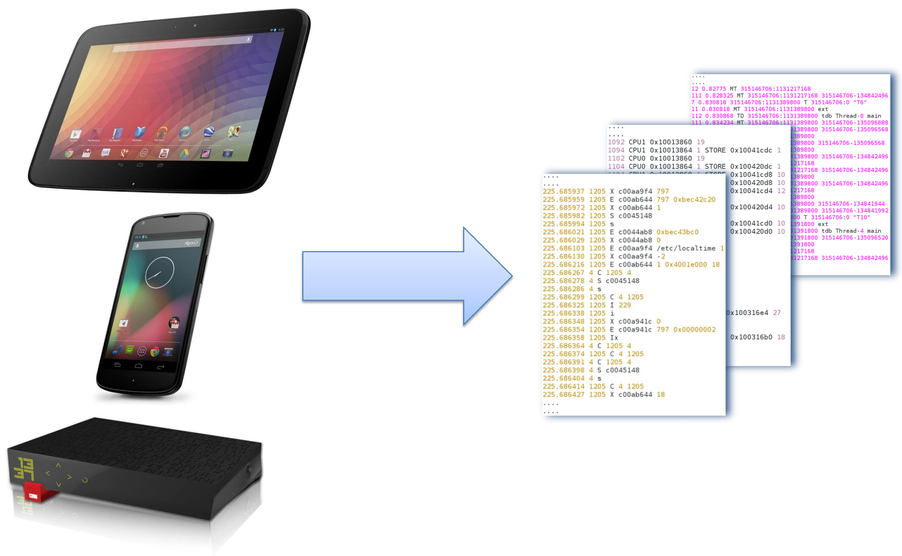
SoC-TRACE: Handling the Challenge of Embedded Software Design and Optimization

Vania Marangozova-Martin
Nanosim, LIG
Vania.Marangozova-Martin@imag.fr

Generoso Pagano
MESCAL, INRIA
generoso.pagano@inria.fr

Tracing Embedded Systems



Challenges!

- Many different formats
- Huge amount of data
- Various analysis techniques and tools
- Need for automatic and higher level analysis

- Embedded systems are everywhere!
- Embedded applications are rich and complex
- **Execution traces** are a powerful instrument to debug and improve embedded software

SoC-TRACE project

- Enhance the exploitation of execution traces for debugging and profiling embedded software
- Propose new analysis techniques
- Provide an open-source generic trace management infrastructure

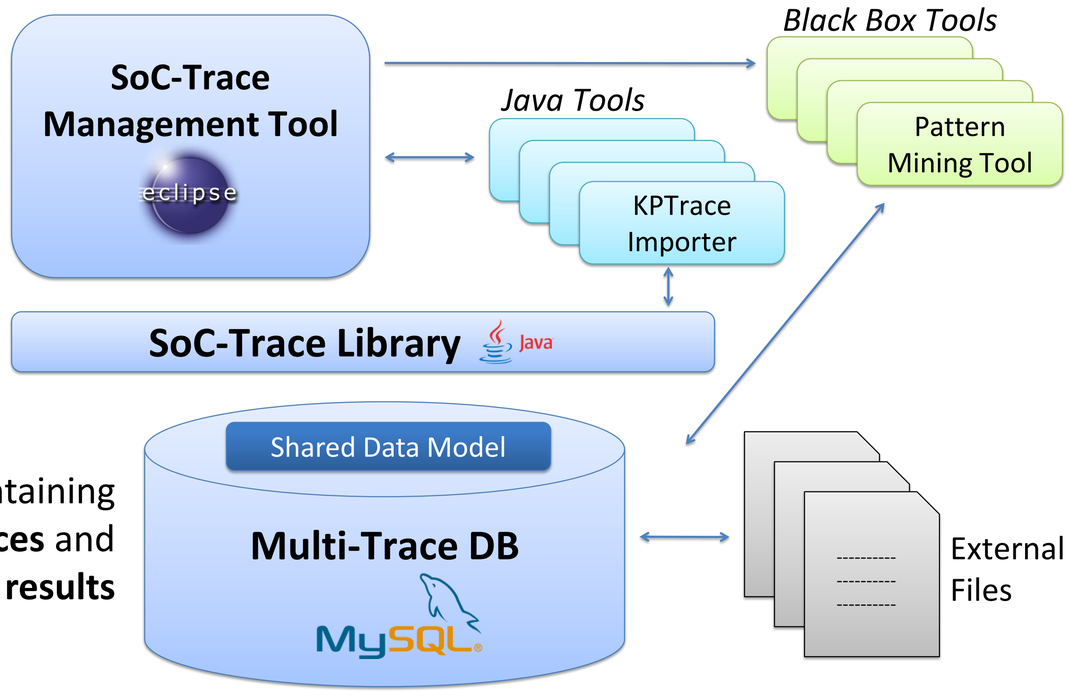
More observability → Increased productivity → Better software quality

Trace Management Infrastructure

- Store several traces in a DB, using a **generic data model**
- Provide access to traces for **several tools**
- Store **analysis results** in the DB

SoC-TRACE Infrastructure Architecture

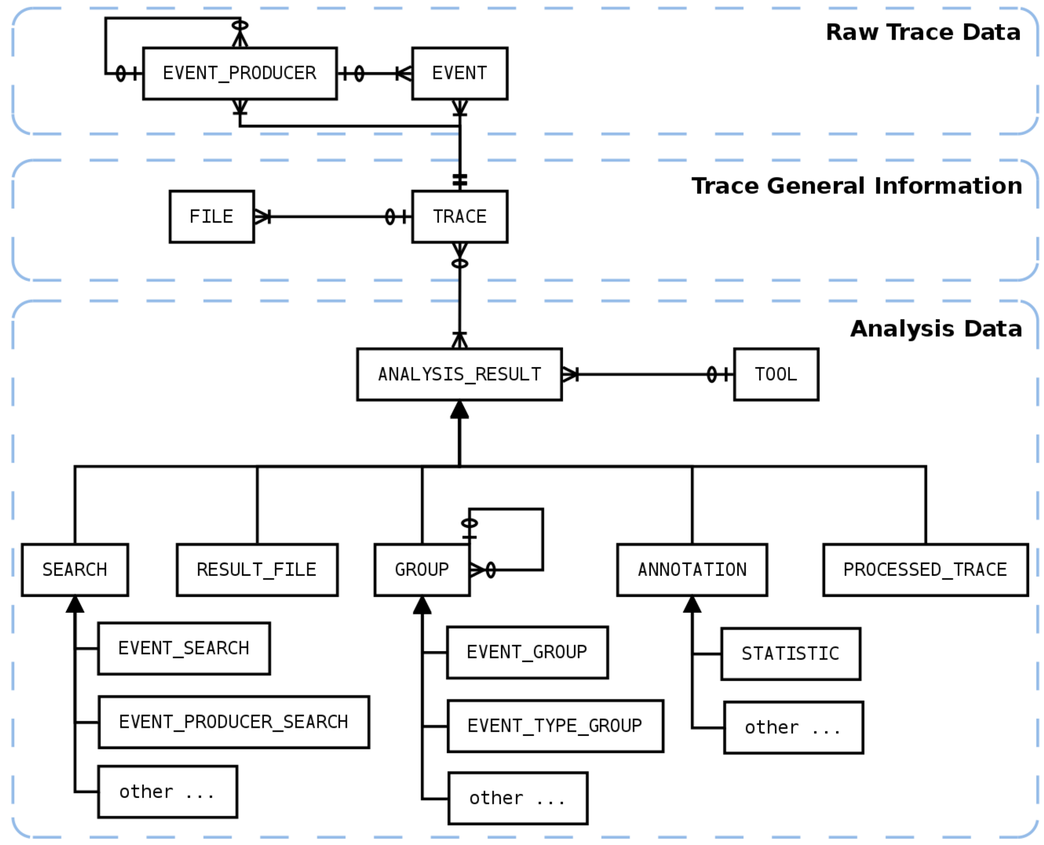
- Import a trace
- Register a tool
- Launch a tool



Tool integration

A standard software API and a shared data model allow for tool integration and cooperation

Generic Data Model



Self defining pattern to represent several formats

Predefined but customizable **analysis result** types

An example of analysis

- A **Pattern Mining Tool** finds a pattern, identified by the exact sequence of events:
  - sys_read
  - alsa_read
- All pattern instances and exceptions (above events outside the pattern) are saved in the DB as a hierarchy of groups

```
....
....
946685201.276705 3095 C 0 3095
946685201.276707 3095 E sys_read 3 0x00083988 1024 0x00083988
946685201.276737 3095 U alsa_read 0xcce446e0 0x00083988 0x00000400
946685201.276798 0 C 3095 0
946685201.276899 3095 C 0 3095
946685201.277012 3095 U alsa_read 0xcce446e0 0x0008398c 0x00000400
946685201.277032 0 C 3095 0
946685201.277073 0 S c007f7b0
946685201.277082 3095 C 0 3095
946685201.277083 3095 E sys_read 3 0x00083180 1024 0x00083180
946685201.277084 3095 U alsa_read 0xcce446e0 0x00084078 0x00000400
946685201.283445 0 C 3095 0
946685201.283475 0 i
946685201.283475 0 Ix
946685201.283507 3095 C 0 3095
946685201.283508 3095 E sys_read 3 0x00083584 1024 0x00083584
946685201.285914 3095 I 36
946685201.286018 3095 E sys_read 3 0x00083988 1024 0x00083988
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946685201.286493 0 I 44
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946685201.293719 567 i
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946685201.293780 567 C 728 567
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....
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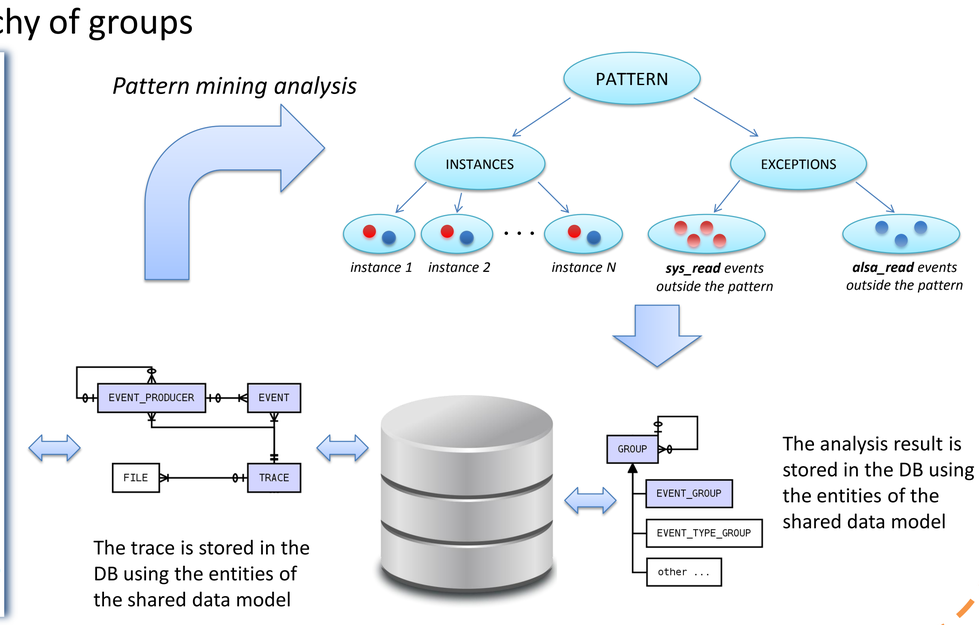

Preliminary results

- ✔ Importing traces of three different formats
  - *the data model is generic!*
- ✔ Management of multiple traces
  - *multi-trace analysis is possible!*
- ✔ Producing and saving analysis results
  - *avoid time-consuming recomputation!*

Future works

- Optimizations
- Validation against new concrete use cases
- Relations between data model and visualization
- Protocol for tool collaboration