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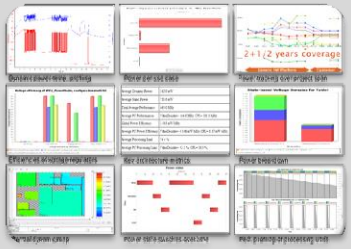
System Level Tools for Power and Thermal

Docea Power Gene Matter, VP Application Engineering

Explore Develop Validate

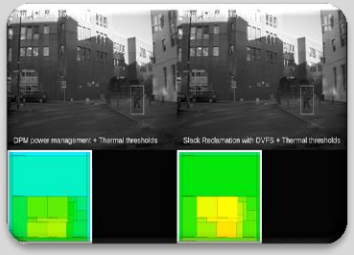
- Early power-thermal exploration, dimensioning and "landing zone"
  - What-if investigation: power consumption, floor planning, assembly/package options
    - Power profiles inputs: from spreadsheets, traces, characterized data from existing design
- Implementation phase
  - Supports Power planning with feedback from thermal behavior
  - Non-regression tests
  - Converge/refine Power/Thermal behavior during implementation
    - Power profiles inputs: power traces from emulators, RTL/Gate level power analysis tools
- Validation phase
  - Replaces thermal probes (often missing or not exact placement) for debug and analysis
    - Power profiles inputs: measurements, power probing

Where is your area of concern ?



Early power-thermal-performance trade-off exploration and architecture specification

Use Case power budget tracking



Power-thermal aware software development and validation

Thermal exploration and validation

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What is the Impact of using the wrong thermal scenario?

Most Thermal Studies Use Simplistic Scenarios due to length of Transient Simulations in CFD tools

Select costly (and un-competitive) packaging ?

Select a cost competitive packaging and take a risk ?

Live with reduced margins ?

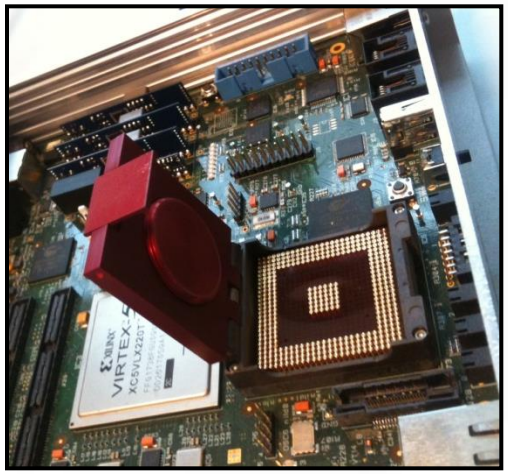
Drop projects that could have been competitive with the right packaging?

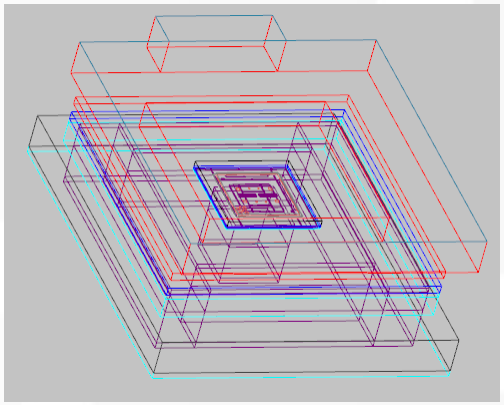
What if it fails?

Validation Support

- How can I validate the power and thermal behavior on packaged devices?
  - Limited number of thermal sensors
  - Limited number of observable power ports

➢ Use power-thermal model!





Power traces from Validation boards

Inside behaviour

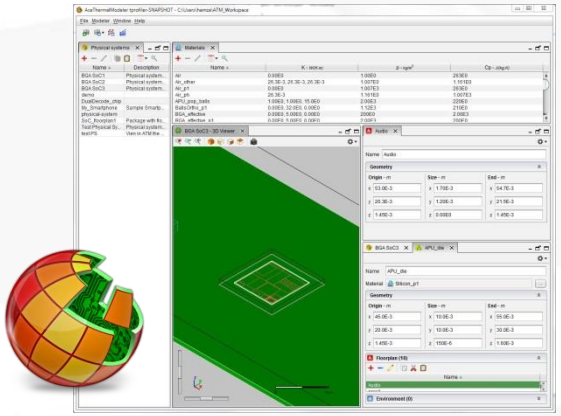
Solution Overview

MODELING

CFD Import

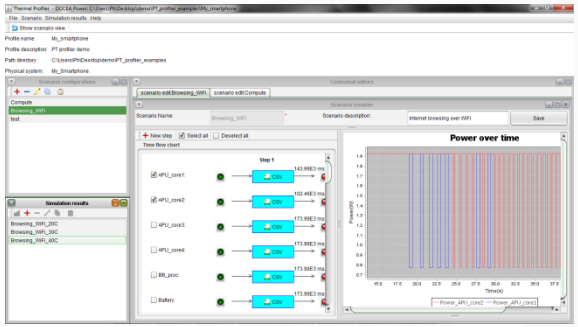
Thermal Model Capture Tool

3D geometry, floorplans, materials,
heat exchange surfaces



Compact Thermal Model Generation

SIMULATION



Simulation Set-up Environment

Result Dashboard

ESL Power Thermal Simulation

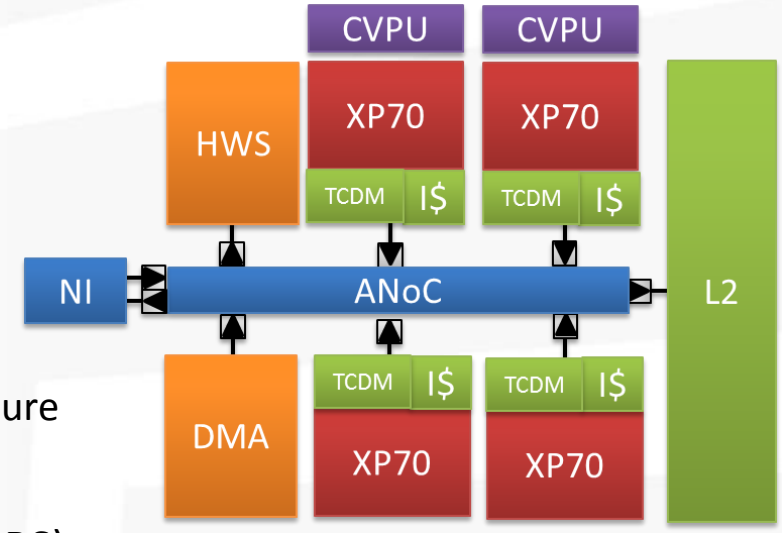
- Enables compact thermal models generation that are a few 100 nodes multi-source models:
  - Suitable for transient simulations and dynamic thermal management modeling
- Using Thermal Models for exploring floorplans and dynamic use cases:
  - Power Architects can perform what-if analysis and take into account thermal issues at a very early stage.
  - Shorter loop cycles between thermal Experts and System Architect/Engineering teams.
- Calculate the power/temperature coupling:
  - Power profiles obtained at an assumed constant temperature can be corrected for more accurate power estimations.

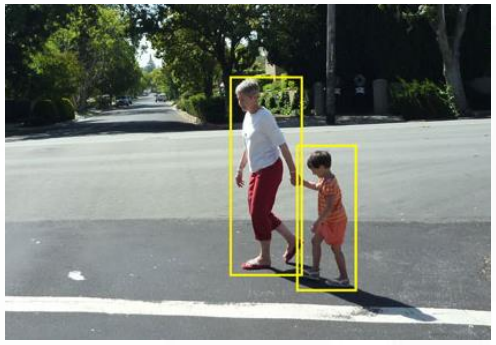
Power/Thermal aware software development:

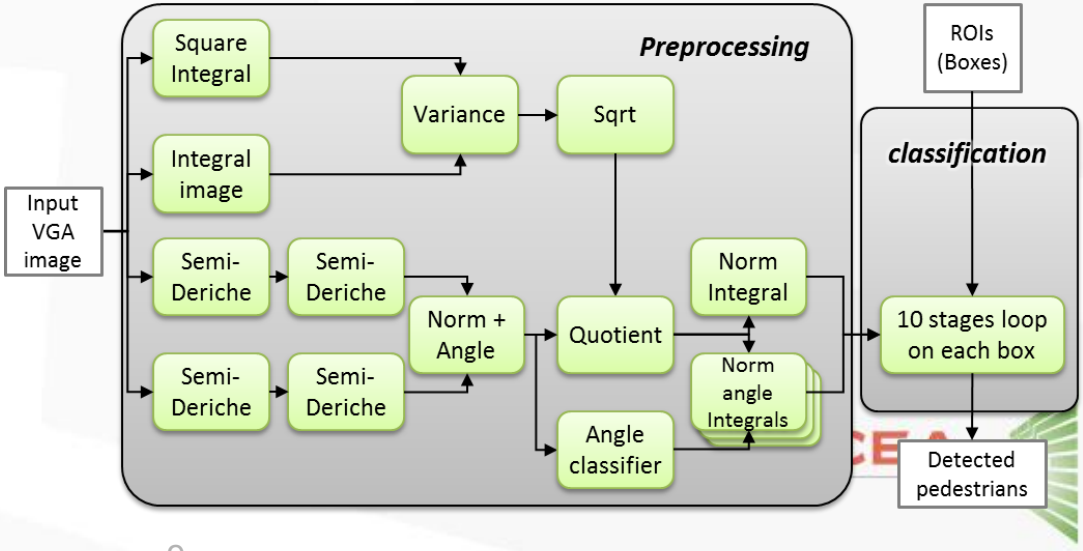
Example of thermal management policies Co-simulated with a Virtual Platform

MPSoC use case: LOCOMOTIV

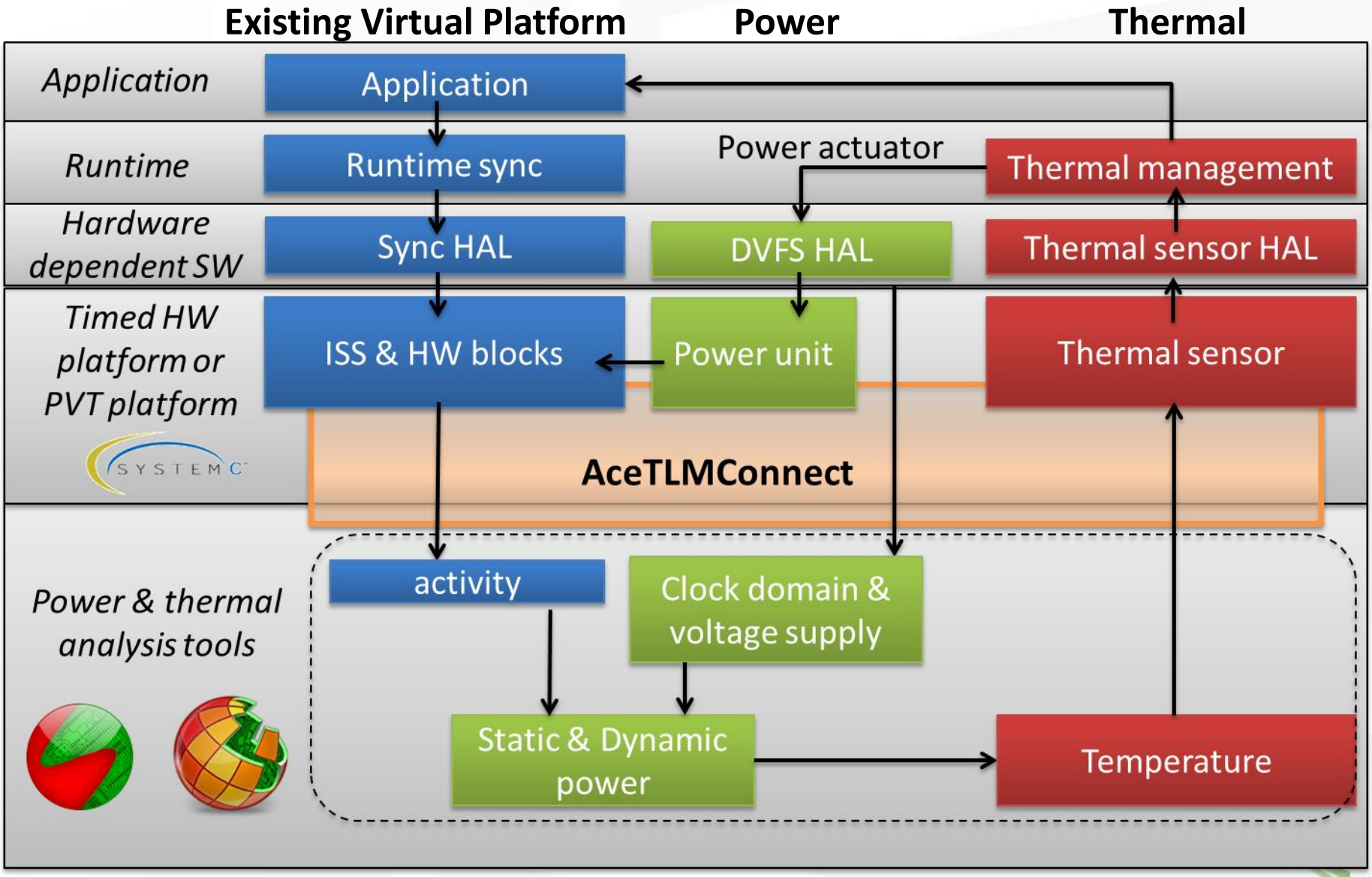
- LOCOMOTIV architecture
  - Multi-Core with shared memory
  - Thermal sensors
  - Power management
    - Local: adapts to process/ageing/temperature
    - Global: DVFS control per core
  - Hardware Assisted Runtime Software (HARS)
- Pedestrian Detection Application
  - Variable execution time
  - Parallel execution



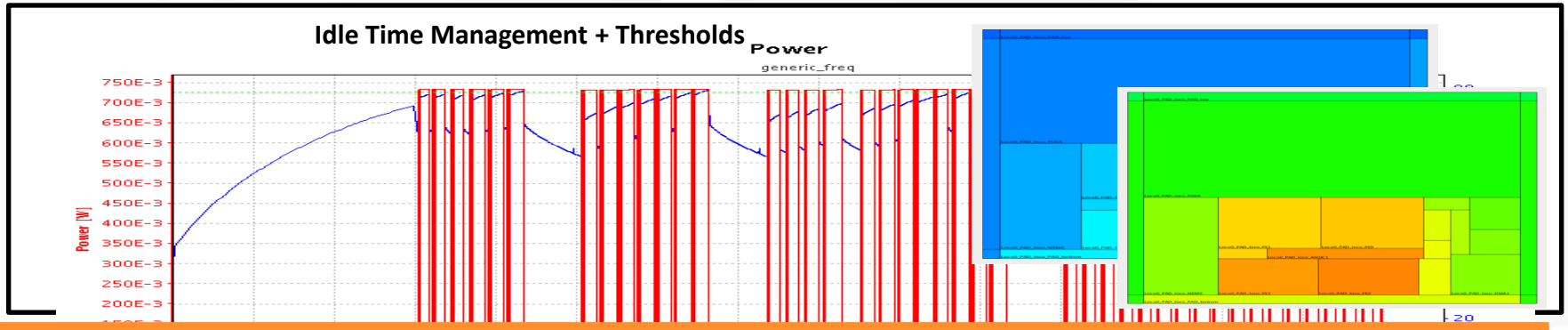




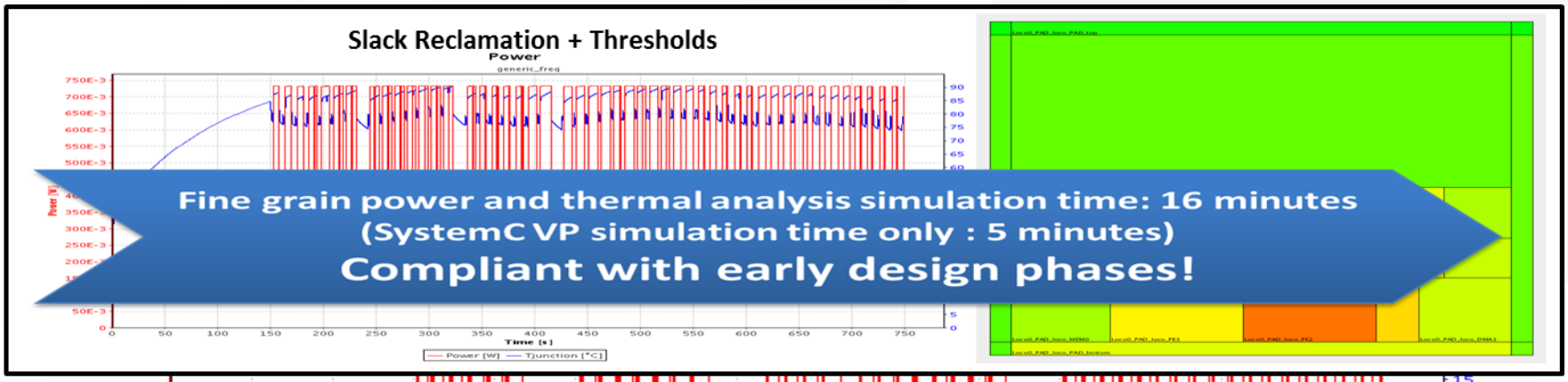
Power & Thermal Aware Virtual Platform



Thermal Management Policy Comparaison

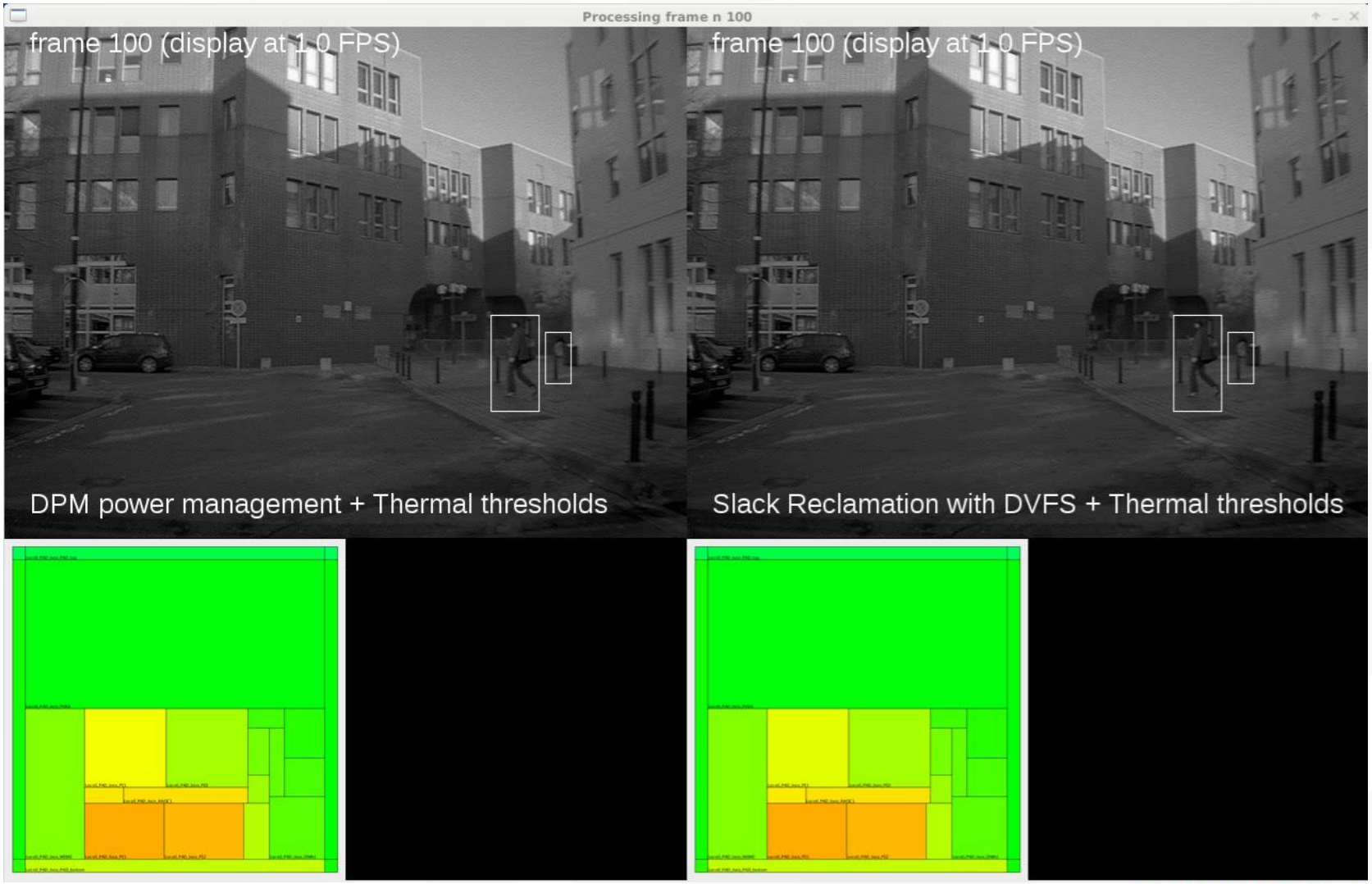


Thermal budget respected : T < 95˚C
Using thresholds : 70˚C < T < 90 ˚C
Peak temperature = 90,71˚C
Thermal control works but with poor application results :
Skipped frames : 10/52 **but successive frames !**



Thermal budget respected : T < 95˚C, same thresholds : 70˚C < T < 90 ˚C
Peak temperature = 91,2˚C
Slack reclamation : allocate remaining time to next frame (data dependency)
Skipped frames : 3/52. **Application rendering is preserved**.

Validation with real software



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