

SENODs (Sustainable ENergy-Optimized Datacenters): Building a Microscope for the Datacenter

Data Centers increasingly constitute a critical backbone of worldwide IT infrastructure



Partnership with Portugal Telecom
SENODs was framed around the needs of a new datacenter being planned by Portugal Telecom



Deployment at the largest national data center
The project targets a new data center that will double Portugal's capability



A new generation of data centers
Aligned with the demanding objectives of environmental sustainability

Energy Management Challenges in Data Centers

Sustainability

Datacenters consume a significant percentage of all electricity (e.g., 2% in the US), with an annual growth of 15%, which is unsustainable.

Cooling Management

Excessive cooling wastes substantial energy costs, while inadequate cooling can lead to hardware errors that can render the performance of a data center to become unacceptably low.

Heterogeneity

Every data center is different and hence has its own unique needs.

Dynamism

Data centers change over time as old servers are retired and new servers, racks and cabinets are added, old cooling equipment is replaced and new cooling equipment is added, denser storage subsystems are added.

Operational Complexity

Data centers continue to scale in size and complexity making operational simplicity a critical requirement to avoid operator errors.

Integrated Toolset

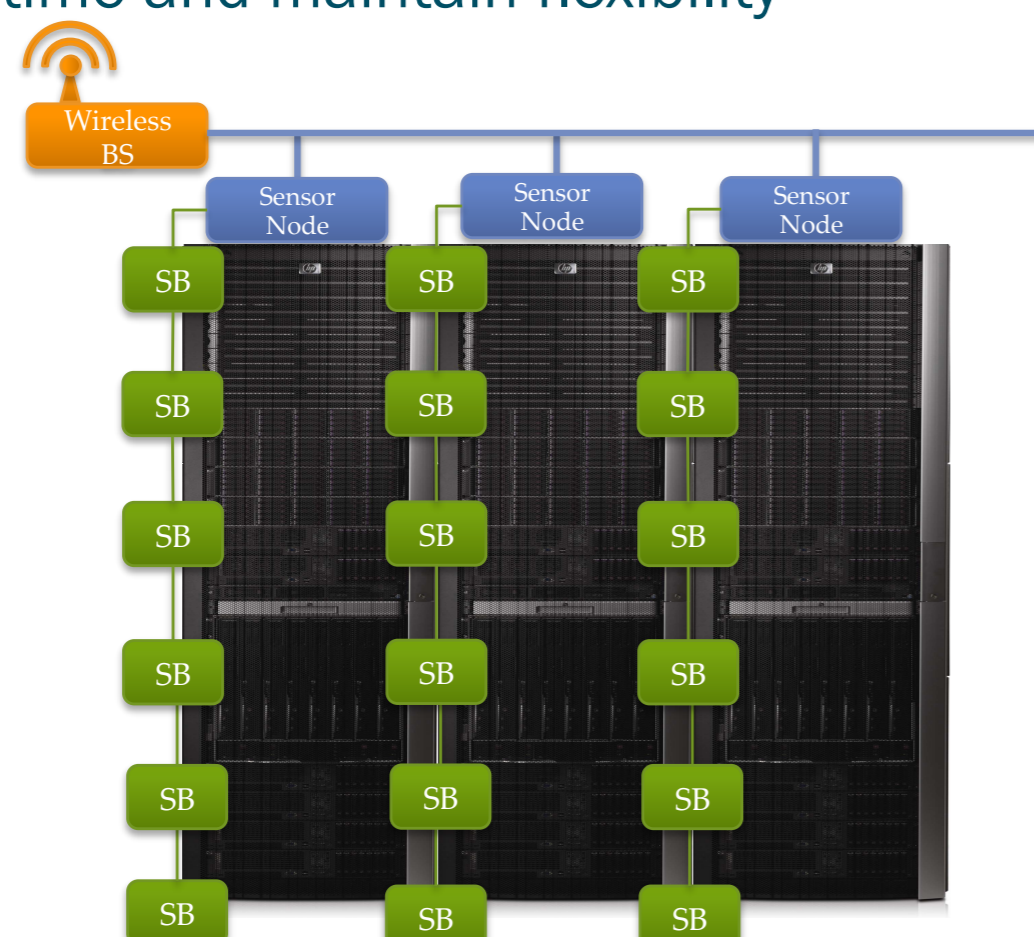
Develop an integrated toolset that enables energy efficient operation of large data centers by incorporating the following features:

- fine-grained monitoring of power consumption and data center environmental variables to identify, model, analyze and optimize energy consumptions;
- dynamic workload balancing that takes into account the interaction of the computing system and the physical environment (e.g. cooling);
- fine-tuned control of the environmental conditions;
- optimization of the physical layout of new hardware;
- flexible management for both data center operators and enterprise customers.

Devices

Common Sensing Platform Developed:

- Monitoring of environmental and power parameters
- Large-scale and fine-grained (time and space) monitoring
- Low cost and ease of installation in the datacenter
- Sensor Nodes and Wireless Base Stations (WBS) share the same base platform
- Mix of Wired and Wireless Communication: Lower costs, reduce development time and maintain flexibility



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Project Achievements

Architecture and prototypes of the environmental and power sensor networks. These allow collection of fine-grained (thousands of sensing points) environmental parameters and per-server power consumptions.

Tools that provide information about the datacenter conditions. These tools were devised to allow integration with many datacenter subsystems.

Pilots and Demonstrators. The project has included several pilot demonstrators, including in a real datacenter.

Best paper award. The paper entitled "Building a Microscope for the Data Center", received the Best Paper Award at the 7th International Conference on Wireless Algorithms, Systems and Applications (WASA2012; paper acceptance ratio of 28.6%).

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