NSF/IUCRC CAC PROJECT

INTEGRATED VISUALIZING, MONITORING, AND MANAGING HPC SYSTEMS

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Detect Abnormal Applications in HPC Systems in Real Time

Background and motivation:

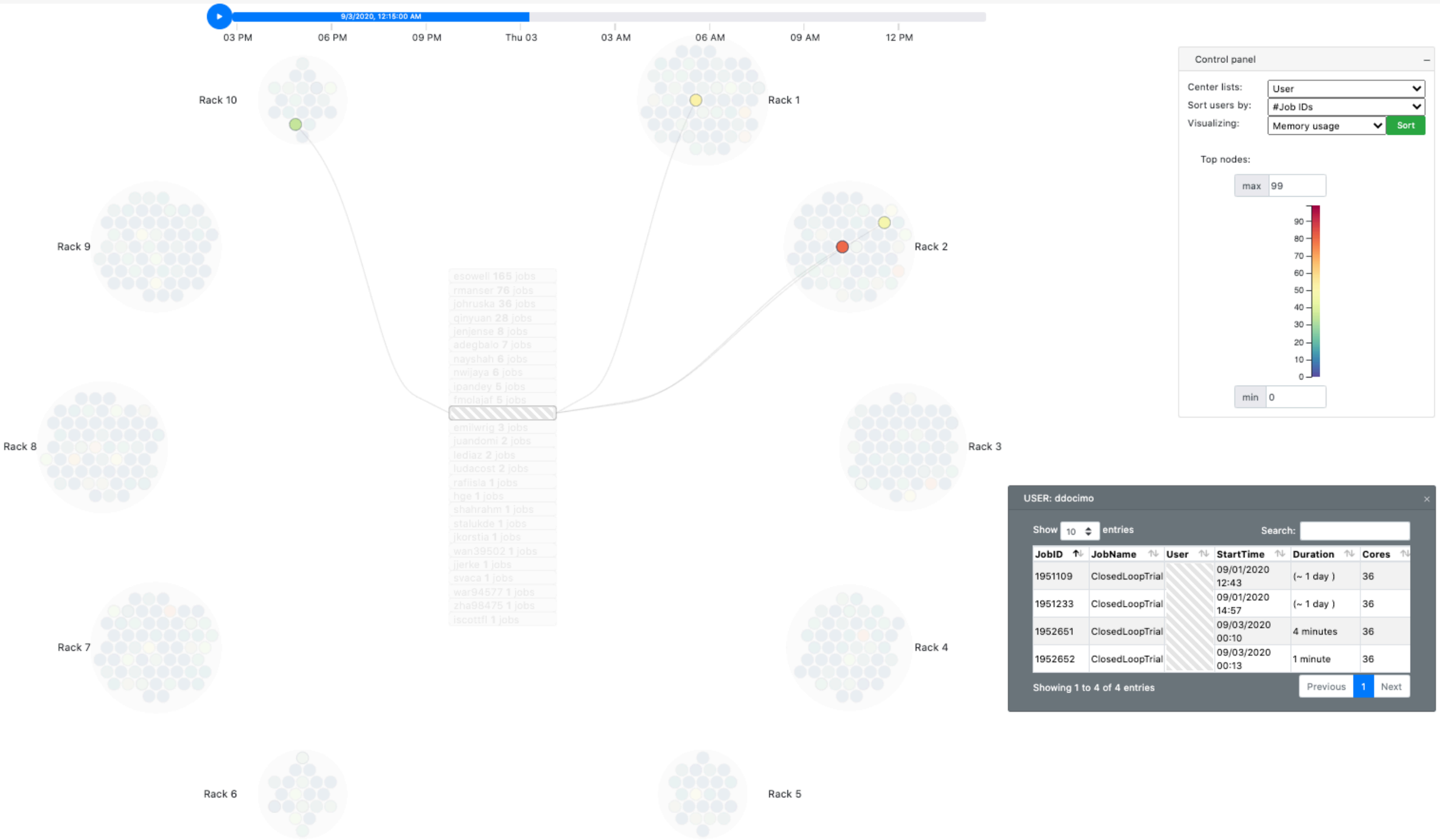
- HPC systems are continuing to grow in scale and complexity
- Accidental conditions, hardware or software failures can degrade the performance of a HPC system
- Many HPC users are experts in their scientific field but do not have advanced experience in developing efficient parallel program
- In many cases, not only users but also system administrators do not know that an application has some performance issues.

Borghesi, Andrea, Andrea Bartolini, Michele Lombardi, Michela Milano, and Luca Benini. "Anomaly detection using autoencoders in high performance computing systems." In *Proceedings of the AAAI Conference on Artificial Intelligence*, vol. 33, pp. 9428-9433. 2019.

Bezrukov, Alexander, Mikhail Kokarev, Denis Shaykhislamov, Vadim Voevodin, and Sergey Zhumatiy. "Machine Learning Techniques for Detecting Supercomputer Applications with Abnormal Behavior." In *International Conference on Parallel Computational Technologies*, pp. 31-46. Springer, Cham, 2018.

Case 1: Application may use the memory abnormally

PROPOSAL-1 - OBSERVATIONS



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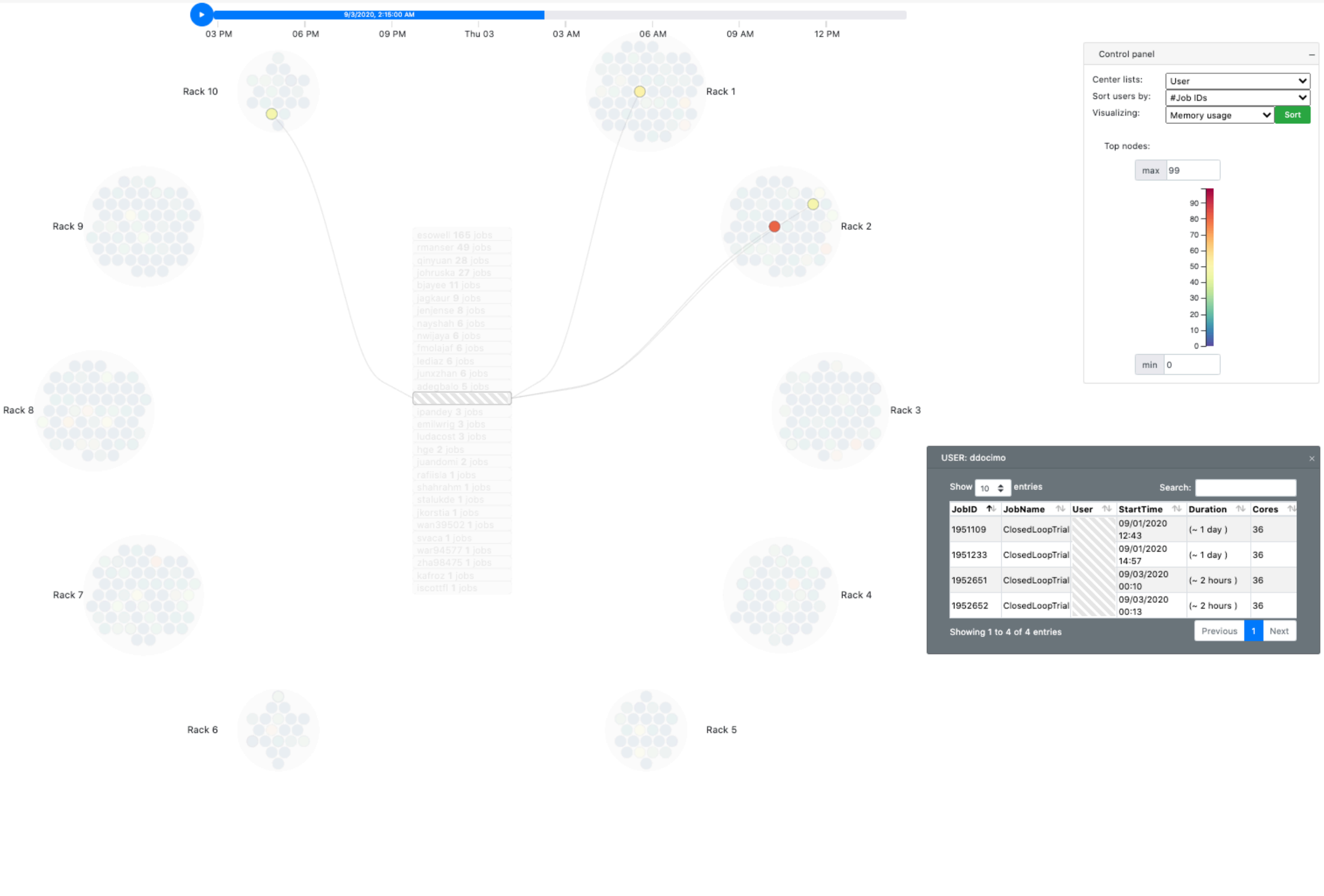

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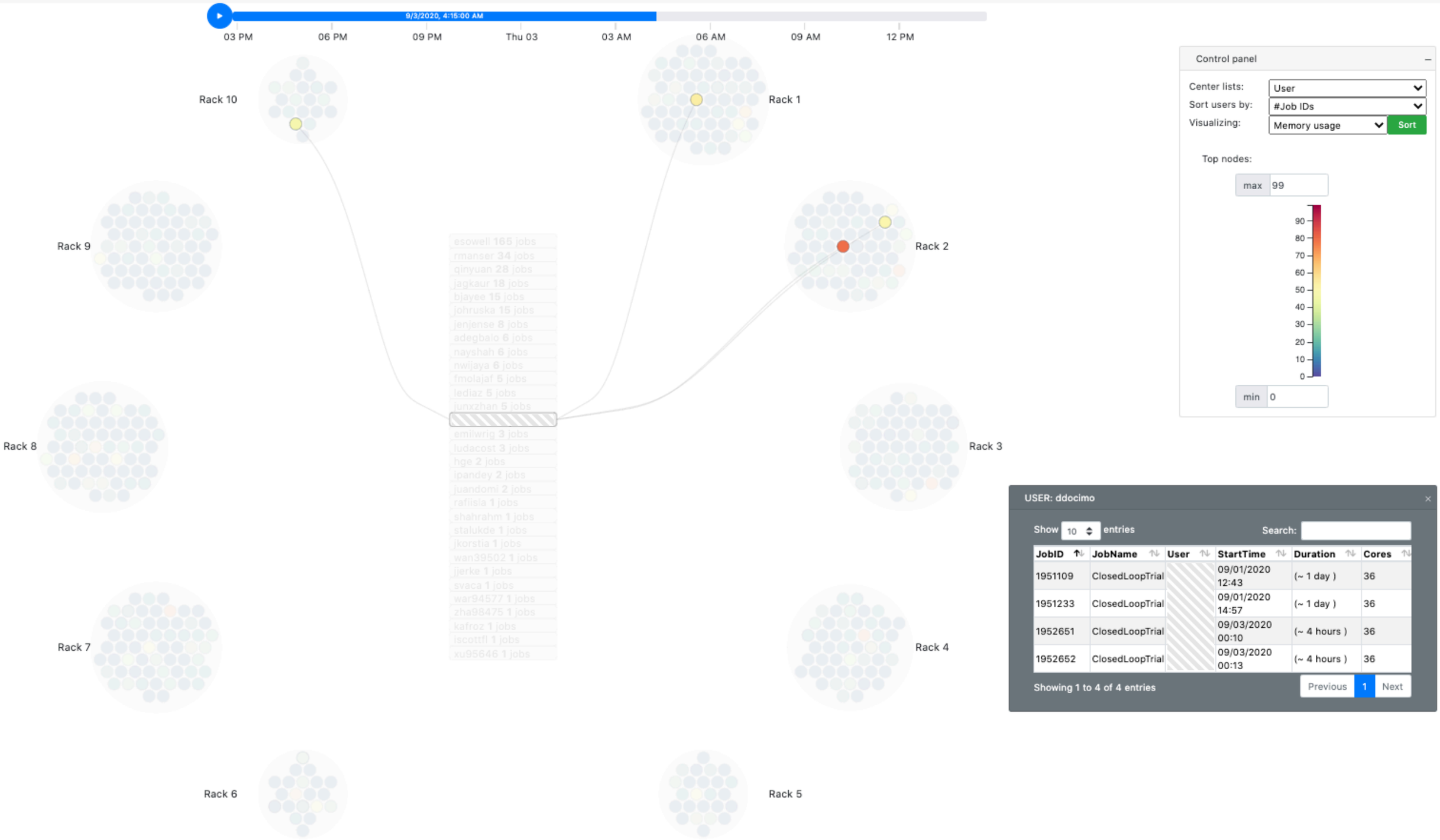

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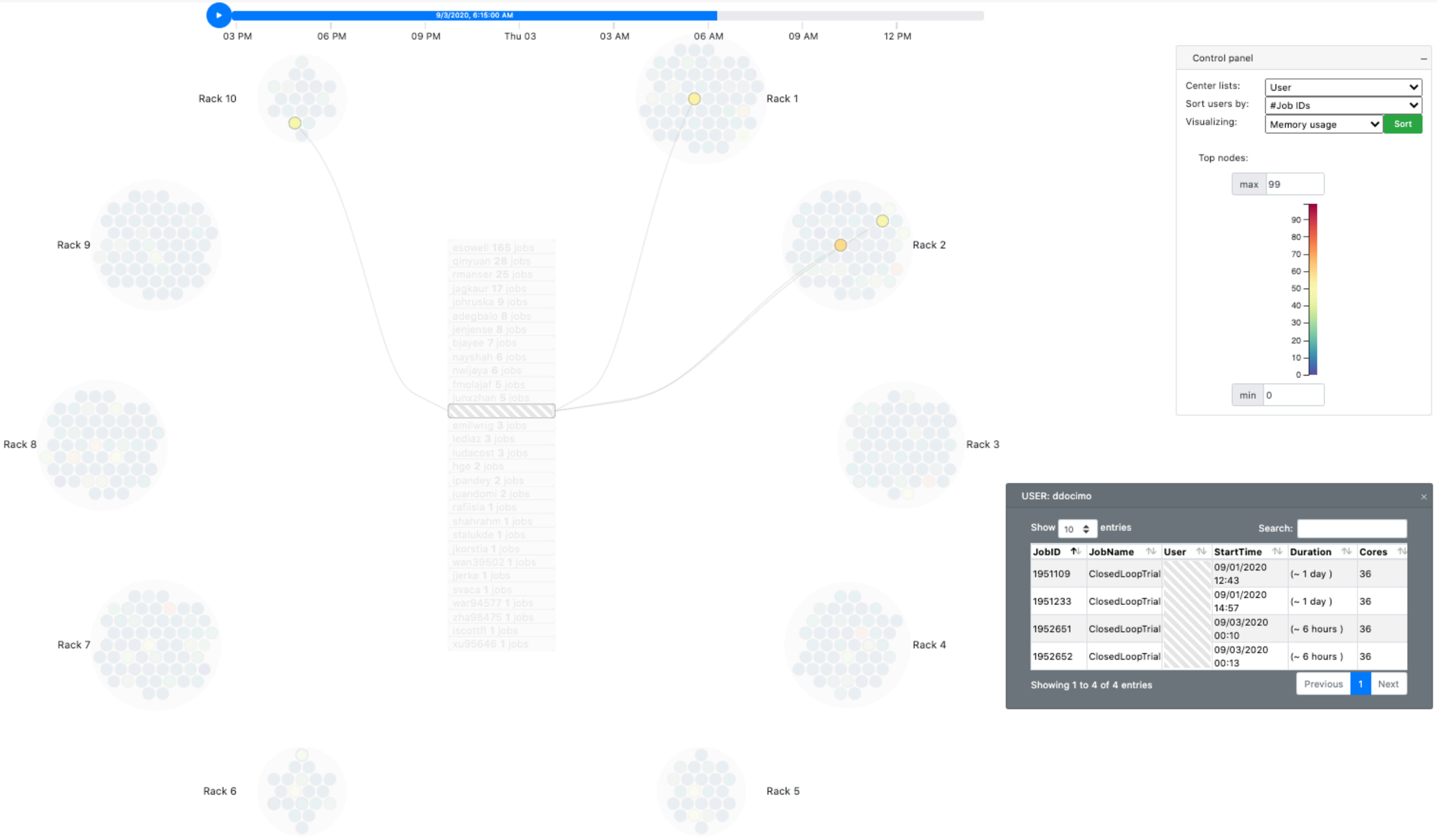

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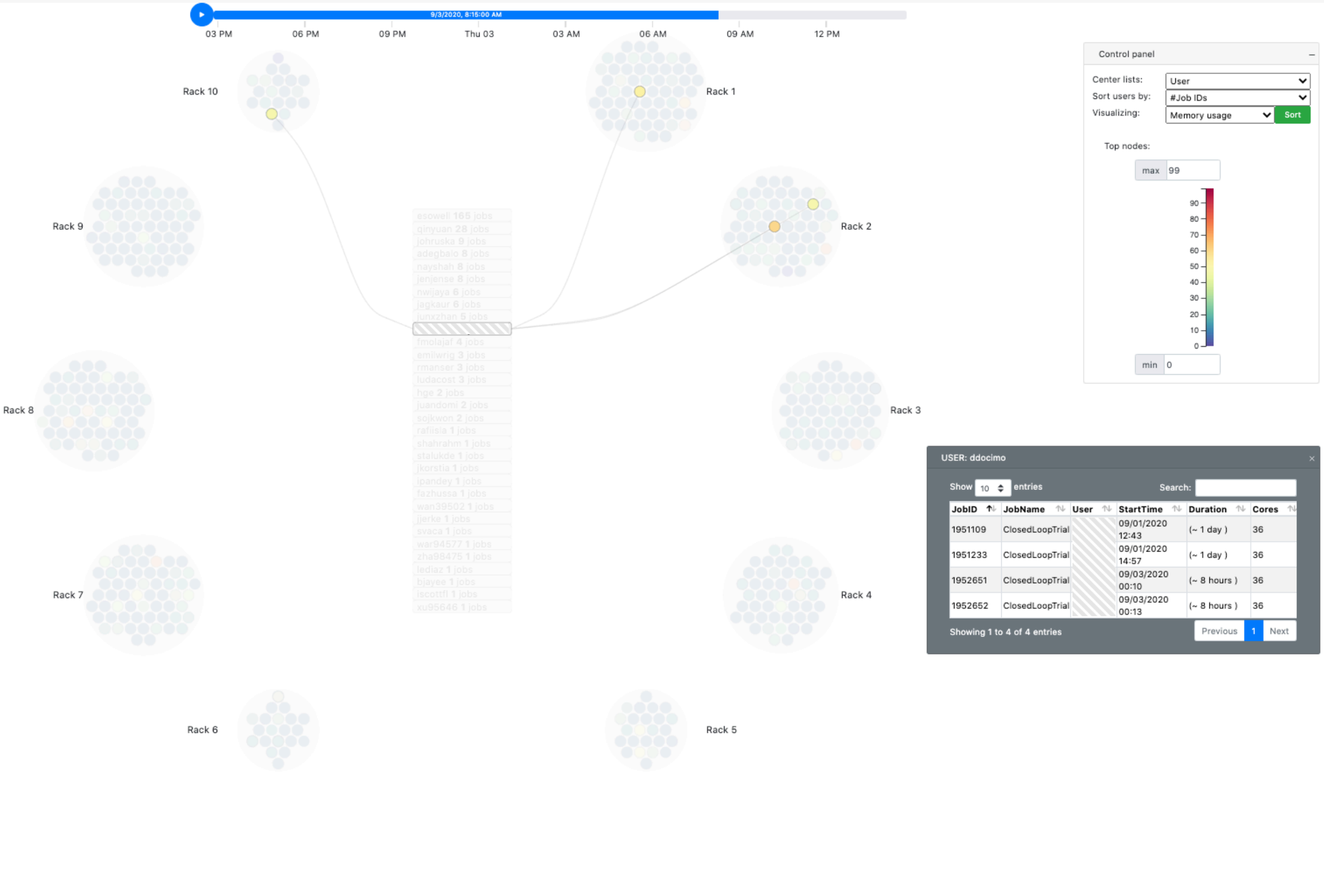

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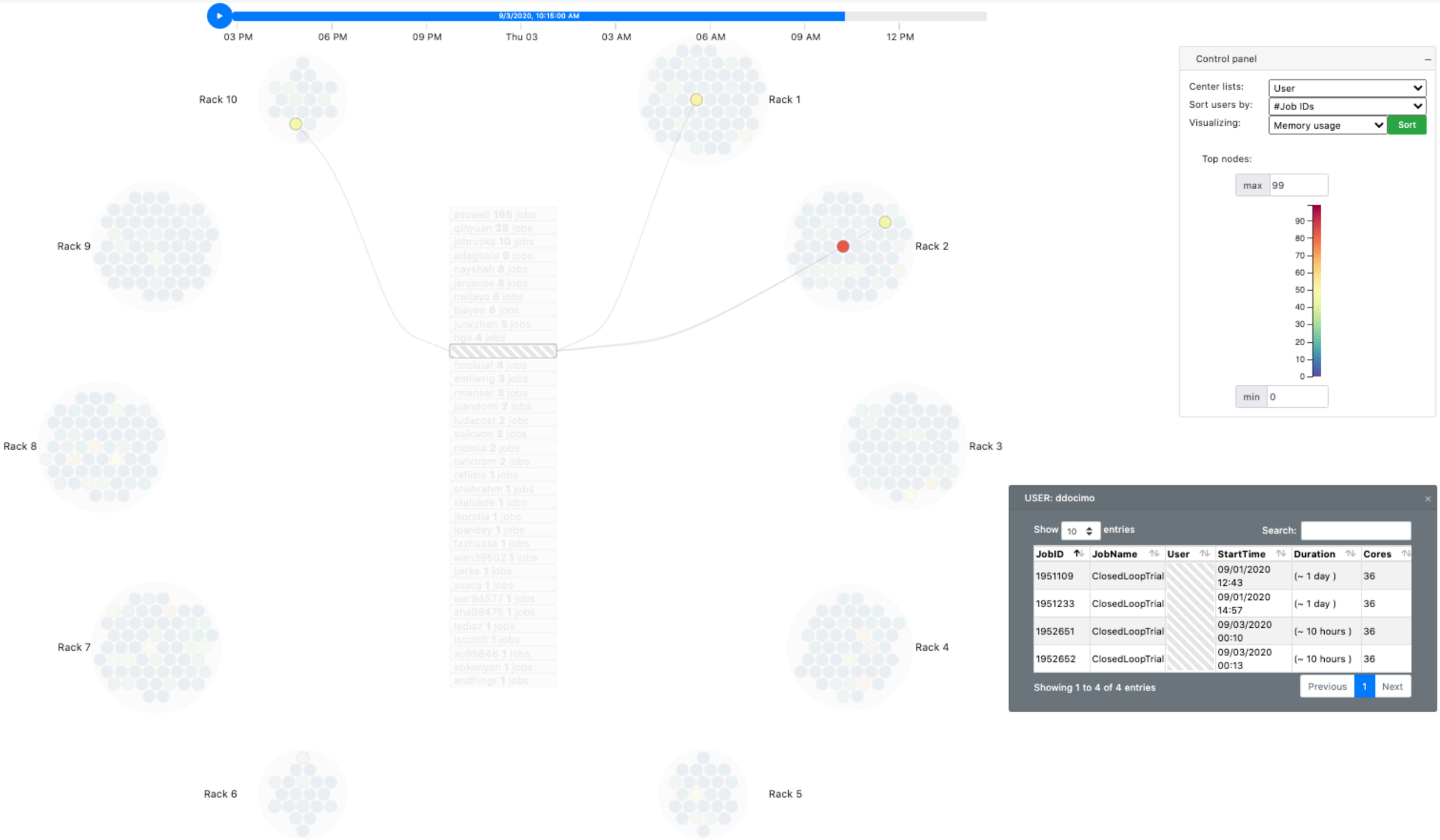

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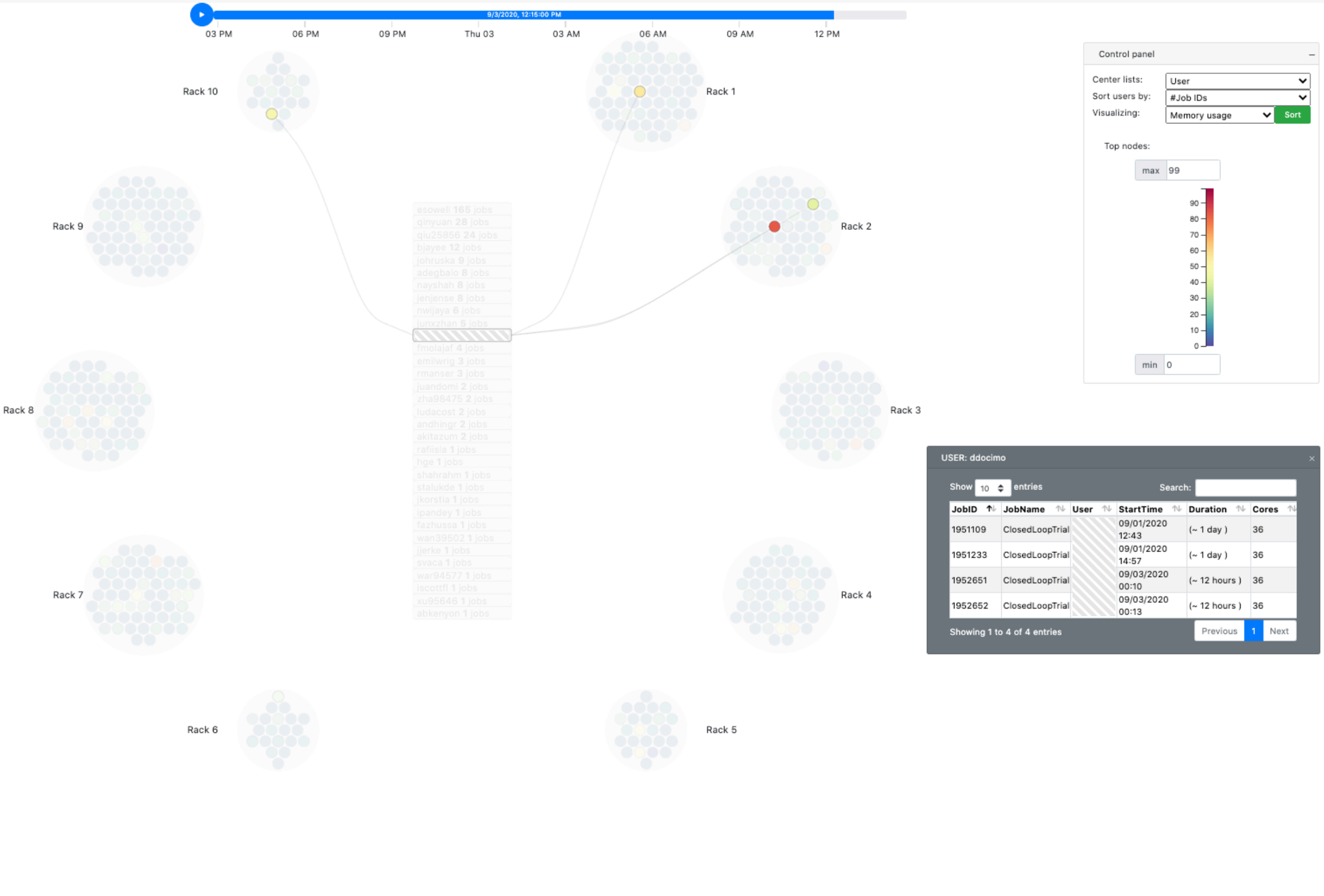
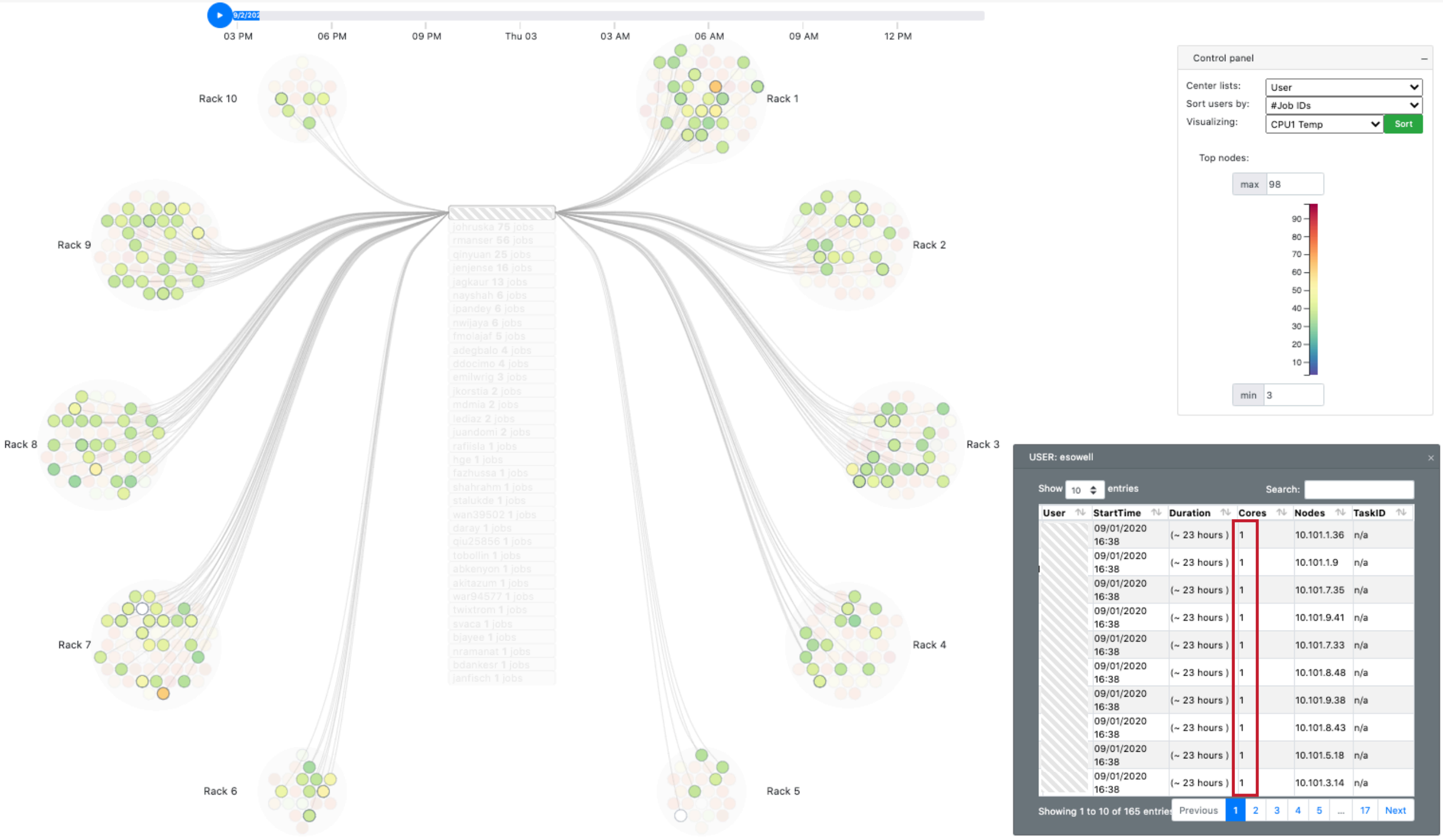


Case 2: Job script may not be well configured

PROPOSAL-1 - OBSERVATIONS



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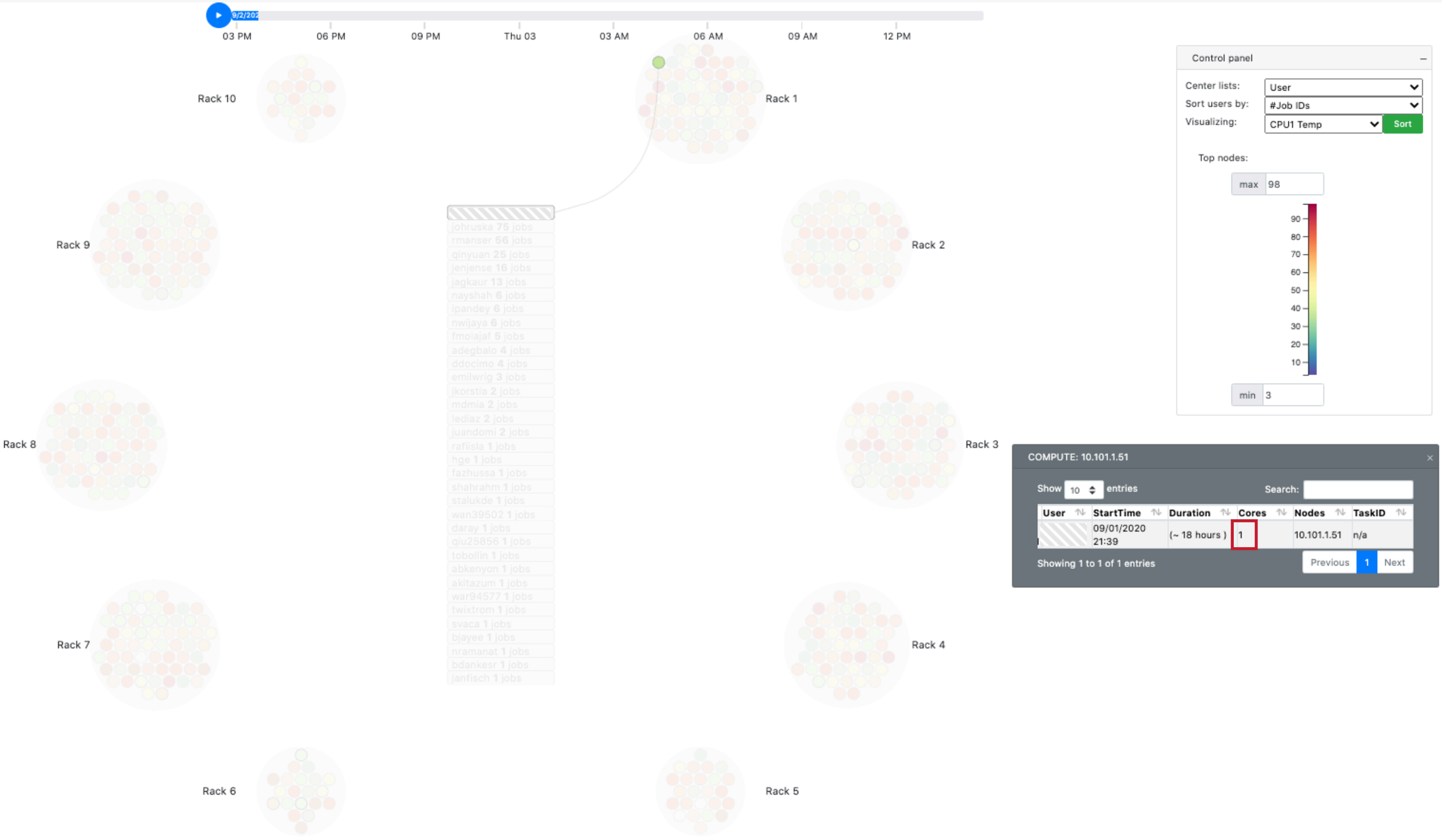

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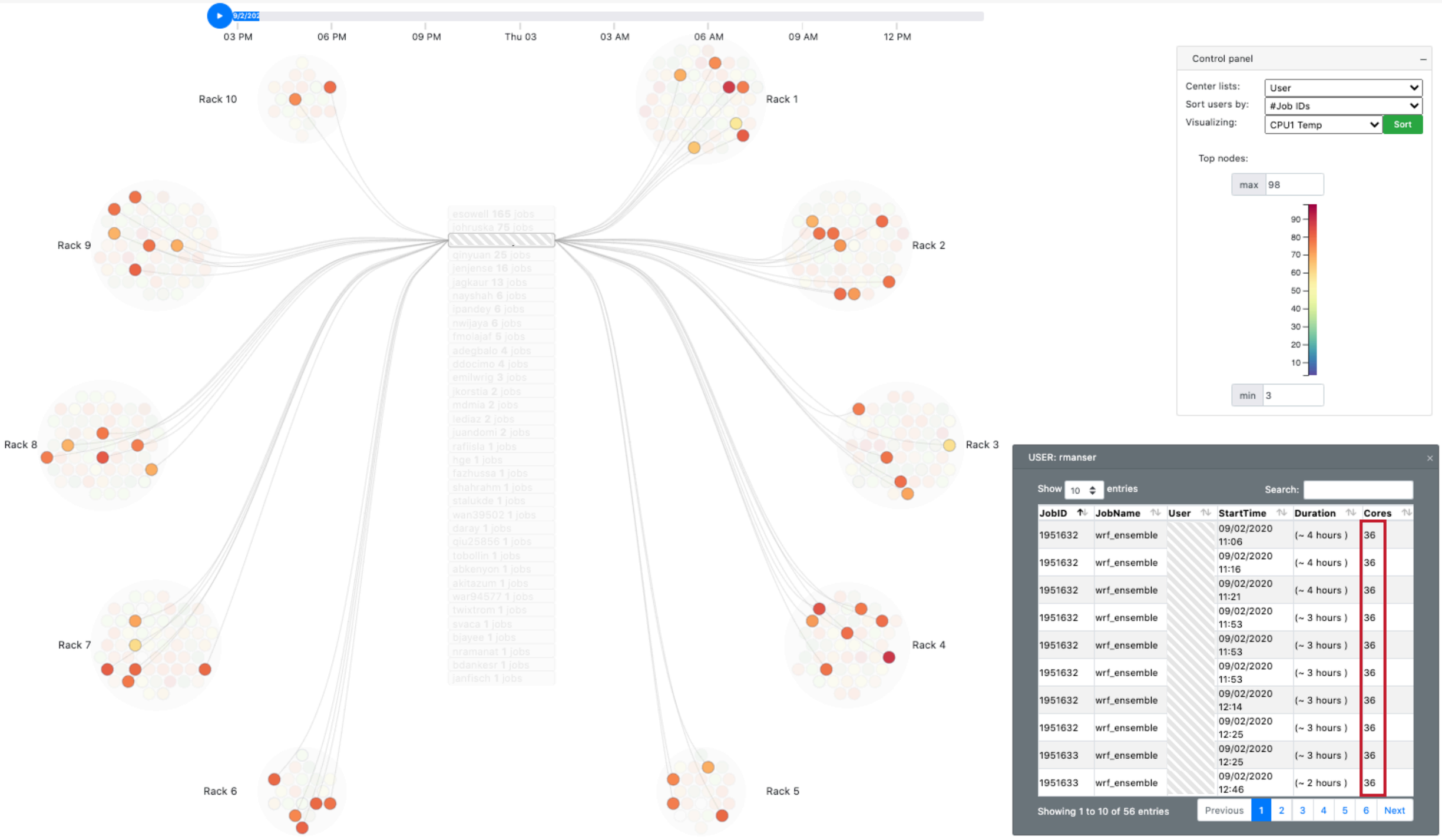

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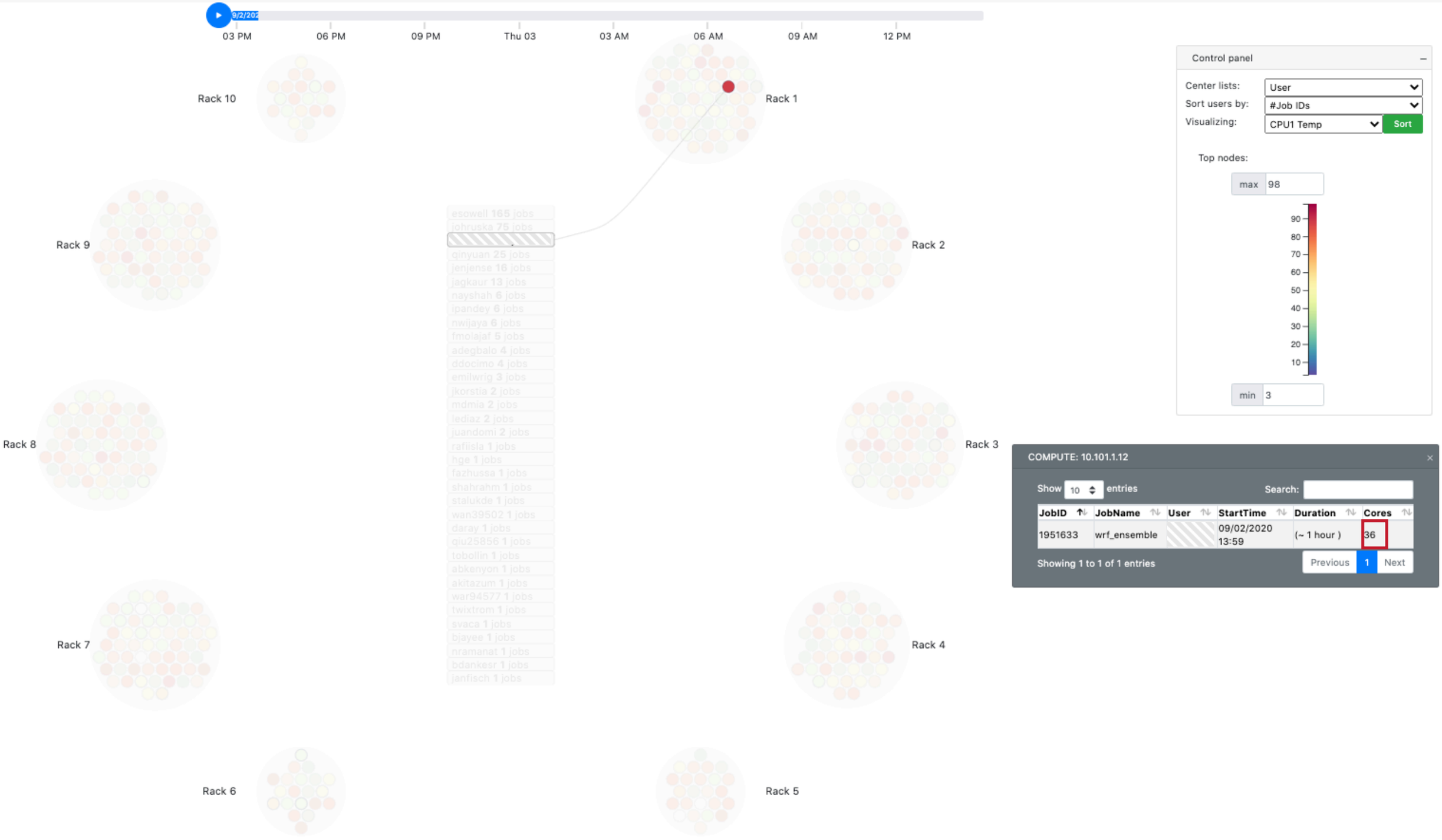

Detect Abnormal Applications in HPC Systems in Real Time

Opportunities and Challenges:

- Anomaly detection allows to cancel abnormally running applications thus increasing the overall efficiency of resource usage
- Automated anomaly detection is still a relatively unexplored area in HPC field
- Anomaly detection will probably be necessity for future Exascale HPC
- No clear criteria for anomalous behavior and the criteria can differ significantly for different computing system
- Anomaly detection is difficult due to the big scale of the systems

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Job Configuration Recommendation System

- A previous procedure before the job submission verifier
- A user needs to know the system-specific information, such as the supported software packages and how many compute cores are appropriate for a specific job
- A user is usually requested to estimated the runtime of a job for scheduling
- The estimation is very inaccurate and have adverse impacts on scheduling performance

Ahmadian, Misha, Eric Rees, Yu Zhuang, and Yong Chen. "Reducing Faulty Jobs by Job Submission Verifier in Grid Engine." In *Proceedings of the Practice and Experience in Advanced Research Computing on Rise of the Machines (learning)*, pp. 1-8. 2019.

Zhang, Hao, Haihang You, Bilel Hadri, and Mark Fahey. "HPC usage behavior analysis and performance estimation with machine learning techniques." In *Proceedings of the International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA)*, p. 1. The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), 2012.

QUESTIONS?/COMMENTS?