New 48V Rack Power Architecture For Hyperscale Data Centers
Why a New Rack Power Architecture is Needed

1. Data Centers are Focused on Reducing Energy Consumption
   - 2% of global electricity use today; equivalent to total electricity usage of Spain or Italy
   - US data centers alone are forecasted to consume 140B kilowatt-hours by 2020
   - Powering IT equipment is one of the largest operating expenses for data centers

2. CPU & Memory Consume Most Power in Rack
   - CPU & Memory represent ~80% of total server power
   - CPU power & dynamic requirements continue to increase

3. New 48V Rack Power Architecture
   - Google introduced a 48V rack power architecture at 2016 OCP Summit to replace 12V
   - Using 48V provides a 16x reduction in power distribution and up to 30% lower conversion losses
   - Requires new high efficiency 48V to PoL regulator
Server Power Consumption

CPU and DRAM memory rails consume over 80% of server power at peak load

Source: [Google Open Compute Summit presentation] The Datacenter as a Computer – Luiz Andre Barroso, Jimmy Clidaras, Urs Holzle
Future Power Challenges for IT Equipment

- CPUs
  - Higher power
    - 150W+
  - Faster transients
    - 500v/μS
- Memory
  - Higher power
    - Faster & more DIMMs
- Accelerators
  - Similar trends as CPUs
  - GPUs, FPGAs, ASICs

Source: [Google Open Compute Summit presentation] Original data up to 2010 by M.Horowitz et al, 2010 to 2015 by K.Rupp
12V Server Motherboard Power Architecture

- **CPU & Memory**
  > 12V to PoL VRs
    - Multiphase buck topology
    - Around for 20+ years
  > Focus is on cost reductions
  > Efficiency gains limited

- **Other PoLs**
  > 12V to PoL VRs
    - Lower power

**Definitions**
- PoL (Point of Load): End user of power
- VR (Voltage Regulators): DC/DC conversion
Maxim’s 48V Solution

- New 48V to PoL DC/DC Voltage Regulators
  > High power CPU & Memory
  > 6 direct 48V conversion VRs

- Existing 12V to PoL DC/DC Voltage Regulators
  > Intermediate 12V voltage bus
  > Lower power rails & storage
New 48V Architecture Benefits

• Energy Savings
  > Up to 30% less conversion losses
  > 16x less power distribution losses
    • Connectors, cables, board
  > Upstream conversion & distribution
    • Power losses reduced

• Efficient & Cost Effective UPS
  > Co-located & high density
  > No boost conversion required

• Existing Infrastructure
  > Telecom ecosystem

Definitions
UPS: Uninterruptible Power Supply
Large data centers are incentivized to move from 12V to higher voltages

Google presented compelling case at OCP Summit for new 48V rack architecture

48V direct to PoL voltage regulators for CPU & Memory are key enablers

Maxim’s integrated power & magnetic solution meets these requirements