



The European Processor Initiative (EPI) to develop the processor that will be at the heart of the European exascale supercomputer effort

8 Feb 2018 Bezons - Europe has an ambitious plan to become a main player in supercomputing. The EuroHPC initiative is a joint undertaking with as one of its goals to construct an exascale supercomputer based on European technology. One of the core parts is a processor. Although there are several processor-related research projects, it is only now that an effort has started to build a production HPC processor with industry quality. This is done as part of a 120 million euro Framework Partnership Agreement (FPA) that has been awarded to a consortium of 23 partners. We talked to the project coordinator Philippe Notton from Atos to learn more about the "European Processor Initiative" as the project is called.



Primeur Magazine: Thanks for the interview opportunity. Could you first please tell a bit about yourself?

Philippe Notton: I am kind of new to HPC. My background is in consumer electronics and semiconductor technology. I was proposed this job because I know how to develop, design and produce a complex System-On-Chip. In my previous job I was the head of the Consumer Product Division at STMicroelectronics. This new design is focused on the HPC market and is very exciting, while I am still in the learning phase in terms of HPC ecosystem and I am very impressed by the skills and experts we have within this consortium.

Primeur Magazine: What is your function in Atos, and what is your role in the project?

Philippe Notton: I started at Atos in June as Vice President to manage this European Processor Initiative (EPI) project that we wanted to send in for the Framework Partnership Agreement call. I am in charge of this processor development in Atos and General Manager of this consortium. I work full time on this project as an Atos employee. Atos is one of the partners in the project.

Primeur Magazine: When I understand correctly, it is a framework contract so you have to put in, additionally to the framework contract, two proposals to get real funded projects.

Philippe Notton: That is correct. We responded to a H2020 call with the deadline end of September 2017. The call name was ICT-42 for the development of low-power microprocessor technology. So we had to submit the pre-consortium. We ended up with 23 partners. By the end of November we got the feedback from the Commission that we were selected. As you can see on their website, they received three proposals. So we were invited to move to the next phase, SGA1, which is to finish the grant agreement and to give them detailed budget, detailed statement of work between the partners, and in the background, write the consortium agreement between the different partners. We have to achieve this by the end of April. The next phase SGA2 is for late 2020.

Primeur Magazine: And when will the project really start? After April?

Philippe Notton: Yes. All the development work I expect to start mid of 2018. Now of course, we are in the preparation and documentation phase. We have started basically to do this end of last year. There is already some work involved from the different partners. And on the technical side it is much more Intellectual Property (IP) selection, negotiations with partners, potential providers, and completion of the architecture. You cannot set up and manage a consortium like this if at the beginning you do not have a clear picture about where you want to go. But in terms of technical development and heavy resources, kick off is much more mid-2018.

Primeur Magazine: So the consortium started with 23 partners. Are they all in for the whole duration? For both the projects?

Philippe Notton: That is the idea. We probably have some other partners that will join during the process. So far we have 23 partners from 10 countries. I have in my records another 22 candidates who would like to join. We have some internal process of determining gaps and filling these with qualified partners to ensure that the new ones have the missing expertise, the value that we need. It is also going to help us create an ecosystem around the technology that we are going to bring to the market and disseminate it around Europe and beyond.

Primeur Magazine: Is the project consortium led by Atos? Or by Barcelona Supercomputing Center (BSC)? That was not clear to me.

Philippe Notton: I am glad you raised the point. Officially, Atos is the coordinator. Atos has submitted the proposal, and BSC, which is quite strong in HPC of course, is one of the key partners. Why Atos? In the guidelines we got from the Commission it was stated that it is an industrial project. Out of this project they want to see a processor that is ready for production. That is why they want an industrial leader. The consortium of 23 partners is a mix of industrial companies, academics and research centres. It is not a pure research project.

Primeur Magazine: So it is a development project. In the call it says that you should develop two types of processors. Is that correct?

Philippe Notton: There are two dimensions. It is one processor but we want also to cover some acceleration technology in it. Why? Because now in HPC, depending on the applications and the countries, it is a mix of general purpose processor and acceleration technologies. So we have to cover both with a main focus on general purpose processor and we will add the accelerator dimension. We then also create the ecosystem and IP's around it.

Primeur Magazine: What will the processor look like? Do you have some more technical details already?

Philippe Notton: It is a bit early. We are stepping into a market which is very, very competitive. So we are still working on the specs, and its target in terms of Performance per Watt. Once the specs are clear, we have to look at the subset of information we are going to disclose to the public. There are multiple companies that are already in a good position in this market, which are working on this area also. Today, we are still in the early days in terms of architecture definition. We will not have a public product brief of specs before six months.

Primeur Magazine: Can you tell already whether it will be something like an ARM processor?

Philippe Notton: That is also a good question. One of the new trends in HPC business is definitely ARM. What is clear also is that for the first product that should be ready in 2021, we cannot design it from scratch. We cannot create everything for this processor, so we need to leverage an existing software ecosystem, that is exascale capable. So yes, ARM is one of the candidates to start from. This time, ARM is not one of the official partners, not one of the 23 partners. We are working with ARM in some other projects, like Mont-Blanc 2020, that has officially started in January this year. They provide a compelling technology, which is proven in the market, and what we need to get a product out quickly and in time for 2021. Negotiations are on the way with ARM and others. We are talking about complex licensing terms. That's why ARM is one of the candidates but not necessarily the final one.

Primeur Magazine: Is OpenPower is one of the other candidates? Or do you not know yet?

Philippe Notton: It is a sensitive topic. We have multiple candidates, and we have enough experts within the consortium to precisely define which technology is very good in terms of software ecosystem, that could be scaled within the proper silicon process and that could make sense to have in an exascale machine.

One of the goals of Europe is to create European technologies. This is also a key point for us. Because such a design cannot be 100% European in the end, since we have potential issues with the available factories for instance. We know that Europe is no longer producing memories, as another example. We are trying to bring as much European DNA as possible into the system. This makes the core selection challenging because there is no off-the-shelf core which is purely European. We have some micro-controllers technology coming from Europe but they are not powerful enough for this class of HPC design. That is why, as part of this consortium, we are going to start our own processor development which is based on RISC-V, and develop some IP's and ecosystem around it. We do not start from zero, because there is some instruction set and elements which are ready. Unfortunately, it is not at HPC production level yet and it will take a couple of generations.

Primeur Magazine: The time schedule is quite tight.

Philippe Notton: Oh yes! We are talking about a four-year project. So we have to produce something during these four years. And during these four years if you want to reinvent everything from scratch, forget it. Especially knowing at which pace the competition is moving. So we have to catch up and we will catch up. And the only way to catch up is to start from some IP, and an ecosystem that already exists. Being fabless is also a nice feature in this case. We leverage some proven technologies and supplier channels.

Primeur Magazine: Your project is about the processors only? It is not about memory or interconnect?

Philippe Notton: Memory is no longer produced in Europe. So we will reuse available and future memories. But we will have to take care of the memory controller ourselves. We have some technology for interconnect and memory controller within the partners. We do have interconnect and Network-On-Chip experts among the 23 partners. And it is also part of the value we have to create. As I said, it has to be European. So the internal NOC, the interconnect, the power management, are all key elements we need to have fully under control and we have lots of value to create around it and it is one of the corner stones for high performance computing.

Primeur Magazine:*But is that also part of the project?*

Philippe Notton: Interconnect is outside of the EPI project but part of the Pre-Exascale and Exascale machine. What is part of the project is that we have to produce and design a chip and some IP's around it.

Primeur Magazine:*How does EPI relate to Mont-Blanc 2020 and other projects like the ExaNoDe family of projects that are also creating chips?*

Philippe Notton: I'll comment on Mont-Blanc 2020 since Atos is involved in it and 5 other EPI partners. Mont-Blanc 2020 has seven partners. Most of the IP that will be developed as part of Mont-Blanc 2020 will be reused and productized in EPI. In fact the IP's that will be used in the European Processor Initiative will come from Mont-Blanc 2020, will also come from the external world, and some parts will be developed within EPI, like the accelerator technology. So it is a continuous story from the early Mont-Blanc programme to Mont-Blanc 2020 which has started recently, and EPI which is a different scale in terms of budget and complexity. We will reuse what has been designed and proven before.

Primeur Magazine:*How is EPI embedded in the wider EuroHPC initiative?*

Philippe Notton: The European Processor Initiative (EPI) is one of the components to build the EuroHPC machine. So EPI will provide the microprocessor technology for the machine. The machine will be built on top of EPI, so EPI will provide the chip technology like General Purpose Processor, accelerator, part of the low level software, like an SDK, and compilers. But in terms of middleware, applications on top of it, this is part of the EuroHPC programme. The building of the complete machine with 10k - 50k processors, is also part of the EuroHPC programme. You can consider EPI as a prerequisite: EPI is really one of the foundations in terms of technology.

Primeur Magazine:*There will also be some pre-exascale demonstrator prototypes.*

Philippe Notton: That is correct, we start with this before the big machine, and these will be part of the calls under discussions. We expect the chip to enter the first pre-exascale demonstrator. Part of the FPA-EPI framework is to deliver the chip, and have a couple of boards to prove that the chip is working. The demonstrator is the step after, but obviously using this new flag chip. That is the ultimate goal. So you start with the IP in the Mont-Blanc programme, you develop and bring the main chip to the market and finally you provide the full machine on top of the processors.

Primeur Magazine:*What is the time scale you have in mind?*

Philippe Notton: The timescale that we put in the project plan is that the first demo is in 2020. We expect the chip to be alive in the second part of 2020, and ready for production in 2021, which should be in line with the pre-exascale demonstrator. I believe everything is in sync. There is a kind of global calendar from which we work. Indeed the interest of this full EuroHPC project is to use these technologies, so we must be in time. This means that the room we have for the execution of this programme, and the development of this chip is strict. We cannot waste euros in dreams, it is going to be a strong project execution.

Primeur Magazine:*Will this mean that EuroHPC will reach exascale by 2023?*

Philippe Notton: The way I see it today, we have tough internal technical debates about exascale but it is likely to be the generation after EPI. The first chip we are going to build is much more pre-exascale class, because to be exascale in the same timeslot is likely to be too challenging, the silicon technology not being available yet. It is a bit early to conclude because we do not have yet the forecasts in terms of performance and power. We know more in 6 months as part of the architecture study. In fact it is also a question of budget, developing such a technology, and delivering such a node is quite expensive, and some technologies are just not ready yet. HBM3 memory is not ready today, some silicon process technologies are not mature yet. So it is a step-by-step approach. If that technology is not yet ready we have to wait for it. We are also on a learning curve. We know the stakeholders of this market. We know the competitors in this market. So we are going to catch up, and we are going to catch up fast.

We would be very happy to see this chip being used in other places than Europe. The best way to measure its success is to have a chip that is used on a world-wide basis and not only on the domestic market.

Primeur Magazine:*Can you tell a little bit more about the design process and the consortium?*

Philippe Notton: One of the strategies we have, and this was also part of the call, is the emphasis on co-design. That is why this consortium is quite good and well balanced in terms of expertise. We have experts from the chip design industry; architecture experts; embedded software experts, middleware experts, and HPC application experts. We also have HPC customers in the consortium. We cover a wide range of expertise to assure in terms of co-design the chip will work well and is going to provide the

best performance for what is needed. It is not a chip we want to develop in stand-alone mode and later say, let us try to use it on an HPC system. It is really built for HPC with all the expertise in mind and with the HPC target market in mind. That is complex: we are double checking all the applications we have in mind in Europe for HPC. They each have different needs so we need to reach some convergence.

Co-design is one word, and the other is related a bit to the automotive, and the eHPC, so embedded HPC we are going to develop nearby.

Primeur Magazine:*Is there an official list of partners and a project description?*

Philippe Notton: We have an official list of the 23 partners: BULL SAS, France; BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION, Spain; INFINEON TECHNOLOGIES AG Germany, Germany; SEMIDYNAMICS TECHNOLOGY SERVICES S.L, Spain; COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, France; CHALMERS TEKNISKA HOEGSKOLA AB, Sweden; EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH, Switzerland; FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS, Greece; GRAND EQUIPEMENT NATIONAL DE CALCUL INTENSIF, France; INSTITUTO SUPERIOR TECNICO, Portugal; FORSCHUNGSZENTRUM JULICH GMBH, Germany; ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA, Italy; SVEUCILISTE U ZAGREBU FAKULTET ELEKTROTEHNIKE I RACUNARSTVA, Croatia; FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Germany; STMICROELECTRONICS SRL, Italy; E4 COMPUTER ENGINEERING SPA, Italy; UNIVERSITA DI PISA, Italy; SURFSARA BV, Netherlands; KALRAY SA, France; EXTOLL GMBH, Germany; CINECA CONSORZIO INTERUNIVERSITARIO, Italy; BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT, Germany; ELEKTROBIT AUTOMOTIVE GMBH, Germany.

The complete project description is not public yet and as said, to protect industrial interests, we'll follow standard industrial rules for information disclosure but we'll emphasize dissemination of the technology to follow the way the European programmes are working in terms of communication. The website is not yet open either. We have a couple of competitors. For obvious reasons we may not disclose detailed specifications and technical information, at least in the beginning.

Primeur Magazine:*Thank you very much for the interview.*

Ad Emmen