



Battery-Aware Multi-Core Task Scheduling

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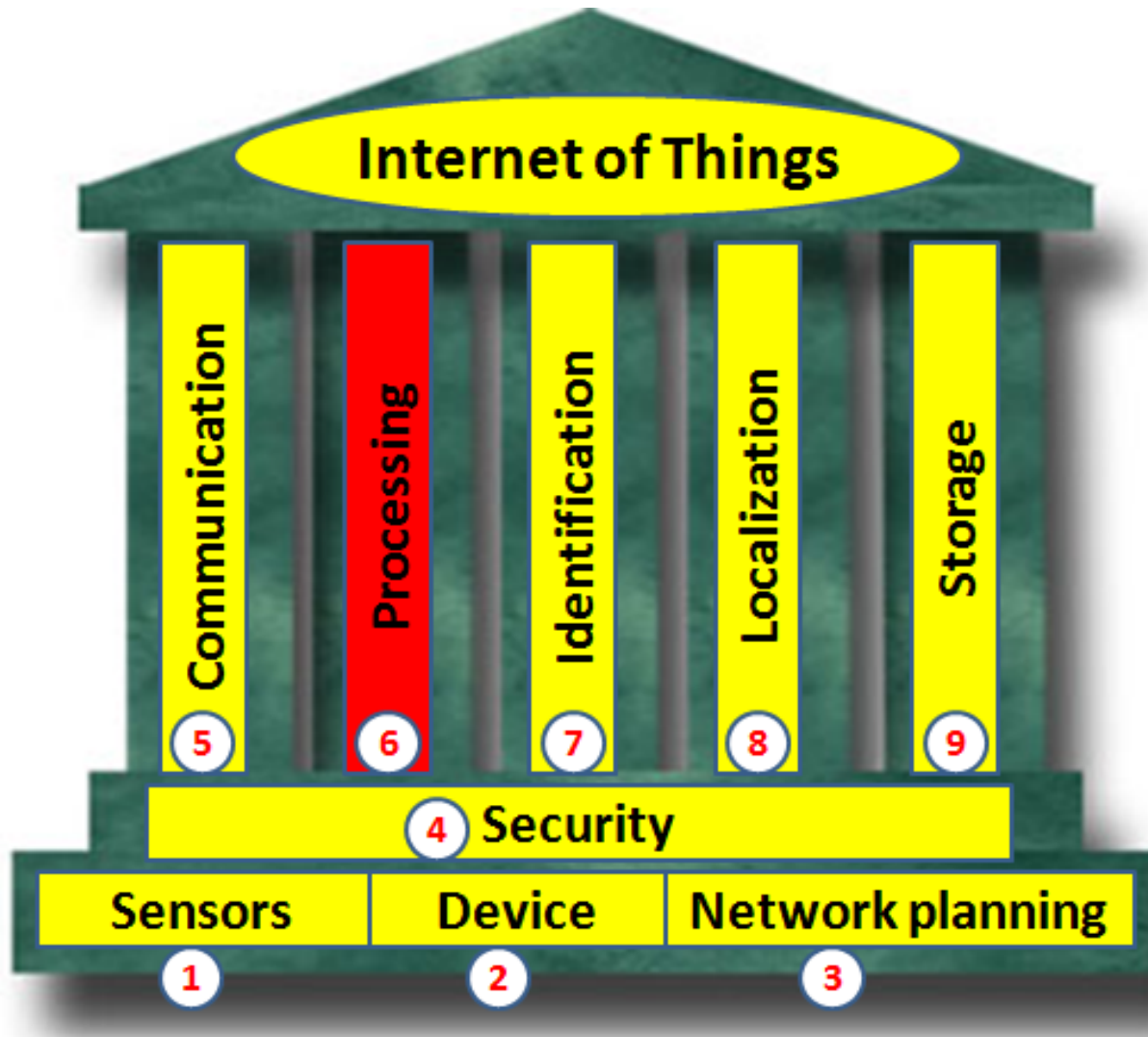
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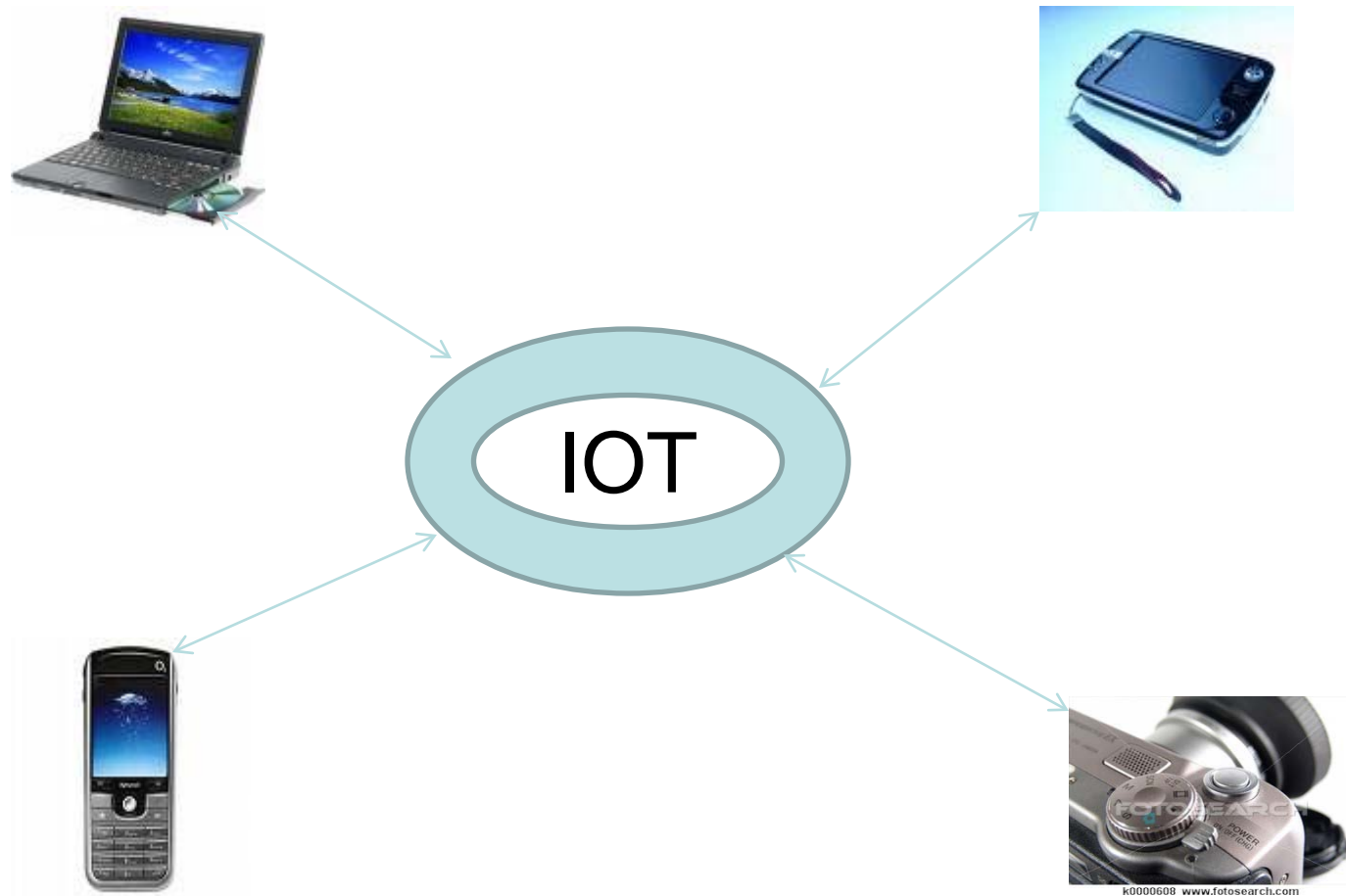
Outline

- Internet Of Things (IOT)
- Issues and challenges
- Traditional approaches to energy optimization
- Static MultiProcessor Scheduling
- Research Goal
- Proposed Framework
- Methodology
- Conclusion

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IoT



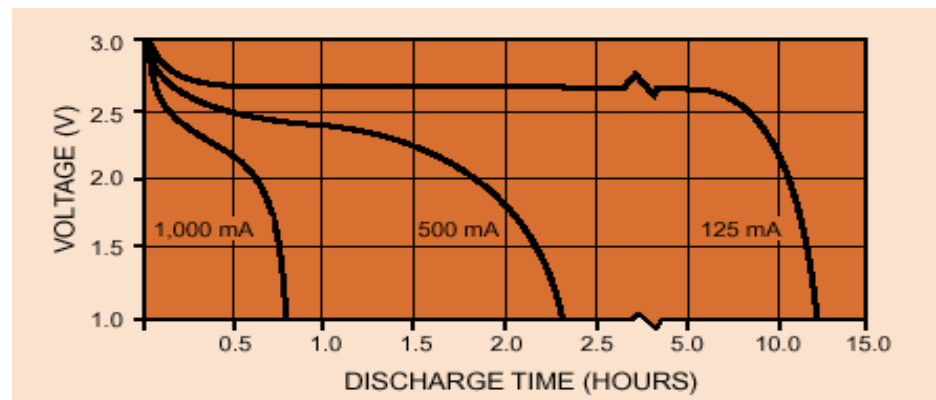
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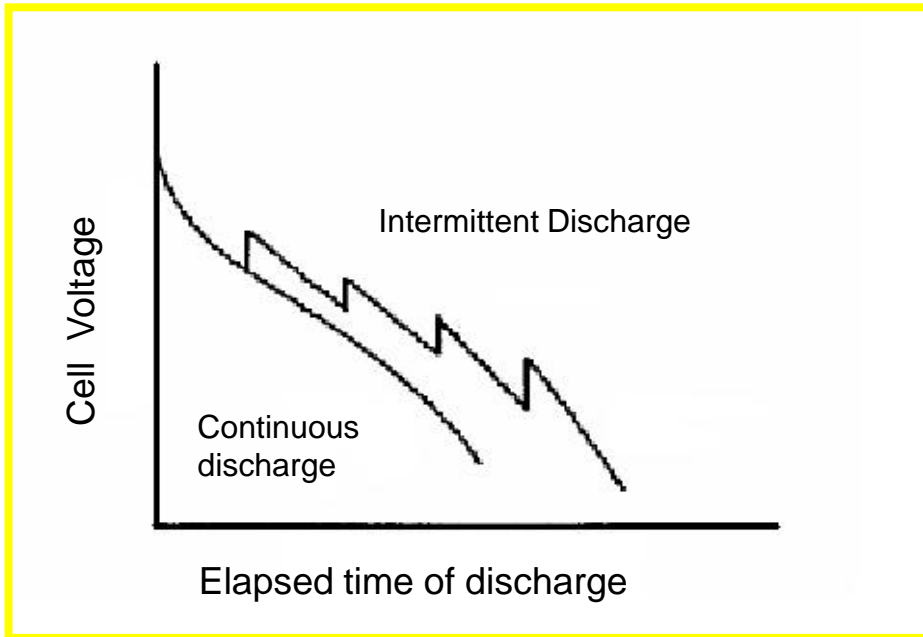
Internet of things (IOT)

- Number of wireless embedded devices are seamlessly connected.
- Able to transmit vast amount of information
- Mostly battery powered devices.
- Overall functionality is constantly increasing.
- Pushing the demands for higher computational performance.
- Require more power and hence there is need to pay more attention towards battery power.

- Many embedded wireless applications are constrained such that their operation has to last from at several months to many years without replacing batteries.
- Battery lifetime is major constraint.
- Rechargeable batteries have nonlinear discharge profiles.
- Partly recover when operated in a discontinuous discharging scheme.



Recovery Effect



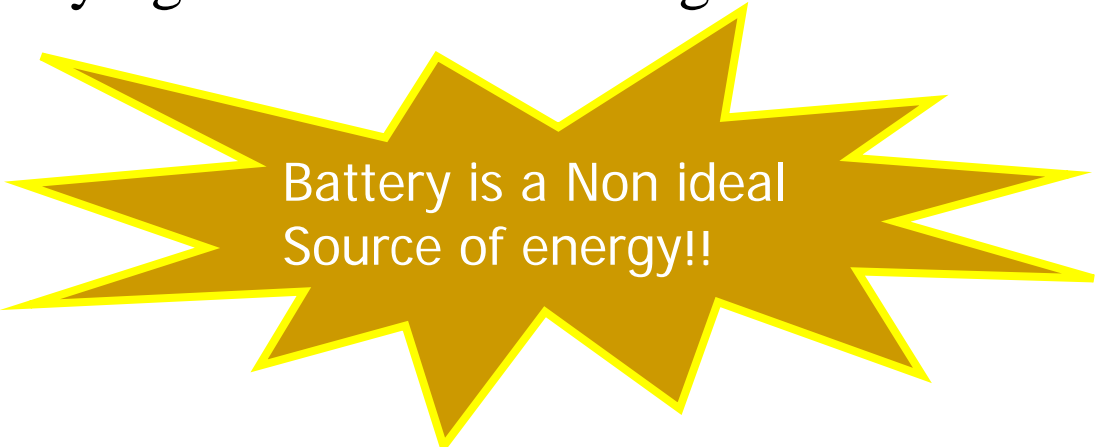
- Battery recovers capacity if given idle slots in between discharges.

Contd..

- Slow growth in energy densities not keeping up with increase in power consumption.
- Existing low-energy design techniques do not take into consideration the power discharge profile and battery characteristics.
- New battery-aware methods could possibly alleviate the need for longer battery life times, e.g. by controlling the discharge current level and shape.

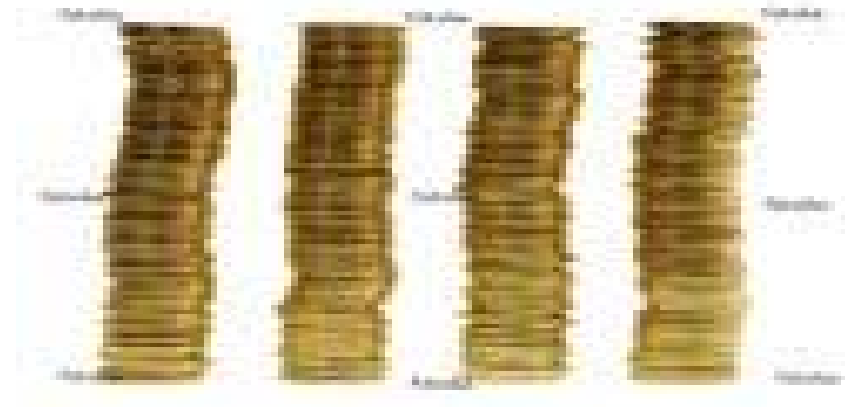
Traditional approaches to energy optimization

- **Dynamic Voltage Scaling (DVS):**
busy system => increase frequency
idle system => decrease frequency
- The algorithms on DVS considers battery as an ideal power source, *i.e.* energy delivered by the battery is constant under varying conditions of voltages and currents.

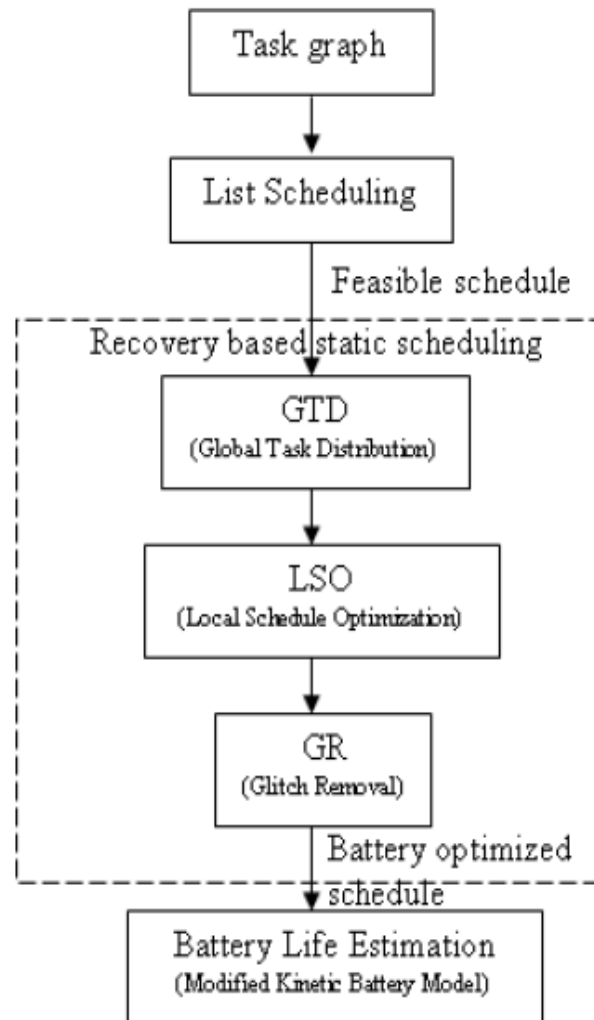


Battery is a Non ideal
Source of energy!!

- Where a single job is broken up into separate parallel tasks which are then schedule onto multiple processors in order to reduce the overall runtime.



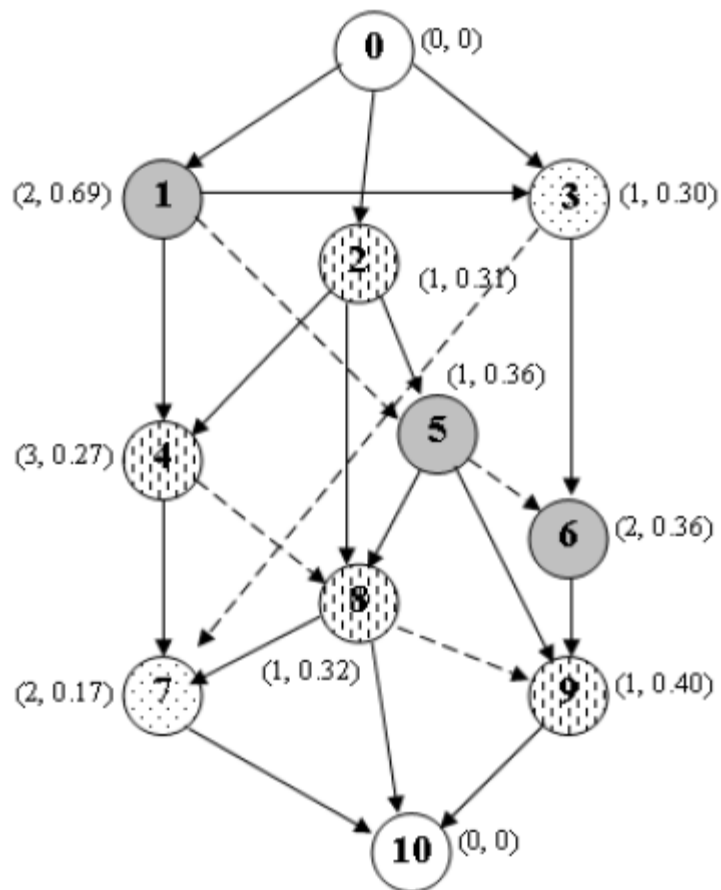
Multiprocessor Scheduling



Block Diagram of Scheduler

* 05 Jun 10 Amir Dan Lahiri et al., "Recovery-based Real-Time Static Scheduling for Battery Life Optimization"

Embedded system specification-Task graph

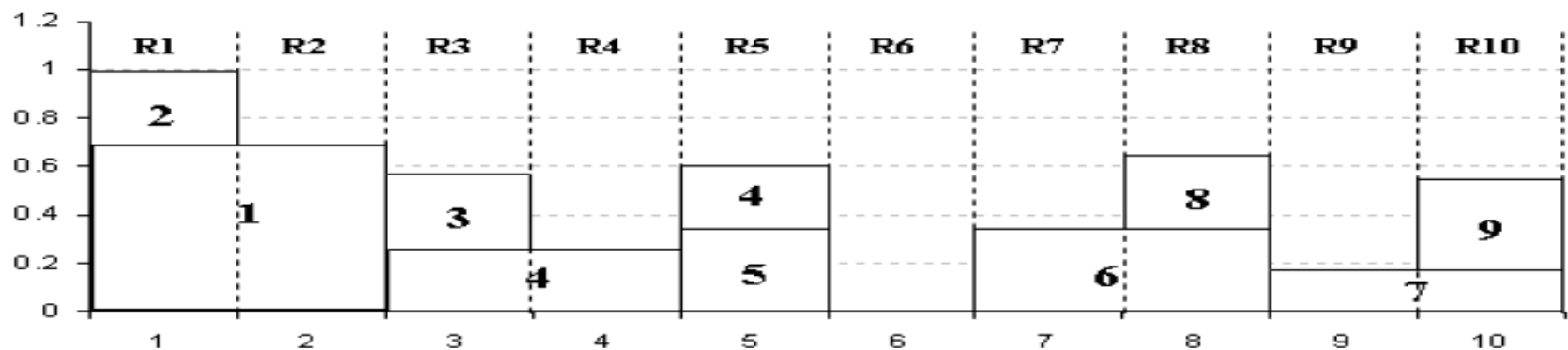
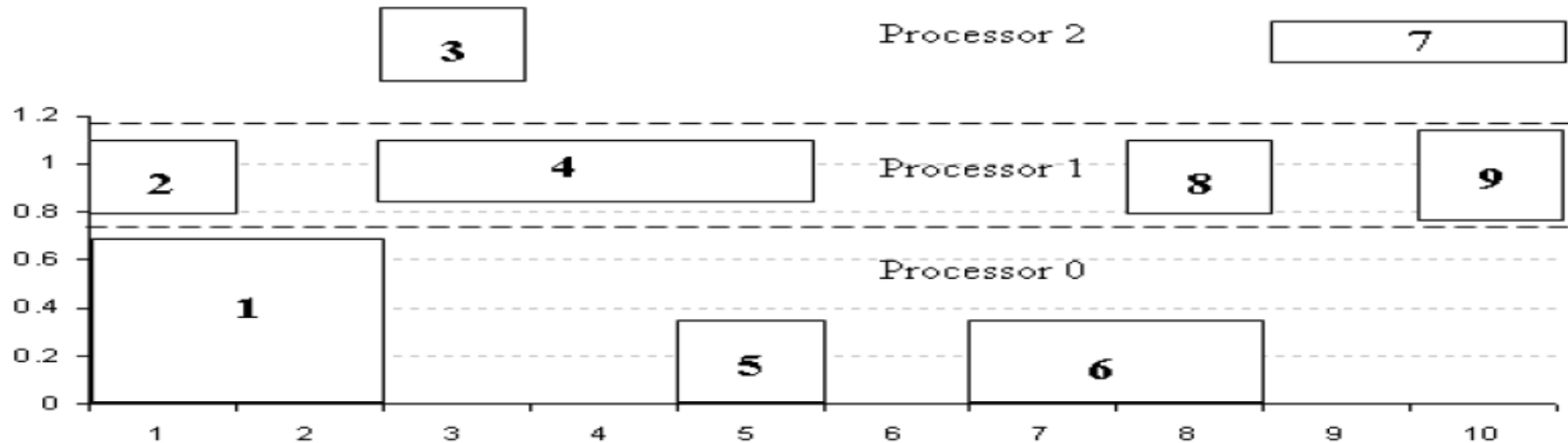


The nodes in the graph represent tasks while the edges denote inter-task constraints.

* Anirban Lahiri et al. "Recovery-based Real-Time Static Scheduling for Battery Life Optimization"

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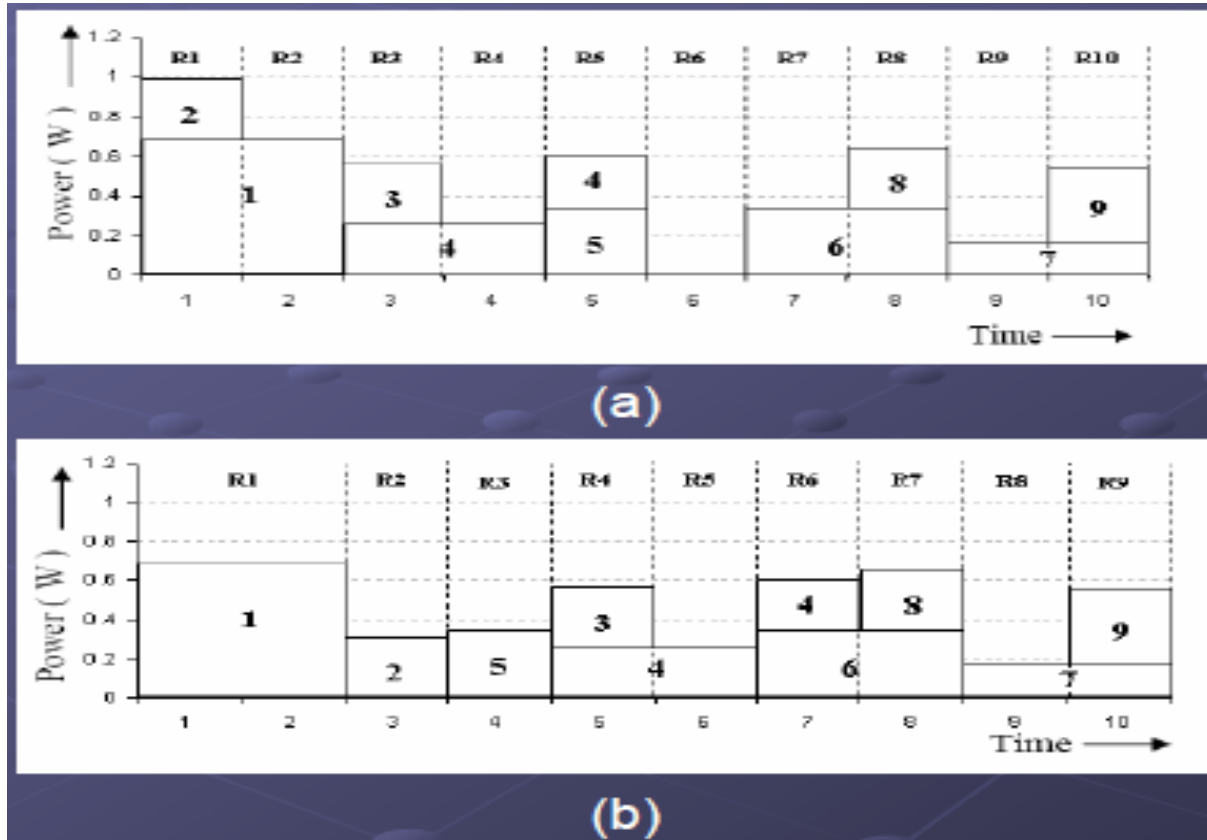
Power Aware Gantt Chart



Local Schedule Optimization

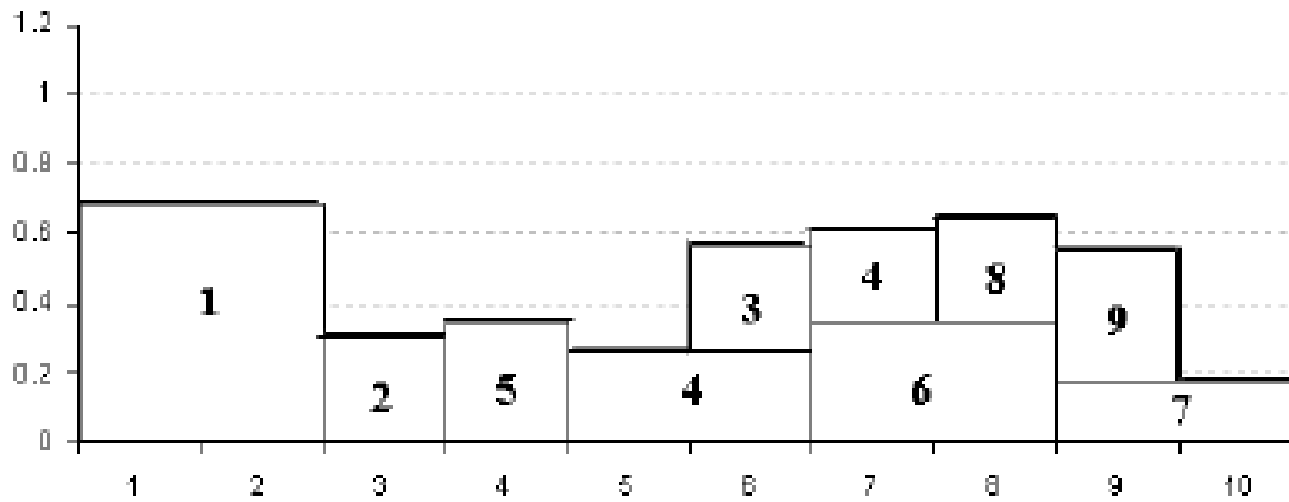
- The local task rearrangement phase aims to modify the schedule obtained through the global task distribution so as to optimize the battery performance.

Power aware Gantt charts showing the schedule (a) before and (b) after LSO phase



Glitch Removal (GR)

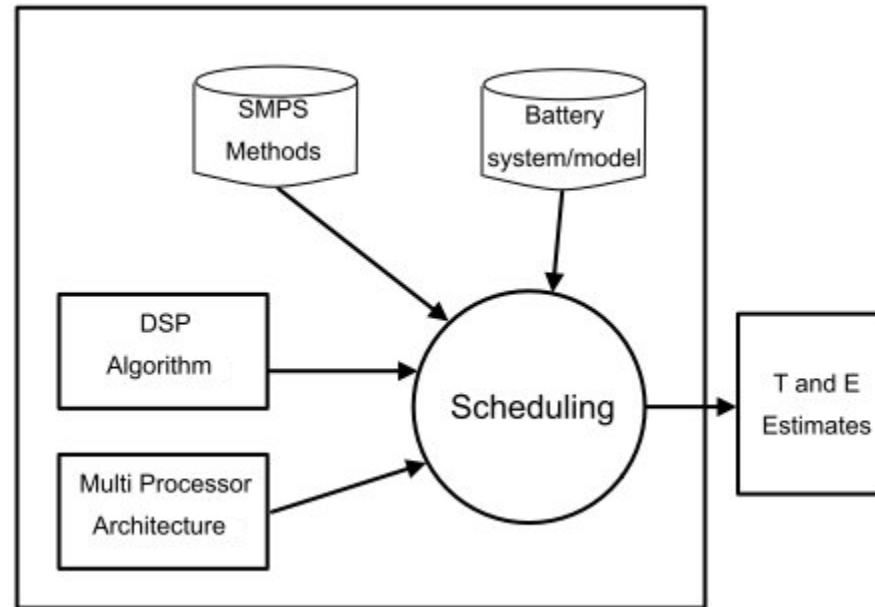
- A glitch in this case refers to an abrupt change in the power drawn by the system from the battery.
- Glitches are detrimental to the battery life



Research Goal

- Design of new methods for Static Multi-Processor Scheduling to operate in a battery powered multi-CPU environment where simultaneous minimization of
 - Overall run time (in order to comply with given hard real-time constrains).
 - Energy consumption.
- Developing a framework which will generate a multiprocessor schedule for a DSP algorithm on a given target architecture in Time & Energy optimal way to maximize the battery lifetime.

Proposed Framework



Frame work can map a DSP algorithm onto a multiprocessor architecture in a battery aware manner.

Methodology

- Study of
 - static multiprocessor scheduling methods,
 - multiprocessor architectures and models,
 - representation of DSP algorithms, and Battery models.
- Modification of existing SMPS methods considering battery lifetime .
- Implementation of new strategies.
- Define an extensive experimental campaign .
 - Identify set of task graphs representig DSP Algorithms.
 - Granularity, Ratio between computation and communication, Degree of parallelism
- Conduct a series of experiments.
 - New SMPS strategies are used to map the algorithms onto architectures

Contd.

- Conduct a thorough analysis of the scheduling results to determine
 - Performance relation between a given scheduling strategy
 - Specific DSP algorithm characteristics,
 - Multiprocessor topology, and a battery-based energy system.
- Formulate a set of guidelines
 - To bring down overall design time.
 - To choose the most appropriate scheduling heuristic when algorithmic, architectural, and energy system information are available.

Conclusion

- A set of new static multiprocessor scheduling methods which are based on existing methods modified to perform Multi-objective optimization in terms of time and energy.
- Set of guidelines which can be used to choose a specific scheduling method, given a battery system as well as a DSP algorithm and a multiprocessor architecture with known characteristics.

Thank You...

Suggestions Please...