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SWEDISH FOUNDATION *for*  
STRATEGIC RESEARCH

## SSF Call for Proposals

# SSF Multidisciplinary Research Center 6G Satellite Communication (6GSAT)

The Swedish Foundation for Strategic Research (SSF) announces 60 million SEK in a national call for proposals for a Multidisciplinary Research Centre (MRC) that meets the highest international scientific standards. The call aims to stimulate truly multidisciplinary research collaboration between academia, research institutes, industry, and society.

SSF intends to approve one (1) MRC application in the field of integrating low-energy telecommunication *via* space satellites into future 6<sup>th</sup> generation global mobile telecommunication systems (6GSAT).

The MRC will be granted up to 40+20 million SEK in total including overhead costs for a period of six years. Full funding will be contingent upon a successful midterm evaluation.

### SSF Multidisciplinary Research Centers (MRC)

Multidisciplinary research is defined here as coordinated research efforts in which several scientific competences, presumably not all from the same department or faculty, each outstanding in their field, work together to solve a major societal problem.

A Multidisciplinary Research Center (MRC) should be characterized by the added scientific value that arises from multidisciplinary research. The potential for an MRC to find new solutions through multidisciplinary and synergistic approaches is a key evaluation criterion.

The research by the MRC should be based on a clear scientific question centered on gaps in knowledge related to a significant problem and opportunity. Moreover, the MRC should have explicit plans for the implementation and/or knowledge transfer of research results into industry and society in a long-term perspective.

Another MRC characteristic should be its strong presence in international research initiatives (*e.g.*, *EU Horizon Europe*), leveraging the SSF-funding with international funding for increased thrust. The potential for an MRC to constitute an internationally leading research center is a key evaluation criterion.

## Aims and Scope

This call aims to create enhanced conditions for novel multidisciplinary research on 6G Satellite Communication. The establishment of a Multidisciplinary Research Center with this orientation (MRC 6GSAT) should consolidate the necessary knowledge base and establish Sweden at a leading international front position in the field.

*Ubiquitous Wireless Intelligence* is the main vision of the future 6<sup>th</sup> generation global mobile telecommunication systems (6G). These systems are foreseen as future critical infrastructure. A mixed physical-digital 'metaverse' with fully integrated artificial intelligence (AI) and increased digital inclusion fundamentally differentiate 6G from previous mobile systems, with 6G having a much more human-centric approach. The 6G goals require a wide ecosystem of technology research and development.

All previous-generation global mobile systems have been earthbound, providing horizontal (terrestrial) communication. However, the 6G-systems will enable also vertical communication via space satellites, airplanes, drones *etc.* No local land-based ICT infrastructure is required if 'line-of-sight' between mobile terminal and satellite exists. For the first time, this enables communication in most mobile situations and in undeveloped or harsh environments. Non-terrestrial communication thus substantially increases the mobile system coverage, potentially finally achieving full global coverage.

6G satellite communication enables connecting the approximately three billion people (about a third of the world's population) who today, for economic, political and/or societal reasons, are completely outside the information society. This directly addresses some of the United Nations' (UN) global goals for sustainable development:

- Sustainability: human equality by enabling trustworthy low-energy communication
- Ubiquity: connectivity across the globe for increased digital inclusion, enabling *e.g.*, sustainable food production, e-health, disaster management, navigation
- Mobility: communication and positioning while moving at air, sea, and land
- Simultaneity: broadcasting timing and content to multiple users at once.

Furthermore, new business opportunities are enabled by 6G satellite communication as new users are covered, *e.g.*, people in developing countries and/or in rural or remote areas, people moving at sea or in the air. Many innovations are foreseen in this process.

Sweden is a world-leading country in mobile telecommunication systems since several decades. Swedish researchers have very actively contributed world-class mobile system research, patents, and innovations. Sweden-based industry is currently one of only three world-wide, and one of two in the western world, that can research, develop, deliver, and support complex mobile systems. This is a unique position in industrial history. Securing continued Swedish global leadership in mobile communication is of great strategic value.

Sweden has a very strong international position in the space sector since several decades. It is one of only about 10 countries worldwide with its own space center having the capability to launch satellites into orbit. The European Union (EU) inaugurated in Sweden in 2023 its first 'spaceport' within continental EU for satellite launches. This will offer an independent European gateway to space, will enable reaching EU and UN sustainability goals, as well as EU security and defense goals. This new 'spaceport' is also foreseen to greatly strengthen Sweden's future active role in space. Developing satellite/space research and industry innovation in Sweden is of great strategic value.

The EU launched in 2022 a 2,4 billion EUR (excluding industrial funding) effort to make Europe a major power in space: IRIS<sup>2</sup> (Infrastructure for Resilience, Interconnection & Security by Satellites). It is a strategic effort, enabling space as an area of European autonomy, connectivity, resilience, and innovation. IRIS<sup>2</sup> will provide connectivity to the whole of Europe and Africa, including areas that do not today have broadband Internet.

Motivated by the above situations, events, and the excellent timing, SSF launches a Multidisciplinary Research Center (MRC) in the field of 6G Satellite Communication (MRC 6GSAT) to be of significant strategic importance.

The successful SSF MRC 6GSAT should have the following characteristics:

- World-class Swedish mobile systems researchers and space researchers join forces in a multidisciplinary research approach to integrate low-energy telecommunication via space satellites into future 6<sup>th</sup> generation global mobile telecommunication systems. The overall 6GSAT goal must be transformative research at the highest international level, not incremental development.
- The actual 6GSAT research efforts might be concentrated on a few selected areas in both space and mobile systems research. However, 6GSAT must have a holistic full system perspective, with relevant quantifiable efforts towards sustainability and the opportunities of non-terrestrial communication as described above. This might be achieved through partnerships with selected research, industrial, and societal partners offering 6GSAT their knowledge, experience, tools and results. Scalability and positive spillover-effects must be quantifiably addressed by 6GSAT.
- 6GSAT must be very active in international research programs such as EU Horizon Europe, IRIS<sup>2</sup>, Smart Networks and Services, EUREKA CELTIC-NEXT and ITEA4. Other international partnerships are also valued. Levering the SSF-funding with international funding must be a quantifiable 6GSAT strategy.
- Energy-efficiency is a 6G key human-centric value indicator (KVI) and a key requirement for the 6G satellite communication features listed above. 6GSAT must have a strong focus on low-power research and solutions, and this must be a quantifiable 6GSAT key sustainability activity.
- Trustworthiness and digital inclusion are other 6G KVIs that 6GSAT should consider and have approaches towards, but no actual research activities need to be allocated to this.
- Access to expert competence in key strategic areas is of crucial importance for Sweden. 6GSAT must quantifiably engage a comprehensive 6G satellite communication community in Sweden, with a significant number of senior researchers, PhD students, MSc students and active industrial/societal partners.

Examples of potential 6GSAT research questions as communicated to SSF through discussions with several relevant key organizations:

- Robust and secure integration of high-precision satellite-based sensing, imaging, timekeeping, synchronization, positioning and navigation into 6G communication systems, including inter-satellite communication (IoT for satellites).
- Energy-efficient co-existence and sharing of 6G and satellite radio spectrum through coordinated terrestrial and satellite radio resource management.
- Energy-efficient integrated 6G-satellite system architecture for optimal functional distribution of computing, data management and AI.
- Trustworthy 6G-satellite communication system performance through robustness and cyber security based on, *e.g.*, redundancy, data authentication, quantum safe encryption, *etc.*
- Goals, approaches and/or demonstrators to match the most demanding applications, *e.g.*, society critical public safety scenarios relying on direct communication between satellites and handheld terminals.

Note that the above listed research questions are included as examples for stimulating research and innovation. They are not to be considered as mandatory SSF-requirements. SSF encourages innovative, multidisciplinary collaborations to propose novel research.

## Eligibility

An MRC consists of applicants from one hosting Higher Educational Institution (HEI) and applicants from one to three other HEIs or research institutes (RI), supported by at least two industrial and/or societal partners.

Each of these organizations may be represented in maximum two (2) applications in this call.

The main applicant (Center Director) must have international standing as a research leader in her/his field, must be actively employed by the hosting Swedish HEI to at least fifty percent of full time and must be prepared to assume operative responsibility for the MRC during the entire grant period.

The co-applicants are the researchers employed to at least fifty percent of full time by the collaborating HEIs/RIs, including the hosting HEI. The total number of co-applicants should not exceed seven (7) persons, and gender equality should be considered in the team.

Applications with industrial and/or societal partners registered in Sweden are prioritized.

International research organizations may participate only by their own means, apart from international researchers that becomes employed by the MRC through the participating Swedish HEIs/RIs.

The MRC must have a Governing Board, approved by SSF, having a majority of industrial/societal representatives. The Center Director shall be part of the Board. The Board, with a chair from industry/society, shall have the mandate to recommend SSF to terminate the funding, in whole or in parts, or to change the management of the MRC. A tentative Board should be stated in the application.

The MRC must assign an international Scientific Advisory Committee (SAC), proposed in the application.

A provisional Center Agreement signed by all partners will be required from the consortium behind the application, if and when it is selected for a hearing. The period for this contract is recommended to be at least three years, *i.e.*, until the mid-term evaluation.

While SSF's statutes stipulate that supported research must be in the realms of natural science, engineering sciences, or medicine, it is appreciated that a higher impact of the concerned MRC may come from collaboration with research initiatives relating to society, including humanities, economy, policy making, operation health and safety, and other science branches complementary to what SSF has for statutes. The proposed MRC should describe how it is connected to those complementary research branches as for liaison or formalized direct collaborations. This is an important criterion for SSF:s evaluation of proposals. Likewise, successful parties should be connected internationally, for example to European Commission initiatives.

Applications not conforming to the above eligibility criteria will not be considered by SSF. It is the responsibility of the main applicant to inform all co-applicants and industrial/societal partners, and to check the proposal for compliance before submission.

## Grant

SSF-funding is available only to Swedish universities or research institutes, where one HEI is the administrative organization for the grant. The industrial/societal partners and international partners must support the MRC by their own means.

The proposed budget from SSF shall be up to 60 million SEK in total during six years.

The budget allocation from SSF will be a decision of 40 million SEK in conjunction with the MRC's start. Up to 20 million SEK will be decided and distributed by SSF after a mid-term evaluation. Three percent (3%) of the grant will be reserved by SSF for supporting utilization/exploitation efforts of the research results proposed by the Center Director.

The universities/research institutes can use the grant for salaries (senior researchers, postdocs, PhD students, *etc.*), research tools/infrastructure, and running costs according to the needs of the MRC. The application must demonstrate how the SSF grant will be adequately distributed among the HEIs/RIs, *i.e.*, with adequate budget for each organization. It must also clearly display any co-funding (in-kind, cash, lab usage, research infrastructure, *etc.*) from the industrial/societal partners.

A maximum of twenty-five percent (25%) of the overall grant may be used for salaries for the Main applicant (Center Director) and/or for the Co-applicants (*i.e.*, these individuals) taken together. However, no more than twenty-five percent (25%) of the salary of each applicant (*i.e.*, the same individuals) may be covered by the SSF grant. A maximum overhead cost of twenty-five percent (25%) is allowed.

## Proposal and submission

A complete application must contain, among other data specified in SSF's online application portal, a full description of the MRC research plan and details of the relevant and complementary expertise of each of the participants. The multidisciplinary approach to the research problem should be clearly described.

Each proposal must clearly describe the international state of the art within the research area(s) addressed, and present how the MRC would be competitive. In addition, the proposal should clearly state the resources available and to demonstrate that the proposed participating organizations will be effective to reach the MRC goals. The plan and potential for international cooperation and leverage should be clearly described.

The application should contain a clear account of the strategic significance of the research, including an IPR plan and a plan for utilization/exploitation of the results in Sweden during the MRC's research operations as well as after completion of the MRC.

The MRC participants must themselves propose a concise set of long/short term Key Performance Indicators (KPI) upon which the MRC can be evaluated in the mid-term evaluation. These indicators must cover scientific, managerial, and business qualities and substance as well as strategic relevance impact. Each of the KPIs should be elaborated in the research plan and tightly connected to the MRC goals.

The following KPIs are mandatory for all MRCs:

- the volume of co-authored papers by the collaborating research groups and partners
- mobility in person-years between the collaborating research groups and partners
- international presence, *e.g.*, grants from EU and/or other international initiatives (state also the starting values of these for base line)

The application should be elaborated jointly by all the MRC participating organizations and must be submitted by the Centre Director (main applicant). All participating organizations must attach Letters of Intent (LoI) signed by the highest management level in the organizations (head of research, or equivalent). The vice-chancellor of the hosting HEI must also sign the application.

**Each participating organization may be represented in maximum two applications.**

The proposal must be written in English and submitted via the SSF online 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. 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 fields are missing. It is possible to submit and re-submit as needed before deadline.

**Applications must be submitted by 3 June 2024, 14:00 hours CET.** No additional material will be considered after this deadline, unless explicitly asked for by SSF.

## Evaluation

Applications will be assessed by an evaluation committee and a hearing committee consisting of national and international experts from industry, academia, and research institutes as well as by international peer reviews.

The applications will be evaluated using the following criteria:

- Conformity to scope and eligibility as outlined above.
- Constituting an internationally leading research constellation.
- Scientific quality; originality, strengths, weaknesses, and feasibility of research plan.
- Added value of multidisciplinary and synergistic approaches.
- Degree of internationalization.
- Strategic relevance to Swedish industry and/or society as well as explicit long-term impact of the proposed research.
- Qualifications of the applicants and composition of the research team, including previous achievements (science, innovation, and entrepreneurship), international experience and networks, gender balance and leadership/management.
- Level of engagement from all participating organizations, including evidence of anchoring of the application to top management (including Letter of Intent, LoI).

## Timetable

**Call announced: 15 December 2023**

**Last date for applications: 3 June 2024, 14:00 hours CET**

The applications will be evaluated in stages:

- Selection of maximum three applications for hearings. **August 2024**
- External peer review. **September 2024**
- Hearings. **October 2024**
- Selection of one application for funding. Contract negotiations. **November 2024**
- Decision by the SSF Board. **December 2024**
- Center start. **1 January 2025.**

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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