CAE Application in Server

2022/12/01 Ken Peng

Agenda

- CAE (Computer Aided Engineering)
- Thermal Evaluation in Server
- Air Cooling
  - Compact Model by Numerical Wind Tunnel
  - Heat Sink Design
  - Heat Sink Optimization
- Liquid Cooling
  - Cold Plate Design
  - CDU Rack Level Simulation
  - Immersion Cooling Application
- Summary

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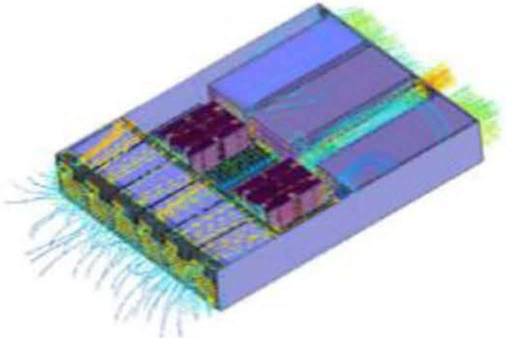
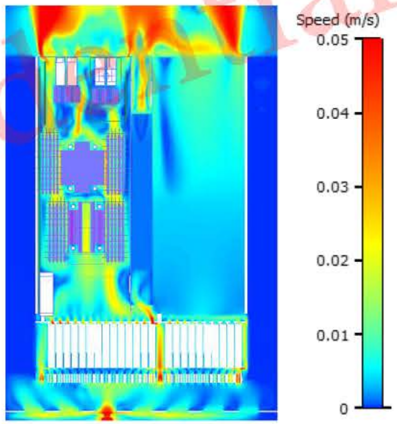
CAE (Computer Aided Engineering)

Shorten Project Development Timeline



Reduce Cost



Electronics CAE

Improve Design Efficiency

Enhance Product Quality and Value

Other Industry :

- ***Aviation Industry***
- ***Ship Industry***
- ***Automobile***
- ***Medical Industry***
- ***Construction Industry***
- ***Semiconductor***
- ***Energy***
- ***Biochemical Industry***







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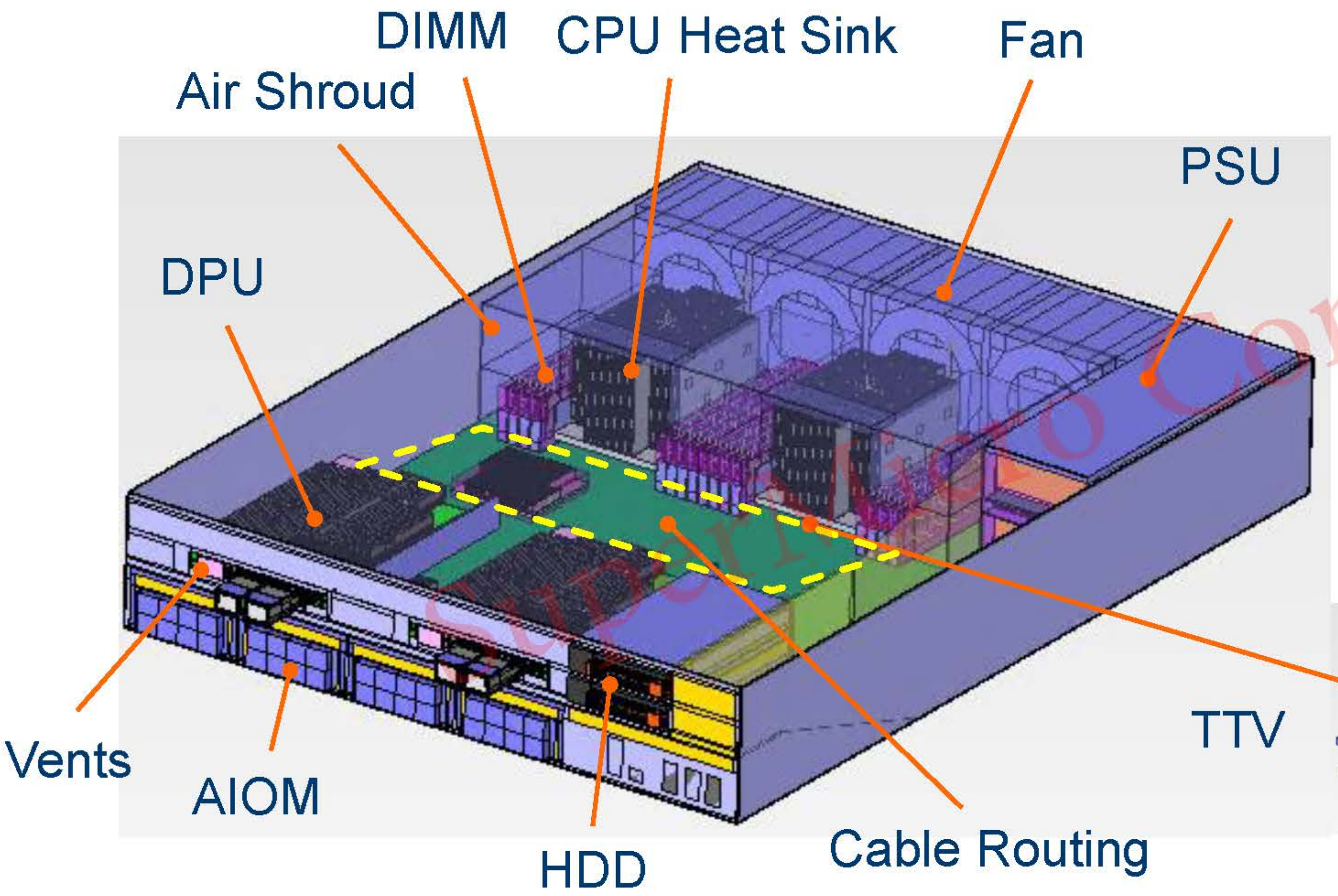
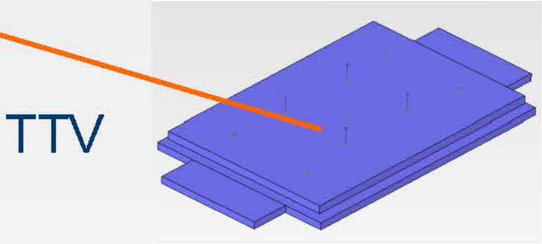
Thermal Evaluation in Server





Cooling Solutions :

Air Cooling	Liquid Cooling
• Heat Sink Design • Optimization	• Cold Plate Design • Rack Level Design • Immersion Cooling

- Critical components temperature, air flow, vents ratio, air shroud design are supposed to be evaluated by simulation in early design stage.

Grid Management Is important !

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Air Cooling

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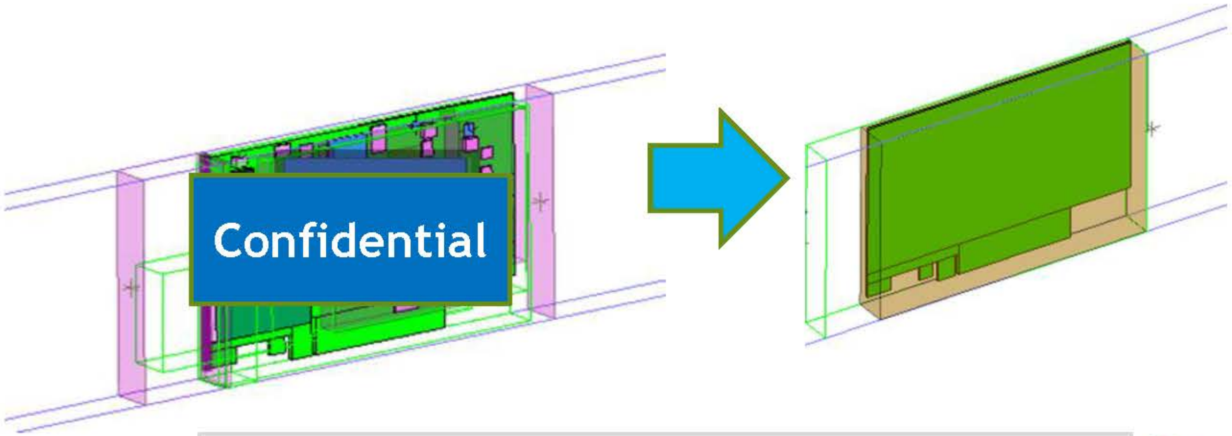
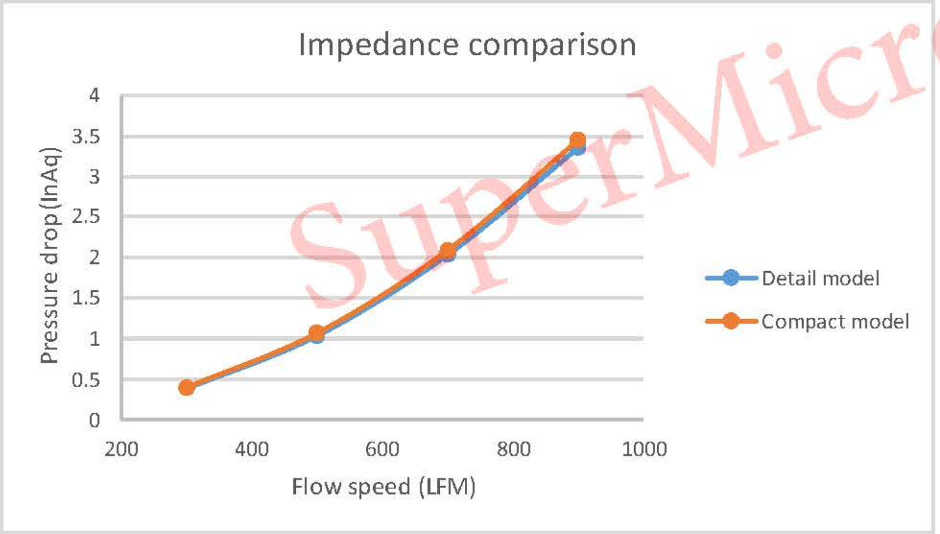
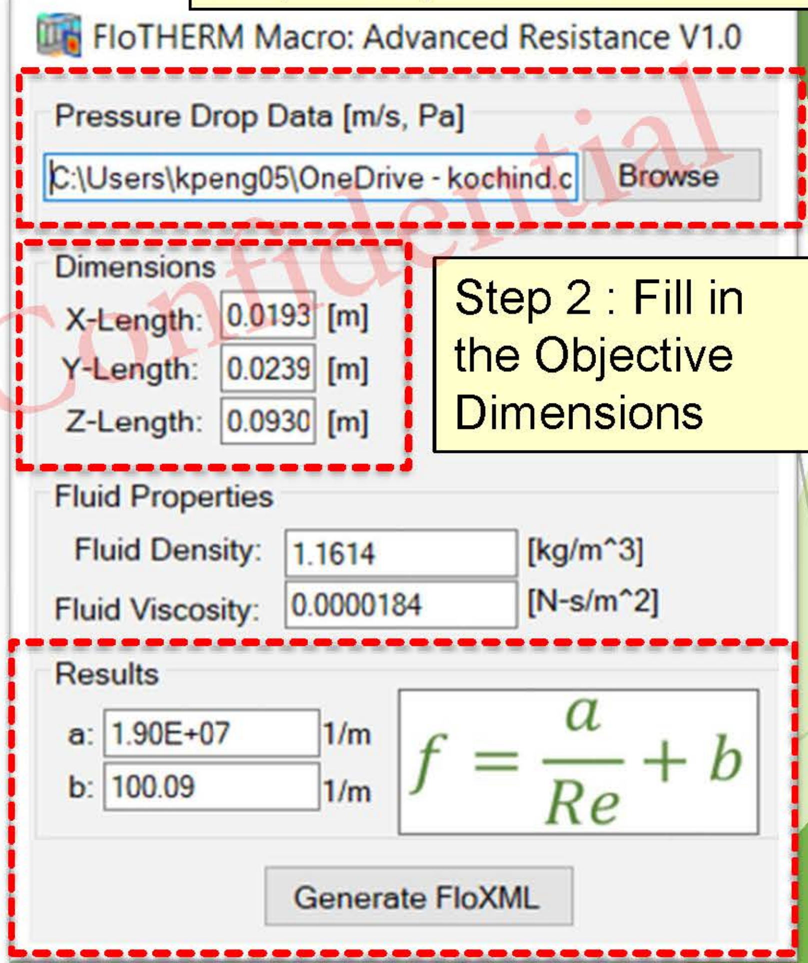
Compact Model by Numerical Wind Tunnel





Step 1 : Upload the Text File



Step 2 : Fill in the Objective Dimensions

Step 3 : Generate FloXML File

- Save grid amount and computing time.

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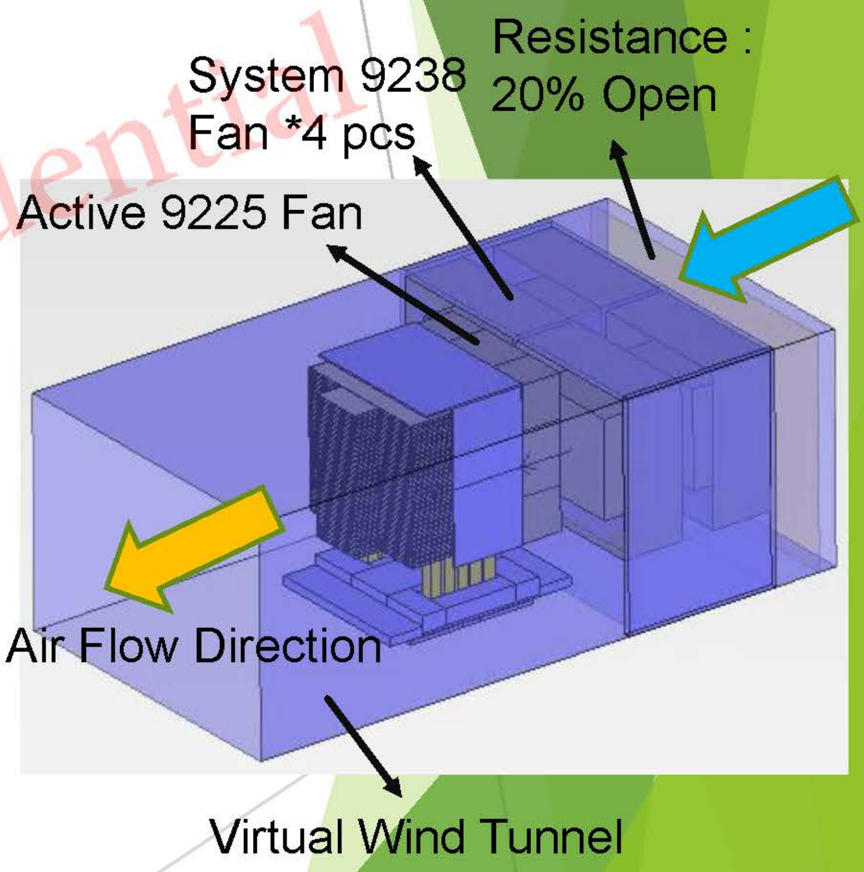
Heat Sink Design

System Fan Impact _ TTS cTDP 400W _ CPU Tc Spec : 70°C				
Scenario	**Stand-alone Heat Sink**	**Include System Fan**	**Remove Active Fan**	**Enlarge Fin Area**
Active Fan Derating	1.0	0.9	n/a	n/a
System Fan Derating	n/a	0.9	0.9	0.9
CPU Heat Sink Air Flow (CFM)	35.8	44.8	46.3	48.9
System Outlet Air Flow (CFM)	35.8	221	232	230
Ta (°C)	35.1	35.5	37.1	36.2
Tc (°C)	72.4	67.4	66.9	64.8
Rca (°C/W)	**0.093**	**0.080**	**0.075**	**0.072**



- We could know the impact promptly with various solutions by CAE.

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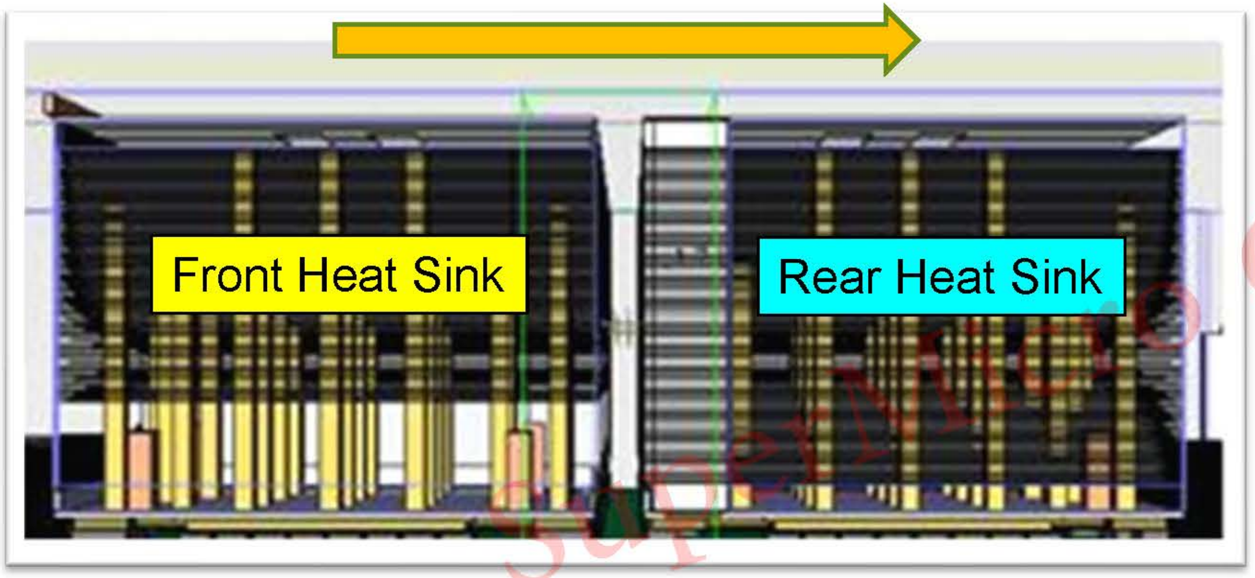
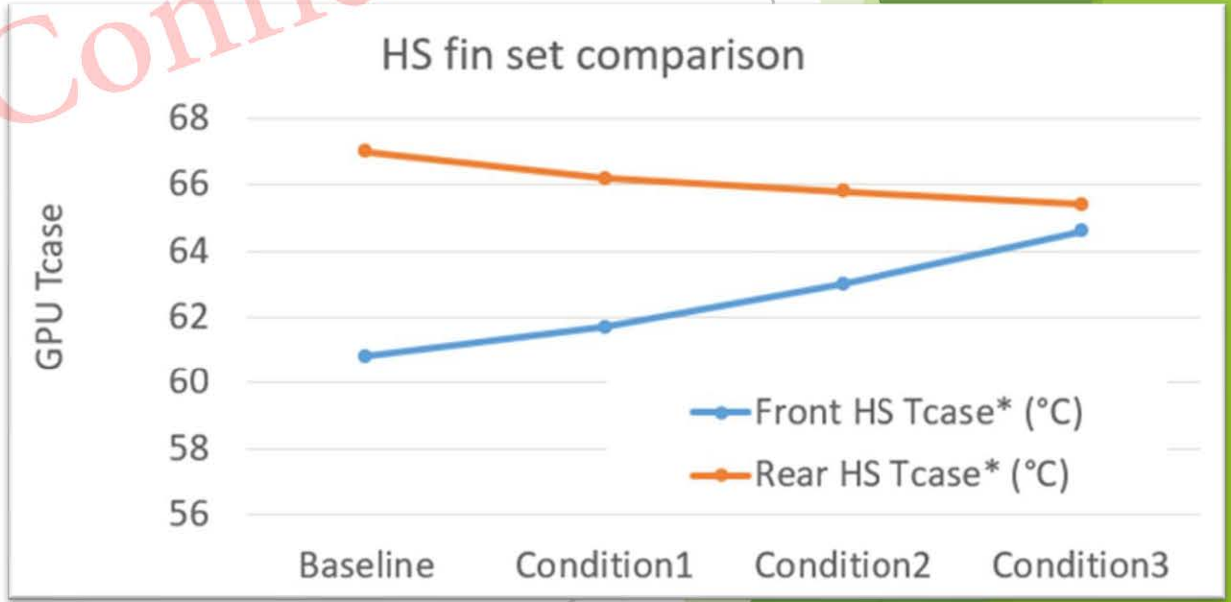
Heat Sink Optimization

	Base Project	Scenario 1	Scenario 2	Scenario 3
Front Heat Sink : Number of Internal Fins	62	57	52	47
Rear Heat Sink : Number of Internal Fins	62	62	62	62
Solution Status	Unsolved	Unsolved	Unsolved	Unsolved
Store Results?	Full	Full	Full	Full
Initialize From	No Project	Base Project	Base Project	Base Project
Front HS Tcase : Temperature (°C)	-	-	-	-
Rear HS Tcase : Temperature (°C)	-	-	-	-

Air flow direction



Shadow Core



- *Command Center* could deal with several cases with various parameters. And find out the best and optimum solution in specific boundary condition.

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Liquid Cooling

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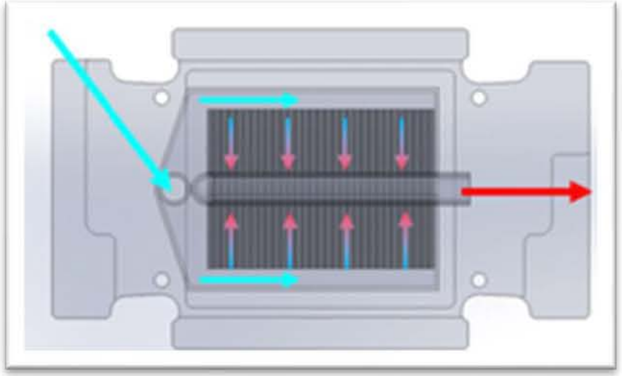
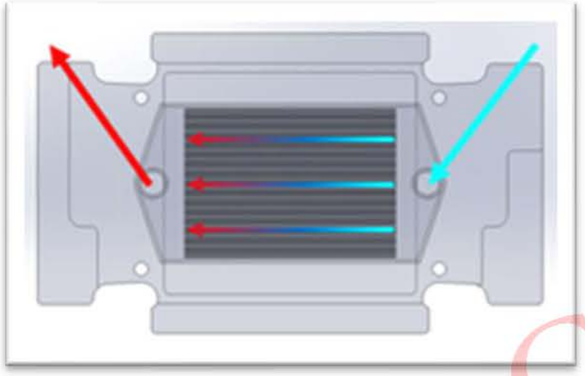
Cold Plate Design



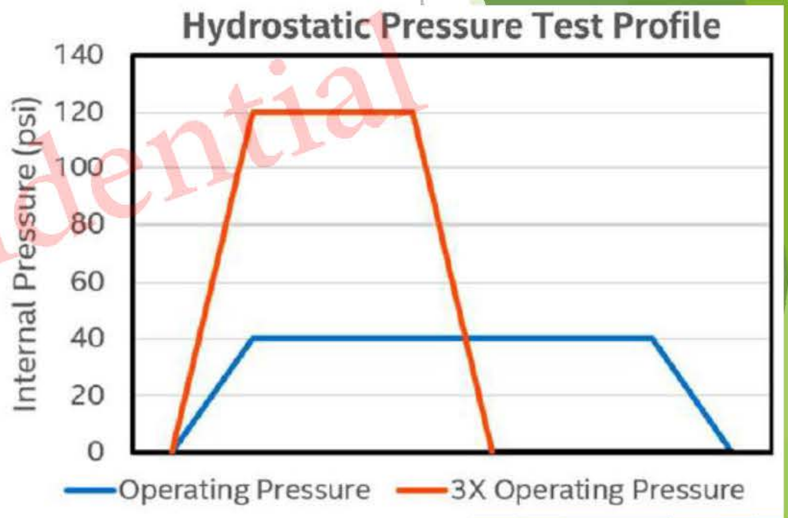
Split Flow



Straight Flow

Tcase point	Spec.	Split flow		Straight flow	
		Max. temp	ave. Temp	Max. temp	ave. Temp
GPU	77.5	69.5	67.4	67.5	64.2
HBM	66.7	64.1	63.0	64.2	61.6

612091 Intel Liquid Cooling Design Guide



Time and safety factor is defined by standard # IEC FDIS 62368-1.

Cold Plate Design by Simulation:

- Thermal Performance Comparison
- Pressure Drop Evaluation

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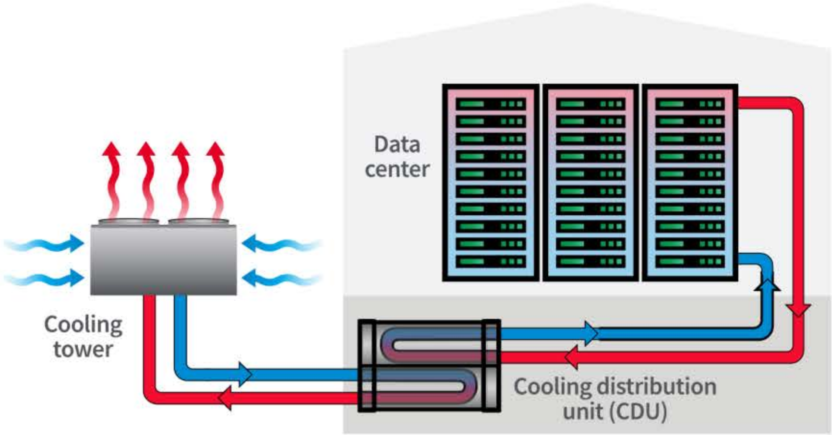
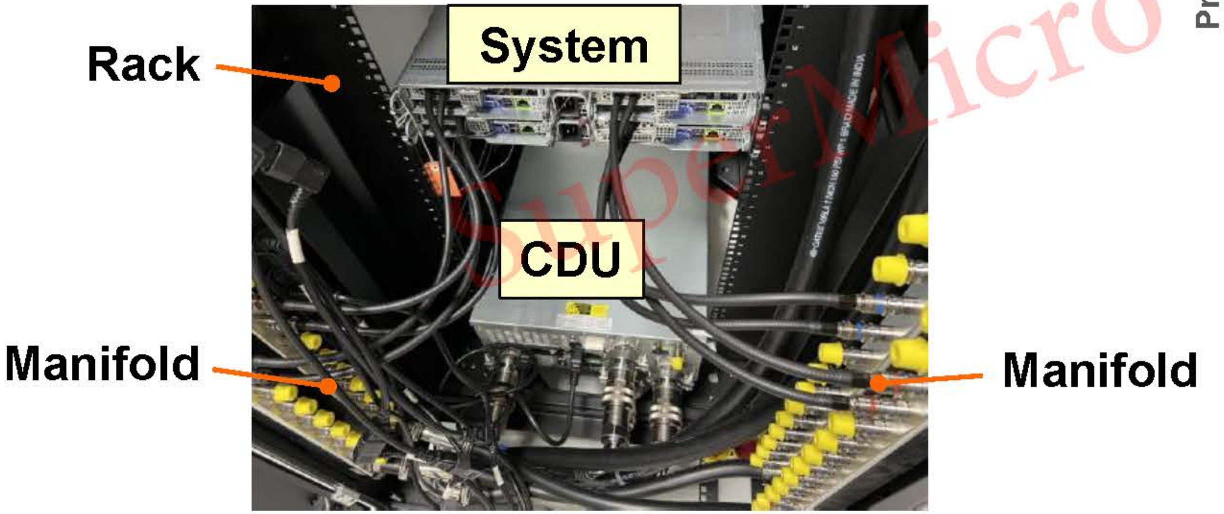
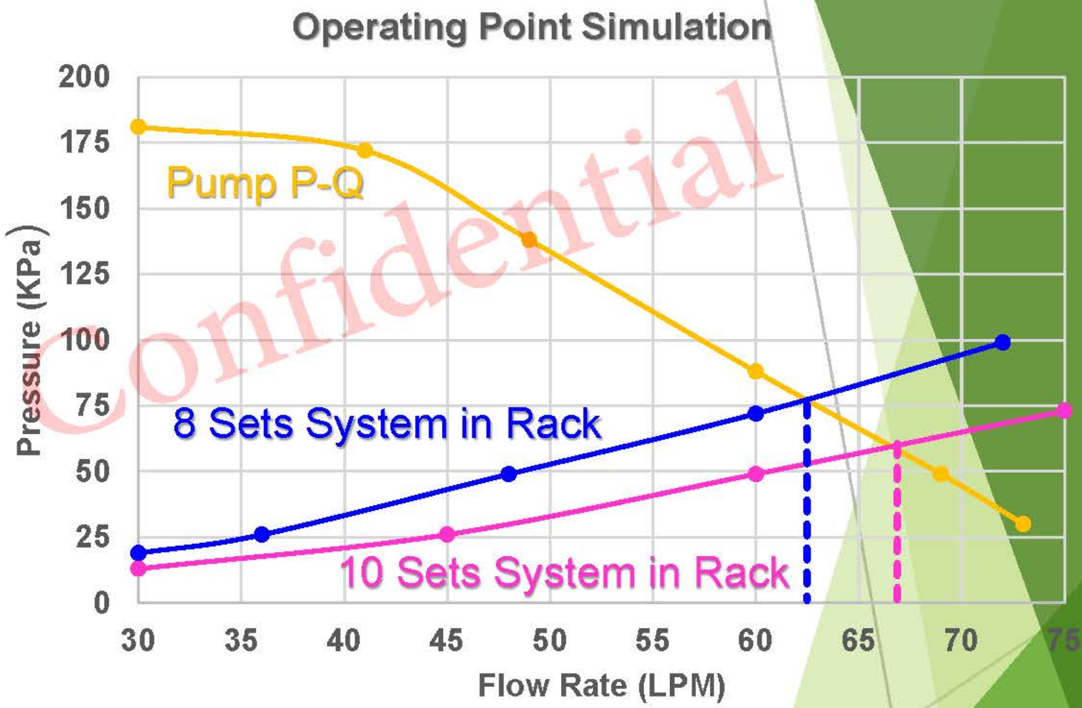
CDU Rack Level Simulation







8 Sets System in Rack (42U)
CDU Flow Rate : 63 LPM
System Flow Rate : 7.9 LPM

10 Sets System in Rack (48U)
CDU Flow Rate : 67 LPM
System Flow Rate : 6.7 LPM

- We could know CDU cooling capability by rack level simulation.

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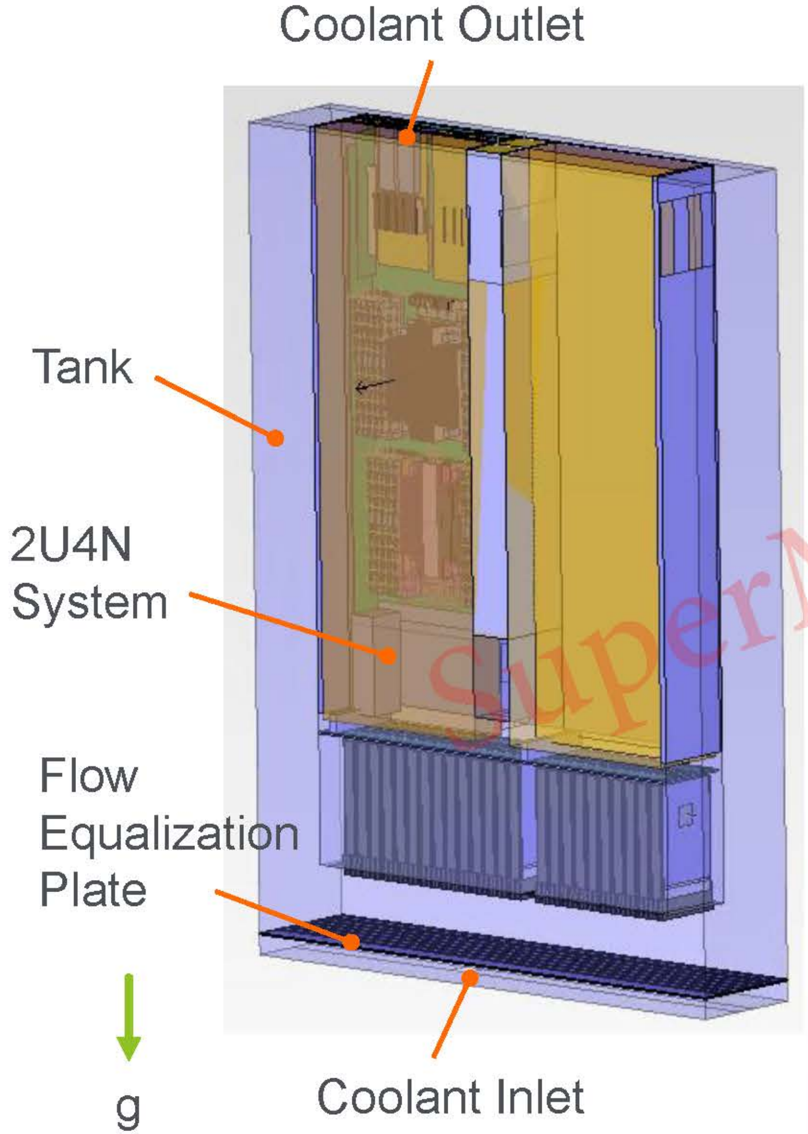
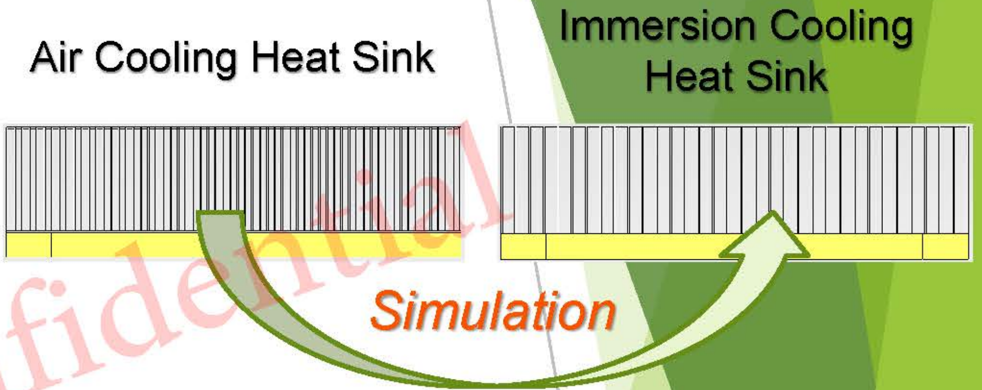
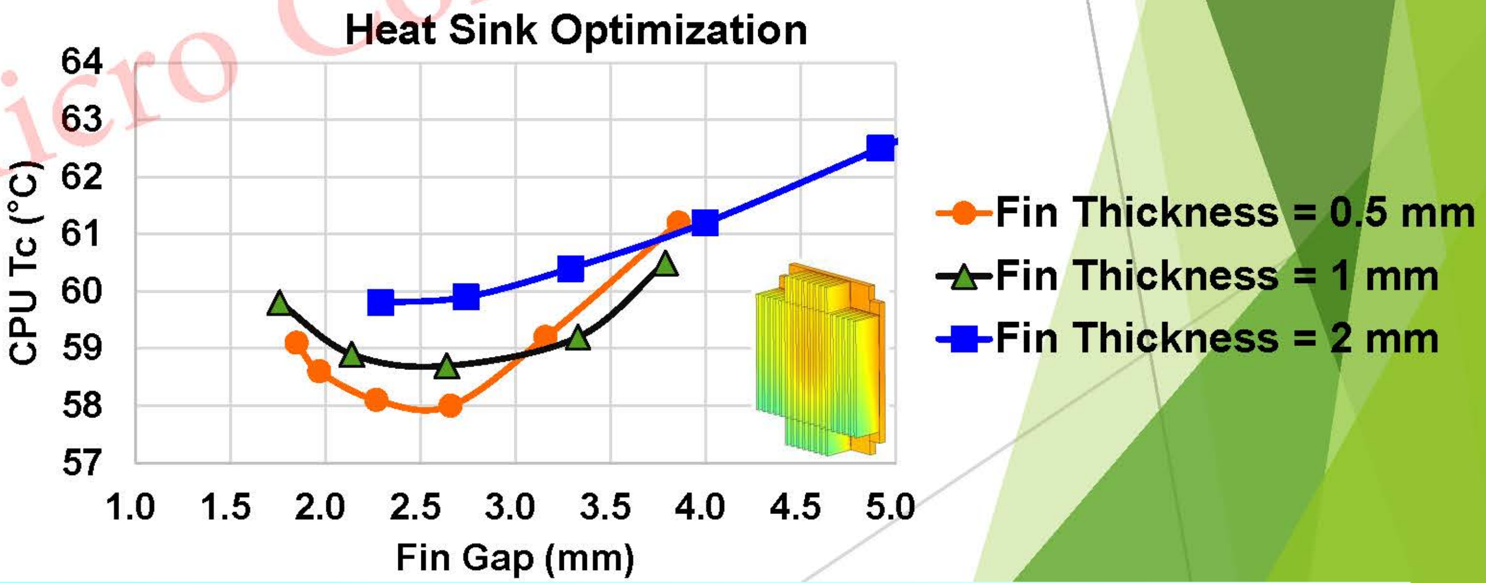
Immersion Cooling Application



Coolant Attribution :
Conductivity : 0.152 W/mk
Viscosity : 5.1805 N s/m^2
Density : 778.5 Kg/m^3
Specific Heat : 2263.55 J/ Kg K
Expansivity : 0.0007 1/K





- Save cost of expensive coolant by preliminary simulation.
- To optimize heat sink with various coolant viscosity.

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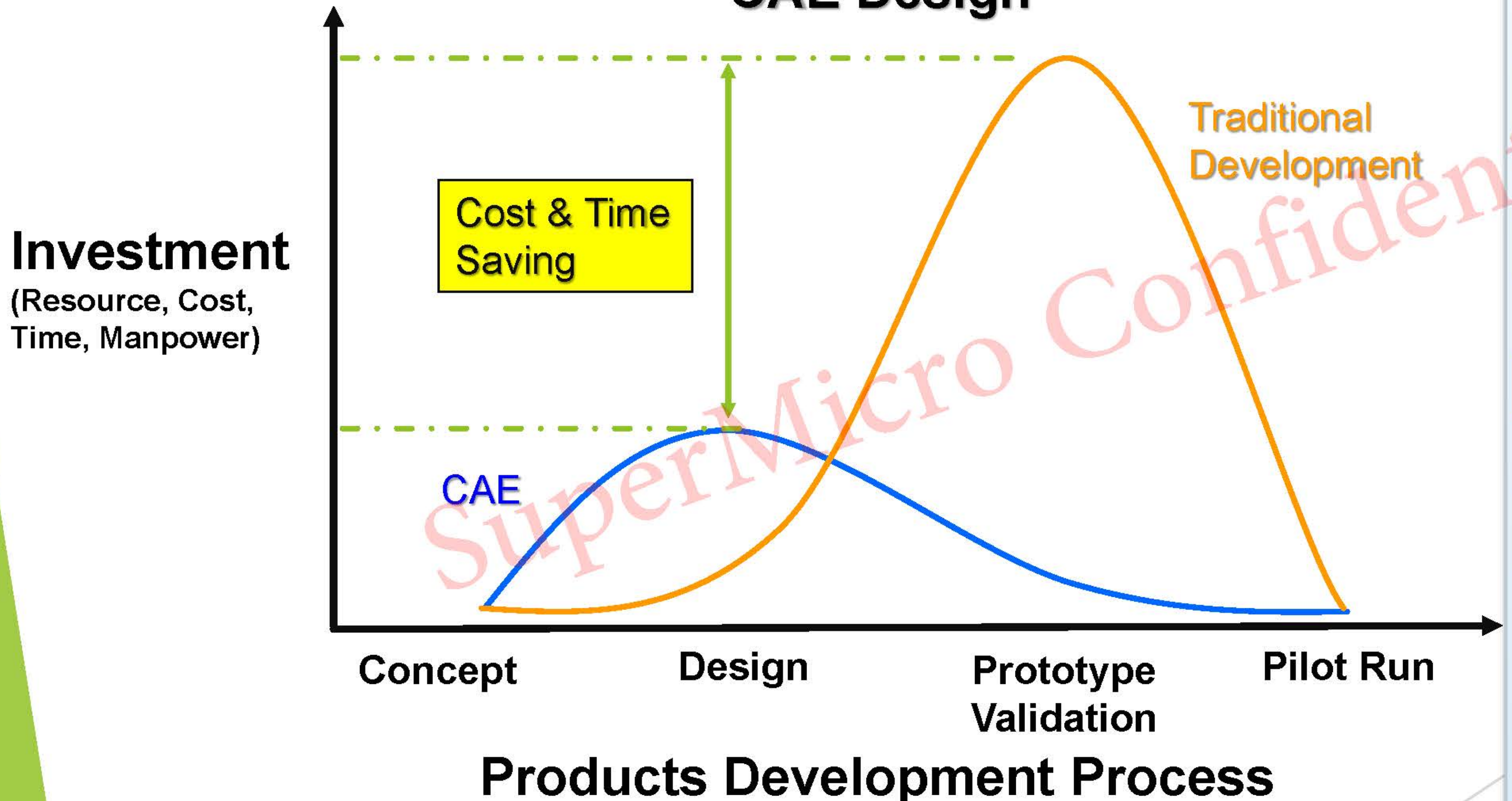
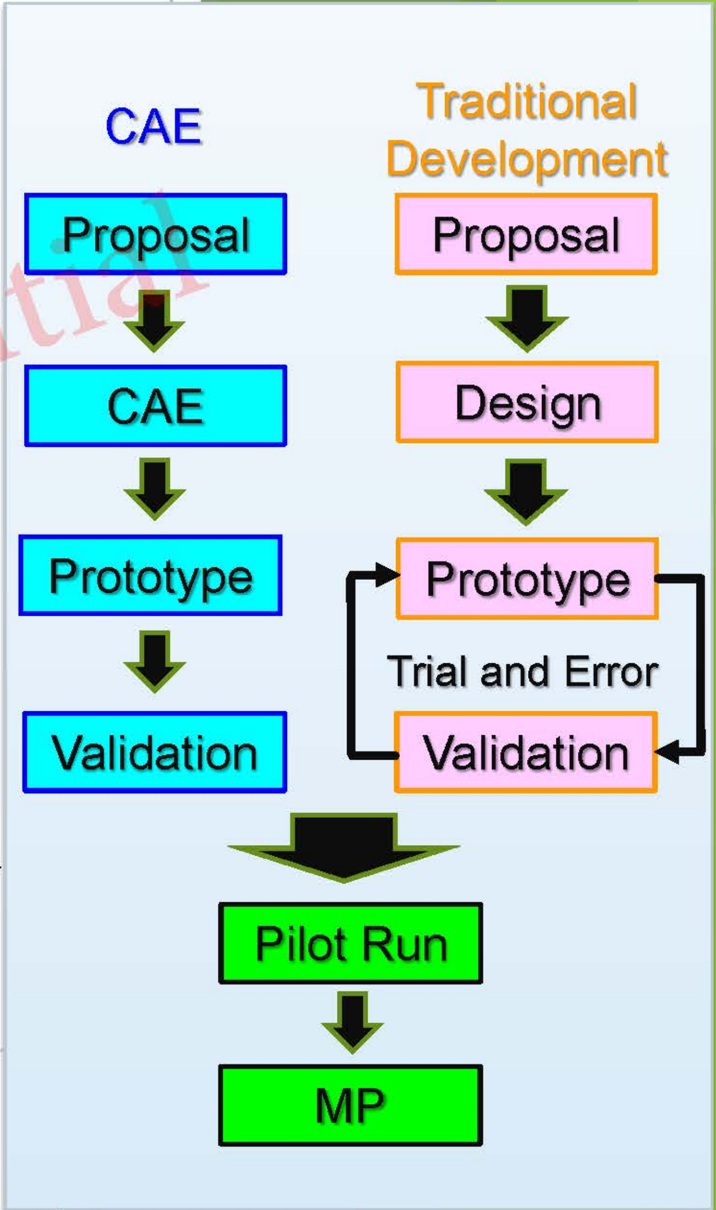
Summary

CAE Design





- CAE improves design quality and saves cost/time significantly.

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Thank You