The SWAP project is structured according to five Work Packages (WPs), as shown in the following figure:

The WPs on the far-left and right sides deal with management and dissemination activities and are active for the whole duration of the project. WP0 is the management work package. It includes the Management Board which is composed of a key person for each partner. The MB will constantly check the consistency and coherence of the work performed by the different WPs through periodic audio conferences and internal meetings. The WPs in the center of the figure are consequential to one another: WP1 is about scenario and state of the art analysis, WP2 performs the investigation and design tasks, WP3 takes care of validation and integration activities and WP4 deals with implementation. The coherence of the solutions provided by SWAP will be granted by the supervision of the Management Board as well as by specific tasks that are defined within each WP for cross-WP alignment and verification.

Description of technical WPs

WP1 State of the Art Specifications & Requirements

Task 1.1: Definition of the applicability scenarios and use cases In this task, Industrial partners will provide scenarios and cases with a wider exploitation market. Academic partners will provide feedback on the scenarios taking into consideration a non-commercial point of view.

Task 1.2: High level specification and requirements In this task, scenarios and use cases will be detailed in terms of technological challenges, desirable functionalities and practical constraints. This task will provide specifications to other WPs.

Task 1.3: Hardware state of the art survey This task will provide a thorough state-of-the-art on WSN nodes hardware as well as on energy harvesting techniques.

Task 1.4 Protocol and standardization survey This task will detail the state of the art on communication protocols and architectures by taking into consideration the academic literature and industrial standards.

WP2 Investigation & Design

Task 2.1 Communication Protocol Design The aim of this task is to develop cutting-edge channel access and routing protocols which are optimized for the low complexity and energy-availability of sensing nodes with harvesting capabilities. At the access level, the biggest challenge is to guarantee suitable sleeping schedules without jeopardizing information delivery. A further challenge is to design schemes that are robust to finite buffer lengths (which are usually neglected in system designs for WSNs). As for routing, we will consider standard WSN paradigms (e.g., data delivery to a single or a few sinks) with the additional complexity of sleep schedules dictated by energy-availability (that may be sporadic or difficult to be known a priori).

Task 2.2 Development of different energy harvester Based on the survey performed in WP1, we aim at developing optimized energy harvesting solutions adapted to the WSN nodes characteristics and to the defined scenarios. At least, we plan to focus our developments on photon harvesting techniques by studying optimized silicon crystal solar cells and electromagnetic harvesting techniques by designing state of the art antennas.

Task 2.3 Development of a modular energy accumulator This task will deal with the development of a secondary power source, which can collect extra energy obtained from the harvesting solution. Specifically, Lithium Sulfur Cells and super capacitors, or their combination, will be studied.

Task 2.4 Reference architecture design This task is in charge of ensuring the coherence of the whole sensor platform. It will receive as input all the innovations provided by other WP2 tasks and will provide as output the requirements needed for all the innovations to work together.

WP3 Validation & Integration

Task 3.1 Protocol Simulation and Testing In this task we plan to demonstrate through simulation the effectiveness of the communication solution provided by WP2. The tests will be performed using simulators such as OPNET++ and a test-bed of telosb nodes.

Task 3.2 Harvesting Simulation and Prototyping In this task we plan to demonstrate through simulation the effectiveness of the solution investigated in WP2. To this aim analytical models will be built using matlab and a prototype device will be built to test its capabilities. This task will also test the performance of the energy accumulator. Additionally, electromagnetic simulation and RF circuit simulation will be used to design rectifying antenna and related circuitry.

Task 3.3 Radio transceiver evaluation In this task will deal with the selection of the radio transceiver that will be integrated in the final platform. To this end, we will evaluate the performance of several available architectures, taking into consideration metrics like energy expenditure per transmitted/received bit as well as other energy figures. Another objective will be the test of the interoperability of the new system with respect to existing wireless solutions, such as Wi-fi and Bluetooth.

Task 3.4 Modules Integration This task, starting from the reference architecture defined by Task2.4, will study the integration of the developed modules in order to provide inputs to the final implementation that will be carried out in WP4.

WP4 Implementation

Task 4.1 Implementation Task The main output of this task will be the design of a new sensor board integrating the solutions proposed in WP2, considering the inputs obtained by WP3.

Task 4.2 Testing Task The objective of this task is that of testing the developed prototype in realistic application scenarios.

Interaction Among WPs

The work across different WPs will be orchestrated as shown in the following figure: