Why DKRZ asked the smart question? Why Bull expertise was key?

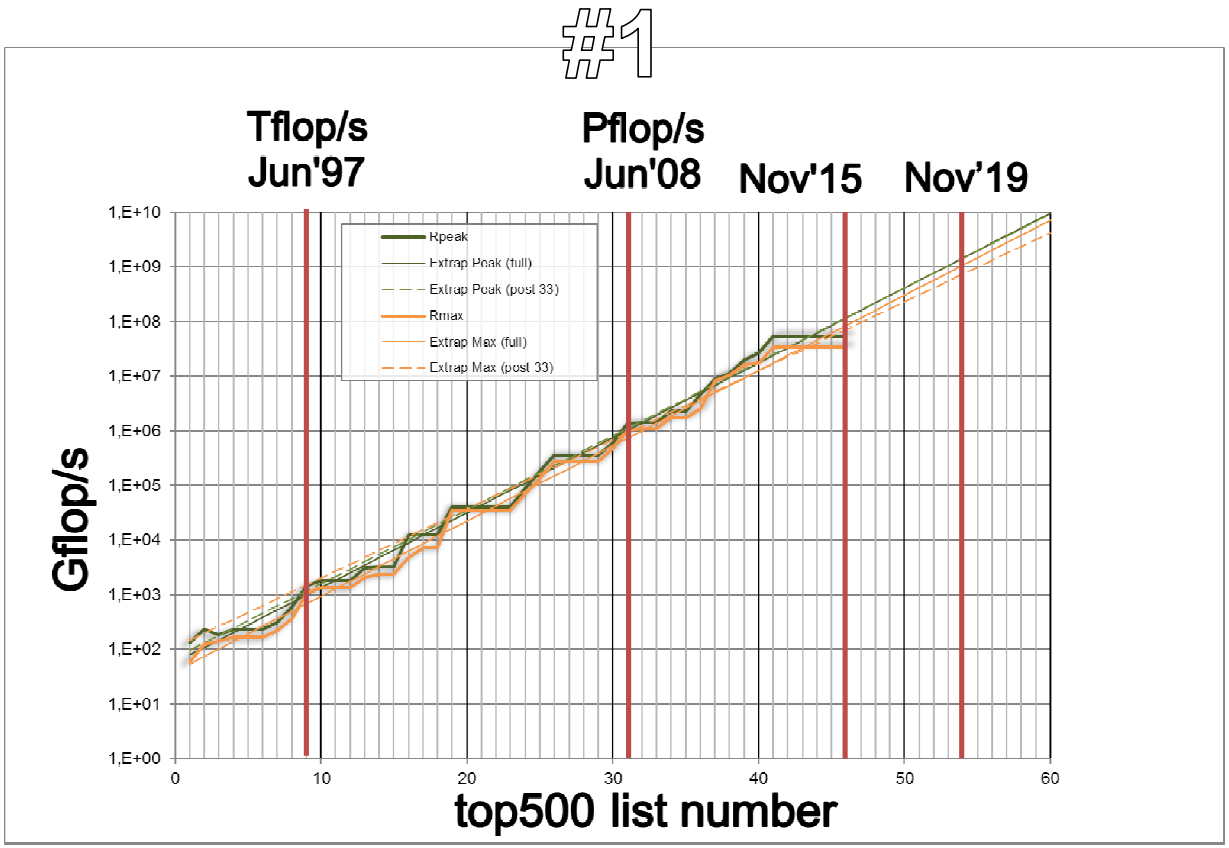
Don’t mudle up Performance and Productivity

Xavier Vigouroux

H1-2016

1 Technology Trends

We want more power!



Peak

[#req] * [#flop/cycle] * [freq]

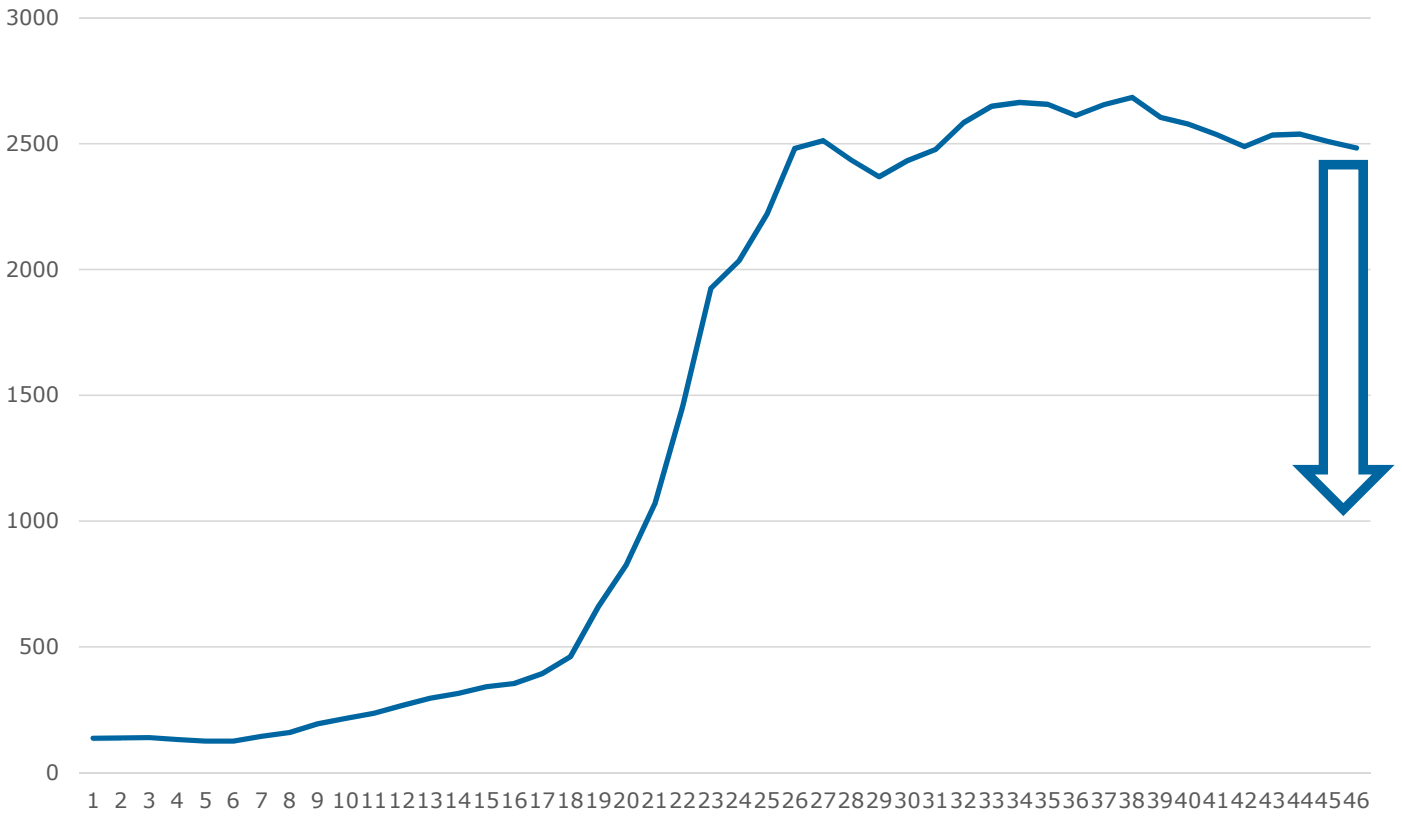
Max / Measured

[Rmax] / [Rpeak]

#1	17.8	MW
#2	8.2	MW
#3	7.9	MW
TGV	8.8	MW

1 W.yr = 1 €

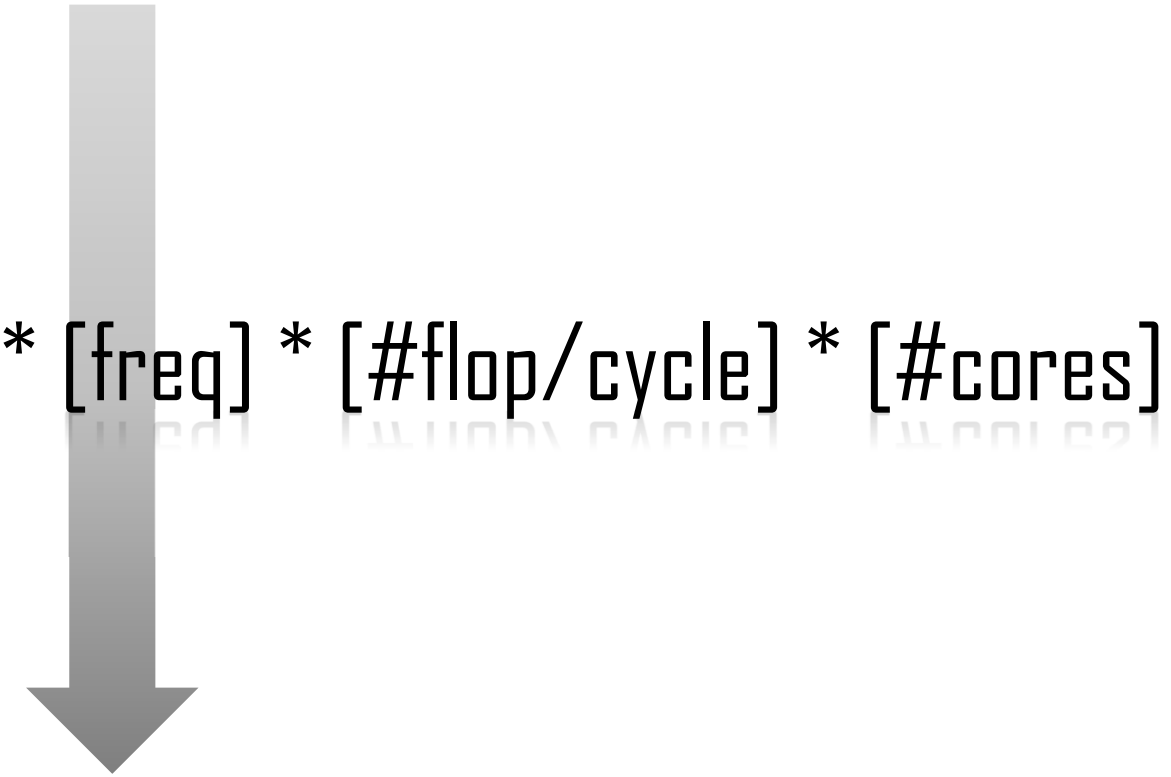
CPU frequency (MHz)
as a function of top500 list



Compute power comes from Processor or Coprocessors?

Are you ready to be back in

2002 ?

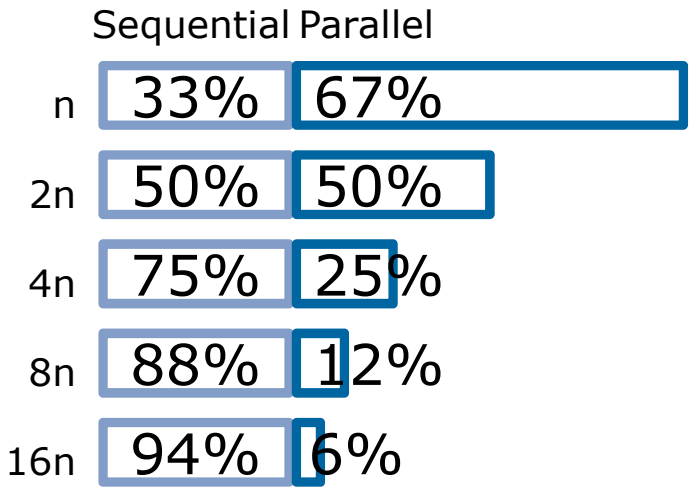

[Eff.] * [freq] * [#flop/cycle] * [#cores]

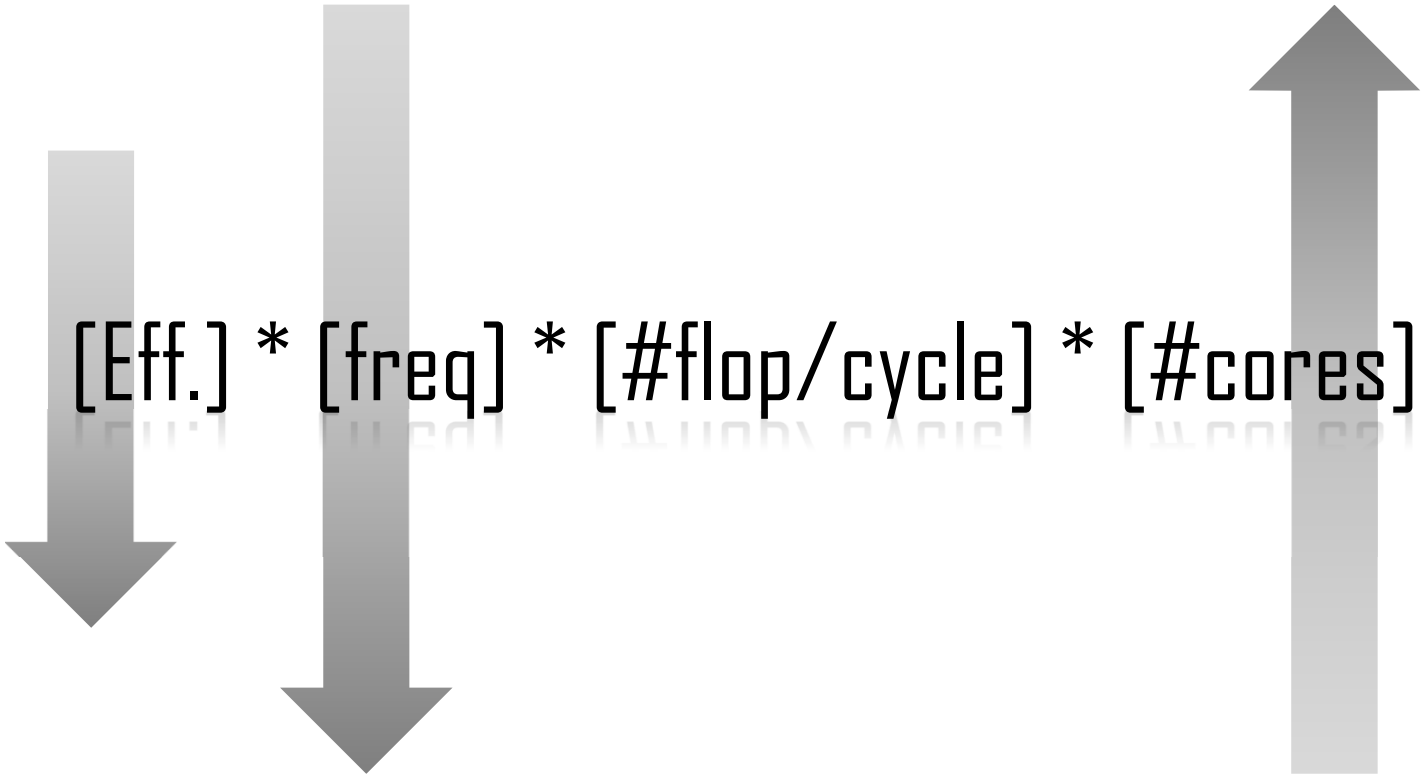
The Amdahl's law

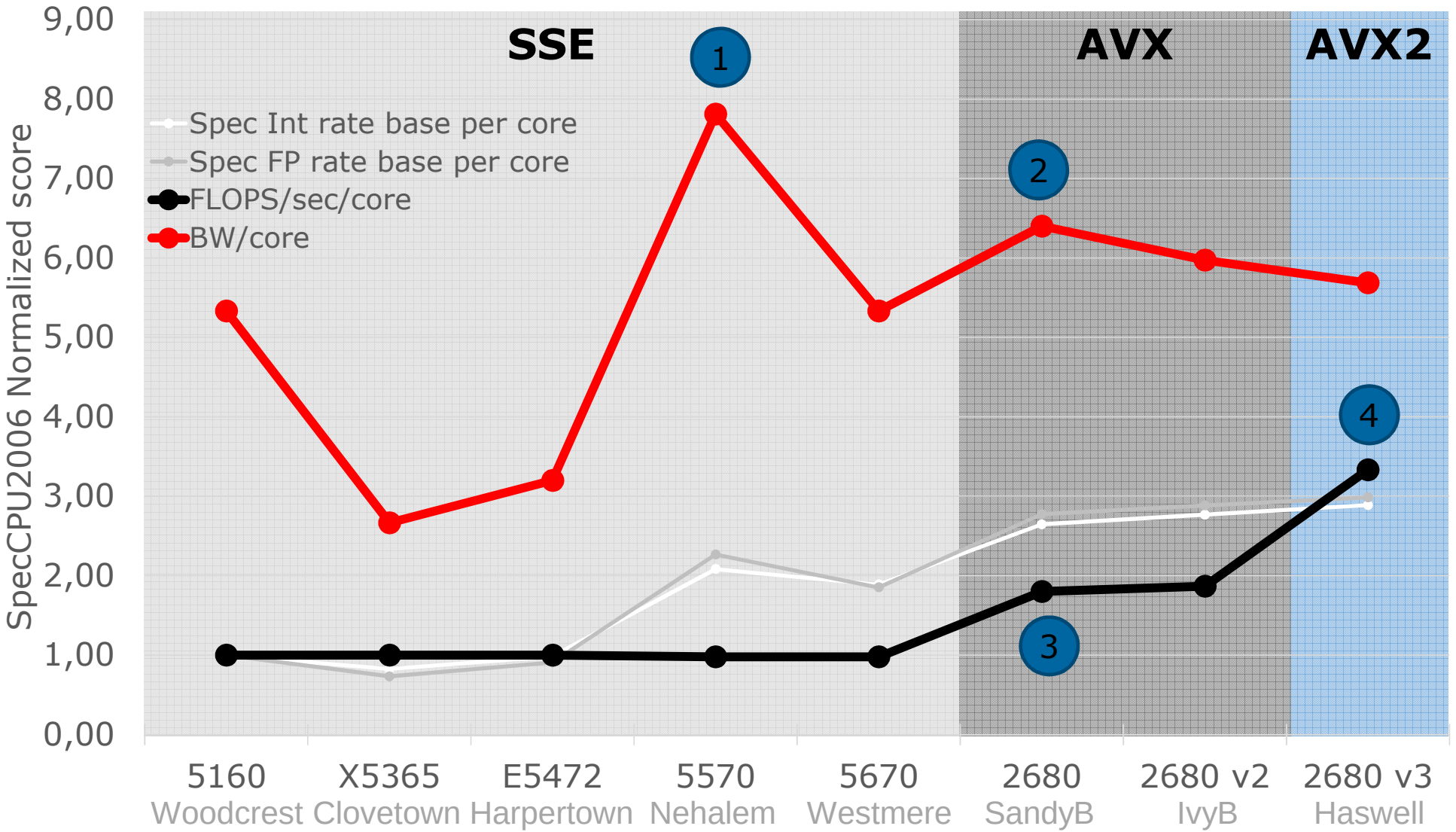
Parallelization only improves parallel sections! ….

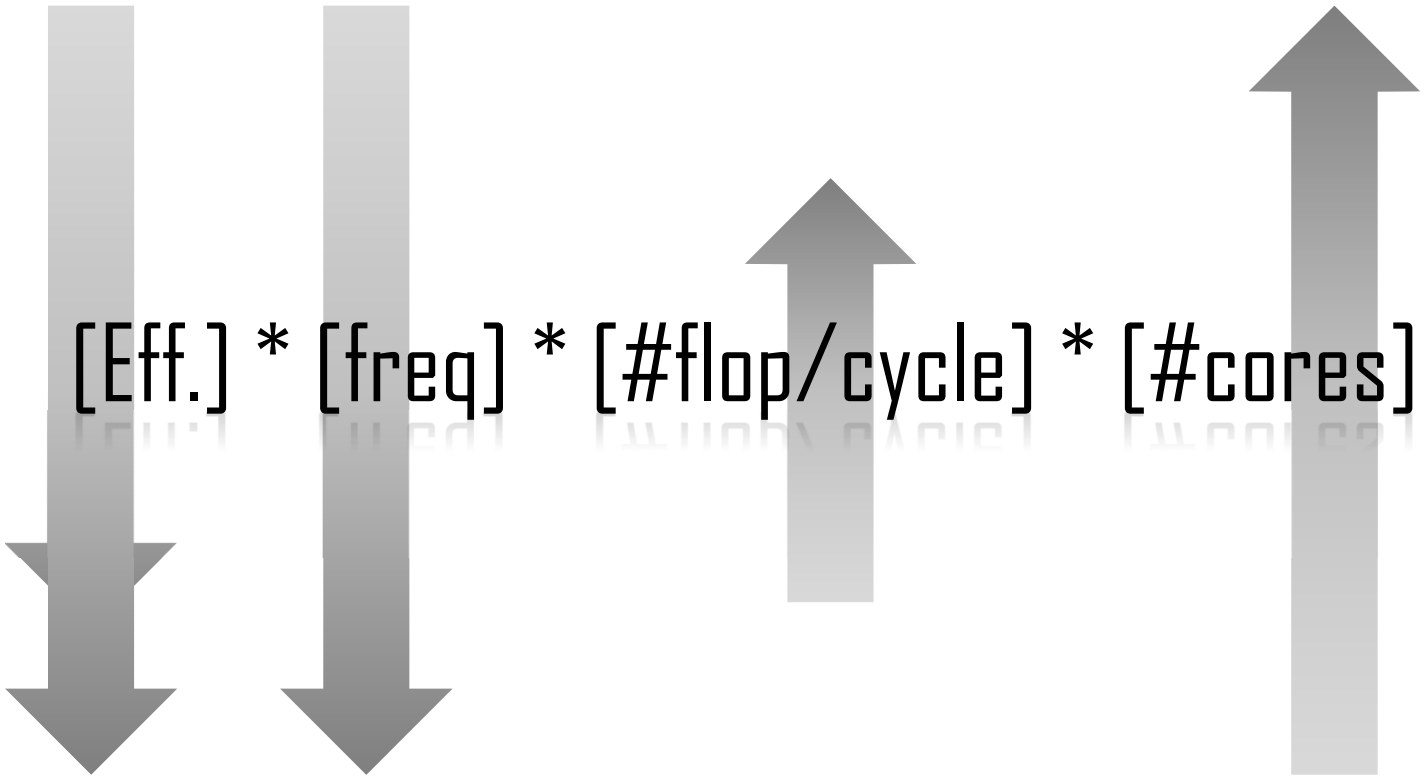
(looks like a tautology ☺)

> "A fairly obvious conclusion which can be drawn is that the effort expended on achieving high parallel processing rates is wasted unless it is accompanied by achievements in sequential processing rates of very nearly the same magnitude."
> (Amdal – 1967)




[Eff.] * [freq] * [#flop/cycle] * [#cores]


SSE
AVX
AVX2
1
2
3
4
Spec Int rate base per core
Spec FP rate base per core
FLOPS/sec/core
BW/core
SpecCPU2006 Normalized score
9,00
8,00
7,00
6,00
5,00
4,00
3,00
2,00
1,00
0,00
5160 Woodcrest
X5365 Clovetown
E5472 Harpertown
5570 Nehalem
5670 Westmere
2680 SandyB
2680 v2 IvyB
2680 v3 Haswell


[Eff.] * [freq] * [#flop/cycle] * [#cores]

Architecture Paradigm shift

90/10

All Improvement targets 90% of workload

10x10

Improvement is spread over different workloads

"10x10: A General-purpose Architectural Approach to Heterogeneity and Energy Efficiency" (Andrew Chien, 2011)

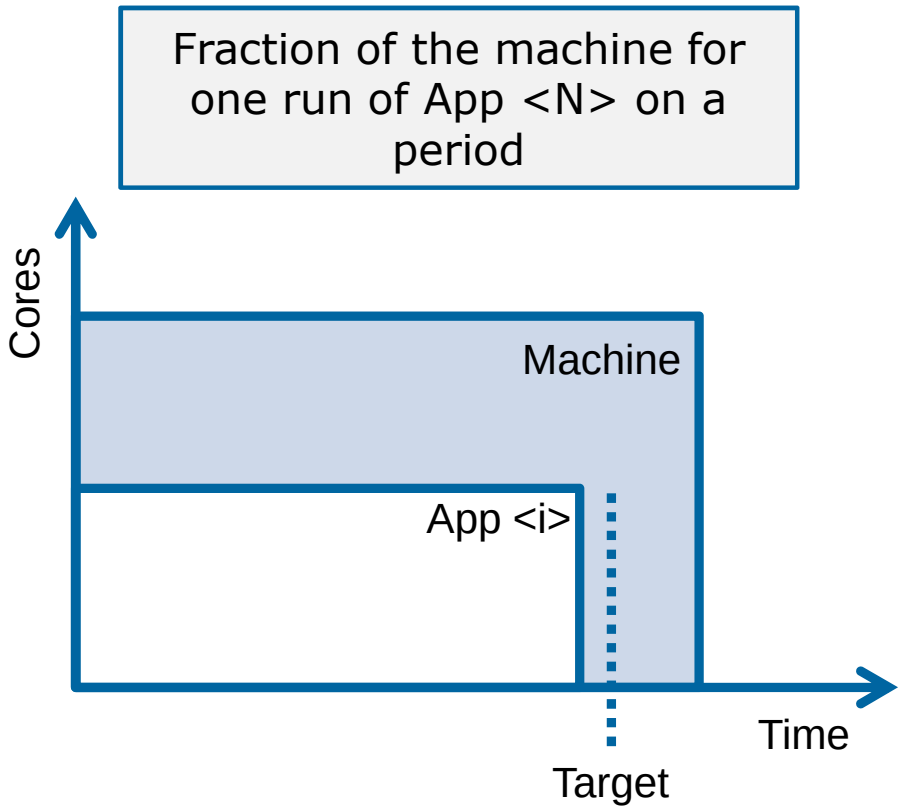
2 What has that to do with DRKZ RFP?

Constraints

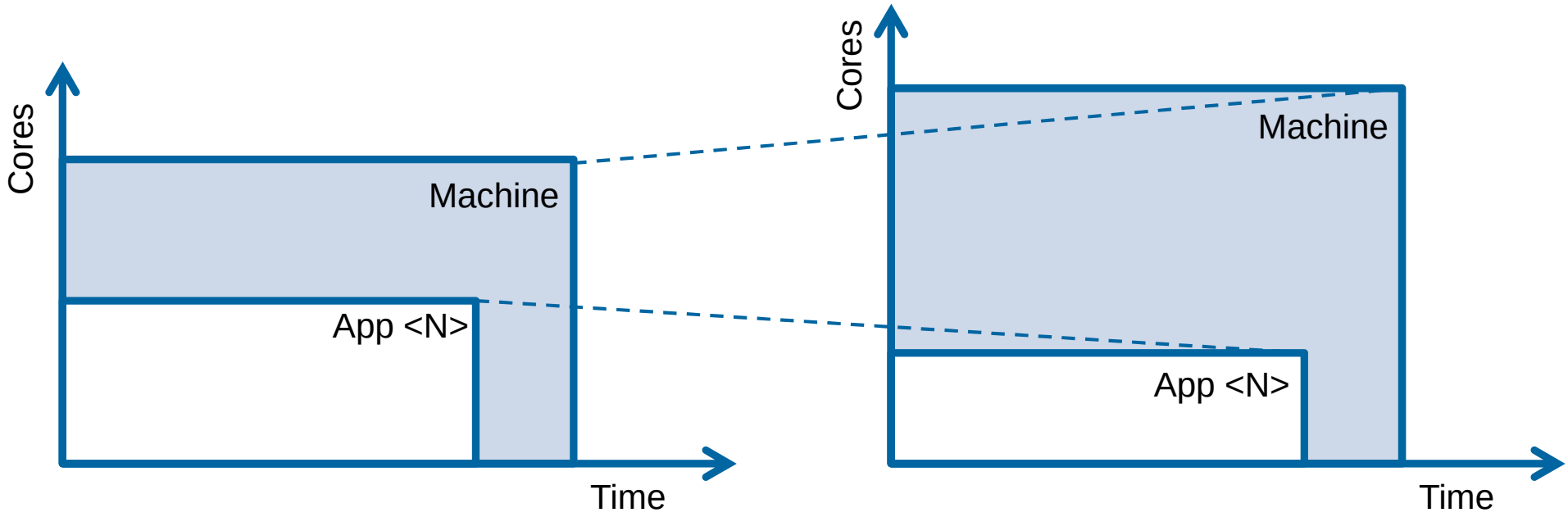
Principles

- Commitments
  - Single performance of Climate codes
  - Performance throughput score
  - Power consumption during a workload

App <i>
Target Time
Weight in workload
Commitment
#cores
Time (<=target)
Watt



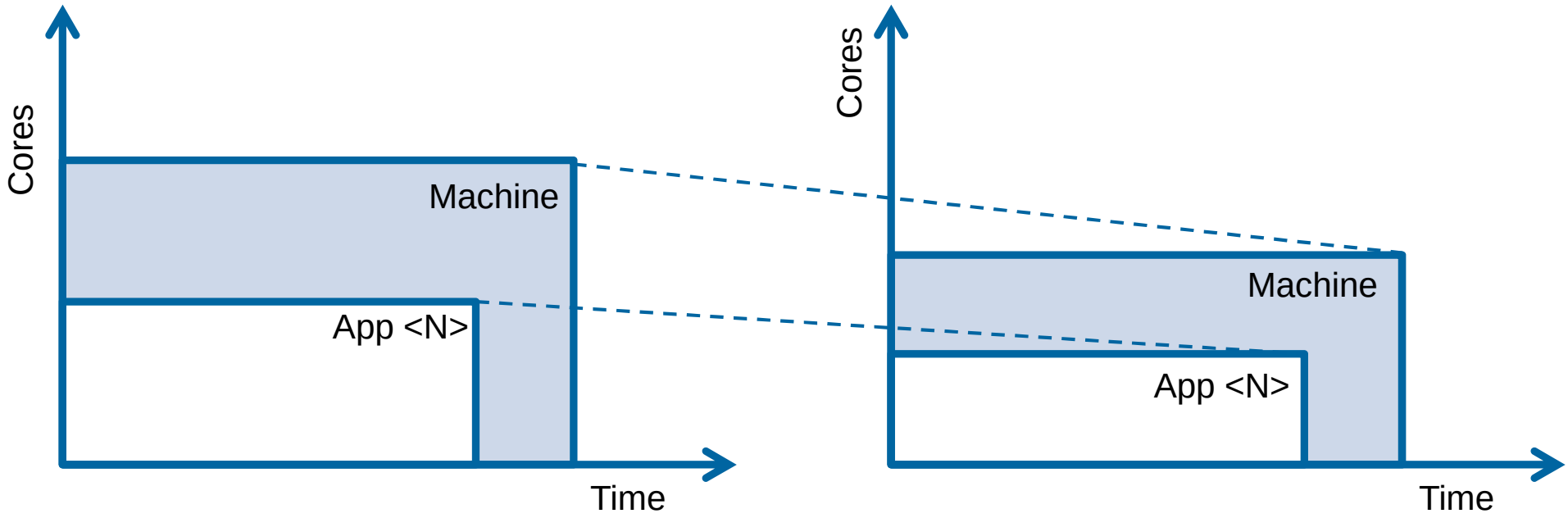
More Throughput…



Reference

Offer

...With less energy



Reference

Offer

Performance Score

$$\text{Throughput Ratio}_{<i>} = \frac{\text{Fraction of the Reference machine for one run of App <i> on a period}}{\text{Fraction of the Offered machine for one run of App <i> on a period}}$$

$$\text{Performance Score} = \sum \text{Throughput. Ratio}_{<i>} * \text{weight}_{<i>}$$

Performance Score

$$\text{Throughput Ratio<i>} = \frac{\text{Cluster time<i>}_{ref}}{\text{Cluster time<i>}_{offer}} \times \frac{\#\text{core}_{offer}}{\#\text{core}_{ref}}$$

$$\text{Performance Score} = \sum \text{Throughput. Ratio<i>} * \text{weight<i>}$$

Performance Score

$$\text{Throughput Ratio<i>} = \frac{\text{Cluster time<i>}_{ref}}{\text{Cluster time<i>}_{offer}} \times \frac{\#\text{core}_{offer}}{\#\text{core}_{ref}}$$

[Eff.] * [freq] * [#flop/cycle] * [#cores]

Atos

Power Consumption Commitment

~~Committed Target Time~~

Additional nodes

Additional power consumption

~~Committed Power Target~~

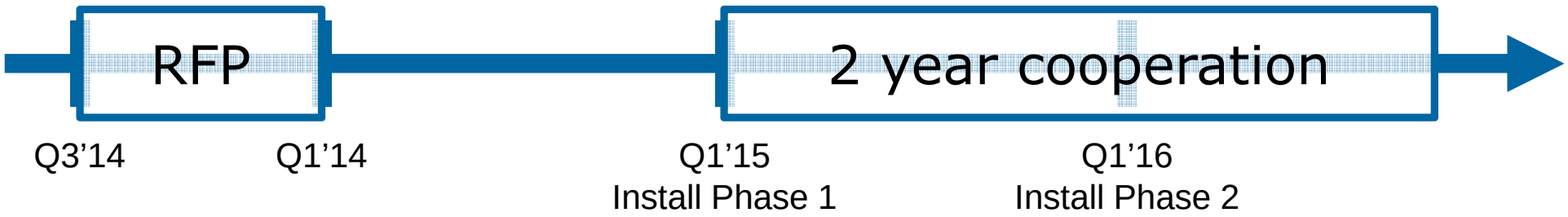
Atos

As-Is vs Optimized

As-Is	Optimized
Porting Modifications	Any modification
Pragmas, compilation flags	
Libraries	
Run-time conditions	
Test Machine Productivity	Test Machine Performance
	Test Application Experts

Atos

2 Phases and cooperation



We had to commit on performance on the next next next processor

3 Conclusion

Only production matters

- Ask for “target time” to compare with reference
- Try to create one unique significant metric
- Test machine productivity with As-Is codes
- Test machine performance and experts skills with optim
- Test experts credibility with longer term comitments

- When you’re confident
  - Select the winner
  - Cooperate on optimizations
  - Build strong relationship

Why DKRZ asked the smart question?

Because they focus on productivity, constraints and prepare the future

Why Bull expertise was key?

Because we can answer the question

This is a bridge!

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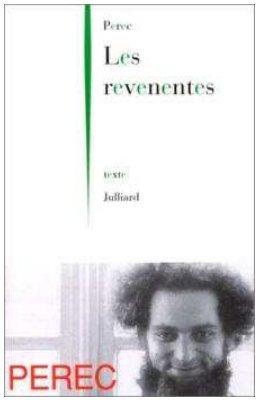
"Constraints Feed Imagination"
George Perec, OULIPO, 1969
(1936 – 1982)

La disparition
315p -
1969

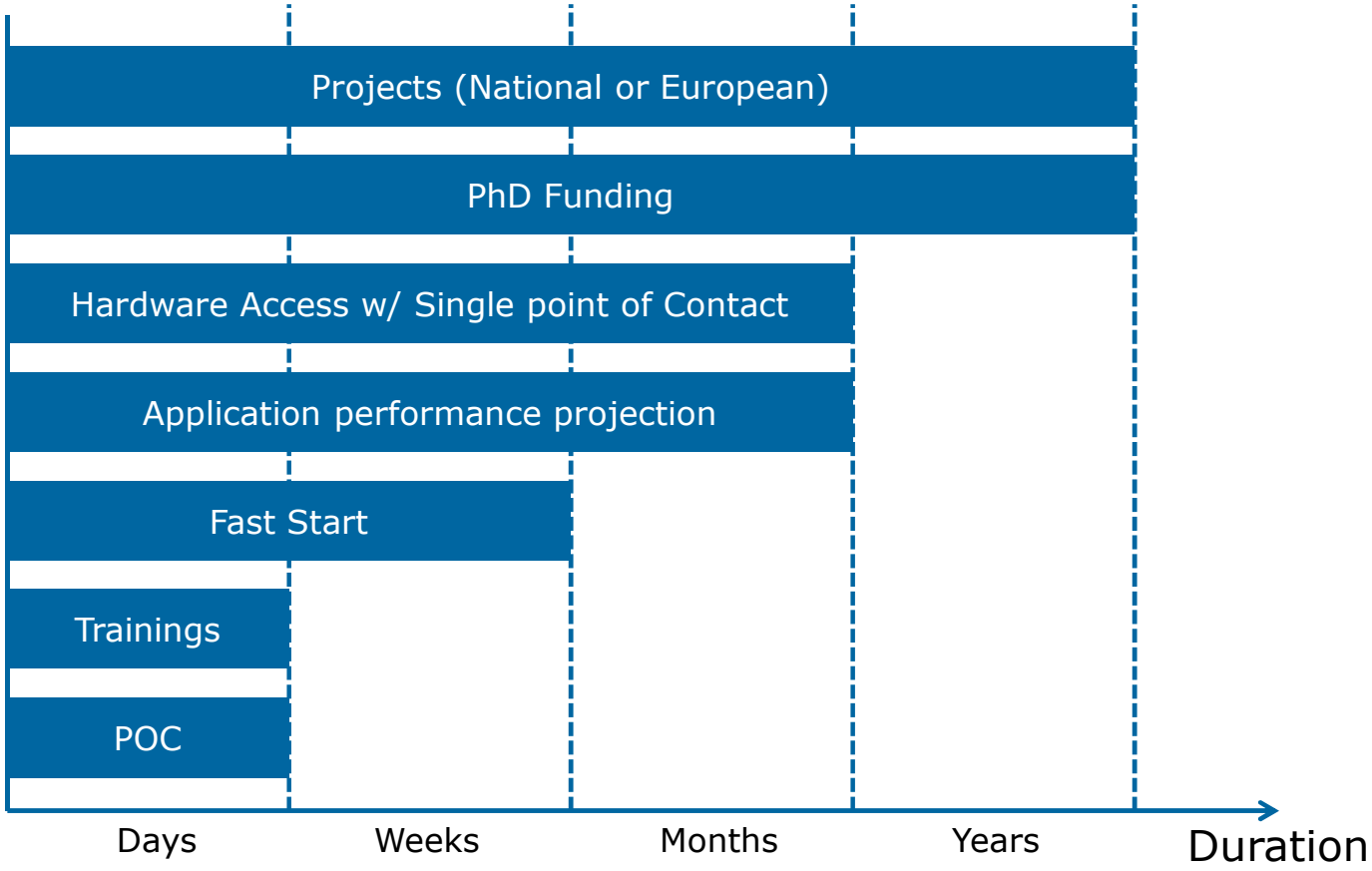


Les revenentes
1972

Thank you

dd-mm-yyyy

Project and Service Map



CEPP references

Royal Netherlands
Meteorological Institute

TECHNISCHE
UNIVERSITÄT
DRESDEN

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