淺談機櫃系統散熱設計
FloTHERM in Rack

Cloud Data Center

AIC
Thermal and Acoustic Solution Design Section
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王維德
2016/11/11

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AIC Introduction

2015

2016

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Mark Zuckerberg

圖片來源：http://jjj1110.pixnet.net/blog/post/66598007

中央社 – 2012年5月8日 下午10:30

Steve Jobs

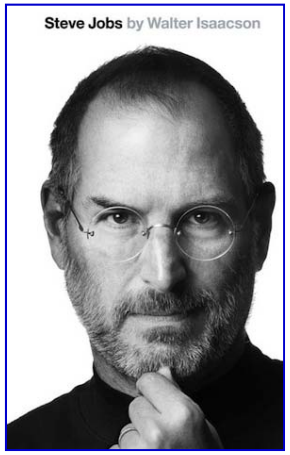

Photo from the Wikipedia of Steve Jobs

https://zh.wikipedia.org/wiki/%E5%8F%B2%E8%92%82%E5%A4%AB%C2%B7%E4%B9%94%E5%B8%83%E6%96%AF%E4%BC%A0

AIC New Client Mr. Mystery

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The New Request from Mr. Mystery

1. Whole Rack level system.
2. The total height is about 48U (2300mm).
3. The width is smaller than 800mm .
4. Each half rack has 21U Sever or JBOD.
5. Two kinds of Sever U.
6. Ambient temperature 35C.
7. 95W / 105W / 135W CPU

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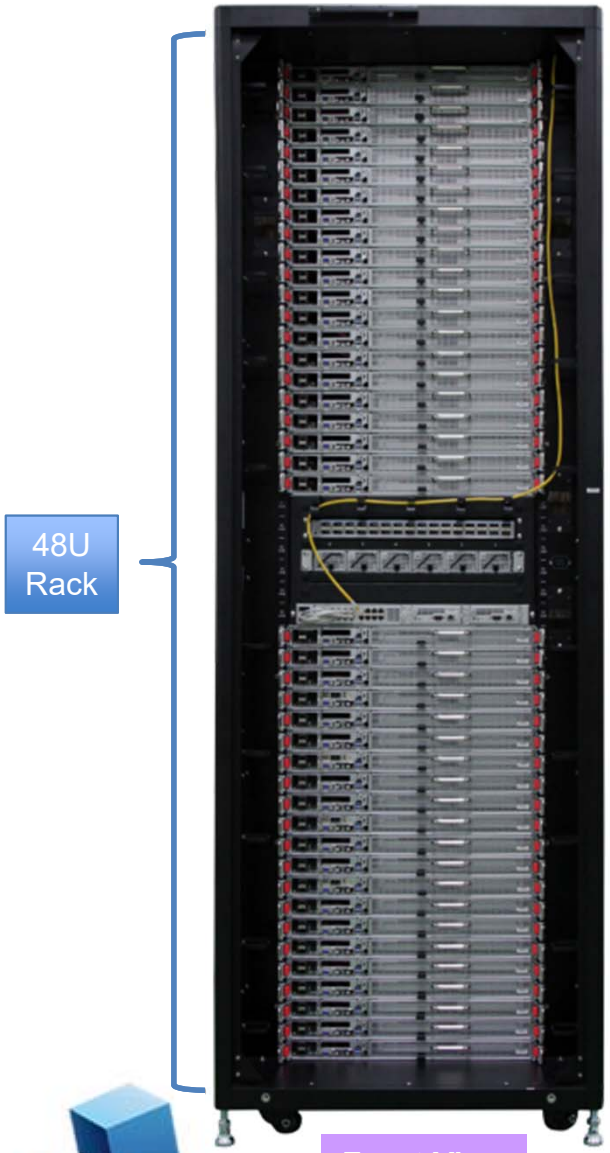
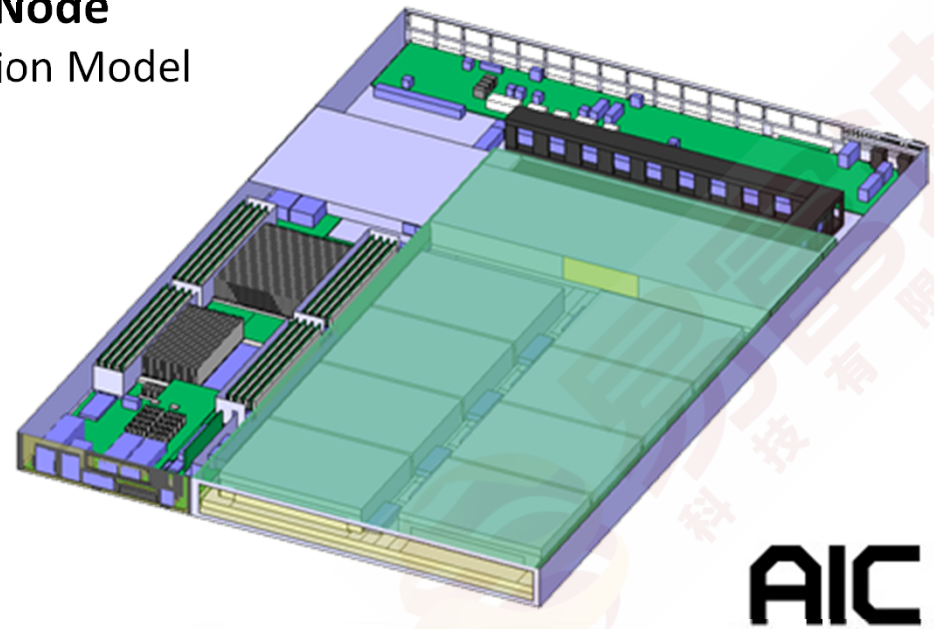
AIC Rack Thermal Simulation



Apply the Single Node into Rack

Single Node

Single Node
Simulation Model



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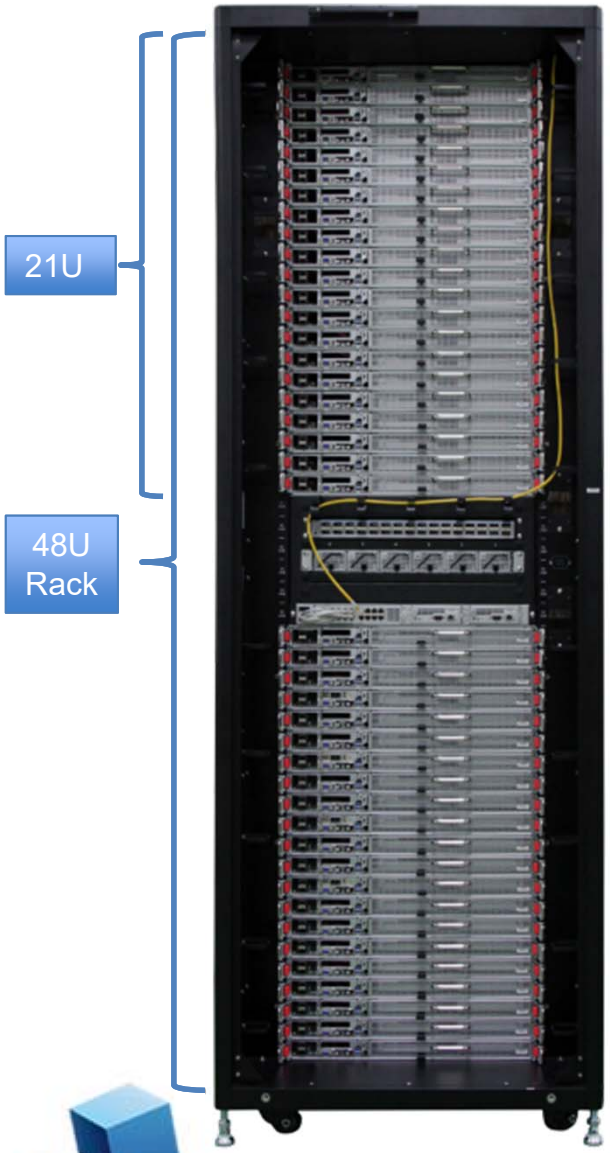
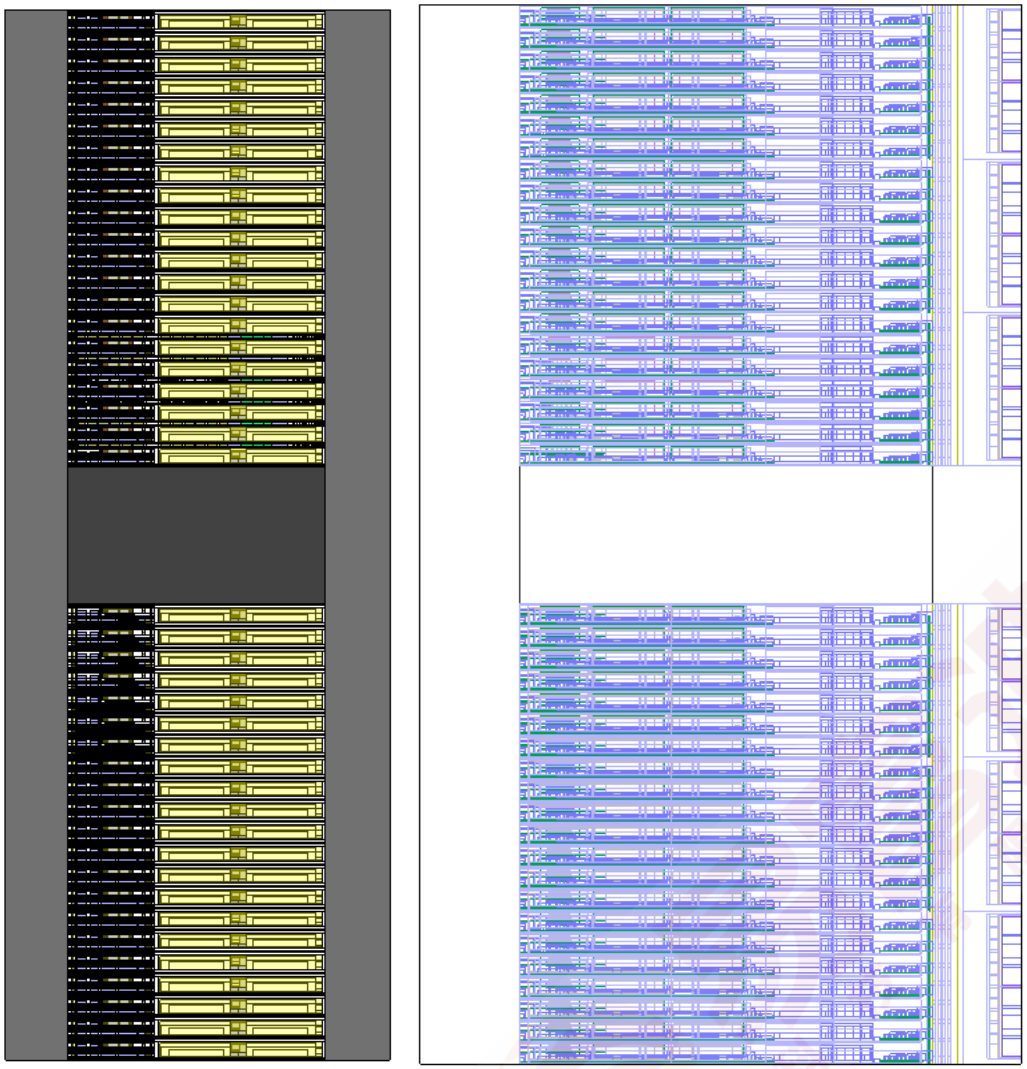
AIC Rack Thermal Simulation



Whole Rack Simulation Model



Front View

Side View

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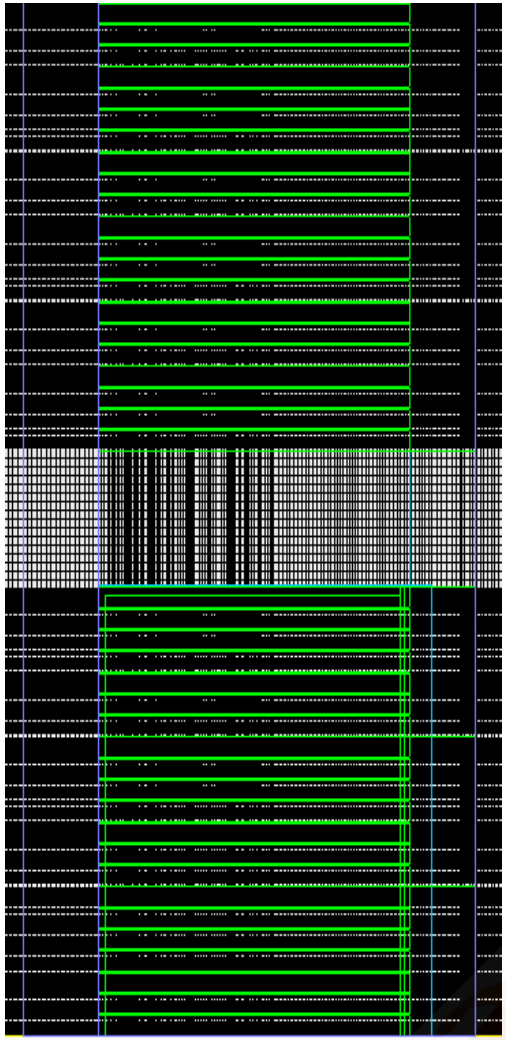
AIC Rack Thermal Simulation

48U Rack

Front View

Grid Generation



Side View

Overall grid cells was over 100 million

Total No. Cells	1.326764e+08

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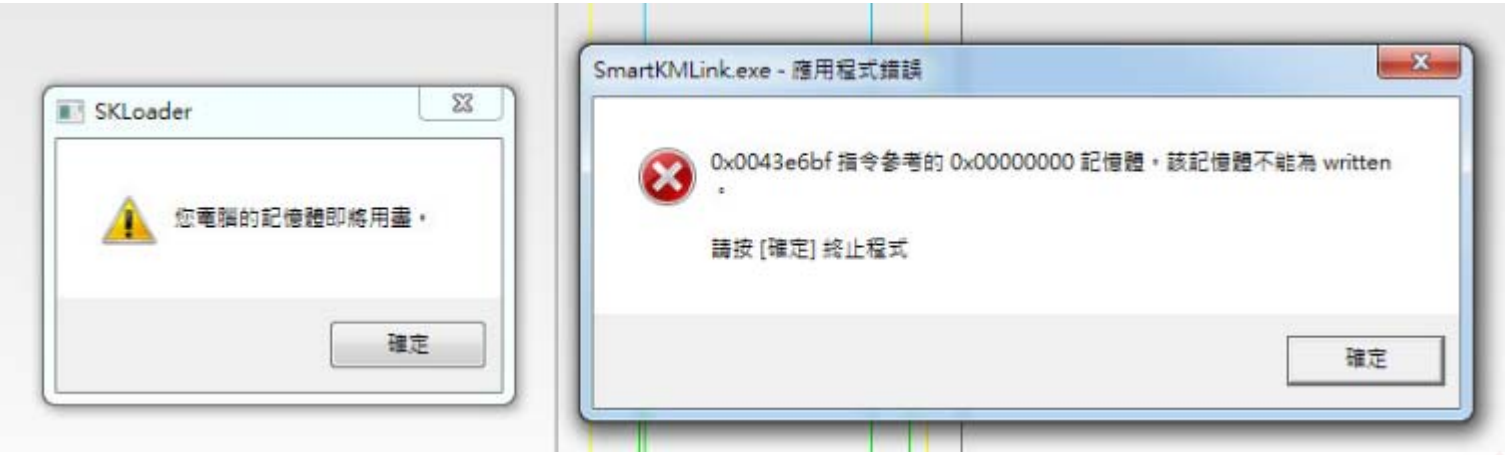
AIC Rack Thermal Simulation Result

After 3 days, I got the below message. → **The memory is not enough.**



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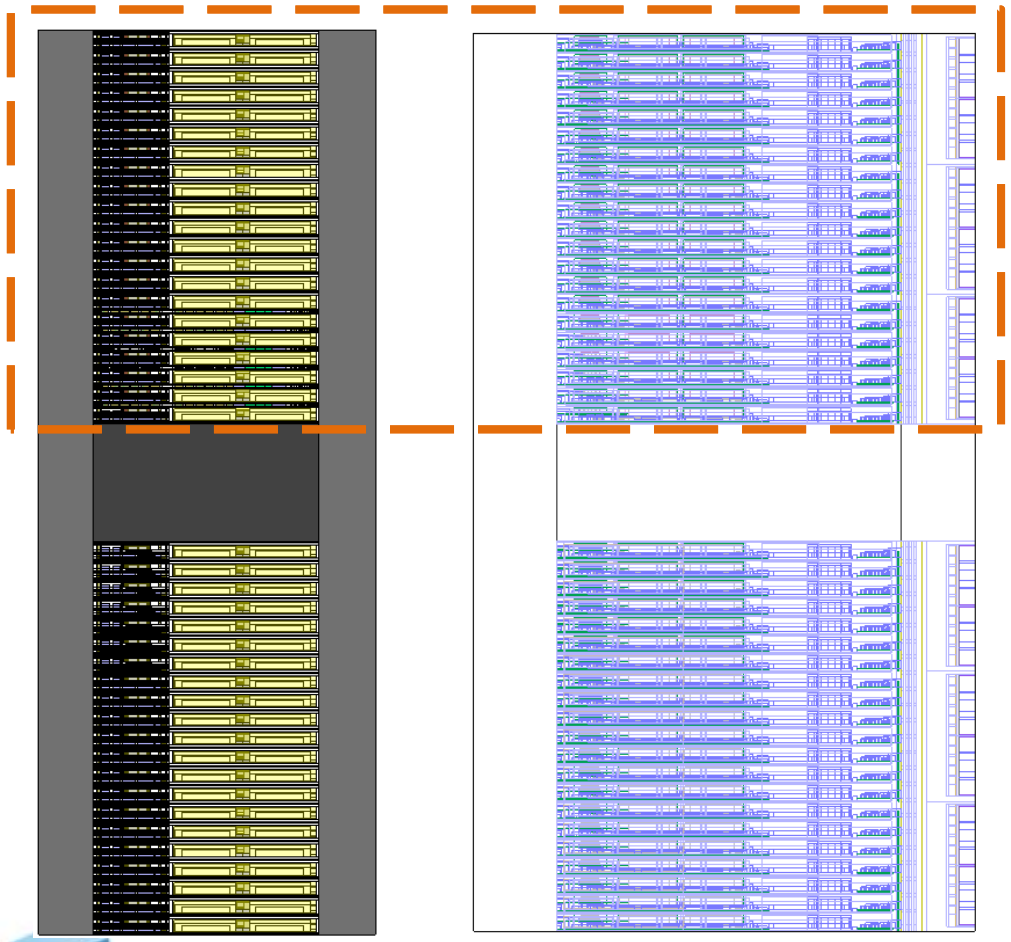
The Solution to Thermal Simulation

Reduce the grid cells amount

→ Apply half Rack



Front View

Side View

Apply

Half Rack (21U)

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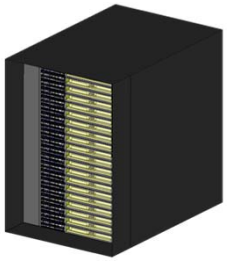
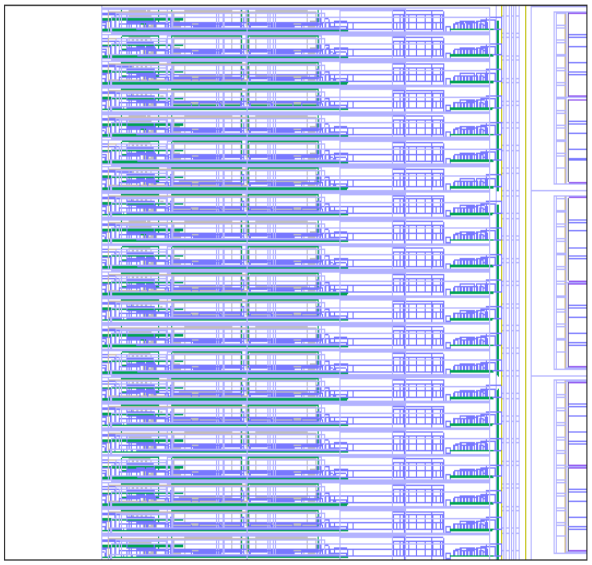
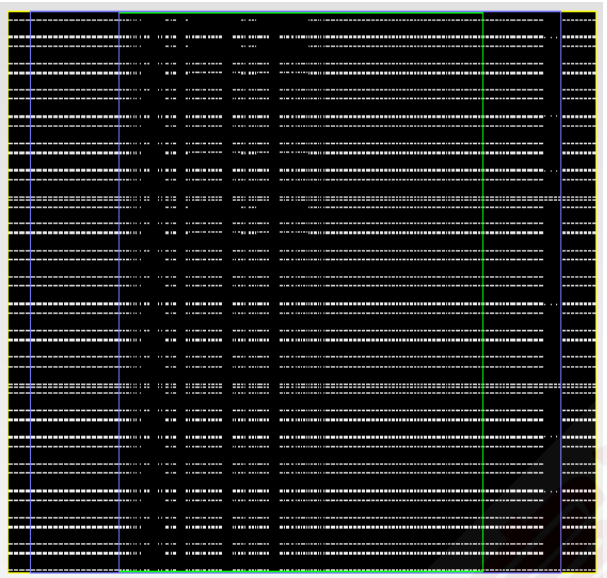
AIC Half Rack Thermal Simulation



Side View



Grid Generation



Total No. Cells 6.578412e+07

The grid cells are still a lot and more than 60 million.

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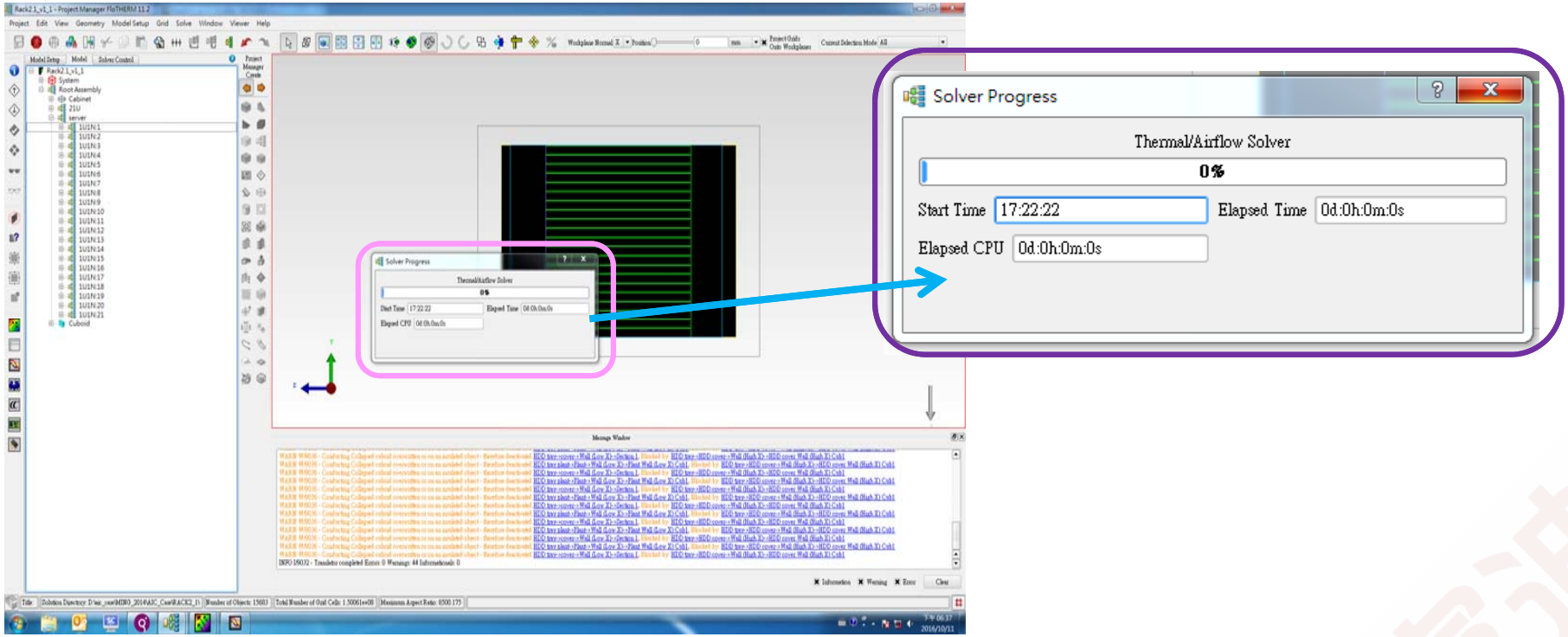
AIC Half Rack Thermal Simulation Result



The thermal simulation can keep going.

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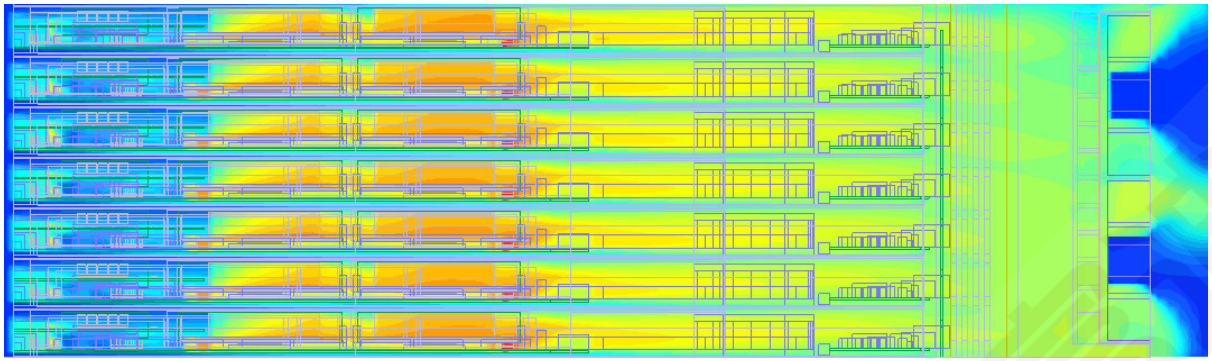
AIC Half Rack Thermal Simulation Result

Front View

Simulation Result

Side View



1. The thermal simulation had done and produced the simulation result..
2. The large grid cells made FloTHERM to spend lots of time performing.

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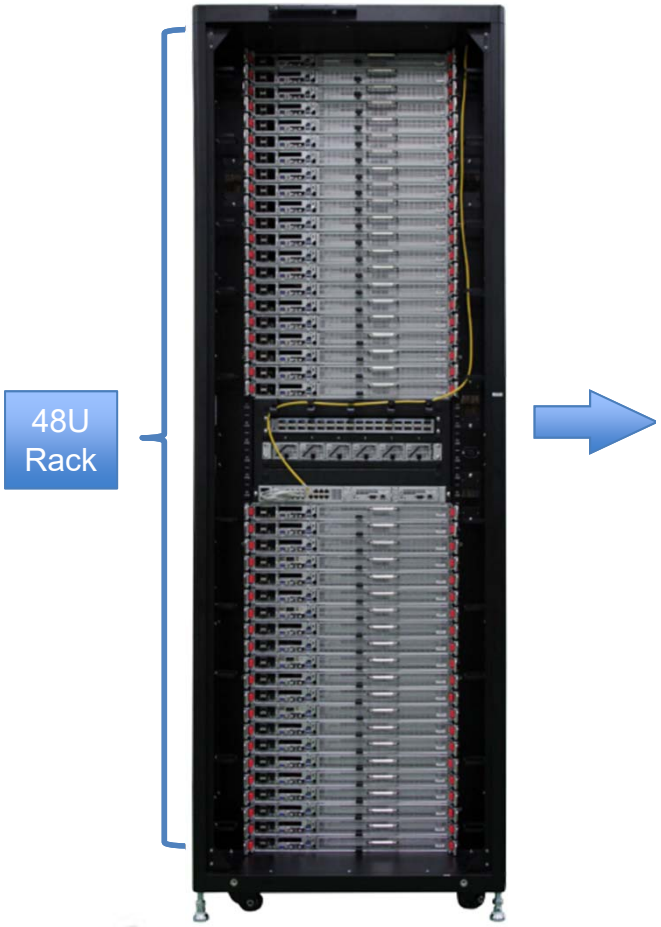
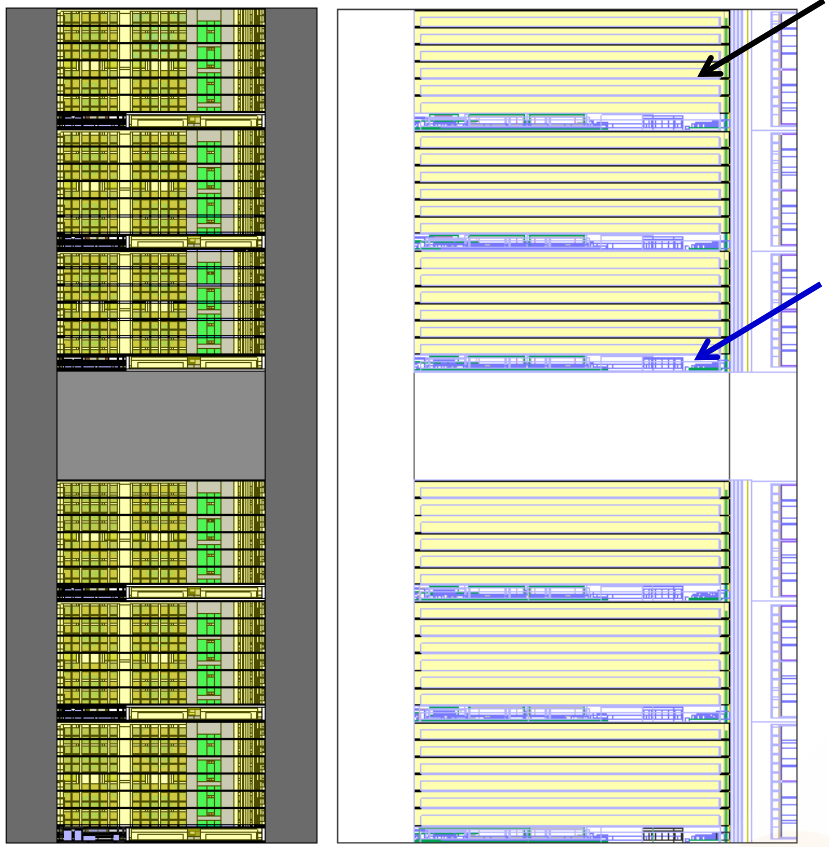
Other Way to Reduce the Grid Cells

Apply volume resistance instead of real Sever model





Dummy Single Node Sever
→ Volume Resistance

Real Single Node Sever

Front View

Side View

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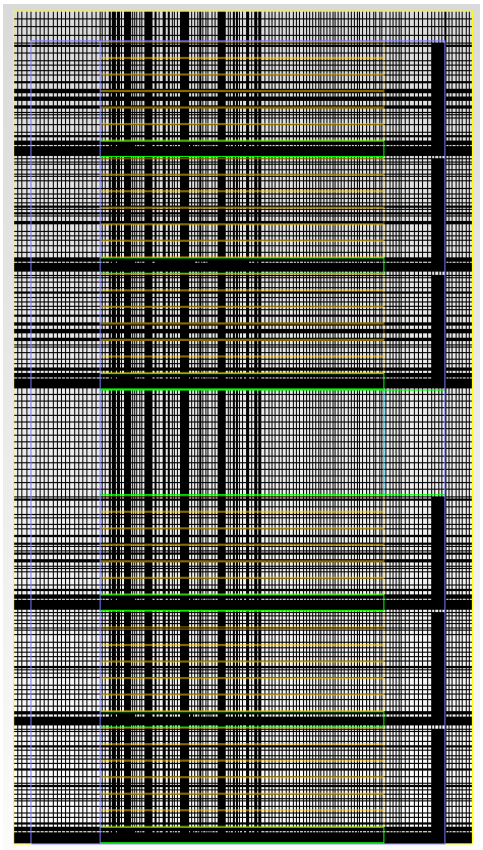
Other Way to Reduce the Grid Cells

Grid Generation



1. The grid cells was reduced to be about 30 million.
2. The simulation result is more easy and more capable to produce the result

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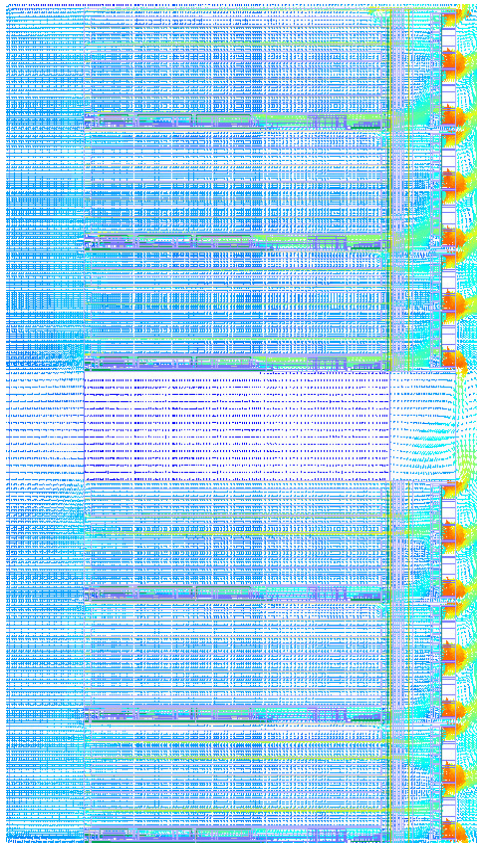
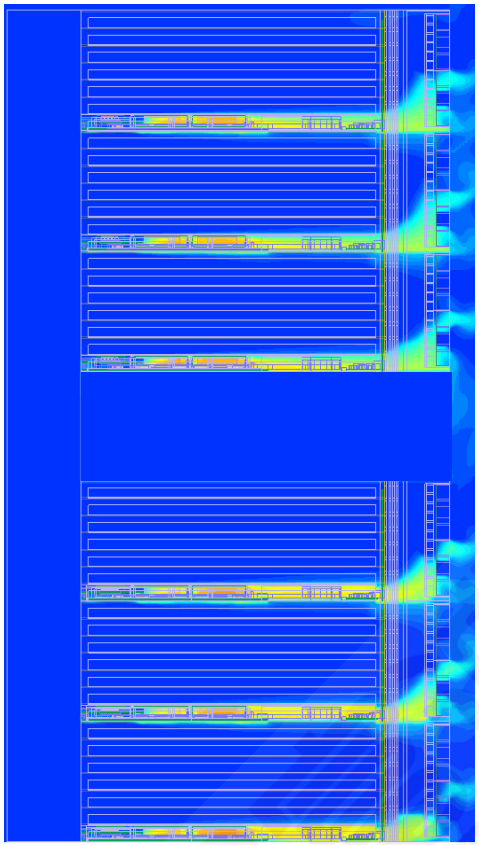
Other Way to Reduce the Grid Cells

Simulation Result





1. The thermal simulation was easily diversion.
2. The simulation result is acceptable.
3. The simulation performing time is acceptable.

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More Request Detail of Mr. Mystery

1. Clearly know Processors' temperature in each node.

2. Clearly know the temperature of Memory, BMC and PCH in each node.

3. Clearly know the chip temperatures of add-on card in each node.

4. Clearly know the temperature of HDDs in Sever Nodes or JBODs.

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Secret Behind of Mr. Mystery Request

Real Situation in Rack

1. Are the inlet temperatures of each node same?

2. Is it separating the cold air zone and hot air zone in rack room?

3. The real situation of remove the server.

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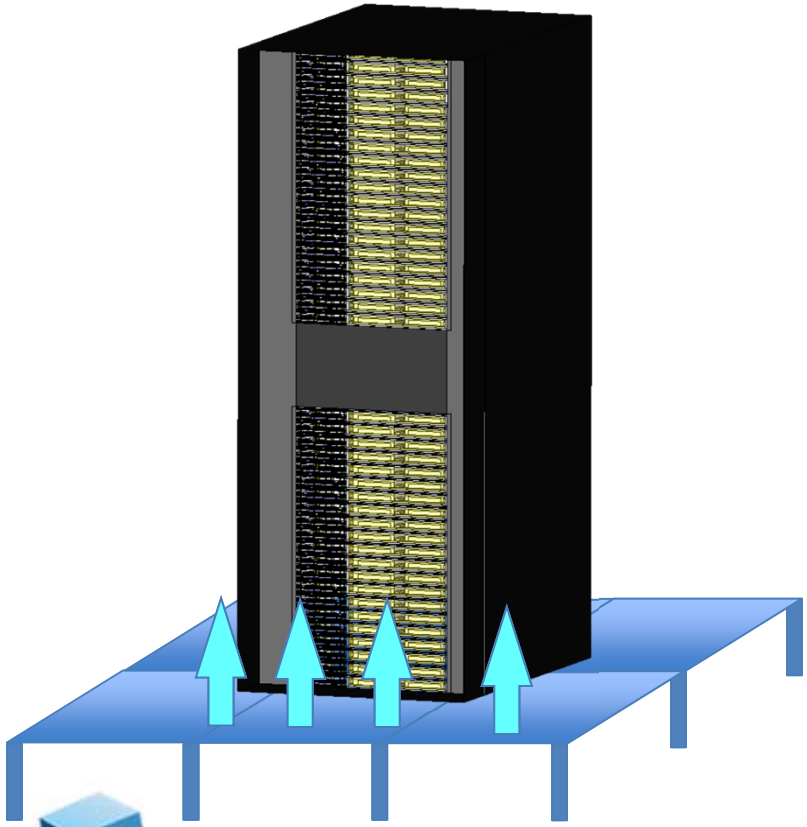
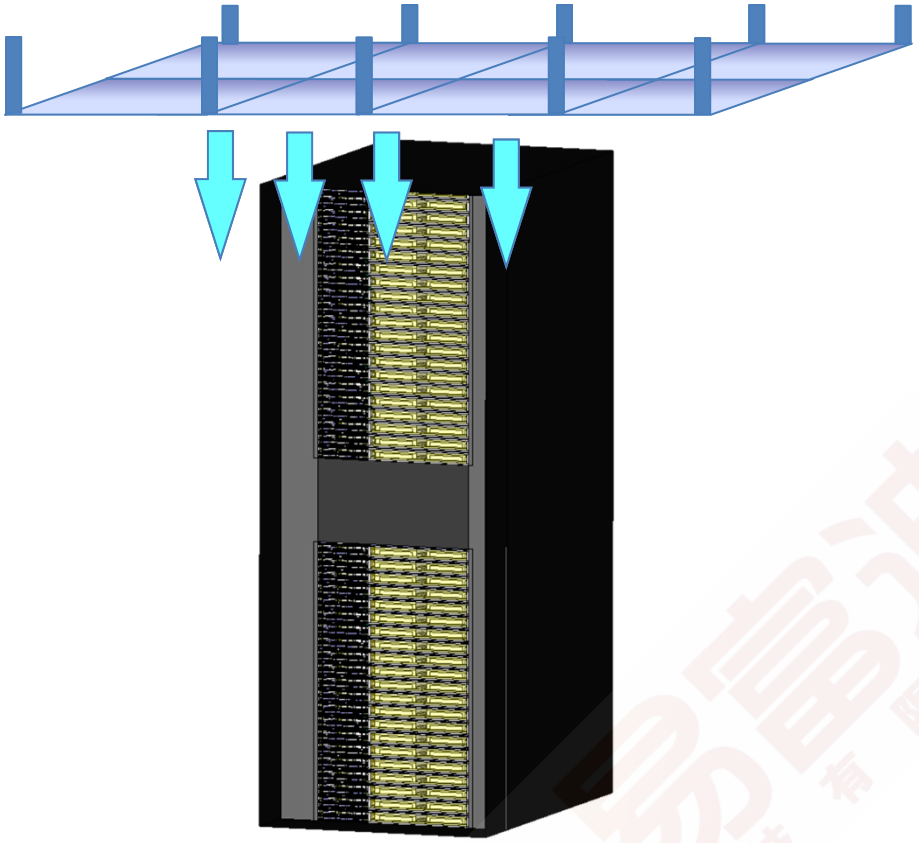
Rack Inlet Temperature

1. Are the inlet temperatures of each node **same**? → dT is 3C ~ 5C

Cold Air Flow Going Up



Cold Air Flow Going Down



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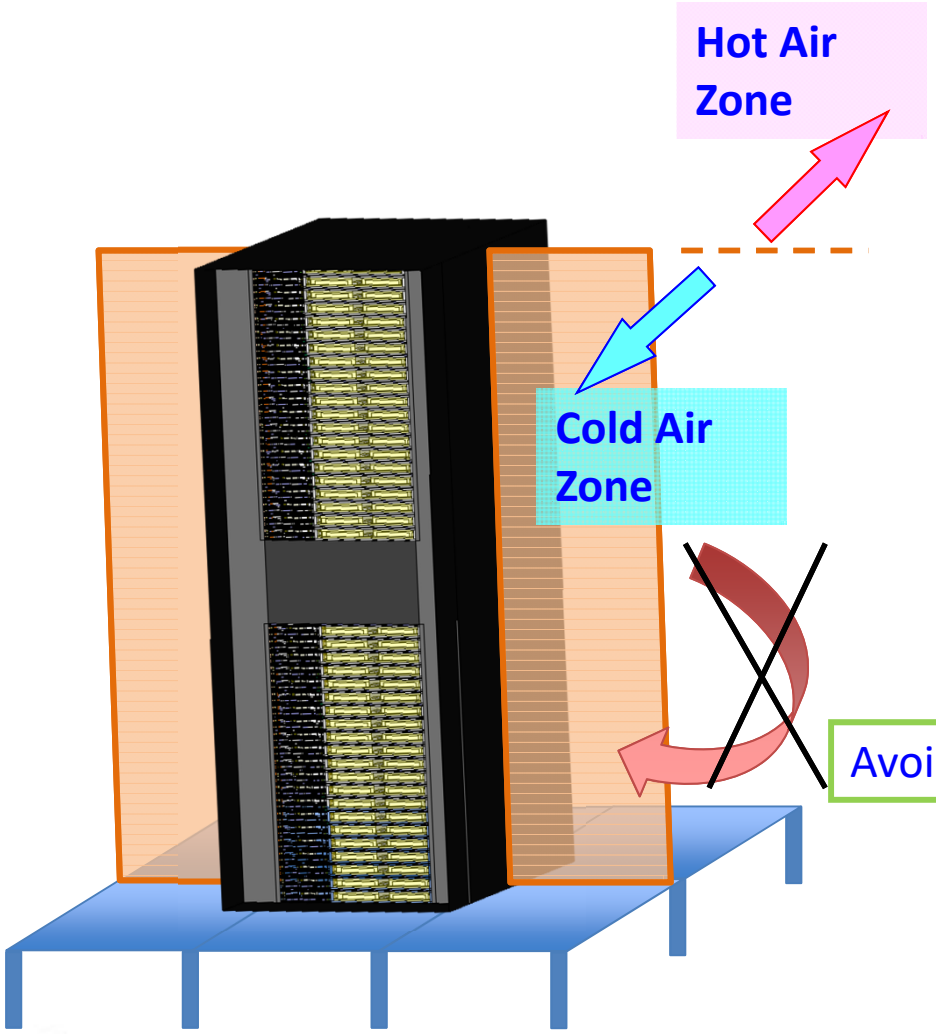
Rack Air Flow Condition

2. Is it separating the cold air zone and hot air zone?



Cold air zone and **Hot** air zone are separated

→ Make sure the hot air not to go back the front air inlet side.

Avoid the counter-flow of hot air.

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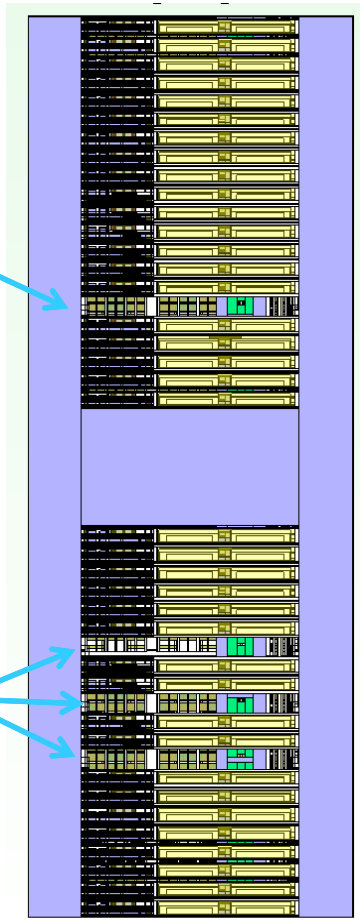
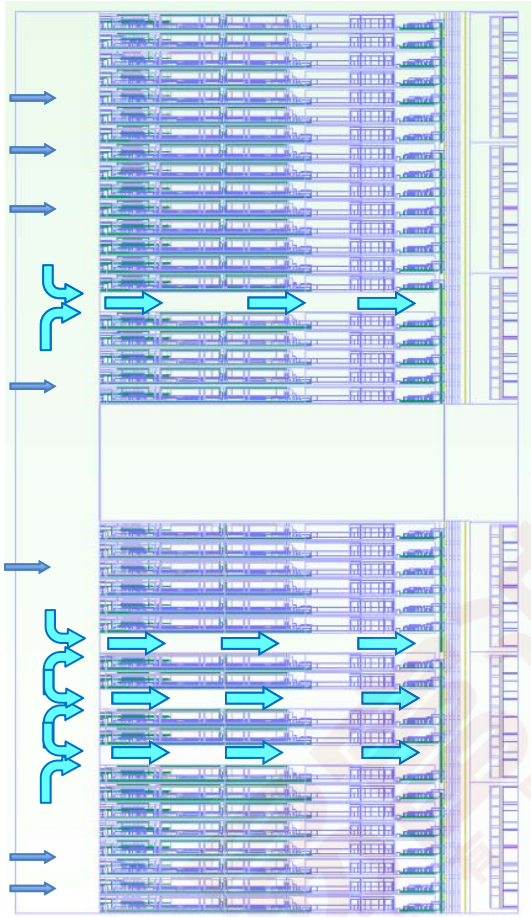
Remove Sever from Rack

Lack of 1U or even more than 1U?

1U is empty

The empty Units are empty





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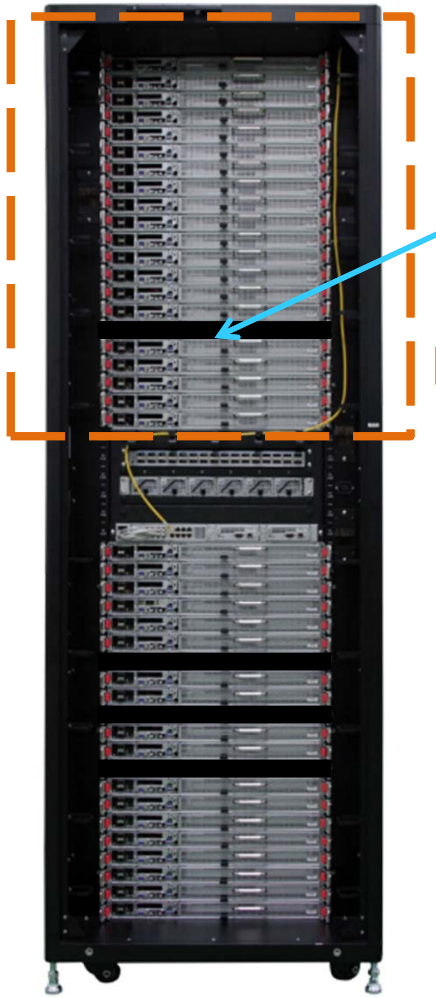
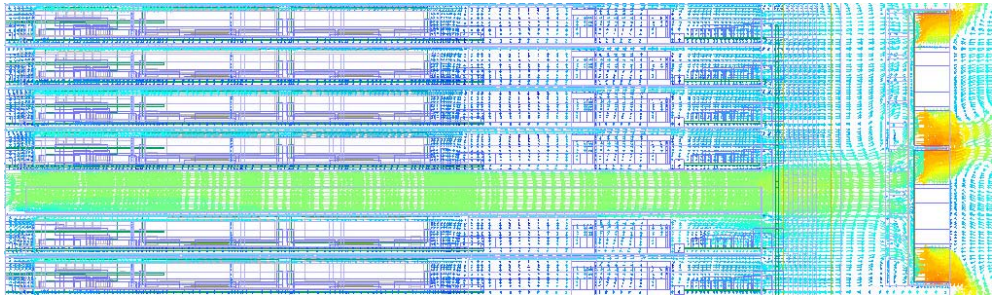
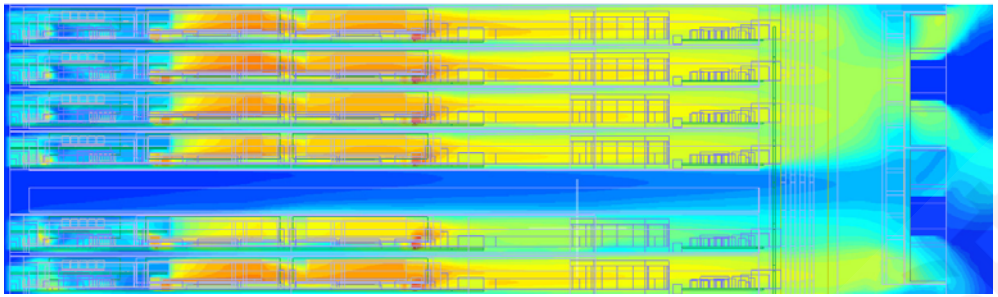
Remove Sever from Rack

1U empty thermal simulation result



1U is empty





The CPU temperature was raising up 10~12C in nearest two Units

→ Needing a cover to block the empty unit.

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Summary

1. In Rack level thermal simulation, the key point is Grid Cells.

2. Building up the suitable grid cells simulation model can save time and get the result.

3. Performing Rack thermal simulation needs to consider more detail in boundary conditions.

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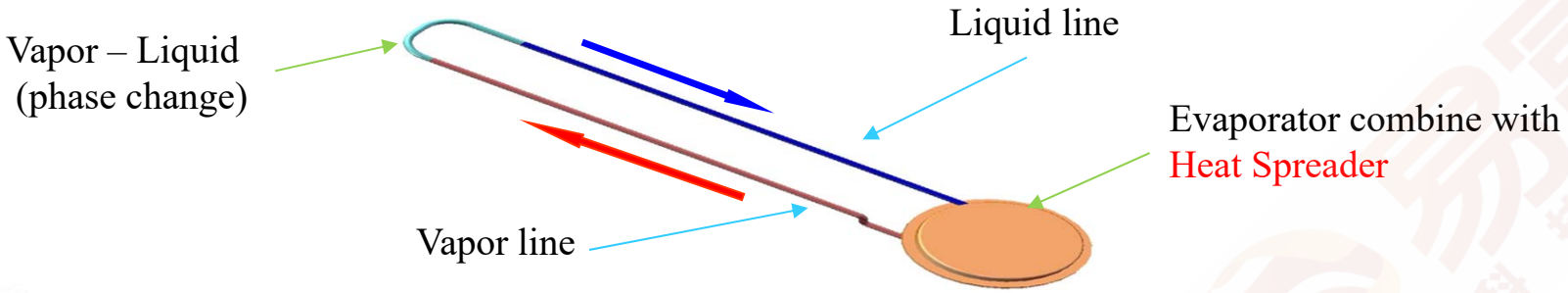
What is Next Step in Rack

1. Liquid Cooling.

- Rack level stand-alone cooling system.
- Combine with the Data Center cooling system

2. Loop Heat Pipe

Hoject provided this new thermal solution Loop Heat Pipe.



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Backup

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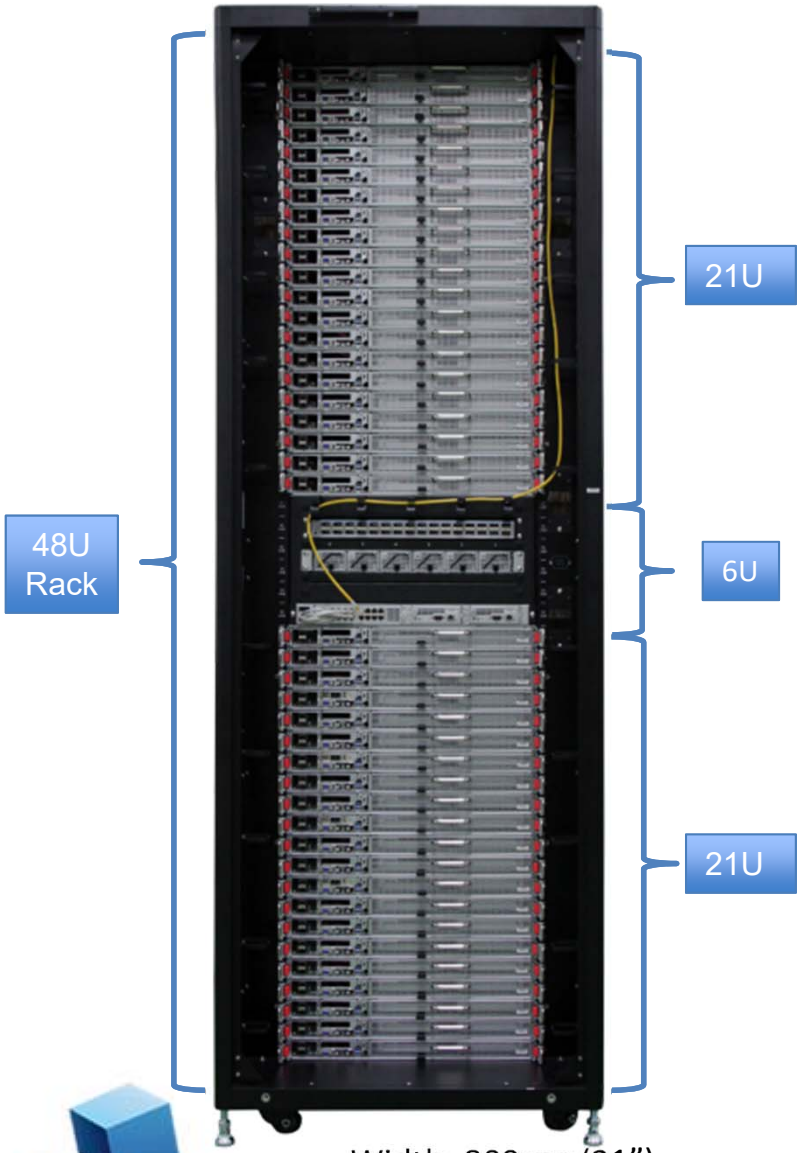
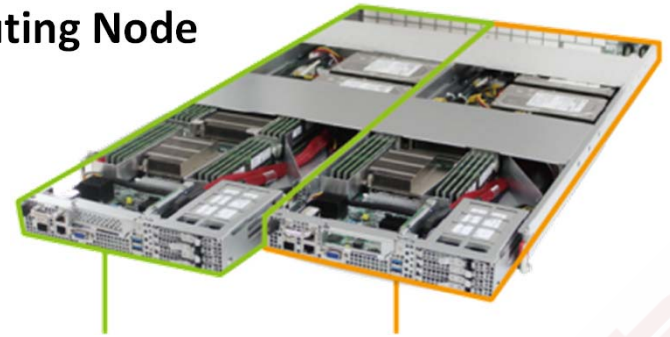
AIC Rack



Single Node

Computing Node



JBOD Node

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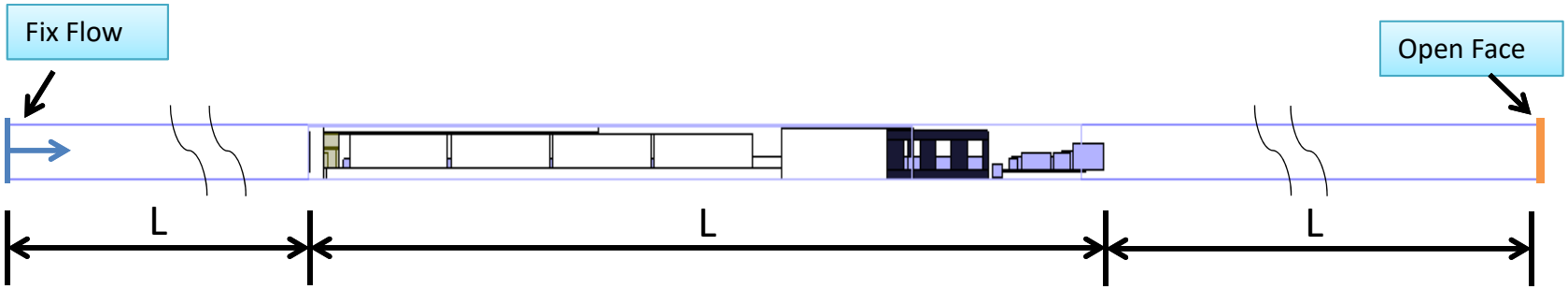
Reduce Grid Amount

Applying Volume Resistance

A. Digital Wind Tunnel



B. Doing Wind Tunnel Experiment

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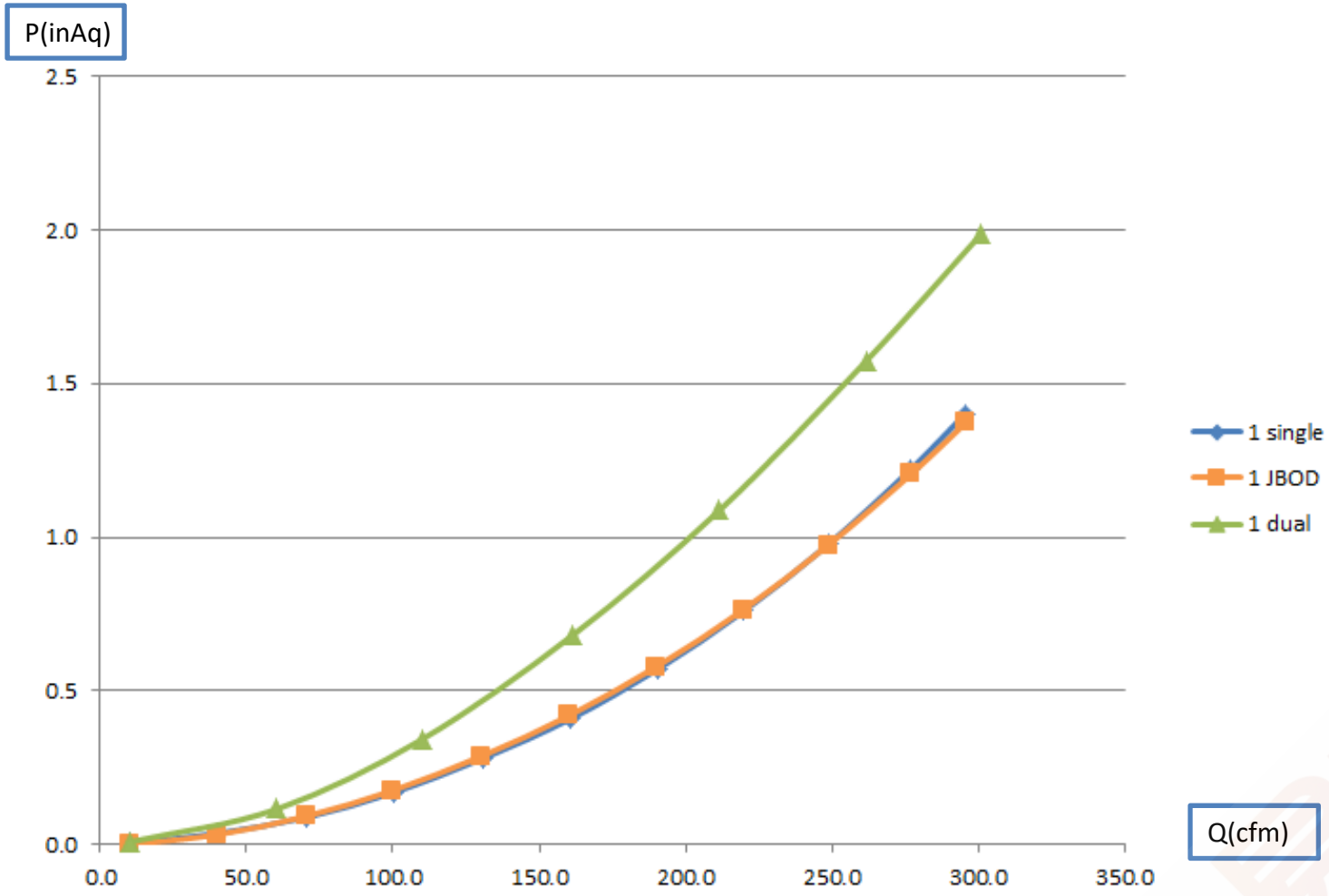
System Resistance



Impedance comparison: Dual node (1U) > Single node (1U)
Note: 2U30 JBOD is 2U node

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Thank you

1. Thank you. Mentor create and provide this amazing tool FloTHERM for our Thermal Engineers. Saving our time, tooling fee and recourse.

2. Tank you. EFD Corporation Jay and Bonnie always provide the strong technology support.

3. Thank you. AIC Thermal team members.

4. Thank you. Hoject provide the thermal solution and Loop Heat Pipe for thermal verification.

5. Thank you, everybody here.

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Thank you

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