

System Operations
Power Flow Study Automation (RD 46) R & D
Distributed Processing Timing Results

June 23, 2010

Overview

- Background
- Bench Marking
 - Distributed & Multi-processing
- Conclusions

Background

- BPA and PowerWorld
 - ATC Tool use to determine thermal limited path System Operating Limits (SOLs)
- Currently single threaded works on one CPU
 - Uses 100% of a CPU
- Time consuming to get limits
 - Based on the path, time takes up to 12 hours.
- Why we need it?
 - Timely response to unplanned outages
 - Speed up the seasonal studies

Bench Marking

Test Conditions and Results

- Hardware
- Test cases
- Contingency analysis results
- ATC tool results

Hardware Environment

● Servers

- Processors – Quad core AMD Opteron™ 2087, 2.80 GHZ (2 processors)
- Memory – 16.0 GB RAM
- Servers – 6
- Installed on a separate network
- Operating system – Windows server 2008 Release 1 (Vista)

● DELL M 6500 Laptop

- Intel Core I7 Q720 @ 1.6 GHZ
- Memory 4GB
- Operating system XP-64

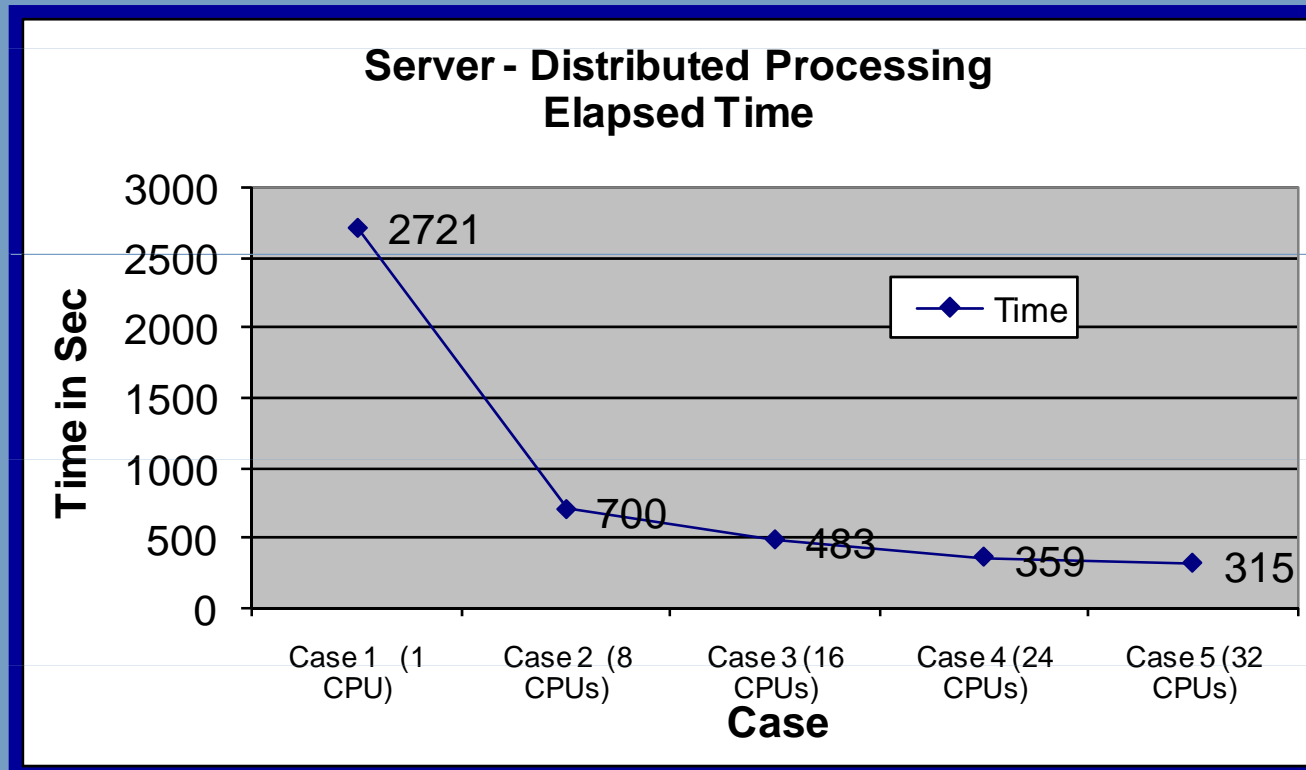
● HP Elite Book 8730

- Intel Core™2 Extreme
- CPU Q9300 @ 2.53GHZ, 4GB of RAM
- Operating system XP-64

Test cases

- **Contingency Analysis**
 - Contingencies – 3233
 - Batch size - no. of contingencies per processor 20
 - SE case Jan 8th 2010 23:16 hour case full topology model
- **ATC**
 - **South of Allston**
 - Summer 2007 WECC case
 - 64 scenarios
 - **Northern Intertie**
 - Winter 2010, 251 contingencies, 12 generation pattern and 5 temperatures (60 scenarios)
 - North to South winter heavy load cases

Contingency Analysis - Server



Case 1: Single process (1 CPU)

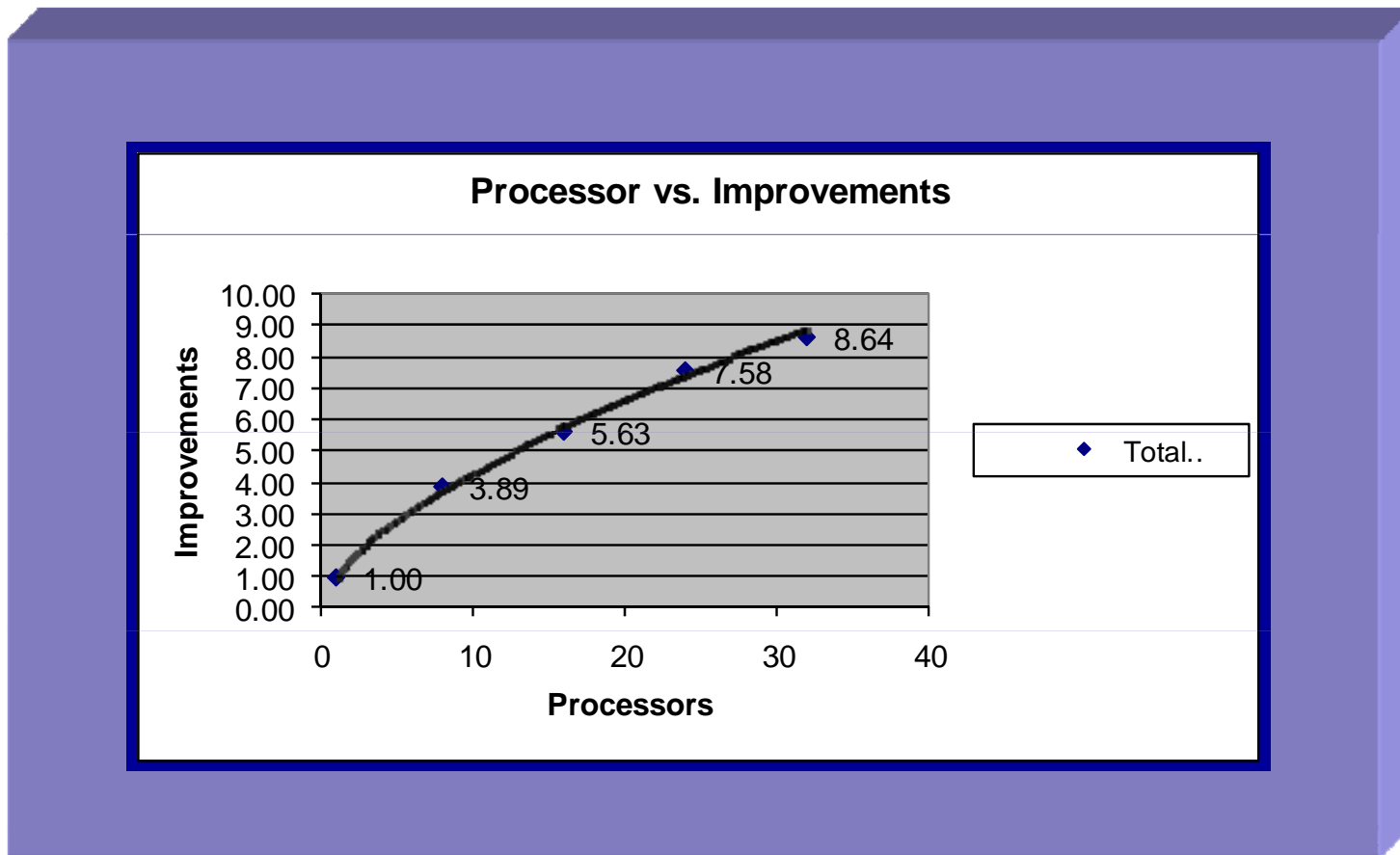
Case 2: 8 Process on Dual Quad single machine (8 CPUs)

Case 3: 8 Process on 2 Dual Quad (16 CPUs)

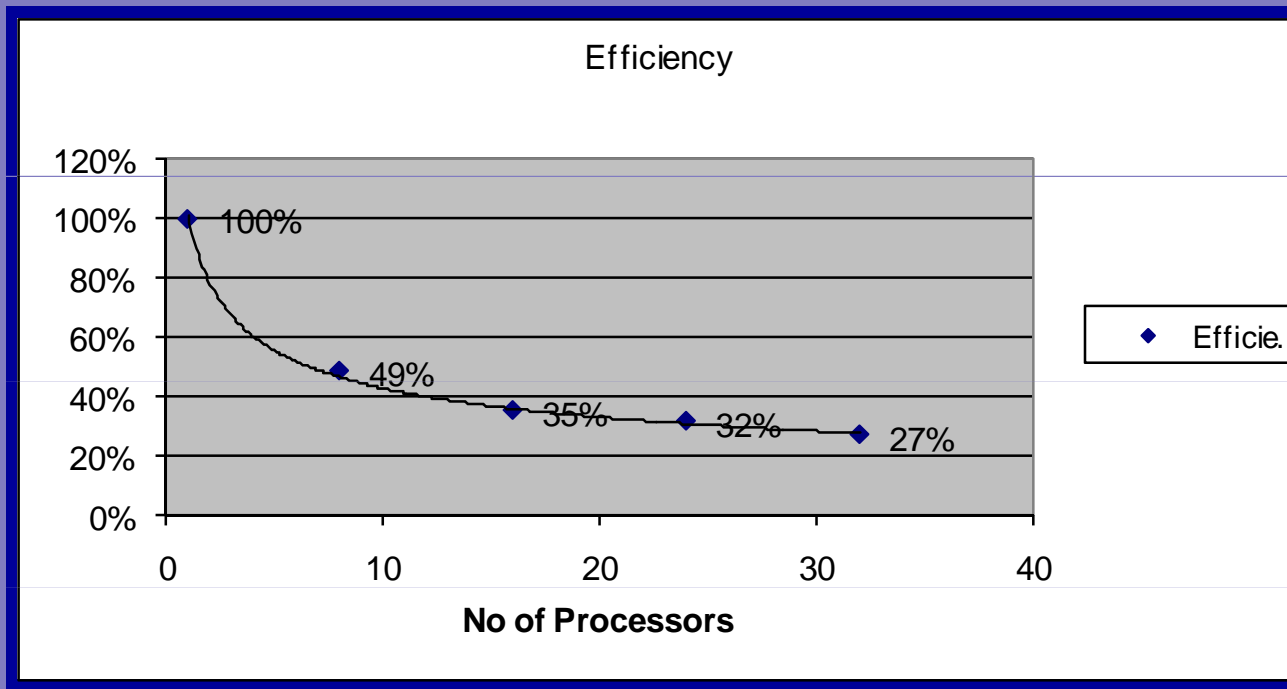
Case 4: 8 Process on 3 Dual Quad (24 CPUs)

Case 5: 8 Process on 4 Dual Quad (32 CPUs)

CA – Server Performance Improvements



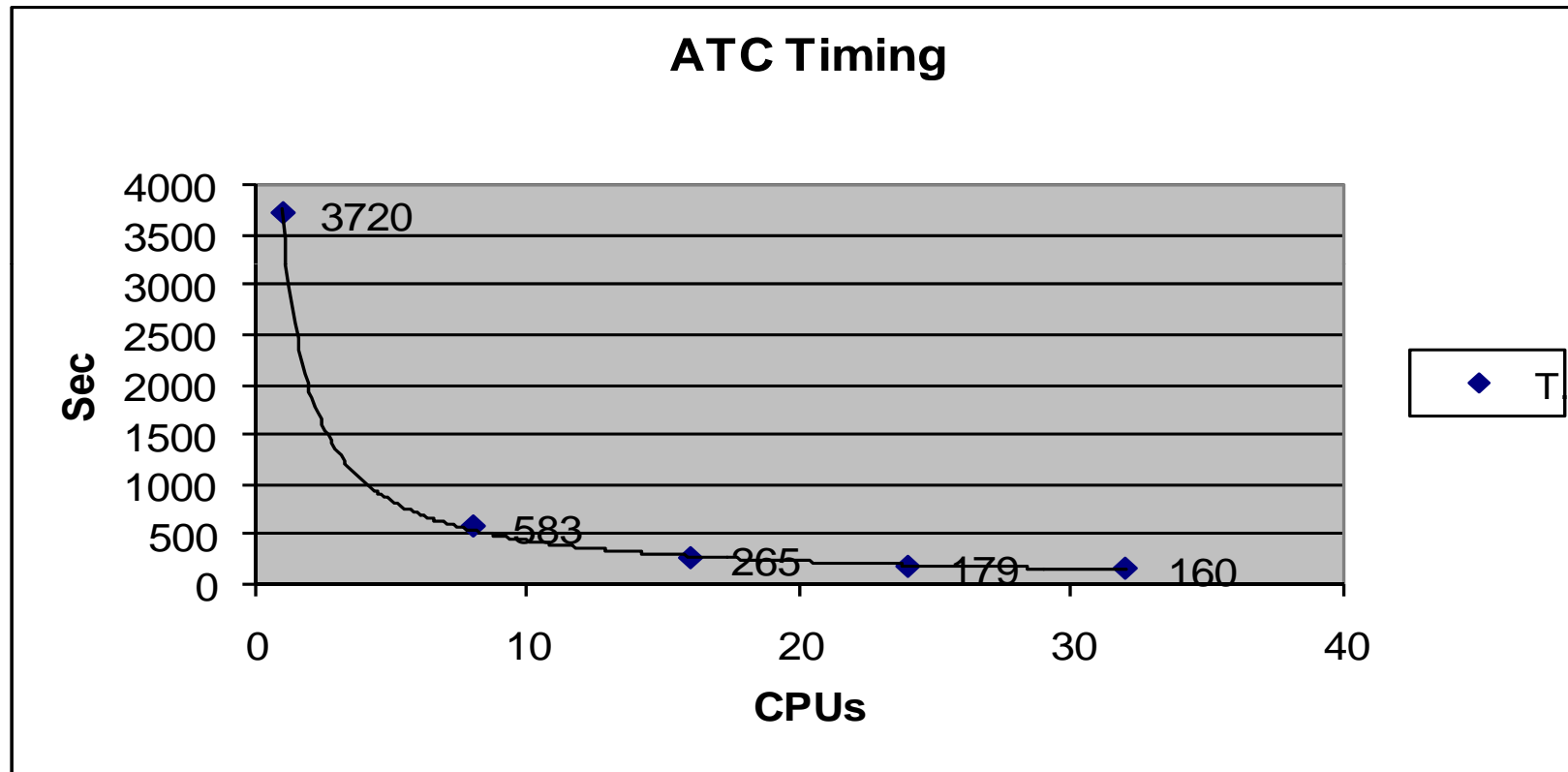
CA – Server Efficiency



Efficiency = % Performance Improvement compared to one CPU/No of CPUs

ATC Analysis Performance

SOA case results

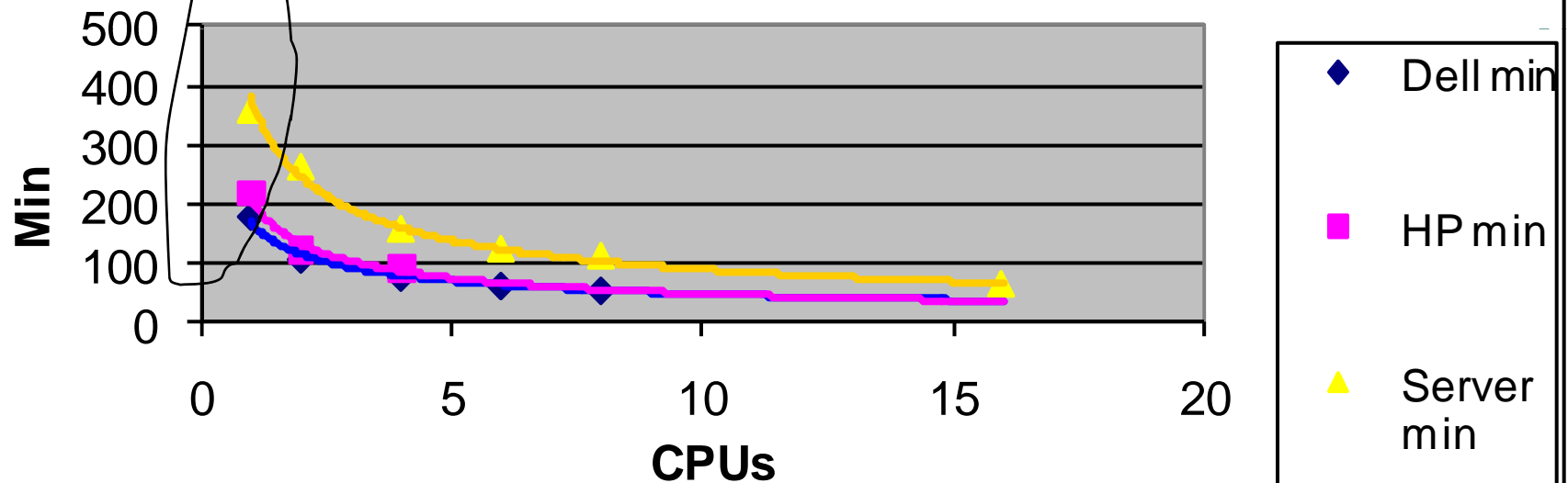


ATC Analysis Performance

Northern Intertie case results

Single CPU no distributed processing

Comparision



Necessary Improvements

- Networked multi-processor cluster challenges
 - Networked issues are related to permissions / security (CIP)
- Queuing
- Improve
 - Error reporting
 - Populate results as it completes
 - Better debugging
- Abort (Orphan process)
- Script commands

Conclusions

- PowerWorld Distributed computing function improves **elapsed time** for ATC and contingency analysis.
 - Performance improvement of 10 times with 3 servers using 8 processors (24 CPUs).
- PowerWorld multiprocessing on a single machine with multiple CPUs is ready for production use
- Performance can be improved by
 - Better CPU
 - Cluster
 - Improve efficiency
 - Faster memory
- Improve software efficiency



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