



SWEDISH FOUNDATION *for*
STRATEGIC RESEARCH

Announcement

SSF Call for Proposals
Framework Grants for Research on
SSF Future Software Systems (FuSS)
Towards Seamless 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. The Call aims to stimulate collaborative multidisciplinary research within the area of Future Software Systems (FuSS) of relevance to present or future Swedish-based industry and to society. The projects should be of benefit for Sweden's competitiveness in advanced large-scale software systems and the development of these.

Selected projects will be supported by grants of SEK 4-7 million per year for a period of five 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 dependent on a successful midterm evaluation.

Background

Towards Seamless Core-to-Edge Computing

The digitization 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. Information based on data is the digitization driver. Transforming data into information requires communication and computation. For this to function at large scale in the future, a computing infrastructure is needed. Here data and computing are seamlessly handled, from the "core" to the "edge" of this infrastructure, depending on timing and computing requirements.

Increased digitization will lead to massive amounts of data. Advanced data communication networks are thus a fundamental part of future computing infrastructures. 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 wireless communication systems. Key requirements for these 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 or in space, while guaranteeing data integrity.

The foreseeable future will bring a billion new Internet users and tens of billions of connected devices as societies digitize. 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 within a decade. Decreasing the energy consumption of future computing infrastructures is thus both an important sustainability factor as well as a technological requirement for many ICT systems to function properly.

The “glue” of the computing infrastructures, enabling control, development, “intelligence”, services, and value, is also its most invisible part: *software*. A shift from hardware products to software services is obvious, with many actors transforming into software organisations. The statement “Software is eating the world” remains relevant. This physical-to-virtual shift puts enormous requirements on the software enabling it. The shift is so rapid that the educational system lags, leading to an increasing shortage of software competence. However, mastering advanced software is crucial to develop competitive computing infrastructures. Advanced software is therefore strategic for Sweden.

Computing infrastructures are expected to become as important as the electricity, water, and road networks. Indeed, they will also control these networks. The ability to control the development and management of national computing infrastructures is called “digital sovereignty”. Sweden's digital sovereignty is of great strategic value, and it is supported by SSF in this call.

The recent SSF Call in Computing and Hardware for ICT Infrastructures (CHI) had a hardware-centric approach to 6G communication, computing and energy-efficiency. SSF now complements CHI with FuSS, a software-centric call. CHI and FuSS are therefore to be considered together as an SEK 400 million SSF research effort towards future Swedish ICT infrastructures, characterised by the tagline *Towards Seamless Core-to-Edge Computing*.

What this FuSS is all about

Given the scenarios described above, there is a surprising lack of advanced software research funding both in Sweden and in the EU. SSF's goal with FuSS is to help bridge this software-gap by providing SEK 200 million to promote Swedish advanced software research.

FuSS has three topics. The first two: “Future Software Challenges” and “Future Advanced Software Development”, are quite open-ended, urging researchers for novel ideas for software systems and software development. SSF here aims to increase Sweden's competence in advanced software, including its development, and wants to support Sweden's software research community.

The third and topic “Next-Generation Wireless Communication Software” is application-directed towards future 6G-systems. Sweden holds a very strong international position in wireless data communication. It is of strategic value to safeguard and develop this position well into the future. The previous SSF CHI Call resulted in 6G hardware projects totalling approximately SEK 150 million. SSF now complements this with 6G-relevant software projects, leading to a total SSF-support to Swedish hardware and software 6G-research of tentatively SEK 200 million or more, and at the same time enables other applications.

No-fuss connectivity to other initiatives

SSF currently supports an ICT research program portfolio consisting of four programs having 33 running projects with an overall budget of approximately SEK 1 billion (EUR 100 million). The funding is focussed on strategic research areas through programs in Smart Systems, Big Data/Computational Science, Cyber Security as well as Computing and Hardware for ICT Infrastructures (CHI). The present call on Future Software Systems (FuSS) aims to complement these programs with software research corresponding to SEK 200 million. As stated above, FuSS is strongly coupled to CHI. SSF's overall ICT-goal is to support future Swedish continuous computing infrastructures.

Future ICT systems must be more energy efficient. FuSS supports this by issuing the Call's topics towards lower energy consumption. Together with SSF's overall ICT-goal, FuSS is thus designed to be well-aligned with both EU's Green Deal (make the EU climate neutral in 2050) and EU's Digital Decade (make the EU digitally sovereign by developing digital infrastructure).

Aligning FuSS projects with EU-initiatives, where applicable, is encouraged. SSF-funding can therefore optionally be used to increase Swedish research presence in ongoing EU-projects. SSF-funding can also be used to enhance results from recently finished EU-projects. Further, the project leaders can use up to SEK 500 000 of the SSF-funding for direct work towards future EU-applications. The relationship between the present application and corresponding EU projects must for these optional cases be comprehensively presented in the submitted application, to ensure synergy between the applicant's research projects and exclude overlap. SSF's overall EU-goal is to increase Sweden's benefits of EU's research programs.

The scheme of this Call is set in concert with the Swedish Government Innovation Partnership Program on the Digital Transformation of Industry.

Scope

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

Topic 1: Next-Generation Wireless Communication Software

This topic includes software research towards **energy-efficient next-generation wireless communication systems beyond current 5G-systems**. Research areas include, but are not restricted to:

- Ultra-large software defined networks that are safe, secure, reconfigurable, and self-managing by design
- Software for data-generative networks (data collection/compression/classification, optimal shared resource usage, etc)
- Distributed software for parallel network core-to-edge execution.

Topic 2: Future Software Challenges

Consider a future scenario of highly complex systems, where classical computing subsystems and novel computing subsystems/accelerators integrate into overall hybrid computing systems; These systems are expected to perform dynamically and evolve over time to handle new requirements, not foreseeable at the system design stage. Full functionality over ICT infrastructures, e.g., networks, as well as energy-efficiency are evident requirements.

This topic includes software research towards **future software-intensive system challenges in 10+ years**. Research areas include, but are not restricted to:

- Hybrid classical-*X* software systems (*X* = quantum, AI/data/ML or other accelerators/functionalities handling specific tasks), which “orchestrates” and optimizes reliable overall system end-to-end functionality
- Dynamic software systems allowing evolution and reconfiguration over time, including the handling of time-variable and/or initially unknown resources
- More energy-efficient ICT enabled by novel and innovative software systems.

Topic 3: Future Advanced Software Development

This topic includes software research towards novel and innovative **future advanced software development techniques and methods** that clearly address crucial key performance indicators such as increased productivity, robustness, security and energy-efficiency. Research areas include, but are not restricted to:

- Increased productivity, optimization and reliability through for example AI-based/data-driven software development
- Safe, secure, and reliable hybrid as well as dynamic software systems enabled by novel software development results
- Performance-optimized and energy-efficient computing-intensive systems enabled by advanced software development results.

Strategic relevance

The proposed research shall aim to provide enabling technologies for future applications, products or services, and solutions to important application problems. Successful proposals are based on clear visions for future impact.

The criterion of strategic relevance means that a proposal demonstrates how it contributes to Swedish international competitiveness by a clear vision of utilization/exploitation of the research results in Sweden in the 5-15 years term. This includes providing effective measures for translation and innovation, as could be eventually evaluated from the creation of enterprises, jobs, or other societal effect. A central part of the relevance is graduate student education and the attractiveness of the corresponding PhD's in industry and society.

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 and can be claimed for such directed utilization activities.

Eligibility

All projects should be based on a collaboration between, preferably, two to four PI's (senior applicants) with different kinds of relevant complementary scientific expertise at the international forefront. All PI's should take active part in the project and their activities should be at least partly financed by the project budget. PI's are encouraged to team up from different faculties and institutes.

The application 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.

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 MSEK 4 to 7 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 can be represented in no more than one application as a main applicant.
- each applicant can be represented in no more than one application as a co-applicant.

Applications 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 application for compliance with the rules before submission.

Proposal and submission

A complete application must contain, among other data specified in the Portal:

- A clear purpose statement and outline how the proposed constellation of research groups will be effective in view of its objectives
- Full description of the research plan with special attention to the collaborative nature of the proposed project
- Details of the relevant expertise and mode of collaboration between the participating groups
- 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
- State-of-the-art description within the area(s) addressed, from which the outstanding research challenges for the project are identified
- Inventory of the resources available to the project
- A Letter of Intent from the Head of the main applicant's department.

The application must be written in English and submitted via the SSF Portal at: <http://apply.strategiska.se>.

Note that to get a complete view of all data required for submission it is necessary to consult the Portal. Please log on to the Portal well in advance of the deadline. Please also submit the application in due time before the deadline. When the application 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 multiple times.

All applications must be submitted by **14:00 hours (2:00 pm CET) on October 11, 2021**. 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, relevance, and projected 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 of the Call and eligibility as outlined above
- Scientific quality; originality, strengths, weaknesses, degree of collaboration, and feasibility of the research plan
- Strategic relevance, with clear purpose and potential impact of the proposed research to Swedish industry and/or society, including explicitly formulated utilization/exploitation plans
- Qualifications of the applicants and composition of the research team with degree of synergy, previous achievements (science, innovation, and entrepreneurship), international experience and networks, and leadership/management of research teams.

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

Timetable

- Last date for applications: Monday 11 October 2021, 14:00 CET at the latest
- Decision by the SSF Board: April 2022
- Project start: 1 June 2022 (pending contract signing)

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.

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