MANGO

Green Days@Toulouse
2/3 Juillet 2018

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 671668

http://www.mango-project.eu

https://twitter.com/mangoeu

Consortium overview

CONCEPT

HETEROGENEOUS NODES

APPROACH

NETWORK

PROGRAM MODEL

RESOURCE MANAGER

APPS

PLATFORM

COOLING

CONCEPT

HPC requirements

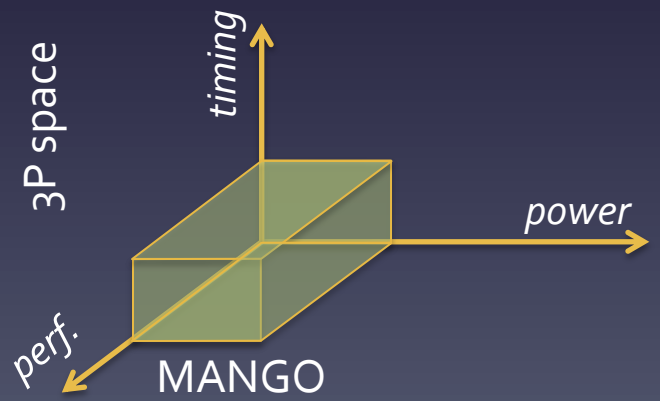
Perfor. | Power | Time

Resources with different power/performance profiles

Netw. | CPUs | GPUs | FPGAs | Accel.

Architecture exploration for HPC systems

MANGO prototype



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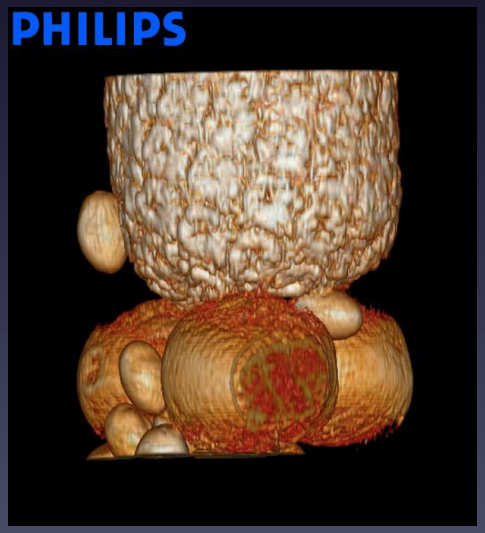
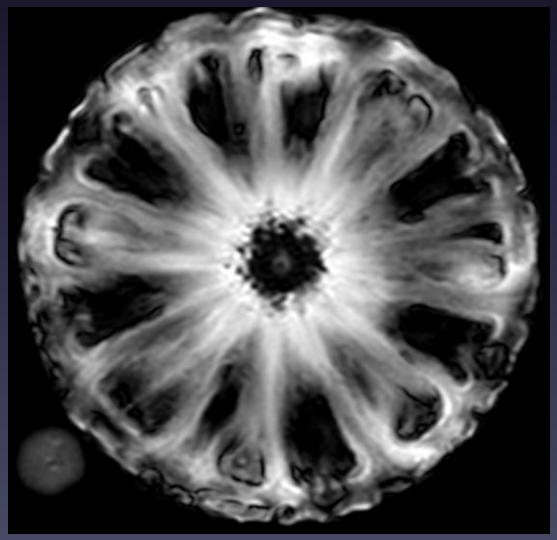
Medical Volume Renderer

- Volume visualization of image slices coming from MRI-, CT- and Ultrasound scanners
- Per pixel-ray casting to visualize a 3D shaded volume
  - Time-critical and computational demanding
  - High data traffic, very strict latency requirements
- Goal: parallelize existing volume renderer and mapping to GPUs and FPGAs using MANGO platform.



Volume renderer in action

PHILIPS



MRI slice of a pineapple

MANGO H.265 Transcoder

- Transforming video bitstream in time critical environment

- Motion estimation
- In-loop filters
- Interpolation filter
- Exploitation of spatial and temporal dependencies

LDPC (Low Density Parity Check)

- Description

  Low Density Parity Check code is a linear error correcting code, a method of transmitting a message over a noisy transmission channel

- Application domains
  - Satellite communications for near and deep space
  - 10 Giga-bit/s Ethernet (802.3an)
  - Wi-Fi 802.11 standard as an optional part of 802.11n

THALES

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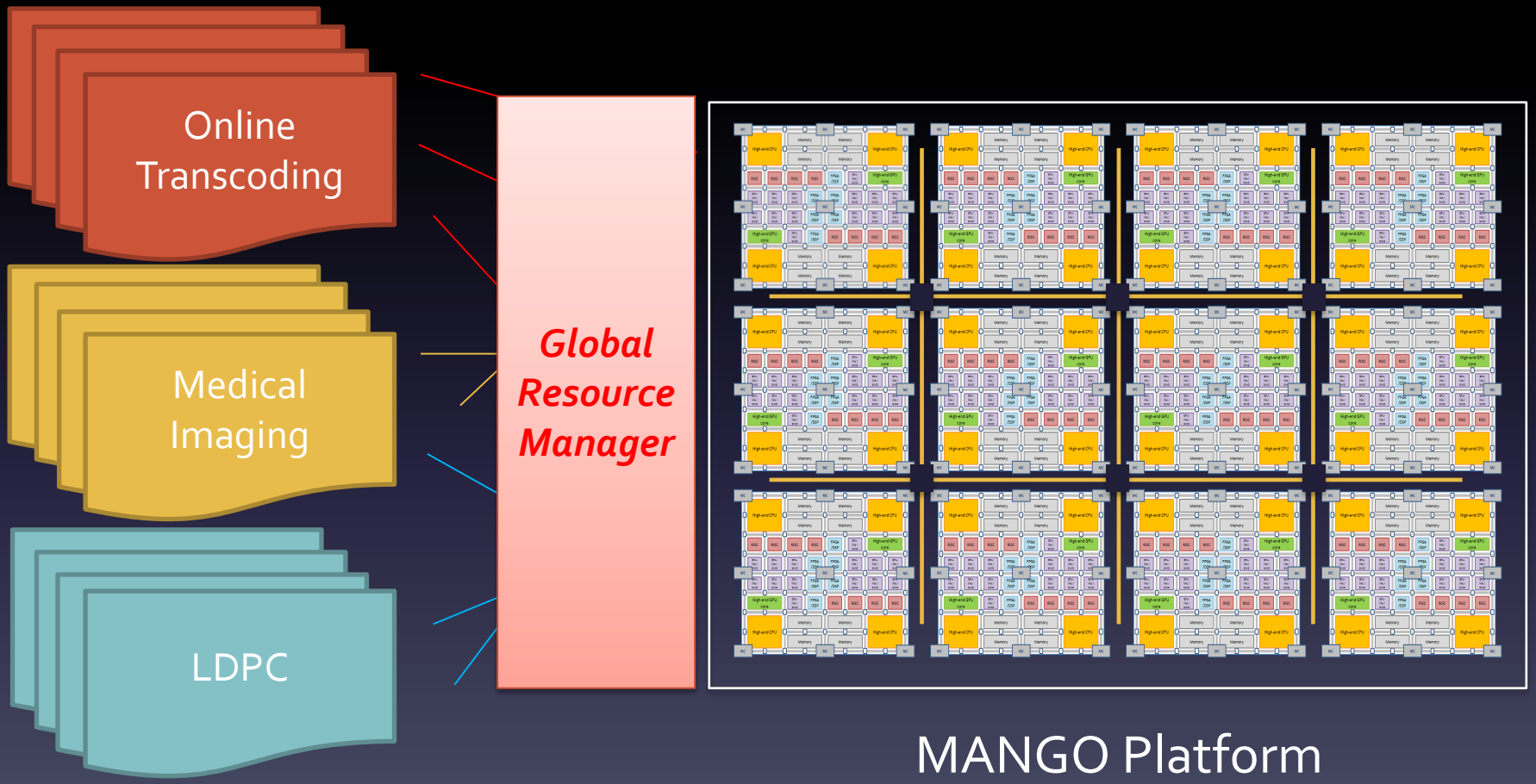
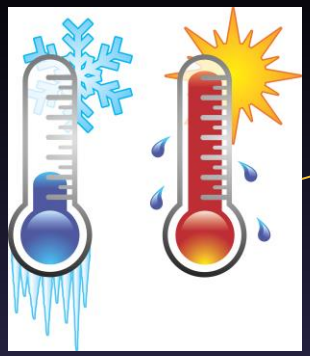
Thermal-Aware Task Mapping and Allocation

Applications

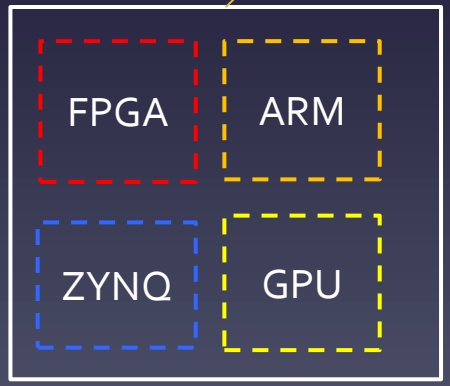


MANGO Platform

RESOURCE MANAGER



Global Resource Manager



Intra Application Mapping

Online Transcodin

HEVC Decoder

HEVC Encoder

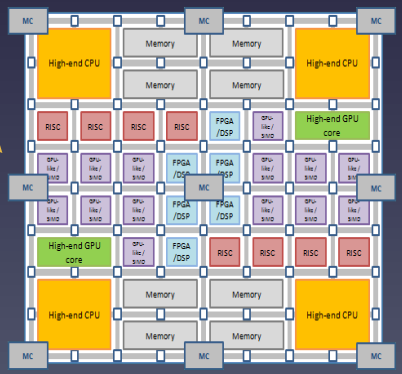
Picture Partitioning

Prediction

Transformation

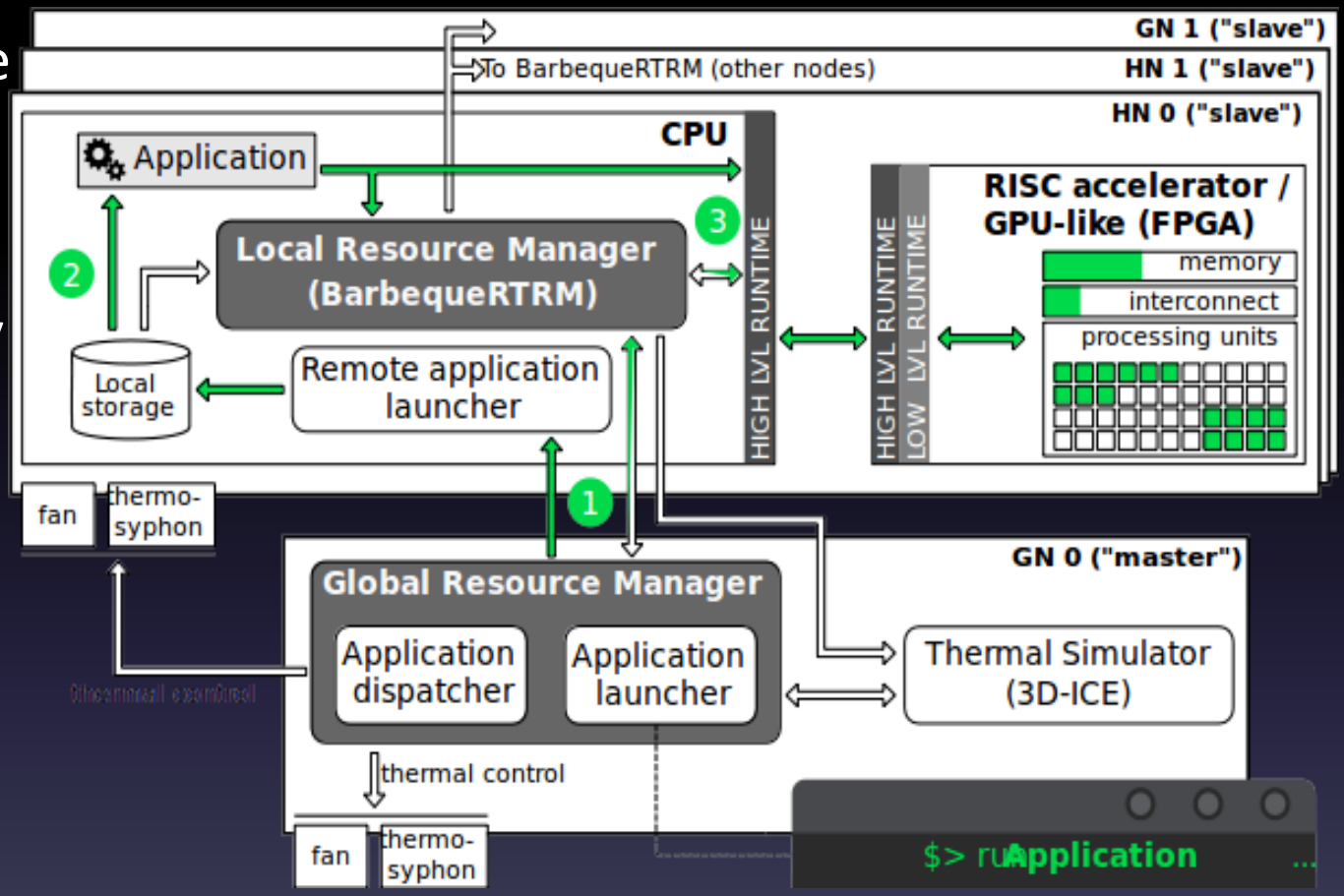
Quantization

Local Manager



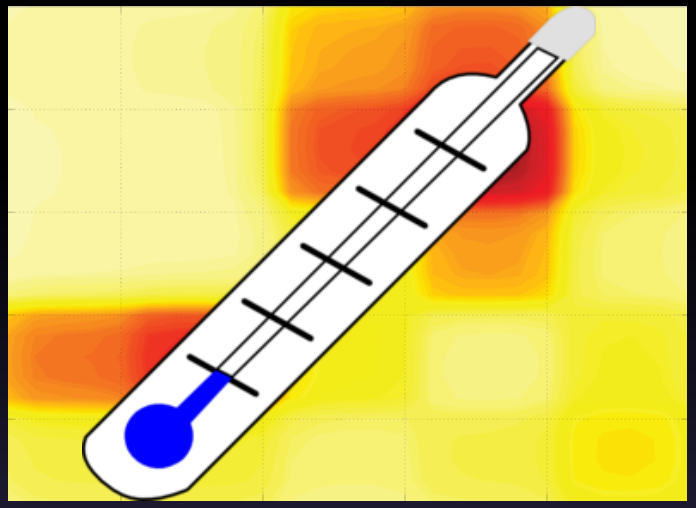
RESOURCE MANAGER

Runtime Resource Management:
-Maximize resource utilization
-Maximize availability for high priority applications



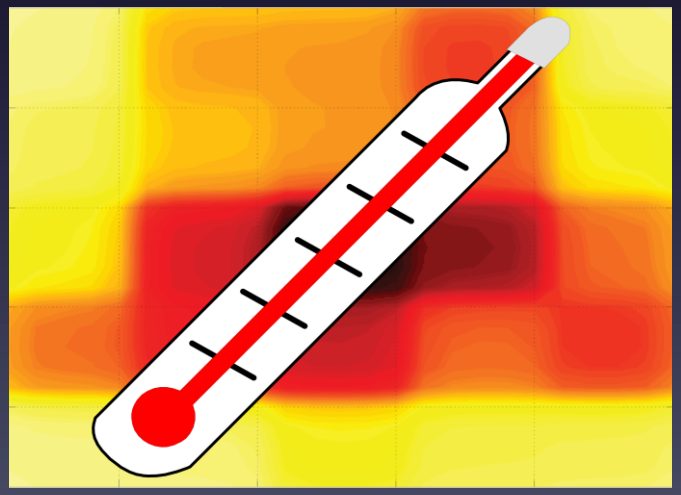
- **Global resource manager**: dispatch and launch apps on nodes
- **Local resource manager**: manage heterogeneous accelerators connected to a given node

Thermal-Aware Task Allocation



Thermal-Aware Mapping and Allocation

Random Mapping and Allocation



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- FPGA Hardware used by MANGO:
  - Up to 256 FPGAs (Stratix 10, Virtex-7, Zynq7000, Ultrascale, Ultrascale+, Ultrascale+ Zynq)
  - Long distance optical Gigabit communication with 40GBit per link, up to 12 Links per FPGA, <1us latency
  - Short distance general purpose communication with 120 GBit/s per link, up to 8 Links per FPGA, < 100ns latency
  - DDR4 memory up to 2400MWords/s

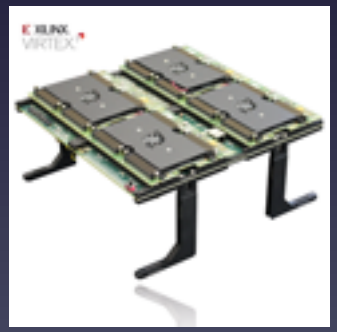
FPGA-FPGA cables

DDR-4 memory

QSFP

PCIe gen3

proFPGA quad Stratix® 10



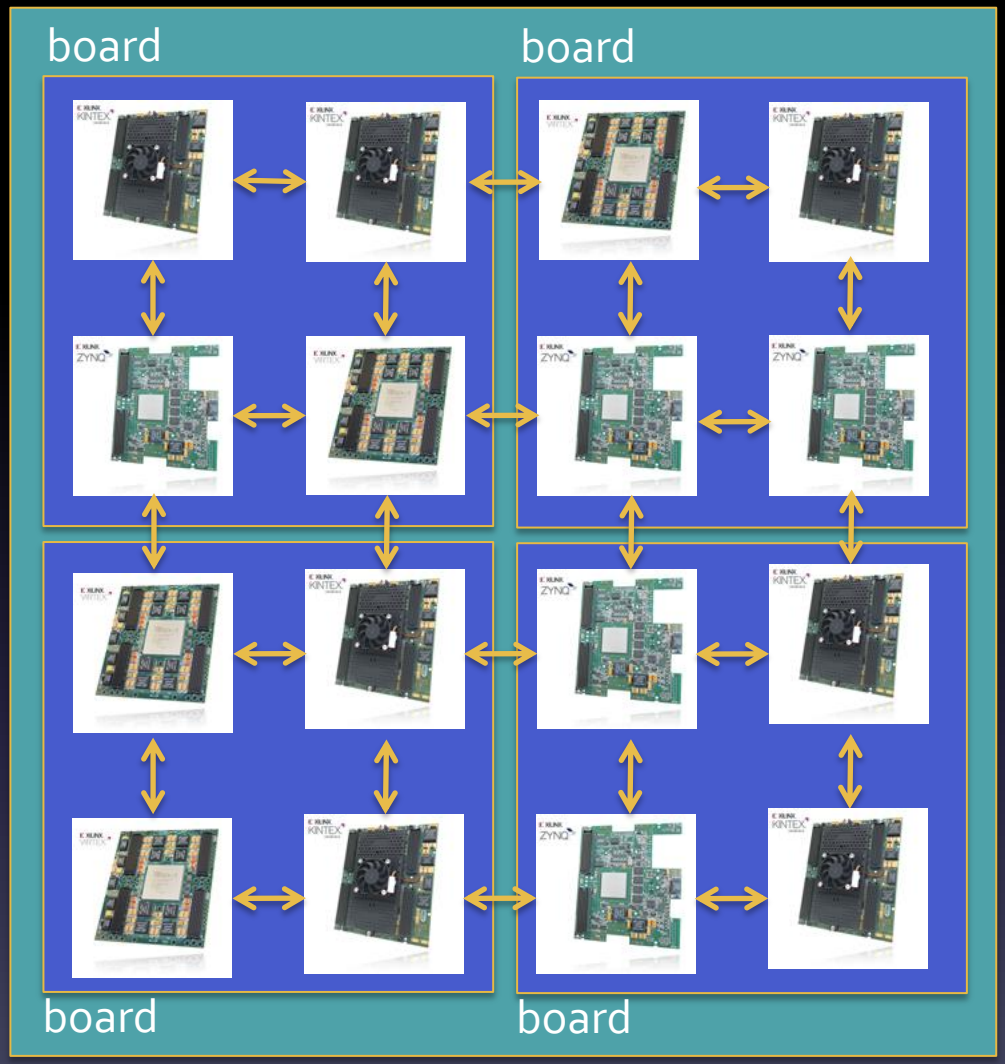
proFPGA quad XILINX Virtex-7

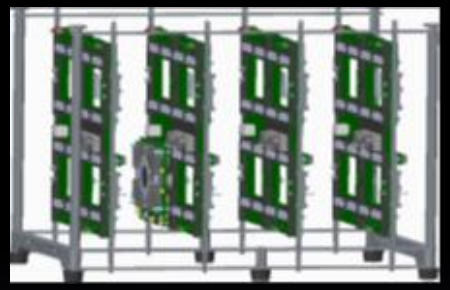
proFPGA quad XILINX Ultrascale

proFPGA Zynq 7000

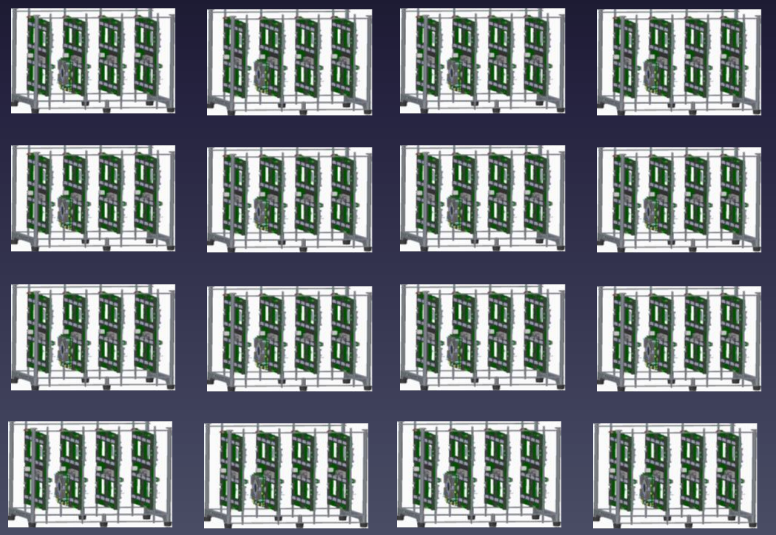
proFPGA Kintex Ultrascale

PLATFORM



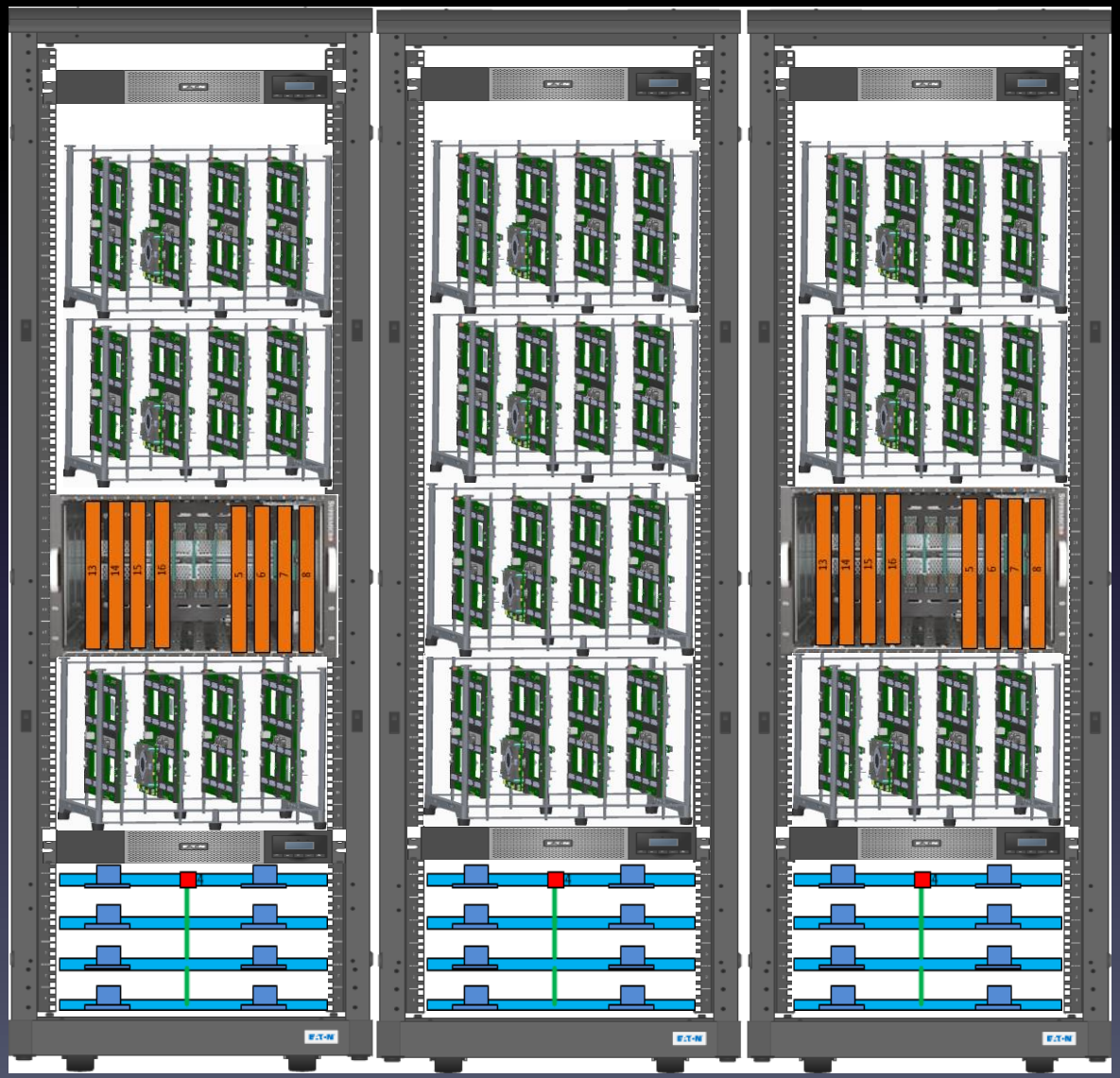


16x clusters

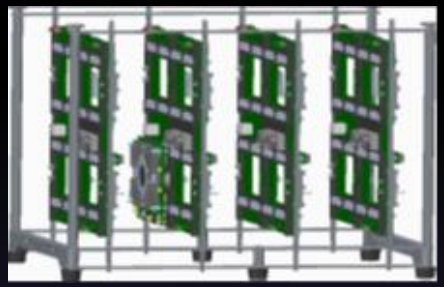


MANGO system (optically interconnected)

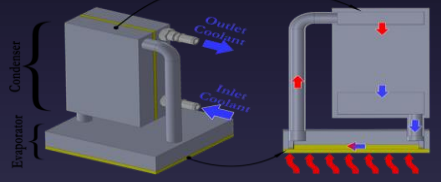
Final prototype layout



FPGA boards (Air cooling)



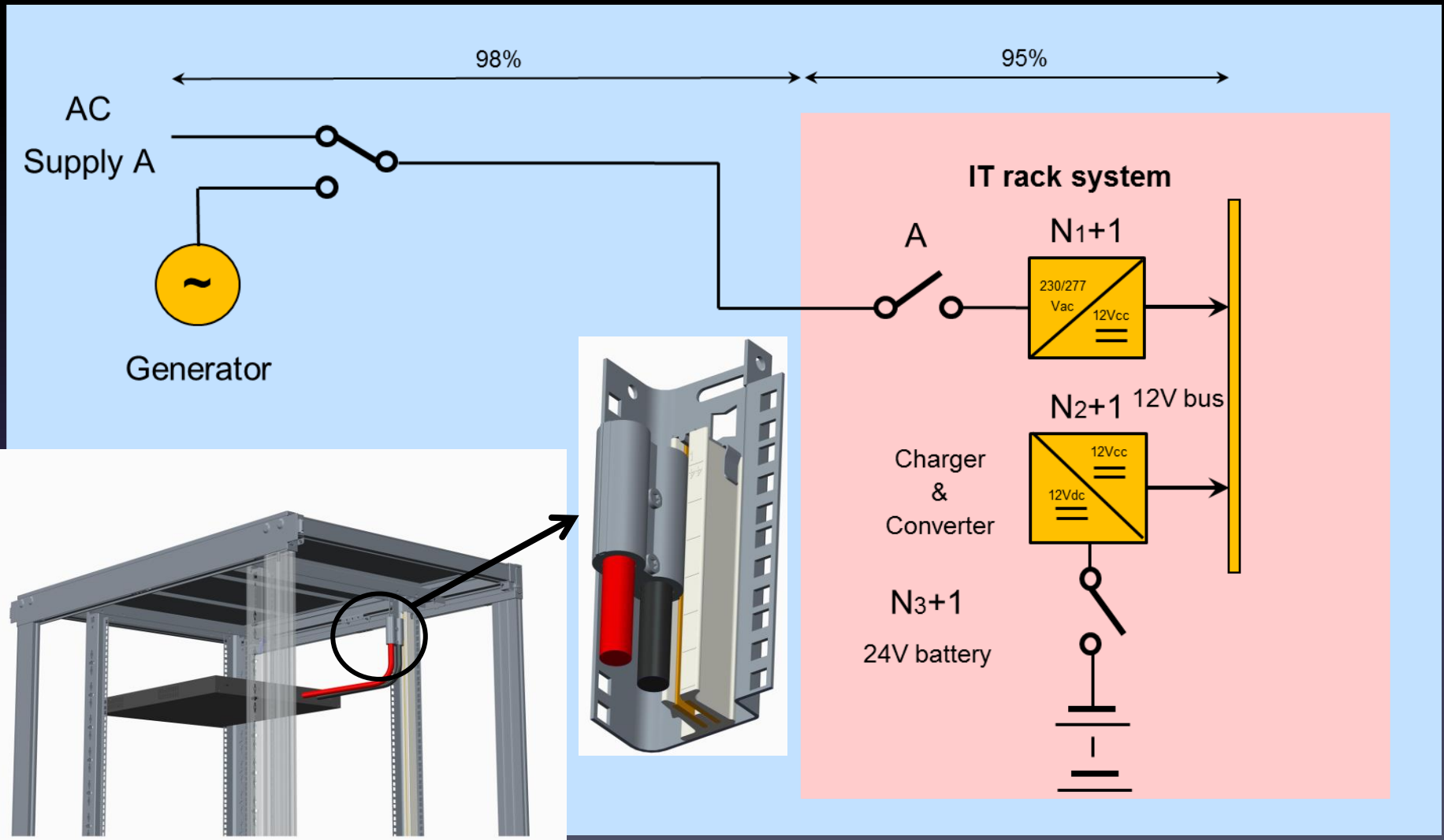
FPGA boards (Thermosyphon cooling)



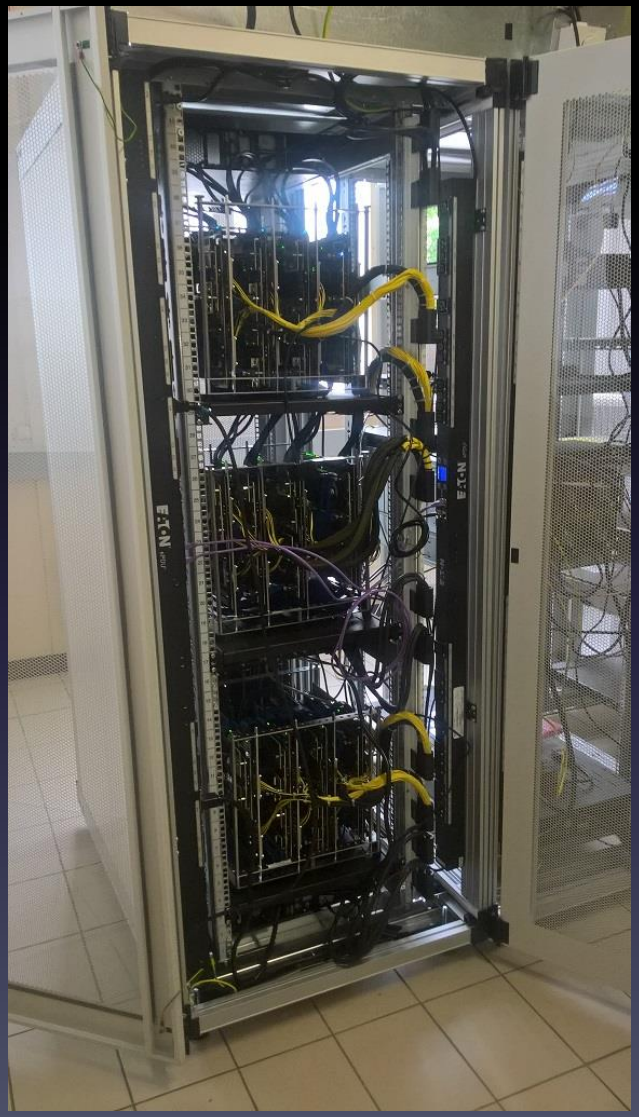
CPU/GPU Servers

12V DC custom UPS

From initial concept…



… to the real demo !



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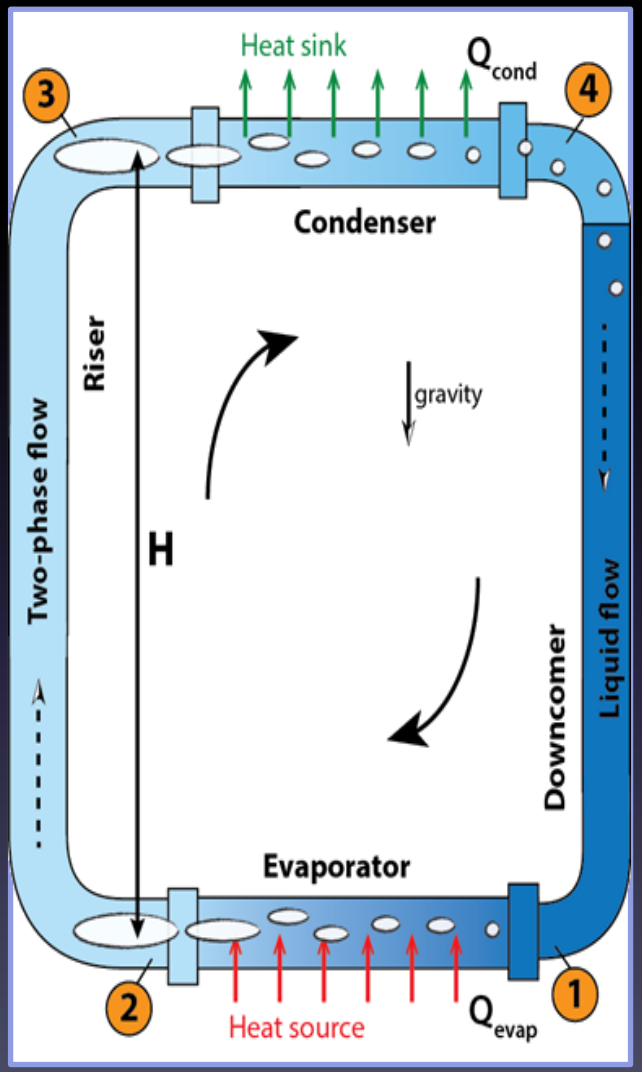
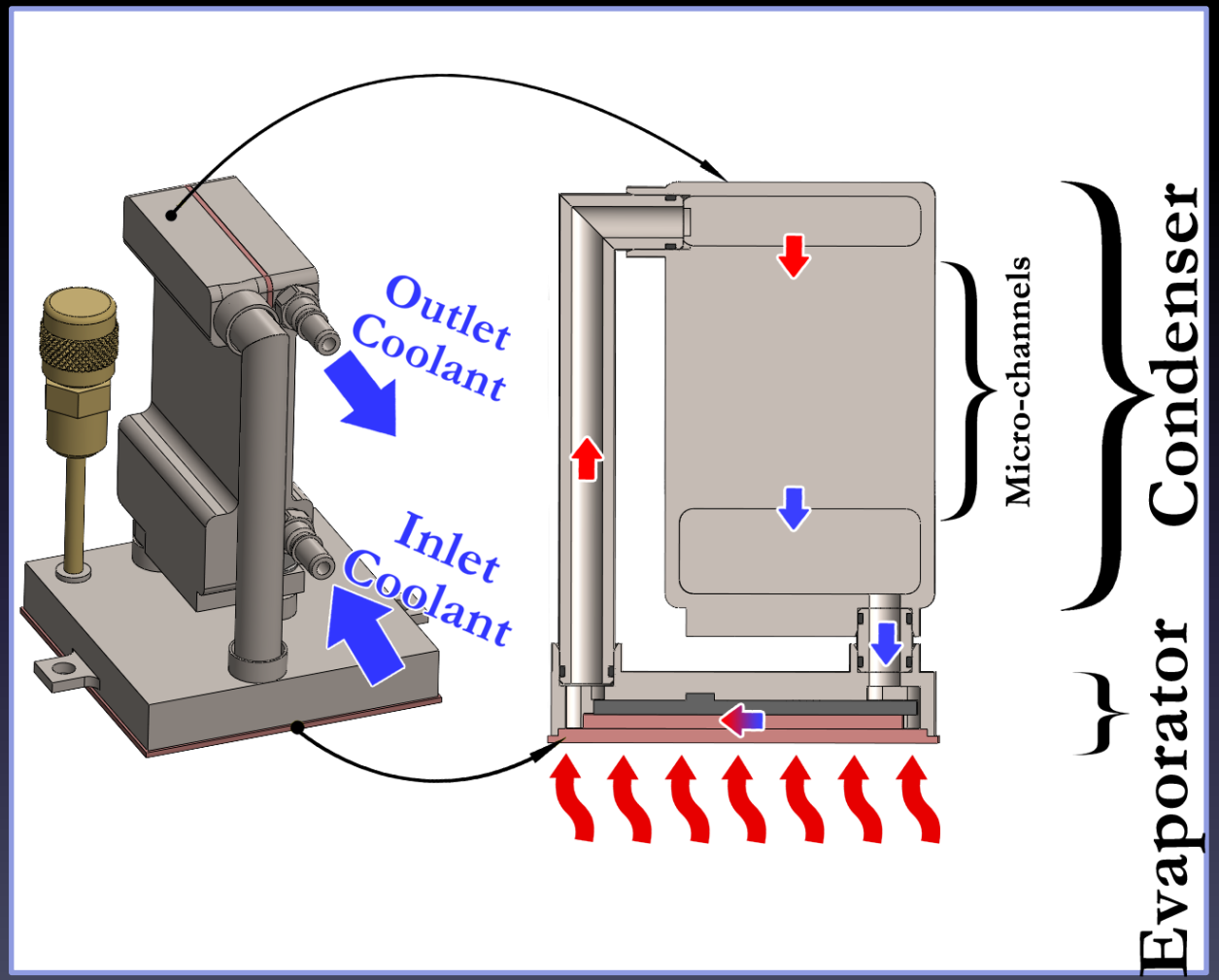
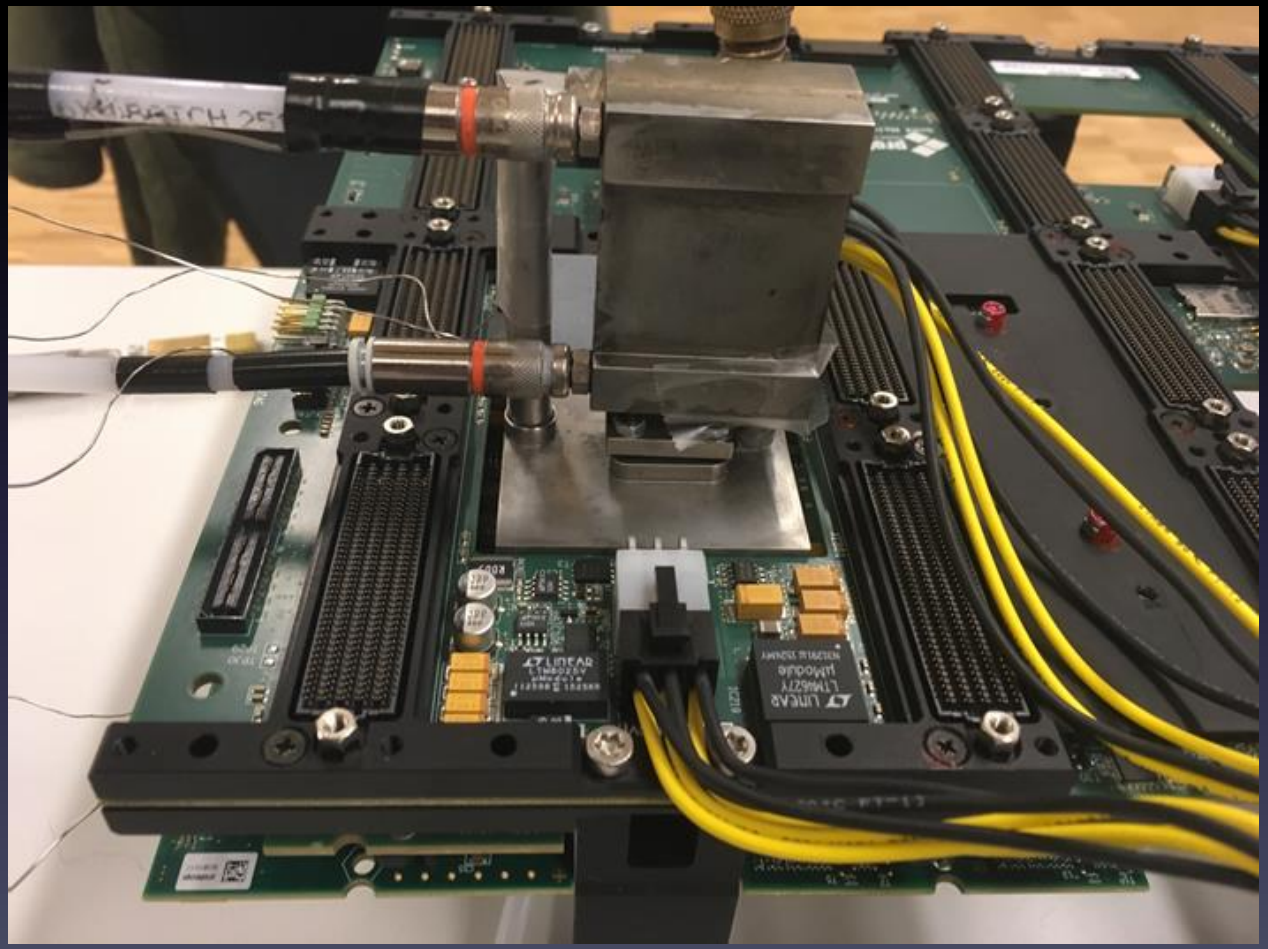
Principle

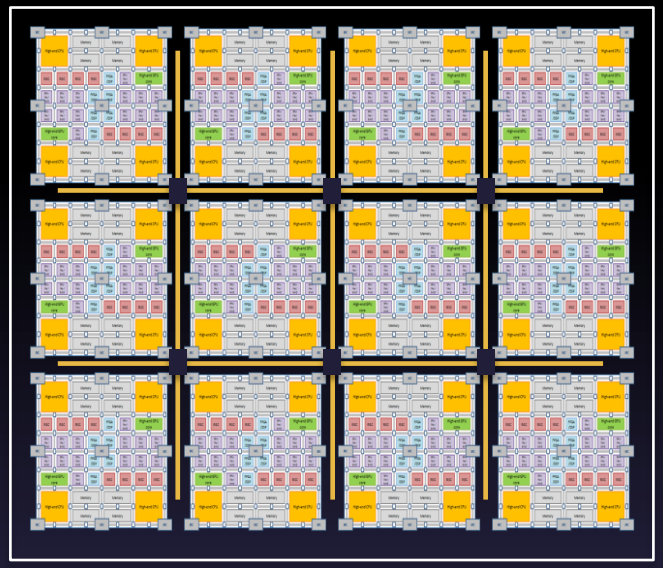

Heat sink
Q_{cond}
3
4
Condenser
Riser
gravity
Two-phase flow
H
Liquid flow
Downcomer
Evaporator
2
1
Heat source
Q_{evap}

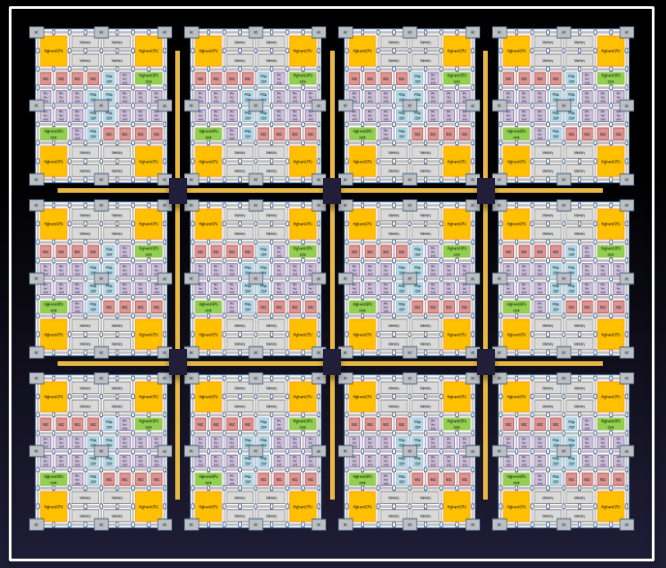

Outlet Coolant
Inlet Coolant
Micro-channels
Condenser
Evaporator

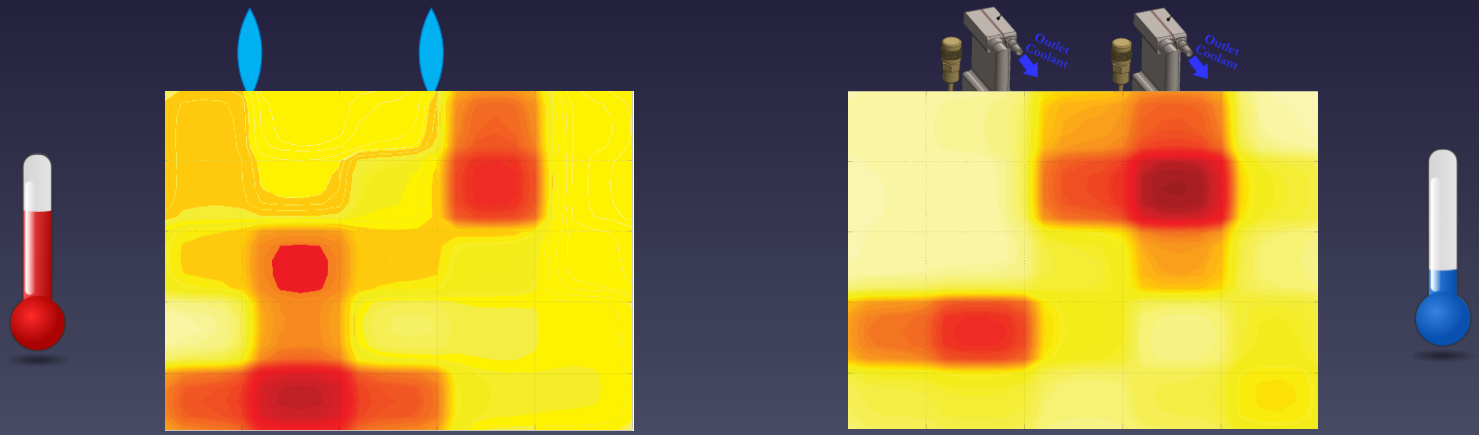
Real prototype on MANGO FPGA



Thermosyphon vs. Fan







Thank you