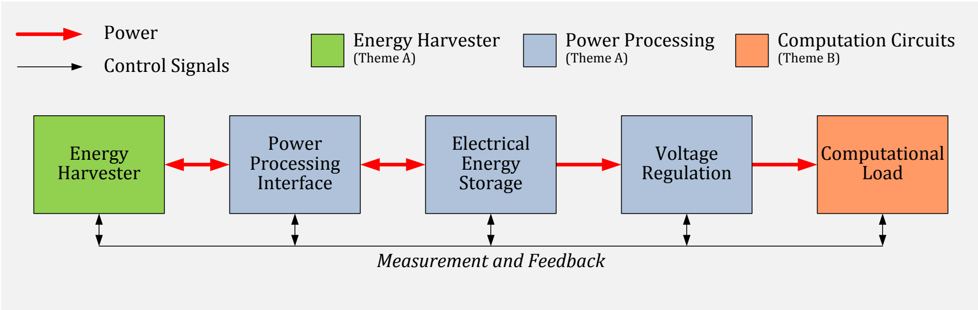
Holistic Energy Harvesting: Level 1 Block Diagram



Energy Harvester: Power should be extracted from the source and converted to an electrical form. The ability may exist to allow the transducer to physically adapt (e.g. through frequency tuning) to maximise the harvested energy.

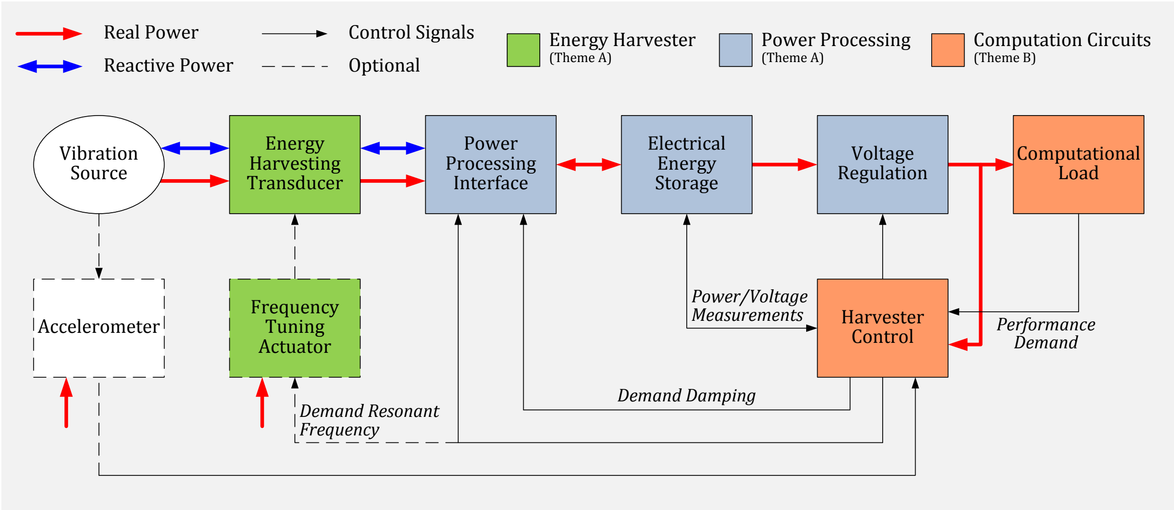
Power Processing Interface: A circuit which connects to the transducer to and enables maximum energy extraction from the transducer. The operation of this interface can have an effect on the operation of the energy harvester, and can permit adaptable energy generation (e.g. frequency tuning, adaptive damping, maximum power point tracking etc).

Electrical Energy Storage: Required to cope with intermittency of generation and consumption. Probably a supercap or a battery or combination of both.

Voltage Regulation: This is required for two reasons: the voltage on the storage element may change depending on the rate of power generation and usage (and may change a lot if the storage element is a capacitor). In addition, the load electronics may request a particular voltage to be supplied in order to minimise its power consumption.

Computational Load: Computational circuits responsible for calculating the required parameters (e.g. damping, frequency or operating point) and sending these demand signals to the energy harvester and the power processing interface. May require measurements of power/energy/voltage at different parts of the system to achieve this. The computational load also does the work of the wireless sensor, containing the wireless transceiver, sensors and application software.

Holistic Energy Harvesting: Level 2 Block Diagram



Vibration Source: Variable frequency and amplitude source of energy

Harvesting Transducer: Exchanges energy with the vibration source. Real power should be extracted from the source and converted to an electrical form. Reactive power is exchanged between source and generator as energy passes between the mass and spring.

Power Processing Interface: A circuit which connects to the transducer to and enables maximum energy extraction from the transducer (*i.e.* maximum power point operation). The circuit configuration is highly dependent on transducer type. Real power will flow from transducer to into the interface circuit. Controlling this real power will change the damping of the generator, which is a key to adaptability of the generator. In addition, some types of transducer (electromagnetic type in particular but possibly also piezo under some circumstances) a reactive power exchange between the interface circuit and the transducer could allow the resonant frequency of the generator to be modified.

Electrical Energy Storage: Required to cope with intermittency of generation and consumption. Probably a supercap or a battery or combination of both.

Voltage Regulation: This is required for two reasons: the voltage on the storage element may change depending on the rate of power generation and usage (and may change a lot if the storage element is a capacitor). In addition, the load electronics may request a particular voltage to be supplied in order to minimise its power consumption.

Frequency Tuning Actuator: This is an optional block as it may be possible to tune the generator using reactive power exchange with the interface circuit. An example of this block is the variable reluctance device currently being prototyped.

Accelerometer: It may be necessary to have an independent measurement of the vibration source so that the target resonant frequency and damping can be calculated.

Harvester Control: Computational circuits responsible for calculating the required damping and resonant frequency (or converting this into reluctance, or real and reactive power) and sending these demand signals to the frequency tuning component and the power processing interface. May require measurements of power/energy/voltage at different parts of the system to achieve this.

Computational Load: The part of the system powered by the energy harvesting system. This is the part of the load that does the work of the wireless sensor and has nothing to do with power generation. It will be energy aware and efficient, but it does not control the energy harvesting system at all. It can send a demand signal back to the harvester for performance scheduling through output voltage of the voltage regulator.