

Le calcul distribué : un outil pour l'imagerie médicale

Tristan Glatard

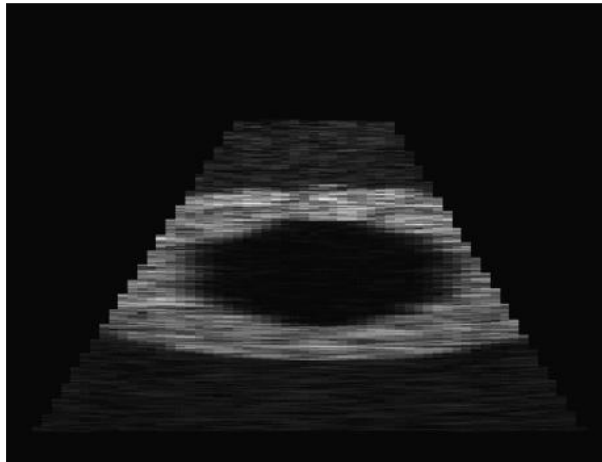
Creatis, CNRS, INSERM, Université de Lyon

14 avril 2011

Creatis

Simulation

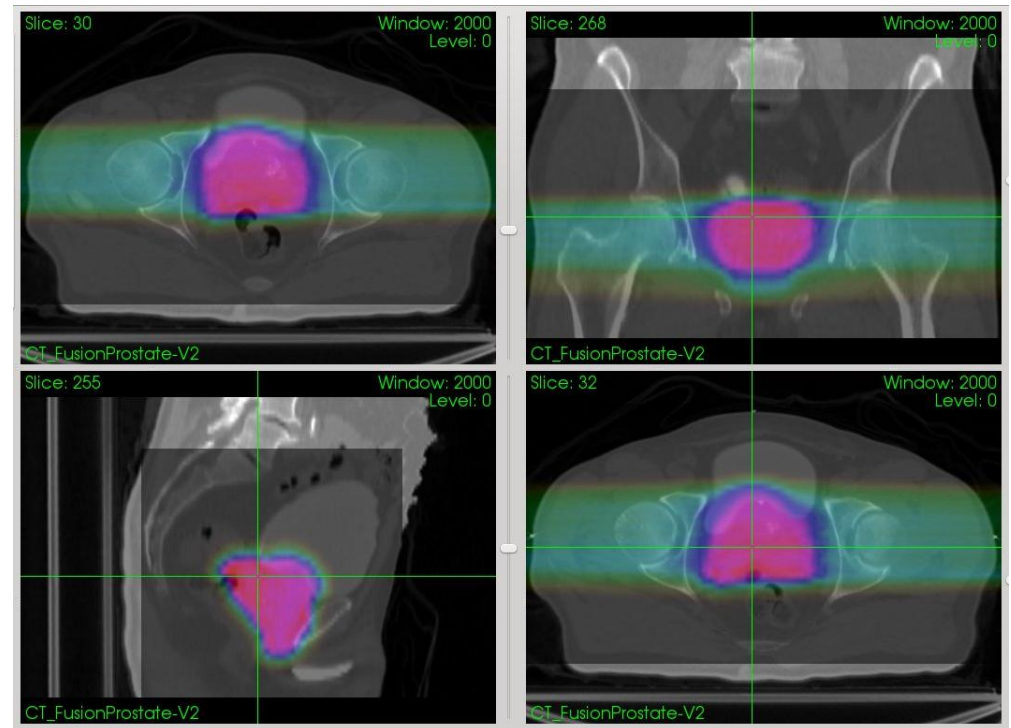
- **Imagerie**



Exemple : simulation 2D+t ultrasons
[O. Bernard]

Calcul: 16h

- **Traitement**



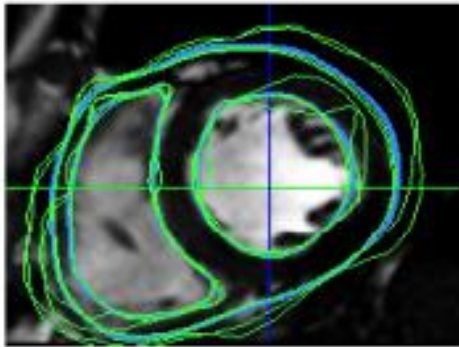
Exemple : plan de traitement de prostate en
protonthérapie.
[L. Grevillot, D. Sarrut]

Calcul: 2 mois

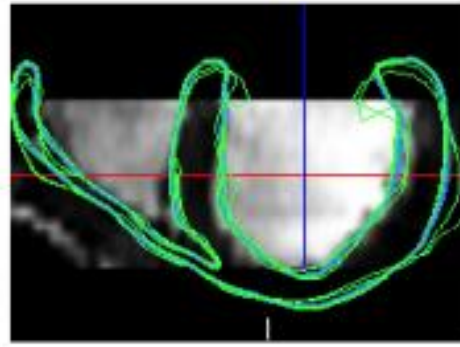
Etudes de paramètres

- **Segmentation**

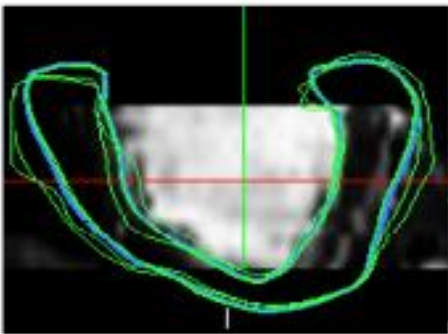
Exemple : 972 segmentations IRM cardiaque 3D



(a) C1, z=30



(b) C1, y=70



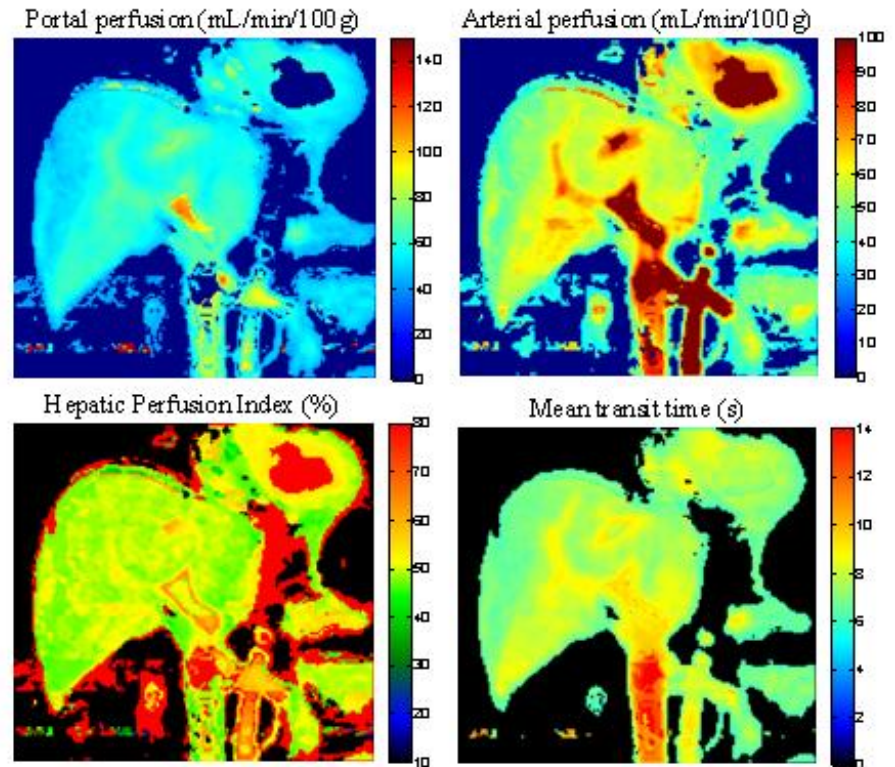
(c) C2, x=88

2.2 jours

[S. Ben Fredj, P. Clarysse, C. Casta]

- **Estimation de paramètres**

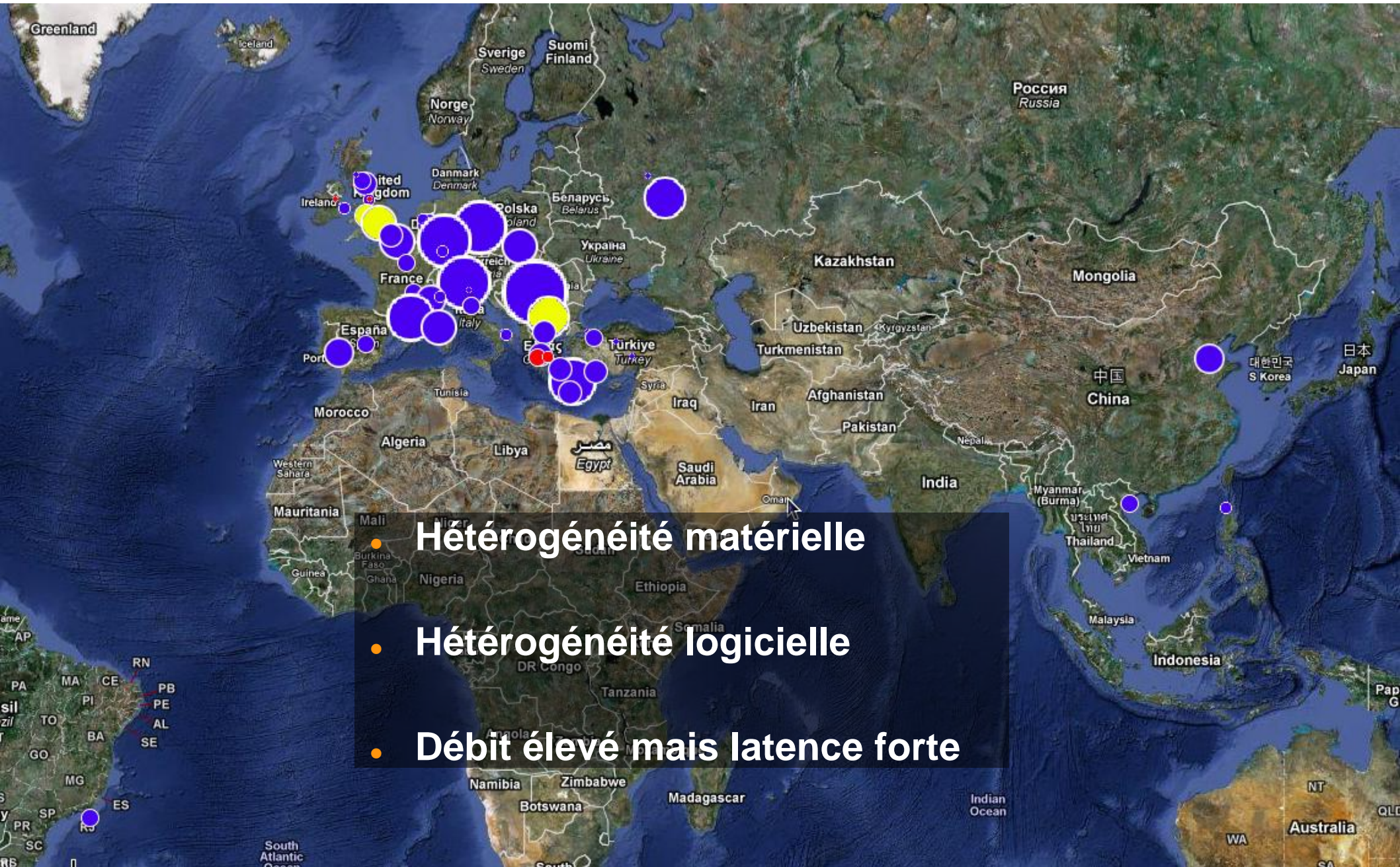
Exemple : paramètres de perfusion hépatique



18 jours / volume

[B. Leporq, F. Pilleul, O. Boeuf]

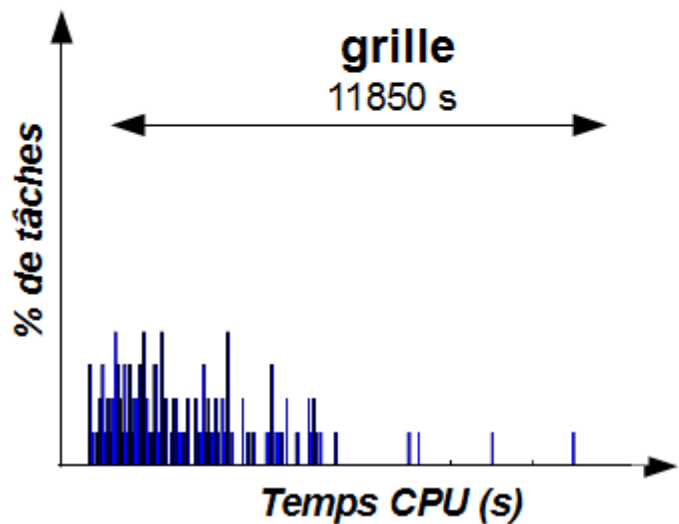
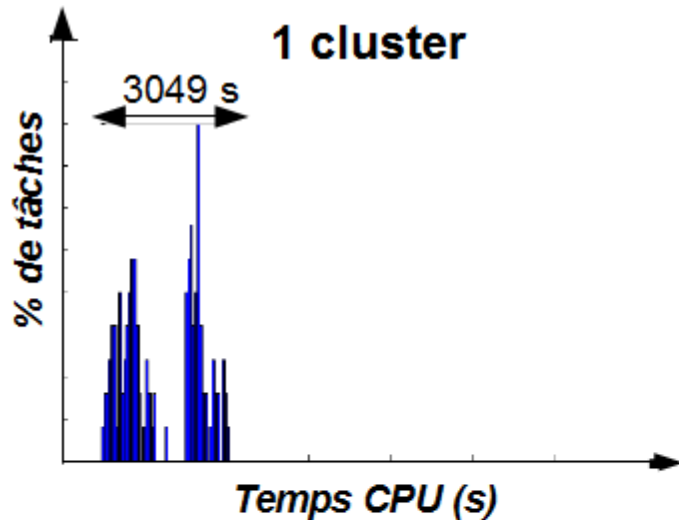
Exécution distribuée



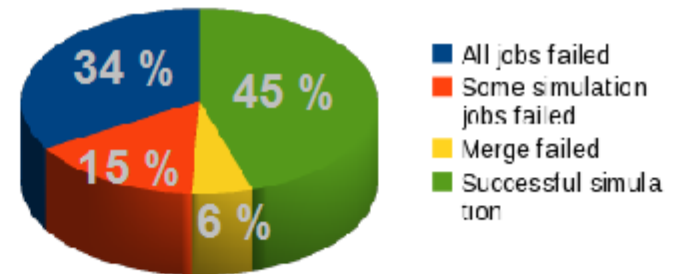
- Hétérogénéité matérielle
- Hétérogénéité logicielle
- Débit élevé mais latence forte

Enjeux

- **Hétérogénéité matérielle**

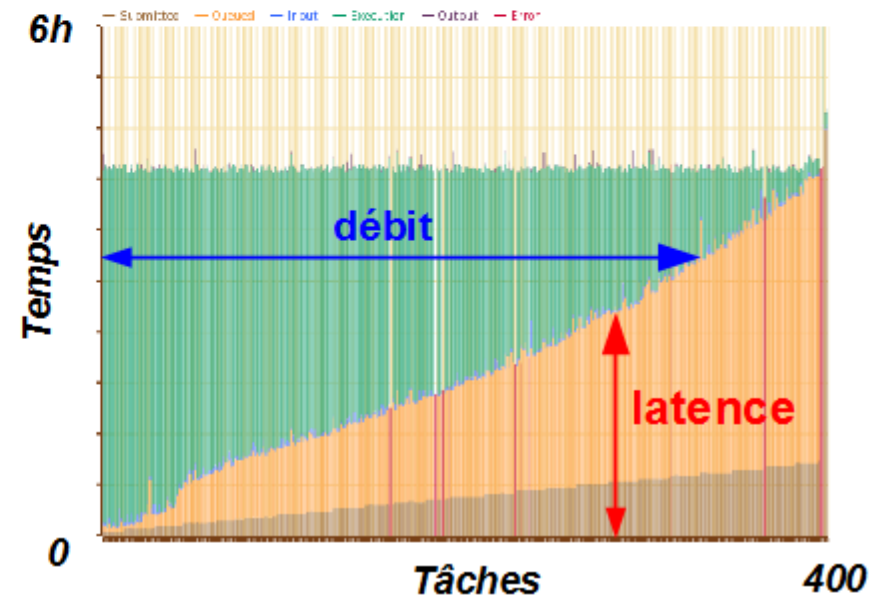


- **Hétérogénéité logicielle**

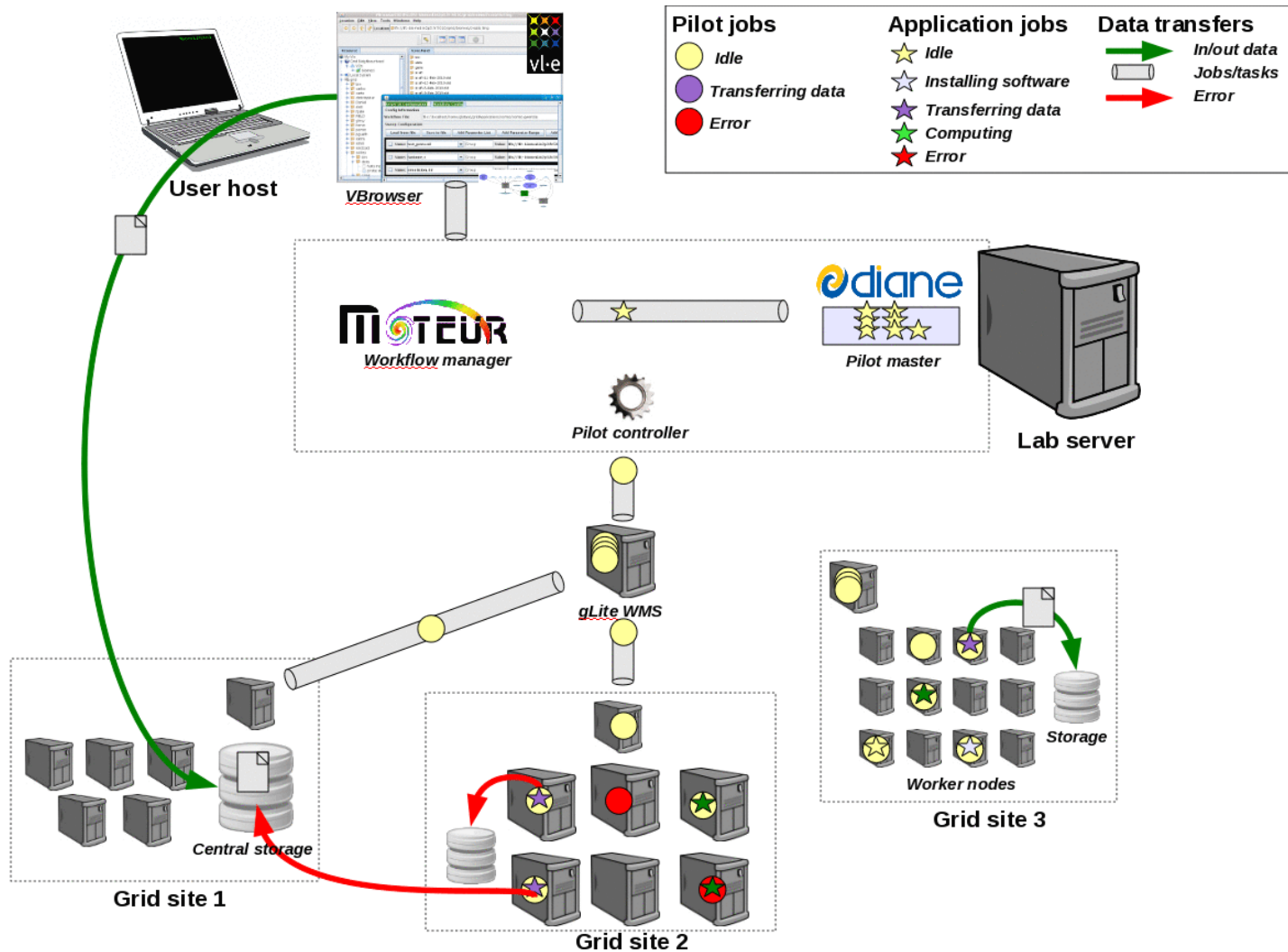


(total: 197 simulations, avril – septembre 2010)

- **Débit VS latence**

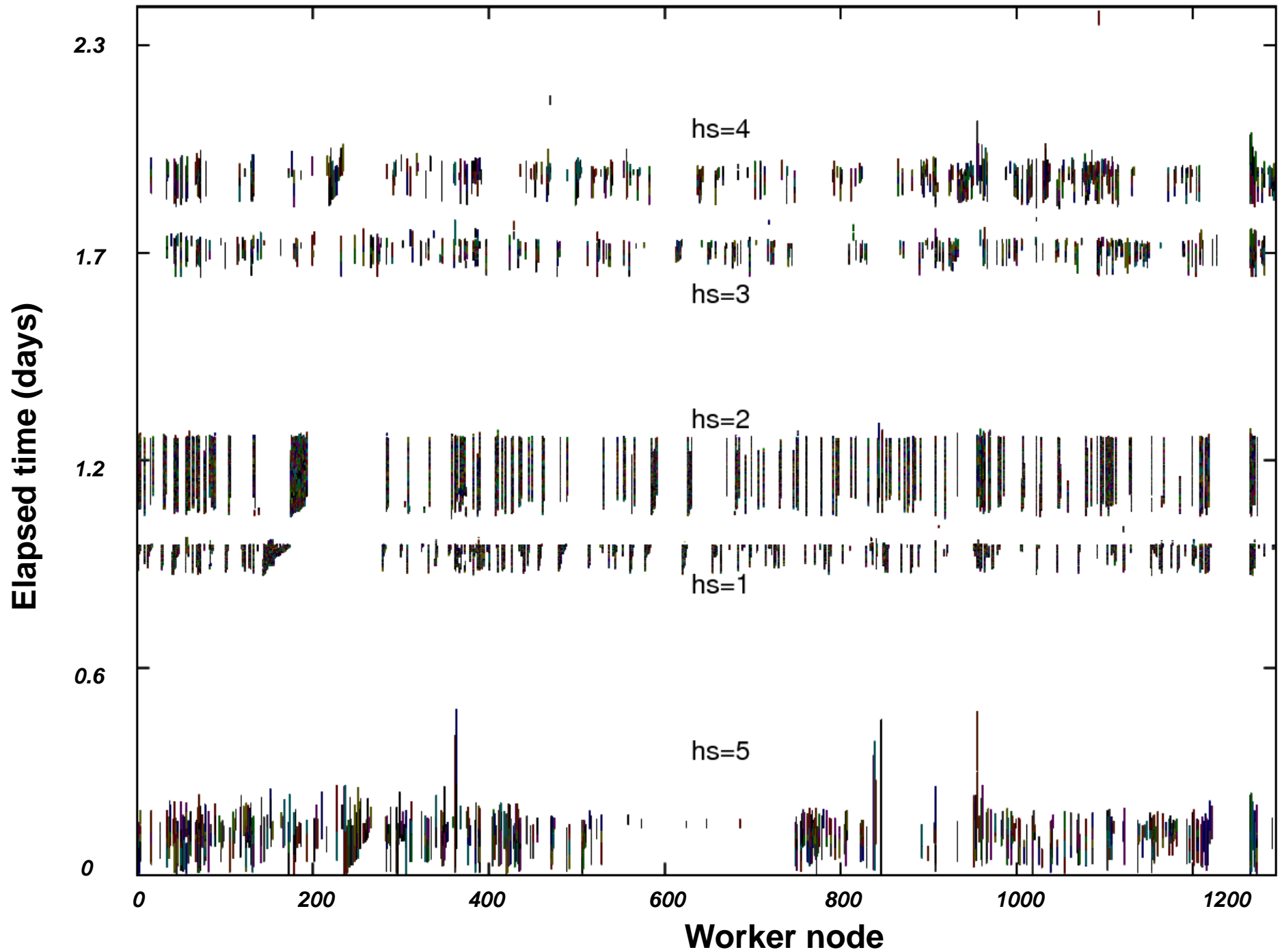


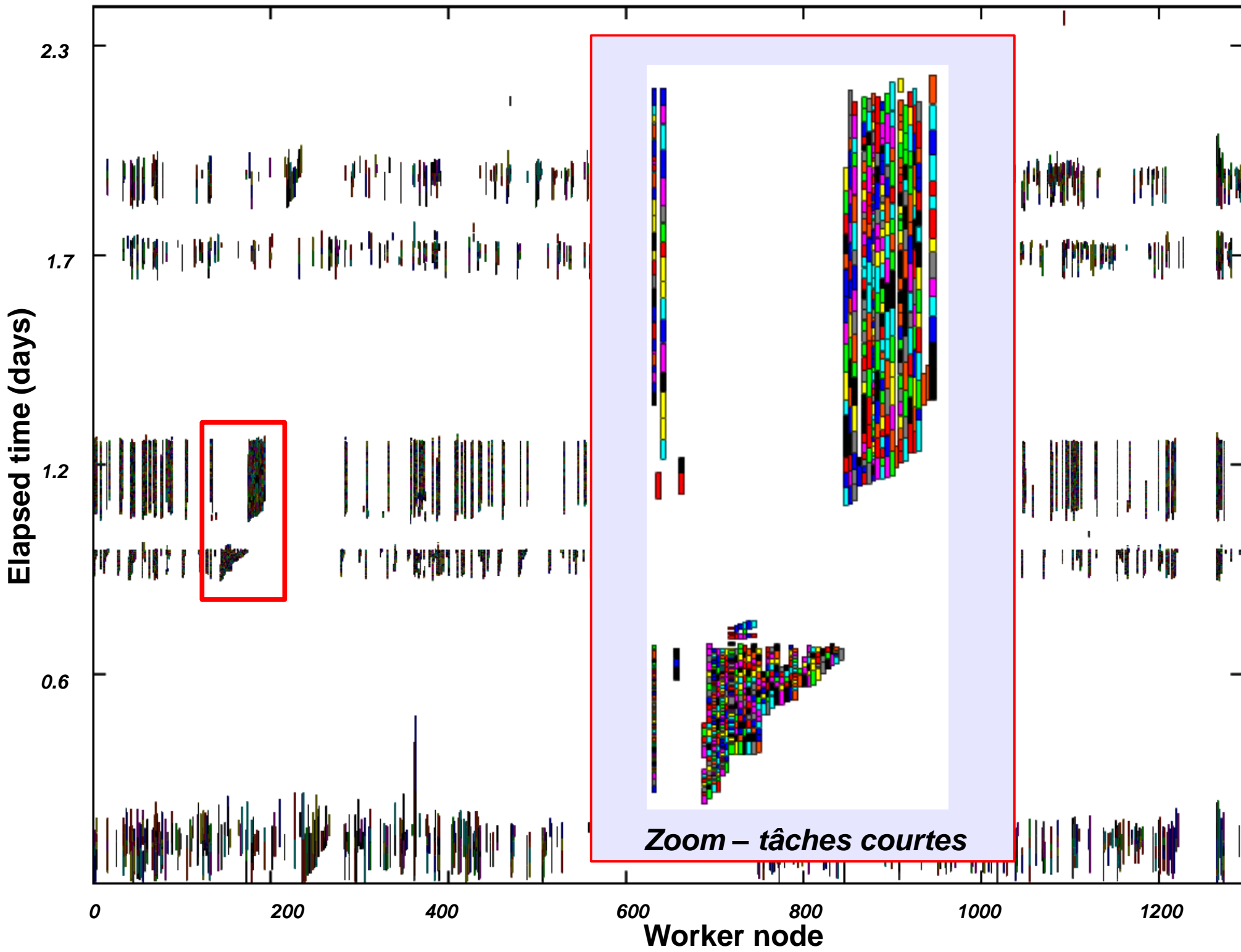
Architecture logicielle

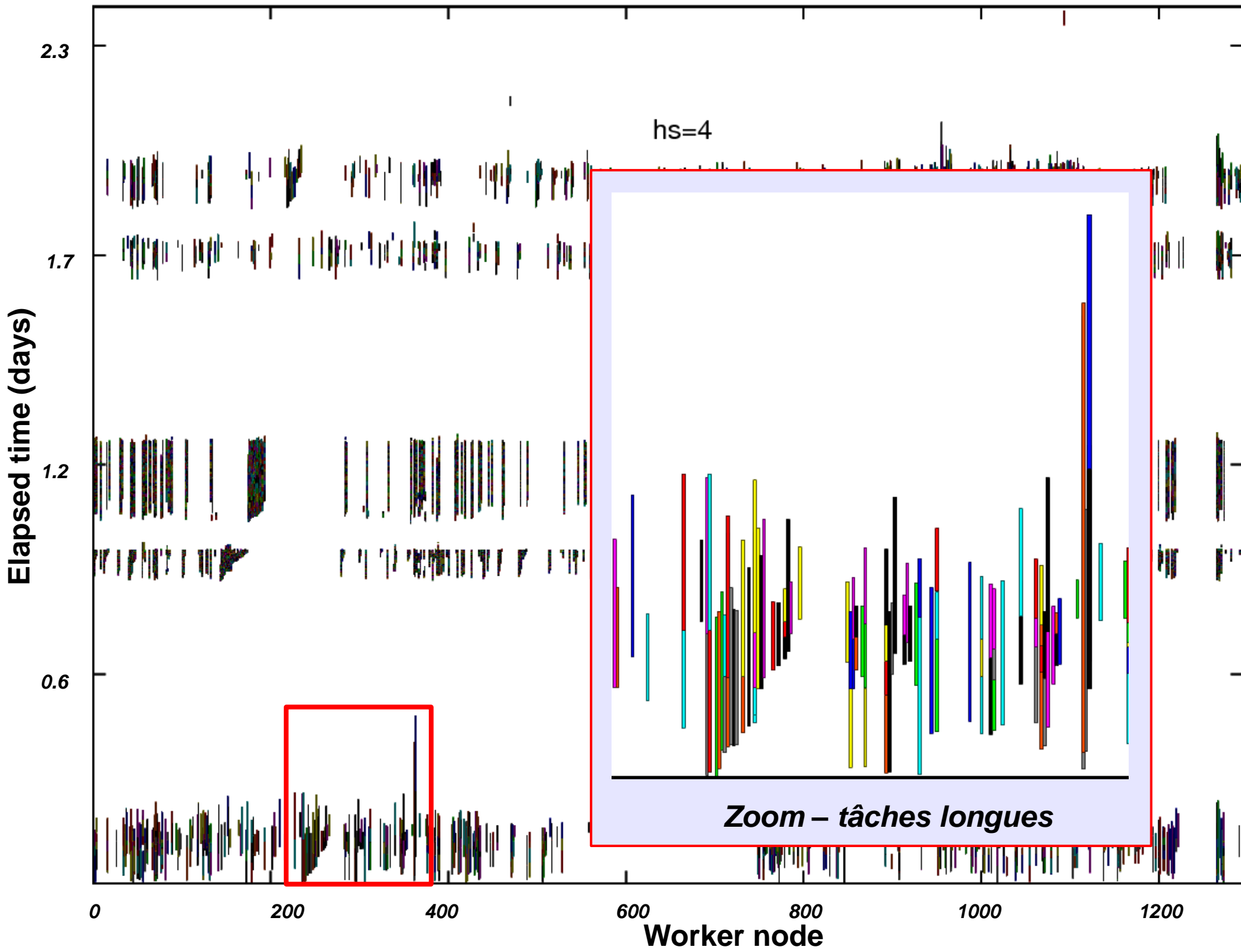


- Résilience
- Passage à l'échelle

Equilibrage de charge



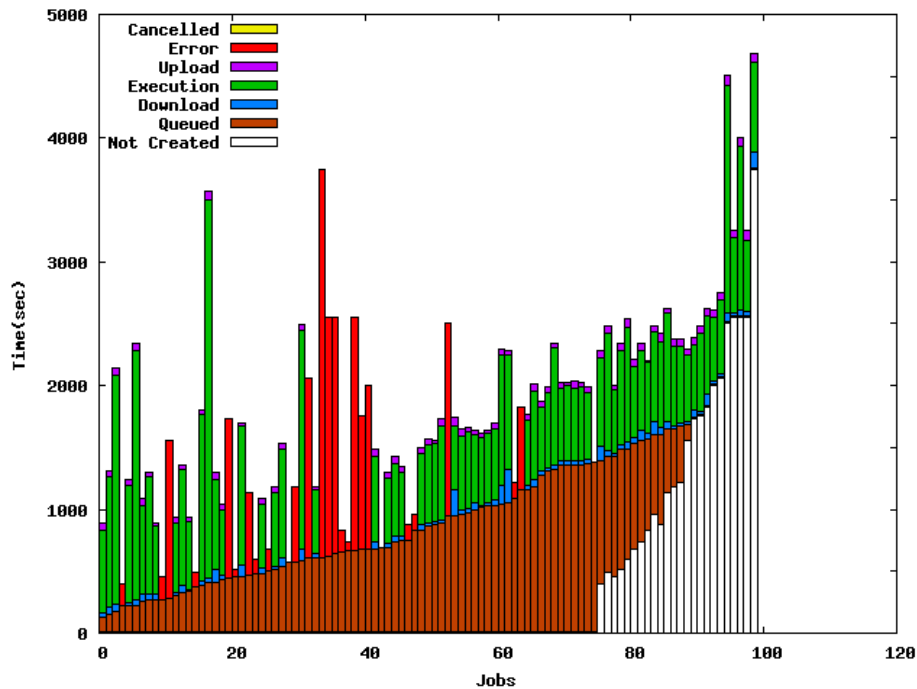




Cas des simulations Monte-Carlo

Statique

Worker:
Simule p/n particules



Dynamique

Worker:
Tant que "stop" non reçu:
Simule 1 particule
Fin tant que

Master:
Tant que $p \neq P$
 $p \leftarrow \#$ particules simulées
Fin tant que
Stoppe tous les workers

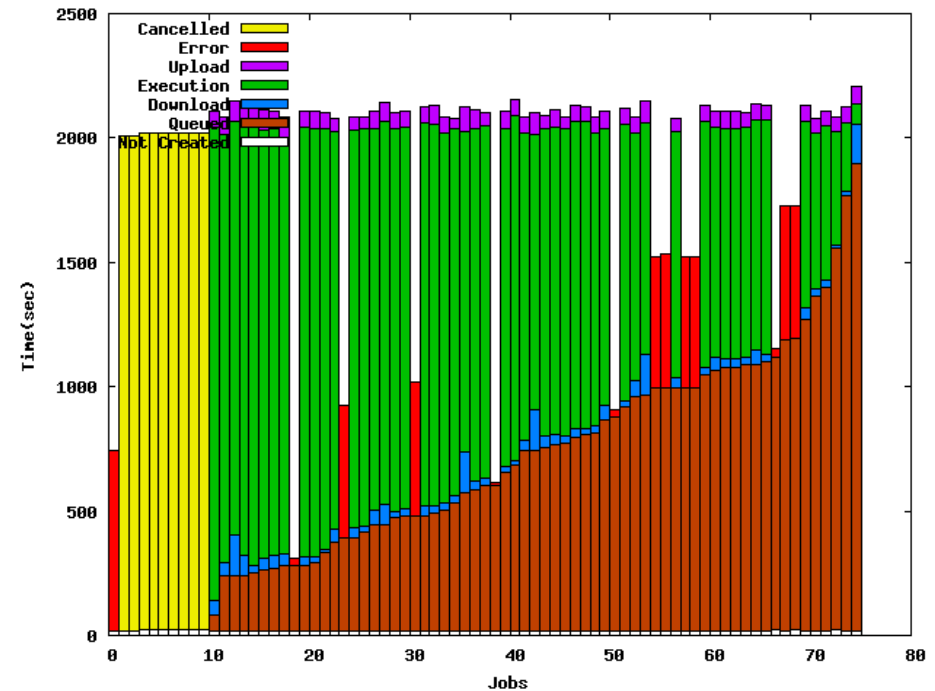


Plate-formes de calcul

- **Grilles de volontaires**

Active: 307,337 volunteers, 513,662 computers.
24-hour average: 5,114.85 TeraFLOPS.

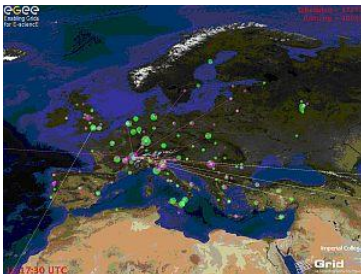
Jiri Kovar is contributing 6,093 GFLOPS.
Country: Czech Republic; Team: LITOMYSL Boinc Team
Czech Republic



**< 500,000
PCs**

Ex: BOINC
5 PFlop/s

- **Grilles**



< 80,000 PCs

Ex: EGI
1 PFlop/s

- **Cluster**



< 5,000 PCs

Ex: CREATIS cluster
700 GFlop/s

- **Supercalculateur**



< 23,000 coeurs

Ex: Tianhe-1A
2500 PFlop/s

- **GPU**



< 1024 coeurs

Ex: NVIDIA Quadro NVS 160M
34.8 GFlop/s

- **CPU Multicoeur**



2 – 80 coeurs

Ex: Intel Core2 Duo
20 GFlop/s

Vers une intégration transparente ?

- Grilles de volontaires

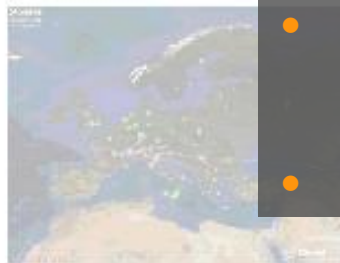
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Czech Republic



- Déploiement d'applications simple

- Grilles



- Exécution fiable

- Exécution efficace

1 PFlop/s

- Cluster



Ex: CREATIS cluster

- Supercalculateur



Ex: Tianhe-1A
2500 PFlop/s

- GPU



Ex: NVIDIA Quadro NVS 160M
34.8 GFlop/s

- CPU Multicoeur



Ex: Intel Core2 Duo

Questions ?

Crédits : S. Camarasu-Pop, R. Silva, D. Sarrut, L.Grevillot, O. Bernard, P. Clarysse, C. Casta, S. Ben-Fredj, B. Leporq, F. Pilleul, O. Boeuf,

Creatis