

## Technology Tracking I

Tracking the evolution of the base computing elements: CPU, Memory, Disk, Tape

This covers technology, markets and costs

Plus one level higher complexity, i.e. servers and networking

Goal : cost predictions of the computing

Currently one report every ~2 years plus a lot of activities in the experiments and sites

Discussion points :

- Make it a more formal WLCG activity
- Total TCO requires inclusion of infrastructure (space, power, cooling, etc.), storage and processing software, etc.
- Once every year ? 2 years ? Continuously updating ?
- Team of people ? Resurrect PASTA ?

There are many good, but not necessary coordinated evaluation activities of new technologies

--> Sites, experiments, non-HEP, Industry

Create an Inventory ? Central place to store talks and papers ? Regular meta-analysis of topics ?

→ Judgement of state ? Base new activities on the outcome

## Technology Tracking II

Inventory and assessment of new software, procedures, hardware ??

Record cards

e.g.

Type: ARM  
Advantages: power efficiency,  
Side-effects: low performance= more infrastructure  
Price/performance : expensive  
Total TCO gain: today probably negative  
Market dev: very slow,

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Hardware: ARM, GPU, FPGA, APU, neuro morphic chips, .....

Software : new language, algorithms (e.g. tuned to specific architectures),  
processing and storage management software,.....

Regular updates, to focus the work on promising evaluations !?

### Technology Tracking III

Platform to benchmark, stress test and generally evaluate new technologies (hardware and software)

At CERN we have the Techlab instance, focus on new computing hardware (ARM, GPU, OpenPower, etc.) available in the market, operational experience is important, identify early side-effects. Other sites have probably similar instances.

- One or two central instances ? Good support and reasonable size budget ? How large ?
- Spread across many sites ? Effort to coordinate activities ? Avoid duplication !
- Potential large phase-space
- regular summaries of evaluation results ? Really coordinated ! Judgement of technologies = invest further or stop. Hepix ?
- Hardware+software, collaboration with concurrency forum and HSF --> formal structure ?

Bleeding edge technology evaluations in collaboration with Industry, access to prototypes, but also help in complex debugging exercises. At CERN we use the openlab framework for this.

- Expand this effort ? Access to expertise ! NDA ? Hooks ?
- Very good potential ! Don't mix collaboration and purchase !

## Holistic TCO !!!

Random examples of technology choices and consequences/side-effects :

Multithreading avoids to cross the 'magic' 2GB/core limit → move from 2 to 4 GB/core = ~ +15% server cost  
side effects: scheduling, IO, software complexity, debugging complexity, .....

T0 RAW data processing should in principle be low IO (~100 KB/s), lately changes in procedures and software requires now SSDs on the worker node → +20% server cost

Virtualization improves scaling , operations and flexibility of resource allocations

→ Created 20% overhead in CPU processing plus IO overhead. With quite some effort reduced now to 5%

These effects strongly limits the usefulness of pure technology cost predictions !

More coordination ? Intensive QA ? More complex in-situ monitoring ?

Need to understand and control dependencies and side-effects for a full TCO calculation:

Hardware – software – physics requirements – site boundaries – user convenience - .....

Value for the money: throw hardware or throw software at a problem !?

--> Total TCO to be kept in mind