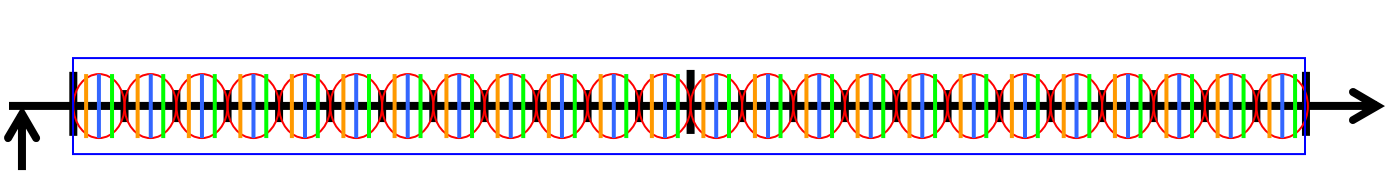
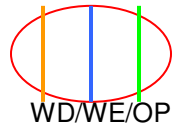
Performance of the Annual CRR Auction Calculation & Mitigation Strategies

November 29, 2006

*Current Annual Auction Implementation at ERCOT**

- **3 time-of-use blocks**
  - Weekday peak (WD – yellow in images)
  - Weekend peak (WE – blue in images)
  - Off-peak (OP – green in images)
- **One-month or consecutive multiple month strips for the next two years**
- **The time-of-use blocks and the monthly strips will be auctioned simultaneously**
- **3 × 2 ×12 = 72 periods to be solved simultaneously**



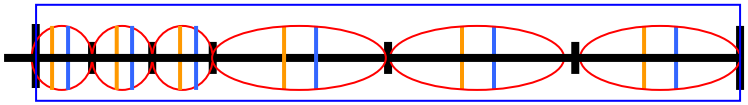


Simultaneous Solution

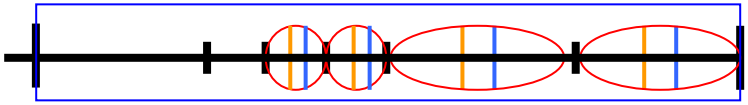
* According to August 2006's Nodal Protocols

Implementations at Other ISOs & RTOs I

- **PJM**
  - Two time-of-use products simultaneously for both monthly and annual auctions
    - Peak
    - Off-peak
  - Monthly Balance of Planning Period CRR/FTR Auctions
    - Offers CRRs/FTRs for the next month
    - Several additional auction periods
      - Remaining months in the current planning period
      - Any complete planning period quarter remaining in the planning period



Notes:
1. This figure applies to the auction at the beginning of the planning period
2. As the planning period window shortens, the # of periods decreases as well, as shown below



Implementations at Other ISOs & RTOs II

- **Midwest ISO**
  - Two time-of-use products decoupled
    - Peak
    - Off-peak
  - Four seasonal auctions decoupled (some auctioned before the season, some together)
- **CAISO**
  - Two time-of-use products decoupled
    - Peak
    - Off-peak
  - Four seasonal auctions decoupled, all auctioned at the same time prior to the beginning of the annual term

Assumptions for Performance Estimates

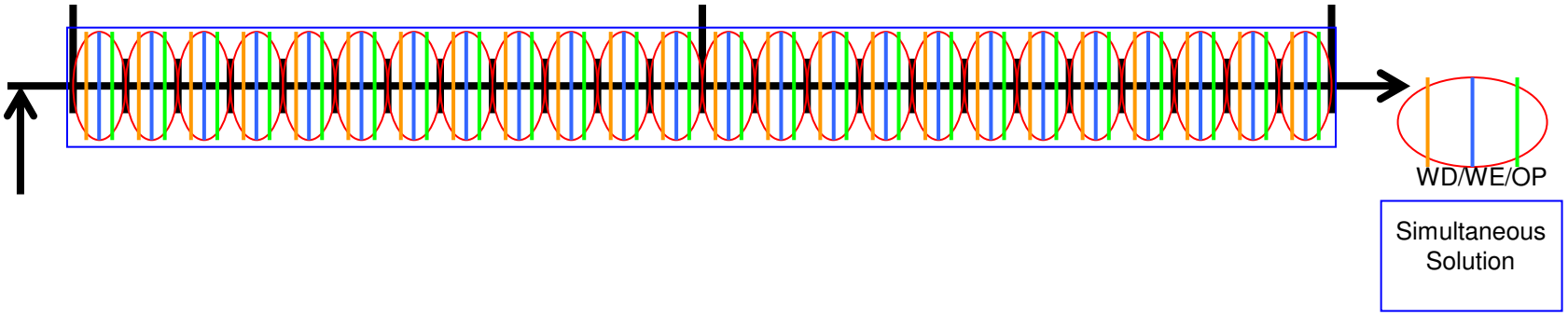
- **Network**
  - 5,000 number of buses
  - 7,000 number of branches (100% monitored)
  - 3,000 contingencies
- **Market**
  - 800 sources and sinks
  - 100,000 bids and offers (75% options and 25% obligations)
  - 30% of 24-hours and 70% of one time of use bids
  - 15% of bids spanning a single slice
  - 30% of bids spanning one season (three slices)
  - 55% of bids spanning all two years (24 slices)
- **Hardware**
  - IBM P550 with 8 processors
  - ERCOT development servers are used for running simulations

Calculation Time Sensitivities

Factor	Assumption	Impact on Calculation Time
Buses	5000	+ Medium
Branches	7000	+ Medium
Contingency	3000	+ Medium
Number of binding constraints	Most bids and offers were assumed to go from Generators to Loads (limiting the number of binding constraints)	+ High
Hedge Type	75% options and 25% obligations	+ Medium
Number of periods	3-72	+ Very High
Number of Processors	8	- Medium

Processing Time Estimate for the Current Annual Auction Implementation at ERCOT

- **Proposed model will be extremely time consuming to solve as defined (1300 hours or almost 8 weeks)**



Calculation times with respect to some parameters

	Computation Time in Hours (Simulated)
Contingencies	
500	1088
1000	1131
2000	1218
3000	1300
Hedge Type (% Options / % Obl)	
75/25	1300
50/50	1228
25/75	1152
10/90	1106
Periods	
12	63
36	283
72	1300

Strategies to Reduce Optimization Time

- **Two strategies have been identified to reduce optimization time (with respect to period parameter)**
  - Increase Duration of Periods
  - Decouple Optimizations
- **Another option is to eliminate one of the time-of-use blocks, treating all hours as either On Peak or Off-Peak.**

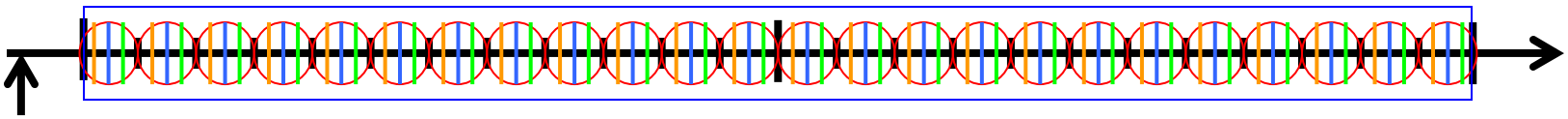
Strategy I - Increase Duration of Periods

- **Models representing periods in later timeframes will have less predictable short-term grid conditions**
  - Seasonal/annual models are more readily available than monthly for future periods
  - The further in the future represented by one model, the greater the probability that grid conditions will differ from forecasted
- **CRR Account Holders will only be able to submit bids and offers for the entire period**
- **ERCOT CRR System will not require auction periods to have the same duration*, allowing CRR Market Operators to configure the period being auctioned**

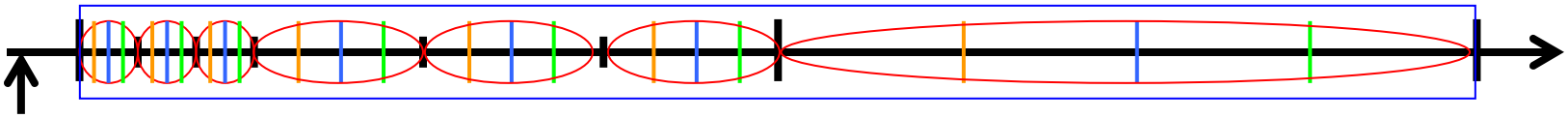
* Standard i-HEDGE feature

Possible Implementations for Strategy I

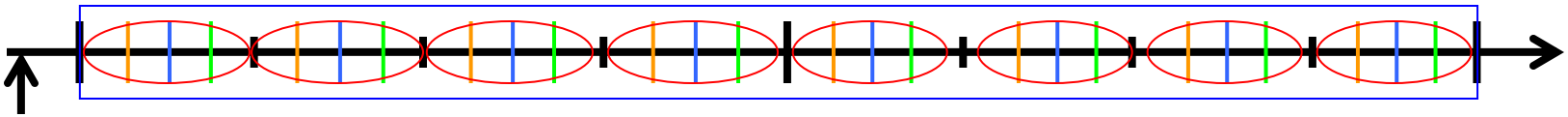
a. Model according to August 2006's Nodal Protocols (1300 hours)



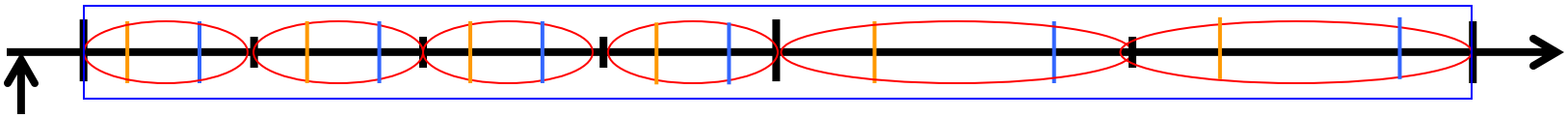
b. Decreasing resolution in time (122 hours)



c. Seasonal Models (147 hours)



d. Seasonal & Semi-annual Models with two time-of-use blocks (60 hours)



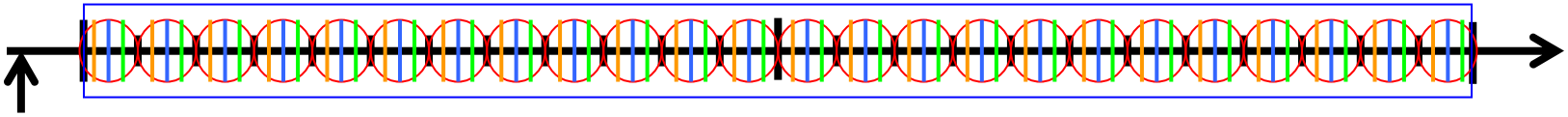
Strategy II - Decouple Optimizations

- **The asymmetry in available network capacities between first and second year models may result in unexpected bid awards**
  - Network Capacity
    - Uncertainty will increase as the timeline moves further into the future
  - Previously awarded CRRs
    - There will be existing CRRs for the first year (from previous year's annual auction)
    - There will not be any existing CRRs for the second year
- **ERCOT CRR System allows CRR Market Operators to configure as many markets as required***
- **Need to determine what is more valuable**
  - Long-term products (i.e., access to CRRs in year 2)
  - Single coverage over long periods of time (i.e., 2-year CRR)

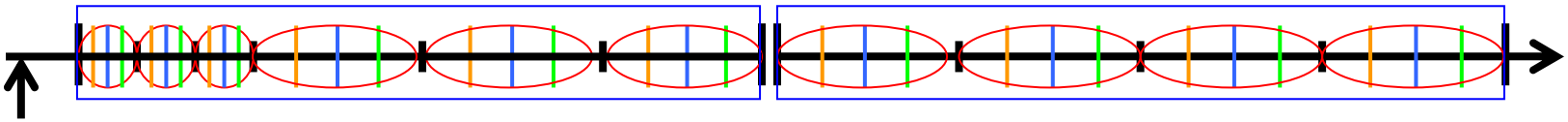
* Standard i-HEDGE feature

Possible Implementations for Strategy II

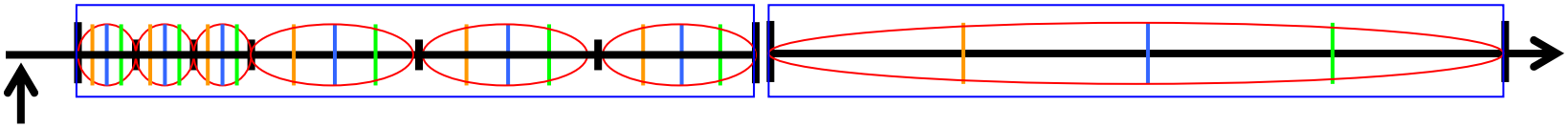
a. Model according to August 2006's Nodal Protocols (1300 hours)



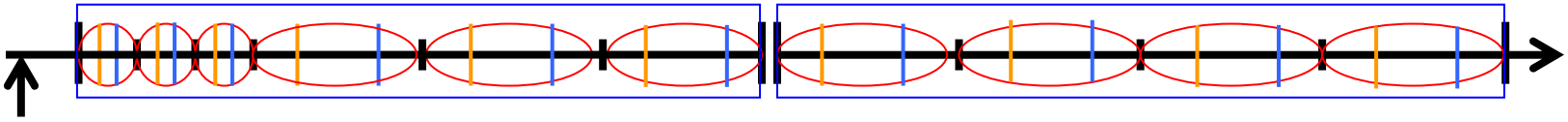
b. Monthly and Seasonal with two optimizations (100 hours)



c. Decreasing resolution with two optimizations (100 hours)



d. Option b with two time-of-use blocks (60 hours)



Next Steps

- **Direction from TPTF**
  - Discussion on the alternatives
  - A decision process to be put in place
- **Recommend reducing the number of periods being optimized**
  - Eliminating one of the time of use blocks
    - 7 x 16 on peak (merge Weekday and Weekend)
    - 7 x 8 off peak
  - If seasonal products are acceptable, adjust the annual auction time so that seasonal case represents Dec – Feb, Mar – May, Jun – Aug, and Sep - Nov.