Selective Policies for Efficient State Retention in Transiently-Powered Systems

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Energy Harvesting
- Alternative energy source to batteries to power embedded electronic devices
- Scavenge energy from the environment:
  - Light, Vibration, Motion, Temperature
- Large energy buffers to cope with source variability
- Increased weight, size and cost

Transient Systems
- Class of energy-driven systems
- Computation sustained despite variability
- No need for additional energy storage
- Figure of merit: Forward Progress
- System state (registers and main memory) saved to Non-Volatile Memory (NVM) and restored once power is available again
- Existing approaches (e.g. Hibernus [1]):
  - Save the entire state to NVM (Figure 1a)
  - Significant energy/time overhead for the saving/restoring process
  - Less energy spent on useful computations
  - Use a universal policy without regard for the characteristics of the NVM

Selective Policies
- Saving only the necessary parts of memory to reduce the energy/time overhead
- Dynamic identification of unallocated space proposed in [2] (Fig. 1b)
- We implemented this policy on different platforms: FRAM and Flash memory.
  - Positive impact on FRAM (Fig. 2a, 2b)
  - Saving cost proportionally reduced with size of allocated memory
  - Up to 85.1% energy/time savings when memory usage is 18%.
- Far less effective on Flash due to the overhead of erasing required (Fig. 2c, 2d)
- Saving process strongly affected by the erasing process which accounts for up to 94% of the total cost for saving.
- Need for novel selective policies, targeted at minimising the energy/time overhead for the saving process
- Policies need to be tailored to:
  - Specific NVM characteristics:
    - Need to erase before writing
    - Symmetric read/write
  - Memory usage

References