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Computational Experiences and Challenges at MISO

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Opportunities

- **Approaches to improve the efficiency of resources commitment and dispatch**
  - Enable participants to offer the actual capability of resources into the markets
  - Methods to take uncertainty into account
  - Optimize energy transfer across the seam
- **Allow price signals to reflect costs incurred when participants can react and drive efficiency**

Committing and Dispatching CC Resources

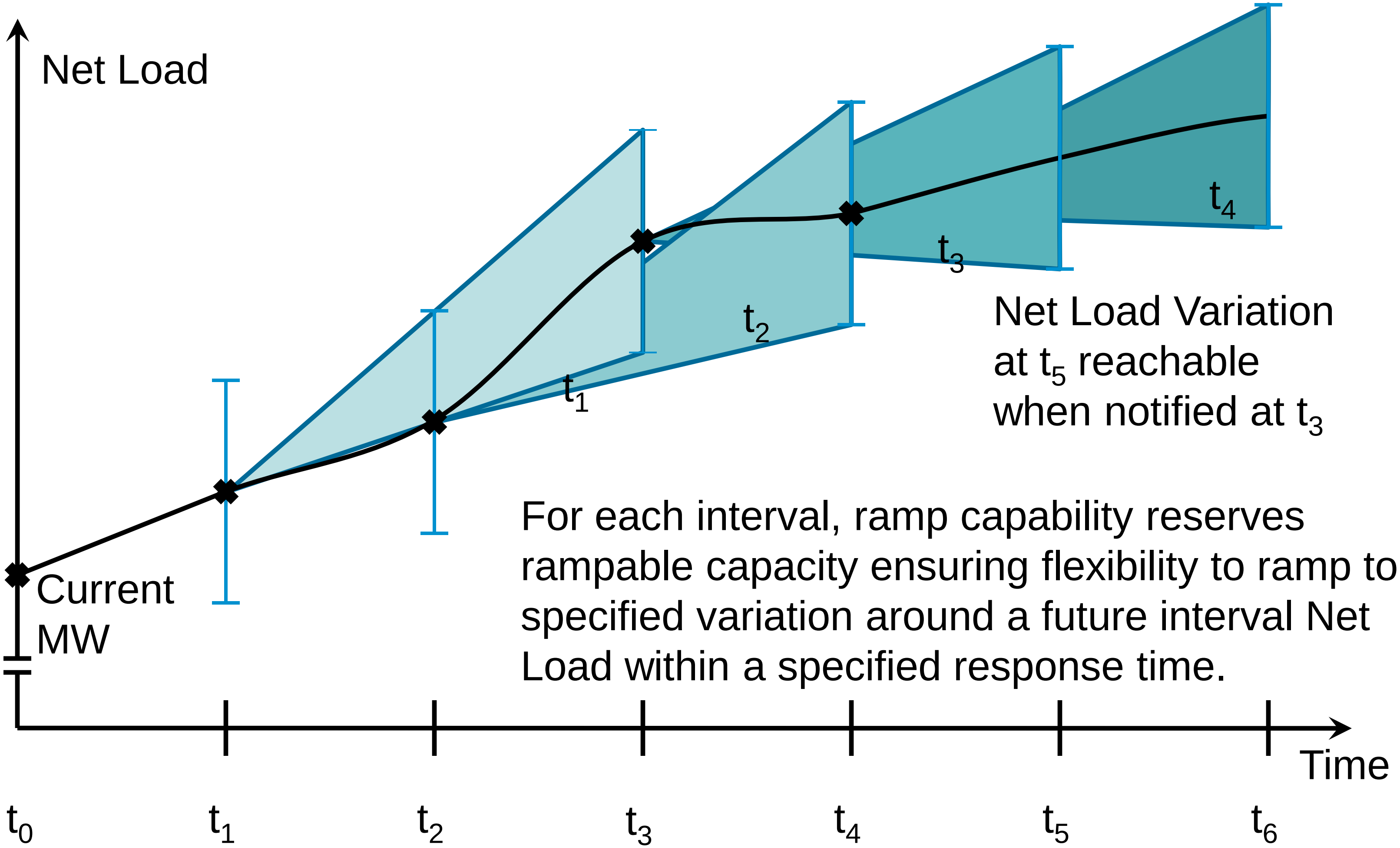
- **Modeling a CC Group represents a challenge for the MIP based unit commitment and scheduling applications.**
  - Unit commitment decisions and dispatch instructions have to be operationally feasible.
  - They should also be optimal in terms of minimizing the overall objective (cost) function.
- **MISO is conducting proof-of-concept testing of commitment and dispatch engine developed by Alstom**
  - Computational performance is critical
  - Offer flexibility and profitability are important for CC owners
  - Should ultimately achieve cost savings as well

MISO

Locational Ancillary Service Procurement

- **MISO seeks to ensure deliverability of reserves procured in the day-ahead and real-time markets**
  - Reserve Requirement and deployment on zonal basis
- **Recently implemented approach to enforcing post deployment transmission constraints**
  - Model impact of reserve deployment on transmission constraints
  - Does a better job than manually disqualifying resources
- **MISO is investigating moving to procurement of reserves on a nodal basis**
  - Co-optimization process will deploy the reserves on a nodal basis using independent decision variables

Ramp Capability for RT Dispatch



For each interval, ramp capability reserves rampable capacity ensuring flexibility to ramp to specified variation around a future interval Net Load within a specified response time.

Extended LMP

- **Market Clearing Price achieved by SCUC dual**
  - Considers start-up and no-load costs typically ignored by conventional SCED dual
  - Prices the effect of the constraints
  - Requires solution algorithms for non-differentiable convex programming problems.
- **Practicality considerations**
  - Justify implementation cost against desired precision
  - Ease of adjustment to achieve other policy goals
  - Computational performance and stability
- **Developed convex hull approximation**
  - Selective inclusion of start-up and no-load costs in SCED dual
  - Solve modified linear programming problems

Reliability commitment and Uncertainty

- **Ideally, we want to commit resources taking into account the uncertainties around future conditions (Demand, NSI, Intermittent Resource Availability)**
  - Minimize cost of committing slow start resources before uncertainty is resolved, plus, expected cost of committing and dispatching fast start resources after uncertainty is resolved
- **Challenges**
  - Problem size grows exponentially in number of states and decision variables as number of stages grows (time steps)
  - It can be difficult to set realistic probabilities on the states
- **Simplification approach may use two stages and ignore cost of fast start resources in stage 1 optimization**
  - Form of robust optimization
  - Similar to MISO's current formulation

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