sparsix corporation

Mathematics empowered

Sparsix Overview

- Sparsix is a computational mathematics company
- Our specific areas of expertise are:
  - Computational modeling and simulation
  - Mathematical programming and optimization
  - Linear systems solutions and linear programming
  - Learning algorithms and machine learning technologies
  - Parallel programming techniques and architectures

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Power Systems Engineering

- Our specialty is to develop new approaches to complex problems where standard tools and methods just don't work.
- Three cases with similar computational challenges
  - Extremely long solve times
  - Underlying LP problem to be optimized
- Our solution – problem specific pre-processing

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- Optimus Performance Testing
  - Review test problems
  - LP solver test results

Optimus Data Transformation Tool

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Test Problem Parameters
(February 2010)

	ISO / RTO (Grid Transmission Rights Modeling Program)			National Research Lab (Grid Capacity Modeling Program)	
LP Characteristics	Case 1 **(DAM)**	Case 4 **(FTR)**	Case 6 **(FTR)**	**Short Lab**	**Long Lab**
Number of rows	641,345	83,506	172,469	215,135	301,434
Number of columns	957,326	137,809	338,853	262,724	668,693
Number of non-zeros	7,233,065	25,149,526	39,874,928	11,320,176	25,193,051
After Optimus Transformation					
Number of non-zeros	6,139,919	40,219,310	93,113,096	4,059,685	6,793,680

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Optimus – LP Solver Test Results
(February 2010)

	CPLEX 11.2			Gurobi 2.0		
Case 1 – DAM	Iterations	Solve Time	Performance Gain	Iterations	Solve Time	Performance Gain
Without Optimus	60,542	82.3		91,598	90.1	
With Optimus	54,047	49.4	**1.67 x**	90,256	91.2	**.99 x**
Case 4- FTR						
Without Optimus	58,542	2859.3		158,945	24,255.1	
With Optimus	11,142	627.5	**4.56 x**	15,238	831.2	**29.18 x**
Case 6 – FTR						
Without Optimus	108,124	20,479.3		800,622	196,030	
With Optimus	27,458	4,806.5	**4.26 x**	68,142	10,008.6	**> 19.59 x**
Short Lab						
Without Optimus	N/A	333.9		228,135	2,633.8	
With Optimus	N/A	294.0	**1.14 x**	194,447	494.4	**5.33 x**
Long Lab						
Without Optimus	N/A	6,657.8		490,235	15,331.8	
With Optimus	N/A	2,541.2	**2.62 x**	338,365	1,439.0	**10.65 x**

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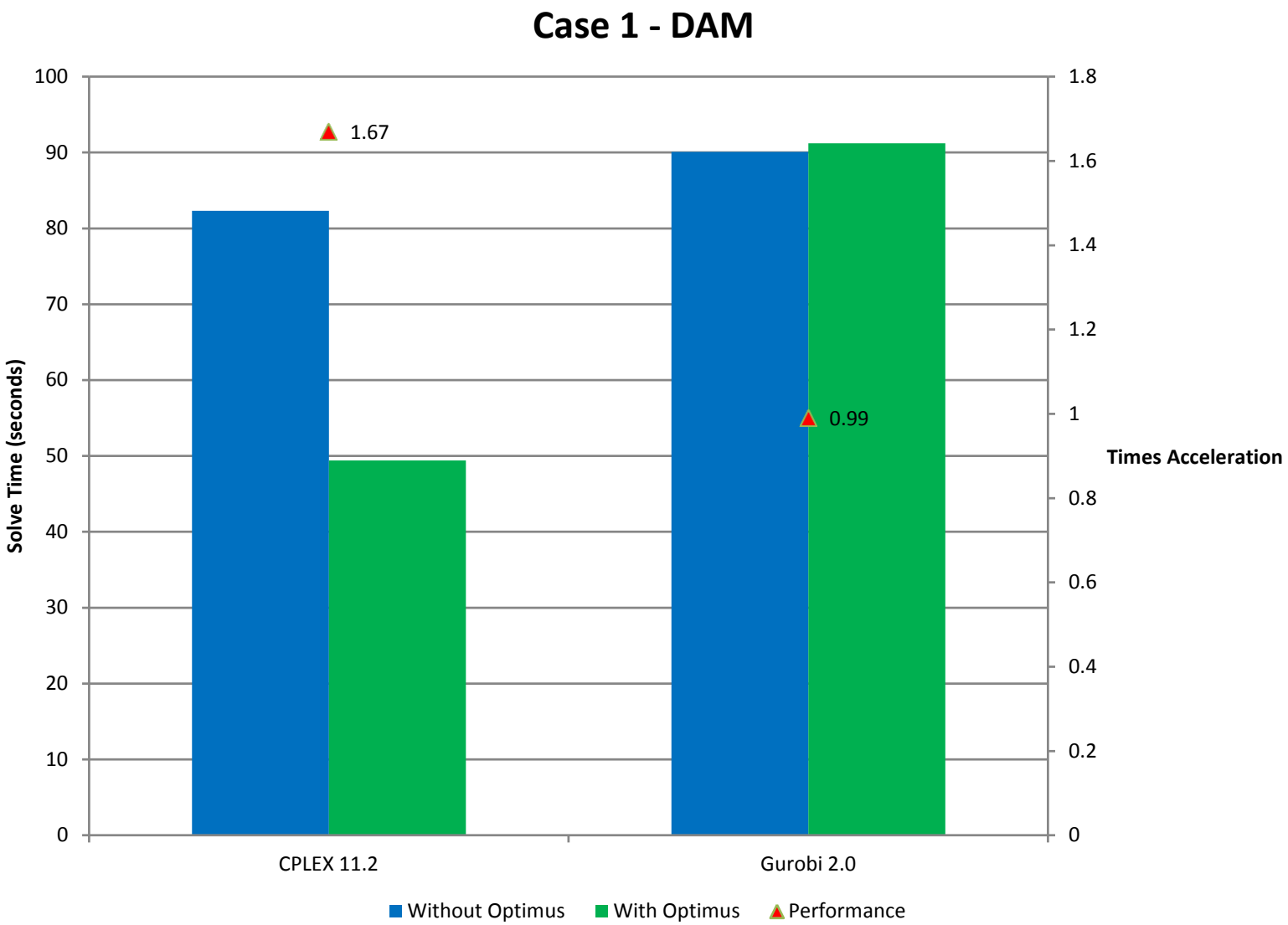
Optimus – LP Solver Test Results
Feb 2010



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Optimus – LP Solver Test Results
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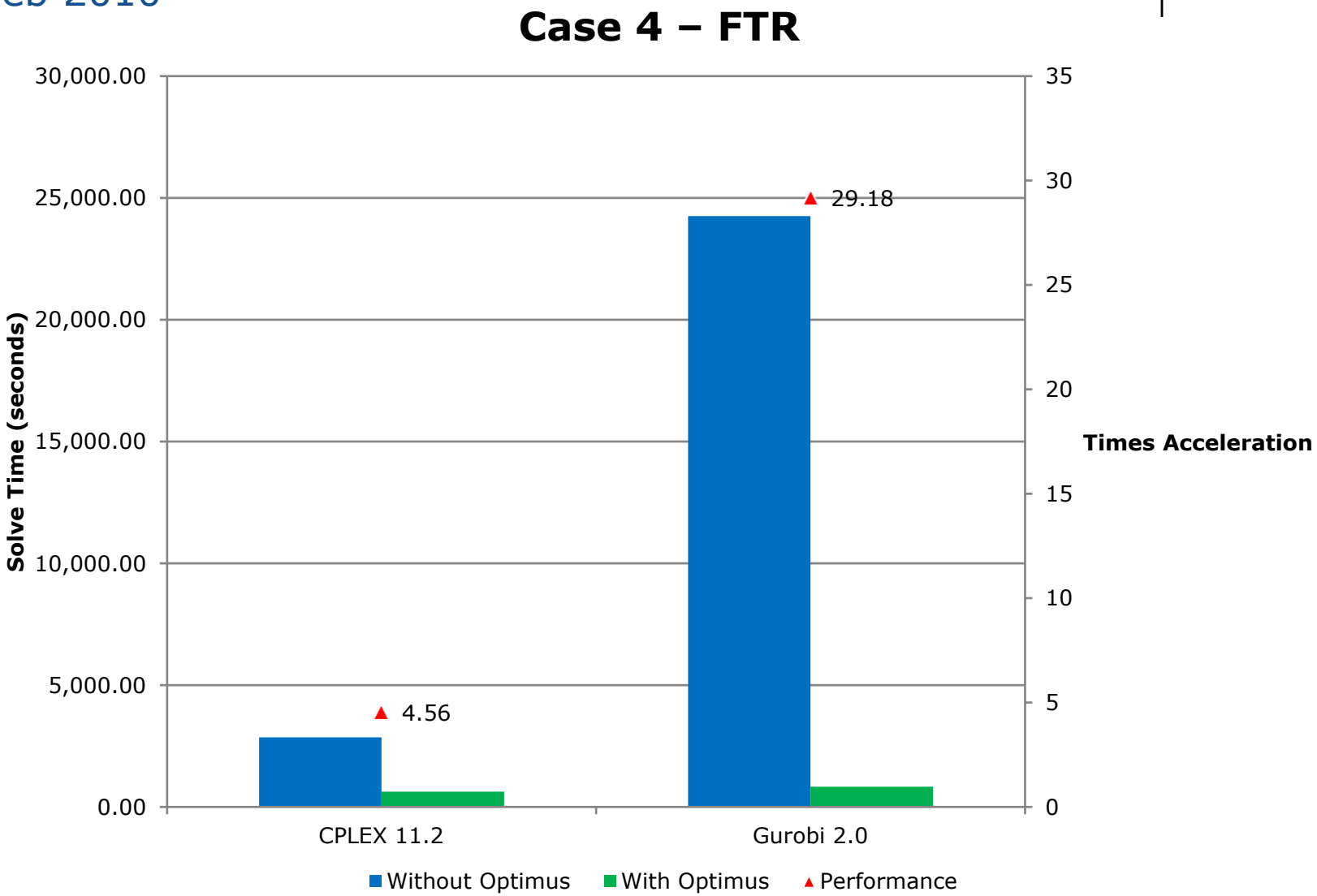

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Optimus – LP Solver Test Results
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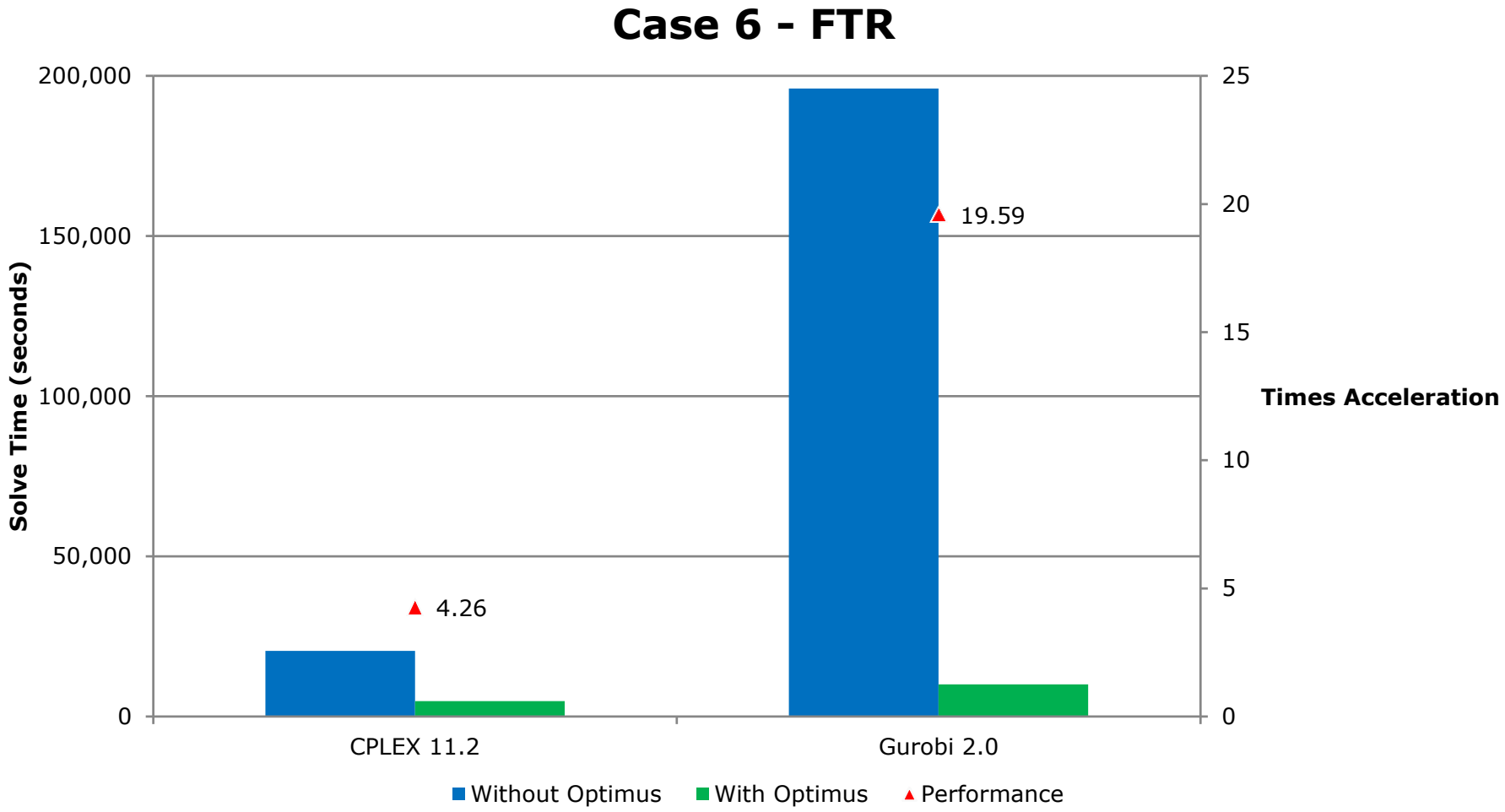

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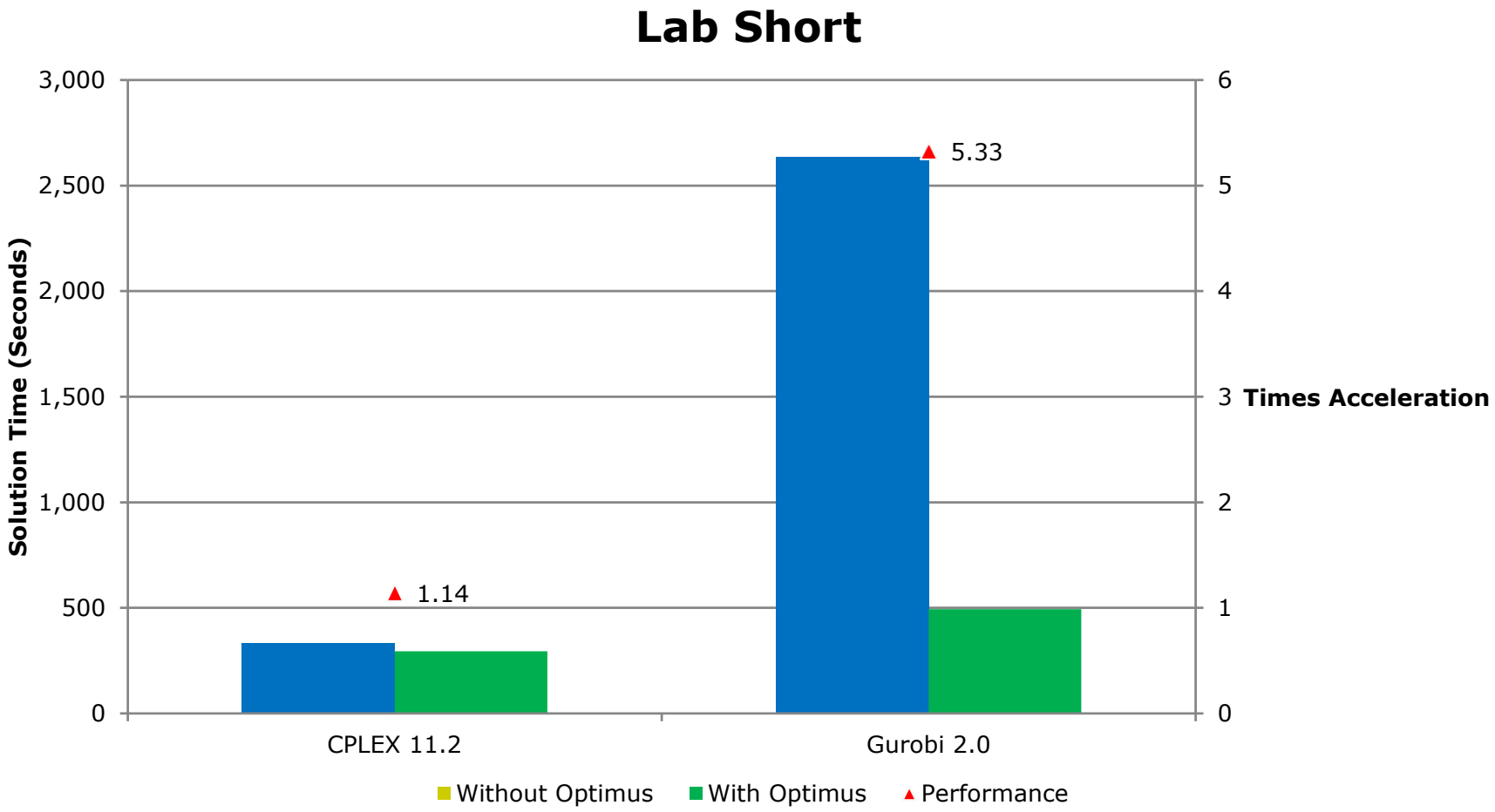

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Optimus – LP Solver Test Results
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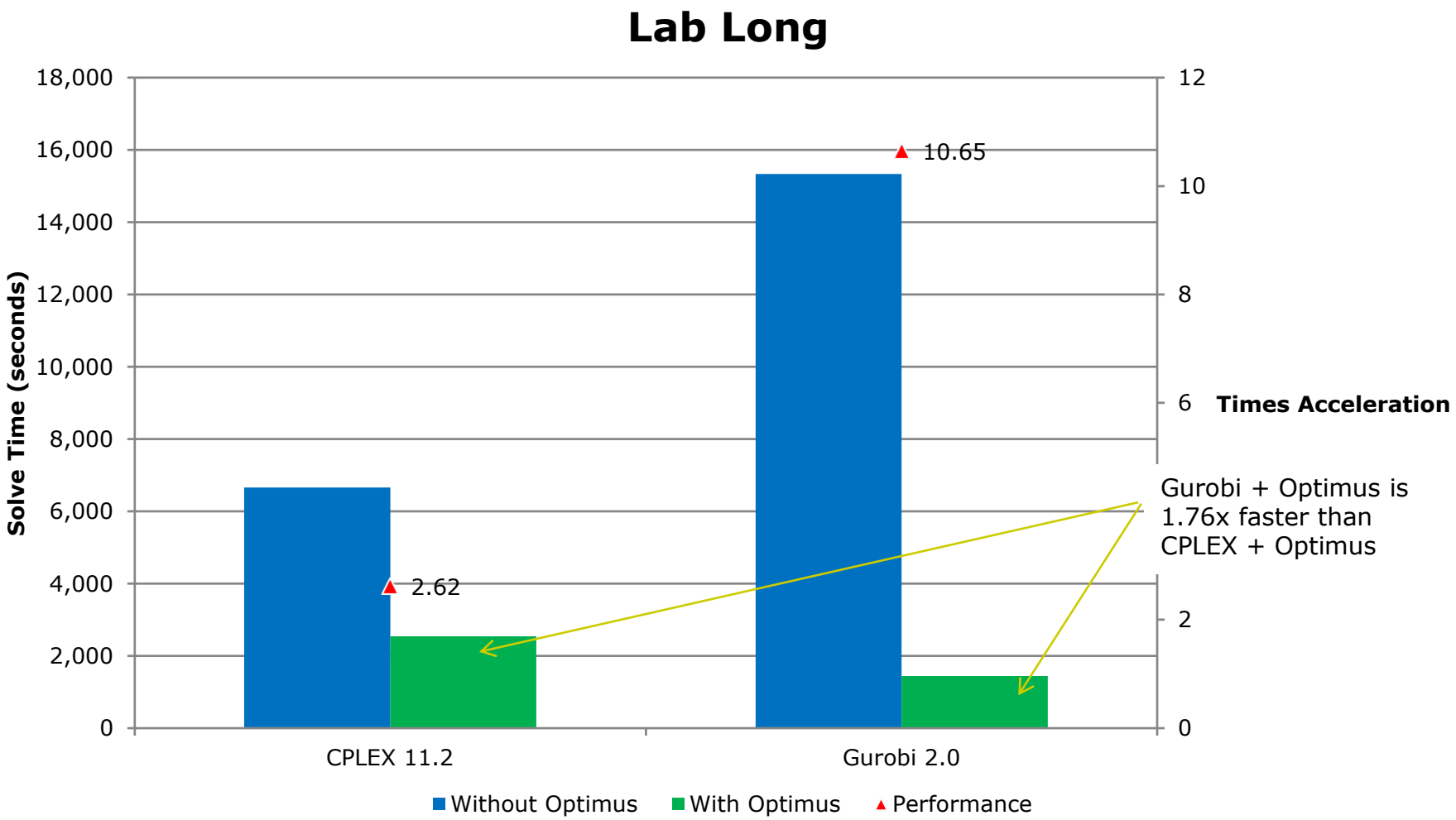

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Test System Parameters

- CPU
  - 2x Intel quad-core Xeon 5462
    - *Note: Optimus not yet multi-threaded*
  - 2.8 GHz, 1.6 GHz FSB, 12 MB L2 cache (2x6)
- RAM
  - 16 GB DDR2-667 (8x 2GB FB-DIMM, ECC)
- OS
  - 64-bit Microsoft Windows Server
  - Windows Visual C++ 2008

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Comments

- Times shown are for solver processing only
  - Primary intent of testing was to show impact on solver performance
- Overall solution time includes both solver & Optimus
  - Total time = read MPS data* + Optimus pre-processing+ solver processing+ Optimus post-processing
    - Reading MPS data not required in production version – will use native formats
  - Current overall performance gains heavily influenced by size of problem
    - Fixed Optimus overhead becomes relatively insignificant with long solver times

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