



SWEDISH FOUNDATION *for*
STRATEGIC RESEARCH

Call for Proposals

Framework Grants for Research on

Computing and Hardware for ICT Infrastructures
(SSF CHI)

Towards Continuous Core-to-Edge Computing

The Swedish Foundation for Strategic Research (SSF) announces SEK 200 million in a national Call for problem-, challenge- or application-driven research projects that meet the highest international scientific standards. Alignment with relevant EU initiatives is encouraged.

The Call aims to stimulate collaborative interdisciplinary research within the area of Computing and Hardware for ICT Infrastructures (CHI), including related low-level software. The research should be of relevance to present or future Swedish-based industry and to society. The following ICT-topics are included in the Call:

- Topic 1: Next-Generation Wireless Communication Hardware
- Topic 2: Accelerated Computing Performance
- Topic 3: Energy-efficient ICT

Selected projects will be supported by grants of SEK 4-7 million per year for a period of 5 years (incl. overheads) to be used for salaries (senior researchers, postdocs, PhD students, etc.), expensive equipment and other research infrastructure, research tools, and running costs according to the needs of the project. Funding for the last two years will be contingent upon a successful midterm evaluation.

Background

The digitalization of our societies is the major technological and societal change of our time. Some reports indicate that it will impact our way of living on a fundamental level comparable to the industrialisation. Data is the digitalization driver. Transforming data into usable information requires communication and computing. For this to function at very large scale requires data and computing to be continuously handled from the “core” to the “edge” of ICT systems depending on timing and computing requirements. These enabling computing infrastructures are expected to become as important as the electricity, water and transport networks. Indeed, it will also be used to control these networks.

SSF CHI aims to strengthen Sweden’s position on future continuous core-to-edge computing infrastructures through research in three strategic areas: communication, computing, and energy efficiency.

Large-scale digitalization will lead to massive amounts of data. Much data will be generated by sensors and small systems at the “edge” of the computing systems where time-critical data analysis might be done locally (e.g. in “intelligent” cameras). More advanced analysis will require aggregated data from many such “edge” devices and will therefore need powerful computing resources. Advanced data analysis will thus be performed closer to the “core” of the systems (e.g. in data centers). This process, together with the expected intensive “edge” device-to-device communication, will result in massive data flows. Advanced data communication is thus required. As many of the “edge” nodes are believed to be autonomous, mobile and/or in difficult-to-reach locations, there will be a corresponding need for very powerful trustworthy wireless communication systems.

A digitally transformed society will be strongly dependent on its computing capabilities. Data is controlled, secured and transformed into usable information through computing. Surprising results in Artificial Intelligence are mainly based on the recent combined availability of big data sets together with powerful computing capabilities to process them. Access to advanced distributed, trustworthy and application-optimised processing power will thus be essential for future computing performance.

The foreseeable future will include a billion new Internet users and tens of billions of connected devices as societies digitalize. The current IT sector is estimated to consume more than 5% of global electricity. Some studies predict an IT energy footprint approaching 20% of the world’s electricity usage within a decade. Increasing the ICT energy-efficiency is thus both an important sustainability goal as well as a technological requirement for many systems to function properly.

SSF currently supports an ICT research program portfolio consisting of 27 running projects having a total budget of approximately SEK 800 million. The funded research is strategically focused on key areas of future computing through programs on Smart Systems, Big Data/Computational Science and Cyber Security.

The present call on Computing and Hardware for ICT Infrastructures (CHI) focuses on ICT hardware-intensive research, including related low-level software, to complement SSF’s ongoing, more software-intensive programs. The call is divided into three topics which are described below.

Scope

Strategic research topics included in this call, alone or in combination, are:

Topic 1: Next-Generation Wireless Communication Hardware

Key requirements for future wireless communication systems are higher data rates, higher data throughput and higher reliability and security. Flexible connectivity to a multitude of different devices will be essential. Future wireless systems are expected to be operable on land, in the air and possibly in space while guaranteeing data integrity. Hardware-intensive approaches have the potential for building trustworthy wireless communication systems from the ground level.

This topic includes hardware-intensive research, including related low-level software, towards trustworthy and efficient next-generation wireless communication systems beyond the current 5G-systems. Research areas include, but are not limited to:

- High-capacity low-latency wireless communication systems
- Compact, high-power and energy-efficient antenna arrays and systems

- Ubiquitous connectivity for “edge” nodes etc. to wireless systems
- Deterministic, reliable, safe and secure wireless by hardware design.

Topic 2: Accelerated Computing Performance

Future accelerated computing performance will likely come from a variety of technologies and architectures. Examples are increased adaption to the computing environment through configurable application domain optimisation and heterogeneous computing accelerator approaches. Hardware-intensive approaches have the potential for building trustworthy computing systems from the ground level.

This topic includes research towards trustworthy accelerated computing performance. Research areas include, but are not limited to:

- Application domain optimisation, e.g., hardware-software co-design
- Heterogeneous architectures, e.g., including hardware accelerators
- Deterministic, reliable, safe and secure computing by hardware design.

Topic 3: Energy-efficient ICT

Lowering the power consumption is a key issue for future ICT systems, from large energy-consuming data centers via small long-time-autonomous Internet of Things (IoT) devices and Cyber-Physical Systems (CPS) to energy-density problems inside the computing processor chips.

This topic includes research towards more energy-efficient computing devices and systems. Research areas include, but are not limited to:

- Energy-efficient large computing systems, e.g., data centers and high-performance computing
- Energy-efficient small computing systems, e.g., IoT- and CPS-systems
- Energy-efficient electronics, e.g., processors, sensors, network devices
- Energy harvesting, e.g., for autonomous and mobile systems.

Aligning SSF projects with EU-initiatives are encouraged for stronger strategic impact and to increase Swedish international research collaboration. SSF-funding can thus be used to boost and enhance Swedish research presence in SSF-relevant EU-projects. The relationship between the present application and corresponding EU programs or any ongoing projects by the applicants with support from SSF, Vinnova, VR, EU, KAW or other funding source must be comprehensively presented in order to ensure synergy between the applicant’s research projects and to exclude overlap.

Some initiatives at the EU-level are related to this call, for example:

- EuroHPC Joint Undertaking (High-Performance Computing)
- ECSEL Joint Undertaking (Electronic Components and Systems)
- European low-power Processor Initiative (EPI)
- Smart Networks and Services future proposal for Horizon Europe.

Strategic relevance

The proposed research shall aim to provide enabling technologies for future applications, products or services, or in solutions to important application problems. Successful

proposals are based on clear ICT research visions for future impact. Proposals evaluated to be mainly focused on current applications or usage instead of strategic future-oriented ICT research will be rejected.

The criterion of strategic relevance means that the proposal shall demonstrate a clear vision of utilization/exploitation of the research results in Sweden in approximately ten years' time. Successful proposals have trustworthy descriptions of how the research results could then be disseminated to Swedish industry.

A central part of the relevance is graduate student education and the attractiveness of the corresponding PhD's in industry and society. This includes providing effective measures for translation and innovation. It is recommended that the PI's involve partners that can continuously support utilization/ exploitation efforts of research results. One way to do this is to involve a university innovation office and/or holding company, already at the formulation stage of the application.

Three percent of the grant will be reserved by SSF for such directed exploitation activities during the course of the project, as proposed by the applicants (see SSF-terms here: <http://strategiska.se/utlysningar/vilkor-regler-och-policy/>).

Eligibility

All projects should be based on a credible collaboration between, typically, two to four applicants with different kinds of relevant complementary scientific expertise. The applicants should be from one or different research group(s), not necessarily co-localized - and may be from different departments or universities for added interdisciplinary value. All applicants should take active part in the project and their activities should be at least partly financed by the project budget.

The proposal must be submitted by a main applicant, employed to at least 50% by a Swedish university, University college or Research institute, who has the capacity to assume coordination responsibility for the project during the entire grant period. The co-applicants must be employed by a Swedish university, university college, university hospital, or by a public or private non-profit research institute. At least one of the applicants must be employed by a university or university college. A Letter of Intent from the Head of the main applicant's department, or the equivalent, is compulsory.

While project participation from industry, public authorities or other relevant organizations is an evaluation criterion, such participants cannot be funded by the SSF grant but may participate on their own budget. Although SSF-grants may not be transferred to universities outside Sweden, they may be used for, e.g., visits by foreign-based scientists to applicants working in Sweden.

The proposed budget should be in the interval of SEK 4 to 7 million per year for five years. A maximum of 25% of the grant may be used for salary for the main applicant and/or the co-applicants, but only to cover up to a maximum of 25% of the salary of each applicant. Junior participants (PhD students, postdocs or other junior researchers) may be funded by 100% of the salary. A maximum of 10% of the grant may be used for covering cost of expensive equipment and other research infrastructure.

Please note:

- each applicant is allowed to be represented in one application as a main applicant.
- each applicant is allowed to be represented in one application as a co-applicant.
- any one person is allowed to have maximum two SSF-framework grants simultaneously (with an overlap in time of up to three years) as a main applicant.

Proposals not conforming to these conditions will not be considered. It is the responsibility of the main applicant to inform all the co-applicants and to check the proposal for compliance with the rules before submission.

Proposal and submission

The proposal must be written in English and submitted via the SSF application portal at: <http://apply.strategiska.se>. Note that in order to get a complete view of all data required for submission it is necessary to consult the portal. Log on to the portal well in advance of the deadline. Please also submit the proposal in due time before the deadline. When the proposal is submitted, the system will reject it if some data field is missing. If this is done before the application deadline it is possible to submit and re-submit as many times as necessary.

A complete proposal must contain, among other data specified in the portal, a clear purpose statement, a full description of the research plan and full details of the relevant expertise of the participating groups as well as the planned exchange. It should contain a clear account of the strategic significance of the research in the medium to long term, including a plan for utilisation/exploitation efforts that should commence in parallel with the research activities, already from day one in the project.

Each proposal shall clearly describe the state of the art within the area(s) addressed. It is also important for the proposal to give a clear picture of the resources available and to demonstrate that the proposed constellation of research groups will be effective in view of its objectives.

All proposals must be submitted by **14:00 hours (2:00 pm CET) on March 3, 2020**. No additional material will be considered after this deadline.

Evaluation

Applications will be assessed by an evaluation committee consisting of generalists and specialists from industry, academia, and research institutes. In a first selection the applications will be judged primarily with regards to scope (as described above), relevance and potential impact. Furthermore, applications that are judged unable to compete in the final step of the evaluation, or that are considered too incomplete to be meaningfully assessed, will not pass this first step. The selected applications will be sent on international peer review. The results of this expert review will be taken into account by the evaluation committee in order to produce a recommendation on which SSF will base its decision.

The applications will be reviewed using the following criteria:

- Conformity to the scope and eligibility as outlined above,
- Scientific quality; originality, strengths, weaknesses, degree of internationalization and interdisciplinarity, and feasibility of the research plan,
- Strategic relevance, with clear purpose and potential impact of the proposed research to Swedish industry and/or society,
- Qualifications of the applicants and composition of the research team, including exchange and gender balance; previous achievements (science, innovation, and entrepreneurship), international experience and networks, and leadership/management of research teams.

SSF practices equal opportunity for female respectively male main applicants (project leaders).

Timetable

- Last date for applications: March 3, 2020, 14:00 CET at the latest
- Decision by the SSF Board: October 2020
- Project start: January 1, 2021

No additional material submitted after deadline will be considered.

Please note that the Foundation is subject to the Principle of Public Access to Official Records (Offentlighetsprincipen). Thus, applicants should avoid submitting material that they do not wish to be made public, e.g., information that could prevent patenting.

Contact persons at SSF:

Jonas Bjarne, Scientific Secretary ICT & Applied Mathematics,
jonas.bjarne@strategiska.se, 073 – 358 1673

Joakim Amorim, Research Programmes Manager, joakim.amorim@strategiska.se,
08 - 505 81 665