TLVR for Computing
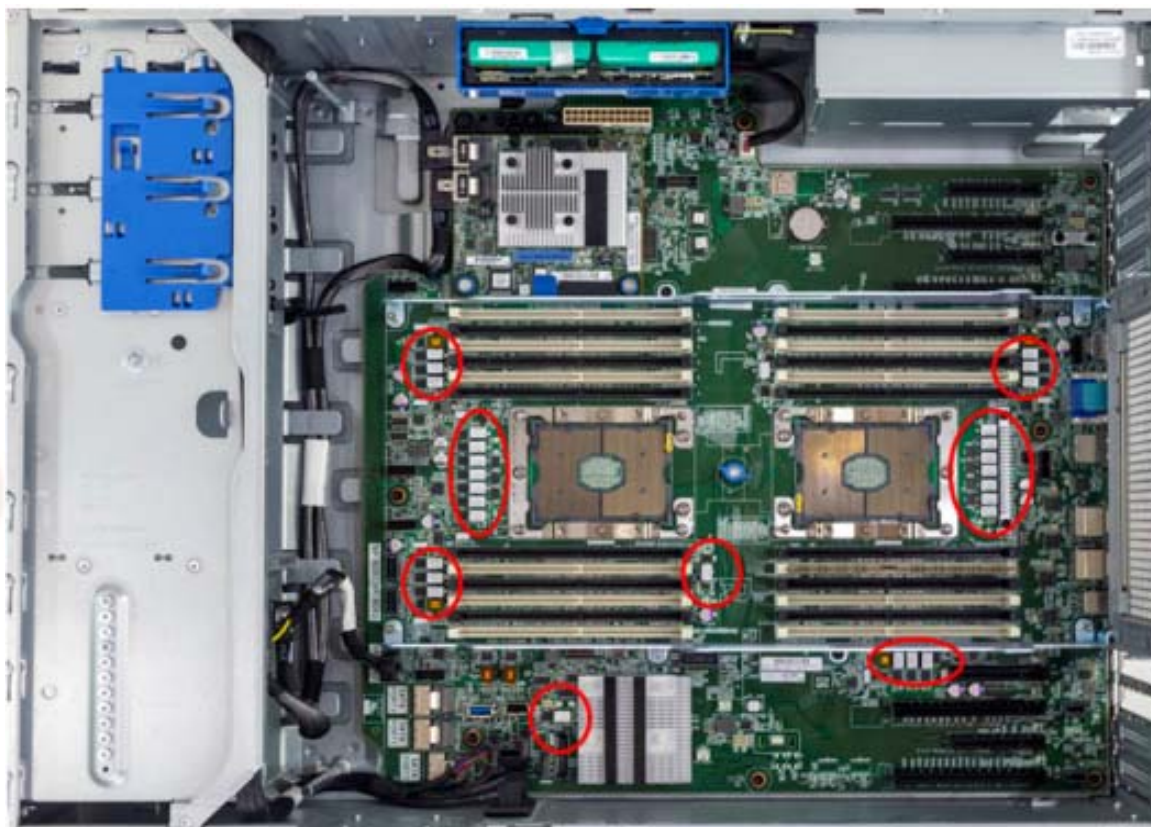
2024/6/25

Computing: Server
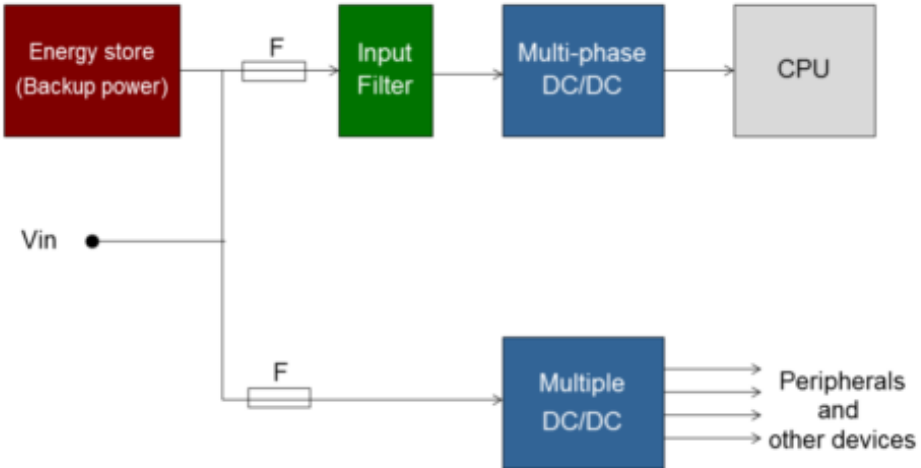
Datacenter

**Server Motherboard: HPE G10 DL360 Server
28 Power Beads in 2 Processor System**

Innovative Service Around the Globe

IOE Group

Intel VR14 Platform Block


VCCIN(1.8V)/520A(8p)
VCCINFAON(0.7V)/33A(2p)
VCCFA_EHV(1.8V)/6.25A(1p)
VCCFA_EHV_FIVRA(1.8V)/136A(4p)
VCCD_HV(1.1V)/21.3A(1p)
VPP_HBM(1.8V)/6A(1p)
VNN_MAIN(1V)/1.9A(1p)

Usage: 18 pcs per CPU
Example:2 CPUs, 36 pcs
Usage: 10 pcs for POLs(3.3V, 5V and so on)
Total Usage: About 46 pcs

CPU working frequency is from 500khz to 2.2Mhz

Innovative Service Around the Globe   IOE Group

TLVR VS Traditional multi-phase Buck

- The trans inductor voltage regulator (TLVR) topology was disclosed in May 9th, 2019 in the Technical Disclosure Commons and is therefore not subject to any IP.
- It proposes to improve transient response by replacing the inductors with 1:1 transformers (or trans-inductors) and a compensation inductor (Lc)
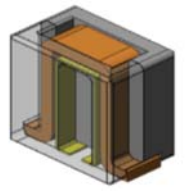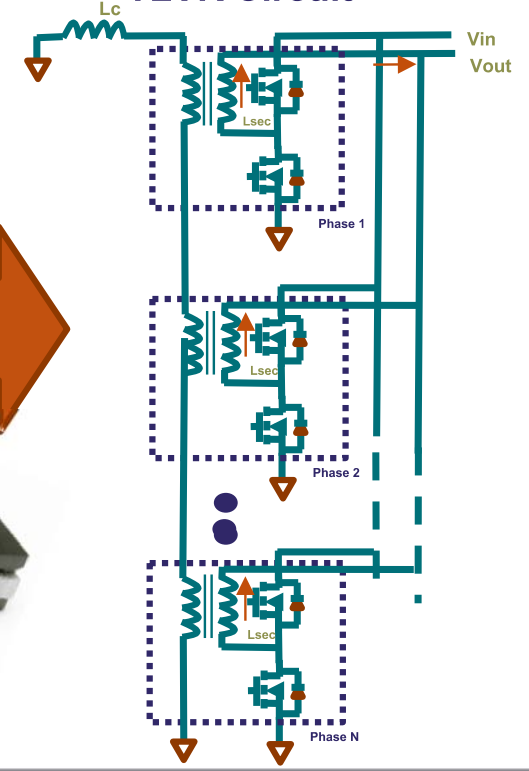- These trans-inductors have the same construction as traditional power beads but with an additional 1T winding

Traditional Multi-phase Buck
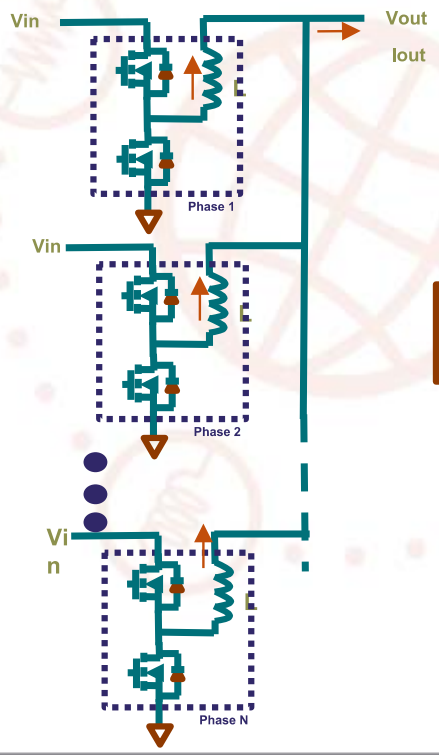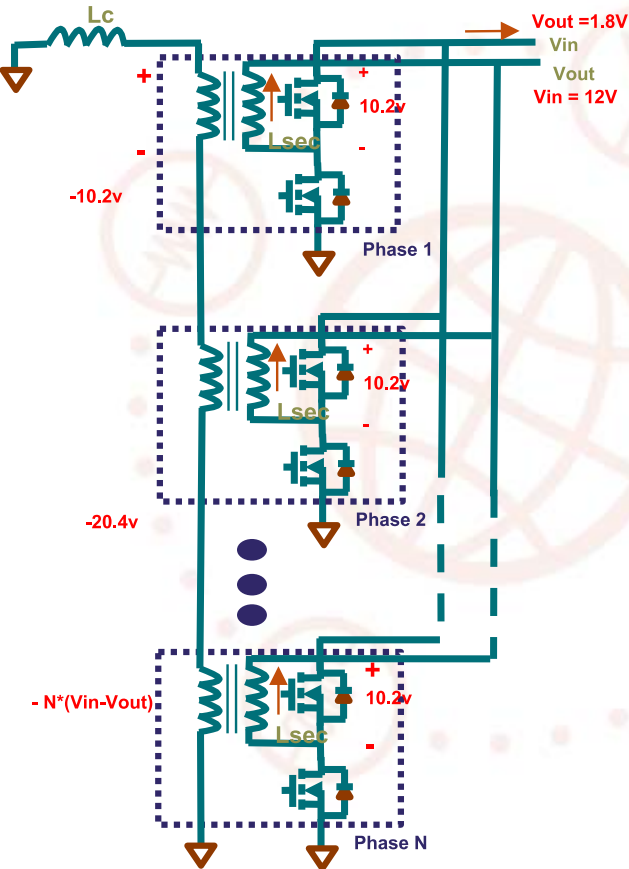
Traditional Multi-phase Buck (re-drawn)
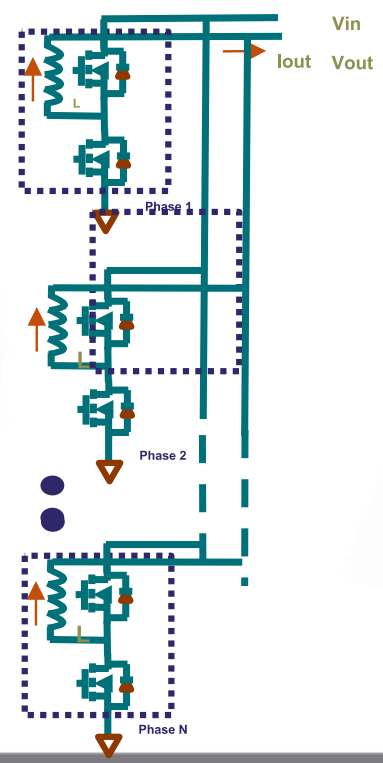
TLVR Circuit

TLVR Potential Issues and Solutions

TLVR Circuit

- The TLVR topology is new and is just being implemented into end-application production in 2021.
- The potential obstacles to mass adoption are increased cost, isolation barrier issues and potential mechanical instability.

Cost
- TLVR construction is similar as the traditional power bead inductor but has one more winding within the same size, also need the isolation between two windings, process would be one challenge for mass production.

Isolation Barrier
- Most existing TLVR constructions have limited isolation between the primary and secondary windings. With limited phase count (4-6) this is sufficient but as phase count increases the real voltage across the inductor Nth inductor is ≈ N * (Vin-Vout) which can quickly get to >60v.
- Insulated TLVR (>100V hi-pot) can be made available.

Mechanical Stability
- The total solution width is often limited and as phase count increases, the width of individual TLVR inductors must be reduced making the inductors mechanically unstable and likely to tip.

Coplanarity
- There are four pins for two windings and need the control to coplanarity, some customer would need the 0.1mm max for the coplanarity, would be one challenge for the technology, need the tiny tolerance for the size, which cost would be increased.

TLVR—BOM (CPU) COST

Non-TLVR Capacitors

Cap	Size	Qty	USD/PCS	Cost Total
100UF	0805	49		
47UF	0603	4		
22UF	0402	79		
	Power bead	16	0.2	3.2
			TTL	
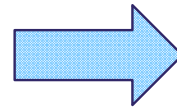
TLVR Capacitors

Cap	Size	Qty	USD/PCS	Cost Total
47UF	0805	49		
47UF	0603	4		
22UF	0402	79		
	Power bead	2	0.25	0.5
	TLVR	16	0.4	6.4
			TTL	

TLVR Inductor list

Part Number	L (mm)	W (mm)	H (mm)	Primary DCR (mOhms)	Secondary DCR (mOhms)	Inductance Range (nH)	Peak Current Range (nH)
IOGL6303.151HLT	11	7.5	12.5	0.105+/-10%	0.27+/-10%	150nH	82A
IOGL6181.XXXHLT	12	6	12	0.125+/-10%	0.6+/-10%	105~150nH	82~118A
IOGL6215.XXXHLT	12	6	12	0.125+/-10%	0.45+10%/-20%	105~200nH	60~125A
IOGL6365.XXXHLT	12	6	11	0.125+/-10%	0.5max	105~150nH	85~123A
IOGL6380.XXXHLT	12	6	11.15	0.125+/-10%	0.37+/-10%	120~170nH	70~102A
IOGL6501.XXXHLT	12	6	11.15	0.125+/-10%	0.37+/-10%	100nH	123A
IOGL6489.XXXHLT	9.6	6.4	13	0.14+/-10%	0.5+/-10%	100~170nH	66~114A
IOGL6520.XXXHLT	9.6	6.4	12	0.125+/-10%	0.5+/-10%	100nH	106A
IOGL6519.XXXHLT	10	6	12	0.16+/-10%	0.38+/-10%	120nH	88A
IOAL6373.XXXHLT	12	6	12	0.14max	0.45max	100~180nH	65~120A
IOAL6374.XXXHLT	10	5	12	0.135+/-10%	0.45max	70~180nH	45~121A
IOA5573.101HLT	12	6	11	0.18+/-10%	0.58max	100nH	106A

New TLVR for Vcore power(server)

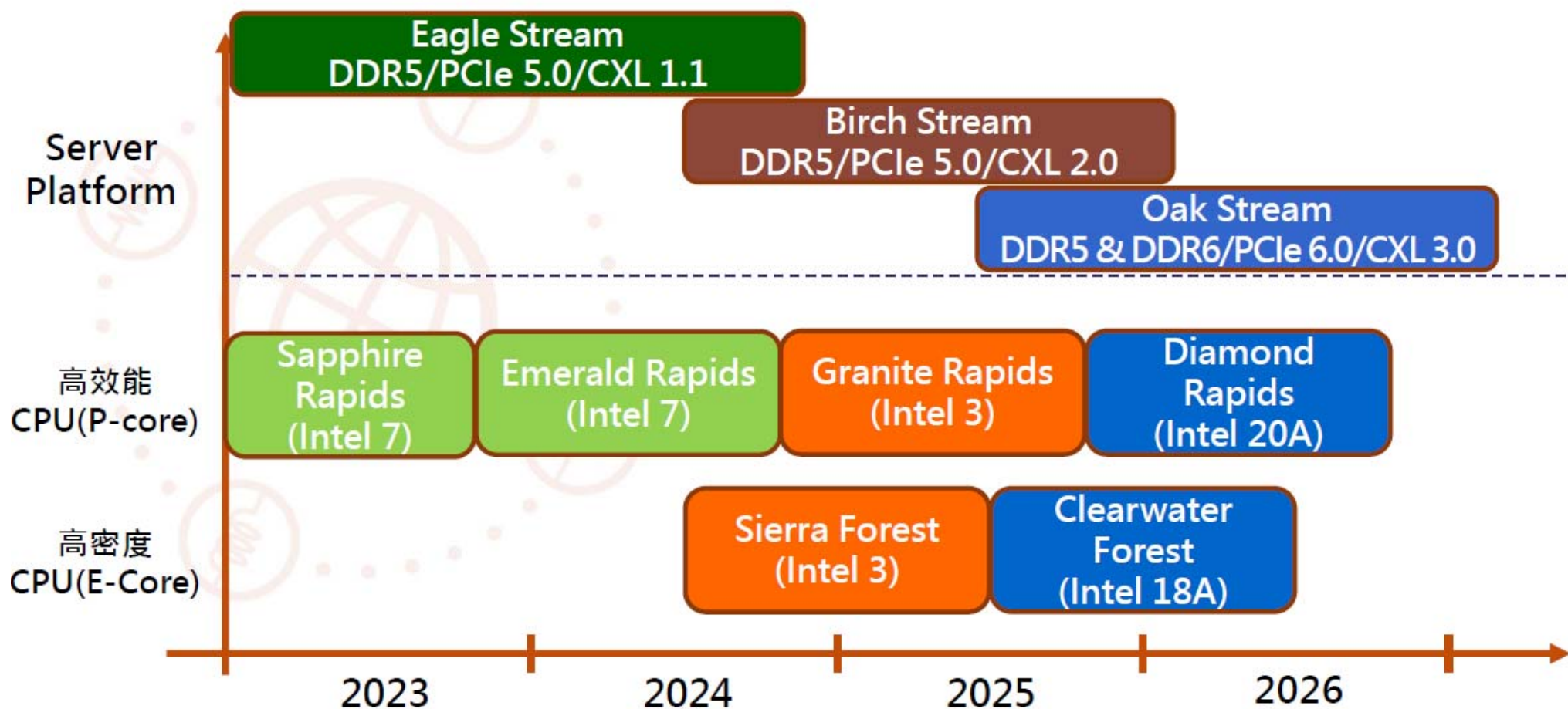## TLVR Inductor integrated Lc(IOGL7216.XXXHLT)

TLVR Inductor with lower height(IOGL7250 with side winding for sec) , IOGL7195 series is used for Intel Oak stream DDR power(4 phase)

Part Number	L (mm)	W (mm)	H (mm)	Primary DCR (mOhms)	Secondary DCR (mOhms)	Inductance Range (nH)	Peak Current Range (nH)
IOGL7195.XXXHLT	10.2	5	6	0.5+/-10%	1.6 max	100~150	68A
IOGL7250.101HLT	13	8	5	0.55+/-15%	0.99+/-15%	100	90A

For AI server, future height requirement would be 3mm min based on information from Google/Nvidia, would be one challenge for us, quite different technology. Lower power for single parts but more usage for the quantity.

Intel Server platform

Innovative Service Around the Globe

IOE Group

Intel Server platform

Innovative Service Around the Globe   *IOE Group*