



Market Restricting Policies Due to Outdated Technology

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Outline

1. Problem & Consequences
2. How we arrived here
3. Recommendations for improvement
4. Summary



Problem

Observations regarding market restrictions:

- Reduction of the number of tradable nodes
- FTR Options and Point to Point transactions are:
 - Restricted usage
 - Not properly implemented
 - Not implemented at all
- Outages are improperly modeled in auctions (sequential vs simultaneous)
- Lack of zero impedance lines modeled to emulate limits on bus-splits
- Limited number of monitoring lines and transformers



Consequences

Less liquidity

- Reduced number of bids in FTR & Day Ahead markets
- Inability to properly price constraints and consequently LMPs

Increased cost to hedging

- Harder to pinpoint constraints precisely
- Lack of products available to mitigate risks

Decreased auction revenue

- More conservative bidding due to increased risks of counterflows and exposure to unintended constraints



How we arrived here

At the time most ISO's were created:

- Power system software was designed to be used in a single mainframe with one or few processors
- The software was not much different than what was used since the 60's
- ISOs participation was much smaller in size
- Distributed computing was in its infancy and not fully developed
- As serious systemic problems arose, "band-aid" solutions were implemented with no long term planning



Advances in Technology Over the Last 20 Years

- Computer cores are smaller and processors have multiple cores per chip
- Computers have several gigabits of RAM
- Creating computer clusters using off-the-shelf components are easy to build
- Computer software for batch processing in clusters are becoming robust and freely available (e.g. Apache, Spark)
- Cluster system using a large number of off-the-shelf computers is very robust: the failure of one or more individual machines barely modify the performance
- The machines can be fixed/swapped whenever is convenient making it much cheaper to build and maintain
- No need of full replica hardware
- The workload can be shared by different applications



Recommendations for improvement

A new approach is needed: Decompose the problems to solve them in a distributed manner

- Upgrade system hardware to make the ISOs ready for the next 20 years of operations
- Undertake a comprehensive redesign of the software to be able to perform in a cluster environment and to make problem solving decentralized
- Solve core power system problems distributively
- Solve optimization problems using decomposition methods (Benders, Lagrange, Dantzing-Wolfe)



Advantages of Our Proposal

Resiliency:

- This system design could provide and maintain an acceptable level of services in the face of some individual machine faults
- In case massive failure, due to the distributed nature of the solution algorithms, “off-the-shelf” services could be used (Cloud Service Providers)

Performance:

- Performance in orders of magnitude can be achieved by re-writing algorithms to take advantage of multiple cores

Scalability:

- Because the system is distributed across different machines, they are inherently scalable
- No need to restrict trading nodes, monitored elements, number of bids, etc.



Advantages of Our Proposal (continued)

Economy:

- The same cluster could be used to solve different algorithms, load balancing the usage in each node
- Hardware upgrades can be done progressively

Better tools for participants to hedge:

- FTR Options are notoriously expensive to calculate...not with a cluster

Increased frequencies:

- FTRs could be run daily for balance of the month or balance of the week
- DA-like solutions could be run multiple times as opposed to once a day



Our experience

The purpose of this presentation is not to demonstrate a proof-of-concept approach. We make these recommendations based off of our own research and experience. At Vitol we have built our own cluster machine to:

- Run contingency analysis in a fraction of a second
- Run a whole year hourly DA simulation of a market in a few minutes
- Price FTR options



Summary

- If ISOs adopt new infrastructure and technology improvements, they will improve market quality, be able to add new products or services, and in some cases eliminate market restrictions...markets should not get restricted due to technology limitations
- Unlike most other markets, the electricity market heavily depends on optimization software for its existence
- Most of these issues can be resolved with a new infrastructure and software
- The USA demand is approximately a 4,000 TWh per year...each 1 cent/MWh of achieved efficiencies produces annual savings of \$40 million each year
- Resiliency, better performance and lower costs could be achieved with our proposal
- It is definitely doable! We are doing it!

