

# Energy Efficient Edge Computing

The Intel logo is located in the bottom left corner of the slide. It consists of the word "intel" in a white, lowercase, sans-serif font, followed by a registered trademark symbol (®). The logo is positioned to the right of a decorative graphic of several overlapping squares in various shades of blue.

intel®

# Intel's Mission

Sustainable computing for a sustainable future

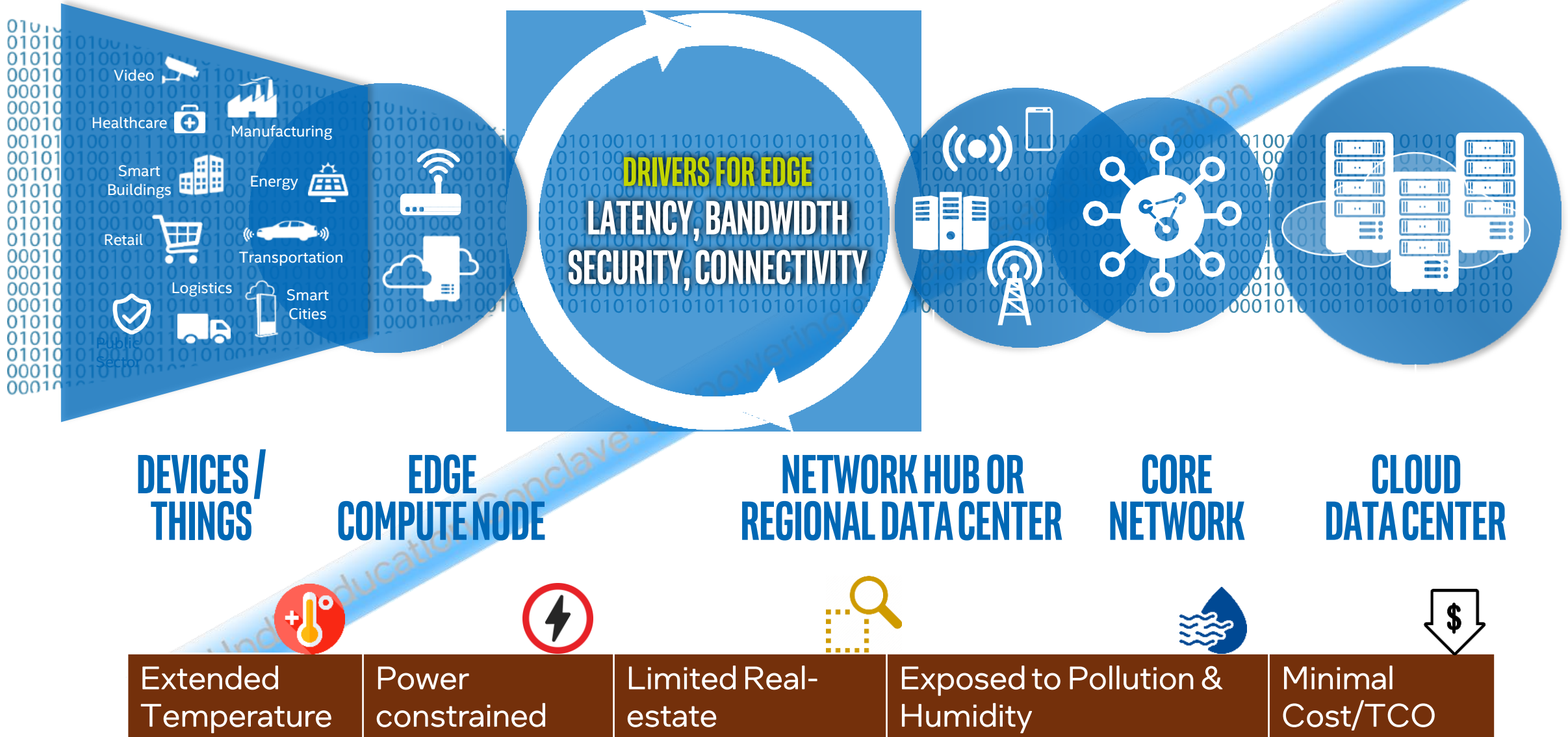
Reduce Intel's carbon footprint through manufacturing and supply chain partnership

Design sustainability into products, platforms, software and services

Collaborate across ecosystems to create standards and scalable solutions



# The Emerging Demand For Edge Compute



# Sustainability & Regulatory Factors

- Many countries/UN are driving for
  - Global carbon dioxide emissions need to be reduced by 45 per cent by 2030 from 2010 levels
  - Reach net-zero emissions by 2050
- India's emission goal
  - Net-Zero emissions by 2070
  - Reducing total projected carbon emissions of 1 billion tonnes by 2030

## Singapore puts 'temporary pause' on new data centres: Why and what it means for the industry

Source: <https://www.channelnewsasia.com/business/new-data-centres-singapore-temporary-pause-climate-change-1355246>

## Europe Edges Closer to Green Data Center Laws

<https://www.datacenterknowledge.com/regulation/europe-edges-closer-green-data-center-laws>

Table 2: Recent Examples of Legislation to Reduce Environmental Impact

Amsterdam	<ul style="list-style-type: none"><li>• PUE* limits on data centers</li><li>• Moratorium on new licenses until environmental impact assessed – city wants heat re-use</li></ul>
Singapore	<ul style="list-style-type: none"><li>• Restrictions on new builds due to land use, energy</li></ul>
Santa Clara, CA	<ul style="list-style-type: none"><li>• On-site generation must use non-fossil fuels</li></ul>
Shanghai	<ul style="list-style-type: none"><li>• New data centers must have PUE* 1.3 or less</li></ul>
European Union	<ul style="list-style-type: none"><li>• New rules governing server energy use when idle, thermal reporting and recyclability</li></ul>

\* PUE – Power Usage Effectiveness Source: Uptime Institute Intelligence, October 2018



Save Energy



Reduce CO<sub>2</sub> Emissions



Save Water

Efficiency and Sustainability requirements are equally important

# 4<sup>th</sup> Gen Intel® Xeon® Scalable Processors

## Intel's most sustainable processor ever



**Integrated AI**  
**Up to 14x perf / watt boost<sup>1</sup>**

AI inference workloads with Intel AMX accel vs no accel

**Made with 90% renewable energy<sup>4</sup>**  
for a smaller carbon footprint



**Built in accelerators provide an avg 2.9X improvement in perf/watt<sup>2</sup>**

**Up to 20% CPU power saving at less than 5% performance impact<sup>3</sup>**  
with Optimized Power Mode



**Manufactured at Sites with State-of-the-art Water Reclamation**  
2.8 billion gallons of water recycled in 2021<sup>4</sup>



**Built with circular economy strategies for waste**  
5% total waste to landfill<sup>4</sup>



**Built in advanced telemetry enables monitoring and control of electricity consumption and carbon emissions**



<sup>1</sup>See backup for config details.

<sup>2</sup>See intel.com/processorclaims: 4th Gen Intel® Xeon® Scalable processors. Claim E1. Results may vary.

<sup>3</sup>On select workloads. See intel.com/processorclaims: 4<sup>th</sup> Gen Intel Xeon Scalable processors. Claim E6. Results may vary.

# Providing Customer Value: Improved TCO through Energy Efficient Edge

## Processor



4<sup>th</sup> Gen Intel Xeon  
 Energy savings thru:  
 Optimized Power Mode\*  
 Built in Accelerators\*  
 Built in telemetry

## System



## Monitor & Control

New Platform  
 Telemetry  
 CPU temp, power  
 and package C  
 state residency

## Workload



## Software

Power Management  
 Software Tools

## Center Efficiency



## Liquid Cooling

Available immersion  
 cooling warranty rider  
 Liquid validation  
 Reference documents  
 Qualified DLC/CP  
 partners

Embodied  
 Carbon &  
 Environ  
 Benefits  
 Too!

Scope 3 GHG emissions benefits due to manufacturing with 90-100% renewable electricity  
 Produced at sites with state-of-the-art water reclaim facilities (2021: recycled 2.8 billion gal of water)

Intel India Education Conclave: Empowering educators and innovation

\*See claims [E3-E6] on the 4th Gen Xeon page of intel.com/performanceindex for workloads and configurations. Results may vary.

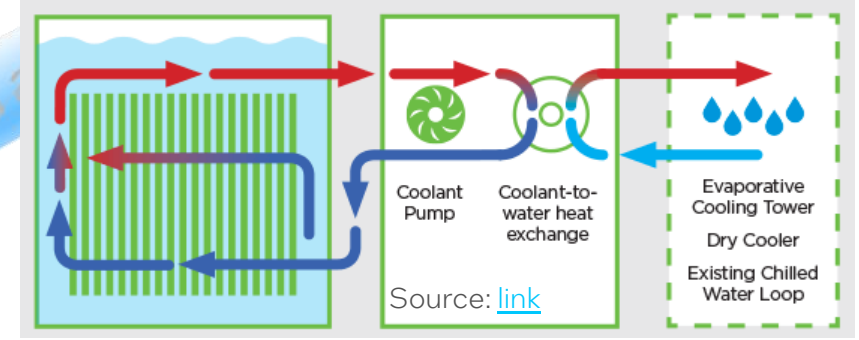
\*\*granulate.io

# Liquid Cooling Technology Solution

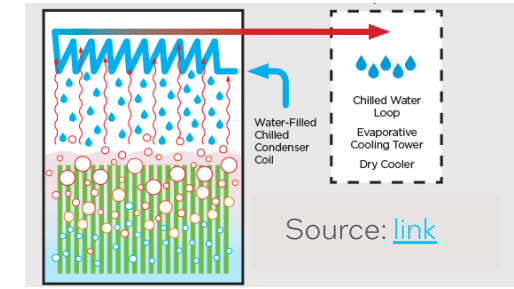
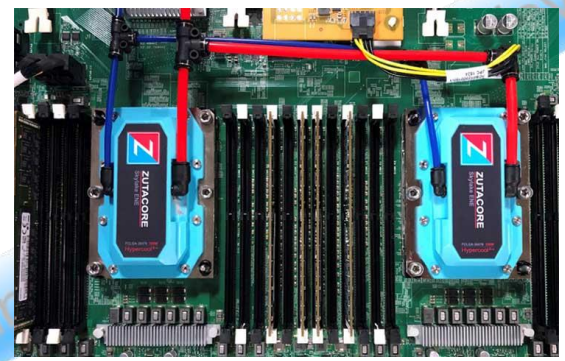
## Cold Plate Based

## Immersion Based

### Single Phase



### Two Phase



# Infrastructure Efficiency: Reducing Power Usage Effectiveness (PUE) through Liquid Cooling

Liquid cooling enables lower PUE



Traditional  
Heat Sink



Enhanced  
Volume Air  
Cooling

Great for greenfield



Immersion

Great for brownfield



Cold Plate

Down to  
**1.3-1.2**

**PUE**

Down to  
**1.03**

## Intel Support for Liquid Cooling

Available immersion cooling warranty  
rider

Liquid validation

Reference documents

Qualified DLC/CP partners

Learn more: [https://www.youtube.com/watch?v=yBVO\\_YQBYjc](https://www.youtube.com/watch?v=yBVO_YQBYjc)



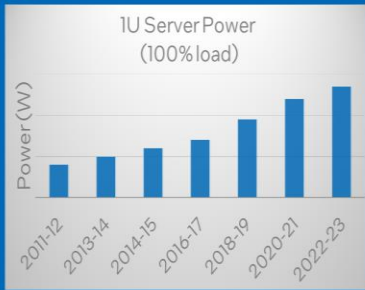
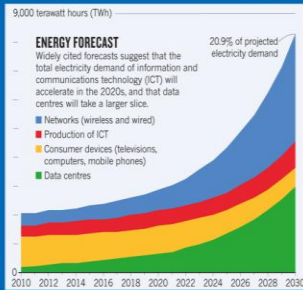
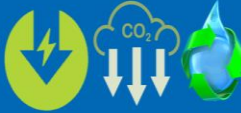
# Energy Efficient Edge and Data Center

## India's emission goal

- Net-Zero emissions by 2070
- Reducing total projected carbon emissions of 1 billion tonnes by 2030



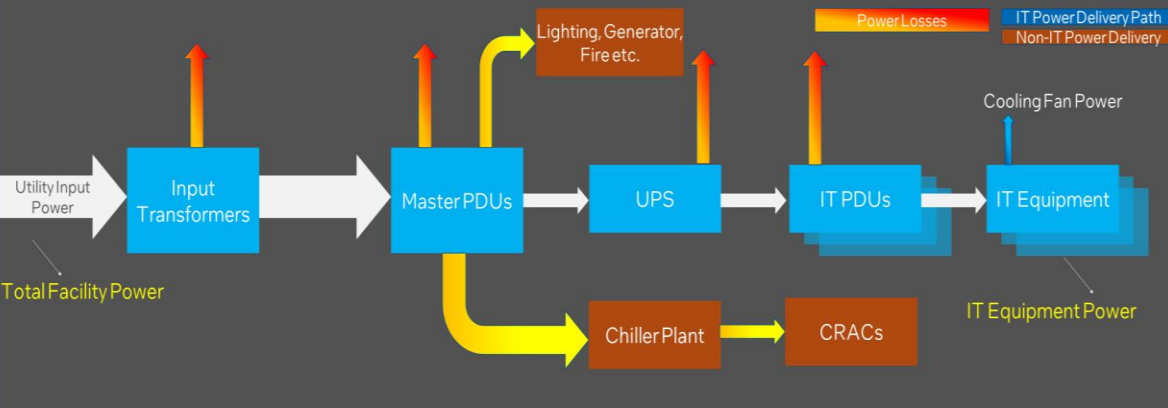
Need of technologies improving the energy efficiency levels



**Power Usage Effectiveness (PUE)**

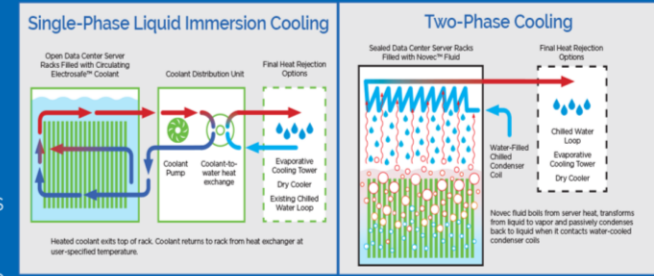
$$PUE \text{ (Power Usage Effectiveness)} = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}} \quad 1.0 \rightarrow \text{Perfect}$$

	PUE	Type of Cooling
Industry Average	1.67	Chillers
India Hyperscale DC	1.3-2.0	Air cooled Chillers
Energy Efficient DC*	<1.05	Liquid Cooling/Immersion Cooling



## Sustainable system at EDGE and DC

- Reduce overall power consumption at heterogeneous deployment of edge devices
- PUE <1.05 vs typical 1.3-2.0 for air-cooled DC
- Improves server /IT Equipment reliability
- Reduces dependency on Air-conditioning/Chillers
- Less water wastage, smaller footprint
- Sustainable even in harsh environmental - extreme and varied temperature condition in India
- Protected from dust, moisture and other air pollutants
- Some of the Liquid Coolants come with Zero GWP (Global Warming Potential)



	PUE=1.5	PUE=1.05
1MW Data Center		
IT Power Consumption	1.0 MW	0.9 MW*
Total Facility Power	1.5 MW	0.945 MW
Energy Consumption per Year	13.1 M kWh	8.3 M kWh
Carbon Emission per year (India WAEF=0.79#)	10.3 Million Kg CO2	6.5 Million Kg CO2
<b>CO2 Saving/Yr (for 1MW DC)</b>	<b>~3.8Million Kg CO2 per Year per MW</b>	

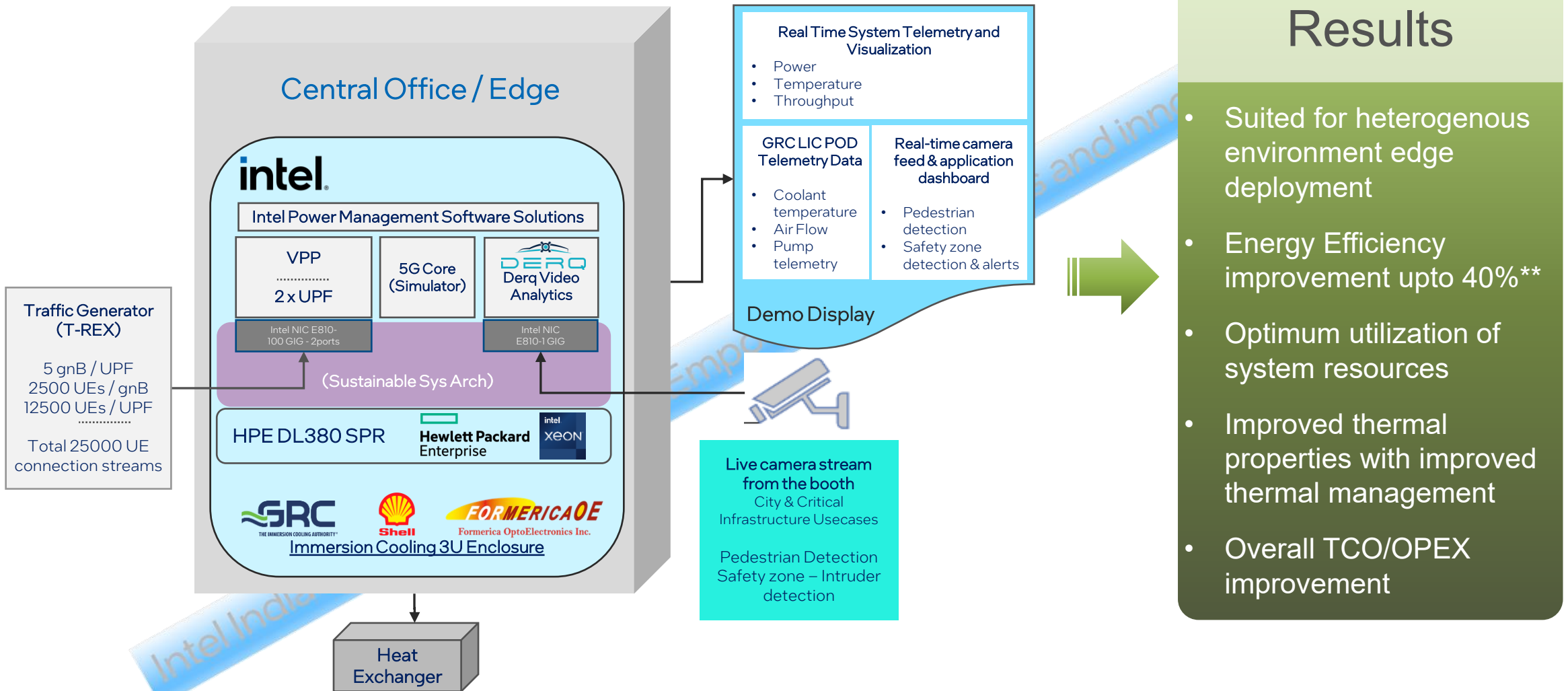
# WAEF - Weighted Average Emission Factor (as per CO2 Baseline Database for the Indian Power Sector released on March 2021 by Central Electricity Authority, Govt. of India)

\*Reduction due to Fan Removal

Intel is committed to driving innovative & more sustainable technology solutions like Liquid Immersion/precissions Cooling to address critical global environmental issues



# Demo Setup Architecture



\*\* Based on demo setup observations

# Demo – Liquid Cooling Ecosystem Partners

## Enabling Xeon based Sustainable Edge Solution with Liquid Immersion technology through our Strong Ecosystem Partners

### Hewlett Packard Enterprise

- HPE ProLiant DL380 fully integrated Gen11 Immersion Compliant Server
- Improved energy efficiency (no Fans)
- Improved reliability and reduced component failures
- Air-to-Liquid Conversion supported through Avaso®, system integration partner



- 14+ years focus on development of single-phase immersion cooling
- Pioneer & Recognized as The Immersion-Cooling Authority®
- Environmentally Resilient – Eliminates risks of dust & moisture contamination.
- Maximizing performance to Energy ratio with PUE < 1.05



- Stabilized hydrocarbon fluids based on Shell gas-to-liquids (GTL) technology
- Coolants are designed for optimized operations for both Data Centre and Edge deployments
- Shell S3X Coolant demonstrating high cooling efficiency, excellent flow behavior and outstanding thermodynamic properties



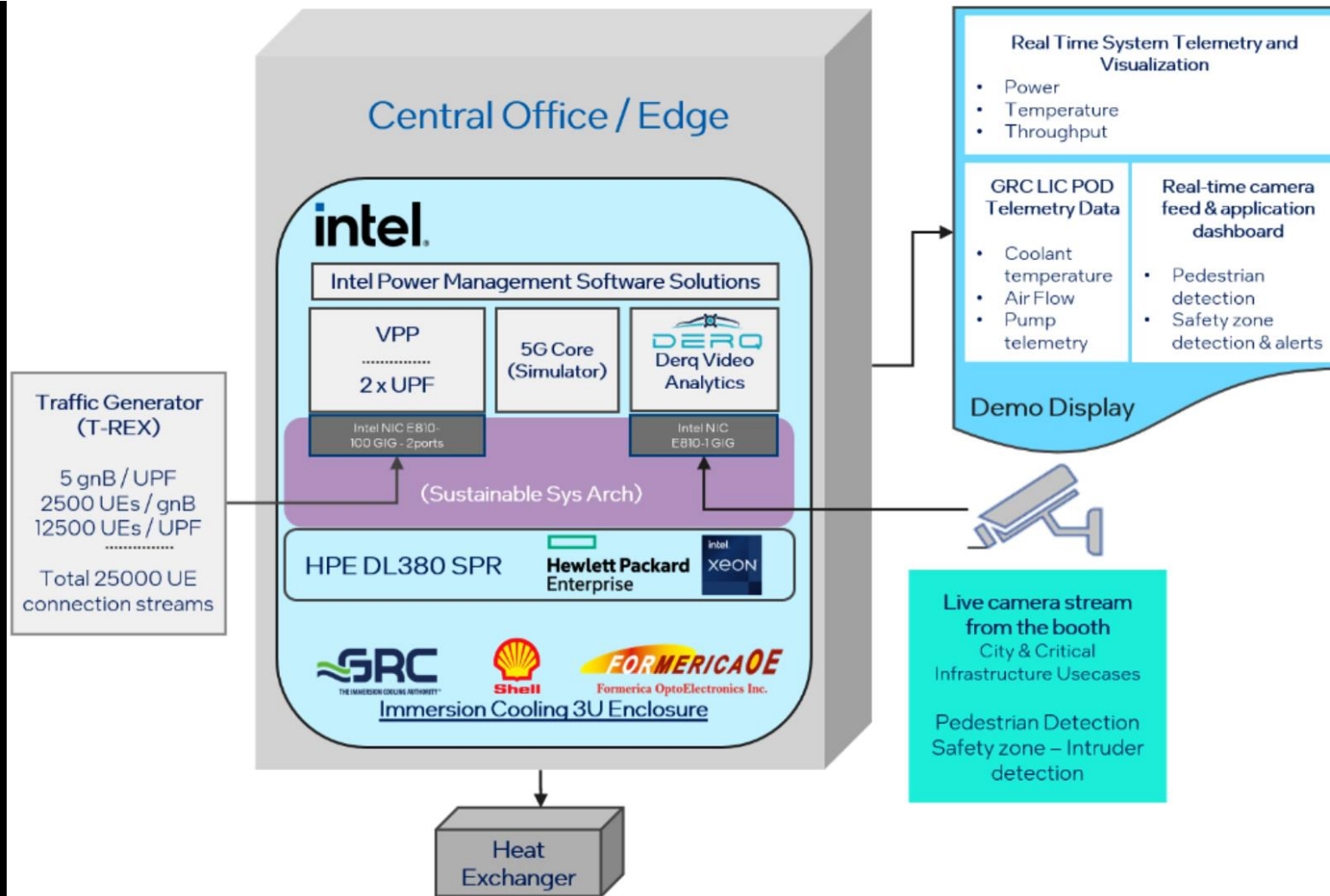
- Robust construction to seal the Active Optical Cable and Active Optical Pigtail for Immersion
- LSZH (Low Smoke Zero Halogen) cable material stays flexible and bendable
- 1G, 10G, 25G, 40G, 100G, 400G sealed optical cables or pigtails at rated operating temperature for 70C and 85C



- Derq, MIT spinoff, leader in AI-powered video analytics for traffic safety & smart cities.
- Derq's platform ingests & fuses data from traffic cameras & other sensors to run real-time analytics & off-board perception
- Derq's applications include comprehensive traffic & safety insights as well as connected & autonomous vehicles solutions

Showcasing Energy Efficient & Sustainable Edge Solution on 4th Generation Intel® Xeon® Scalable Processors

# Demo - Video



# Live @ India Mobile Congress 2023, Delhi



# Notices & Disclaimers

- Intel is committed to the continued development of more sustainable products, processes, and supply chain as we strive to prioritize greenhouse gas reduction and improve our global environmental impact. Where applicable, environmental attributes of a product family or specific SKU will be stated with specificity. Refer to the 2022 Corporate Responsibility Report (p. 64) for further information.
- Performance varies by use, configuration and other factors. Learn more on the Performance Index site.
- Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.
- Your costs and results may vary.
- Intel technologies may require enabled hardware, software or service activation.
- Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.
- © Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries. Other names and brands may be claimed as the property of others.

The Intel logo is centered on a solid blue background. It features the word "intel" in a white, lowercase, sans-serif font. A small blue square is positioned above the letter 'i'. To the right of the word "intel" is a registered trademark symbol (®).

intel®

# HPE ProLiant rack Servers with 4th Gen Intel® Xeon® Scalable processors

**Rack-optimized  
General Purpose Virtualization**

**1U, 2P**

HPE ProLiant DL360 Gen11



**Performance, expandability, and scalability  
for diverse workloads and environments**

HPE ProLiant DL380 Gen11



**IT infrastructure  
Infrastructure**

Up to 16 NVMe SFF SSDs on 1P  
Up to 32 D.A. NVMe E.3s 1T SSDs on 2P  
Smart Cooling Module for highest TDPs

**Collaborative, Ent. Bus. Solutions<sup>1</sup>, Data &  
Analytics, AI, VDI, and Content Mgmt**

Up to 32 SFF or 19 LFF drives  
Up to 36 E3.s T1 x4 NVMe (Gen5) SSDs  
Up to 8 SW or 3 DW Accelerators

Intel India Education Conclave: Empowering educators and innovation





**Specification**

**Quad Small Form Factor Pluggable**

**Immersion Liquid Cooling QSFP28 Active Optical Cable**

**Dual Rate 100 Gigabit Ethernet/40 Gigabit Ethernet**



**TQS-QxJH8**

Operating temperature range: 0°C ~ +85°C  
 Length: 1M...100M

**Ordering Information:**

Model Name	TQS-Q1JH8-X8M01	TQS-Q1JH8-X8MA0	TQS-QJJH8-X8M01	TQS-QJJH8-X8M10	TQS-QJJH8-X8MA0
Voltage	3.3V				
Device type	850nm VCSEL/InGaAs PIN				
Interface	CML/CML				
Temperature	0°C ~ +70°C		0°C ~ +85°C		
Length	10M	100M	1M	10M	100M
Latch Color	Beige				

**■ Features**

- Hot pluggable electrical interface
- Supports 103.1Gb/s aggregate bit rate
- Low power consumption of max 2.0W (each terminal)
- Compatible with immersion cooling liquid
- Operating case temperature range option of 0 to 70°C
- Maximum link distance of 70m on OM3 MMF and 100m on OM4 MMF
- Compliant with 100GBASE-SR4 and 40GBASE-SR4 and IEEE 802.3bm
- Compliant to SFF-8665 (QSFP28)

**■ Applications**

- 100Gb/s Ethernet and Infiniband EDR
- High density computing environment

**Absolute Maximum Rating**

Not necessarily applied together. Exceeding these values may cause permanent damage.

Parameter	Min	Max	Unit	Note
Storage Temperature	-40	85	°C	
3.3V Power Supply Voltage	-0.5	3.6	V	
Relative Humidity	0	85	%	

**■ Recommended Operating Conditions**

Parameter	Min	Typical	Max	Unit	Note
Case Operating Temperature	TQS-Q1JH8-X8M##	0	70	°C	
	TQS-QJJH8-X8M##	0	85		
Power Supply Voltage	3.135	3.3	3.465	V	
Data Rate per Channel	10.3125		25.78125	Gbps	
Control Input Voltage High	2		Vcc	V	
Control Input Voltage Low	0		0.8	V	
Liquid immersion depth				10	M

# DERQ: LEADING REAL-TIME AI ANALYTICS PLATFORM

Powering advanced solutions for Traffic Management and CAVs

