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Disaggregated Recursive Datacentre-in-a-Box
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D7.3 – Dissemination Plan and Report (b)

WP7: Dissemination and Exploitation



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Disclaimer

This deliverable has been prepared by the responsible Work Package of the Project in accordance with the Consortium Agreement and the Grant Agreement No 687632. It solely reflects the opinion of the parties to such agreements on a collective basis in the context of the Project and to the extent foreseen in such agreements.

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The partners in the project are IBM IRELAND LIMITED (IBM-IE), PANEPISTIMIO THESSALIAS (UTH), UNIVERSITY OF BRISTOL (UOB), BARCELONA SUPERCOMPUTING CENTER – CENTRO NACIONAL DE SUPERCOMPUTACION (BSC), SINTECS B.V. (SINTECS), FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS (FORTH), TELEFONICA INVESTIGACION Y DESSARROLLO S.A.U. (TID), KINESENSE LIMITED (KS), NAUDIT HIGH PERFORMANCE COMPUTING AND NETWORKING SL (NAUDIT HPC), VIRTUAL OPEN SYSTEMS SAS (VOSYS), POLATIS LTD (POLATIS).

The content of this document is the result of extensive discussions and decisions within the dReDBox Consortium as a whole.

More information

Public dReDBox reports and other information pertaining to the project will be continuously made available through the dReDBox public Web site under <http://www.dredbox.eu>.

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Executive Summary

dReDBoX aims at bringing innovation in the Cloud and data centres by proposing a functional disaggregated architecture. dReDBoX will prototype a data centre in a box system that will enhance IT resource (i.e. compute, memory) utilization, best match application/workload/VM needs to resource usage, while delivering a modular and scalable and resilient solution. The project will bring innovation on optical interconnects to deliver a high performance information transport network as well as novel solutions on remote memory access, control, hypervisor, and orchestration of IT and network resources. The proof of concept prototype will be evaluated on a number of applications such as mobile edge computing, network data analytics and security.

In dReDBoX, dissemination aims to deliver the widest possible impact of the project results and outputs. This is carried out by concentrating the efforts in the following activities:

- Scientific dissemination: dReDBoX due to its highly innovative aspects is expected to deliver numerous publications in top conferences and journals with high impact factor. The consortium has already and will also engage with the research community through participation on leading international conferences by presenting the results but also organize workshops that will bring together industry and academia as well as other EU research funded projects for maximum impact.
- Industrial and broader dissemination: Industrial partners aim to participate and contribute to relevant open source ecosystems. This will create a return of the initial investment done by the EU community over the whole population. It will also help companies in creating a strategic position with respect to competitors, and boosting the market uptake of innovation.
- Collaboration with other EU projects: dReDBoX has initially identified EU funded projects that are complementary and has already initiated and otherwise will initiate a dialogue of collaboration in order to maximize impact. Common workshops will aid the process of potentially working together at technical level.

This deliverable provides [an update of the first deliverable \(D7.2\) on the topic which focused on strategies planned by the project consortium to carry out dissemination \(Section 2\), collaboration with other projects \(Section 3\), and list of dissemination fora \(Section 4\), as well as dissemination of the current scientific outcomes \(Section 5\). The industrial dissemination plan that mostly aims at exploitation will be reported on a dedicated series of deliverables \(exploitation plans\).](#)

[The internal and scientific dissemination plan was well thought out and documented in D7.2. In this update of dissemination activities and plans, an incremental update is provided to report on the latest interactions and plans with other H2020 projects. In addition, new dissemination activities undertaken during the last six months of the project are reported. Particular to scientific publications and on a per publication basis, an assessment in terms of actual](#)

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scientific contribution, as well as its alignment with project activities, is reported. All scientific publications reported herein, as a result of the project activities, are listed on the public project website (cf. deliverable D7.1), together with links leading to the publication material. Also, all project deliverables that are classified as publicly available (PU) are made available on the public project website, once these have been accepted.

Throughout this deliverable, a blue font colour has been used to signify updated content, relative to deliverable D7.2.

1 Introduction

In dReDBoX, WP7 and in particular Task 7.2 is in charge of dissemination and awareness related to the outcomes and results of the project. The main goal is to ensure the dReDBoX impact, by harmonizing and stimulating dissemination activities in the consortium, with the final aim of pushing the results for impact generation, wide acceptance and adoption across Europe and beyond.

The dReDBoX dissemination will target a wide audience of research and industrial community in Europe and the world by publishing the results produced in scientific journals and conferences and participate to as well as organize events such as workshops and special sessions.

The consortium also aims to contribute to the open source community to boost innovation, better position industrial partners in the market place and have rapid uptake on innovative solutions.

2 Dissemination

Scientific and industrial dissemination of the project vision and outcomes is of fundamental importance in the dReDBoX project. We have considered several tools to disseminate our work from both, scientific and industrial perspective.

2.1 Internal Dissemination

At the onset of the project, a complementary and complete set of tools has been put in place to facilitate internal exchange and flow of information. Specifically, IBM has created and kindly provided access to all consortium members to its online, secure document sharing facility named Box¹. Box sports securely sharing files and collaborating with anyone, both on desktop and mobile devices. It allows to easily but securely create, edit and review documents among consortium partners in real-time or on-the-go and keeps the project moving forward, with handy features like collaborative editing, versioning and fine-grained access controls. The dReDBoX Box space is the central internal repository for document exchange, including editing of deliverables and design drafts, communication material, scientific dissemination manuscripts, related art and literature sharing, up-to-date information of consortium contacts, meeting minutes and information, and others.

IBM has also put in place a comprehensive set of mailing lists, operating on top of its mailing service infrastructure, with membership to each mailing list on a need to know basis. The set of mailing lists is listed in the table below:

Mailing List Name	Description
dReDBoX_ALL	All Partners (serves WP1 and WP7 communications too)

¹ <http://www.box.com>

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dReDBox_WP2	WP2 Partners
dReDBox_WP3	WP3 Partners
dReDBox_WP4	WP4 Partners
dReDBox_WP5	WP5 Partners
dReDBox_WP6	WP6 Partners
dReDBox_WG_Arch	Cross-Work-Package dReDBox Architectural Discussion Group
dReDBox_WG_Prototype	Cross-Work-Package dReDBox Prototyping Discussion Group
dReDBox_WG_Sim	Cross-Work-Package dReDBox Simulation Discussion Group
dReDBox_WG_SysSoft	Cross-Work-Package dReDBox Software Discussion Group
dReDBox_PCB	Project Coordination Board
dReDBox_FA&Admin	Project Financial Administration

IBM has put in place appropriate templates for internal documentation and reporting, including presentation templates for use in project meetings, document and spreadsheet templates for quarterly reporting and project documentation. Also, Kinesense has put in place scorecard templates to keep track of external dissemination and communication actions pursued as part of the project activities. Last, an audio conferencing of global reach is being used for the numerous conference calls taking place within and across work-packages, as well as plenary calls. The aforementioned Box repository is being used to promptly share produced minutes capturing all these calls, follow-up on action items and tracking standing sub-tasks and issues.

2.2 Scientific Dissemination

International and national conferences and workshops

dReDBox will organize workshops possibly co-located with relevant European and international events such as conferences aiming at disseminating the relevant results and fostering collaboration with other European and International projects. The partners will also distribute printed brochures and posters at such events.

Publications and magazines

Thanks to its highly innovative aspects, dReDBox is expected to deliver numerous publications. The quality and volume of published articles will be of high importance since they will provide a visible and quantifiable assessment of the project-induced innovation. Both theoretical and experimental results will be presented at international conferences, leading journals and magazines. In addition some partners will communicate the results to industrial specific events which they will participate to and/or organize.

Exhibitions, seminars and media

Exhibitions and technology transfer seminars also exploiting resources made available by the Commission through information activities, interviews in magazines, presentations in various institutions and government officials will broaden the dissemination spectrum of dReDBoX. Also newsletters and leaflets will be prepared, printed and distributed on public events, research centres and associations. dReDBoX has active role on twitter and other social media described in deliverable D7.1.

2.3 Industrial and broader Dissemination

Contribution to the Open Source community

The Open Source community has always been a useful medium for the dissemination of European Projects' outcomes. On one side the Open Source community will help the outcomes of the project to become visible to a wider audience that could benefit of the novelties introduced by the project, creating a return of the initial investment done by the EU over the whole population. On the other side contributing to Open Source projects helps companies in creating a strategic position with respect to competitors, and boosting the market uptake of innovation.

The dReDBoX consortium aims to exploit open source software in various levels of its architecture. Namely the Linux kernel, QEMU and relevant cloud management/datacenter operating system ecosystems, such as e.g. OpenStack. Contributions to such ecosystems will be pushed to the relevant communities when not creating confidentiality issues and per partner-internal clearance policies; also, subject to what is accepted by the leadership/decision-making structures governing each open source ecosystem.

Industrial commitment in research-oriented projects

Partner VOSYS believes that the work carried on the dReDBoX project is extremely important for the company to enter the cloud/high performance computing segment with a solid experience to be transformed in actual market possibilities. For this purpose VOSYS has hired a PhD student who has been completely dedicated to the project to boost the scientific impact of the company and maximize the effort put in the project.

The research questions to be answered within the project and innovation outcome of dReDBoX is highly relevant to IBM, particularly as part of exploring novel architectures and designs for cloud datacenters and near-memory computing, evaluation of fitness and limits of existing commercial and experimental technologies, as well as ramifications and evolution of open-source system software and management platforms driving these evolutions.

Sintecs has noticed that the dReDBoX participation is yielding interest from other (H2020) research projects and therefore creating possibilities for future cooperation in multidisciplinary projects. Before participating in dReDBoX, its

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focus has mainly been on industrial partners, whereas now it broadens towards the scientific field as well. Furthermore, participating in a Horizon 2020 project has a positive impact on communication with current and potential future industrial customers.

Industrial commitment in video analytics

Partner Kinesense sees an increasing pace of change in recent months in the video analytics industry. Particularly notable is the trend towards large regional datacentres for processing police and security acquired surveillance video data. Such datacentres will need to deal seamlessly with massive variations in data processing loads. These variations are caused by events (e.g. criminal investigations and terrorist incidents) and are impossible to predict. Kinesense feels that the advantages of the dReDBox architecture presents huge advantages for this kind of adaptable regional datacentre.

Industrial commitment in network analytics

Nowadays, businesses are being migrated to the cloud and the importance of the digital economy is relentlessly growing. Therefore, network analytics are becoming more and more necessary in order to assess the quality of online services, guarantee the security of transactions, and obtain valuable business data. It is particularly important to monitor application performance, and also to keep a close watch on systems in order to avoid attacks or thefts.

Unfortunately, network monitoring is becoming an increasingly difficult task due to high speed of network backbones (100 Gbps) and the huge amounts of data involved (tens to hundreds of terabytes per day). Naudit considers that the current architecture of servers will soon not be able to cope with the complexity of network monitoring. It is necessary to develop a new architecture such as the one proposed by dReDBox: highly parallel, scalable, flexible, and power efficient. Particularly, flexibility is very important for this problem, in order to balance resources between online and offline analysis, and be able to tackle sudden increases in traffic.

3 Collaboration with other relevant EU projects

Below there is a list of EU funded projects that have considerable complementarities and as such we plan to explore targeted cooperation on different levels. Some of the dReDBox partners participate in these projects that aids communication; in addition, already undertaken and further planned cross-project workshops aim at enhancing the dialogue.

1) ICT STREAMS project (<http://155.207.169.35/streams/>)

The objective of STREAMS project is to develop the necessary Silicon Photonics Transceiver and Routing technologies towards a new, power efficient, WDM-based, Tb/s, optical on-board interconnection paradigm. STREAMS will develop a distributed routing system based on a passive Si-Pho AWGR routing element to provide simultaneous any-to-any communication between 16 end-

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points, such as high-end processor sockets. On that account, constructive collaboration is aimed to be established with dReDBoX in terms of AWGR-based optical network performance metrics that can be employed towards investigating alternative optical passive routing implementations for Brick-to-Brick or Tray-to-Tray optical interconnection.

2) ICT Vineyard project (<http://vineyard-h2020.eu/en/>)

The ICT Vineyard project is about building an integrated platform for energy-efficient datacentres based on novel programmable hardware accelerators (Dataflow engines and FPGA-based servers). It aims at developing a high-level programming framework and big data infrastructure for allowing end-users to seamlessly utilize these accelerators in heterogeneous computing systems by employing typical data-centre programming frameworks (i.e. Spark.). The dReDBoX architecture is of interest to the Vineyard project.

3) ICT Uniserver project (<http://www.uniserver2020.eu>)

The principal aim of UniServer is to facilitate the evolution of the Internet from an infrastructure where data is gathered in centralized datacentres to an infrastructure where data is handled in a distributed and localized manner, close to the data sources, enabling essentially Edge Computing. UniServer aspires to deliver, by 2019, a unique, fully working prototype able to exploit the intrinsic system heterogeneity with lightweight software mechanisms for improving the energy efficiency and performance of micro-servers. The UniServer platform will support classical cloud applications such as financial trade management and analysis, while enabling the development of new applications at the Edge of the cloud such as smart traffic control and in-home directed advertisement. dReDBoX shares overlapping value-add targets with Uniserver and will strive to benefit from the innovation produced by its partner project, as well as share produced innovation, among others on energy-efficient micro-datacenters, expanded use-case reach and virtualization technologies. The participation of IBM in both projects is expected to facilitate ease of information exchange. In fact, this interaction has been materializing e.g. in the form of deliberations for organization of joint events.

4) H2020 ExaNoDe project (<http://exanode.eu/>)

The ExaNoDe H2020 European project is about development and prototyping of a highly efficient, integrated, multiway, high performance, heterogeneous compute element for an Exascale HPC computing node. Demonstrated using hardware emulated interconnect, it will build on top of multiple European initiatives for scalable computing, utilizing low-power processors and advanced technologies.

dReDBoX can be definitely interested in the research done by ExaNoDe on the compute node, with the aim of reducing energy consumption, while still remaining competitive with respect to other compute node architectures (i.e., provide higher energy efficiency).

5) H2020 ExaNeSt project (<http://www.exanest.eu/>)

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ExaNeSt develops and prototypes solutions for Interconnection Networks, Storage, and Cooling, as these have to evolve in order for the production of Exascale-level supercomputers to become feasible. ExaNeSt is addressing HPC challenges by using ARMv8 energy-efficient cores, close integration of non-volatile memory, efficient interconnects and virtualization features.

The interconnection architecture of dReDBoX might be of interest for ExaNeSt to help scaling towards Exascale. On the other hand, some studies performed on the UNIMEM memory architecture could be of interest for dReDBoX in order to better shape its memory disaggregation facility.

6) H2020 ECOSCALE project (<http://www.ecoscale.eu/>)

ECOSCALE works towards a scalable programming environment and hardware architecture tailored to the characteristics of current and future HPC applications. The ECOSCALE architecture, programming model and runtime system follows a hierarchical approach where the system is partitioned into multiple autonomous Workers in Partitioned Global Address Space (PGAS) partitions. ECOSCALE Workers will employ reconfigurable accelerators that can perform coherent memory accesses in the virtual address space utilizing an IOMMU.

Potential synergies with dReDBoX lie in the accelerator architecture and construction, and in the possible application of memory disaggregation in the UNIMEM memory architecture.

7) H2020 Mont-Blanc project (<http://www.montblanc-project.eu/>)

The Mont-Blanc project has the goal to study building scalable HPC systems based on low power embedded processing elements such as ARM based SoCs. The project has successfully experimented with various platforms, clusters and build a prototype of 1080 nodes. Its next challenge is to build an even larger system. BSC is a partner in both the dReDBoX and Mont-Blanc projects. Because the dReDBoX architecture is based on ARM, dReDBoX would readily benefit from the knowledge and insights acquired in Mont-Blanc. Additionally, the hardware, software, workloads and the prototypes build in Mont-Blanc are already publicly available and accessible and dReDBoX would use them for experimentation. In fact dReDBoX already uses some of the Mont-Blanc experimental clusters for evaluation and simulation.

As part of this dissemination avenue, the dReDBoX consortium has initiated a discussion of cooperation with the Uniserver and Vineyard projects, both among the targets listed above. Areas of overlap and complementarity have been identified and avenues of pursuing further cooperation have been discussed. The first tangible outcome of this action has been the joint organization of the EnESCE workshop (Workshop on Energy-efficient Servers for Cloud and Edge Computing), to take place as part of the HiPEAC 2017 (High Performance and Embedded Architecture and Compilation) conference. Coordinators and members from the consortia of dReDBoX, Uniserver and Vineyard have put together a full-day joint workshop programme (including 2 keynote presentations), which is anticipated to capture results in relevant cross cutting areas, but also offer an avenue for further cooperation and exchange of ideas between the three projects. Two of the organizers are from the dReDBoX consortium (Dionisios Pnevmatikatos -FORTH)

and Kostas Katrinis – IBM Research Ireland), along with the Uniserver project coordinator Georgios Karakonstantis (Queen's University Belfast) and with Christoforos Kachris (Institute of Communications and Computer Systems) from the Vineyard project. Further information about the EnESCE workshop can be found under following URL:

<https://www.hipeac.net/events/activities/7423/enesce/#fndtn-main>

4 Scientific dissemination fora of dReDBoX outcome

The table below shows a list of major international technical journals and peer-reviewed conferences that are considered most appropriate for the project outcomes. A list of relevant call for papers will be maintained on the dReDBoX internal Box and website, continuously updated.

Journals	<ul style="list-style-type: none"> • IEEE Journal on Optical Communications and Networking • IEEE Journal of Lightwave Technology • IEEE Transactions on Networking • Elsevier – Journal of Parallel and Distributed Computing • IEEE Transactions on Parallel and Distributed Systems • IEEE Transactions on Computers • IEEE Transactions on Cloud Computing • ACM Transactions on Architecture and Code Optimization • ACM Transactions on Computer Systems (TOCS)
Conferences	<ul style="list-style-type: none"> • International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS) • International Symposium on Computer Architecture (ISCA) • International Symposium on Microarchitecture (MICRO) • The International Symposium on Memory Systems • International Conference on Computational Science http://www.iccs-meeting.org/iccs2016 • International Conference on Parallel Processing http://icpp2016.cs.wcupa.edu • IEEE International Conference on High Performance Computing, Data, and Analytics • Symposium on Principles and Practice of Parallel Programming • IEEE International Parallel & Distributed Processing Symposium • ACM International Symposium on High-Performance Parallel and Distributed Computing • EuroSys • VHPC • KVM-Forum • HiPEAC • Linux Plumbers conference • Linux Kernel Summit

	<ul style="list-style-type: none"> • OSDI Usenix • OSA/IEEE Optical Fibre Communications (OFC) Conference (http://www.ofcconference.org/en-us/home/) • European Conference on Optical Communications (ECOC) (http://conference.vde.com/ecoc-2016/Pages/ECOC2016.aspx) • GLOBECOM (http://globecom2016.ieee-globecom.org/) • ICC (http://icc2016.ieee-icc.org/) • ACM SIGCOMM (http://www.sigcomm.org/) • International Conference on Field-Programmable Logic and Applications (FPL) • International Symposium on Field-Programmable Custom Computing Machines (FCCM)
Magazines	<ul style="list-style-type: none"> • IEEE Communications Magazine • IEEE Network • IEEE Micro

5 Dissemination outcome and scientific contribution

A critical dissemination activity of the dReDBox project partners is the publication of the technical results in international leading journals, conferences, workshops, etc. The following sections report the early activities carried out during the first year of the project.

5.1 Scientific publications

1. Katrinis, K., Syrivelis, D., Pnevmatikatos, D., Zervas, G., Theodoropoulos, D., Koutsopoulos, I., Hasharoni, K., Raho, D., Pinto, C., Espina, F., Lopez-Buedo, S., Chen, Q., Nemirovsky, M., Roca, D., Klos, H. and Berends, T., "Rack-scale disaggregated cloud data centers: The dReDBox project vision." 2016 Design, Automation & Test in Europe Conference & Exhibition (DATE). IEEE, 2016.

Paper scientific contribution: This publication has been accepted to DATE 2016 after undergoing a peer review process and subsequently presented at the aforementioned venue. This publication presented a concise early version of the dReDBox architecture concept, outlining featured subsystems and high-level approach and discussing challenges to be addressed. It also positioned the project relative to conventional systems, forming the motivation of the approach. Particular to objectives set out in dReDBox, this dissemination action aligns with the objective of *"dReDBox aims to design and develop a vertical approach for a flexible modular datacentre-in-a-box architecture"*.

2. Yifan Liu, Hui Yuan, Adaranijo Peters, Georgios Zervas, "Comparison of SDM and WDM on Direct and Indirect Optical Data Center Networks", accepted for publication at ECOC 2016.

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Paper scientific contribution: In order to come-up with the dReDBoX interconnect architecture that could scale up and out as well as operate with the least power consumption and minimum footprint we studied a range of topologies and benchmarked two competing multiplexing techniques. The first is wavelength division multiplexing (WDM) and the second is space division multiplexing (SDM). The simulation results clearly indicated the benefits of two-tier network topologies as per dReDBoX one within the rack that can be extended to 3-tier between racks. Such topologies can deliver the best network utilization critical for the performance of the computer architecture. Also, SDM appears to perform better than WDM that clearly justifies our choice of silicon photonic transceivers on the Brick operating at 1310nm in combination with fibre ribbons and beam-steering switches. This provided scientific input to WP2 and associated deliverables in order to formulate the dReDBoX architectures and also drive further analysis and implementation decisions in WP3 and WP5.

3. Mishra, V., Chen, Q., Zervas, G., “REoN: A Protocol for Reliable Software-Defined FPGA Partial Reconfiguration over Network”, IEEE Reconfig 2016, Nov-Dec 2016

Paper scientific contribution: Dynamic, remote and automatic deployment of different accelerators in the form of IPs on partial reconfigurable (PR) regions is critical for the widespread use of FPGAs/SoCs in data centres. This paper reports on a reliable protocol that can transport, deliver and deploy partial-bit files to FPGAs over standard Ethernet networks. Crucially, this protocol eliminates the need of any embedded or attached processor and so creates a generic method for any type of FPGA/SoC system. The protocol was validated on NetFPGA using 10GE ports for high bandwidth partial bit file transfer together with a high frequency iCAP controlled and internal protocol engine. This is a method that can be further investigated as one of the possible ways to control networked attached accelerators designed in WP3 across the whole dReDBoX system.

4. Chen, Q., Mishra, V., Zervas, G., “Reconfigurable Computing for Network Function Virtualization: A Protocol Independent Switch”, IEEE Reconfig 2016, Nov-Dec 2016

Paper scientific contribution: This paper reports the first protocol independent switch using network accelerators such as Ethernet/IP/UDP parsers deployed partial reconfiguration regions on the programmable logic. Crucially, an architecture that involves a dynamic packet/circuit based network on chip (NoC) interconnects multiple plug-in partial regions and decouples them from the high-speed IOs. Methods have been deployed to demonstrate hitless (no data loss) switch-over between IPs that perform different functions. This is the first step to realise a network on chip able to route data from the PS section to the high speed I/Os on each of the dReDBoX bricks which is under development in WP3.

5. J.F. Zazo, S. Lopez-Buedo, G. Sutter, J. Aracil, "Automated synthesis of FPGA-based packet filters for 100 Gbps network monitoring applications". 2016 International Conference on Reconfigurable Computing and FPGAs (ReConFig 2016).

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Paper scientific contribution: Even in highly parallel systems, online traffic analysis at 100 Gbit/s is extremely challenging due to the huge amount of data that needs to be processed per second. Traffic filtering will allow us to focus on the relevant data, discarding those packets that do not provide any valuable information. This is the first of two papers that tackle packet filtering at 100 Gbit/s, and the goal is to integrate these filters in the FPGA accelerators of dReDBox. Here, a tool for automatically synthesizing packets filters from a custom grammar has been implemented. Thanks to parser generators (Bison) and lexical analyzers (Flex), Verilog code is automatically generated from the filter specification. Rules can be applied over a protocol, a protocol field, the packet payload, or a combination of them. Filters are fully pipelined, so the full 100 Gb/s rate is guaranteed. As the framework uses a cut-through approach, latency is kept to a minimum. The paper delivers an insight into accelerators aimed for dReDBox accelerators serving the network analytics use case in WP6.

6. M. Ruiz, G. Sutter, S. Lopez-Buedo, J.E. Lopez de Vergara, "FPGA-based encrypted network traffic discrimination at 100 Gb/s", 2016 International Conference on Reconfigurable Computing and FPGAs (ReConFig 2016).

Paper scientific contribution: This the second paper that tackles packet filtering. While the previous one presented a generic methodology for creating packet filters, this one aims at solving a specific problem: ciphered traffic. Ciphered packets are useless for deep packet inspection, but detecting them is tricky. In this work, we present an FPGA implementation of a simple yet effective algorithm that can work at 100 Gbit/s. Another interesting feature of this paper is showing how High-Level Synthesis (HLS) can be leveraged in order to significantly reduce the development time of FPGA-based networking applications. The paper delivers an insight into accelerators aimed for dReDBox accelerators serving the network analytics use case of WP6.

7. Adaranijo Peters, Georgios Zervas, "Network Synthesis of a Topology Reconfigurable Disaggregated Rack Scale Datacentre for Multi-Tenancy", accepted for publication at OFC 2017

Paper scientific contribution: Following the design of the dReDBoX function programmable and hybrid packet/circuit architecture using the bricks as protocols independent/programmable switches this papers will report for the first time the benefits of the dReDBoX compared to a state-of-the art hybrid packet/circuit data centre network. More importantly the papers reports on the algorithm that can dynamically synthesize the reconfigurable topology and place associated network function chain(s) to support virtual machine requests. This work directly contributes to both WP2 and WP3 activities by better understanding how the network architecture can perform.

8. Qianqiao Chen, Vaibhawa Mishra, Nick Parsons, Georgios Zervas, "Hardware Programmable Network Function Service Chain on Optical Rack-Scale Data Centers", accepted for publication at OFC 2017

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Paper scientific contribution: This paper reports on first demonstration of an on-chip system using both static and partial reconfigurable regions to deliver hardware programmable service chains. The system is part of an optical network using standards low-cost SFP+ 10 Gb/s transceivers and a Polatis beam-steering switch to demonstrate its ability to communicate over an optical network. Results indicate the low latency performance of the system under certain conditions. This is a WP3 activity.

9. G. Zervas, F. Jiang, Q. Chen, V. Mishra, H. Yuan, K. Katrinis, D. Syrivelis, A. Reale, D. Pnevmatikatos, M. Enrico, N. Parsons, “Disaggregated Compute, Memory and Network Systems: A New Era for Optical Data Centre Architectures”, accepted for publication at OFC 2017

Paper scientific contribution: This paper reports on the holistic dReDBoX architecture and describes a number of proposed orchestration algorithms designed to allocate compute, memory, storage and network resources in order to serve incoming virtual machine requests. The algorithms aim to deliver maximum utilization of IT resources (compute, memory, storage) while required the least possible network resources. Also the dReDBoX disaggregated architecture is compared with the state-of-the-art direct-attached memory Server based systems. The results prove that dReDBoX can deliver maximum IT resource utilization and perform substantially better than the classic data centres under a number of diverse VM requests. This is a WP2, WP3 and WP4 activity.

10. M. Bielski, C. Pinto, D. Raho, R. Pacalet, “Survey on memory and devices disaggregation solutions for HPC systems”, 19th IEEE International Conference on Computational Science and Engineering (CSE 2016), 2016

Paper scientific contribution: This paper surveys the state-of-the-art for the disaggregation of memory and peripherals in HPC systems. Various techniques are evaluated and compared based on various metrics, among which high importance has been given to support for virtualization and actual disaggregation level. The main goal of the paper is to identify the limitations in current state-of-the-art solutions to help define the dReDBoX approach for virtualization of disaggregated memory and peripherals, and drive the technical work performed in WP4.

11. N. Pleros, “Board- and Chip-level Software-Defined Optical Interconnect Architectures for Multi-socket Communication”, Microphotonics Conference 2016, 11-13 Oct. 2016, Berlin, Germany

Paper scientific contribution: This paper presents an overview of the research of alternative revolutionary optical routing schemes investigated within STREAMS and dReDBoX project. The presented architectures and technologies explored are also extended to support resource disaggregation in data centres as currently being pursued in the H2020 project dReDBoX, where the any-to-any collision-free routing scheme is proposed for connecting disaggregated computing and memory bricks trying to minimize remote memory access latency and energy consumption. This work has been performed within WP3.

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12. N. Pleros, N. Terzenidis, T. Alexoudi, D. Syrivelis, K. Vyrsoinos, and G.T. Kanellos, "Software-Defined Board- and Chip-level Optical Interconnects for Multi-Socket communication and Disaggregated Computing" to be presented in HiPEAC 2017, 23-25 Jan. Stockholm, Sweden.

Paper scientific contribution: This work presents our recent research results towards implementing on-board single-mode optical interconnects that can support Software Defined Networking allowing for programmable and flexible computational settings that can quickly adapt to the application requirements. This work was performed within WP3.

13. Miltiadis Moralis-Pegios, Nikos Terzenidis, Christos Vagionas, Stelios Pitris, Evangelia Chatzianagnostou, Antoine Brimont, Andrea Zanzi, Pablo Sanchis, Javier Marti-Sendra, Jochen Kraft, Karl Rochracher, Sander Dorrestein, Bogdan Sirbu, Tolga Tekin, Dimitris Syrivelis, Leandros Tassioulas, Amalia N. Milliou, Nikos Pleros, Konstantinos Vyrsoinos, "A programmable Si-photonics node for SDN-enabled Bloom filter forwarding in disaggregated data centers", to be presented in SPIE Photonics West, 28-2 Feb. San Francisco, CA, USA

Papers scientific contribution: This paper presents a programmable 4x4 Silicon Photonic switch that supports SDN through the use of Bloom filter (BF) labelled router ports. This scheme significantly simplifies packet forwarding as it negates the need for large forwarding tables, supporting at the same time network size and topology changes through simple modifications in the assigned BF labels. This research work investigates potential silicon photonic-based switching schemes for alternative optical routing solutions for disaggregated architectures of dReDBox project and it was performed within WP3.

5.2 Workshops and participation on international networks

1. "dReDBox project: Efficient blade servers via disaggregation", Dionysios Pnevmatikatos, Microserver: Energy Efficient Servers workshop, in conjunction with Hipeac Conference, Prague, Czech Republic, Jan. 20, 2016
2. "Impact of optical network virtualization – When realizes, what happens and how it works", workshop co-hosted with OECC-PS, Motoyoshi Sekiya (Fujitsu Labs), Georgios Zervas (University of Bristol).
3. "Sneak Preview of dReDBox Project", presented by Kostas Katrinis (IBM), Dimitris Syrivelis (UTH) and Roy Krikke (Sintecs), Advanced Computing and Cyber-Physical Systems 2016 Collaboration Workshop, Brussels, 14 June 2016
4. Subscription to HIPEAC; the driving network and probably important to the EU
5. "Versatile Reconfigurable Acceleration in Datacenters: a Bioinformatics Case Study", Nikolaos Alachiotis Dimitris Theodoropoulos Dionisios Pnevmatikatos, Workshop on Energy-efficient Servers for Cloud and Edge Computing(EnESCE), in conjunction with the HiPEAC 2017conference, January 23-25, 2017, Stockholm, Sweden.

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Paper scientific contribution: In this work, we explored an initial accelerator architecture, targeting the programmable logic (PL) of the accelerator bricks. The architecture exhibits a static part as well as a dynamic one. While the former provides configurable interconnect between input/output ports and accelerator modules, the latter allows the placement of one or more accelerator modules in a partially reconfigurable region (PRR). This approach allows to repurpose a PL by programming the configurable interconnect of the static part, and/or by reconfiguring the PRR by placing a different set of accelerators, driven by the application. In this exploratory study, we evaluate the effect of the two configuration alternatives on the total execution time of a compute-intensive Bioinformatics application. The results indicate that, for the chosen application, partial reconfiguration is deployed in the PL of an accelerator brick without significant overhead. This is work associated with the accelerator design and development within WP3.

6. “dRedBox:Towards Rack-scale disaggregated cloud datacenters”, Poster at HiPEAC 2017conference, January 23-25, 2017, Stockholm, Sweden.
7. “Disaggregated Recursive Datacentre-In-A-Box”, project description at the Innovation Europe section of the HiPEAC info 49 newsletter.

Contribution: In order to further boost the dReDBoX dissemination, we submitted a paper to the HiPEAC info 49 newsletter, which will be distributed on HiPEAC 2017conference, January 23-25, 2017, Stockholm, Sweden. The paper presents an overview of the project and its goals. All partners have been involved.

5.3 Wider dissemination: Press releases and interviews

At the beginning of the project a press release was prepared with the aim of disseminating the new project and its objectives. The press release was written in English and then translated in other European languages.

The Spanish version of the press release was sent to technical Spanish media by the Communications Department at BSC (1 March 2016). Also press releases in UK and interviews by online media have already increased and broadened the visibility of the project. The following list details the impact of this initial press release:

Date	Country	Title media	Headline	Link
25/01/2016	IE	Biz Plus	Kinesense And IBM Share In €6.4m Fund	
26/01/2016	IE	Silicon Republic	Irish consortium wins €6.4m to develop next-gen cloud server	
09/02/2016	NL	Link Magazine	Horizon 2020 Subsidie dRedBox consortium om Cloud computing groener te maken	
15/2/2016	EU	Irish Examiner	Kinesense CCTV investigative technology saves time for police forces	

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16/2/2016	NL	H2020 Projects.com	H2020 to support greener cloud computing	
11/02/2016	NL	Link Magazine	Horizon 2020 Subsidie dRedBox consortium om Cloud computing groener te maken	
01/03/2016	ES	Computer World España	El Centro Nacional de Supercomputación trabaja en una arquitectura de 'data center' de bajo consumo	On 02/03/2016: 5 shares in Facebook and 7 shares in LinkedIn
01/03/2016	ES	@ComputeworldES	El BSC trabaja en una arquitectura de 'data center' de bajo consumo http://bit.ly/bsc_arquitectura_data_center_bajo_consumo ... @BSC_CNS	On 02/03/2016: 5 retweets and 3 likes
01/03/2016	ES	@BSC_CNS	Cómo integrar los recursos desagregados de un data center de bajo consumo para mejorar su eficiencia http://ow.ly/YVvKAY @dredbox	On 02/03/2016: 1 retweet
01/03/2016	ES	@BSC_CNS	El BSC participa en esta investigación financiada por @EU_H2020 @myCORDIS	On 02/03/2016: 1 like
01/03/2016	ES	SYSGURU	El Centro Nacional de Supercomputación trabaja en una arquitectura de 'data center' de bajo consumo	
01/03/2016	ES	BSC Facebook page	El BSC investiga cómo integrar los recursos desagregados de un data center de bajo consumo para mejorar su eficiencia.	
02/03/2016	ES	Conectónica	El BSC-CNS investiga cómo integrar los recursos desagregados de un centro de datos de bajo consumo	

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02/03/2016	ES	CIO España	El CNS de Barcelona trabaja en una arquitectura de data center de bajo consumo	
04/03/2016	ES	@TSystems_Iberia	El @BSC_CNS prepara una arquitectura #datacenter de bajo consumo http://bit.ly/1QRgUho @ComputerworldES #cloud	
11/04/2016	UK	techWEEK.es	El BSC-CNS investiga cómo integrar los recursos desagregados de un data center de bajo consumo para mejorar su eficiencia	
26/05/2016	UK	v3.co.uk	Future of the server: the data centre is the server	

6 Conclusions

This deliverable has described all dimensions of dissemination plan and strategies of dReDBoX project. The activities aim at ensuring the widest possible impact of concepts, results, prototypes and outputs.

The dReDBoX dissemination activities are targeting a wide audience of data centre and HPC community in Europe and the world that spans across individual researchers, technology vendors, providers and users.

Interestingly, the consortium aims at bridging the communities focusing on HPC/Data centre design and system software with the ones working on optical interconnects and they fundamentally need to work together in order to deliver maximum impact on the newly-formed research area of disaggregated data centres, supported by beneficiaries of application use-cases. The trial of real applications can bring added value on the planned technological innovation strategy.

The incremental deliverable D7.3 reports on the up-to-date interactions with other H2020 projects. It also provides insight on the additional research output since the submission of deliverable D7.2 that clearly summarises the scientific value and impact for each of the publications.

13 publications in top-tier conferences (mostly delivering technical outputs) and extensive participation in workshops, reflecting the work across a number of work packages, indicates the substantial visibility and influential scientific stance of the project.