



Overheating of Chips

Group number: 10

Contents

- 1** Introduction
- 2** Problem
- 3** Solutions
- 4** Evaluation
- 5** Question time

01...

Introduction

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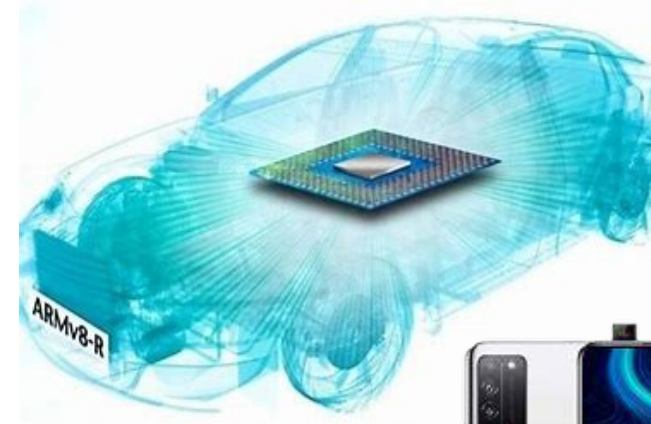
Question

**Do you often feel your smartphone
is overheating?**

Introduction

Chip is Widely Used

- Vehicle
- Smartphone
- Computer
- Air conditioner



Introduction

Snapdragon 888

- Serious chip heating problem



- High chip power

Single Thread: **3.3w**

Multi Thread: **7.8w**

- Technology

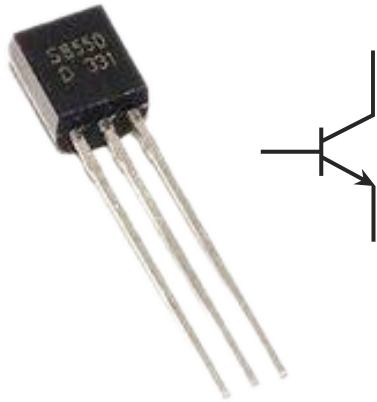
Samsung **5nm** process



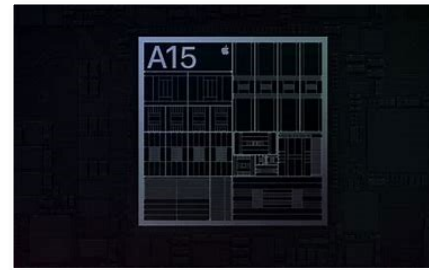
Introduction

What caused the chip to overheat?

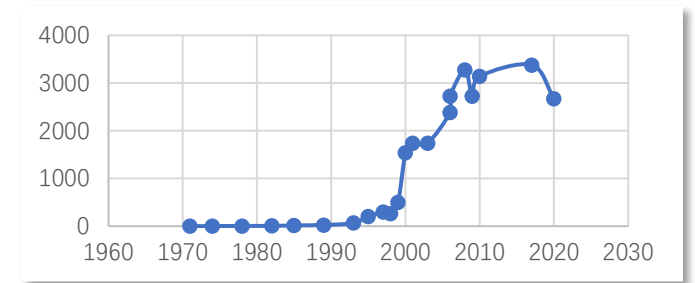
Transistors



Process



Frequency

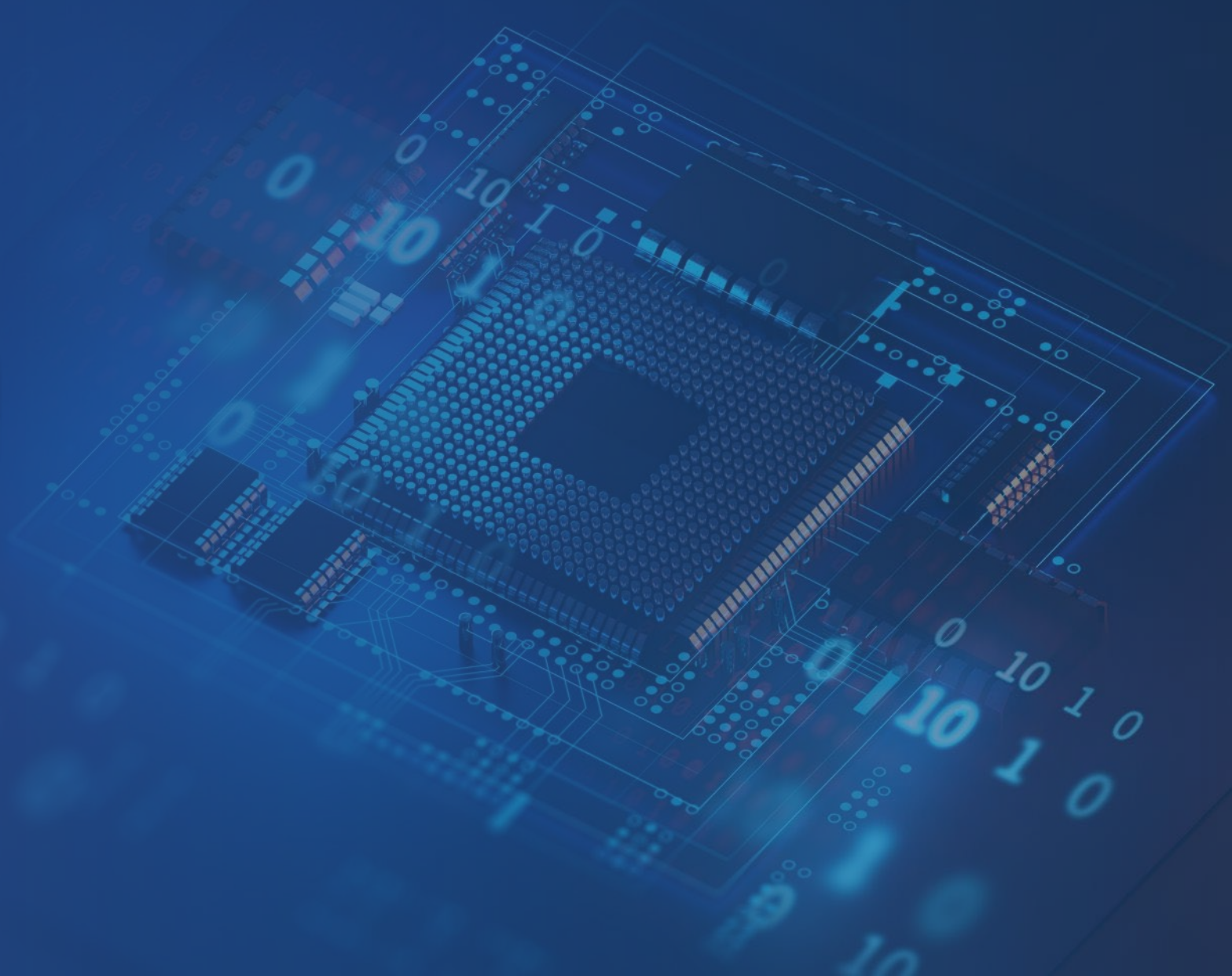


Power Increased

02....

Problem

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01

Main

Obviously, the most critical problem at present is that the chip will generate a lot of heat when it runs.

02

Extended

To solve the main problem, thermal sensors should be used. The error in the process of detection and reading of thermal sensor is the biggest challenge.



Problems

Your logo

Principle

The heat of the transistor comes from the current passing through it. We know that when the current passes through the conductor or semiconductor, it will always release some heat, just like the electric heater in life.



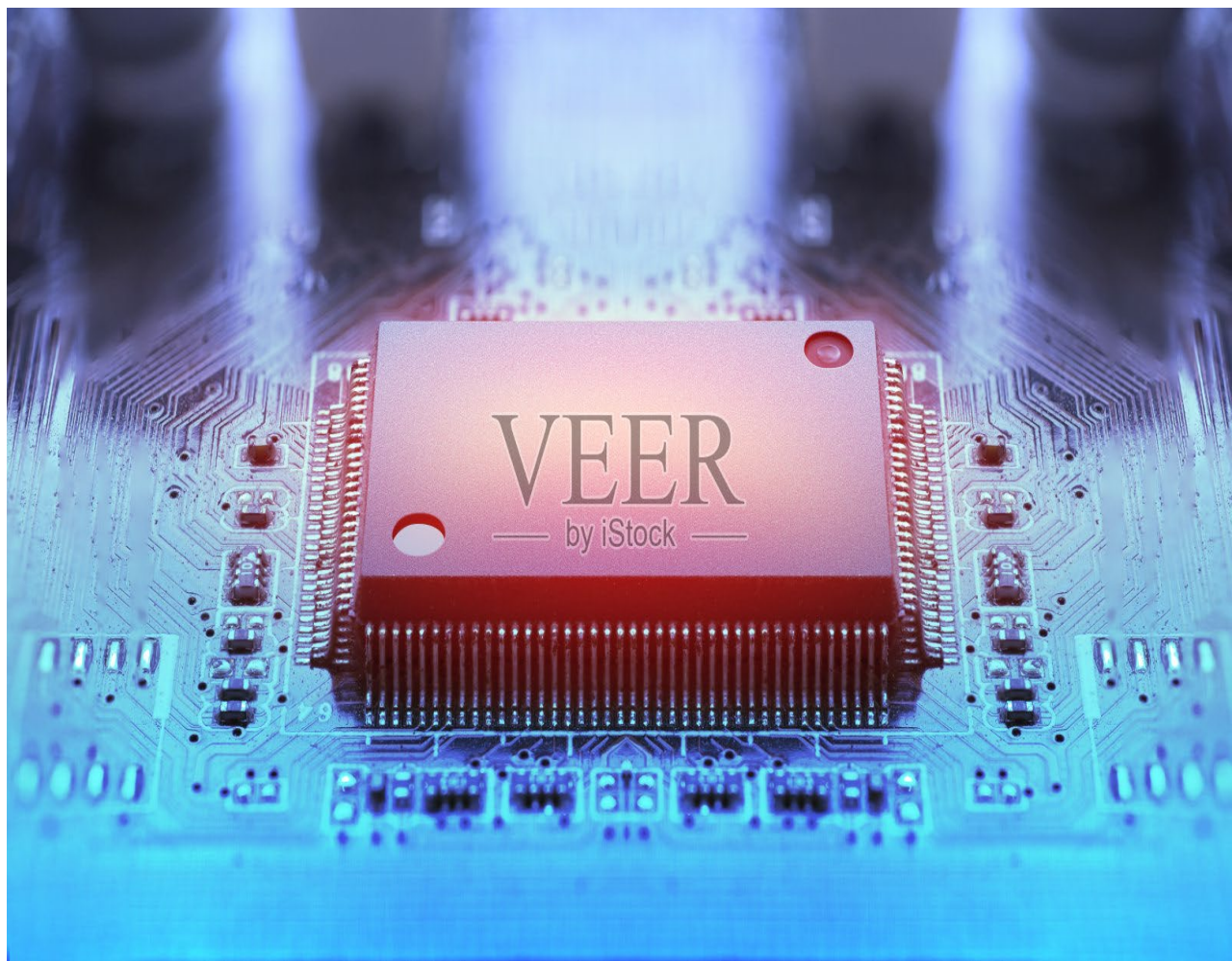


Problems

Your logo

Explain

At present, the number of integrated transistors of high-performance chips, whether mobile phone processors or desktop or server processors, ranges from hundreds of millions to billions. Take Intel's Core processor as an example. The high-end CPU contains more than 700 million transistors, each of which contributes a very small amount of power consumption and heat, and its overall value will be a terrible figure. At the same time, due to the high CPU frequency, for example, I7 Remax can reach above 3GHz. This means that at the peak performance, a considerable number of transistors flip (0 \rightarrow 1, 1 \rightarrow 0) as many as 322 million times per second. Each time is accompanied by current consumption and heat generation.





part 1

“Modern microprocessors utilise embedded thermal sensors to continuously monitor the chip's temperature during runtime. However, the overheating locations change temporally and spatially depending on the various workloads running on the chip.



part 2

Furthermore, on-chip thermal sensor readings are highly affected by noise due to fabrication fluctuations and randomness, which makes the task of thermal monitoring particularly challenging.”

03...

Solutions

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Solutions

- 1 Dynamic thermal management (DTM)**
- 2 Better heat dissipation materials**

Solution 1

Dynamic thermal management (DTM)

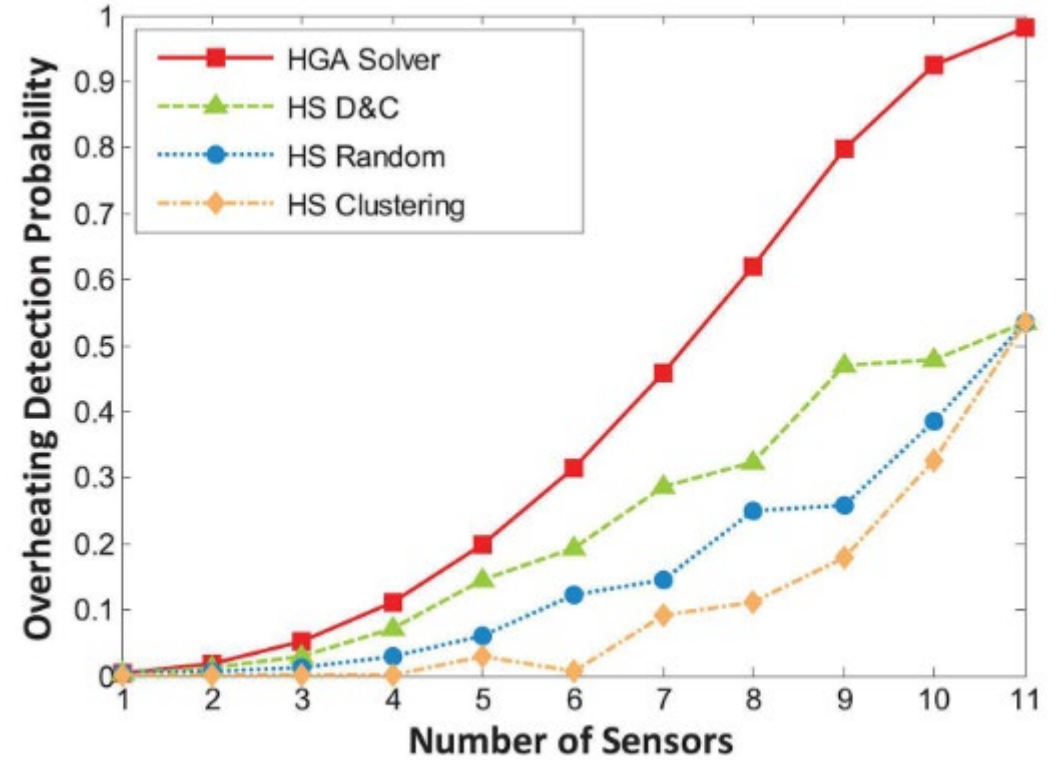
- 1 Heuristic thermal sensor allocation
- 2 Send a warning to the host and take cooling measures

Reference: X. Li, X. Wei and W. Zhou, "Heuristic thermal sensor allocation methods for overheating detection of real microprocessors," IET Circuits, Devices & Systems, vol. 11, (6), pp. 559-567, 2017.

Solution 1 Dynamic thermal management (DTM)

1 Heuristic thermal sensor allocation

1. Find a near-optimal thermal sensor allocation solution (HGA solver)



HGA solver

Number of sensors

Increase the overheating detection probability

Solution 1 Dynamic thermal management (DTM)

1 Heuristic thermal sensor allocation

2. Give a corresponding control threshold to different temperature sensors

Solution 1 Dynamic thermal management (DTM)

2 Send a warning to the host and take cooling measures

1. Send a warning to the host

2. Take cooling measures

Solution 2

Better heat dissipation materials

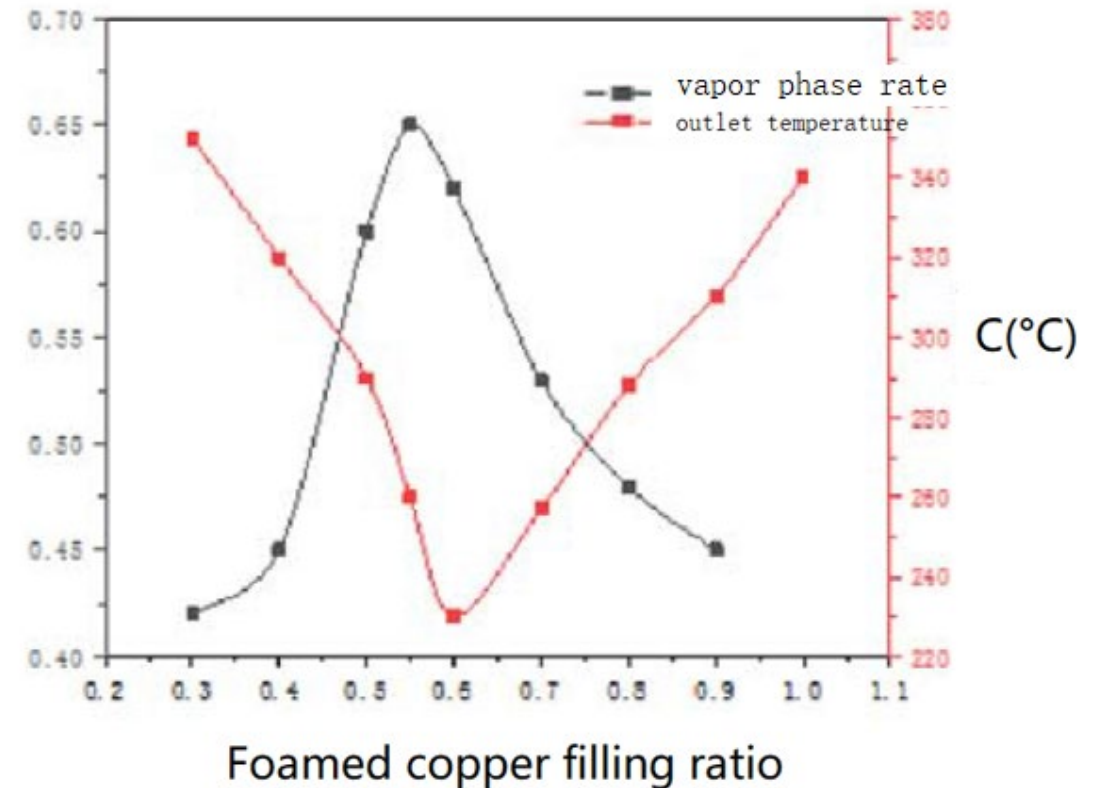
- 1 Better heat dissipation materials can solve the overheating chip problem in a way

Reference: Y. Shen, "Numerical study on the influence of foamed copper on flow boiling characteristics," IOP Conference Series. Earth and Environmental Science, vol. 714, (2), pp. 22066, 2021.

Solution 2 Better heat dissipation materials

1 Better heat dissipation materials can solve the overheating chip problem in a way

1. Metal foam materials provide new solutions for chip heat dissipation



04....

Evaluation

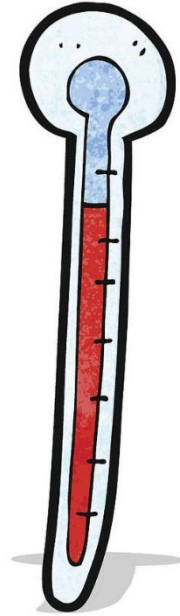
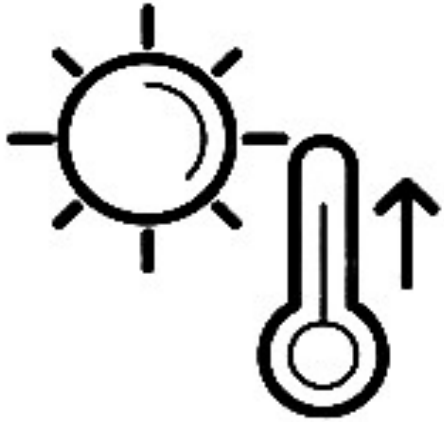
Analysing for every solution and evaluating

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FOUR EVALUATION

Your logo

Preliminary Evaluation



Protect temperature
sensor

- CONFIRMED



Experimental proof

- EFFECTIVE
- AFFIRMED

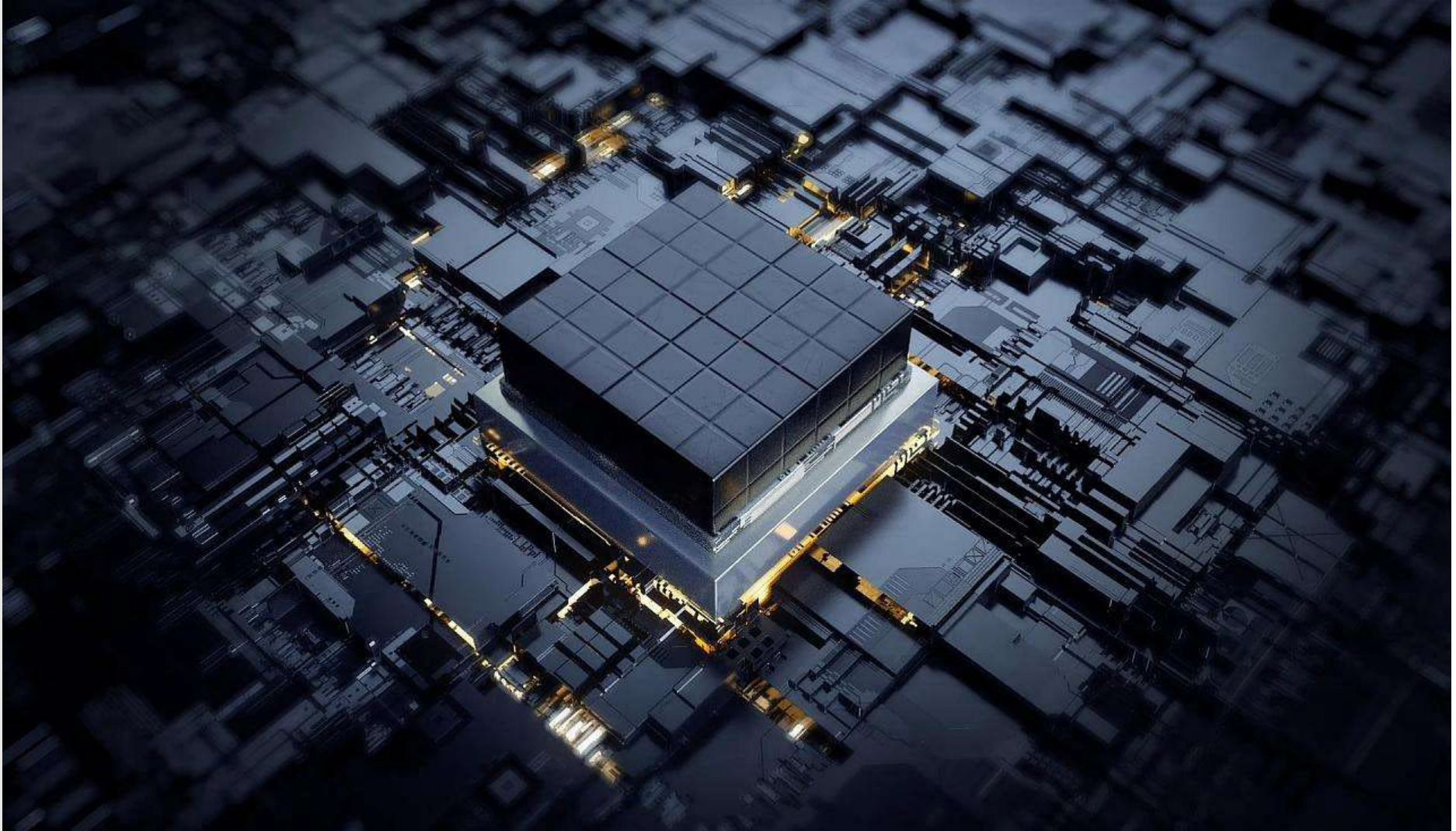
Preliminary Evaluation



Hardware

- Quickly respond
- Implement strategies

REDUCE THE LOAD



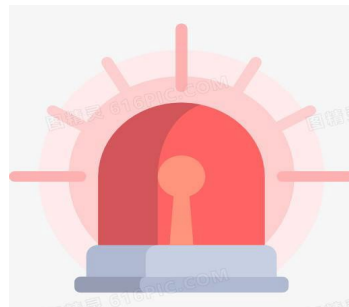
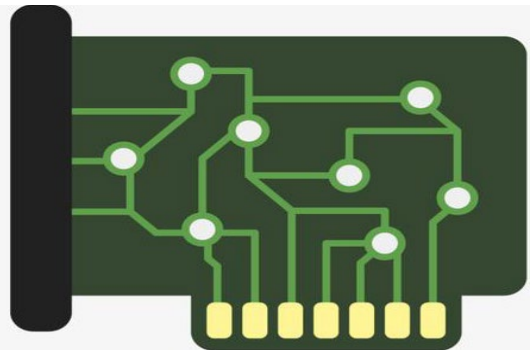
Second Evaluation



Device

- Save to memory
- Send an alarm

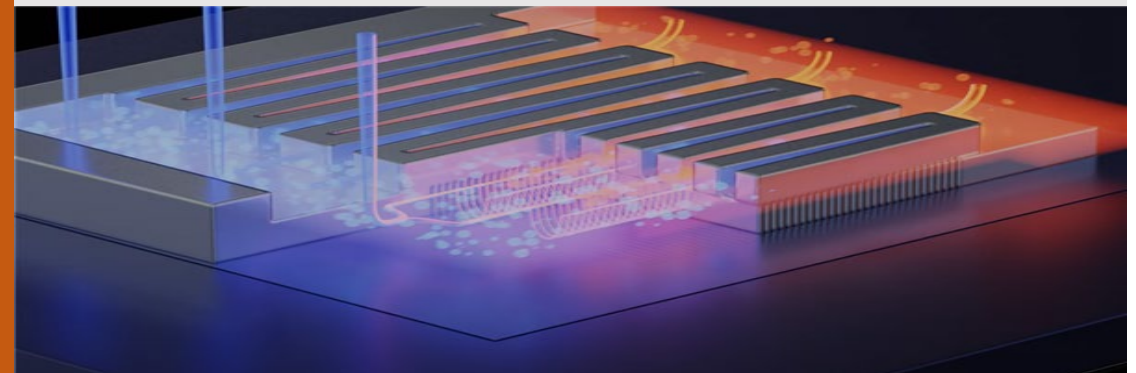
EFFICIENT SCHEME



Anti-Overheating

- Conduct heat dissipation
- Cooling quickly
- Easy to assemble and disassemble

AVAILABLE



05

Question time

Reference list:

- [1] Chip overheat protection, R. B. EUGENE, F. P. MARK, N. V. CAO, L. M. YU and K. S. LOONG. , 2008.
- [2] Xin Li,Xueting Wei,Wei Zhou <Heuristic thermal sensor allocation methods for overheating detection of real microprocessors>
- [3] X. Li, X. Wei and W. Zhou, "Heuristic thermal sensor allocation methods for overheating detection of real microprocessors," IET Circuits, Devices & Systems, vol. 11, (6), pp. 559-567, 2017.
- [4] ZHANG FUYUN +<Chip overheating automatic protection method and device>
- [5] LIU MICHAEL YU [US]; ROACH BRADLEY EUGENE [US]; NGUYEN VUONG CAO [US]; FIACCO PETER MARK [US]; KWOK SHAK LOONG [US] +<Chip overheating protection>
- [6] NING BAIFENG; LUO WEIFENG; LIU WEI; DENG WEI + <Anti-overheating device for secondary relay protection chip of transformer substation>