

# **Airflow/Thermal Analysis of a Rack-mounted Telecommunication system**



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# Objectives

- ⌘ Carry out a system-level simulation to determine the total airflow and distribution
- ⌘ Determine maximum junction temperatures of critical packages in worst case scenario (NEBS Level 3)
- ⌘ Feasibility of cooling with one fan failure.

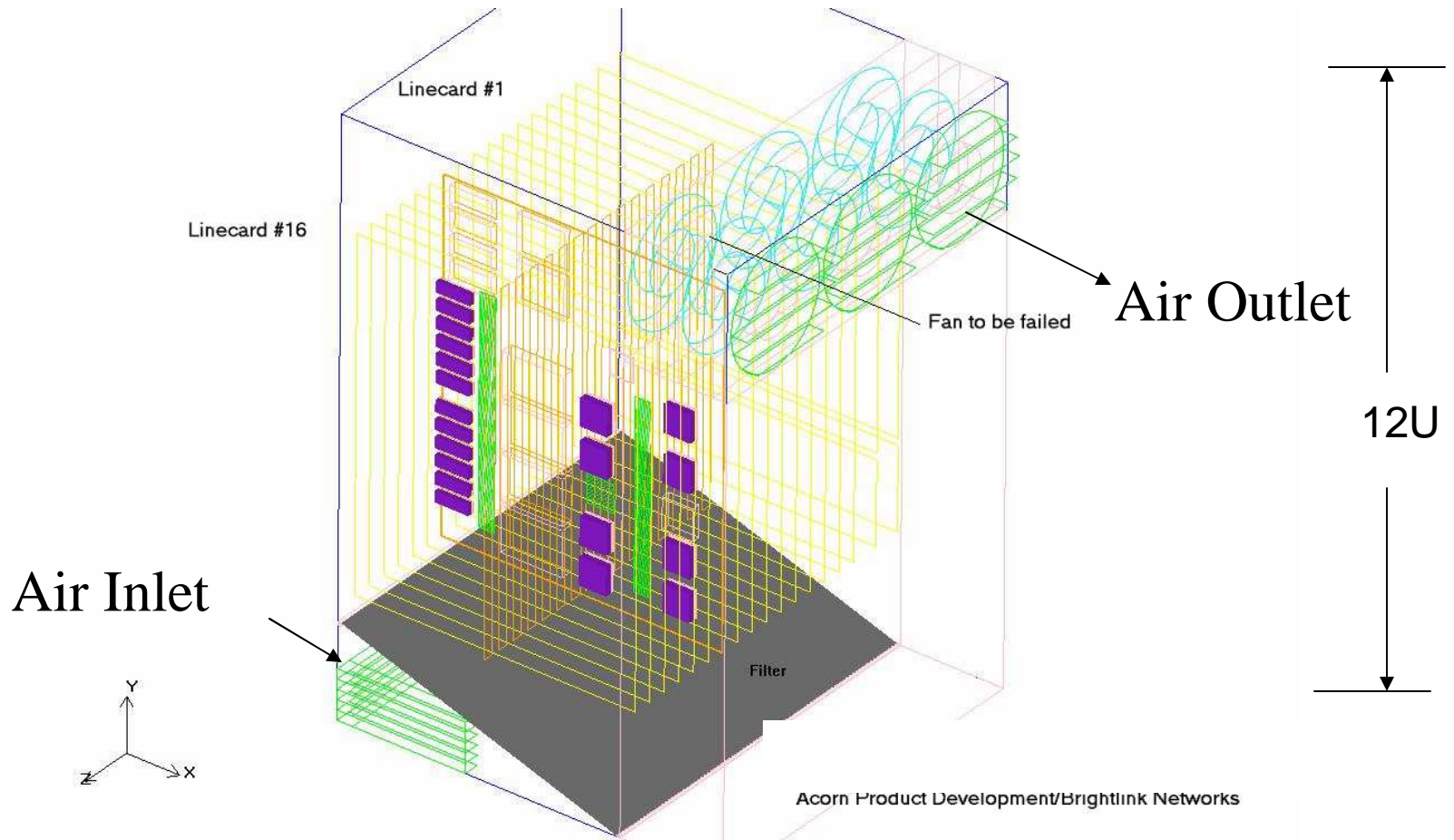


# Modeling Assumptions

- ⌘ Ambient outside air temperature is 55C
- ⌘ System Power Dissipation:
  - ⌘ 2-CPU boards: 2 x 100W
  - ⌘ 2-Timing boards: 2 x 100W
  - ⌘ 16-line cards: 16x219W
  - ⌘ Total 3504W
- ⌘ Inlet and outlet vents are 60% open
- ⌘ Six 300CFM free flow fans laid out in 2 rows
- ⌘ Air filter (inclined) with 83% dust arrestance

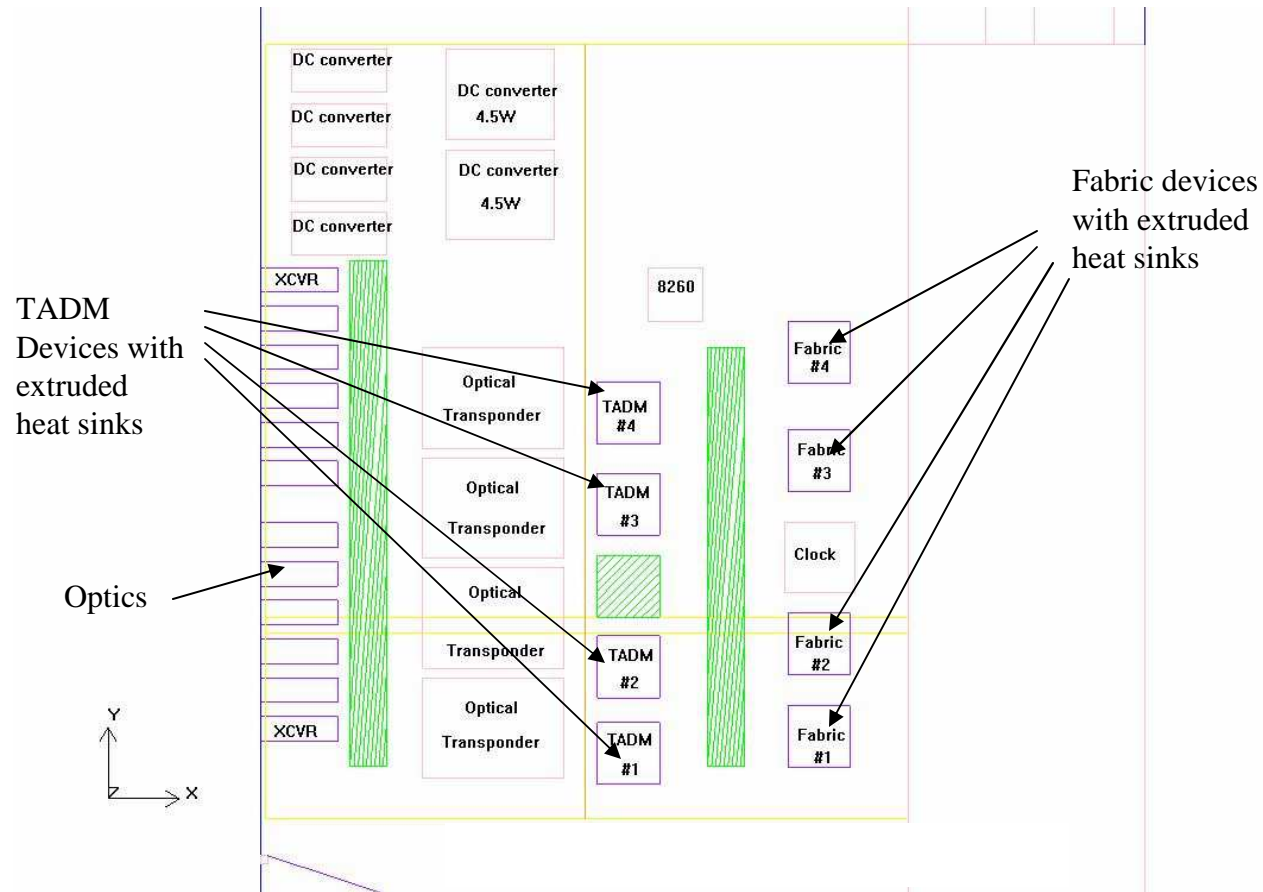


# Simulation Model



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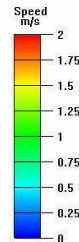
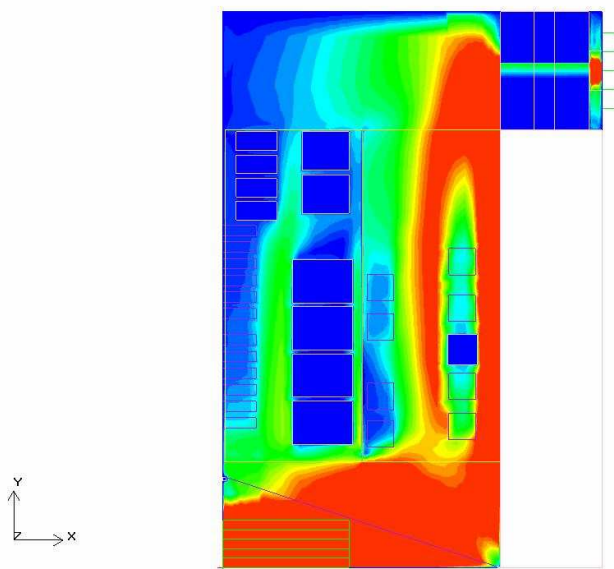
# PC Board Layout (Line Card)



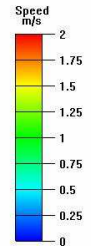
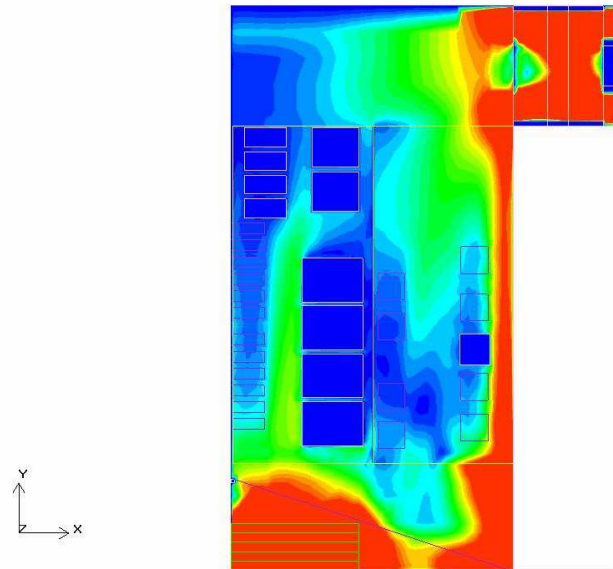
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# Modeling Results

## Air speed near line card #10



All fans running



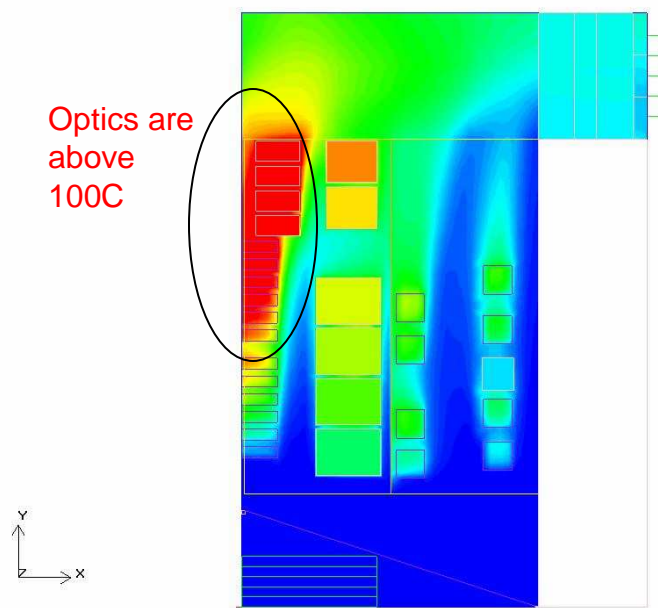
One fan failed



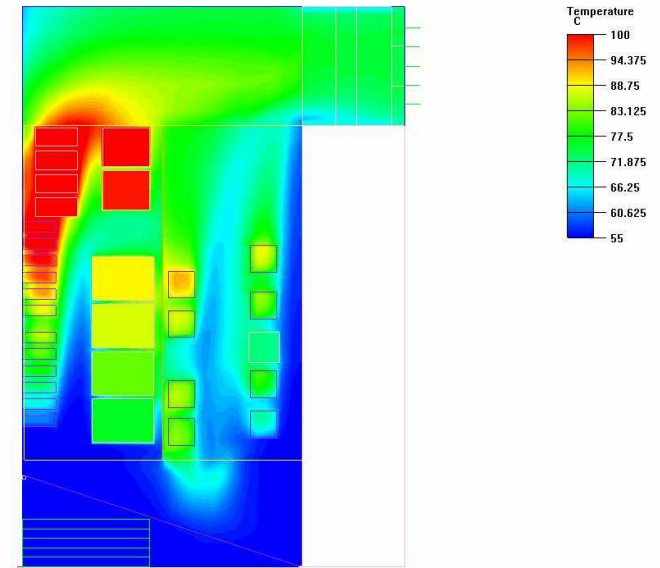
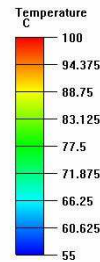
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# Modeling Results

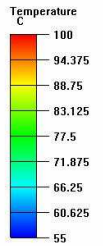
## Air temperature near line card #10, 55C



All fans running



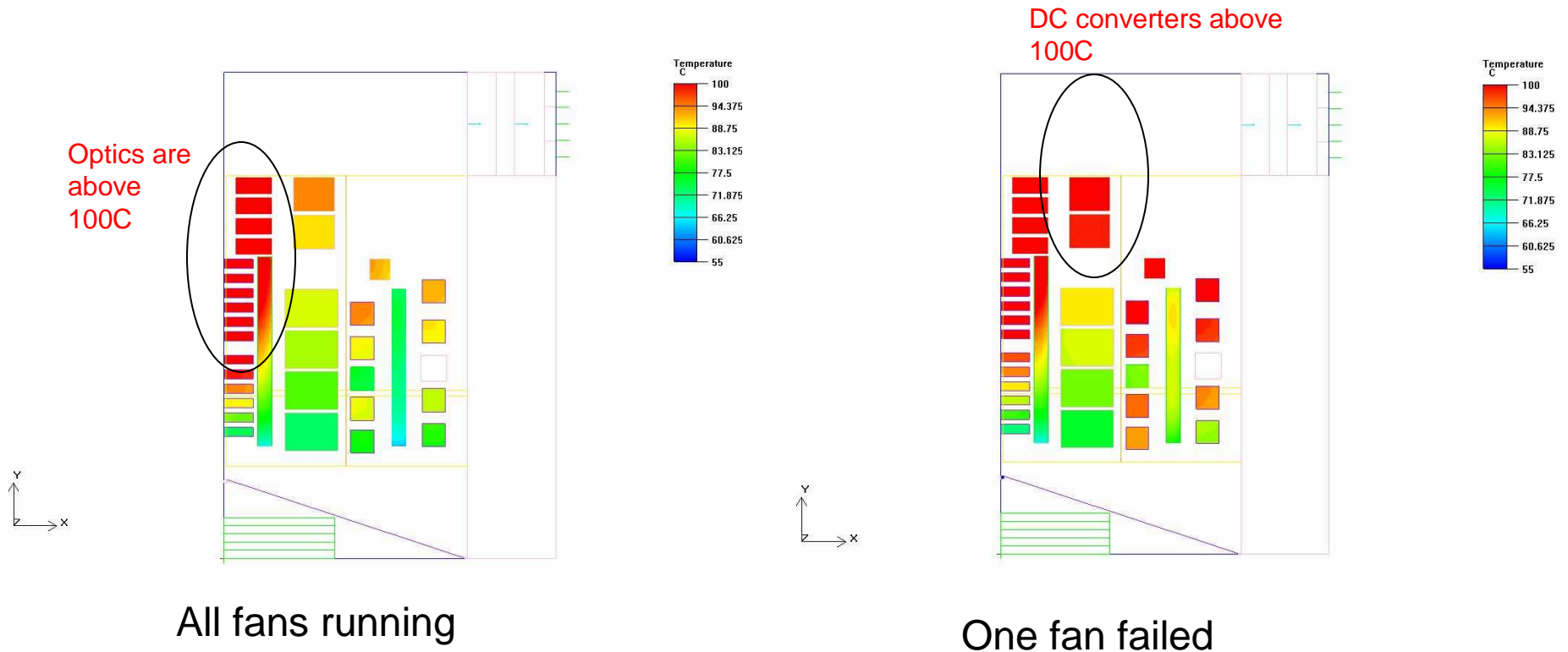
One fan failed



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# Modeling Results

Component Tj on line card #10, 55C, all fans running



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# Results summary

## Airflow distribution

### ⌘ All fans running:

- ☑ Total airflow: 380 CFM
- ☑ Air temperature rise (avg.): 16.5C
- ☑ Airflow in each slot: 22 – 25 CFM

### ⌘ One fan failed:

- ☑ Airflow in worst slot: 18 CFM
- ☑ Air temperature rise in worst slot: 22C



# Results summary

## Component Temperatures

Chip	Power (W)	All Fans, Line card #10		One Fan Failure, Linecard #10		
		Local Airspeed (lfm)	Tjunction at 55C (C)	Local Airspeed (lfm)	Tjunction at 55C (C)	Tjunction at 40C (C)
Lower 6 Parolis	6x3.5	100-200	74-104*	100-200	73-97*	58-82*
Upper 6 Parolis	6x3.5	25-100	108-126*	50-100	101-123*	86-108*
Optical trnspondrs	4x7	75-150**	74-87*	50-125**	77-90*	62-75*
3260	2	450	93	200	103	88
ADM 1	6.5	100	81	100	96	81
ADM 1	6.5	100	90	50	98	83
ADM 1	6.5	120	92	50	101	86
ADM 1	6.5	120	97	75	105	90
Fabric 1	10	300	84	150	90	75
Fabric 2	10	200	90	125	98	83
Fabric 3	10	150	94	100	103	88
Fabric 4	10	200	96	100	106	91
DC converters	4x2.25	50-100**	111-113*	50-100**	115-120*	100-105*
DC converters	2x4.5	100-150**	91-95*	100-150**	100-107*	85-92*

\*Case Temperatures Reported

\*\*Air speeds taken above upper surfaces



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# Conclusions

- ⌘ The optical devices do not meet temperature specifications even with all fans operational at 55C. To solve this problem the following changes should be considered
  - ☒ Generate more airflow using more fans
  - ☒ Use different layout (staggered)
  - ☒ Airflow baffles to direct more air in that area
- ⌘ DC-DC converters exceed 100C under fan failure. They will require heat sinks.
- ⌘ The Fabric and TADM devices are within their maximum temperature limit using extruded heat sinks.

