VICOR

The Need for New AI Processor Power Delivery

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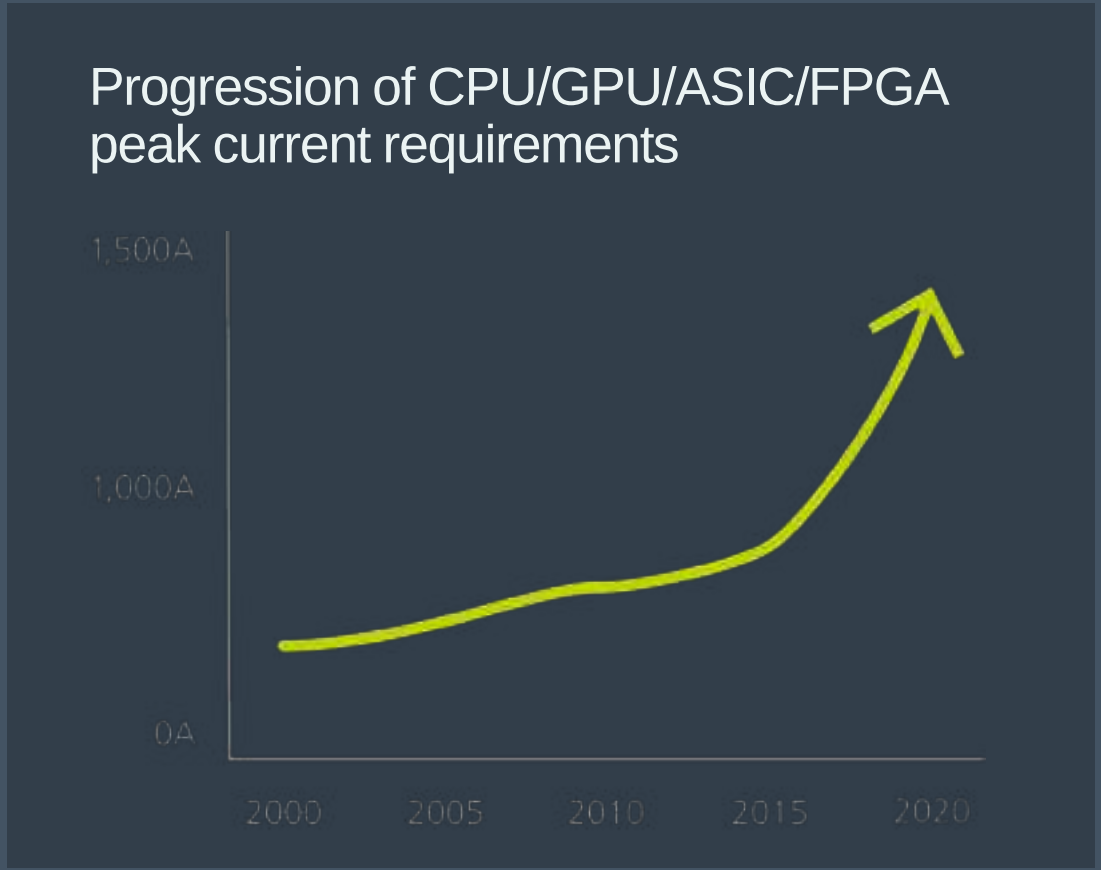
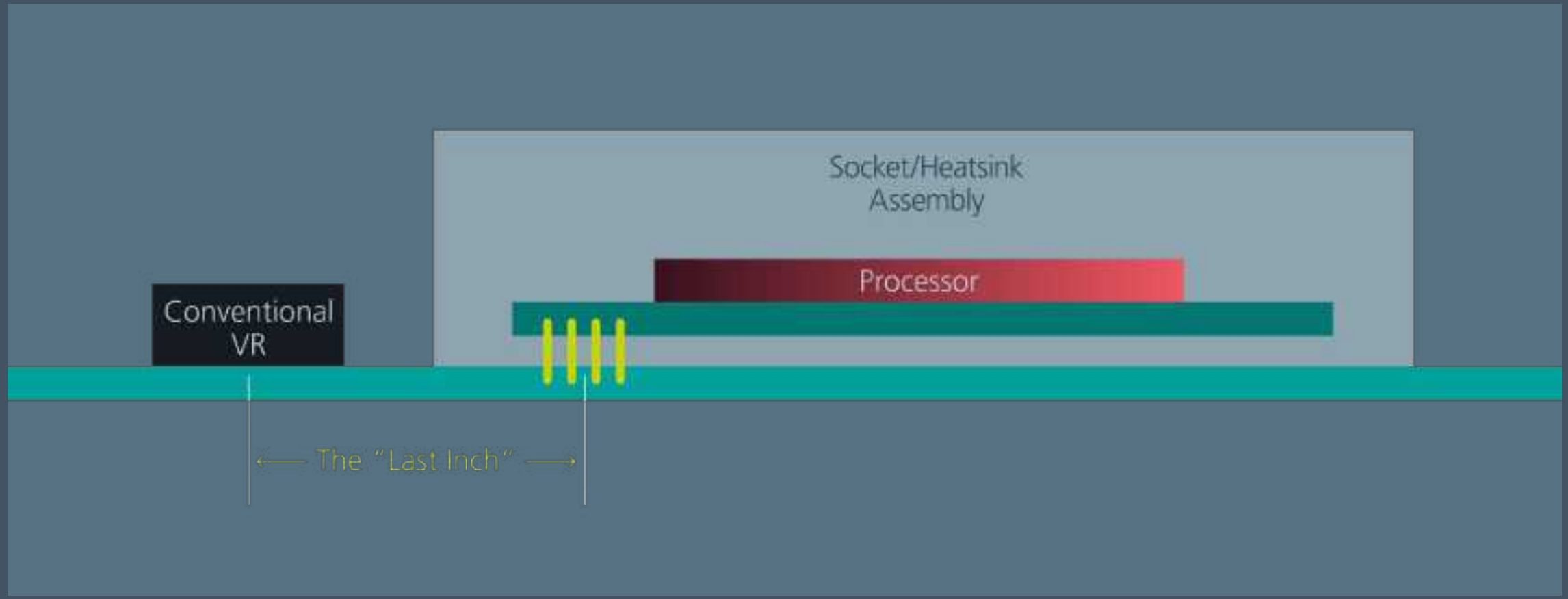
Challenge in powering AI processors

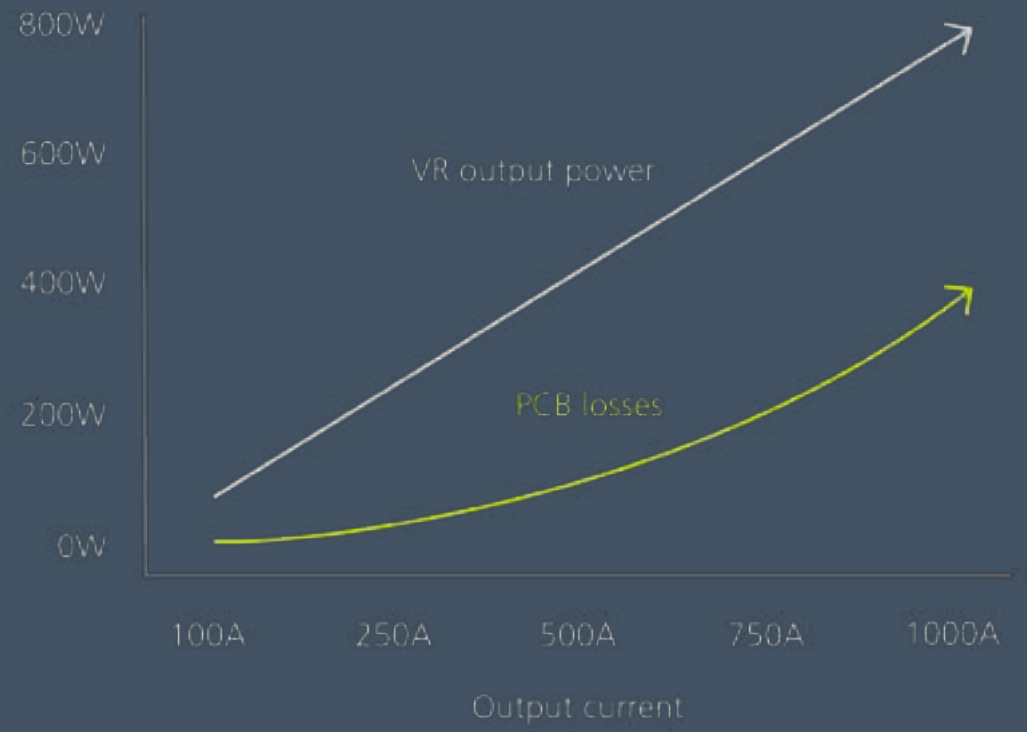
- AI processors need a lot of current…
- Decreases in power efficiency
  - increasing PDN distribution losses
- Significant operating performance reduction if power demands are not met

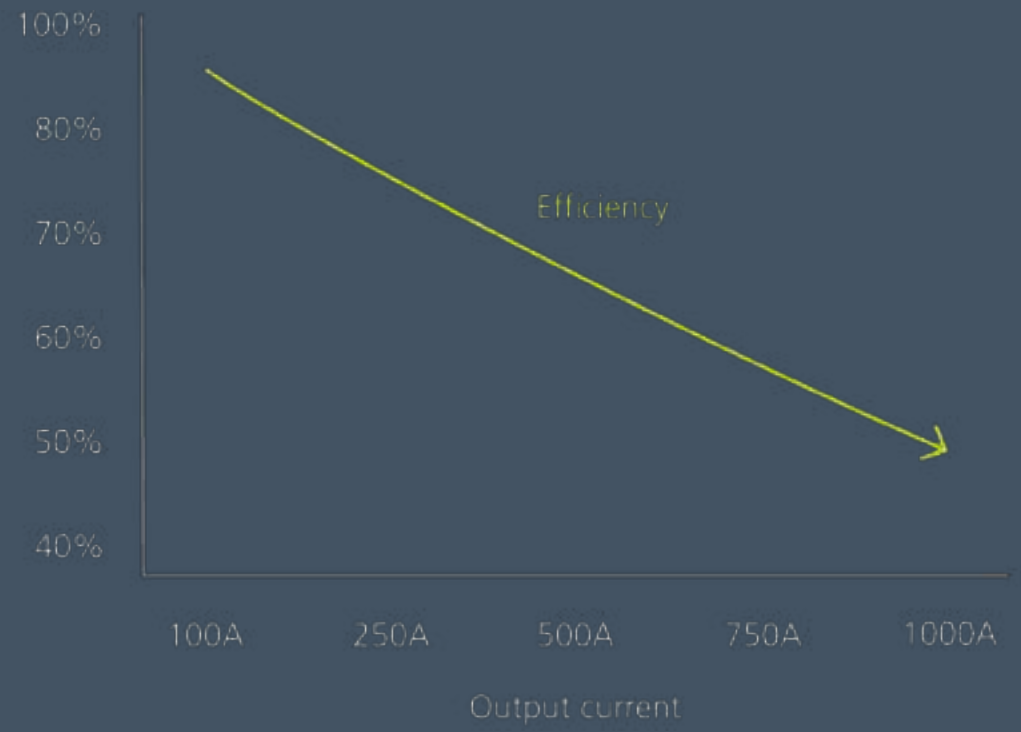


The “last inch”



VR to the processor losses, the “last inch”

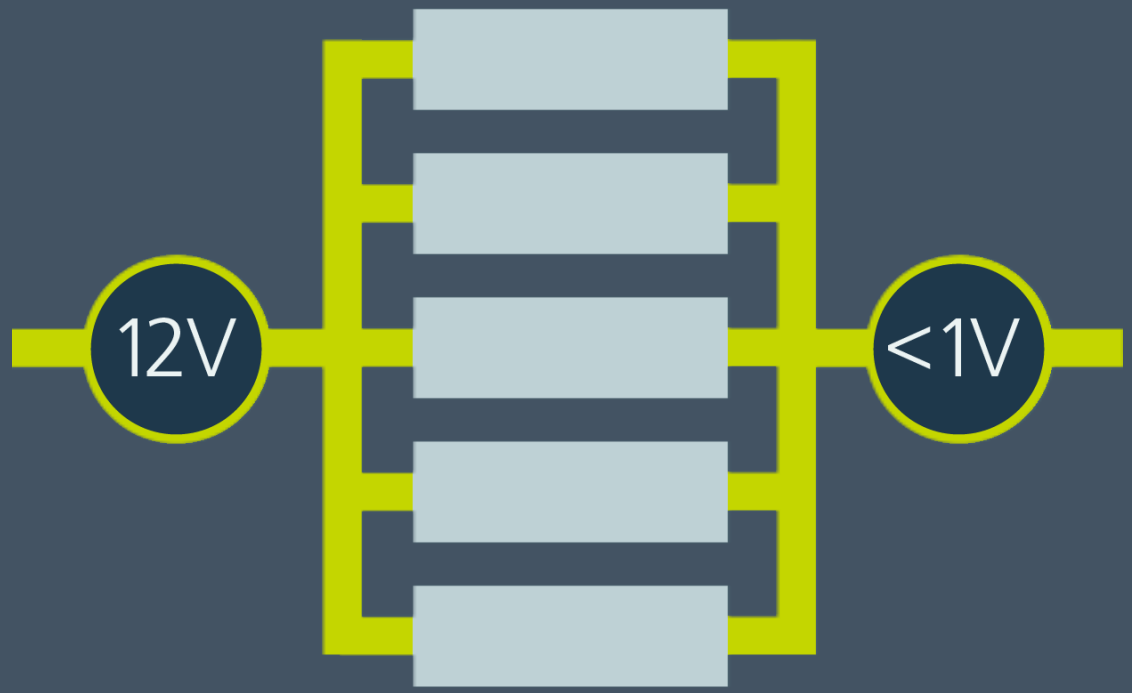




Example with PCB resistance of 400uOhm (VR at 0.8Vout)

Conventional multiphase

- Conversion performed by DrMOS/Inductor
- High conversion ratio (minimum 12:1)
- Challenging to scale for higher currents
- Phase imbalancing
- Noise generation
- Size prohibits reducing PDN



Factorized Power Architecture

- Regulation followed by transformation
- Allows for optimization of each function
- Enables re-distribution of power
- High density
- Low noise

Factorized Power Architecture

Processor

Factorized Power Architecture

Processor

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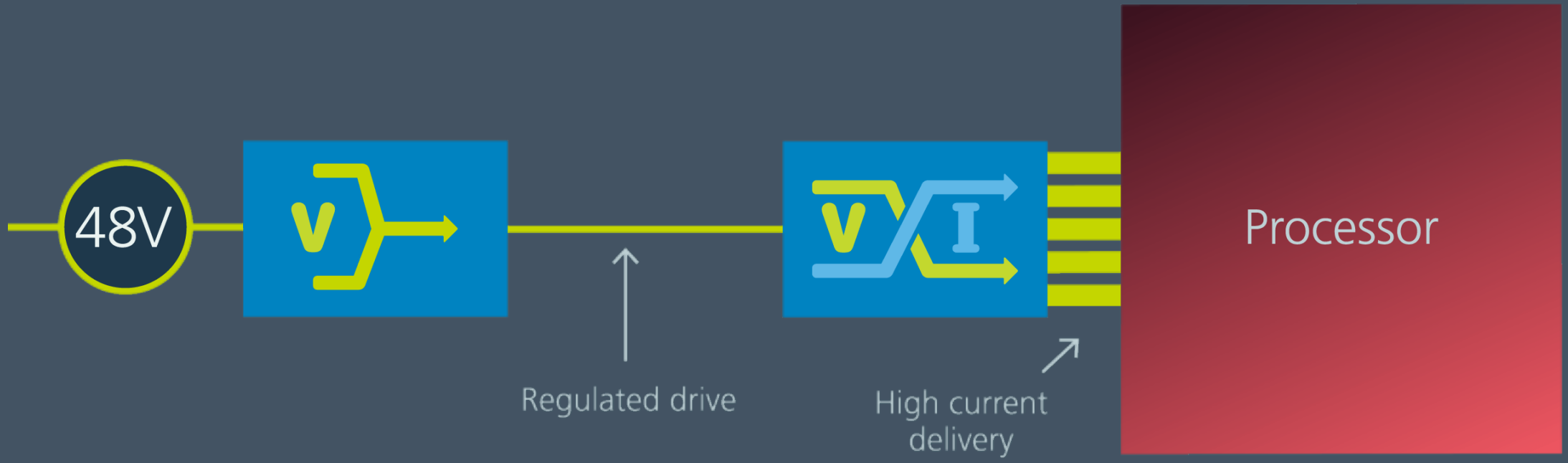
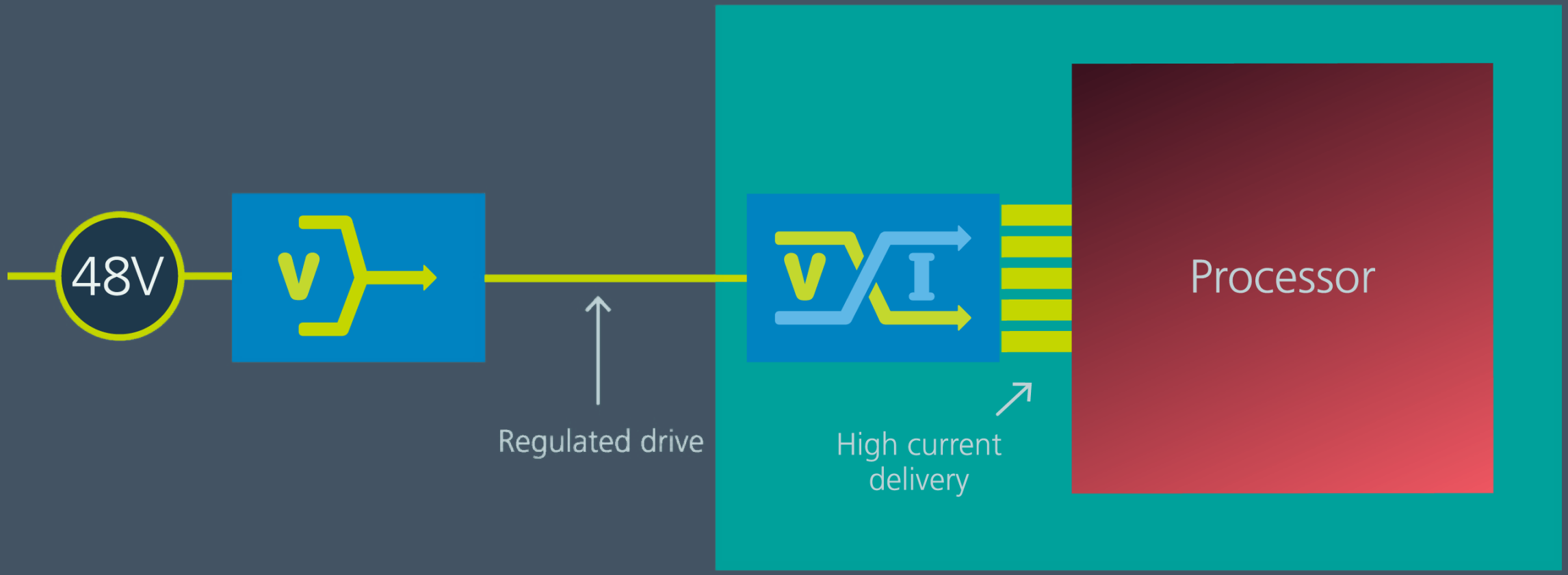
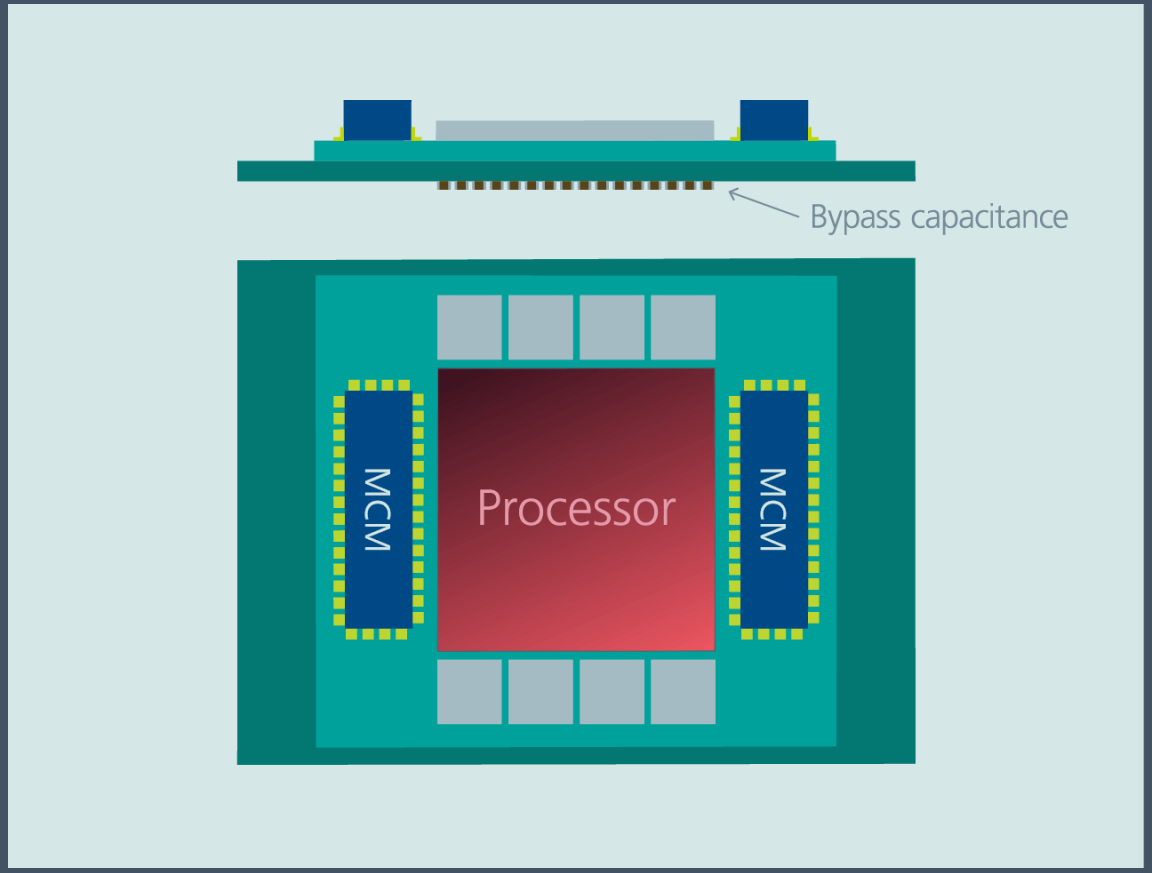
Factorized Power Architecture

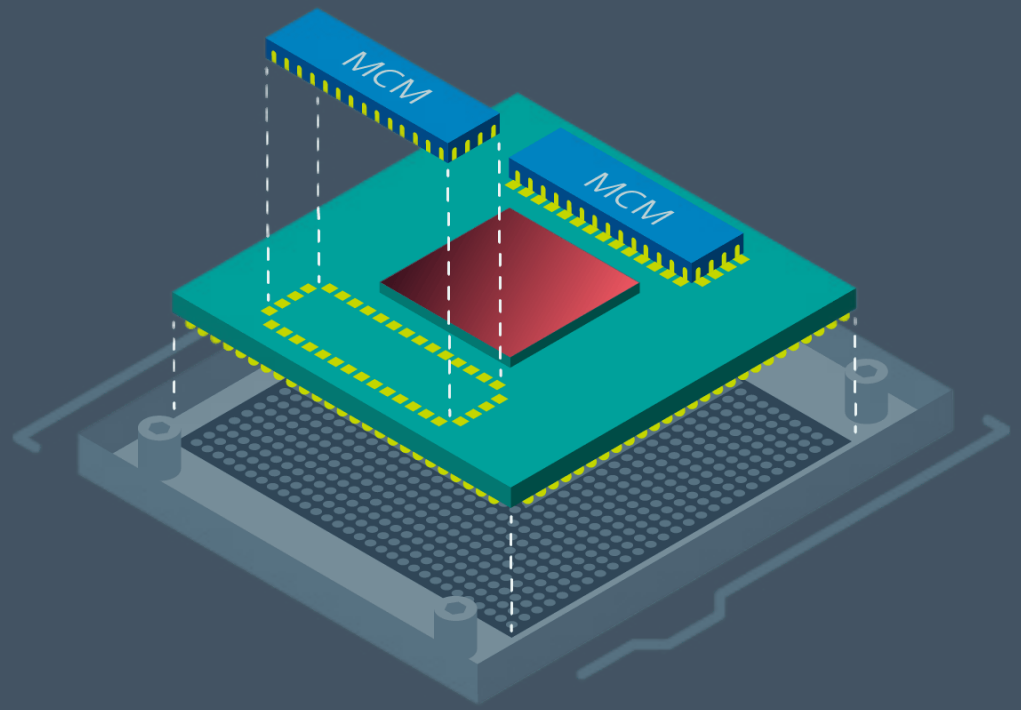


Lateral Power Delivery



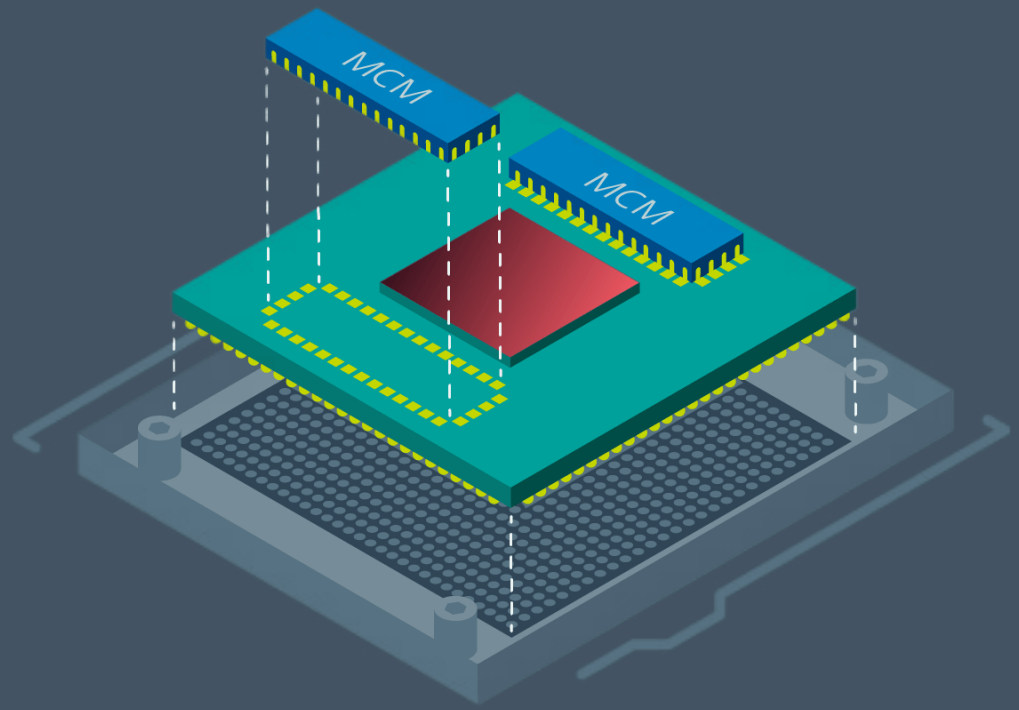
Lateral Power Delivery





Lateral Power Delivery

- Current Multipliers (“MCMs”)
  - Current Multiplication (e.g. 64-to-1) close to processor
  - Typical interconnect resistance: 100µΩ per processor side
- Example MCM module performance
  - Two 46 x 9 x 3.2mm devices
  - Provide 750A continuous and 1,400A peak

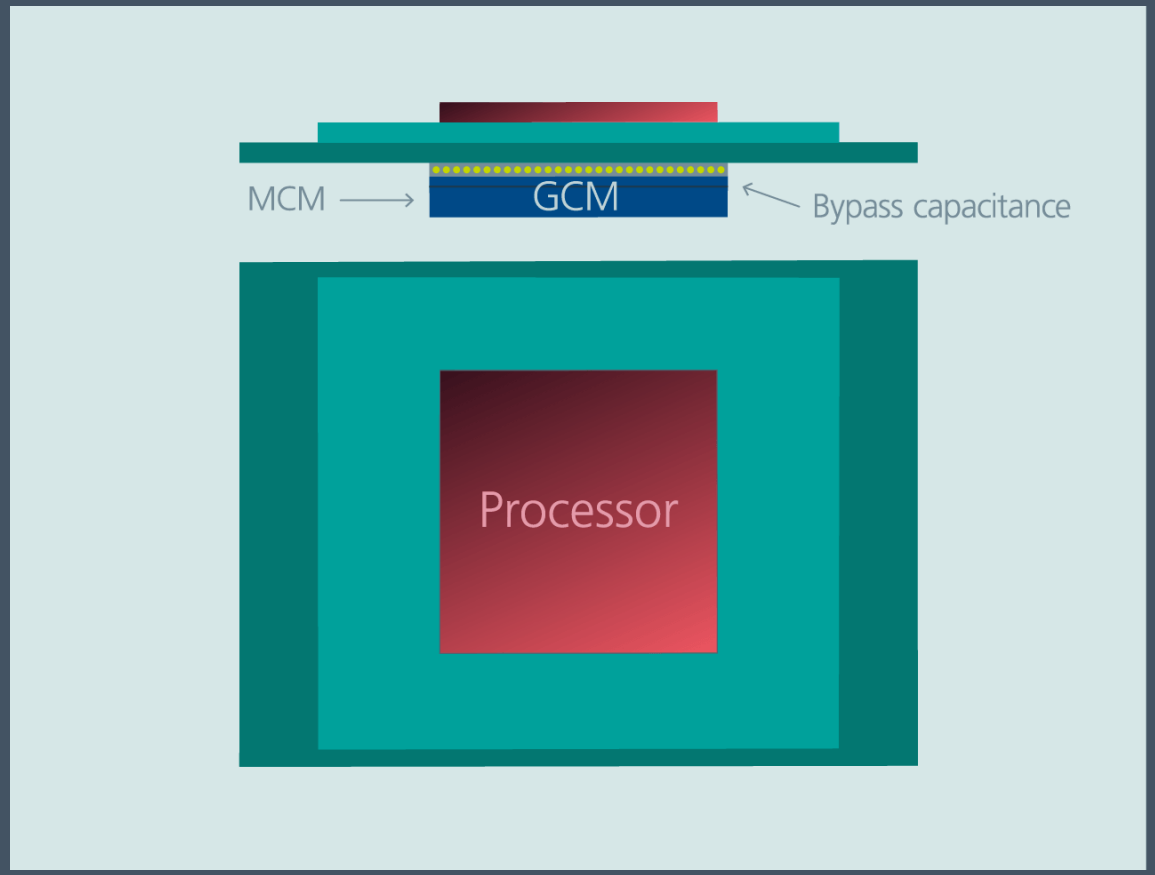


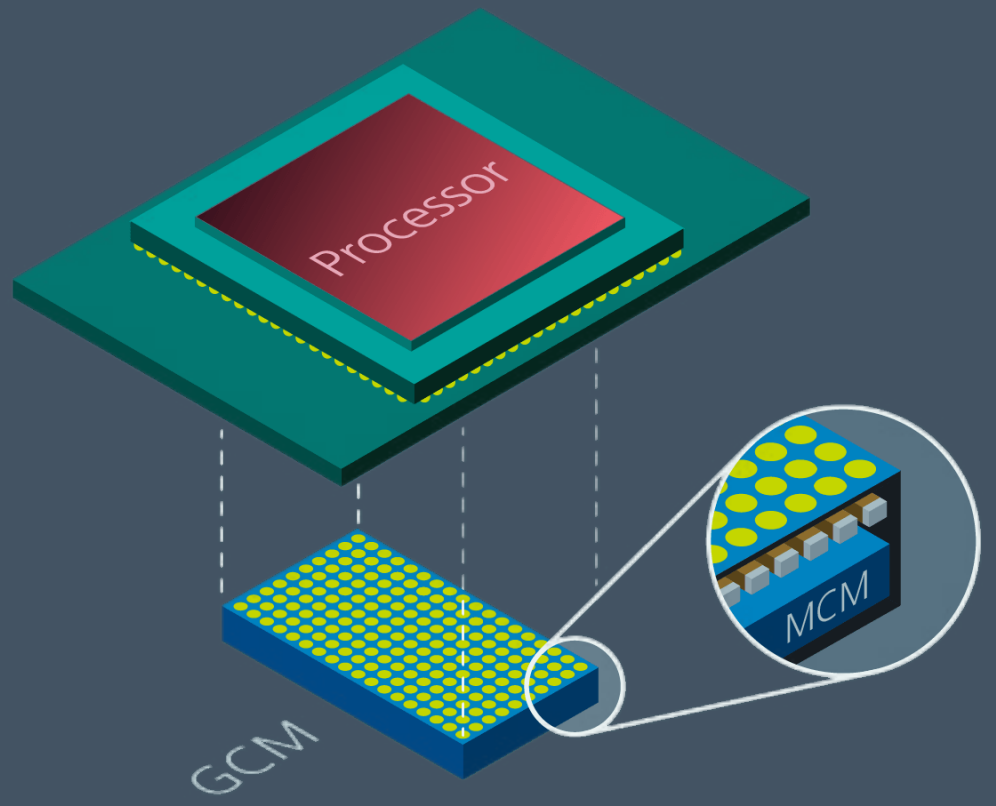
Performance loss analysis

	Vicor Lateral	Conventional
PDN resistance	50μΩ	400μΩ
PDN loss @ 500 Amps	12.5W loss 96.8% efficiency	100W 75% efficiency
PDN loss @ 1000 Amps	50W loss 93.75% efficiency	400W 50% efficiency

PDN Power Loss, due to circuit board copper resistance = I^2R

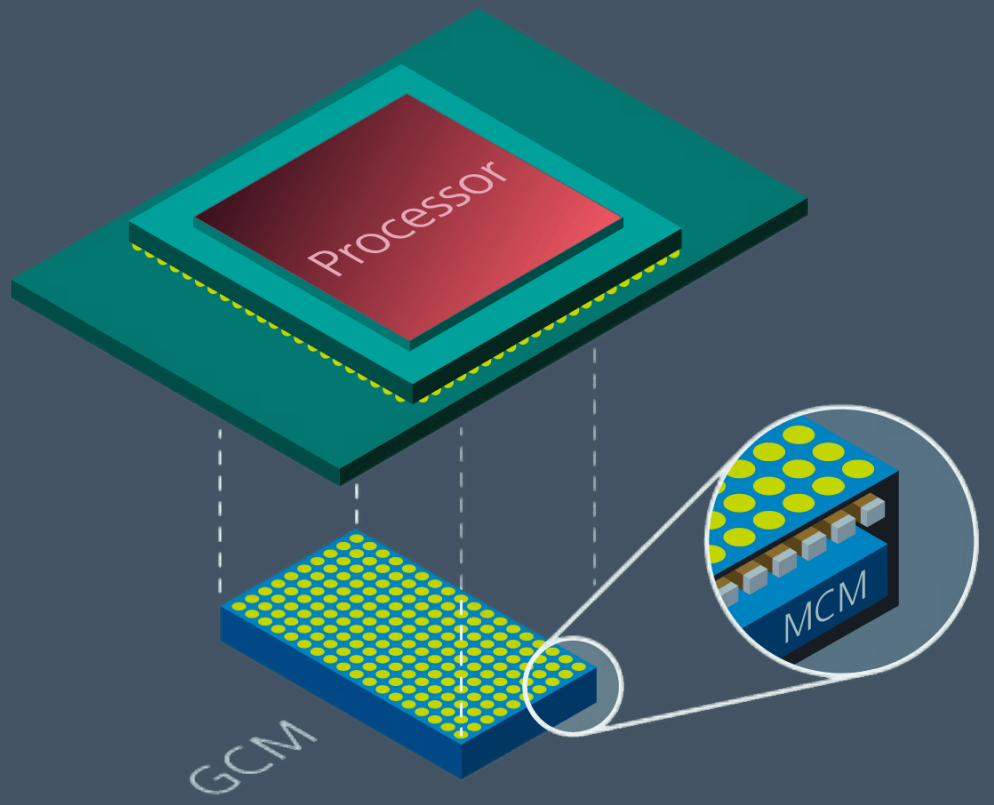
Vertical Power Delivery





Vertical Power Delivery

- Geared Current Multiplier (“GCM”)
  - Low interconnect resistance
  - Terminal pitch matched to processor (e.g., 1mm)
  - Processor perimeter unobstructed
- Power integrity
  - Bypass capacitors re-located within the GCM
  - Low GCM output inductance
  - Low noise ZCS/ZVS current multiplication



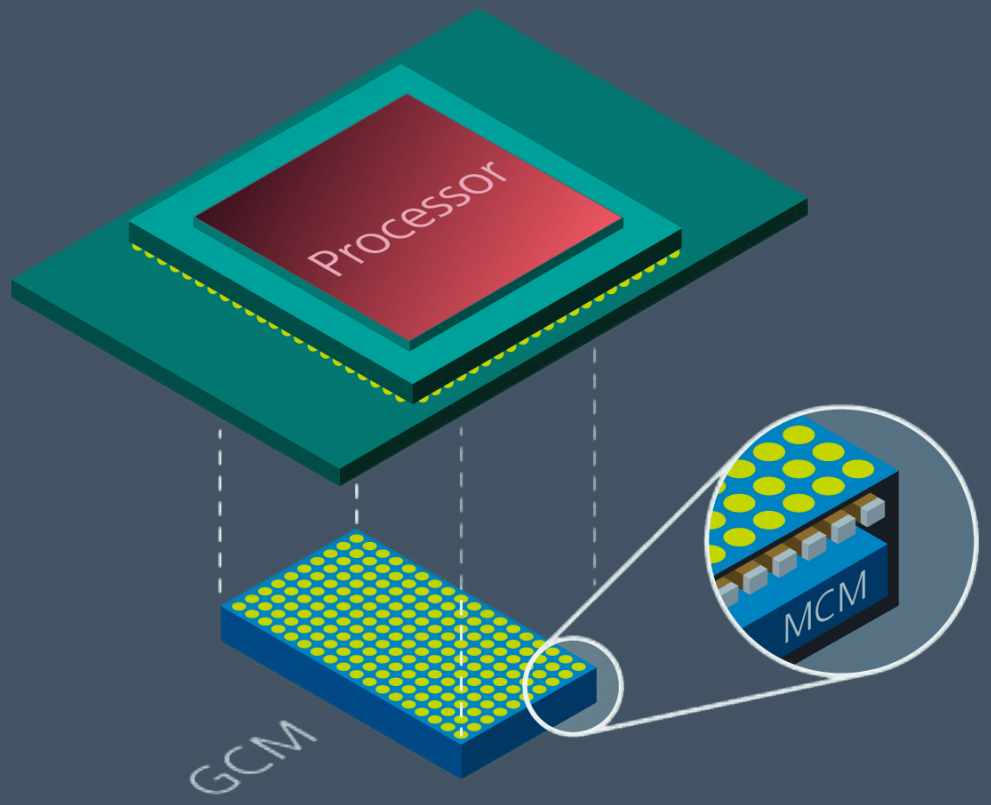
Performance loss analysis

	Vicor Vertical	Vicor Lateral	Conventional
PDN resistance	5μΩ	50μΩ	400μΩ
PDN loss @ 500 Amps	1.25W loss 99.7% efficiency	12.5W loss 96.8% efficiency	100W 75% efficiency
PDN loss @ 1000 Amps	5W loss 99.4% efficiency	50W loss 93.75% efficiency	400W 50% efficiency

PDN Power Loss, due to circuit board copper resistance = I^2R

Vertical Power Delivery

- Easy to cool
  - Vertical PDN loss much lower than Lateral PDN
  - Relatively low GCM heat density
- Example GCM module performance
  - One 33 x 30 x 4.1mm
  - Provides 1,000A continuous and 1,800A peak
- Also enables GCM mounted above processor for top side power delivery



Thank You