A Model-driven development framework for highly Parallel and EneRgy-Efficient computation supporting multi-criteria optimisation

# Addressing Time Predictability in AMPERE

## AMPERE Final Event Webinar

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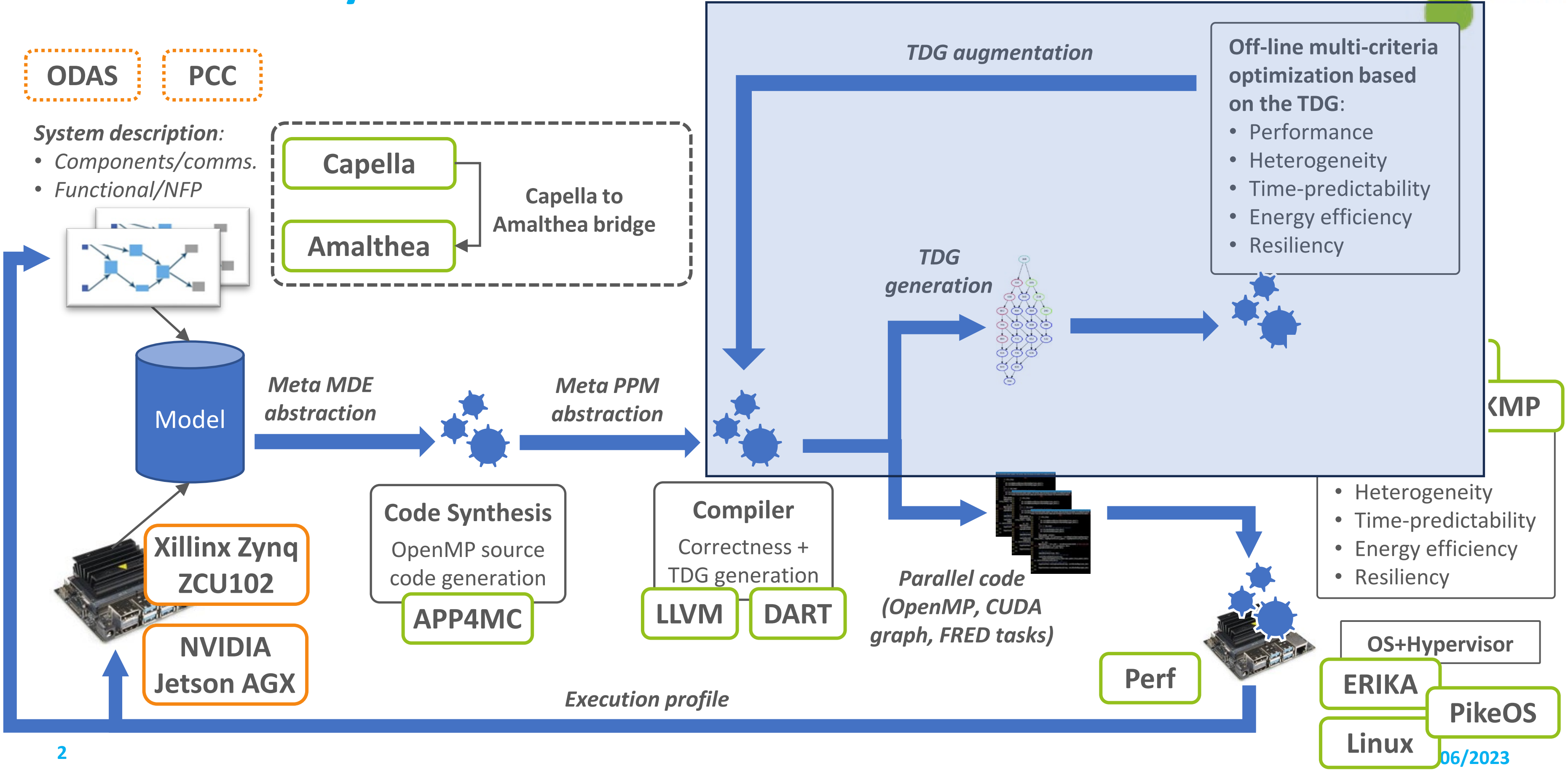
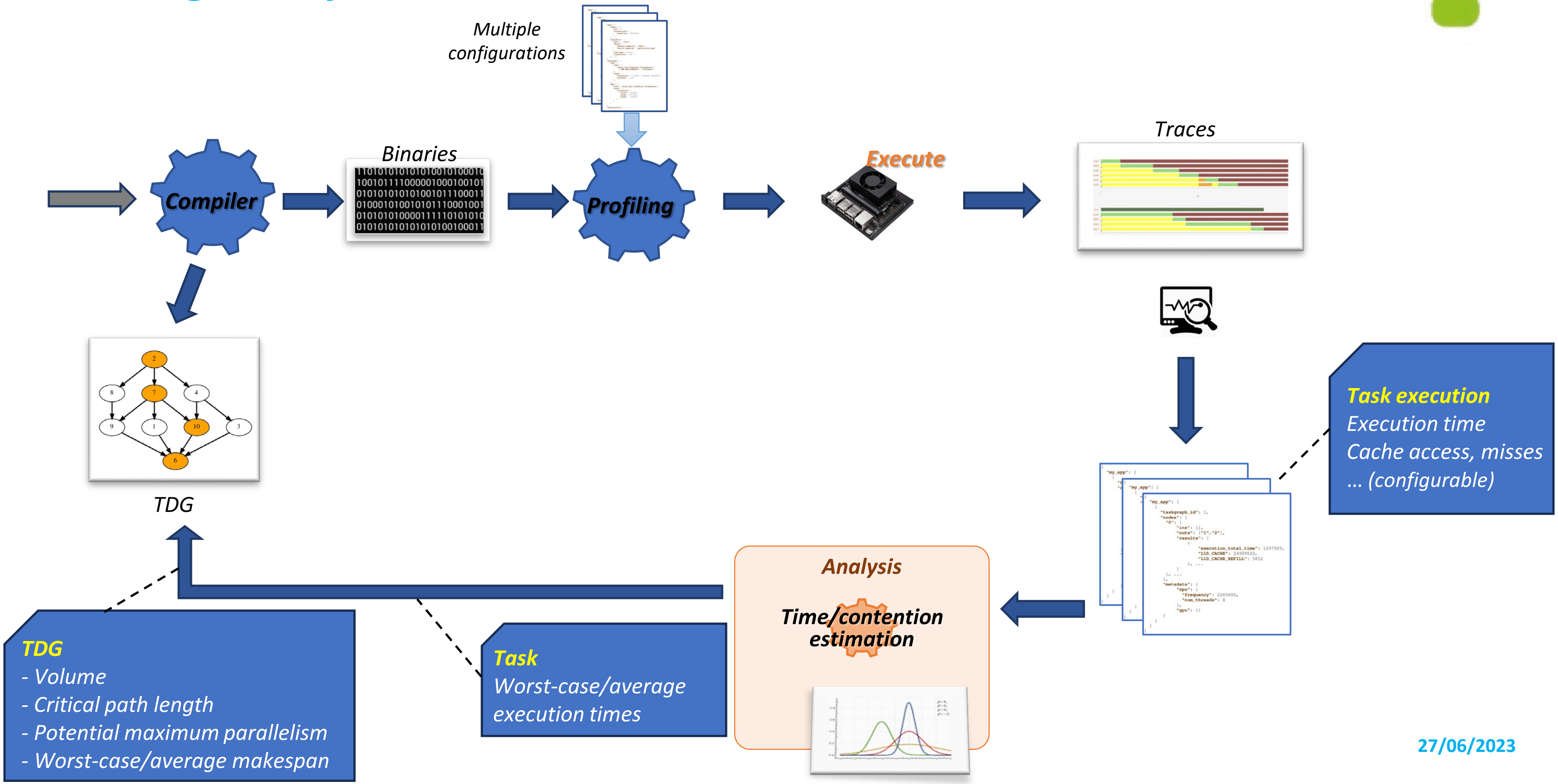
The AMPERE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 871669

# AMPERE ecosystem workflow



# Timing Analysis Flow



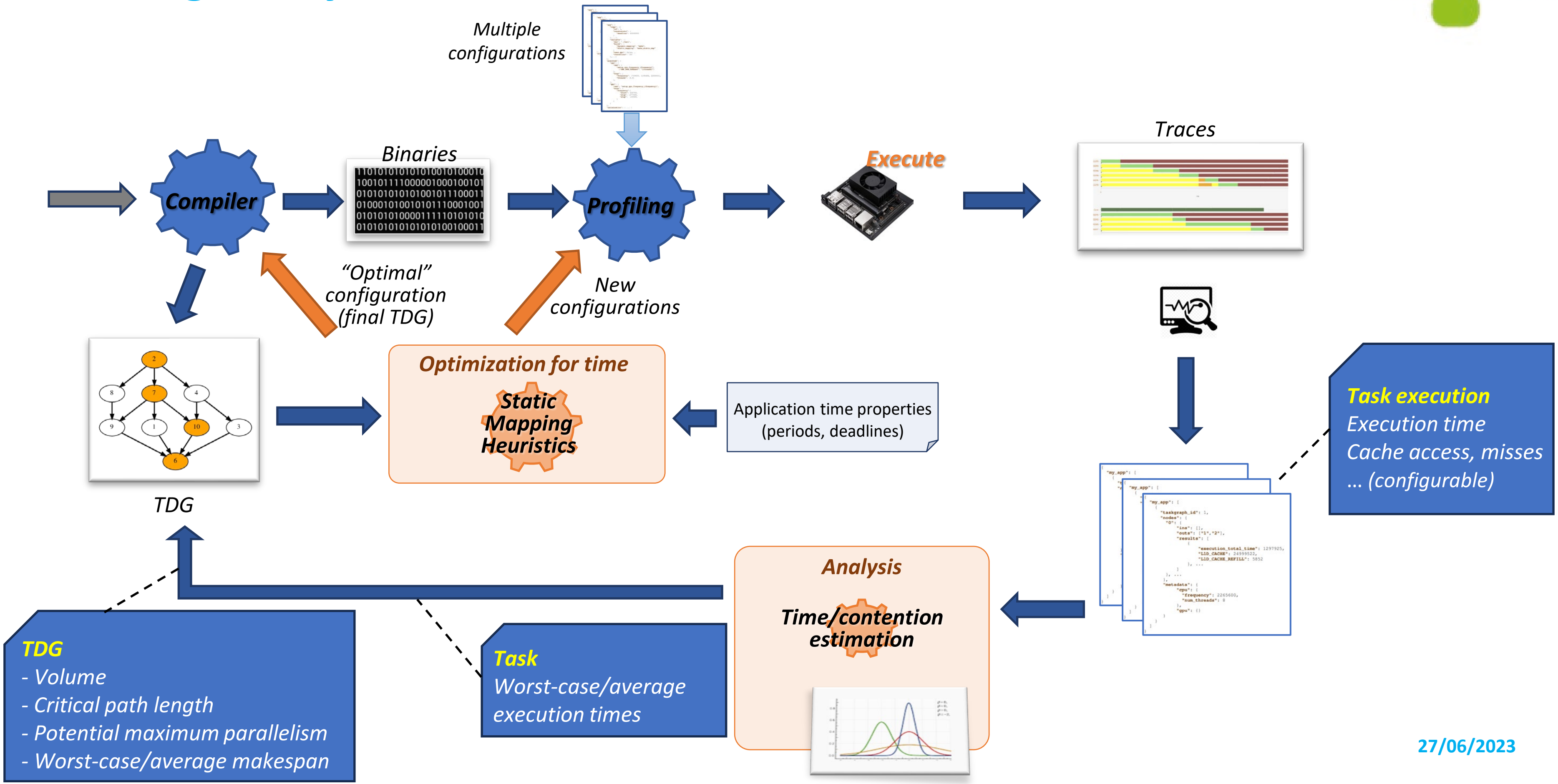
# Timing Analysis

- **Some numbers of the use cases**

| Use Case | Task | Runnable | WCET (us) | AVG_Time (us) |
|---|---|---|---|---|
| **ODAS** | RADAR Processing | RADAR spatial synchronization | 2 585 | 541 |
| **PCC** | Perception ACC | T100_ms | 7 140 | 2 449 |

| Use Case | Task | Volume (us) | Worst case Makespan (us) | Average Makespan (us) | Max Parallelism |
|---|---|---|---|---|---|
| **ODAS** | RADAR Processing | 42 000 | 11 199 | 3 008 | 3 |
| **PCC** | Perception ACC | 5 863 416 | 615 548 | 364 877 | 29 |

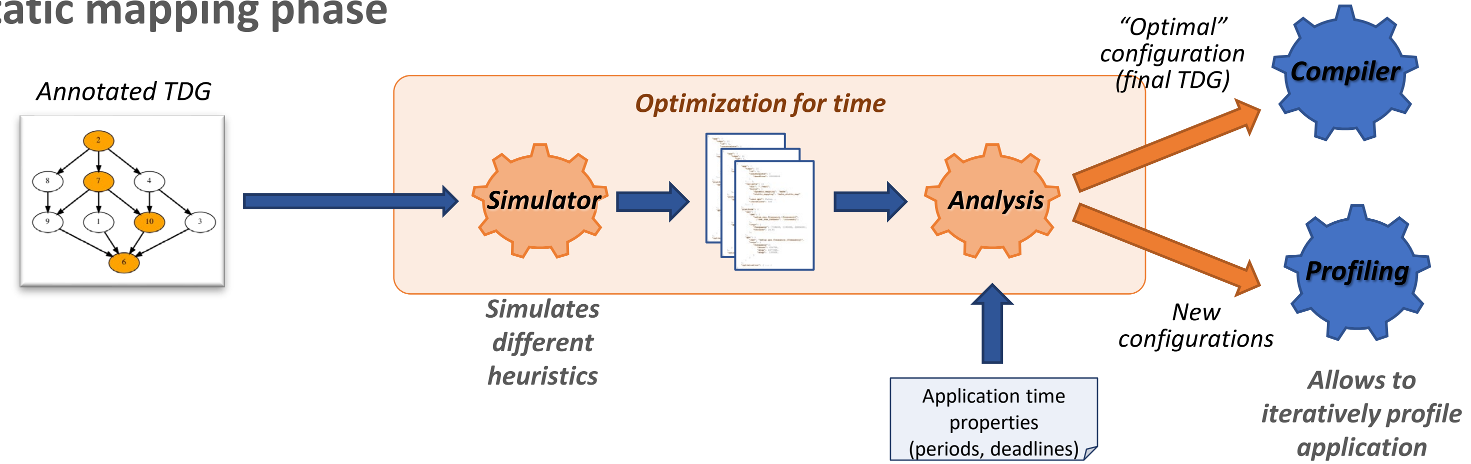
# Timing Analysis Flow



# Static Mapping

- **Add "staticness" to the execution to allow for**
  - Less execution time variability
  - Less analysis pessimism

- **Static mapping phase**



# Static Mapping

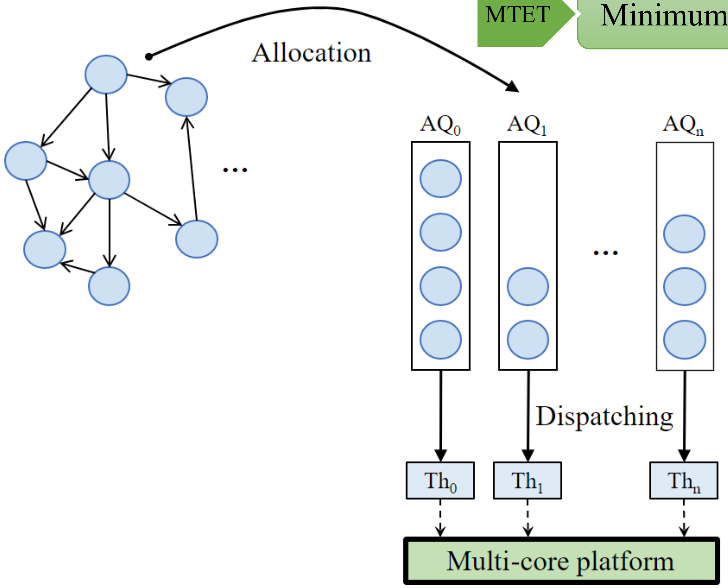
- **Mapping Heuristics**
  - Task allocation and dispatching

MNTP Minimum Number of Task-Parts

NT Next Thread

MRIT Most Recent Idle Time

MTET Minimum Total Execution Time




MET Minimum Execution Time

MRT Maximum Response Time

# Static Mapping

- **Mapping Heuristics**
  - Different heuristics provide better results for different benchmarks
  - But the MTET-MET combination is usually dominant
    - “Static” load balancing

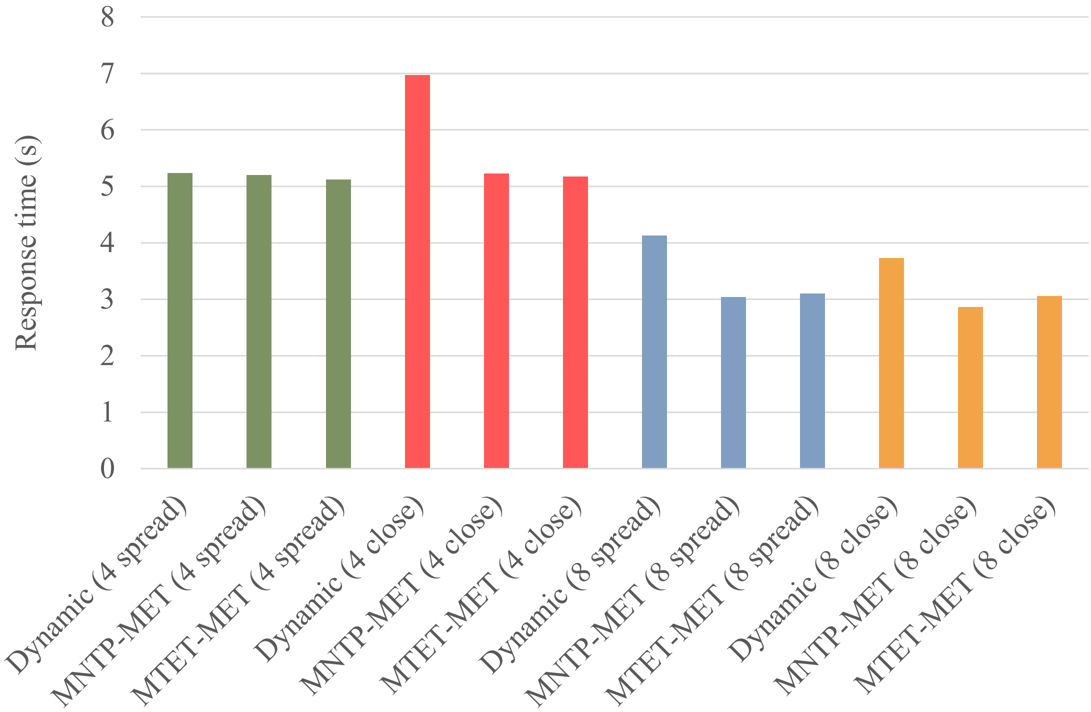
| System Model | Tied Tasks | | | Untied Tasks | | |
|---|---|---|---|---|---|---|
| | BFS | WFS | LNSNL | BFS | WFS | LNSNL |
| 1-level nested tasks | -4.03% | 55.99% | -0.19% | -3.64% | 39.21% | 33.66% |
| 2-level nested tasks | 20.13% | 87.67% | 37.29% | 18.77% | 43.81% | 49.62% |
| n-level nested tasks | 19.88% | 88.64% | 49.06% | 23.19% | 47.49% | 67.01% |
| Average | 11.99% | 77.43% | 28.72% | 12.77% | 43.50% | 50.10% |

Main focus


27/06/2023

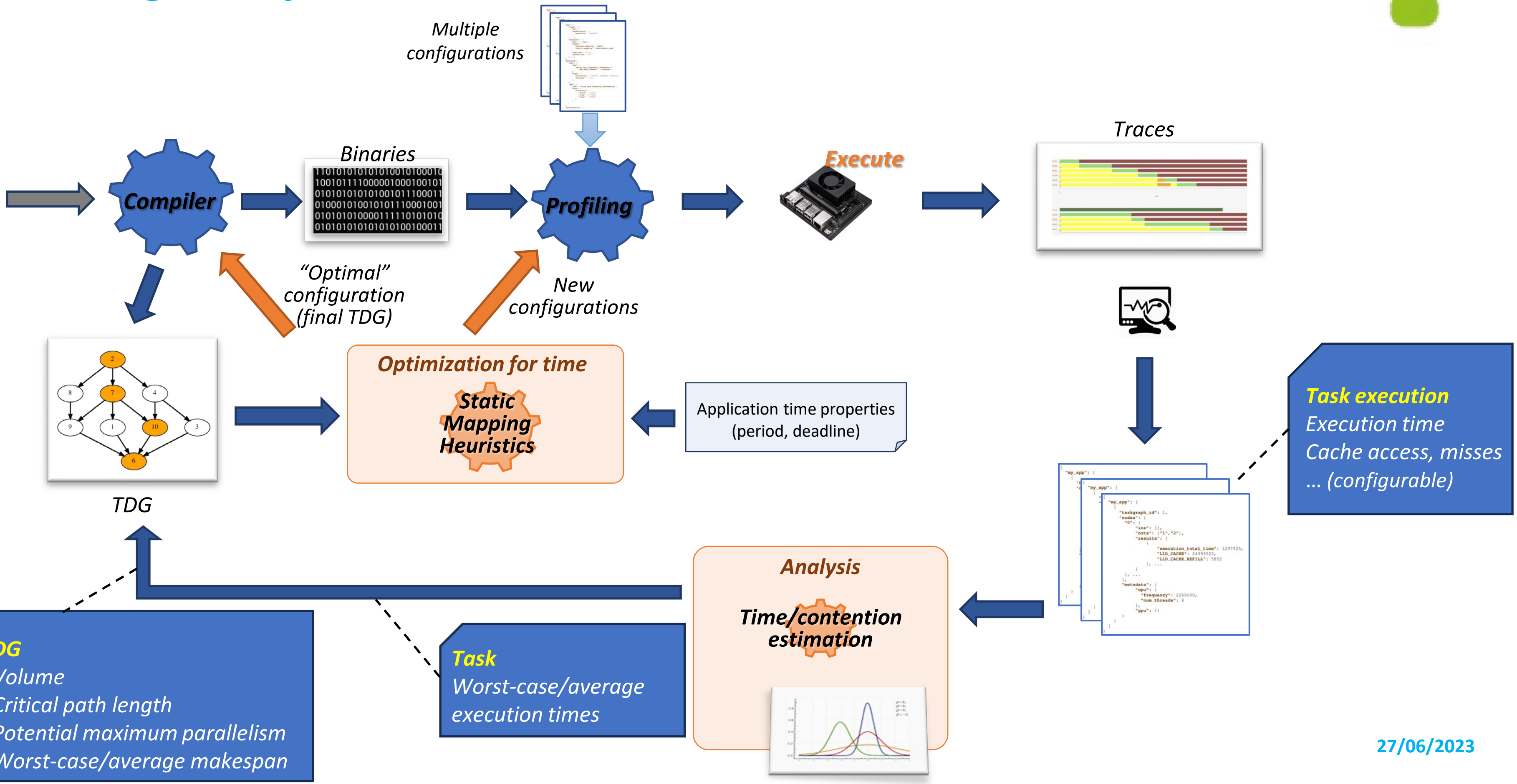
# Dynamic mapping

- **Two heuristics have also been implemented for runtime mapping**

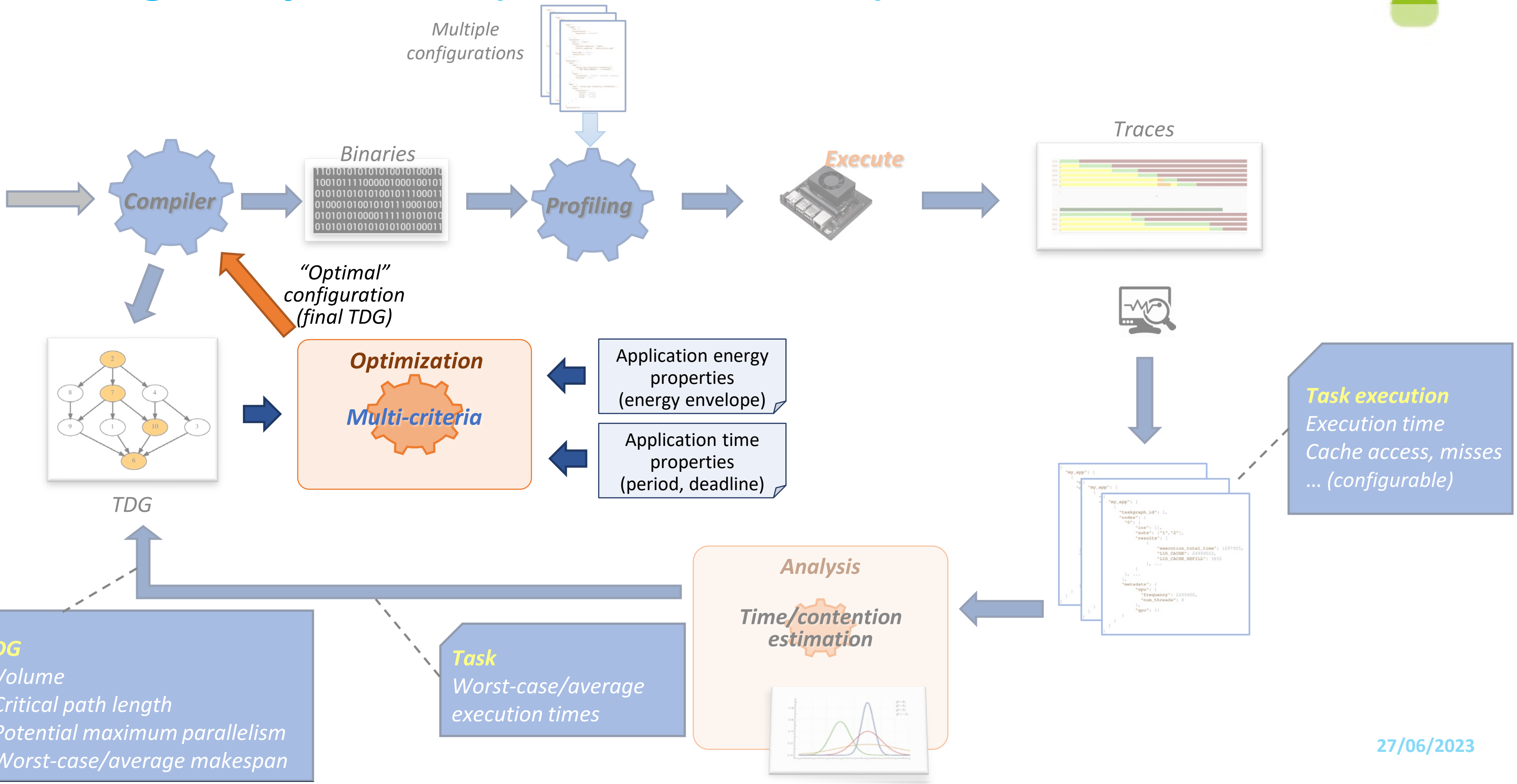



Dynamic: LLVM work-stealing
Spread: if possible, no sharing of L2
Close: sharing of L2 by 2 threads

# Timing Analysis Flow



# Timing Analysis Flow (for multi-criteria)



# Thank you!

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AMPERE

www.ampere-euproject.eu

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