How to obtain better insight in power consumption and performance already in design phase of a data centre?

Design high-level models for both power consumption and performance for give data centre configuration and job streams. Analyse these models to obtain insight in the power-performance trade-off, which is caused by power management.

Approach

Accurate high-level models for simulation and numerical solution are obtained from “real world” data centres via a modelling and validation cycle. The basic model below distinguishes the most relevant parts to be modelled.

1. Simulation
   - Discrete-event and agent-based models
2. Numerical solution
   - Petri cycle
   - Simulation models and numerical solutions of simple stochastic Petri net models
3. Measurements
   - on servers
   - data centres
   - environmental testbeds

Data Centres

How to reduce energy consumption in a data centre?

- **Power management** aims to switch servers into a lower power state to reduce power consumption, while performance is kept intact.
- **Virtualisation** creates virtual resources from available physical resources.
- **Per server monitoring and control of temperature, humidity, etc.** to increase cooling efficiency.
- and many more …

Simulation

The simulation framework, implemented in AnyLogic, consists of cooperating discrete-event and agent-based models for data centres, allowing:

- Various configurations
- Different workload
- Heterogeneous servers
- Different power management strategies

Conclusions

- Simulation models and numerical solutions of simple stochastic Petri net models of data centres lead to insight into important power and performance indicators.
- Insight is provided into the power-performance trade-offs caused by different power management strategies.

Numerical Solution

This framework is implemented in Möbius, consists of Stochastic Petri Net models, that generate Markov chains to obtain metrics via a numerical solution. The models support data centres with:

- Various configurations
- Exponential distributed workload
- Homogeneous servers
- One power management strategy

**Experiment results**

- Power-performance trade-off
- Cumulative utilisation plot

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**Literature**

