Aggregation and multiscale visualization for embedded system program trace analysis

Damien Dosimont [1] Guillaume Huard [2] Jean-Marc Vincent [2]

[1] INRIA

[2] Université Joseph Fourier
Grenoble

firstname.lastname@imag.fr

MOAIS 2013 Seminary

Table of Contents

Section

Context : SoC-Trace Project

SoC-Trace Project

- Embedded system program trace analysis
- Solve architecture and software growing complexity analysis issues
- Storage, data-model, trace/tools/results management
- Analysis flow : statistics, trace processing, data-mining, **visualization**

Partners

- INRIA
- UJF
- STMicroelectronics
- ProbaYes

Context : SoC-Trace Project

SoC-Trace Project

- Embedded system program trace analysis
- Solve architecture and software growing complexity analysis issues
- Storage, data-model, trace/tools/results management
- Analysis flow : statistics, trace processing, data-mining, **visualization**

Partners

- INRIA
- UJF
- STMicroelectronics
- ProbaYes

FrameSoc : SoC-Trace infrastructure

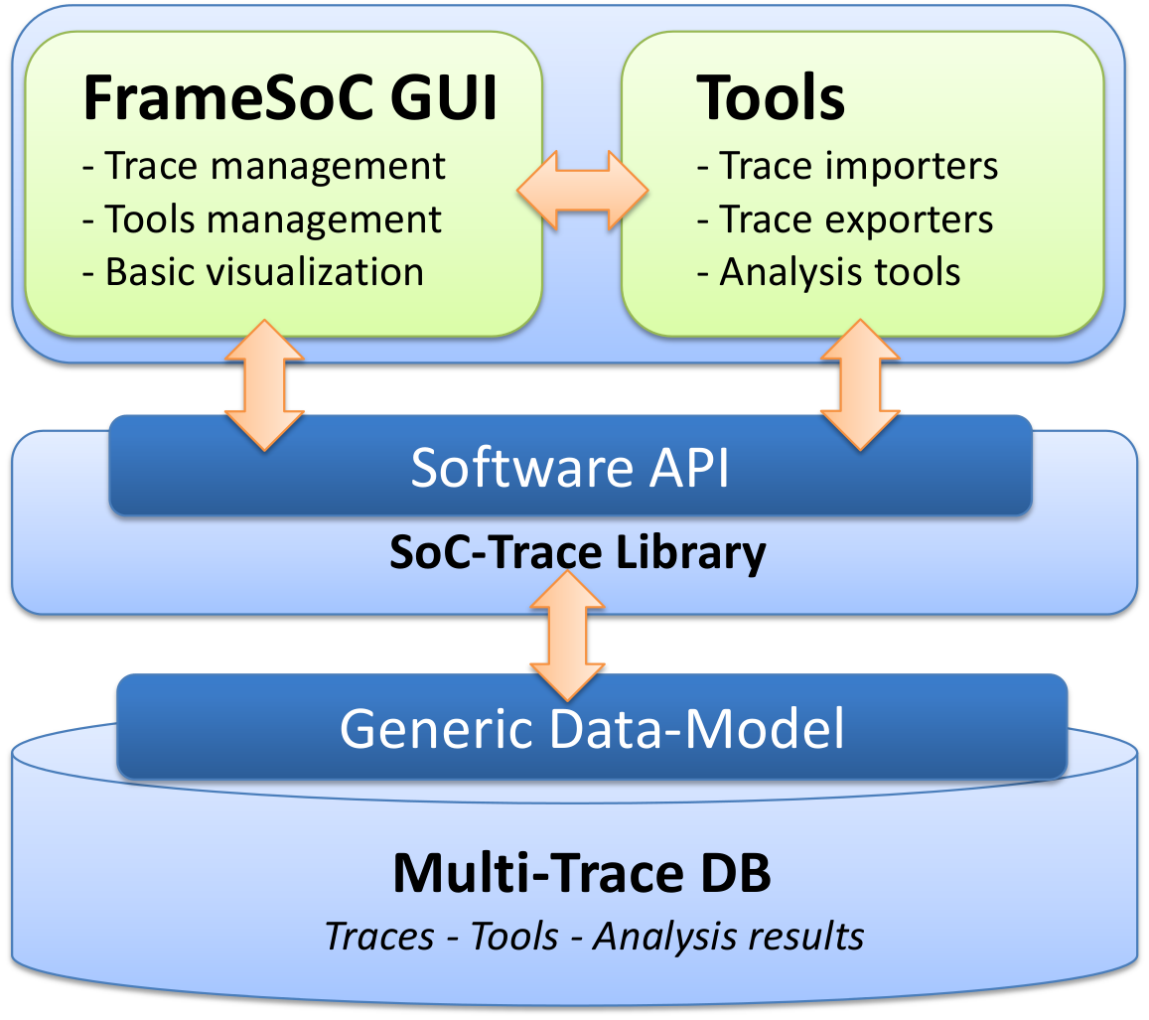


FIG. 1: *FrameSoC architecture and its features*

Section

Visualization scalability issues

In traditional visualization techniques

- **Fidelity** : aliasing artifacts, proportions (zoom out)
- **Understanding** : loss of context (zoom in, scroll), information loss (aggregation)

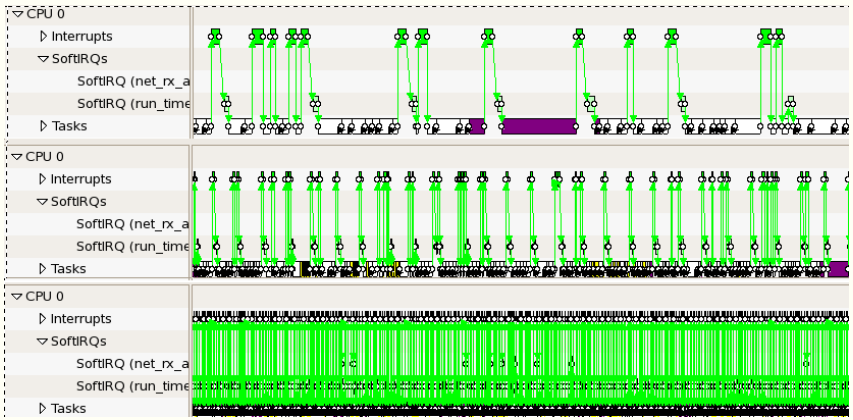


FIG. 2: *KPTrace dezoom : example of time axis scalability issues*

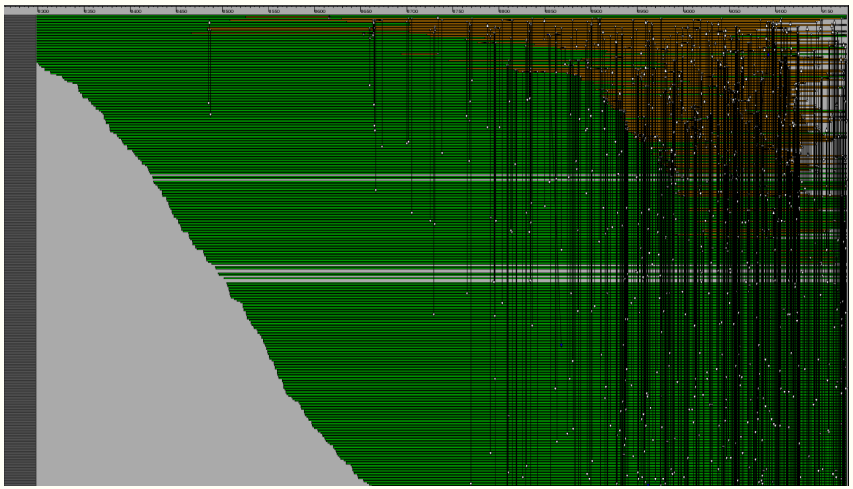


FIG. 3: *Example of space limitations : Pajé trace with 700 producers*

Thesis objectives

Visual representation that enables to...

- Show **behavior** evolution over **time**
- Spot **disruptions**, phases
- Relate time behavior to **space** dimension

Scalability issues solving

- Avoid **artifacts**, context and information **loss**
- Keep reasonable **performance**

Relevant techniques

- Time and space **aggregation**
- User **interaction**

Thesis objectives

Visual representation that enables to...

- Show **behavior** evolution over **time**
- Spot **disruptions**, phases
- Relate time behavior to **space** dimension

Scalability issues solving

- Avoid **artifacts**, context and information **loss**
- Keep reasonable **performance**

Relevant techniques

- Time and space **aggregation**
- User **interaction**

Thesis objectives

Visual representation that enables to...

- Show **behavior** evolution over **time**
- Spot **disruptions**, phases
- Relate time behavior to **space** dimension

Scalability issues solving

- Avoid **artifacts**, context and information **loss**
- Keep reasonable **performance**

Relevant techniques

- Time and space **aggregation**
- User **interaction**

Works summary

Visualization tools

- Simple aggregation prototype (STMicroelectronics)
- **FrameSoC visualization module** using time aggregation mechanisms (Lamarche-Perrin, Pagano)

Papers

- D. Dosimont, G. Huard et J.-M. Vincent - *La visualisation de traces, support à l'analyse, déverminage et optimisation d'applications de calcul haute performance* (VIF-EGC'2013)
- G. Pagano & al. - *Trace Management and Analysis Infrastructure for Embedded Systems* (Inria RR-8304, submitted to MCSoC'13)

Works summary

Visualization tools

- Simple aggregation prototype (STMicroelectronics)
- **FrameSoC visualization module** using time aggregation mechanisms (Lamarche-Perrin, Pagano)

Papers

- D. Dosimont, G. Huard et J.-M. Vincent - *La visualisation de traces, support à l'analyse, déverminage et optimisation d'applications de calcul haute performance* (VIF-EGC'2013)
- G. Pagano & al. - *Trace Management and Analysis Infrastructure for Embedded Systems* (Inria RR-8304, submitted to MCSoC'13)

Section

FrameSoC visualization module : presentation

Principle

- Trace is divided in **time slices**
- **Variable parameter** enables to aggregate **consecutive slices**
- **Aggregates** are related to phases, disruptions

Theoretical aspects

- Trace time-slicing (Schnorr)
- **Best-Cut partition** algorithm (Lamarche-Perrin)

Implementation

- C++ library (best partition algorithm)
- FrameSoC module/Java (GUI, database queries, time-slicing)

FrameSoC visualization module : presentation

Principle

- Trace is divided in **time slices**
- **Variable parameter** enables to aggregate **consecutive slices**
- **Aggregates** are related to phases, disruptions

Theoretical aspects

- Trace time-slicing (Schnorr)
- **Best-Cut partition** algorithm (Lamarche-Perrin)

Implementation

- C++ library (best partition algorithm)
- FrameSoC module/Java (GUI, database queries, time-slicing)

FrameSoC visualization module : presentation

Principle

- Trace is divided in **time slices**
- **Variable parameter** enables to aggregate **consecutive slices**
- **Aggregates** are related to phases, disruptions

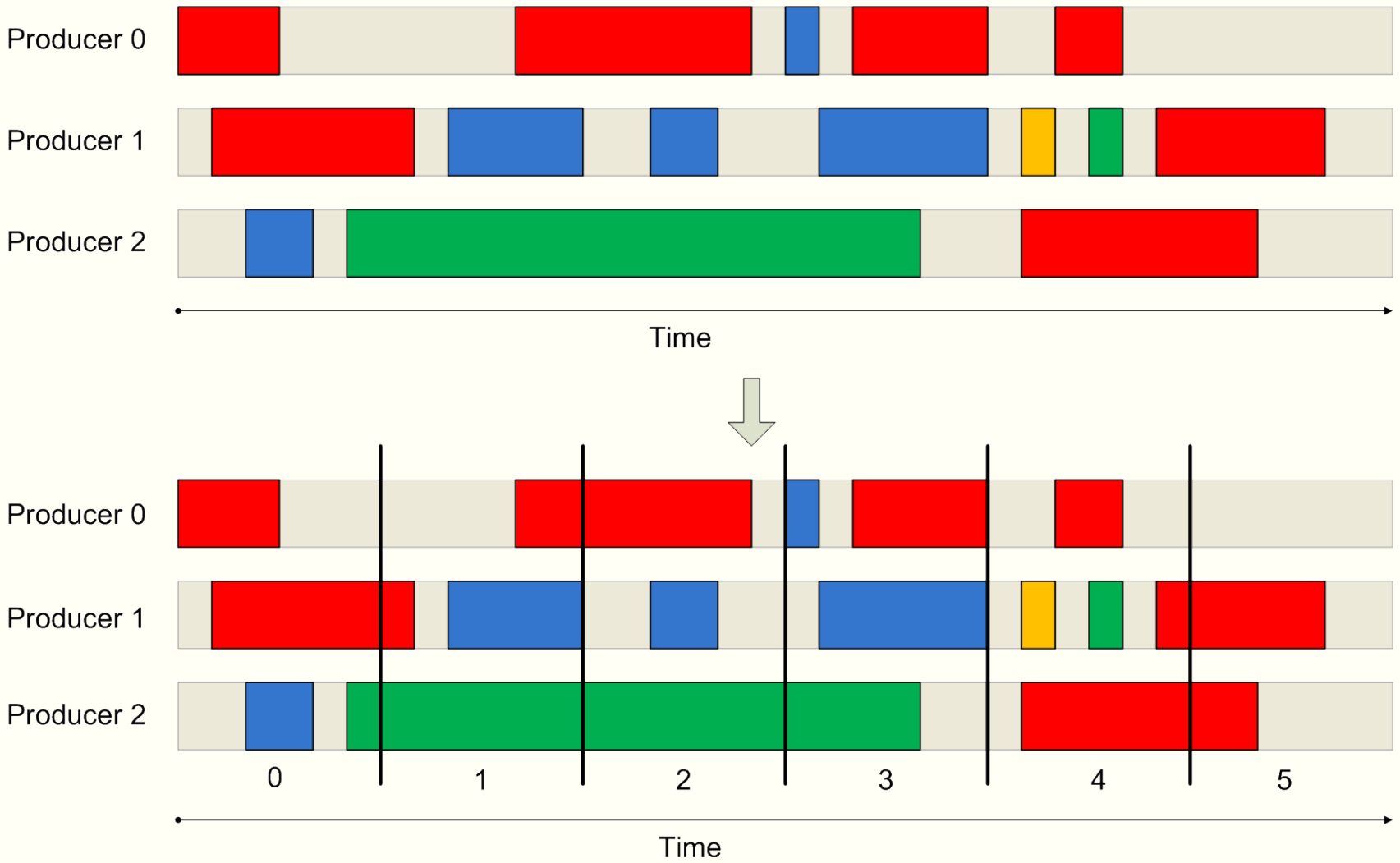
Theoretical aspects

- Trace time-slicing (Schnorr)
- **Best-Cut partition** algorithm (Lamarche-Perrin)

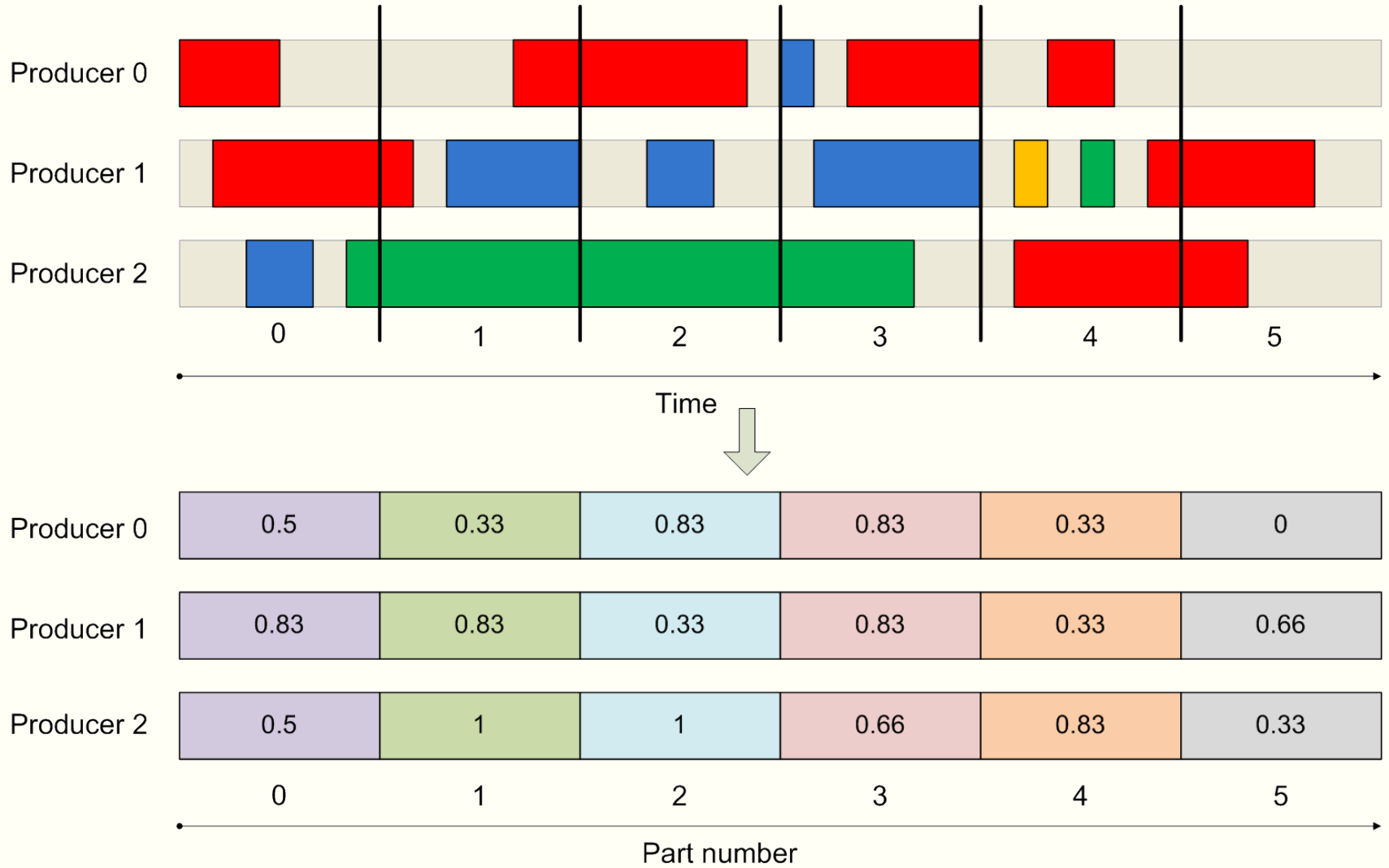
Implementation

- C++ library (best partition algorithm)
- FrameSoC module/Java (GUI, database queries, time-slicing)

Time-Slicing : example of a synthetic trace



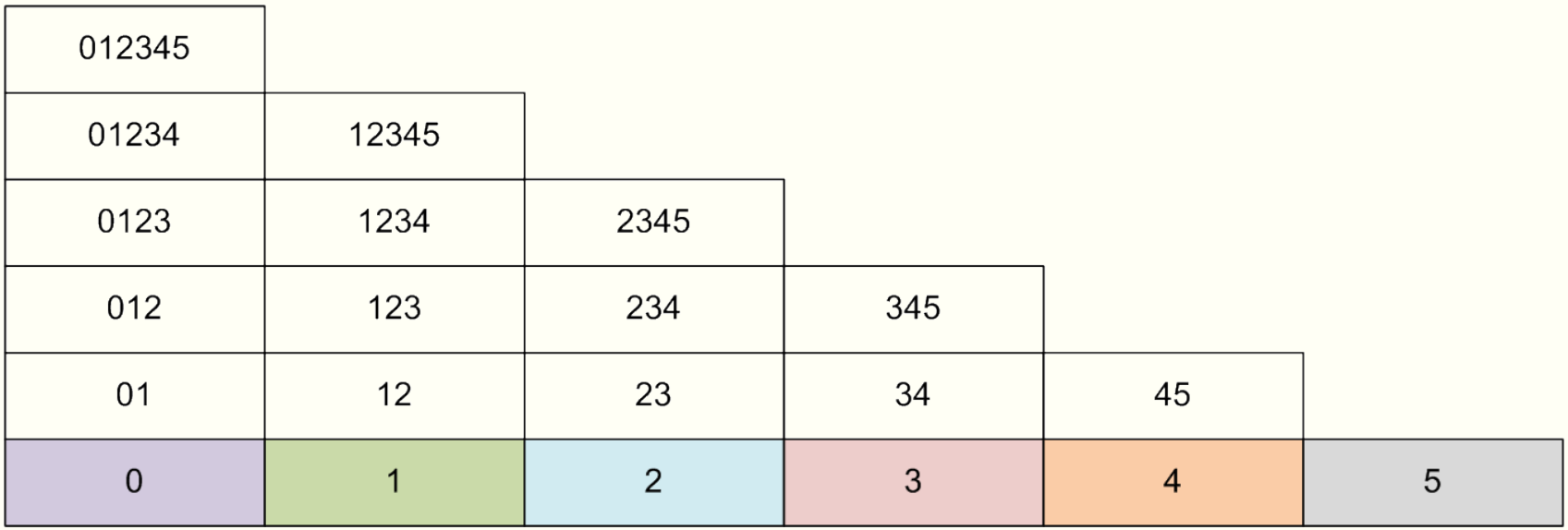
Time-Slicing : activity time matrix generation



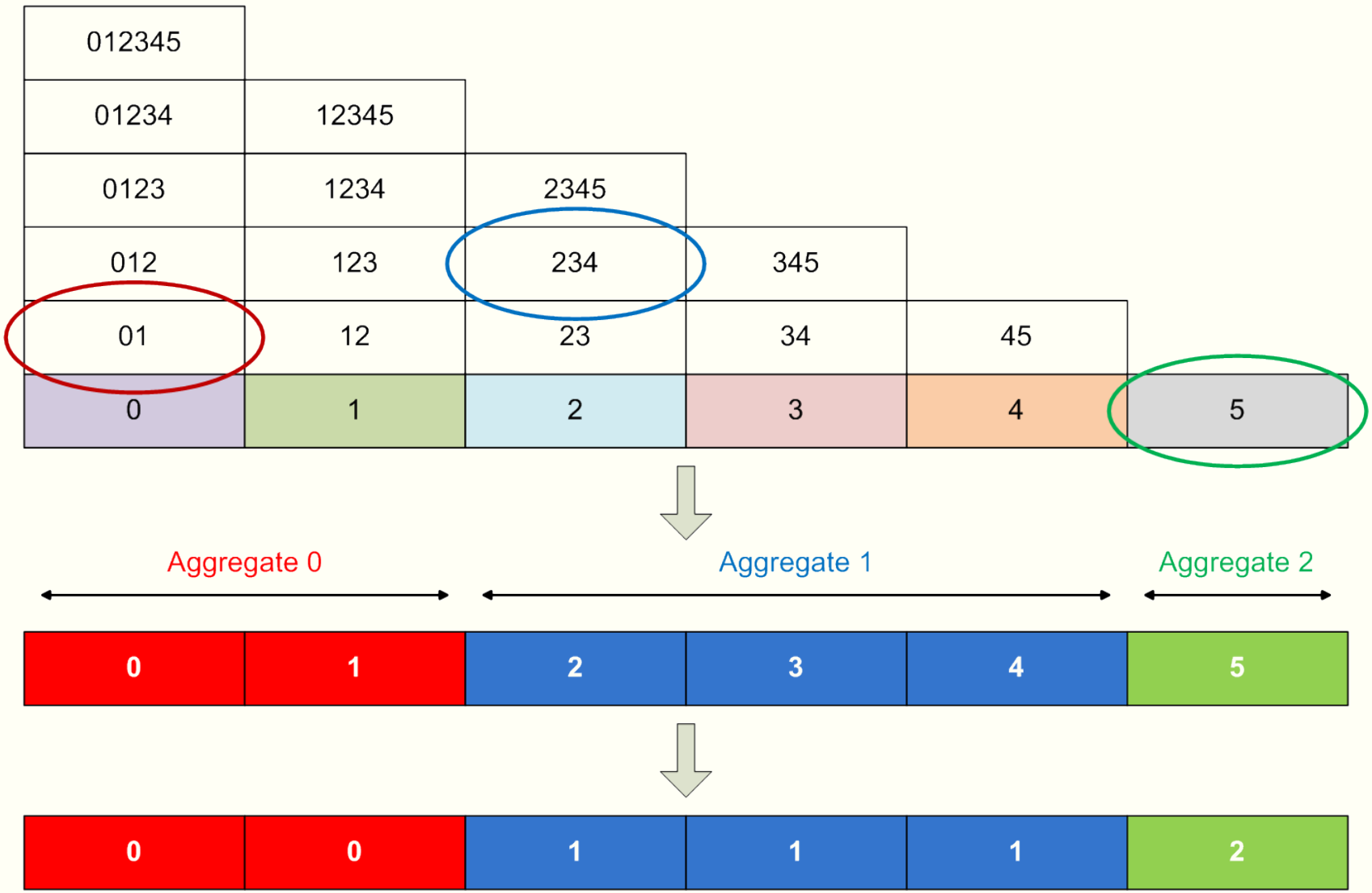
Best-Cut Partition algorithm : qualities

Qualities : Gain and loss

- Computed from Shannon Entropy and Kullback-Leibler Divergence
- Used to compute parametrized information criteria
  $\text{pIC}(\mathcal{A}) = p \times \text{gain}(\mathcal{A}) - (1 - p) \times \text{loss}(\mathcal{A})$



Best-Cut Partition algorithm : parts aggregation



Demonstration

Section

Future Works

Analysis module

- Discontinue parts **similarity**
- **Hierarchy** aggregation/clustering
- Aggregation **metrics**
- Visualization/parts representation improvement
- User **interaction**

Use cases

- From embedded applications (ST, LIG ?)
- From various parallel applications (ex : Kaapi Pajé traces)

Future Works

Analysis module

- Discontinue parts **similarity**
- **Hierarchy** aggregation/clustering
- Aggregation **metrics**
- Visualization/parts representation improvement
- User **interaction**

Use cases

- From embedded applications (ST, LIG ?)
- From various parallel applications (ex : Kaapi Pajé traces)

Merci de votre attention !

http ://moais.imag.fr/membres/damien.dosimont/