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Thermal-aware relocation of servers in green data centers

Key words: Servers, Green data center, Thermal-aware, Relocation

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Introduction

- Rise in inlet air temperature increases the corresponding outlet air temperature from the server.
- As an added effect of rise in inlet air temperature, some active servers may start exhaling intensely hot air to form a hotspot.
- Increase in hot air temperature and occasional hotspots are an added burden on the cooling mechanism.
- Based upon mutual comparison of inlet temperature sensitivity of heterogeneous servers, a proactive approach for thermal-aware relocation of data center servers is presented.
- The thermal-aware relocation of servers helps in the establishment of green data centers

Main idea

- Identifying and comparing the thermal sensitivity to inlet air temperature for various servers helps in the thermal-aware arrangement and location switching of servers to minimize the cooling energy wastage.

- The peak outlet temperature among the relocated servers can be lowered and even be homogenized to reduce the cooling load and chances of hotspots.

Method

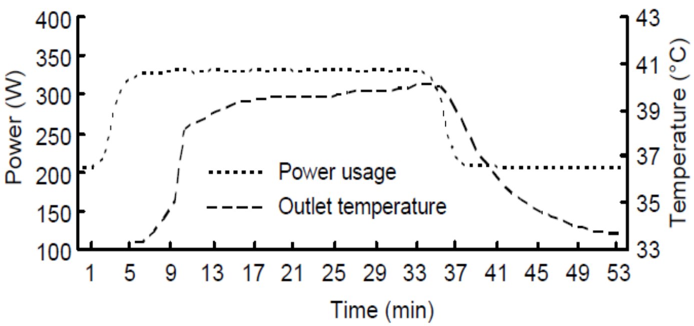

Fig. 2 Power usage and outlet temperature of type A server under experiment set 1

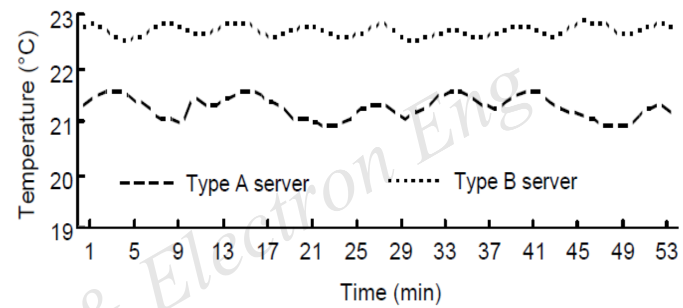

Fig. 4 Inlet temperatures of type A and type B servers under experiment set 1 (type B server is receiving hotter air at inlet)

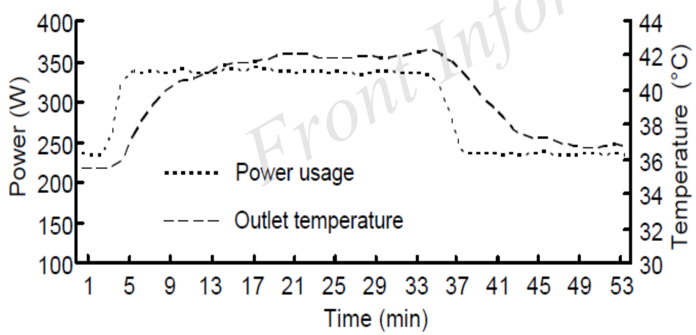

Fig. 3 Power usage and outlet temperature of type B server under experiment set 1

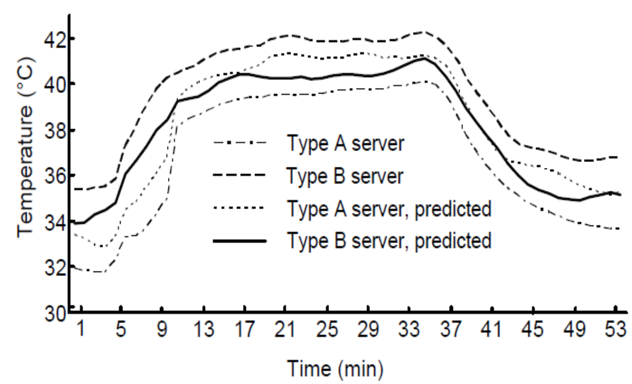

Fig. 10 Current and predicted outlet temperatures of type A and type B servers under experiment set 1

Major results

Server type	Average inlet temperature (°C)	Average maximum outlet temperature before relocation (°C)	Average outlet temperature after relocation (°C)	$E_{cooling\_wasted}$ (W/min)	Cooling energy saving (W/min)	Total energy consumed before relocation (W/min)	Total energy consumed after relocation (W/min)
A	21.2	38.7	39.4	0	11	423	422
B	22.7	41.3	39.6	24	24	444	404

Conclusions

- An energy model is presented to explain the effect of rise in inlet temperature of each server and the effect of this upon the total power consumption of the data center.
- A proactive algorithm for server relocation is proposed to (1) avoid hotspots, (2) lower the peak temperature of hot air from the outlets of the relocated server set, and (3) homogenize the outlet temperatures of the set of relocated servers. These will result in lower cooling load, avoidance of hotspots, ensuring equipment safety, and help maintain green data centers.
- Recommendations or best practices for server relocation are presented which will help the data center manager to identify, analyze, and perform a relocation to save power and to minimize cooling power wastage.