project consortium started already in February 2021 building an MLIR-based prototype of the DAPHNE system architecture, DSL, and related APIs. Partners in WPs 2 and 3 defined the overall architecture, language abstractions, and optimizing compiler. WPs 3, 4, and 5 designed and implemented initial runtime kernels and system support for local and distributed computation, as well as a vectorized (tiled) execution engine, which allows operator fusion, different task scheduling strategies, and code generation. In year 2 the system architecture has been successfully completed (see D2.2 [1]). Partners can now work in parallel on different components of the system architecture in their specific WPs. In addition, an initial documentation of the APIs and DaphneDSL was written and published in the context of DAPHNE 0.1 release. In this way we have worked towards the major goal of developing an open and extensible reference implementation of the necessary compiler and runtime infrastructure to simplify the integration of current and future state-of-the-art methods.

2.2 Objective 2 Hierarchical Scheduling and Task Planning (WP5-WP7)

The second strategic objective aims at increasing the utilization of available computing infra-structure such as compute clusters, heterogenous hardware devices, and even exploit modern storage and memory technologies. To achieve this goal WP5 has engaged in the development of static (compile-time) and dynamic (at run-time) scheduling techniques and is also in the process of devising intelligent task planning by leveraging interesting data characteristics such as sorting, redundancy, and sparsity.

In WP 6 development of input and output (I/O) primitives is conducted to add support for computational storage devices and in WP7 kernels are implemented to leverage the compute power of hardware accelerators like graphics processors (GPU) or field-programmable gate arrays (FPGA). Furthermore, these devices should also benefit from code generation which is another challenge tackled in this WP.

2.3 Objective 3 Use Case Studies and Benchmarking (WP8-WP9)

WPs 8 and 9 have analyzed and categorized existing benchmarks and real-world use cases provided by our project partners to get an overview of the variety of real-world use cases and datasets and how they have been covered in benchmarks so far. Based on the resulting insights of this work, we have defined DaphneBench and started with the initial development of a benchmarking toolkit. Both the definition and the toolkit are generic and able to cover a variety of integrated data analysis pipelines.

3 Status and Progress Update of All Work Packages

This section provides an overview of the progress made in year 2 throughout the work packages.

3.1 WP1 Project Management (led by KNOW) [M1-M48]

This WP seeks to facilitate high-quality environment for research activities to thrive, to keep track of reporting and deliverables and to improve communication throughout the consortium, the European Commission and beyond. In this section WP1 Lead KNOW reports about the objectives of WP1 and the work towards those objectives in project year 2.

Regarding the main objectives of this WP (1) to act as the communication interface with the European Commission, DAPHNE project management has sought to share information effectively via the EU portal, reporting on all relevant continuous reporting items (deliverables, milestones, risks, publications, dissemination and communication, patents/IPR, innovation, open data, gender, ABS regulation) and communicate with the project officer (PO) on relevant topics such as organizing meetings (organization of general assembly and Review meeting) asking for changes to the Grant Agreement and support (1st project amendment) or reaching out for exploitation purposes (invitations to conferences, workshops, etc.).

Concerning WP1 objective (2) to establish means of effective communication and collaboration within the consortium, DAPHNE project management has reported on these means in D1.1 Project and Risk Management Plan [2]. In line with this plan, we have updated the PM Gantt chart, kept our basic 4-level project structure, used the, in D1.1 [2] described, mailing lists and tools, e.g., Nextcloud and GitLab, as well as file storages for communication and collaboration purposes. Updates are that we have migrated the development from a private GitLab instance to GitHub and initiated a DAPHNE registration procedure to ensure a smooth transition into (and out of) the project communication platforms and channels. Complementary to these channels and platforms we use regular WP-specific meetings, bilateral meetings, as well as All-hands meetings across the entire consortium to ensure accurate and high-quality communication.

Resulting in WP1 objective (3) the organization of calls and meetings of the consortium, we have rescheduled our All-hands meetings from every 2 to every 3 weeks from 1 to 1,5 hours. In these consortium meetings, we discuss administrative and team updates, WP/technical updates, reporting and deliverable tracking such as news on for example publications and conferences. The meeting serves the purpose of bringing together all consortium members, providing relevant information in a structured way, asking for support and alignment if required and giving everyone the chance to clarify questions that are preferred to be discussed orally within the whole consortium.

In addition to these regular general meetings, project consortium has met for the general assembly meeting once a year. The purpose and general outline of this meeting format have been elaborated in various documents such as the Proposal, the Grant Agreement or the Project Plan (D1.1) [2]. Updates are that now, as we are at the end of the second project year, multiple demo presentations (demo prototype Quickstart, demo on Vega, demo on CPU/GPU/FGPA, WP5 demo, WP6 demo) complement the WPs and UCs presentations and give more variety to the meeting. More information on our 1st Review meeting is provided below (see Chapter 4.2).

WP1 project management reinforces the communication structure devised in D1.1 Project and risk management plan [2] and reminds the entire consortium to be aware of the objectives and the related deliverables. Specific internal project management tracking tools are the deliverable and reviewer tracker, the dissemination and exploitation tracker (see Chapter 3.10) and the financial tracking; their results are filtered and – depending on confidentiality-level - reported further within the EU portal and/or our project website [3]. A striking WP1 O4 year 2 milestone tracking update is that the initial end-to-end system prototype that was planned to be due by project month 24/Nov 2022 has been released already on March 31, 2022 (see Chapter 4.1).

Moreover, this objective seeks to ensure strategic realignment in case of unforeseen circumstances. Strategic realignment in project year 2 was necessary in terms of changes to DAPHNE project team (countermeasures to risks 1 and 2). In the general assembly and in the following entire-consortium meeting DAPHNE team have discussed the situation that two core members of DAPHNE (Matthias Boehm and Patrick Damme) are transferring to TU Berlin by the end of project year 2, resulting in an agreement that TU Berlin should be added as beneficiary to DAPHNE consortium. The amendment resulting from the agreement including budget and effort changes has been approved of by the European Commission.

Objective (5) addresses the coordination and quality assurance of reporting efforts. All submitted reports and deliverables have been accepted and we have received the (reviewer) feedback that they are of high quality. Yet, we need to include more details, complementing our cross-referencing, and improve our prototype documentation efforts. Financial controlling, budget and effort reporting have been carried out, depicting deviations from the original budget plan, and giving the consortium partners the chance to compensate for these deviations in the upcoming project periods. The new and current DAPHNE website https://DAPHNE-eu.eu [3] shows those reports that are available to the public in the section on publications.

The central project management endeavors to maintain a general project overview across all WPs and the budget, to relate the actual work being done to the original project plan and to ensure effective communication have been carried out in this second project year - with many lessons learned, such as valuable insights into the management processes from EU to partner-institution level as well as the importance of a professional team or high responsiveness and empathy.

3.2 WP2 System Architecture (KNOW) [M1-M21]

Following an analysis of trends in the space of integrated data analysis and discussions with our use case partners, a summary of the outcome was one of the tasks completed by WP2. The result is an open system architecture that fosters extensibility and caters to the needs of data analysis and data processing in the fields of machine learning (ML) and high-performance computing (HPC), which was documented in deliverable D2.1 [4]. In addition, D2.2 [1] refers to the refined overall architecture and key design decisions of the DAPHNE system infrastructure as an open and extensible system for IDA pipelines, comprising query processing, ML, and HPC.

Major elements are an MLIR-based compilation chain, frame, and matric representations, HW accelerators and computational storage, multi-level scheduling, a domain-specific language for linear and relational algebra, and a vectorized execution engine that allows for fine-grained fusion and parallelism across these heterogenous components. This system architecture and initial experiments formed the basis for a joint publication by all partners at the CIDR 2022 conference (see Chapter 4.3). The system architecture in its initial specification also considers the interaction of different persons using the DAPHNE framework and sets the goals of envisioned deployments in various settings. Furthermore, major design decisions like the use of MLIR as our central piece of compiler architecture were enabled by the tasks completed in this WP. D2.2 [1] refers to the refined overall architecture and key design decisions of the DAPHNE system infrastructure as an open and extensible system for IDA pipelines, comprising query processing, ML, and HPC. Major elements are an MLIR-based compilation chain, frame and matric representations, HW accelerators and computational storage, multi-level scheduling, a domain-specific language for linear and relational algebra, and a vectorized execution engine that allows for fine-grained fusion and parallelism across these heterogenous components.

3.3 WP3 Abstractions and Compilation (ETH) [M1-M48]

In WP3 we also defined the DAPHNE language abstractions in the form of DaphneDSL (a domain-specific language for integrated data analysis pipelines), and DaphneLib (a Python API with lazy evaluation as an additional entry point to simplify adoption). These language abstractions have been described with sufficient detail of underlying design principles, supported data types and operations, scoping and polymorphism, control flow, and means of configuration/extensibility, in D3.1 [5]. In this context, we already described the initial design of the MLIR-based optimizing compiler, DaphneIR as the central intermediate representation of the compiler, and future extensions by higher-level built-in operations.

Since February 2021, we have been actively developing an initial prototype of the DAPHNE system including the parser, compiler, and runtime as well as build scripts and a continuously growing test framework. The source code and artifacts as well as development tasks were initially managed in a private Gitlab repository hosted on premises of KNOW. Since the end of the first project year until now, we are seeing increasing contributions by many project partners, which go through a pull-request/review/merge process in order to ensure high quality. A demonstrator of the prototype was shared in D3.2 [6]. As of March 31, 2022, the initial prototype has been migrated to a public OSS repository https://github.com/daphne-eu/daphne [7] with Apache v2 license, where development continues in public in order to allow external reuse and facilitate community building efforts.

3.4 WP4 DSL Runtime and Integration (ICCS) [M1-M48]

Our initial design and implementation of the distributed runtime as reported in D4.1 [8] did not support the execution of fused operator pipelines in a distributed fashion. We refactored significantly that initial implementation in order to provide such support and improve the performance speedups that can be obtained through distributed execution. In addition, the initial distributed runtime was based on the gRPC communication framework. We also decoupled the distributed runtime implementation and execution from gRPC which was tightly linked in the past. This makes it easy to extend DAPHNE with any communication framework. In that context we provided support for distributed execution by integrating DAPHNE with MPI, in order to leverage its characteristics for improved communication performance, particularly when fast interconnection networks are available. Furthermore, we extended the I/O support for using multiple data formats, such as Arrow and Matrix market, in addition to the CSV format. We also defined and implemented our own DAPHNE file format along with custom (de)serialization support. Furthermore, we performed some initial experimentation to measure and quantify the impact of NUMA placement and data locality when executing parts of IDA pipelines on multi-socket systems. In addition, we initiated the discussion, design, and implementation for providing basic infrastructure for profiling and logging. Finally, we extended the documentation support targeting both the user and the developer of the DAPHNE system, regarding how to use and how to enhance/extend the distributed runtime, respectively.

3.5 WP5 Scheduling and Resource Sharing (UNIBAS) [M1-M48]

A key component of vectorized execution in local and distributed runtime environments is hierarchical scheduling across nodes, multiple heterogeneous hardware devices, and threads per device. The related discussions and design decisions are closely related to WPs 3 and 4, with a specific focus on deployment environments and workloads (ML pipelines, task-parallel

loops, and operator pipelines), task partitioning, scheduling algorithms, queue management, as well as data and task placement for data-parallel processing of fused operator pipelines and kernels. Initial work laid the foundation of common terminology, devised, and materialized the scheduler design in deliverable D5.1 [9], as well as developed and integrated a library of alternative scheduling primitives (e.g., static and self-scheduling) for exploratory experiments into the vectorized execution engine. Sparsity exploitation is a major trend across the software/hardware stack from ML algorithms, over ML systems, to the underlying hardware. Sparse data and operations in turn have challenging runtime characteristics due to irregular structures and skew. For that reason, hierarchical scheduling and task planning is a strategic objective because advanced scheduling algorithms can yield significant performance improvements by mitigating the resulting load imbalance across workers. Additional work outside the prototype also investigated additional distribution primitives, collective operations (e.g., MPI, NCCL), parameter servers, and similar distribution strategies. In ongoing and future tasks, these topics are brought together for holistic hierarchical scheduling.

3.6 WP6 Computational Storage (ITU) [M1-M48]

The integration of computational storage in DAPHNE requires the availability of devices supporting code offload, from the hosts where DAPHNE is run. WP6 started with a review of the state of the art and of the gaps that exist in the area of computational storage (deliverable D6.1 [10]). In particular, we have identified existing computational storage platforms and realized that none of them supports extended Berkeley Packet Filters (eBPF) code offload. We developed a software framework for eBPF code offload, called Delilah (described in deliverable D6.2 [11]) that we have implemented on the Daisy platform. The Daisy platform was not equipped with the FPGA blocks that make it possible to connect it with its environment (i.e., the host via PCIe, local DDR4 memory or the direct attached M.2 SSDs). We developed this block design and made it available on-line so that it can be used more easily by a larger community. With Delilah, we are now ready to integrate computational storage with DAPHNE. We also explored alternative computational storage platforms, including Samsung SmartSSD and the combination of FPGA and SSDs connected via a PCIe switch. We will thus be able to compare different approaches to computational storage, using DAPHNE.

We implemented I/O kernels that support read and write operations where a data object (e.g., a table or a matrix) is read or written in its entirety to file. In terms of data representation, the current DAPHNE prototype supports common data formats for matrices and frames (CSV, Parquet, Matrix Market), as well as DAPHNE binary data format. The prototype integrates existing access libraries (Arrow and Parquet).

3.7 WP7 HW Accelerator Integration (TUD) [M1-M48]

The integration of hardware accelerators in DAPHNE as initially discussed in D7.1 [12] was driven further to refine the design and eventually integrate first operations of GPU and FPGA accelerators. These operators or kernels are important for the exploitation of state-of-the-art hardware setups and to reach high performance in data processing. In the domain of GPU processors, the supported operations range from common unary and binary arithmetic over linear algebra to machine learning specific kernels commonly applied in neural networks. Additionally, supporting a certain type of hardware accelerator brings along the need for kernels that deal with context creation and device initialization, to keep track of the handles to their API and other specifics. The memory management aspects of these devices are wrapped inside their respective classes and data handles and details of its representation is organized in so-called meta data object. This structure enables fine grained data placement decisions. For GPU computing we rely on the CUDA API and the hardware that supports it to a large extent. However, an initial integration of OneAPI is pending integration in the code base to further extend the list of supported devices in this category and not solely rely on the products of a single vendor. This initial integration also drives the documentation efforts of extensibility to guide potential third parties in the endeavor of adding functionality to DAPHNE. The second major family of hardware accelerators, namely FPGA, has also seen the successful development of important operations like quantization or general matrix multiply (GEMM) and an initial integration of an Intel Stratix based accelerator. Further operations are either pending to be integrated into the DAPHNE code base or intended to be accessed through abstraction layers like the virtual vector library. In order to simultaneously exploit these heterogeneous devices, we started to add the functionality of running fused pipelines through our vectorized execution engine on them. This integration not only enables us to further exploit available resources but also gives us the opportunity to add tuning knobs for scheduling and load balancing where extra care needs to be taken to cater to every device's needs. Regarding input and output, as the utilization of accelerators usually implies a certain cost of pushing the task to the compute units and pulling the result back to main memory. Further efforts of more specialized work dealing with SIMD exploitation, performance models and code generations is conducted outside of the DAPHNE framework (with the intent of later integration). The deliverable D7.1 [12] further details our efforts of design and integration of hardware accelerators.

3.8 WP8 Use Case Studies (KAI) [M1-M48]

Within WP8 regular monthly meetings were coordinated to align on the implementation status of the pipelines and possible extension to DaphneLib and DSL as well as the preparation for the first Review meeting. The individual use case partners worked on their specific use case implementation:

DLR:

DLR worked on streamlining the LCZ classification pipeline. This included the generation of LCZ maps at country scale. In this context, we worked on implementing our pre-processing pipeline (mosaicking cloud free images) outside of Google Earth Engine allowing for better control of the used resources. Additionally, the pre-processing and inference pipeline was rolled out to an HPC environment. Furthermore, we worked on the model calibration, allowing for improved aggregation of multiple LCZ predictions and conducted further studies on the geographic transferability of models.

DLR will work on further improving the geographic transferability of the models and scaling out our processing pipeline. Furthermore, we are looking into studying cities at finer scales, i.e., mapping building functions from remote sensing images.

IFAT:

A Python demonstrator pipeline has been created, including a pre-processing step with scikit-learn, different models (Random Forest, SVC, CatBoost, densely connected neural network with Keras (with dropout)) were tested and compared against each other. There is an option to perform hyperparameter tuning (optuna) and to evaluate the performance with suitable metrics. As a result, we calculate tuning success probabilities based on equipment condition (indicated by sensors) and recipe data. The scalability was tested; it appears we can use the same model for all equipment of the same type and have a potential of improving uptime by more than 2%. It is vital to provide these probability values to the dispatching system, so they can be acted upon.

Outlook: There will be a master student researching a predictive maintenance optimized deep learning model for this use case (starting Dec. 2022 for 8 months). The current endeavor is to migrate the pipeline from a custom MySQL database to the APC/FDC system employed within IFAT. This will enable us to roll out this use case in production and reap its benefits mid-2023. For the deployment we will also have to find a smart way to integrate it into pre-existing dispatching rules.

KAI:

In the course of a bachelor thesis project, different parts of the initial pipeline implementation have been investigated. Thereby, the bottlenecks were identified and partly addressed. Special focus was also given to the evaluation of several implementations of the so-called "polyline simplification" routine – a problem mainly described in cartography to reduce the number of data points. By selecting the proper algorithm implementation, a performance speedup of a factor of about 24X was demonstrated.

Meanwhile, the focus on the KAI pipeline implementation was put on creating a small Python-based pipeline architecture, that reads individual processing steps from a configuration file. It

can read various data formats into a data frame object and passes the data along several pipeline stages. This will be the basis for further performance investigations and possible enhanced use case scenarios.

In November 2022, a student project has been started to develop and investigate an unsupervised ML model for detecting anomalies in the time-series data files provided within the material degradation Use Case. An expected outcome will be additional stages such as data cleaning and inference for the pipeline implementation.

AVL:

Within the Automotive Vehicle Development Case Study "Ejector geometry optimization for fuel cells", the focus was directed towards the design of experiments (DoE) workflow. While continuously growing the training data set, the prediction quality of the optimizer could be improved, leading to a smaller number of required simulations for the verification. As a next step, the DoE loop should be fully automated. Furthermore, adding new simulation results to the database is sought to improve the prediction quality of the optimizer.

In the second case study "Virtual Prototype Development", a demonstrator (which is capable of creating artificial training data and running a Gaussian process regression) has been created, analyzed and its bottlenecks have been identified. Here it is sought to improve the training data generation process. As possible scenario, the use of genetic algorithms for refining the data generation pipeline were identified and will be investigated in the next reporting period. Finally, the existing ML model will be retrained using the new data.

WP8 created common terminology and a joint understanding of requirements via regular joint meetings for in-depth discussions of the individual Use Cases (including knowledge sharing between partners), the use case descriptions, and ML pipeline implementations. A major outcome of these discussions are the Use Case pipelines documented in D8.1 [13], which serve as example top-down use cases for the DAPHNE system infrastructure and real-world benchmarks. During these discussions, we already identified future work for improvements of the individual pipelines and relevant measurements to quantify the use case improvements achieved through DAPHNE (in terms of development productivity and runtime performance for training and scoring).

3.9 WP9 Benchmarking and Analysis (HPI) [M1-M48]

Based on the real-world Use Cases and the survey of existing benchmarks, the partners of WP9 defined an initial version of DaphneBench, an internal benchmark that allows to quantify the overall progress of the DAPHNE prototype at all levels of the system stack in D9.2 [14].

In addition to the definition of the DaphneBench, WP 9 started developing a benchmarking prototype that follows the DaphneBench and discussed with WPs 2-7 how to make low level runtime tracing and performance information available for the benchmarking toolkit.

3.10. Dissemination and Exploitation (KNOW) [M10-M48]

The primary objective of dissemination and exploitation is a broad and open sharing of the project results via publications and talks, dedicated networking efforts, and an open-source reference implementation. In project year 2 these activities have been re-defined in D10.1 Refined Dissemination and Exploitation plan [15] and have been carried out accordingly.

In the first task of this WP T10.1 - which is the only active task until M24 - Continuous Dissemination via Publications and Talks [M10-M48, Lead: KNOW, Participants: all, Effort: 13PM] - complementary to the core research WPs (that also perform dissemination via scientific publications, which is interleaved with the actual research) – the broad scope of publications, talks and events that have been organized or co-organized are being listed and further communicated via the EU portal and conveyed to the public via our DAPHNE website [3]. The dissemination tracking document is sent out every 3 months asking project partners to provide details concerning their DAPHNE-related activities and update the listed items. The publications and talks are inter-linked and can therefore be accessed easily. The organization of the dissemination tracker is an admin task on its own, but important as all relevant dissemination activities must be recorded. These publications and talks arising from DAPHNE project work are also presented and discussed in our regular All-hands meetings and posted via our DAPHNE social media or partner lead accounts.

Thus, the lists in the appendix of this document give an overview of our publications and talks throughout the project runtime till now (M1-M24). 31 publications and 46 talks are listed and directly link to the source material. The DAPHNE consortium has been focusing primarily on top-tier conferences and journal publications in the research communities of DM, HPC, and ML systems. We have achieved to promote DAPHNE in the central venues of data management, such as VLDB and SIGMOD as well as workshops organized by the European Big Data Value Association (BDVA16), with Stefanie Lindstaedt (the CEO of KNOW) being a BDVA board member as well. One highlight to be pointed out particularly for project year 2 was the DAPHNE prototype release announcement at CIDR2022 in January (see Chapter 4.3).

In addition to the listed publications and talks we have also connected to similar projects such as EVEREST or eFlows4HPC exploring synergies within ML/DL systems and system support, architectures for gathering heterogenous data, language abstractions, intermediate representation, methods for extreme-schale analytics, e.g. combination of ML models, simulations and subsequent data analysis in different use cases, standardized interconnection methods, e.g., runtime integration, HPC libraries as well as data fusion and data integration technologies. In the upcoming project months 25-28 we plan to, in addition to the 2nd workshop for ICT-51 project, organized by the BDVA, reach out to particularly those two projects as well to define the areas in which we would like to cooperate in more detail.

As complementary dissemination and exploitation measures to maximize impact - in addition to publications and talks and exploring synergies by reaching out to similar projects - we have contributed to benchmarks and standards and have open-sourced DAPHNE reference implementation. We have started to facilitate real-world data or datasets with similar characteristics to simplify reproducing our experimental results and allow incremental progress at all levels (from system infrastructure to use case studies) by the scientific community at large.

Eventually, as planned we have created and launched our DAPHNE website https://DAPHNE-eu.eu [3] which communicates the project idea and objectives clearly. The website gives a general overview of the project, presenting news, listing all consortium partners, referring to the EU's Horizon 2020 research and innovation program, displaying a regularly updated list of publications and talks including the public deliverables, presenting the DAPHNE use cases, and showing a contact form for visitors to get in touch. The website also invites to visit the open-source community on GitHub and follow DAPHNE project on social media. To reinforce the open-source strategy of DAPHNE the displayed publications and talks are inter-linked.

Regarding DAPHNE major target groups, our dissemination efforts address system or data engineers that are designing and operating robust infrastructures, and application users that are mostly concerned with productivity and accurate predictions. The system itself and its open-source strategy as well as multiple dissemination and exploitation efforts – publications, conferences and talks, website, and social media, but also lectures and teaching - have been mobilized to attract these target groups. Feedback loops with these additional users and stakeholders enable us to improve DAPHNE system. Inconvenient or not directly applicable user requests are retained for potential joint follow-up research or industry projects with these users, which is also part of our go-to-market strategy.

4 Highlights of Project Year 2

4.1 Prototype Release

On March 31st we released DAPHNE into open source. The release at that time was purely making the code base plus documentation available to the general public via a GitHub repository https://github.com/DAPHNE-eu/DAPHNE [7]. Later this year, in October, we released our first software artifact resulting in DAPHNE release 0.1. The focus of this first release was to provide a first set of algorithms implemented in DAPHNE's domain specific language (DSL) to have stable running show case for interested users. Thus, our efforts towards the time of release were focused on improving documentation of the internals for developers and the DSL for users. The release artifacts materialized in three main components besides various checksums and digital signatures to verify the authenticity of the provided materials. Two packed archives containing compiled and runnable binaries (for the common 64-bit X86 architecture) and one containing a snapshot of the source code that was used to produce the compiled binaries. For technical reasons (library linking issues) we provided two downloadable binary release archives with and without GPU support (using the CUDA library) as we wanted to provide a smooth experience for a wide audience without the need to install this extra proprietary dependency. The consortium decided on a six-month release cadence which would leave the next release to be expected in April 2023.

4.2 1st Review meeting

The 1st Review meeting of DAPHNE project took place on July 6, 2022. In this meeting DAPHNE WP-Leads covered in addition to an introductory overview DAPHNE Use Cases and benchmarking, compiler and system infrastructure, runtime and scheduling, computational storage and accelerators, a live demo of DAPHNE as well as an overview of the financial situation and a joint discussion on the innovation potential of DAPHNE.

The feedback received was satisfying in the relevant sections - overall assessment, objectives and work plan, impact, implementation and resources, deliverables as well as milestones. Items, that we could improve, were also mentioned such as increased documentation and social media efforts, as well as closer inter-connectedness across work packages. These recommendations motivated us to improve these items immediately. We have developed a roadmap including aspects to be considered and tasks to be carried out based on these recommendations, e.g., we added a feedback loop to our weekly social media updates to track which activities have been carried out and which got stuck internally or we have agreed to communicate the strong collaborations across DAPHNE WPs with more emphasis in the next outside expert meetings.

4.3 Synergy Conferences and Workshops

The dissemination tracker document (see Chapter 3.10 above) gives an overview of DAPHNE-related conferences and workshops. A few of them were particularly interesting and should thus be documented in this annual report.

CIDR 2022

CIDR 2022 – the Conference on Innovative Data Systems Research (CIDR) – took place in Santa Cruz, California from January 9-12. This conference is a highlight of project year 2 in DAPHNE, because the paper entitled "DAPHNE: An Open and Extensible System Infrastructure" [16] presented by Matthias Boehm and including the whole consortium as authors is regarded as primary and central scientific paper depicting DAPHNE system. It describes the overall DAPHNE system architecture, its key components, and the design of a vectorized execution engine for computational storage, HW accelerators, as well as local and distributed operations, thus making a case for IDA pipelines. CIDR as high-quality conference served as perfect platform to announce the release of the DAPHNE prototype for March 31, 2022. On top of that, this conference was used as networking event, promoting DAPHNE within a highly motivated, competent, and promising target group of computer science and data management experts. Covid-restrictions and travelling were a bit of a challenge; yet representing DAPHNE at such a prestigious venue and reaching out to many new contacts we could connect to from there (via social media), the extra travel efforts were worthwhile.

German Spring DB Symposium

The "Fachgruppe Datenbanksysteme" - FG DB (Special interest group for database systems) is part of the "Gesellschaft für Informatik" (Society for Computer Science). The FG DB Spring Symposium is a bi-yearly symposium organized by the FG DB and is an important event for the German database community. The Symposium gives participants the opportunity to exchange current research with other research groups around Germany and with international industry partners. In the context of this symposium, the DAPHNE project was presented to the German database community, and project partners got valuable feedback.

In detail:
(1) Matthias Boehm was one of the speakers. He presented the DAPHNE project and the DAPHNE CIDR paper.
(2) Pinar Tözün was a speaker and presented on the DAPHNE-related topic: "Toward Hardware-Conscious Data Science."
(3) Tilmann Rabl and Nils Strassenburg, together with industry partner Snowflake Inc., were the main organizers of the event.
(4) Five DAPHNE Project members participated in the event.

ISPDC 2022 (21st IEEE International Symposium on Parallel and Distributed Computing)

The DAPHNE team at UNIBAS (leading WP5) organized the ISPDC 2022 conference in Basel. Parallel and distributed systems for scientific workflows and large-scale applications is a major topic in ISPDC 2022. One of the keynote speakers (Rosa Badia), the scientific and technical coordinator of the eFlows4HPC project, presented the project and their achievements. Patrick Damme (DAPHNE team at KNOW) also presented the DAPHNE project and achievements. The event and these two presentations resulted in discussions about potential synergies between DAPHNE and eFlows4HPC. The two teams discussed the workflow execution strategies of DAPHNE, and the way they can benefit from the eFLows4HPC infrastructure. They also discussed the way the eFlows4HPC infrastructure can benefit from DAPHNE as a software in the software catalog that eFlows4HPC supports. The discussion led to several DAPHNE members attending the eFlows4HPC workshop in the fall of 2022.

eFlows4HPC Workshop

On September 14, 2022, the EU funded project eFlows4HPC organized a workshop at the Barcelona Supercomputing Center (BSC). Several members of the DAPHNE consortium attended. This project is conducting research in the related field of high-performance computing (HPC) and focuses on making HPC infrastructure more accessible and therefore better utilized by capturing problems in preconfigured workflows that can contain several software packages that are orchestrated by their solution. As DAPHNE fits in as one of these software packages we engage in discussion with this project concerning further collaboration and integration of the DAPHNE framework in eFlows4HPC.

ERK 2022 (31st International Electrotechnical and Computer Science Conference)

A poster about the DAPHNE project has been presented at ERK 2022 (31st International Electrotechnical and Computer Science Conference) in Portorož (Slovenia), during the IEEE Slovenia Computational Intelligence Society Chapter meeting and technical paper presentations on September 20, 2022. The ERK conference brings together the computer scientists and electrical engineers in Slovenia and broader, while also offering the opportunity for IEEE members to present their annual achievements.

The poster presentation emphasized the work on DAPHNE system architecture and Use Cases, while also promoting the website of the project [3], presenting the invitations to the

open-source community [7], and referring to the DAPHNE developers mailing list. Presenting the poster at ERK aimed at promotion among Computer Scientists in Slovenia and internationally. The attendees of the conference also included several HPC Vega supercomputer users, which resulted in discussions about further exploitation of the DAPHNE project results.

BDV ICT-51 Projects Workshop

At Big Data technologies and extreme-scale analytics Projects Workshop (Horizon ICT-51-2020), organized by Big Data Value Association (BDVA) in collaboration with project EUH4D (European Federation of Data Driven Innovation Hubs), on September 27, 2022 (online), the DAPHNE project has been presented by Aleš Zamuda (UM) and Eva Paulusberger (KNOW) with the aim to engage for future road-mapping and creating a community around the topic in extreme-scale data analytics.

During the presentation, we had the opportunity to channel our work towards the activities of BDVA, especially in relation to Data Sharing Spaces and standardization. We have highlighted the specific technical and non-technical progress of the DAPHNE project, our Use Cases, the main lessons learnt so far, and contributions to road-mapping activities in the field of extreme-scale data analytics. The workshop has allowed us to reflect on the value and needs for collaborating with other ICT-51 projects (MORE, SELMA, VesselAI, EVEREST, and MARVEL), and how to federate our data sets and services under EUH4D.

5 Conclusions and Future Outlook

This deliverable has provided insights into project work within DAPHNE, particularly in the second project year. In general, we are very satisfied with the progress we have made so far on technical, team-work and administrative level and strive to continue our efforts in the third project year. We are planning, in accordance with the project plan, to bring the bottom-up developed DAPHNE system closer to the top-down developed use cases. Thus, we are planning a use case workshop for Q2/2023 but also stay in line with the research focus of the research and innovation programme. Moreover, we put our efforts towards sticking to our DAPHNE artifact release schedule with a release cadence update every 6 months, expecting v0.2 release by April 15, 2023. DAPHNE future will be discussed more specifically in our General Assembly meeting, coming up on December 7, 2022.

6 References

[1] D2.2 Refined System Architecture [public] https://daphne-eu.eu/wp-content/uploads/2022/08/D2.2-Refined-System-Architecture.pdf

[2] D1.1 Project and risk management plan [confidential]

[3] DAPHNE website https://DAPHNE-eu.eu

[4] D2.1 Initial System Architecture [public] https://DAPHNE-eu.eu/dissemination/

[5] D3.1 Language Design Specification [public] https://DAPHNE-eu.eu/dissemination/

[6] D3.2 Compiler Prototype [public] https://DAPHNE-eu.eu/dissemination/

[7] GitHub repository https://github.com/DAPHNE-eu/DAPHNE

[8] D4.1 DSL runtime design [public] https://DAPHNE-eu.eu/dissemination/

[9] D5.1 Scheduler design for pipelines and tasks [public] https://DAPHNE-eu.eu/dissemination/

[10] D6.1 Report on search space analysis, automatic capability configuration [public] https://DAPHNE-eu.eu/dissemination/

[11] D6.2 Prototype and overview of managed storage tiers and near-data processing [public] [to be made available after M24]

[12] D7.1 Design of integration HW accelerators [public] https://DAPHNE-eu.eu/dissemination/

[13] D8.1 Initial pipeline definition all use cases [public] https://DAPHNE-eu.eu/dissemination/

[14] D9.2 Initial benchmark concept and definition [public] [to be made available after M24]

[15] D10.1 Refined dissemination and exploitation plan [confidential]

[16] CIDR 2022 "DAPHNE: An Open and Extensible System Infrastructure" https://www.cidrdb.org/cidr2022/papers/p4-damme.pdf

DAPHNE

DAPHNE 956407 - DISSEMINATION													
No.	Type	Title	Authors	Title of the Journal/Proc./Book Venue	Number, date or frequency of the Journal/Proceedings /Book	Repository Link	Publisher	Place of Publication	Status: submitted/under review, accepted, published, rejected	Year of publication	Is this publication available in Open-Access, or will it be made available? Please add "Green Open Access" or "Gold Open Access." In case of "Gold Open Access." please add the fees.	Is this paper a peer-reviewed publication?	What is the ISSN or eISSN number (if available)?
1	Publication in Conference	Viper: An Efficient Hybrid PMem-DRAM Key-Value Store	Lawrence Benson, Hendrik Makait, Tilmann Rabl	Proceedings of the Very Large Data Base Endowment (VLDB) Endowment	annually, Vol. 14, No. 9	**paper:** https://hpi.de/fileadmin/user_upload/fachgebiete/rabl/publications/2021/viper_vldb21.pdf **code:** https://github.com/hpides/viper	ACM - Association for Computing Machinery	Copenhagen, Denmark	published	2021	yes (Gold)	yes	DOI 10.14778/3461535.3461543
2	Publication in Conference	A Survey of Big Data, High Performance Computing, and Machine Learning Benchmarks	Nina Ihde, Paula Marten, Ahmed Eleliemy, Gabrielle Poerwawinata, Pedro Silva, Ilin Tolovski, Florina M. Ciorba, and Tilmann Rabl	Proceedings of the Thirteenth TPC Technology Conference on Performance Evaluation & Benchmarking	annually, August 20, 2021	https://doi.org/10.1007/978-3-030-94437-7_7	ACM - Association for Computing Machinery	Copenhagen, Denmark	published	2021	yes (Green Access)	yes	
3	Publication in Conference	Maximizing Persistent Memory Bandwidth Utilization for OLAP Workloads	Björn Daase, Lars Jonas Bollmeier, Lawrence Benson, Tilmann Rabl	Proceedings of the 2021 International Conference on Management of Data (SIGMOD '21)	annually, June 20 - June 25, 2021	**paper:** https://hpi.de/rabl/publications/Document/puma-rabl/pmem_olap_sigmod_21.pdf/424bf7fd6f857bb45757fbd6636b8f86.html?cHash=6cae9c763731db856a252ca0bc2630d7 **code:** https://github.com/hpides/pmem-olap	ACM - Association for Computing Machinery	Shaanxi, China (virtual)	published	2021	yes (Green Access)	yes	DOI: 10.1145/3448016.3457292
4	Article in Journal	Better Database Cost/Performance via Batched I/O on Programmable SSD	Jaeyoung Do, Ivan Luiz Picoli, David Lomet, Philippe Bonnet	Conference on Very Large Data Bases, the VLDB Journal	every other month, February 18, 2021	https://doi.org/10.1007/s00778-020-00648-z	Springer, The VLDB Journal - The International Journal on Very Large Data Bases	online	published	2021	yes (Green Access)	yes	
5	Publication in Conference	Not your Grandpa's SSD: The Era of Co-Designed Storage Devices	Alberto Lerner, Philippe Bonnet	Proceedings of the 2021 International Conference on Management of Data	annually	https://dl.acm.org/doi/abs/10.1145/3448016.3457540	ACM - Association for Computing Machinery	Shaanxi, China (virtual)	published	2021	yes (Gold)	yes	
6	Publication in Conference	Parallelization of benchmarking using HPC: text summarization in natural language processing (NLP), glider piloting in deep-sea missions, and search algorithms in computational intelligence (CI)	Aleš Zamuda	Proceedings of the Austrian-Slovenian HPC Meeting 2021 - ASHPC21	annually	https://ashpc21.si/wp-content/uploads/2021/05/Book_of_abstracts_ASHPC21.pdf	University of Ljubljana, Faculty of Mechanical Engineering, LECAD Laboratory, and Institute of Information Science, Maribor, Slovenia	Ljubljana; Maribor (virtual)	published	2021	yes	yes	ISBN: 978-961-6980-77-7; 978-961-6133-48-7
7	Publication in Conference	Considering a Fear and Greed Index in Bitcoin Price Prediction Through Long Short-Term Memory	Nataša Ošep Ferš, Aleš Zamuda	Proceedings of the 30th International Electrotechnical and Computer Science Conference ERK 2021	annually	https://erk.fe.uni-lj.si/2021/erk21.pdf	Proceedings of the 30th International Electrotechnical and Computer Science Conference ERK 2021, IEEE Slovenia Section	Ljubljana	published	2021	yes	yes	2591-0442
8	Article in Journal	LB4OMP: A Dynamic Load Balancing Library for Multithreaded Applications	Jonas H. Müller Kornörfer, Ahmed Eleliemy, Ali Mohammed, Florina M. Ciorba	IEEE Transactions on Parallel and Distributed Systems	vol. 33, April 2022	https://ieeexplore.ieee.org/document/9524500	IEEE	online	published	2022	yes (Gold Access)	yes	
9	Peer reviewed research poster	Single- and Two-Level Dynamic Load Balancing of Scientific Applications	Ali Mohammed, Ahmed Eleliemy, Jonas H. Müller Korndörfer, Rubén M. Cabezón, Florina M. Ciorba	Platform for Advancing Scientific Computing Conference	annually	https://pasc21.pasc-conference.org/program/schedule/presentation/?id=post153&sess=sess182	PASC website	online	published	2021	yes (Gold Access: 1267 EUR)	yes	
10	Peer reviewed research poster	Don't Compete, Let's Cooperate: A Cooperative Scheduling Approach	Ahmed Eleliemy, Florina M. Ciorba	Platform for Advancing Scientific Computing Conference	annually	https://pasc21.pasc-conferen	PASC website	online	published	2021	yes (Gold Access)	yes	
11	Scientific Paper in Conference	A Resourceful Coordination Approach for Multilevel Scheduling	Ahmed Eleliemy, Florina M. Ciorba	International Conference on High Performance Computing & Simulation (HPCS) 2021	annually	https://arxiv.org/abs/2103.05809	HPCS	Barcelona, Spain, online	published	2021	yes (Green Access)	yes	
12	Publication in Conference	Ease.ML: A Lifecycle Management System for MLDev and MLOps	Leonel Aguilar, David Dao, Shaoduo Gan, Nezihe Merve Gurel, Nora Hollenstein, Jiawei Jiang, Bojan Karlas, Thomas Lemmin, Tian Li, Yang Li, Susie Rao, Johannes Rausch, Cedric Renggli, Luka Riminik, Maurice Weber, Shuai Zhang, Zhikuan Zhao, Kevin Schawinski, Wentao Wu, Ce Zhang	Conference on Innovative Data Systems Research, CIDR 21	annually	http://cidrdb.org/cidr2021/papers/cidr2021_paper26.pdf	Conference on Innovative Data Systems Research, CIDR	Amsterdam, Netherlands, online	published	2021	yes (Gold)	yes	
13	Workshop	Drop It In Like It's Hot: An Analysis of Persistent Memory as a Drop-in Replacement for NVMe SSDs	Maximilian Böther, Otto Kißig, Lawrence Benson, Tilmann Rabl	International Workshop on Data Management on New Hardware (DAMON'21)	annually	https://github.com/hpides/pmem-nvme-dropin	ACM SIGMOD/PODS	China, virtual	published	2021	yes (Gold)	yes	DOI: 10.1145/3465998.3466010
14	Article in Journal	BAGUA: Scaling up Distributed Learning with System Relaxations	Shaoduo Gan, Xiangru Lian, Rui Wang, Jianbin Chang, Chengjun Liu, Hongmei Shi, Shengzhuo Zhang, Xianghong Li, Tengxu Sun, Jiawei Jiang, Binhang Yuan, Sen Yang, Ji Liu, Ce Zhang	Proceedings of the VLDB Endowment	Vol. 15, Issue 4	https://doi.org/10.14778/3503585.3503590	ACM, VLDB, PVLDB - Proceedings of the VLDB Endowment	Copenhagen, Denmark, online	published	2021	yes (Gold)	yes	ISSN 2150-8097
15	Article in Journal	VolcanoML: Speeding up End-to-End AutoML via Scalable Search Space Decomposition	Yang Li, Yu Shen, Wentao Zhang, Jiawei Jiang, Bolin Ding, Yaliang Li, Jingren Zhou, Zhi Yang, Wentao Wu, Ce Zhang, Bin Cui	Proceedings of the VLDB Endowment	Vol. 14, Issue 11	https://doi.org/10.14778/3476249.3476270	ACM, Proceedings of the VLDB Endowment	Copenhagen, Denmark, online	published	2021	yes (Gold)	yes	
16	Publication in Conference proceedings	CleanML: A Study for Evaluating the Impact of Data Cleaning on ML Classification Tasks	Li Peng, Rao Xi, Jennifer Blase, Xu Chu, Yue Zhang, Ce Zhang	IEEE 37th International Conference on Data Engineering (ICDE)	annually	10.1109/ICDE51399.2021.00009	ETH Zurich, Institute for Computing Platforms	ETH Zurich, Institute for Computing Platforms	published	2021	yes (Gold)	yes	
17	Publication in Conference proceedings	DeGNN: Improving Graph Neural Networks with Graph Decomposition	Miao, Xupeng; Gürel, Nezihe Merve; Ce, Zhang, Wentao; Han, Zhichao; Li, Bo; Min, Wei; Rao, Susie; Ren, Hansheng; Shan, Yinan; Shao, Yingxia; Wang, Yujie; Wu, Fan; Xue, Hui; Yang, Yaming; Zhang, Zitao; Zhao, Yang; Zhang, Shuai; Wang, Yujing; Cui, Bin; Zhang, Ce	Proceedings of the 27th ACM SIGKDD Conference on Knowledge Discovery & Data Mining (KDD '21)	annually	https://dl.acm.org/doi/10.1145/3447548.3467312	ACM - Association for Computing Machinery	Singapore, pnline	published	2021	yes (Gold)	yes	ISBN: 978-1-4503-8332-5
18	Publication in Conference proceeding	DocParser: Hierarchical Document Structure Parsing from Renderings	Rausch, Johannes; Martinez, Octavio; Bissig, Fabian; Zhang, Ce; Feuerriegel, Stefan	Proceedings of the AAAI Conference on Artificial Intelligence, 35 (5)	annually	http://hdl.handle.net/20.500.11850/504620	AAAI Press	AAAI	published	2021	yes (Gold Access: 550 USD)	yes	ISSN 2159-5399 (Print), ISSN 2374-3468 (Online)
19	Article in Journal	The urban morphology on our planet – Global perspectives from space	Xiao Xiang Zhu,Chunping, Qiu, Jingliang Hua, Yilei Shi, Yuanyuan Wang, Michael Schmitta, Hannes Taubenböck	Remote Sensing of Environment	16 volumns / year	https://www.sciencedirect.com/science/article/pii/S0034425721005149	Elsevier Inc.	The Netherlands	published	2021	yes (Gold Access: 3950 USD)	yes	0034-4257
20	Publication in Conference	Efficiently Managing Deep Learning Models in a Distributed Environment	Nils Strassenburg, Ilin Tolovski, Tilmann Rabl	25th International Conference on Extending Database Technology (EDBT)	annually	**paper:** https://openproceedings.org/2022/conf/edbt/paper-60.pdf **code:** https://github.com/hpides/mmlib	OpenProceedings.org	Edinburgh, UK	published	2022	yes(Gold)	yes	DOI 10.48786/edbt.2022.12
21	Publication in Conference	Evaluating In-Memory Hash Joins on Persistent Memory	Tobias Maltenberger, Till Lehmann, Lawrence Benson, Tilmann Rabl	25th International Conference on Extending Database Technology (EDBT)	annually	https://openproceedings.org/2022/conf/edbt/paper-59.pdf	OpenProceedings.org	Edinburgh, UK	published	2022	yes(Gold)	yes	DOI 10.48786/edbt.2022.23
22	Publication in Conference	DAPHNE: An Open and Extensible System Infrastructure for Integrated Data Analysis Pipelines	Patrick Damme, Marius Birkenbach, Constantinos Bitsakos, Matthias Boehm, Philippe Bonnet, Florina Ciorba, Mark Dokter, Pawel Dowgiallo, Ahmed Eleliemy, Christian Faerber, Georgios Goumas, Dirk Habich, Niclas Hedam, Marlies Hofer, Wenjun Huang, Kevin Innerebner, Vasileios Karakostas, Roman Kern, Tomaž Kosar, Daniel Krems, Andreas Laber, Wolfgang Lehner, Eric Mier, Marcus Paradies, Bernhard Peischl, Gabrielle Poerwawinata, Stratos Psomadakis, Tilmann Rabl, Piotr Ratuszniak, Andreas Starzacher, Pedro Silva, Nikolai Skuppin, Benjamin Steinwender, Ilin Tolovski, Pınar Tözün, Wojciech Ulatowski, Yuanyuan Wang, Izajasz Wrosz, Aleš Zamuda1, Ce Zhang, Xiao Xiang Zhu	Conference on Innovative Data Systems Research	annually	http://www.cidrdb.org/cidr2022/papers/p4-damme.pdf	Conference on Innovative Data Systems Research, CIDR	Santa Cruz, California, USA	published	2022	yes (Gold)	yes	
23	Publication in Conference	Darwin: Scale-In Stream Processing	Lawrence Benson, Tilmann Rabl	Conference on Innovative Data Systems Research, CIDR 22	annually	https://hpi.de/rabl/publicatio	Conference on Innovative Data Systems Research, CIDR	Chaminade, USA	published	2022	yes (Gold)	yes	
24	Publication in Conference	Evaluating Multi-GPU Sorting with Modern Interconnects	Tobias Maltenberger, Ivan Ilic, Ilin Tolovski, Tilmann Rabl	Proceedings of the 2022 International Conference on Management of Data (SIGMOD '22)	annually	https://hpi.de/rabl/publications/Document/puma-rabl/mgpu-sort.pdf/16b9fe6eb38ed6d11c87f92593d4be85.html?cHash=c8f0f0ccb54ce81e512e39afb0988876	ACM - Association for Computing Machinery	Philadelphia, PA, USA	accepted	2022		yes	
25	Publication in Workshop Proceedings	Micro-architectural Analysis of a Learned Index	Mikkel Møller Andersen, Pınar Tözün	Proceedings of the International Workshop on Exploiting Artificial Intelligence Techniques for Data Management	annually	https://arxiv.org/pdf/2109.08495.pdf	ACM - Association for Computing Machinery	USA	published	2022	yes	yes	DOI: 10.1145/3533702.3534917
26	Article in Journal	Micro-architectural analysis of in-memory OLTP: Revisited	Utku Sirin, Pınar Tözün, Danica Porobic, Ahmad Yasin, Anastasia Ailamaki	The VLDB Journal, Volume 30, July issue	every other month, July 2021	https://link.springer.com/arti	Springer, The VLDB Journal - The International Journal on Very Large Data Bases	online	published	2021	yes	yes	DOI: 10.1007/s00778-021-00663-8
27	Publication in Conference proceedings	I/O Interface Independence with xNVMe	Simon Lund, Philippe Bonnet, Klaus Jensen, Javier Gonzalez	Proceedings of the 15th ACM International Systems and Storage Conference	annually	https://doi.org/10.1145/3534056.3534936	ACM - Association for Computing Machinery	Haifa, Israel	published	2022	yes	yes	DOI: 10.1145/3534056.3534936
28	Paper abstract	Speeding up Vectorized Benchmarking of Optimization Algorithms	Aleš Zamuda	Austrian-Slovenian HPC Meeting 2022 – ASHPC22	annually	https://vsc.ac.at/fileadmin/user_upload/vsc/conferences/ashpc22/BOOKLET_ASHPC22.pdf	EuroCC Austria	Vienna, Austria	published	2022	yes (Gold Open Access, fee 0 EUR)	yes	
29	Paper	DaxVM: Stressing the Limits of Memory as a File Interface	Chloe Averti, Vasileios Karakostas, Nikhita Kunati, Georgios Goumas, Michael Swift	MICRO 2022 - 55th IEEE/ACM International Synopsium on Microarchitecture	annually	paper: https://www.cslab.ece.ntua.gr/~xalverti/papers/micro2022_daxvm.pdf, code: https://github.com/cslab-ntua/DaxVM-micro2022	ACM/IEEE	yes	accepted	2022	yes	yes	
30	Publication in Conference	TPCx-AI on NVIDIA Jetsons	Robert Bayer, Jon Voigt Tøttrup, and Pınar Tözün	Proceedings of the Fourteenth TPC Technology Conference on Performance Evaluation & Benchmarking	annually	https://itu-dasyalab.github.io/RAD/publication/papers/TPCx_AI_on_Jetsons.pdf	ACM - Association for Computing Machinery	Sydney, Australia	accepted / presented / publication in progress	2022	yes	yes	TBD
31	Publication in Conference proceedings	Predicting Ion Beam Tuning in Semiconductor Manufacturing	Andreas Laber, Martin Gebser, Konstantin Schekotihin, Yao Yang	IEEE Electron Devices Society	annually		IEEE	online	accepted	2022	could not get feedback from the organizers	yes	

DAPHNE

DAPHNE 956407 - COMMUNICATION						
No.	**Type**	**Title**	**Speakers**	**Title of the Journal/Proc./Book Venue**	**Repository Link**	**Year of release**
1	Talk	Data-Intensive Systems in the Microsecond Era	Pınar Tözün	Waterloo Data Systems Seminars (2020-2021)	https://www.dropbox.com/s/4pxf8p1dc4imj1d/SSDs_2021.pdf?dl=0	2021
2	Paper Presentation	A Resourceful Coordination Approach for Multilevel Scheduling	Ahmed Eleliemy	International Conference on High Performance Computing & Simulation (HPCS) 2021	https://drive.switch.ch/index.php/s/NVkk68obhfbOuA0	March 2021
3	Workshop	Big-Data, Cloud and Machine Learning as a key-enabler for the European Automotive Eco-System	Matthias Boehm	BDVA Data Week	https://daphne-eu.eu/talks/	May 26, 2021
4	Paper Presentation	Drop It In Like It's Hot: An Analysis of Persistent Memory as a Drop-in Replacement for NVMe SSDs	Maximilian Böther and Otto Kißig	DAMON'21		June, 2021.
5	Paper Presentation	Maximizing Persistent Memory Bandwidth Utilization for OLAP Workloads	Björn Daase	SIGMOD 2021	https://github.com/hpides/pmem- olap	June, 2021.
6	Tutorial	Not your Grandpa's SSD: Storage in the co-Design Era	Alberto Lerner, Philippe Bonnet	Sigmod 2021	https://exascale.info/assets/pdf/lerner2021sigmod.pdf	June 24, 2021
7	Keynote talk in workshop	Flexible Vector Processing for Database Engines	Wolfgang Lehner	Huawei ACM SIGMOD/PODS 2021		June, 2021
8	Poster presentation	Don't Compete, Let's Cooperate: A Cooperative Scheduling Approach	Ahmed Eleliemy	The Platform for Advanced Scientific Computing (PASC) 2021	https://pasc21.pasc-conference.org/program/schedule/index.html%3Fpost_type=page&p=108&id=post_155&sess=sess182.html	July, 2021
9	Invited talk	Multilevel Scheduling and Load Balancing in Scientific Applications	Florina M. Ciorba	ISC 2021	https://app.swapcard.com/widget/event/isc-high-performance-2021-digital/planning/UGxhbm5_pbmdfNTIwMTI5	July 1, 2021
10	Invited talk	Monitoring and Operational Data Analytics from a User Perspective at First EuroCC HPC Vega Supercomputer and Nation-wide in Slovenia	Aleš Zamuda	MODA at ISC High Performance Digital 2021	https://de.slideshare.net/AlesZamuda/monitoring-and-operational-data-analytics-from-a-user-perspective-at-first-eurocc-hpc-vega-supercomputer-and-nationwide-in-slovenia	July 2, 2021
11	Talk	Multilevel Scheduling and Load Balancing in Scientific Applications	Florina M. Ciorba	University of Delaware	https://crpl.cis.udel.edu/blog/2021/03/02/virtual_webinar_series/	June 22, 2021
12	Paper Presentation	A Survey of Big Data, High Performance Computing, and Machine Learning Benchmarks	Ilin Tolovski	TPCTC @VLDB 2021		September 5-9, 2021
13	Talk	Benchmarking Integrated Data Analysis Pipelines	Tilmann Rabl	Huawei Strategy and Technology Workshop (STW) 2021 in Shenzhen, China		October 14-16, 2021
14	Talk	Drop It In Like It's Hot: An Analysis of Persistent Memory as a Drop-in Replacement for NVMe SSDs	Maximilian Böther, Otto Kißig, Lawrence Benson, Tilmann Rabl	International Workshop on Data Management on New Hardware		2021
15	Talk	ScaleUp, ScaleOut, ...: „ScaleFlex" for the Next-Generation Database engines?	Wolfgang Lehner	Huawei STW2021, Strategy and Technology Workshop		October, 2021
16	Talk	Data Independence in Machine Learning Pipelines and Data Science Workflows	Matthias Boehm	ETH/Stanford Workshop on Data-centric AI		November 18, 2021
17	Keynote talk	Academia meets industry: Is there more than polishing the round ball?	Wolfgang Lehner	SAP Open House Event E33		November, 2021
18	Workshop	DAPHNE: An Open and Extensible System Infrastructure for Integrated Data Analysis Pipelines	Matthias Boehm	Everest workshop at HiPEAC		February 15, 2022
19	Invited talk	Scheduling of Integrated Data Analysis Pipelines	Florina M. Ciorba	Leogang HPC workshop	https://www.mnm-team.org/_events/leogang/	March 21-24, 2022
20	Talk	Toward Hardware-Conscious Data Science	Pınar Tözün	German Spring DB Symposium	https://hpi.de/fileadmin/user_upload/fachgebiete/rabl/events/fgdb-22/slides/FGDB2022.pdf	March 24-25, 2022
21	Invited talk	DAPHNE: An Open and Extensible System Infrastructure for Integrated Data Analysis Pipelines	Matthias Boehm	German Spring DB Symposium		March 24-25, 2022
22	Paper Presentation	Efficiently Managing Deep Learning Models in a Distributed Environment	Nils Strassenburg	EDBT 2022		March 30, 2022
23	Paper Presentation	Evaluating In-Memory Hash Joins on Persistent Memory	Tobias Maltenberger (and Till Lehmann)	EDBT 2022		March 31, 2022
24	Proposal	Hardware-Conscious Machine Learning	Pınar Tözün	Dagstuhl Seminar		April, 22
25	Talk (online)	Sustainable Use of Hardware	Pınar Tözün	IT University of Copenhagen - Climate IT Video Series 2022	https://video.itu.dk/video/75608981/pinar-tozun-on-the-sustainable-use	May, 2022
26	Talk (online)	Peaceful Co-habitation on GPUs for Deep Learning	Pınar Tözün	Microsoft GSL Talk Series	slides at: https://itu-dasyalab.github.io/RAD/talk/files/MicrosoftGSL_RAD.pdf	May 24, 2022
27	Talk	Optimizing Compiler Infrastructure for Data-centric ML Pipelines	Matthias Boehm	Microsoft GSL Talk Series		April 26, 2022
28	Paper Presentation (hybrid)	Micro-architectural Analysis of a Learned Index	Pınar Tözün	Paper Presentation @ aiDM Workshop (co-located with ACM SIGMOD)	workshop: http://aidm-conf.org/ & slides: https://itu-	June 17, 2022
29	Talk (in person)	DAPHNE: An Open and Extensible System Infrastructure for Integrated Data Analysis Pipelines	Matthias Boehm	HiPEAC, Budapest		June 20 - 22, 2022
30	Paper Presentation	Evaluating Multi-GPU Sorting with Modern Interconnects	Tobias Maltenberger and Ivan Ilic	SIGMOD 2022	https://github.com/hpides/multi-gpu-sorting	June, 2022
31	Invited keynote talk	Multilevel Scheduling and Load Balancing in Scientific Applications	Florina M. Ciorba	NHR4CES	https://www.nhr4ces.de	June 21, 2022
32	Talk	DAPHNE: An Open and Extensible System Infrastructure for Integrated Data Analysis Pipelines.	Patrick Damme	International Symposium on Parallel and Distributed Computing (ISPDC)		July, 2022
33	Paper Presentation	Viper: An Efficient Hybrid PMem-DRAM Key-Value Store	Lawrence Benson	VLDB 2022	https://github.com/hpides/viper	Aug, 2022
34	Paper Presentation	Darwin: Scale-In Stream Processing	Lawrence Benson	VLDB 2022		Aug, 2022
35	Poster Presentation	DAPHNE: Integrated Data Analysis Pipelines for Large-Scale Data Management, HPC and Machine Learning	Aleš Zamuda	31st International Electrotechnical and Computer Science Conference	https://events.vtools.ieee.org/event_media/download/17851	September 19, 2022
36	Workshop	DAPHNE meets ICT-Standardization	Aleš Zamuda	BDV ICT-51 Projects Workshop	https://jam4.sapjam.com/groups/meAUlRzqW2WQSePaemuxn3/content?folderid=DHtpCgtHcTJCt3PWVKmxS6	September 27, 2022
37	Talk	Principles of Database and SSD Co-Design	Philippe Bonnet	DFG SSP Summer School	https://datamanagementlab.github.io/dfg-spp-22/	October 12, 2022
Events	**organized or co-organized**					
38	Dagstuhl Workshop	Database Indexing and Query Processing	Pınar Tözün (Co-organizer)	Dagstuhl Seminar 2022	https://www.dagstuhl.de/en/program/calendar/semhp/?semnr=22111	March 13 – 18, 2022
39	Workshop (co-organization)	Heterogeneity in Computing	Florina M. Ciorba (Co-organizer, General Chair)	IPDPS 2021	https://hcw.oucreate.com/hcw2021/	March, 2021
40	Workshop (co-organizer)	MODA: Monitoring and Operational Data Analytics	Florina M. Ciorba	ISC High Performance Digital 2021	https://moda21.sciencesconf.org	July 2, 2021
41	Workshop (co-organization)	9th International Workshop on Database Testing	Pınar Tözün (Co-organizer, co-Chair)	DBTest 2022	https://dbtest-workshop.github.io/	June 17, 2022
42	Minisymposium organizer at PASC22	Swiss Chapter Women in HPC	Florina M. Ciorba	Platform for Advancing Scientific Computing 2022	https://pasc22.pasc-conference.org/program/minisymposia/	June 28, 2022
43	Workshop (co-organizer)	MODA: Monitoring and Operational Data Analytics	Florina M. Ciorba	ISC High Performance Digital 2022	https://moda.dmi.unibas.ch	2022
44	Virtualisation Chair	The Genetic and Evolutionary Computation Conference	Aleš Zamuda	GECCO 2022	https://gecco-2022.sigevo.org	July 9-13, 2022
45	General Chair	21st IEEE International Symposium on Parallel and Distributed Computing	Florina M. Ciorba	ISPDC 2022	https://ispdc2022.dmi.unibas.ch	July 11-13, 2022
46	Technical Program Co-Chair	51st International Conference on Parallel Processing	Florina M. Ciorba	ICPP 2022	https://icpp22.gitlabpages.inria.fr	August 29-September 1, 2022