Integrated Data Center Power and Cooling Analysis

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About the project

- The need for large scale computing continues to rise, and companies are turning to data centers to meet those needs

- Large clusters of servers are expensive to run, and expensive to cool

- Cooling hardware (especially chillers) consume lots of power and are subject to physical wear

- Data center operators need access to as much information as possible!

About the data

- Data for this project was collected from a number of sensors at the PNNL Energy Smart Data Center
- 8 server racks (1 network, 2 air cooled, 5 liquid cooled)
- Two application loads (high density / low density)
- Three different application test runs

Approach 1: Analysis with Scripts

- A set of custom tools was written to work with sensor data provided in CSV format

- Mostly Haskell with calls to Gnuplot (earlier prototypes also used C, Perl and shell)

- Generates a complete report including tables and graphs

- Calculates and graphs metrics such as temperature deltas, COP (coefficient of performance) and power usage

# Analysis with Scripts (cont.)

- Cluster analysis based on output of metric calculations
- Uses ELKI, an open source data mining tool with many customizable options
- We tried clustering on various metrics, including temperature deltas and loads
- We developed a method to overlay cluster information over previously generated graphs
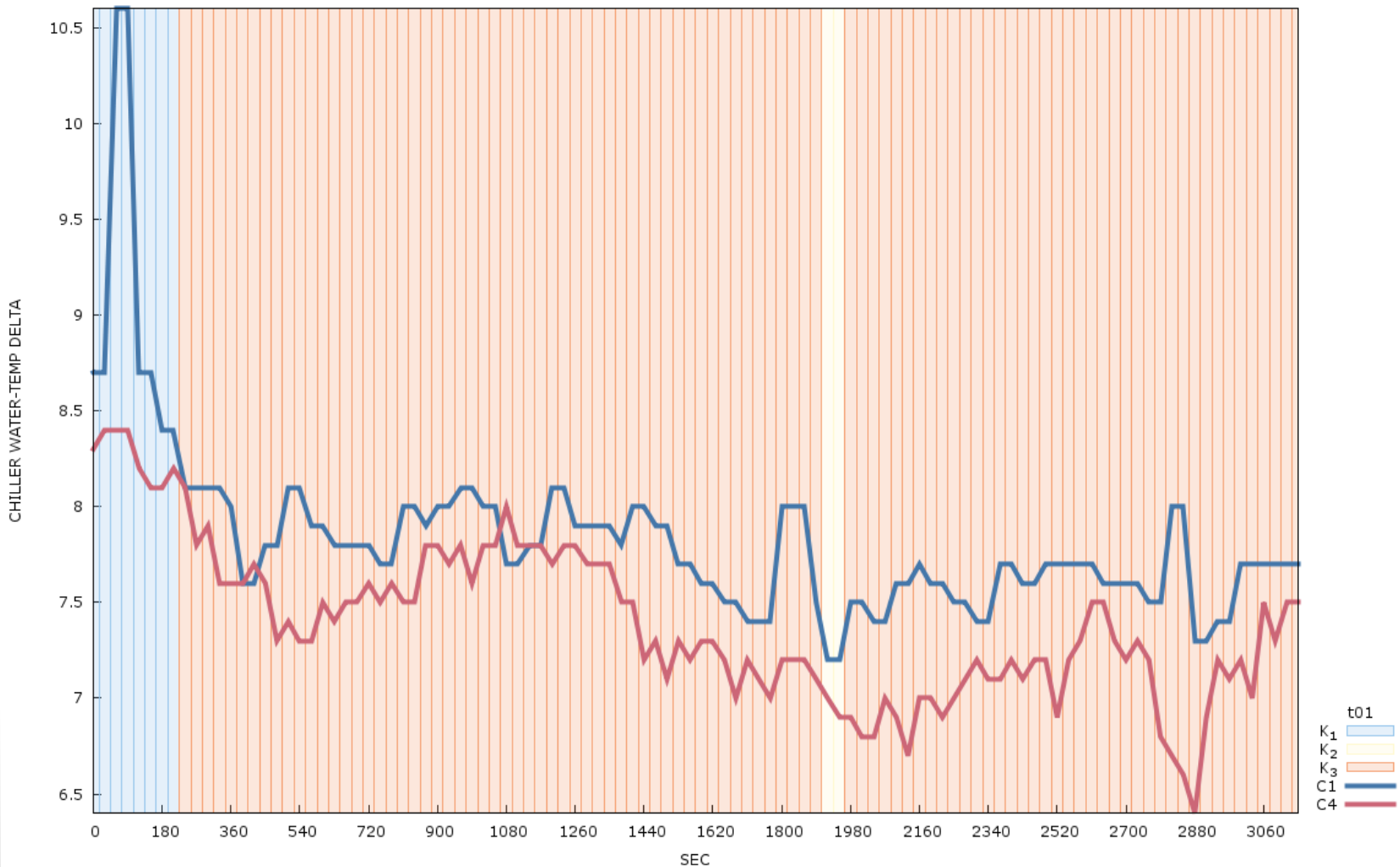
Time-correlated cluster graphs

- On the left – low density chiller temp data
- On the right – time-correlated chart
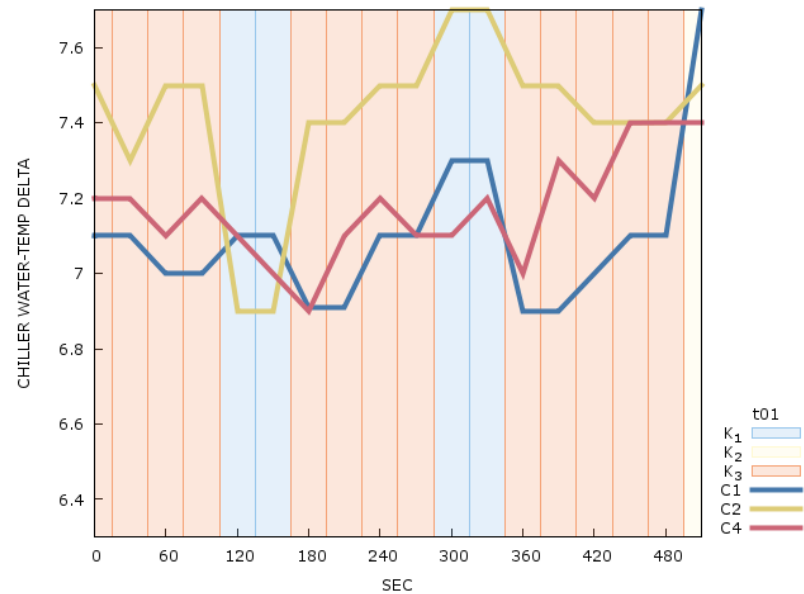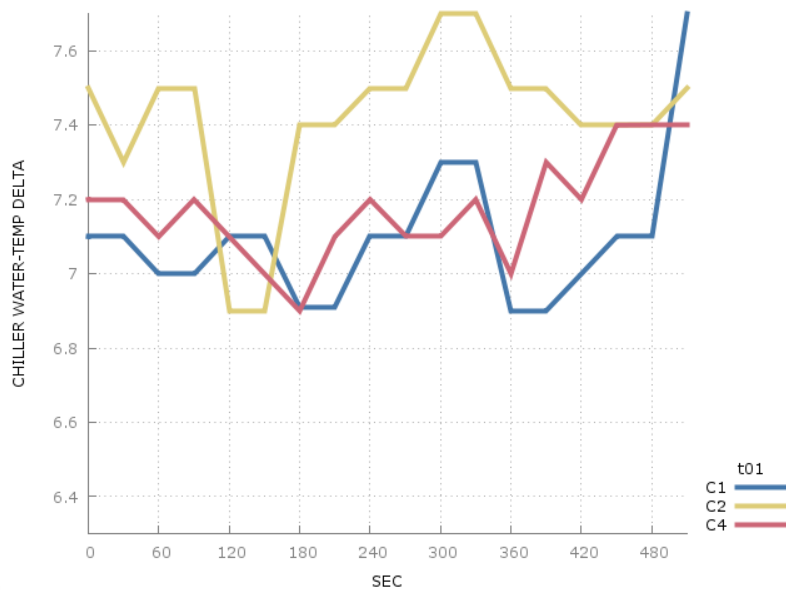
Time-correlated cluster graphs (HD)
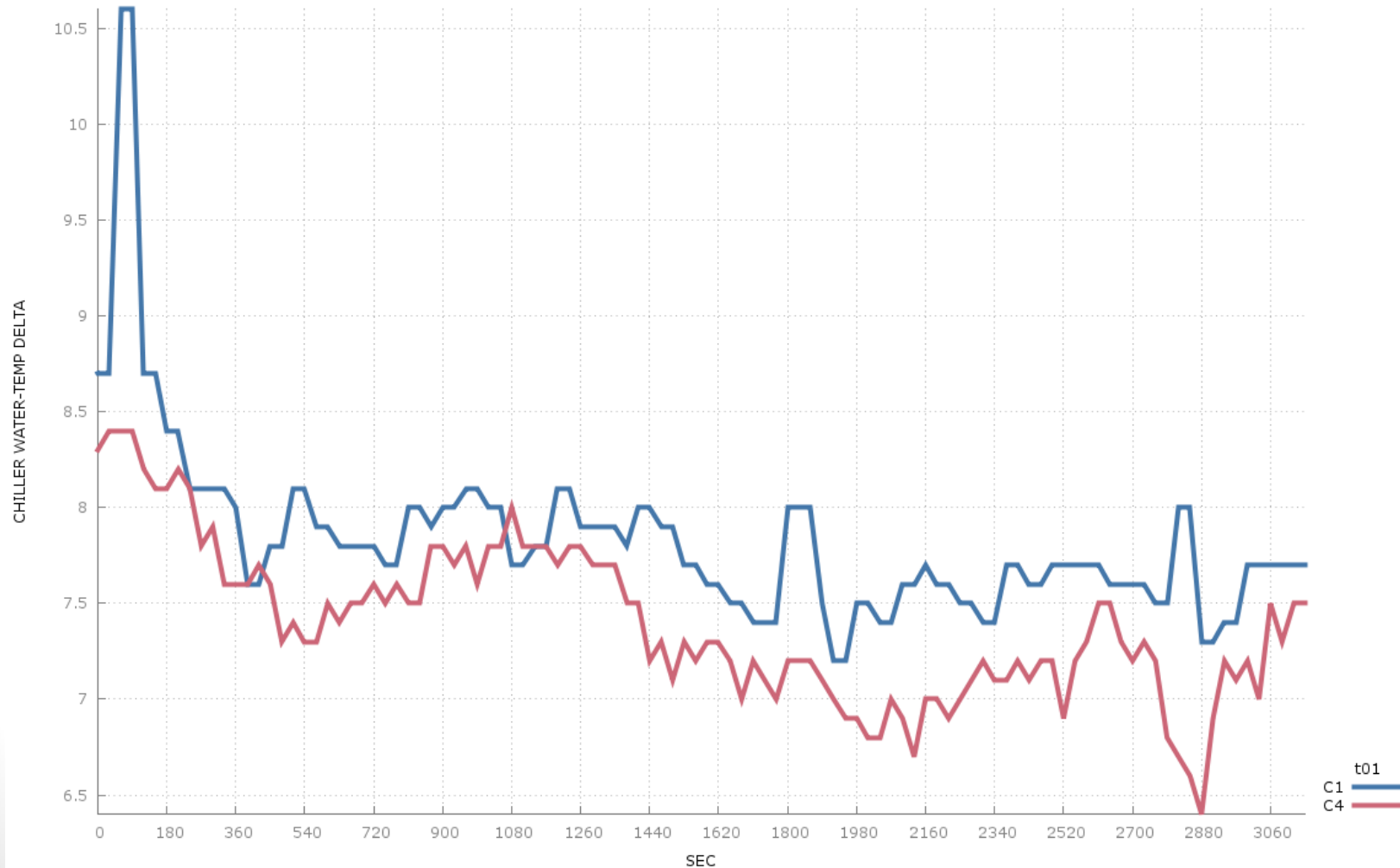
Time-correlated cluster graphs (HD)

Perftrack

Perftrack (cont.)

Limitations / Future work

- Need more (and more accurate) data!

- Full integration of script work into Perftrack
- Modification of scripts to support direct connection to FRED in place of CSV file access
- Experiment with motif-based cluster analysis (this would require more data)