

OCELOT + FRAMESOC : TOOLS FOR HUGE TRACE ANALYSIS OVER TIME AND SPACE

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Context Ocelotl Aggregation Method
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Temporal Overview Spatiotemporal Overview
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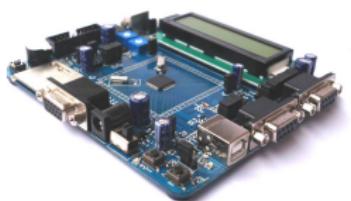
Implementation Framesoc Performance
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TRACES + SLIDES

**[http://moais.imag.fr/membres/damien.dosimont/files/
traces/ocelotl.pdf](http://moais.imag.fr/membres/damien.dosimont/files/traces/ocelotl.pdf)**

CONTEXT

SOC-TRACE PROJECT



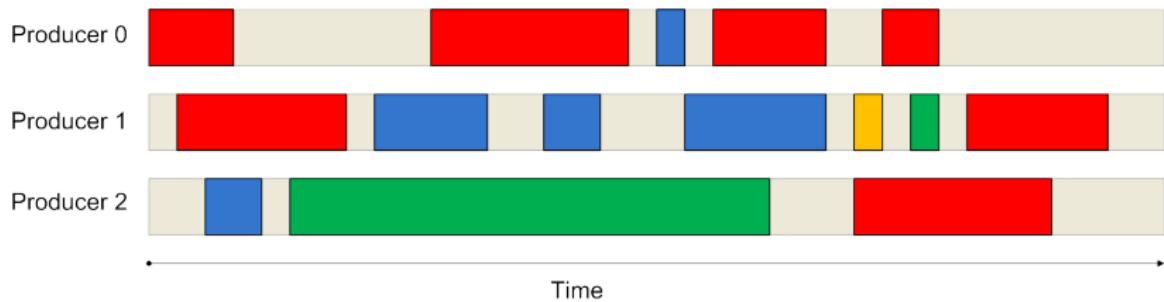
- ▶ Inria, UJF, STMicroelectronics, ProbaYes, Magillem
- ▶ **Objective:** Analysis flow of execution traces of embedded multimedia applications
- ▶ **Main contributions:**
 - **Framesoc: trace, tool and analysis result management infrastructure (MESCAL)**
 - FrameMiner, MegaLog: data mining, pattern recognition, probabilistic analysis (HADAS, ProbaYes)
 - **Ocelotl: trace overviews based on data and visual aggregation (MOAIS)**

PARALLEL AND DISTRIBUTED SYSTEM ANALYSIS



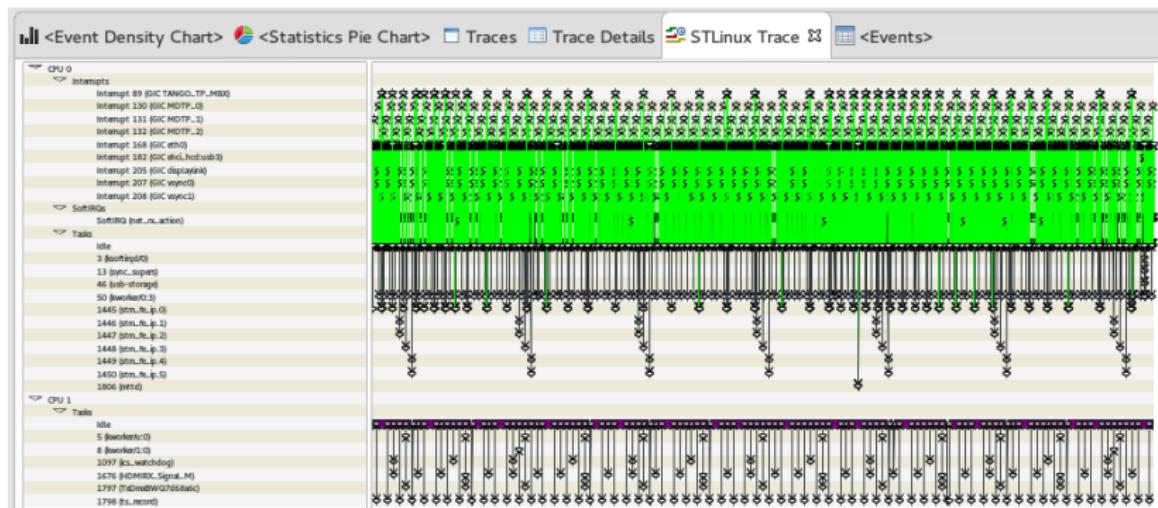
OCELOT : MULTIDIMENSIONAL AGGREGATION FOR HUGE TRACE OVERVIEW

SPACE-TIME REPRESENTATION PROBLEMATIC



- ▶ Structure can be composed of millions of resources
 - ▶ Trace can contain billions of events (up to TB)

LIMITED SCREEN SIZE ISSUES



COMPUTATION - RENDERING - INTERACTIVITY ISSUES



Context
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Ocelotl
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Aggregation Method
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Temporal Overview

Spatiotemporal Overview

Implementation

Framesoc
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Performance

ANALYST CAPABILITY LIMITS

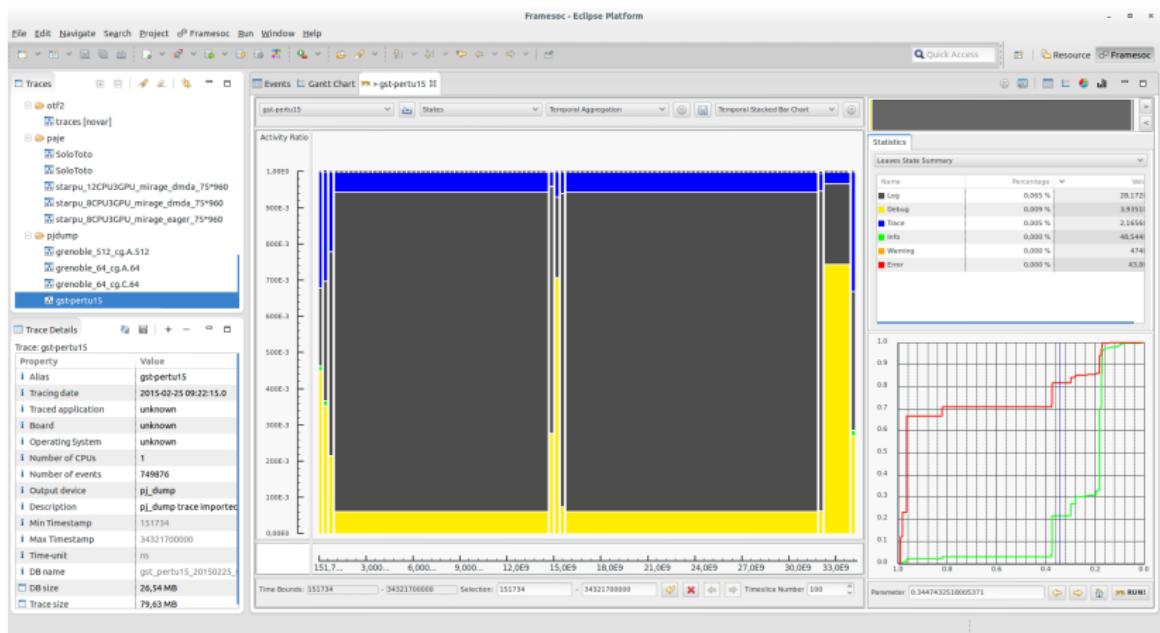


OUR PROPOSAL: OCELOT MULTIDIMENSIONAL OVERVIEWS

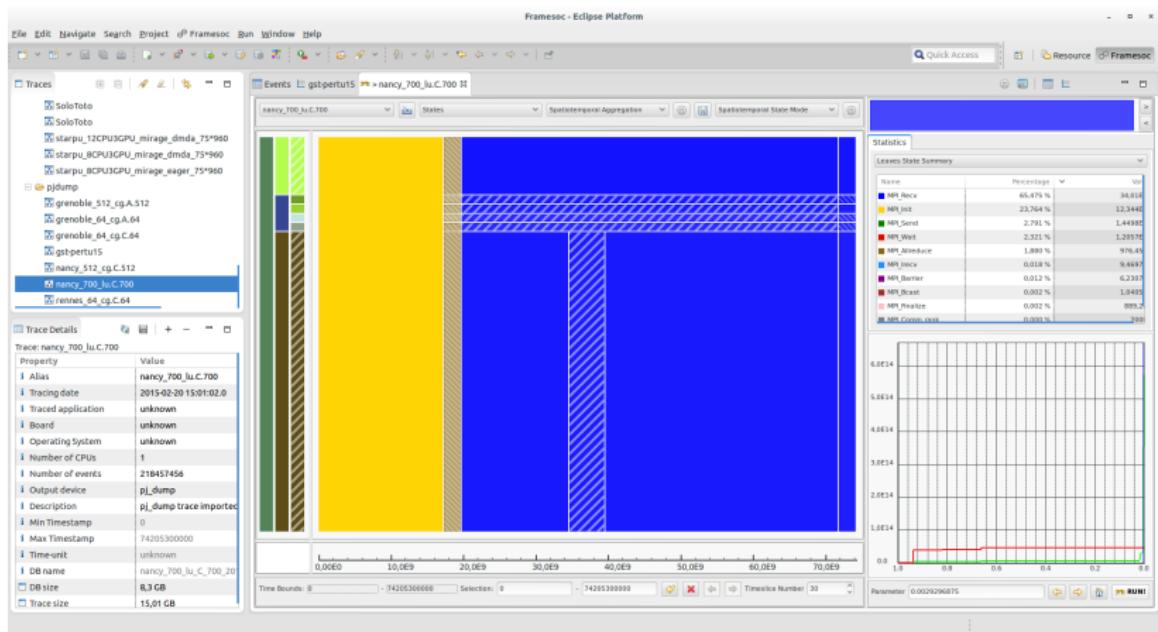


- ▶ Overviews generated using **data and visual aggregation**
- ▶ Showing **meaningful information** (phases, perturbations)
- ▶ Enabling to adjust dynamically the **level of details**
- ▶ **Interaction:**
 - Zoom
 - Filtering
 - Synchronized statistics
 - Switch to other representations

OCELOT: TEMPORAL AGGREGATION

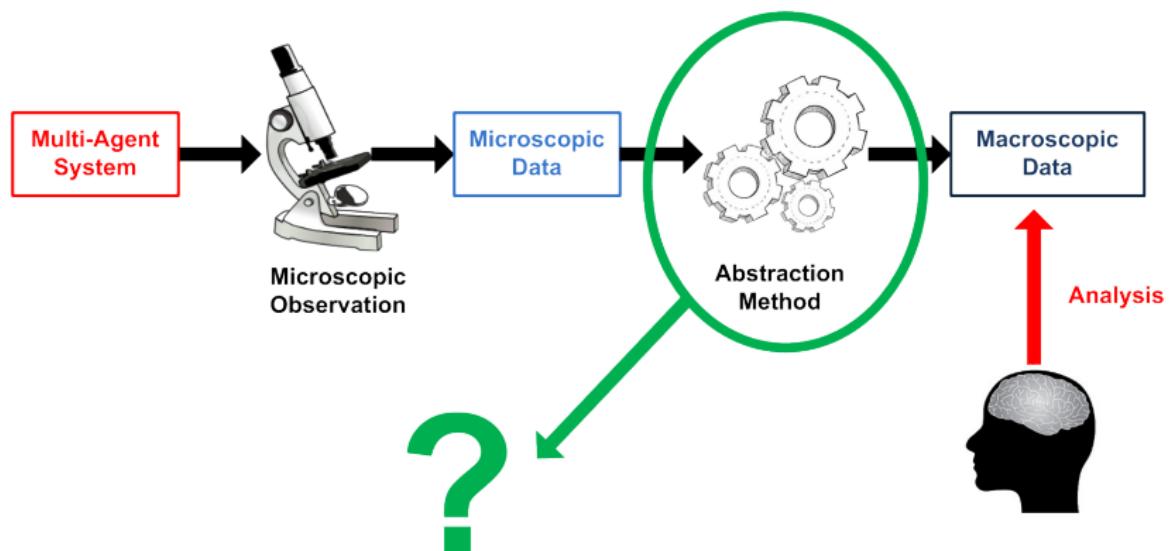


OCELOT: SPATIOTEMPORAL AGGREGATION



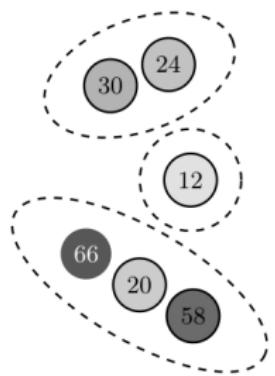
AGGREGATION METHOD

ADAPTING AN AGGREGATION METHOD (LP)

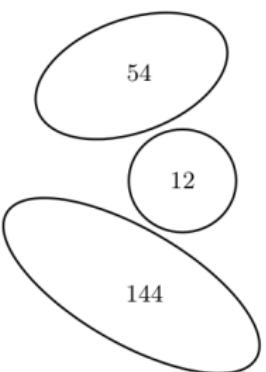


AGGREGATION PROCESS

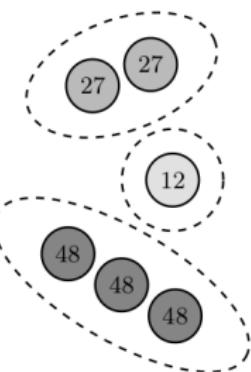
Partition



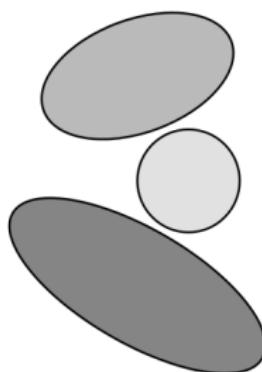
Aggregation



Redistribution

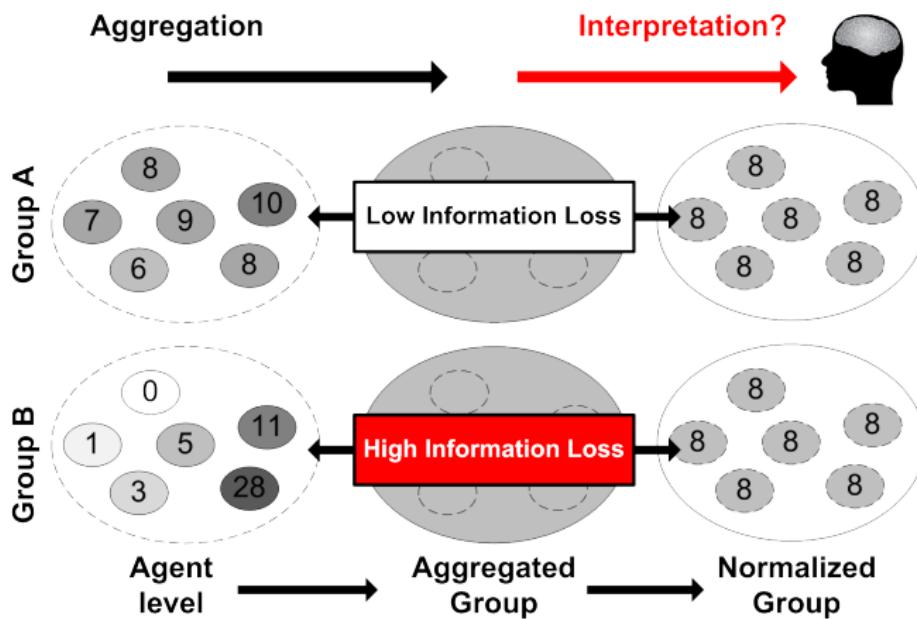


Visualization



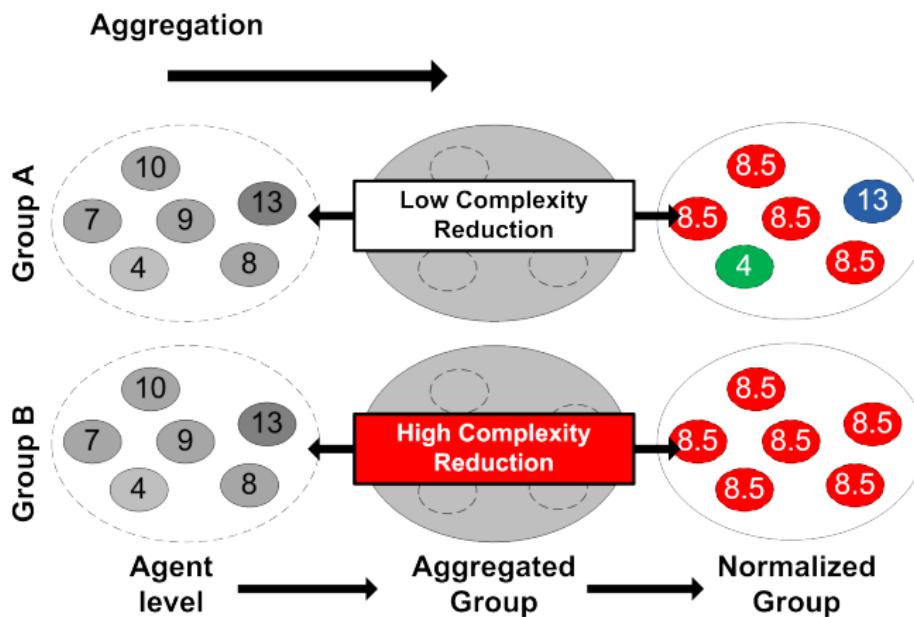
- ▶ **Best Partition Problem** : determine how to partition

INFORMATION LOSS: KL DIVERGENCE



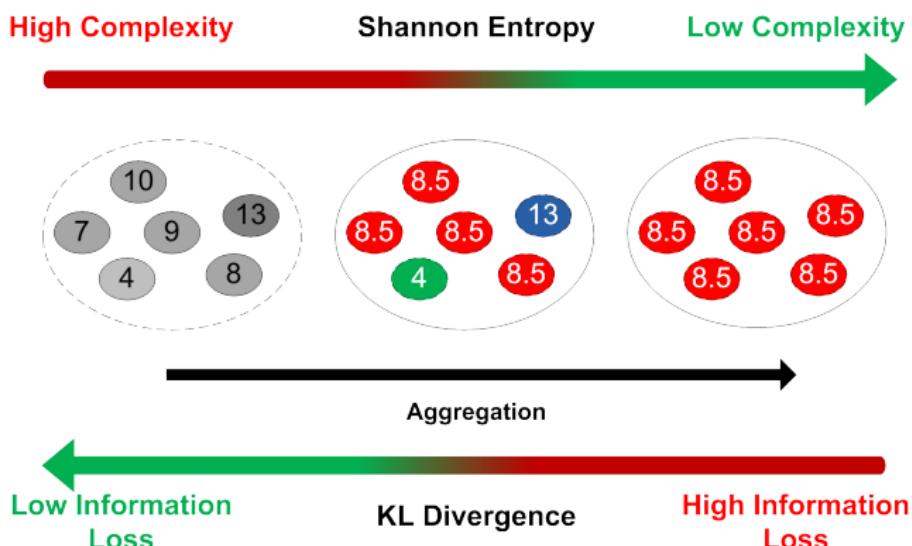
$$\text{loss}_E = \sum_{e \in E} \rho_e \log_2 \left(\frac{\rho_e}{\rho_E} \right)$$

COMPLEXITY REDUCTION: SHANNON ENTROPY



$$\text{gain}_E = \rho_E \log_2 \rho_E - \sum_{e \in E} \rho_e \log_2 \rho_e$$

TRADE-OFF: PIC



$$\text{pIC}_E = p \text{gain}_E - (1-p) \text{loss}_E$$

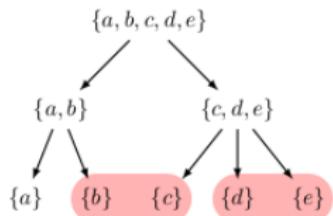
$$\text{pIC}_{\mathcal{P}} = \sum_{E \in \mathcal{P}} \text{pIC}_E$$

- ▶ For a given p : choose \mathcal{P} with the highest pIC
- ▶ Aggregate in priority most homogeneous values

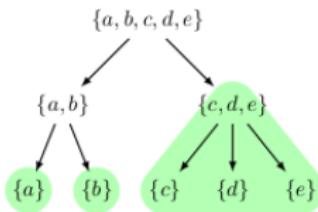
CONSTRAIN THE AGGREGATION

- Ex: Hierarchy

Forbidden Aggregates

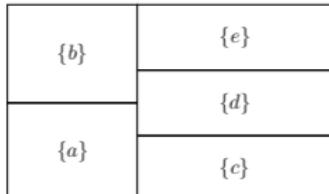


Valid Partition

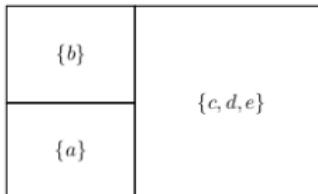


- Associated Treemap Representation

Microscopic Level

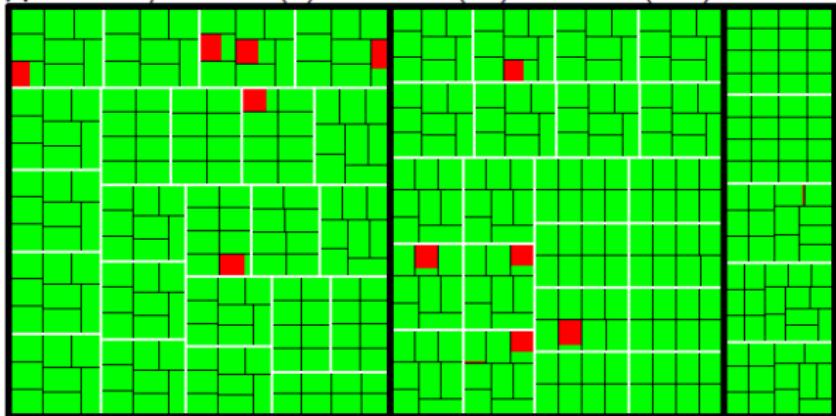


Multiresolution Aggregation



VIVA: SPATIAL AGGREGATION (SCHNORR & LP)

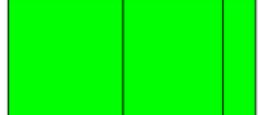
A Hierarchy: Cluster (3) - Machine (50) - Process (433)



A.1 Machine level



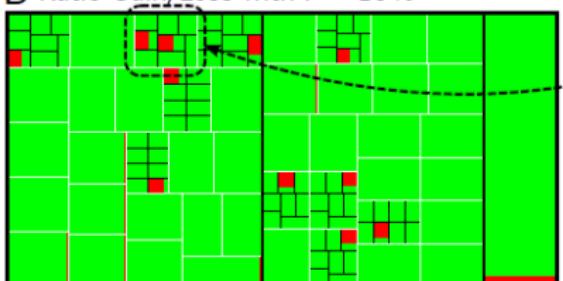
A.2 Cluster level



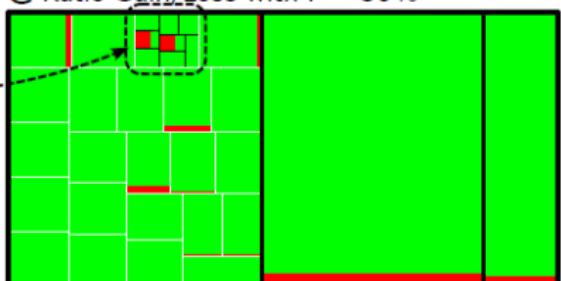
A.3 Full aggregation



B Ratio Gain/Loss with P = 10%

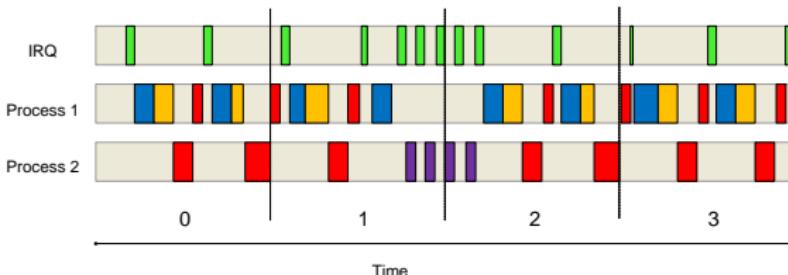


C Ratio Gain/Loss with P = 30%



TEMPORAL OVERVIEW

GENERATE A TRACE MICROSCOPIC MODEL

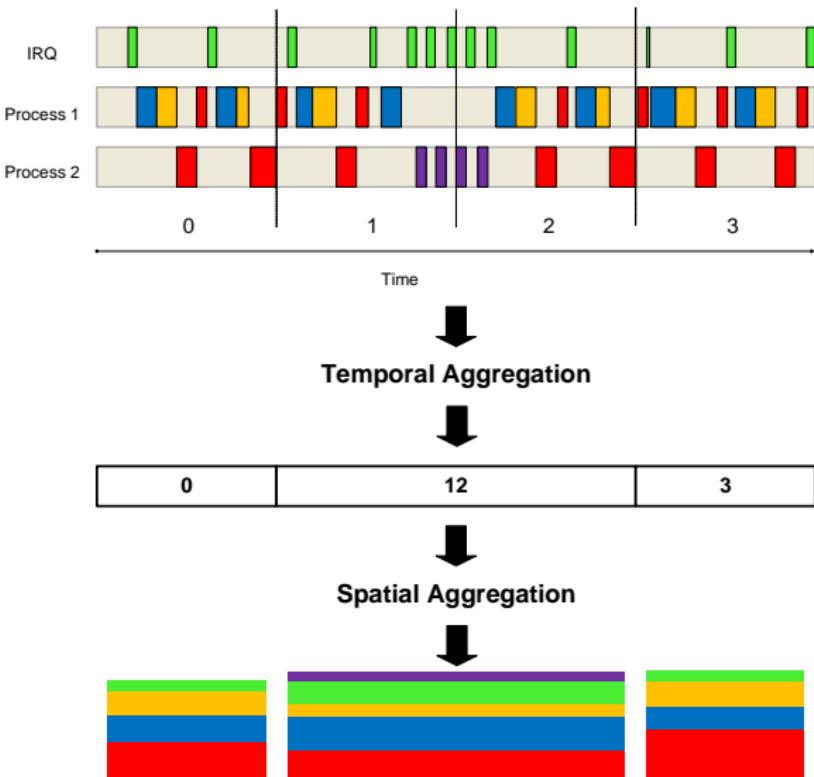


IRQ	0	0	0	0
Process 1	1	2.1	1	3
Process 2	4.1	2	4.1	4

IRQ	2	4.9	3	2.4
Process 1	0	0	0	0
Process 2	0	0	0	0

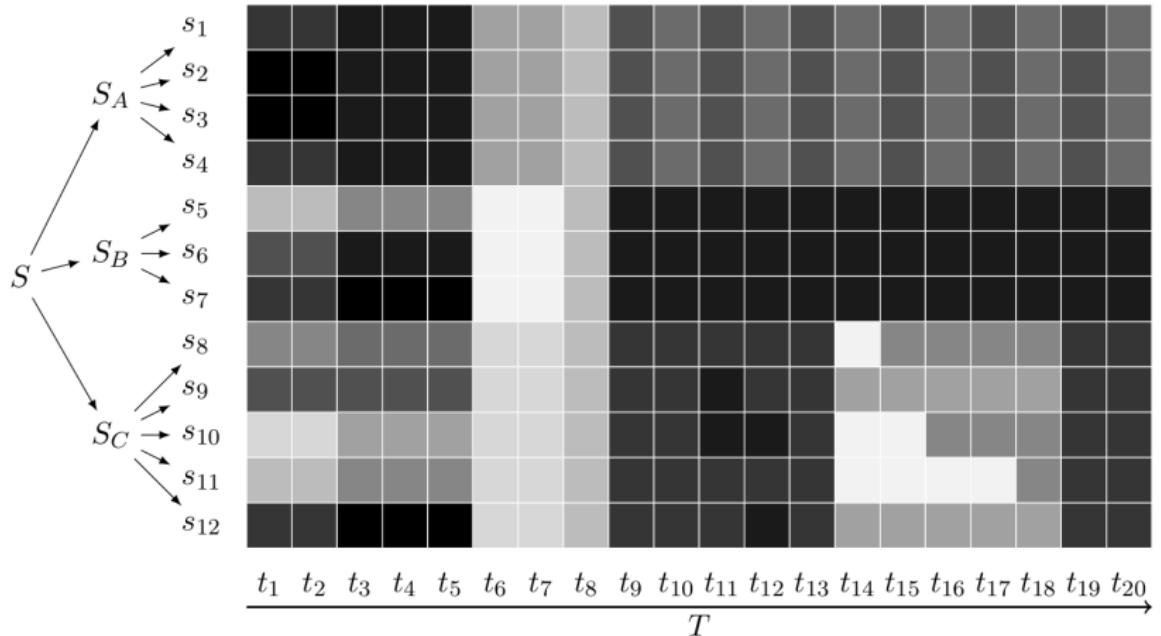
And so on...

TEMPORAL AGGREGATION AND VISUALIZATION



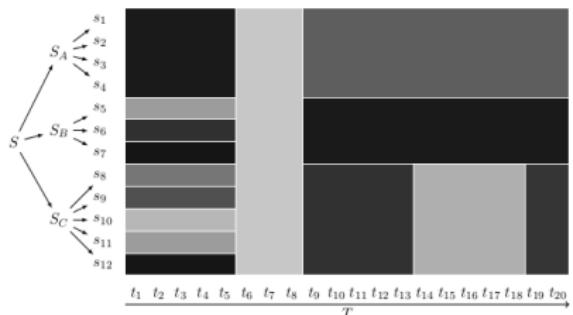
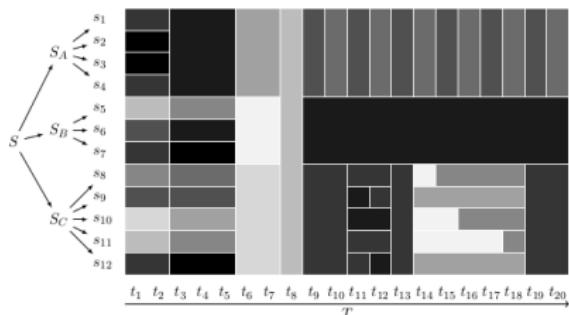
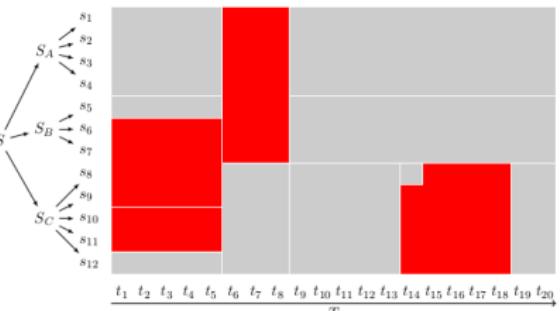
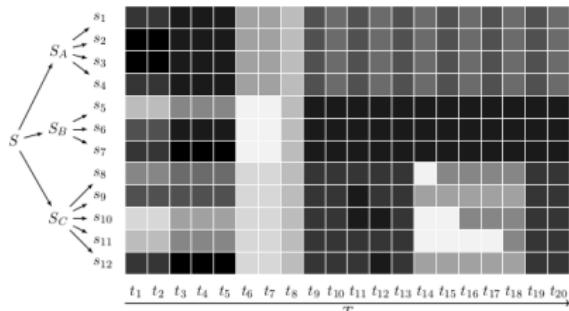
SPATIOTEMPORAL OVERVIEW

TRACE MICROSCOPIC MODEL



$$|X| = 2, \rho_x(s, t) = d_x(s, t)/d(t) \in [0, 1], \rho_1(s, t) = 1 - \rho_2(s, t)$$

AGGREGATE THE MICROSCOPIC MODEL



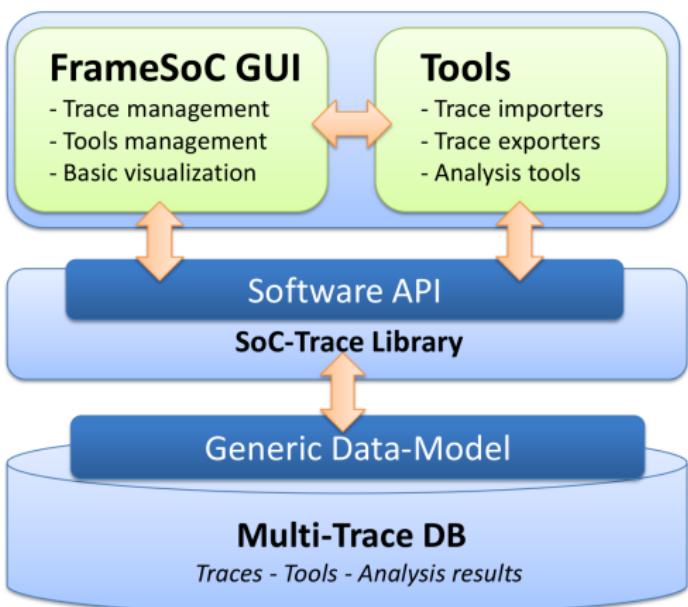
IMPLEMENTATION

OCELOT

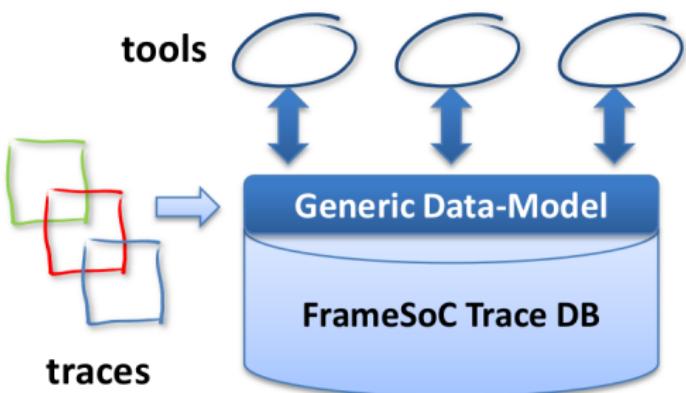
- ▶ Implementation of the overview techniques
- ▶ Generic architecture. Add:
 - Your own **aggregation operator** (dimensions, metric)
 - Your own **visualization**
- ▶ Persistent caches to avoid long recomputations
- ▶ Integrated in **Framesoc**

FRAMESOC

FRAMESOC

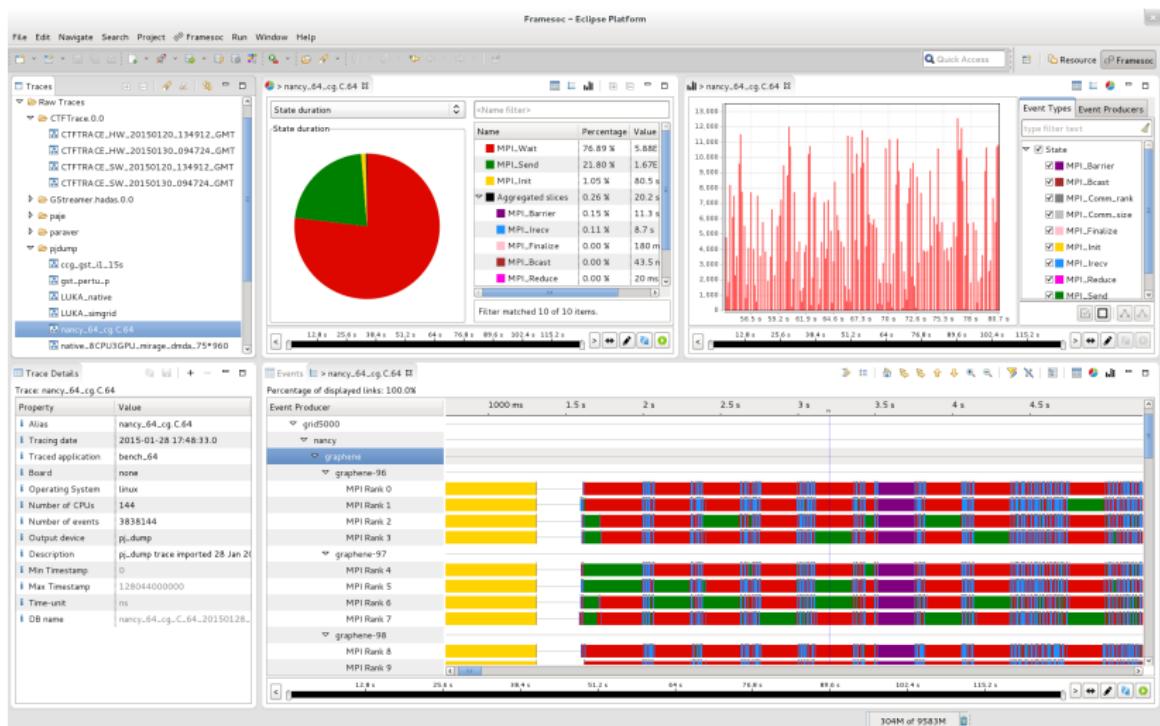


FRAMESOC TRACE MANAGEMENT



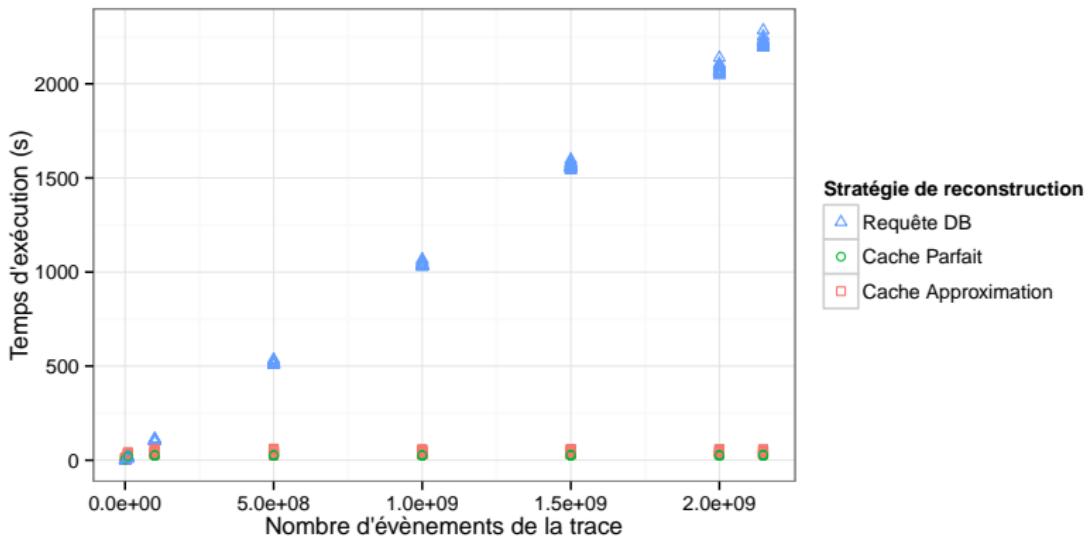
- ▶ Trace **format** compatibility : Pajé, Pajé dumped .csv, OTF2, CTF (LTTng), KPTrace, Paraver (ongoing)
 - ▶ Save trace **meta-data**, execution settings
 - ▶ **DB** performance

GUI AND TOOLS

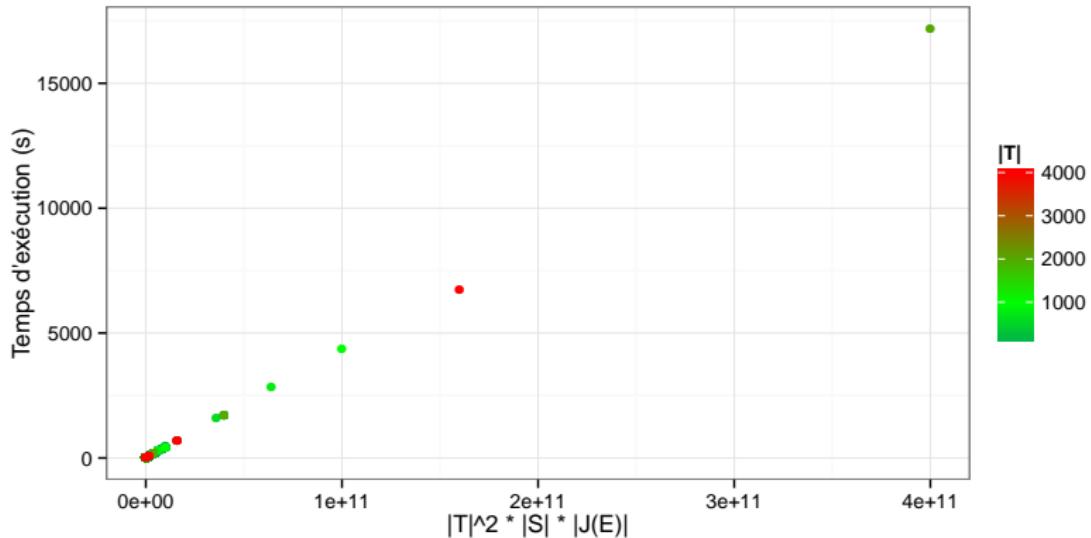


PERFORMANCE

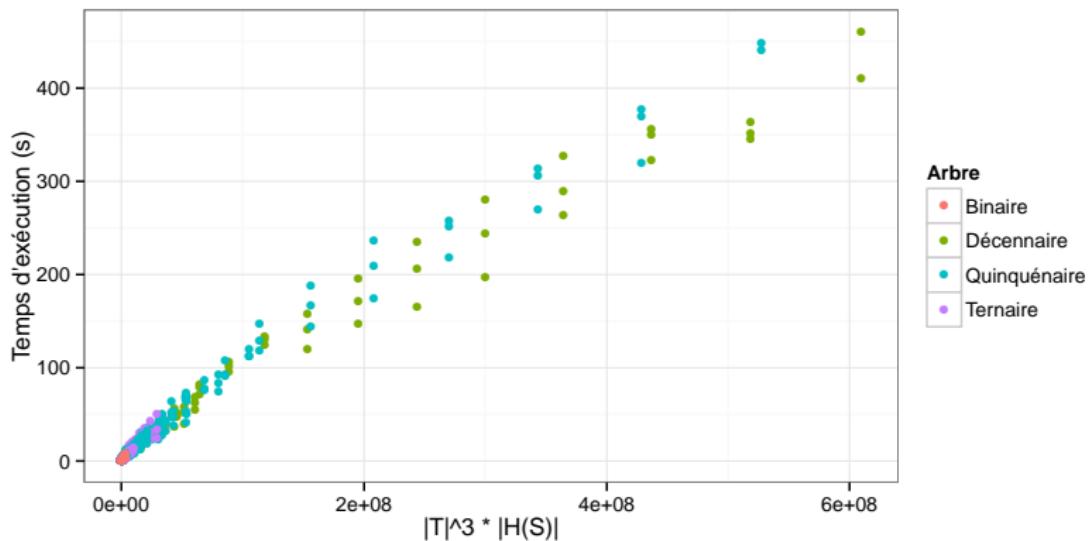
TRACE READING PERFORMANCES



OCELOT TEMPORAL AGGREGATION GLOBAL COMPLEXITY



SPATIOTEMPORAL AGGREGATION GLOBAL COMPLEXITY



JUST A FEW NUMBERS

- ▶ **Nancy LU 700 C:** 12 GB, 218 Mevents
- ▶ **Data cache** (900 time slices) : 32.6 MB
- ▶ **Trace Reading:** 220 s vs Data Cache reading : 1s
- ▶ **Aggregation** : 3 s (T) ; 40 s (ST) vs 3 s with dichotomy cache
- ▶ **Max Ressources** : 10^5 (T), 10^4 (ST), but pre-aggregation possible
- ▶ **Trace Max Events** : 2.1 Gevents (70 GB)
- ▶ Framesoc Gantt : 100 Mevents (5 GB)

CONCLUSION

CONCLUSION

- ▶ **Visualizations based on data and visual aggregation**

- Solves screen, computing and analyst capability limitations
- Gives meaningful information about homogeneity (phases, perturbations)

- ▶ **Implementation:**

- **Interaction** (zoom, switch to other tools)
- **Performance** enhanced by caches and Framesoc characteristics

- ▶ **Improvement axes:**

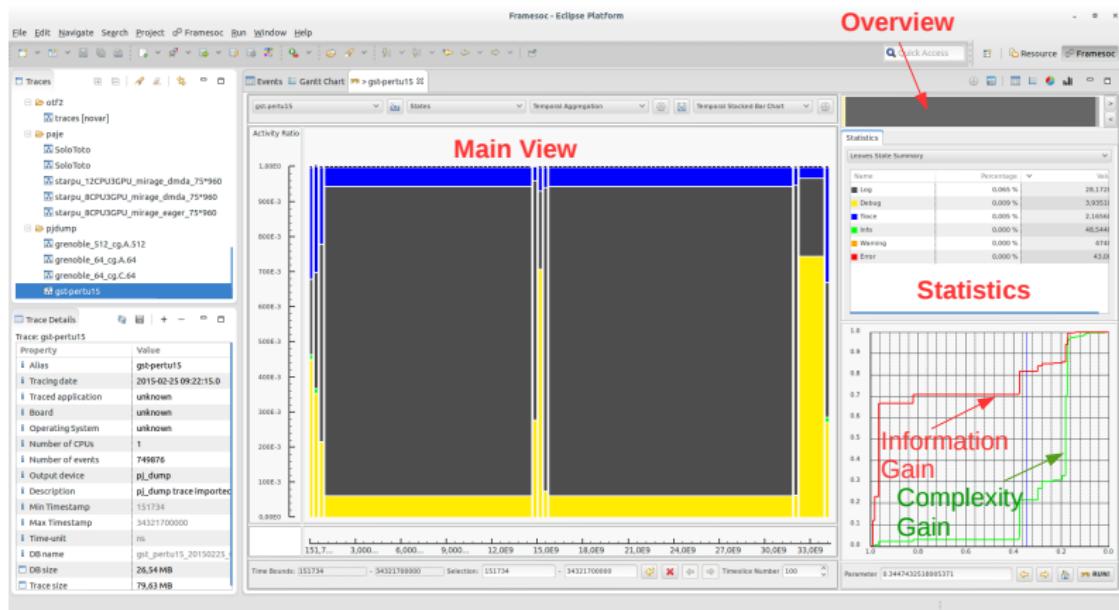
- New aggregation algorithms/metrics/aggregation operators
- Visualization & interaction
- Analysis of **your** applications

THANK YOU FOR YOUR ATTENTION

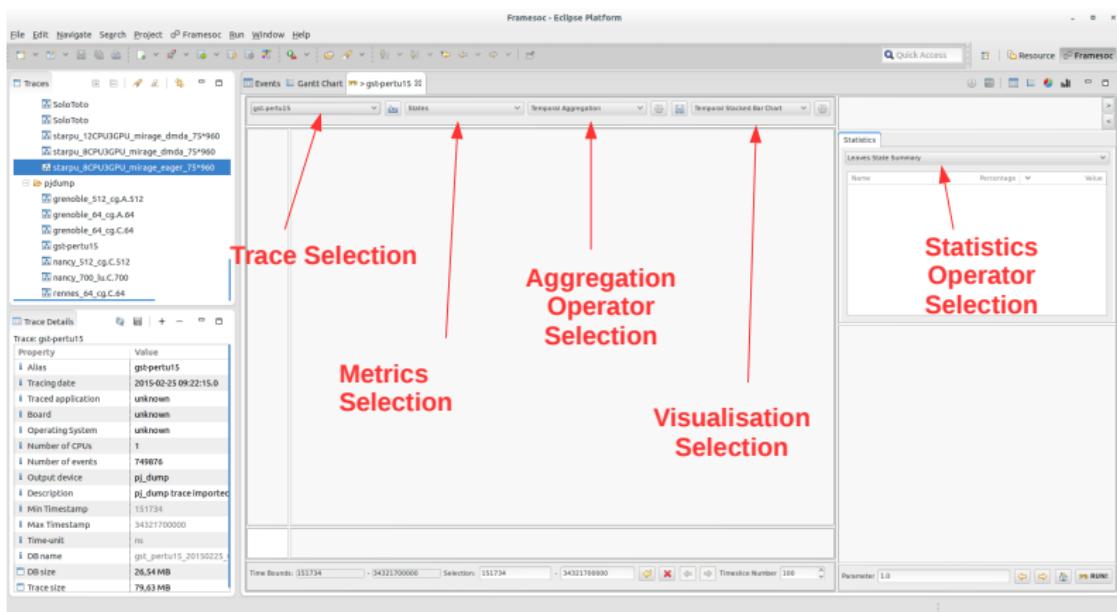


OCELOT TUTORIAL

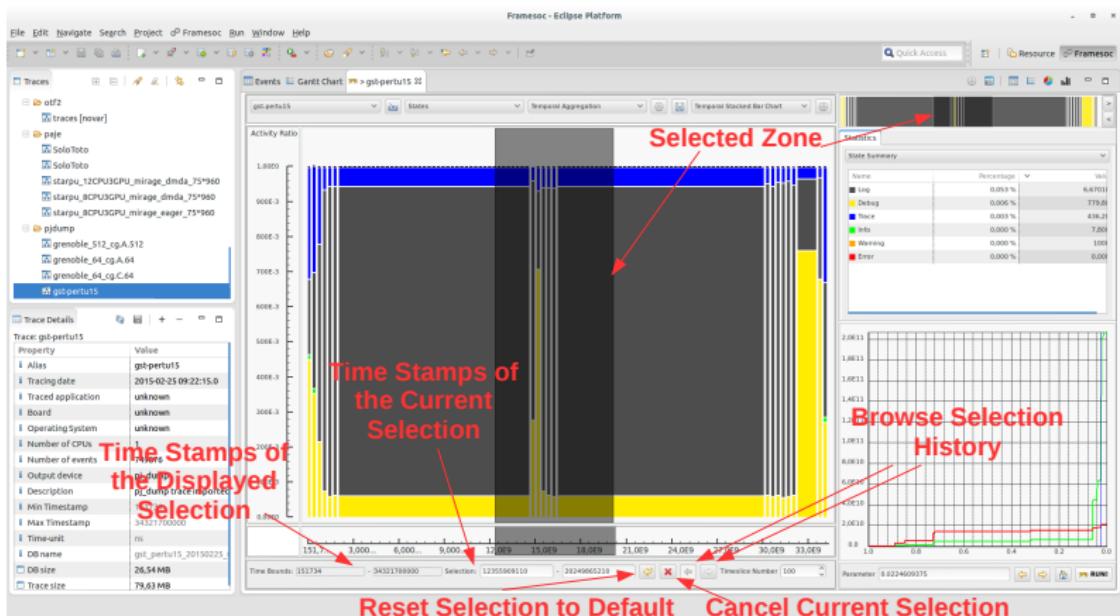
OCELOT: STARTUP OVERVIEW



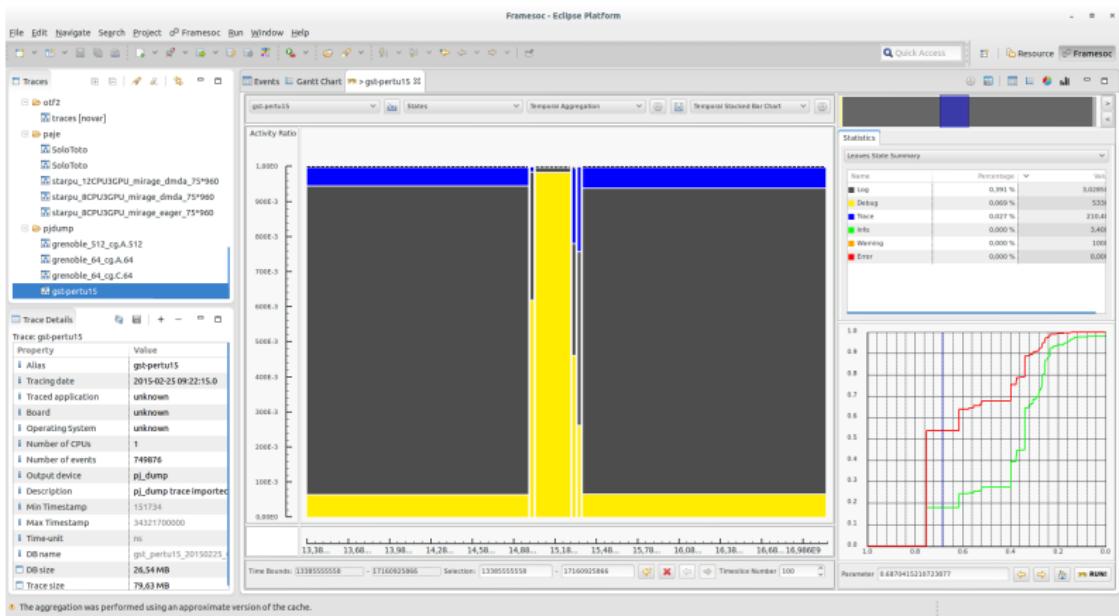
OCELOT: TRACE SELECTION



OCELOT: TEMPORAL SELECTION

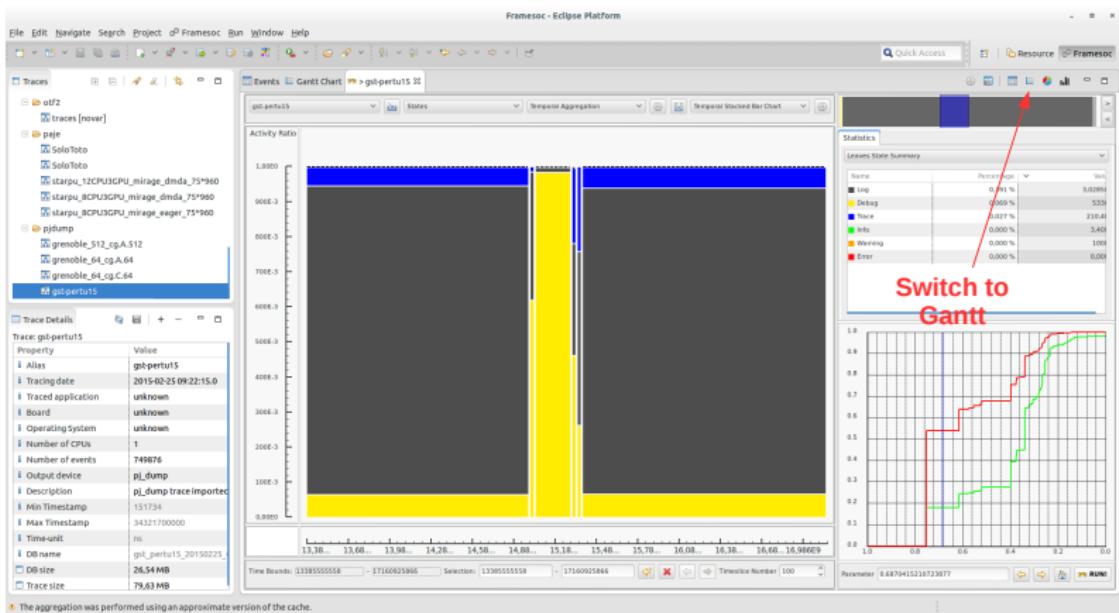


OCELOT: ZOOM RESULT

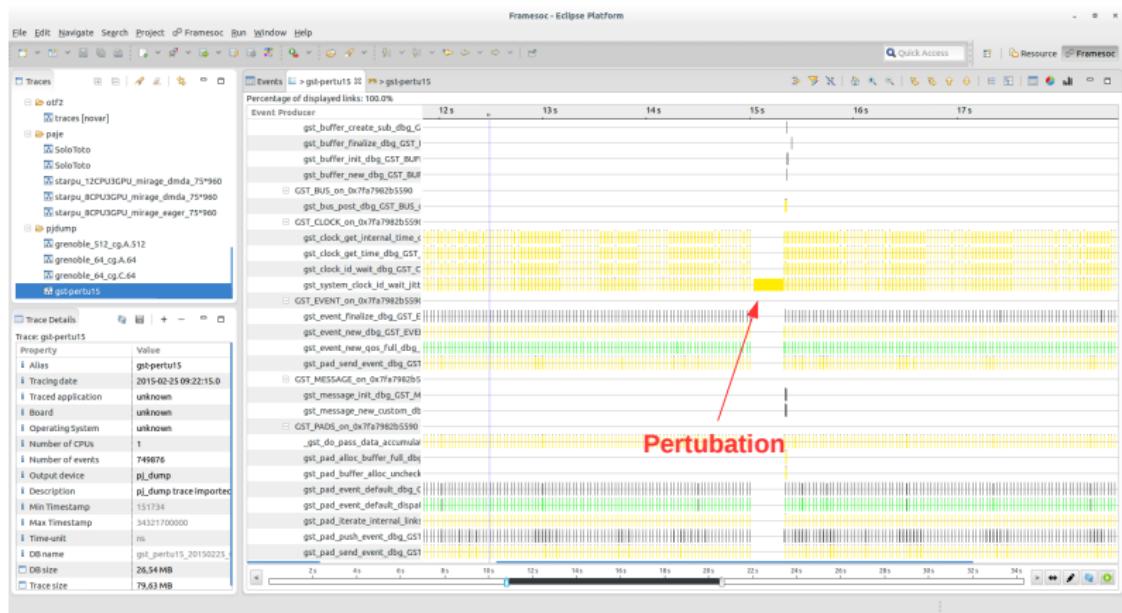


The aggregation was performed using an approximate version of the cache.

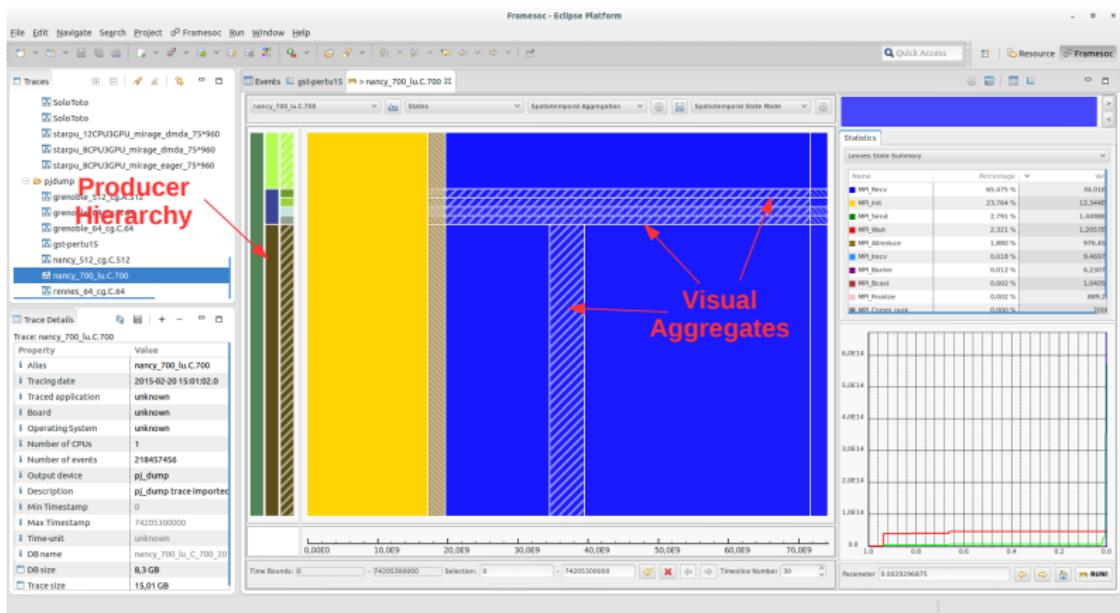
OCELOT: SWITCH TO GANTT



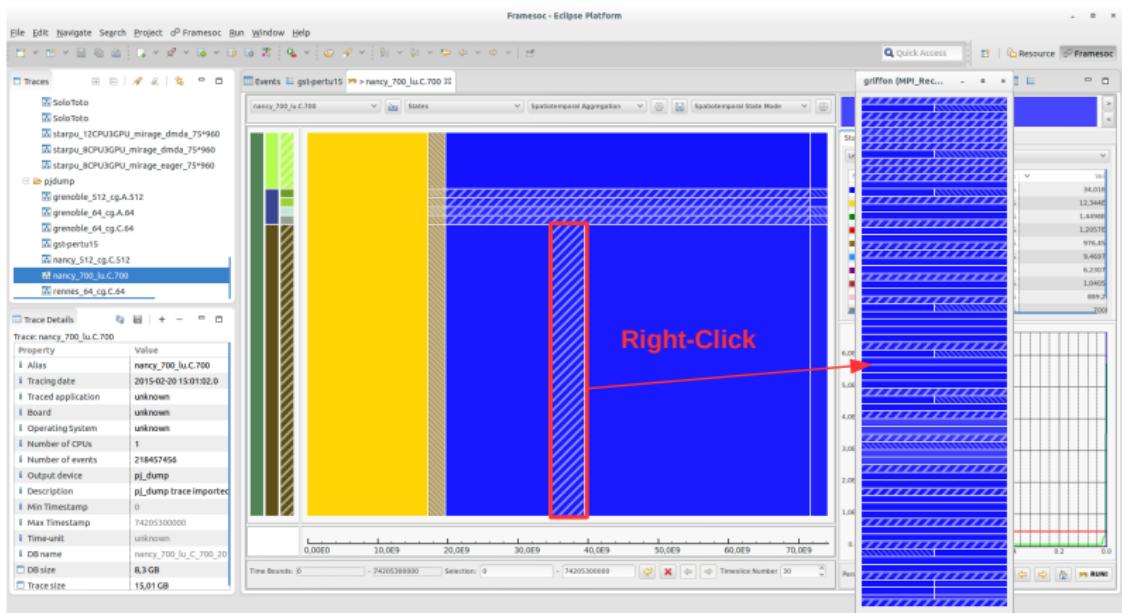
OCELOT: GANTT VIEW



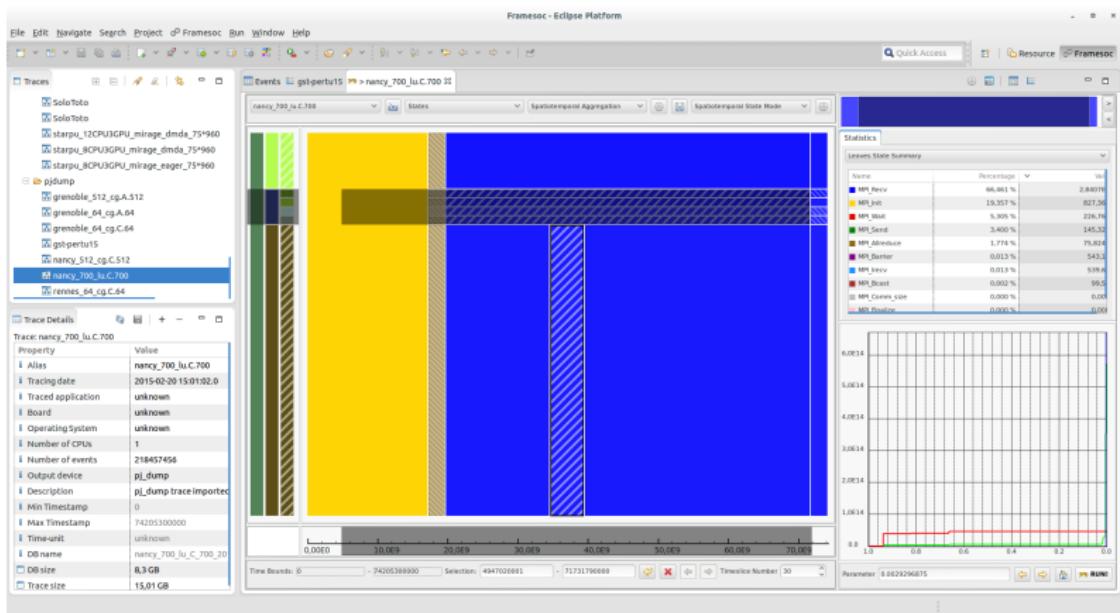
OCELOT: SPATIO TEMPORAL



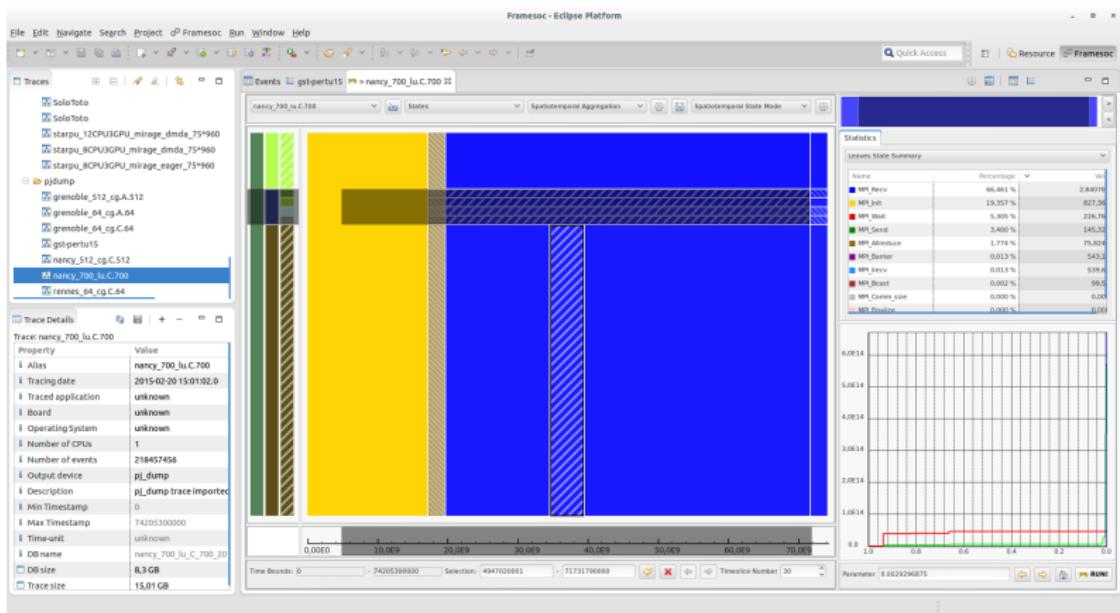
OCELOT: VISUAL AGGREGATE



OCELOT: SPATIO TEMPORAL SELECTION



OCELOT: SPATIO TEMPORAL SELECTION



OCELOT: GITHUB AND USER MANUAL

For a more detailed description of Ocelotl features:

- ▶ Ocelotl User Manual: https://github.com/soctrace-inria/ocelotl/raw/master/docs/OCELOTL_userguide.pdf
- ▶  Ocelotl GitHub:
<https://github.com/soctrace-inria/ocelotl/>