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HPC, simply.

Industrial Application Challenges

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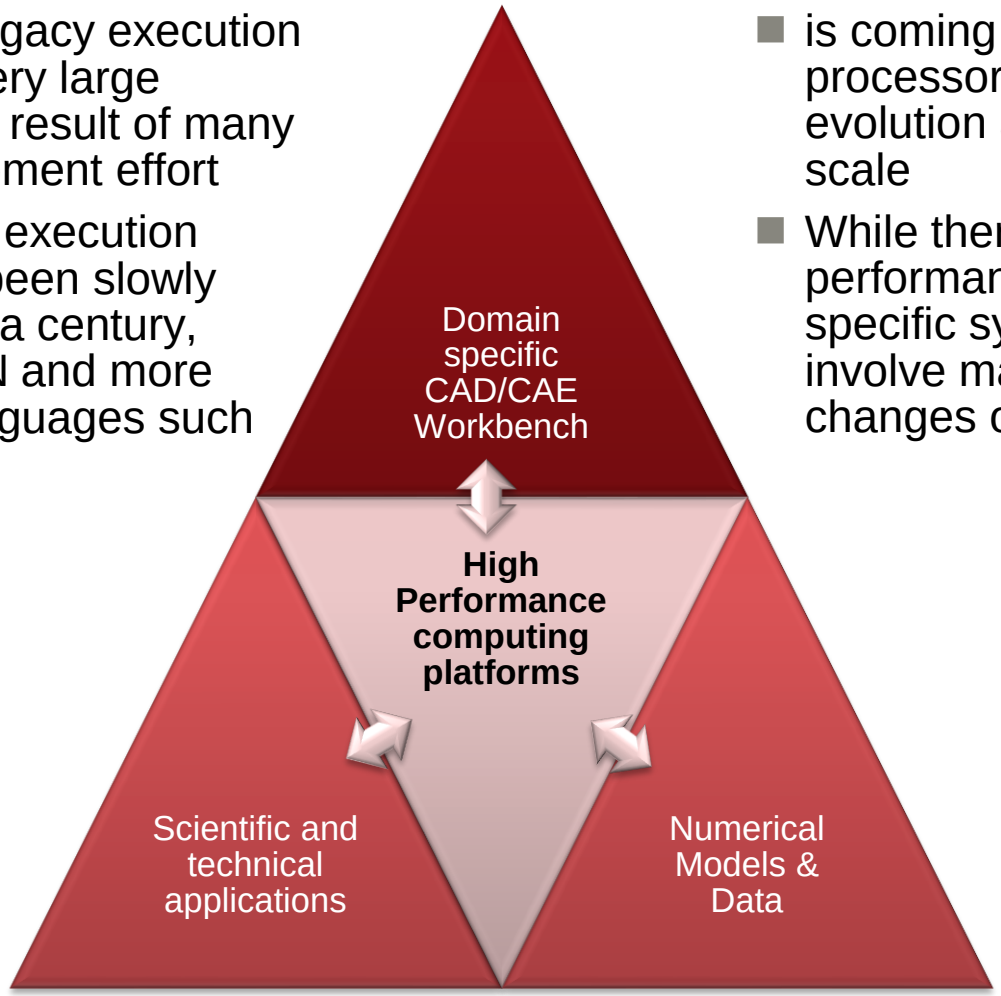
- Most of existing scientific and technical applications
  - Are written for legacy execution model, mostly very large programs as the result of many years of development effort
  - Are following an execution model that has been slowly evolving for half a century, using FORTRAN and more recently new languages such as C++



- Performance increase during the last two decades
  - is coming from single processor performance evolution and larger system scale
  - While there was extensive performance tuning for some specific systems, they did not involve major algorithmic changes or code restructuring

XEON PHI Cornerstones

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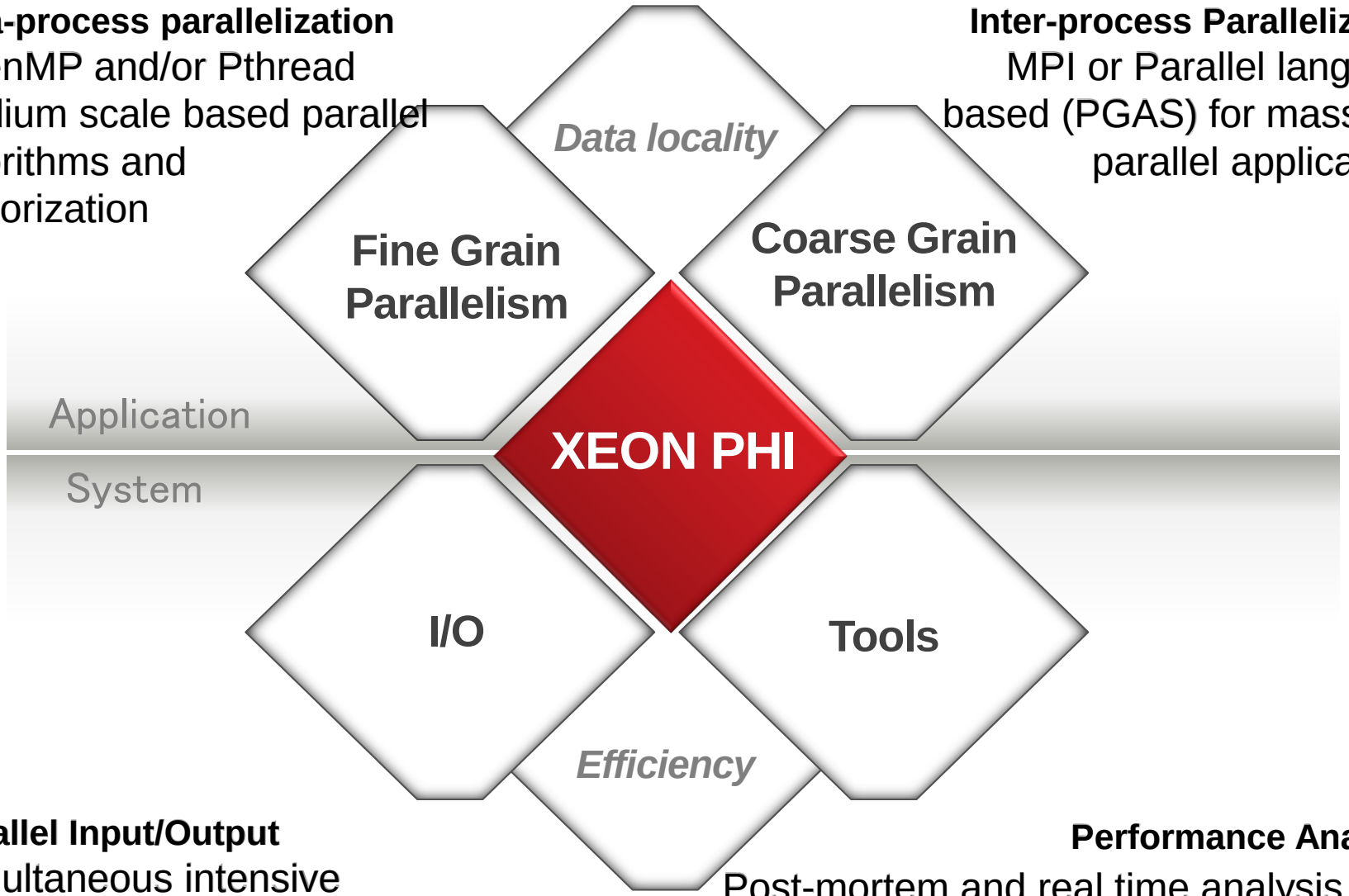
Intra-process parallelization
OpenMP and/or Pthread medium scale based parallel algorithms and vectorization

Inter-process Parallelization
MPI or Parallel language based (PGAS) for massively parallel applications



Parallel Input/Output
Simultaneous intensive data access to/from multiple running processes

Performance Analysis
Post-mortem and real time analysis tools to understand application behaviour

Application Tuning on XEON PHI

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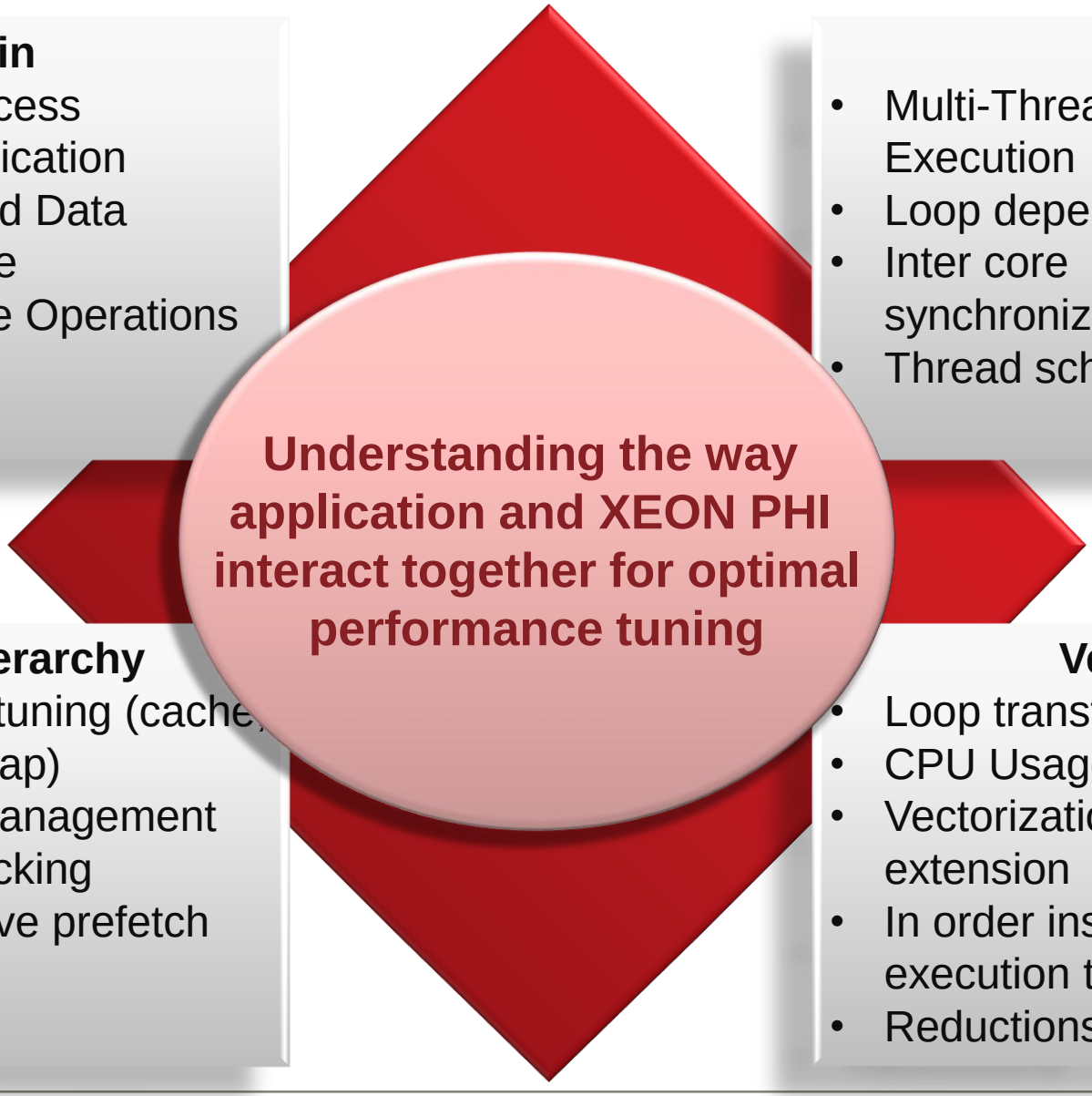
Coarse grain
- Inter Process Communication
- One sided Data Exchange
- Collective Operations
- IOs

Fine Grain
- Multi-Threading Execution
- Loop dependencies
- Inter core synchronization
- Thread scheduling



Memory hierarchy
- Memory tuning (cache, stack, heap)
- Cache management
- Loop blocking
- Aggressive prefetch

Vectorization
- Loop transformation
- CPU Usage
- Vectorization & SIMD extension
- In order instruction execution tuning
- Reductions

Embedded tools

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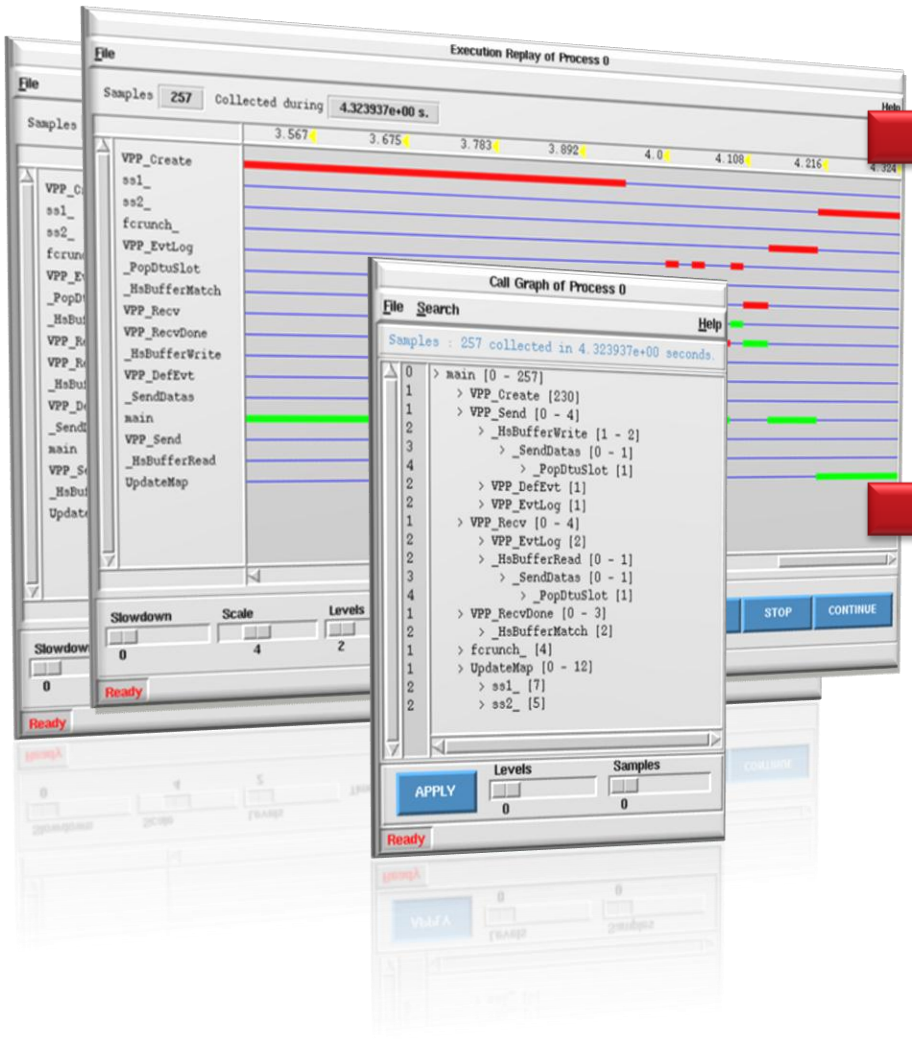
Fujitsu Technology

- Non intrusive tools for fully optimized application binaries performance analysis
- Low overhead (<5%) and reduced memory footprint (few MBs per core)
- Per-thread based rather than system wide
- Integrates measurement data associated with same context from different threads

Efficient & Simple Usage

- Analyzing threads hotspots
- Identify scaling losses
- Quantify load imbalance
- Collect call path trace
- Understanding load imbalance and temporal patterns
- Integrates both MPI and OpenMP

Multi-Thread Analysis



Specific thread oriented tools single XEON-PHI oriented:

- *Thread replay*
- *Thread Call Graph*

Correlation based investigation:

- *Evolution of CPU usage during the run*
- *“hot spot” links with calling sequence and application logic*
- *Evaluation of OpenMP efficiency*
- *Impact of message passing*
- *IOs profile*

Multi-Process Analysis

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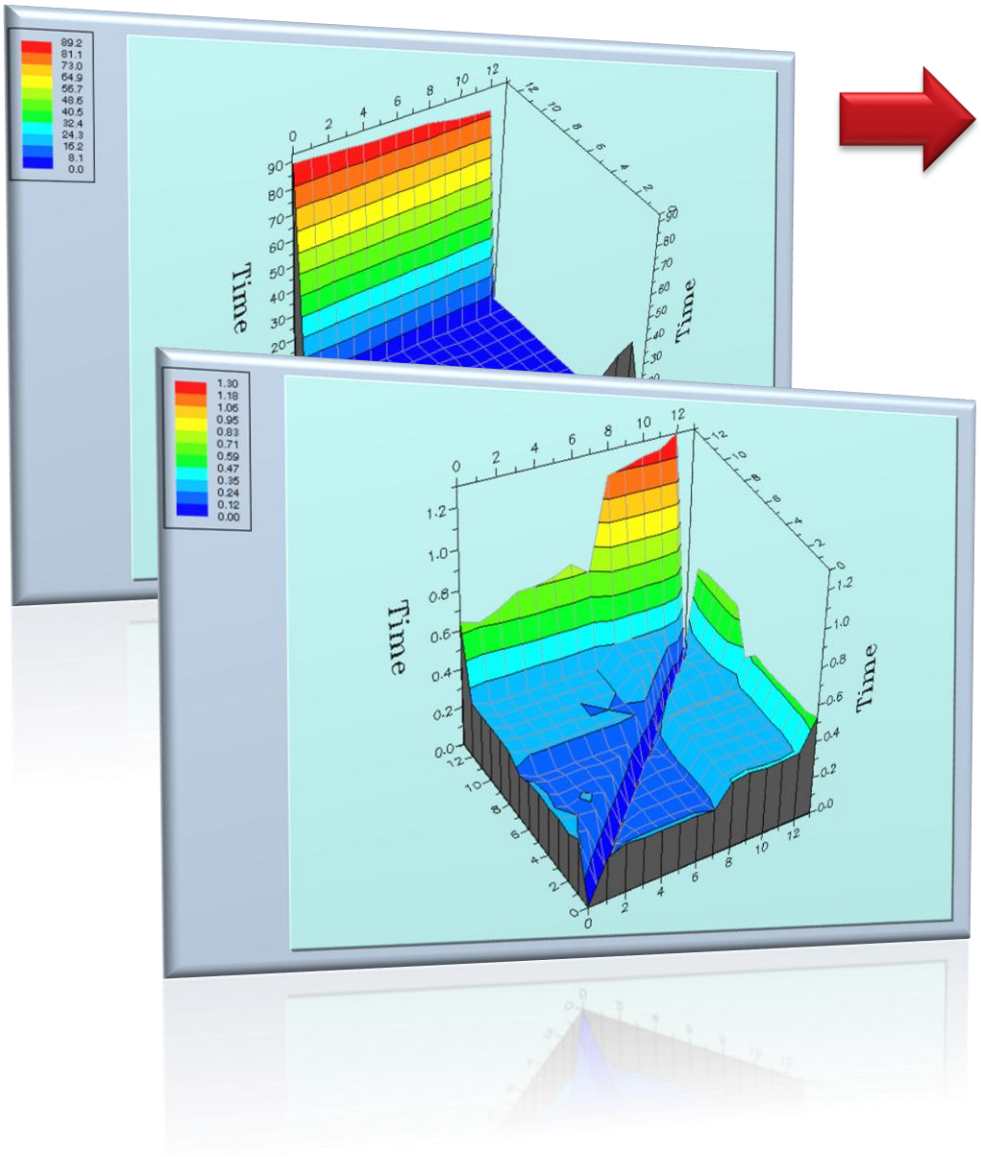

Specific MPI tool multiple XEON-PHI oriented:

- *Heterogeneous large MPI application (MPMD)*
- *Focus on global application behavior*
- *Used to identify global bottlenecks of production applications with real data*

Profiling Accuracy

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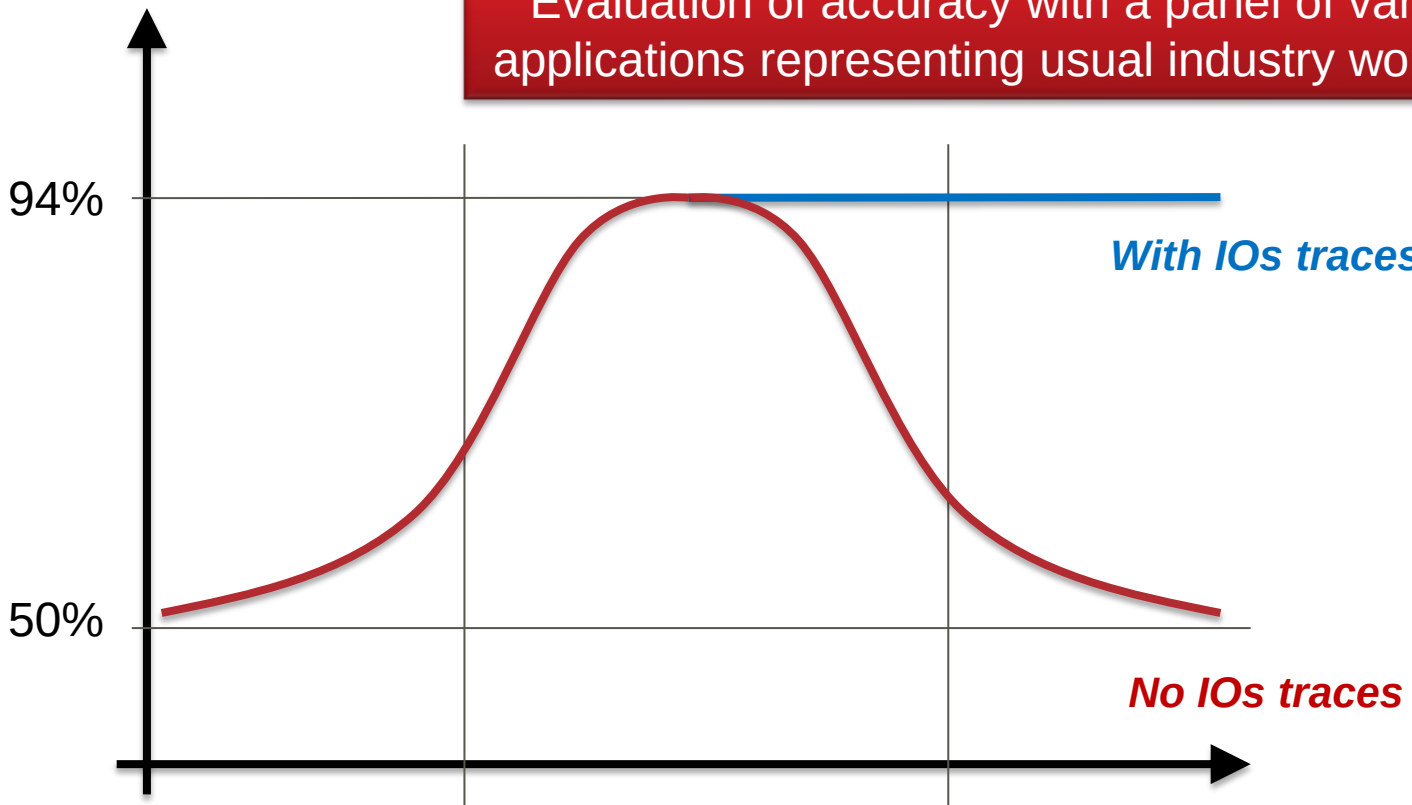
Evaluation of accuracy with a panel of various applications representing usual industry workload

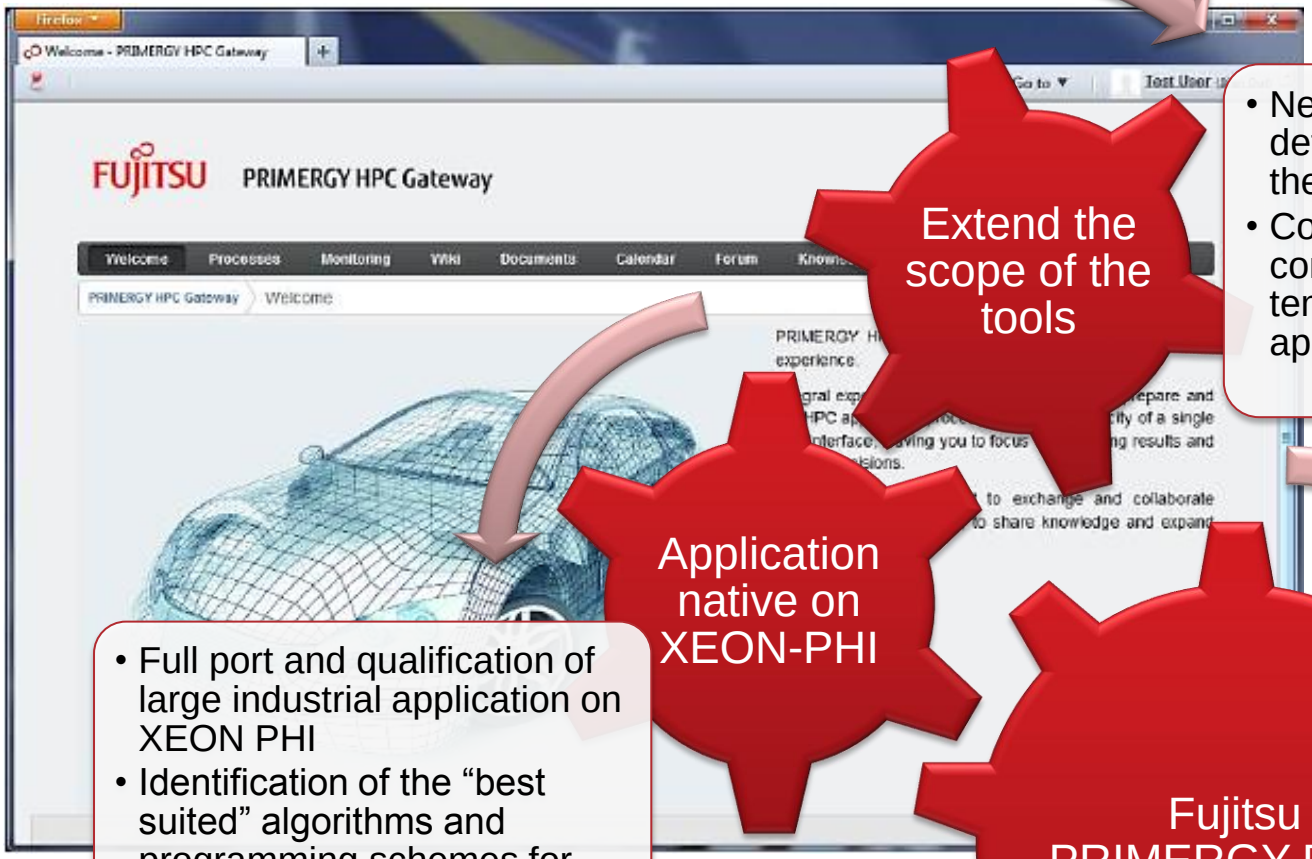


Lowest Accuracy:
- *Flat application profile*
- *Numerous small subroutines*

Highest Accuracy:
- *Typical HPC profile*
- *Vector oriented*

Low/High Accuracy:
- *IOs intensive profile*

And the story continues !



Extend the scope of the tools

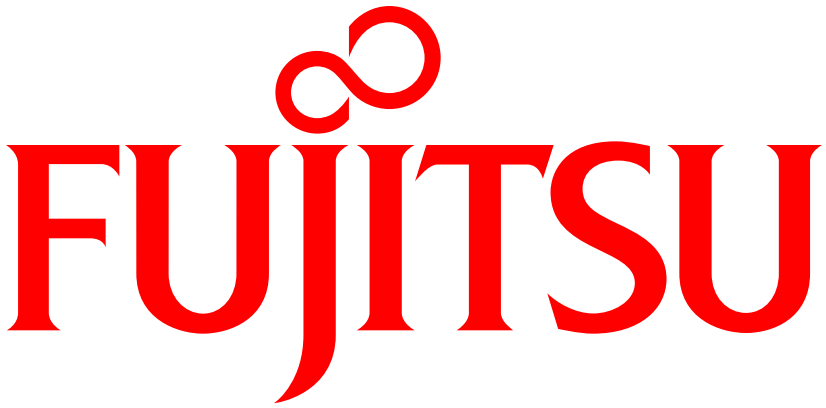
- Network congestion detection and impact on the performance
- Correlation of power consumption and temperature with parts of application execution

Application native on XEON-PHI

- Full port and qualification of large industrial application on XEON PHI
- Identification of the “best suited” algorithms and programming schemes for the XEON PHI

Fujitsu PRIMERGY Portal

- Transparent access to XEON-PHI for end users
- Integration of XEON PHI technology with Business Process engine



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