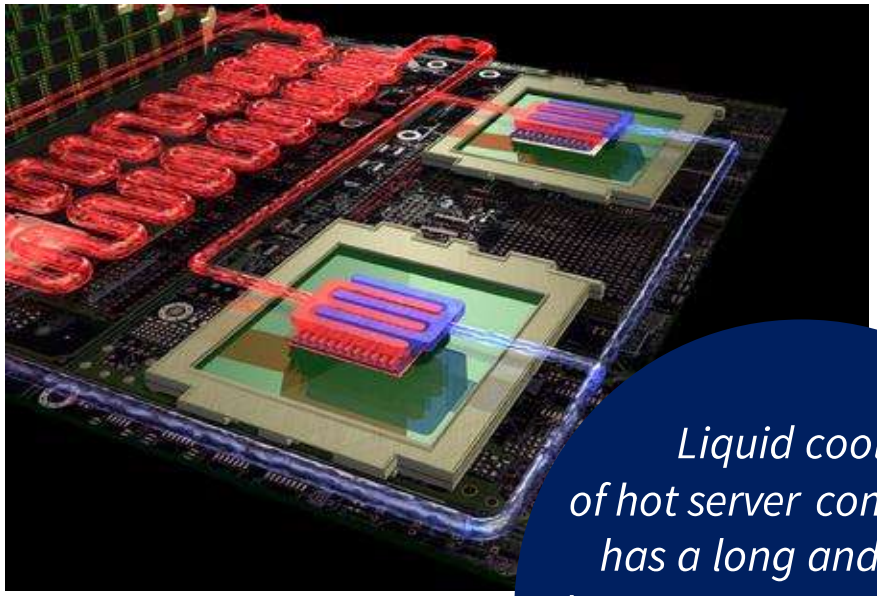
QUICK DISCONNECTS FOR LIQUID COOLING – Design, Specification & Implementation

AGENDA

- **Introduction to Liquid Cooling**
  - Technology scope and benefits
  - Key components
- **Quick Disconnects**
  - Anatomy and design
  - Performance and implementation

WHY LIQUID COOLING?



Liquid cooling of hot server components has a long and storied history; IBM water-cooling in 1964, Cray FC cooling in 1980's, and even more today!

Liquid cooling can provide:

- Energy savings
- Cost savings
- Density increases
- Noise reduction

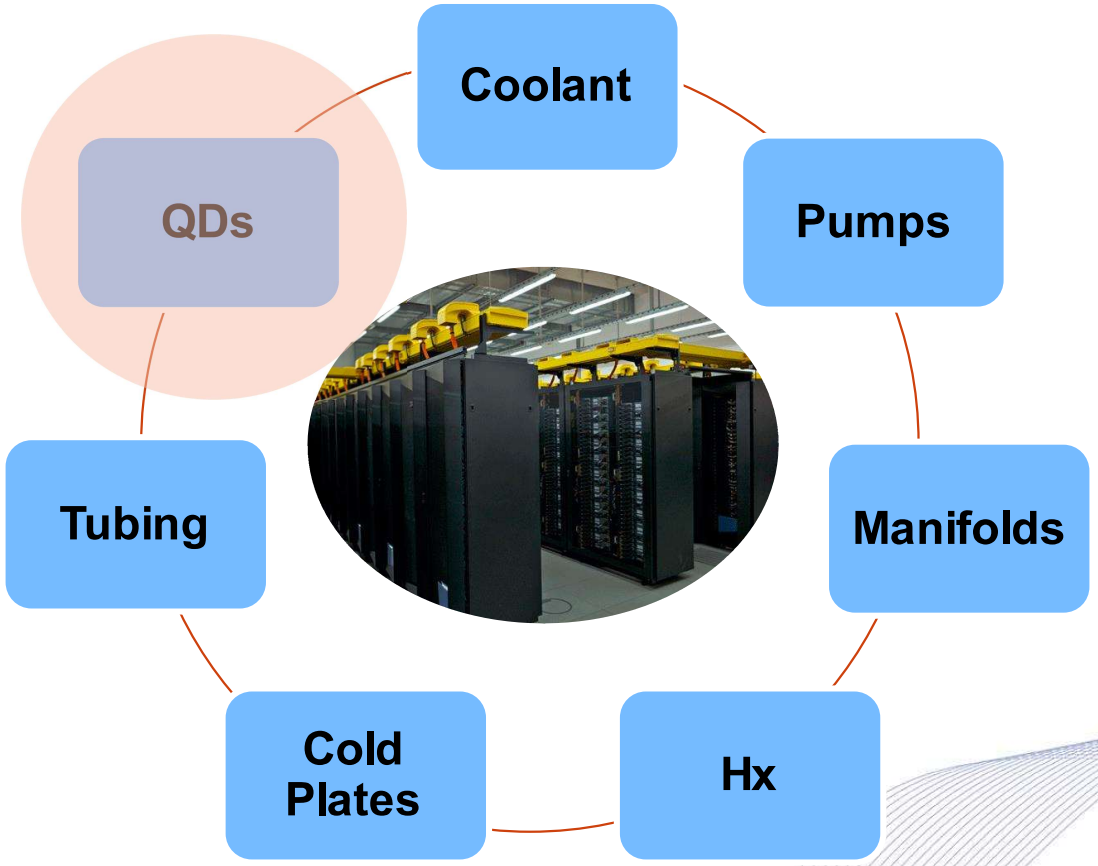
ADVANCED COOLING SYSTEMS ARCHITECTURE

RDHx

Cold Plate

Immersion

SYSTEM COMPONENT SELECTION

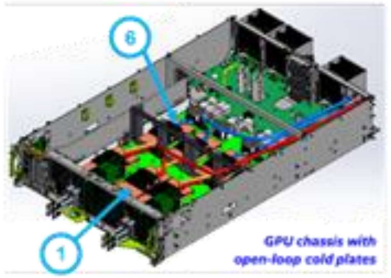


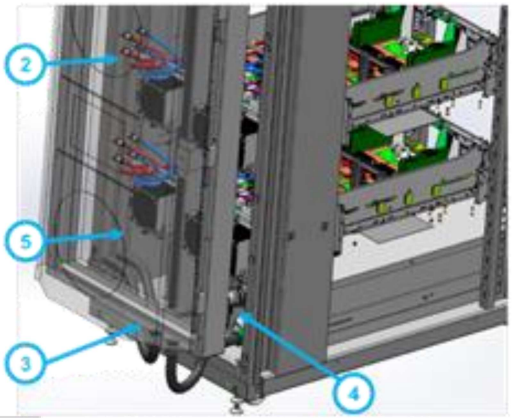
Every component within a liquid cooling system matters

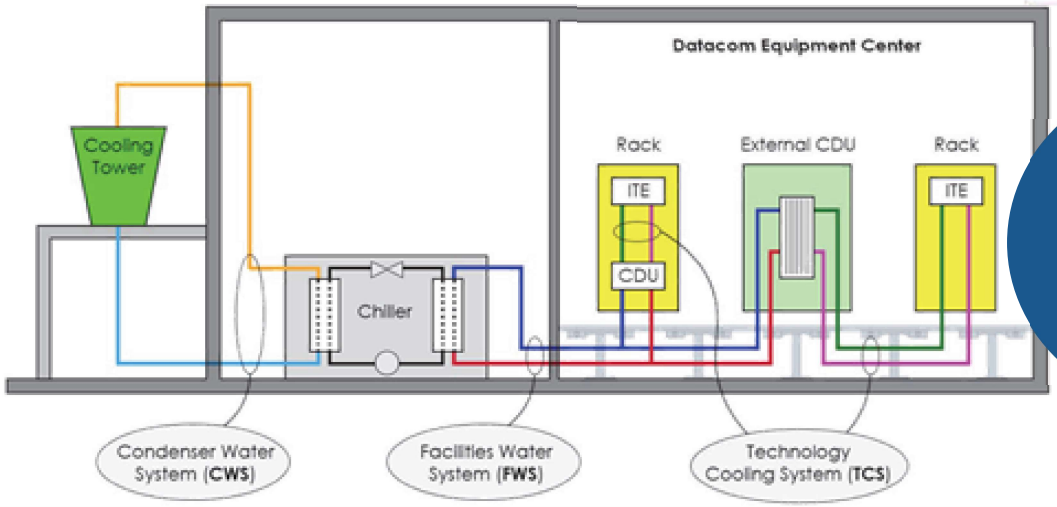
Think holistically throughout the design process

QD POINTS OF CONNECTION

- FWS – Facilities Water System
- TCS – Technology Cooling System
  - RDHx
  - Cold Plate
  - Immersion







The closer to ITE, the more critical the QDs' performance and reliability

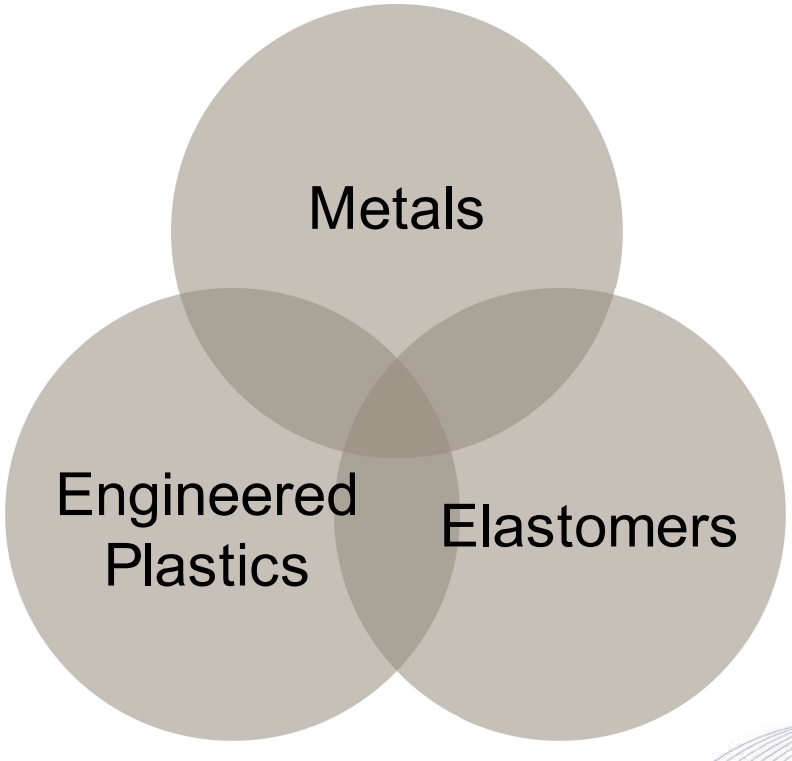
Ref: ASHRAE TC9.9 – Water Cooled Servers

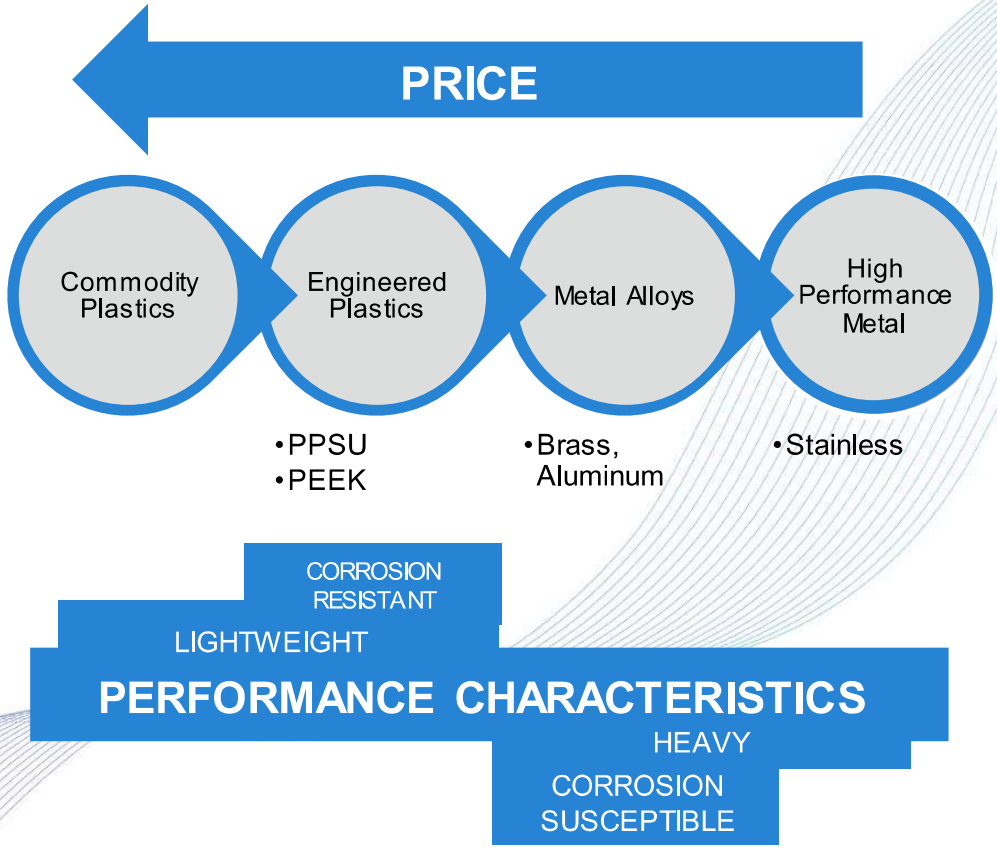
ANATOMY OF A QD

Materials	• Structural • Wetted
Configurations	• Mating • Mounting
Valves and Shutoff	• Nonspill • Flow sizing

SMALL component with **BIG** influence

MATERIALS OF CONSTRUCTION





Chemical compatibility, corrosion, erosion

- Coolant compatibility
  - Elastomeric seals
- Galvanic corrosion
- Flow path erosion
- Environmental exposures

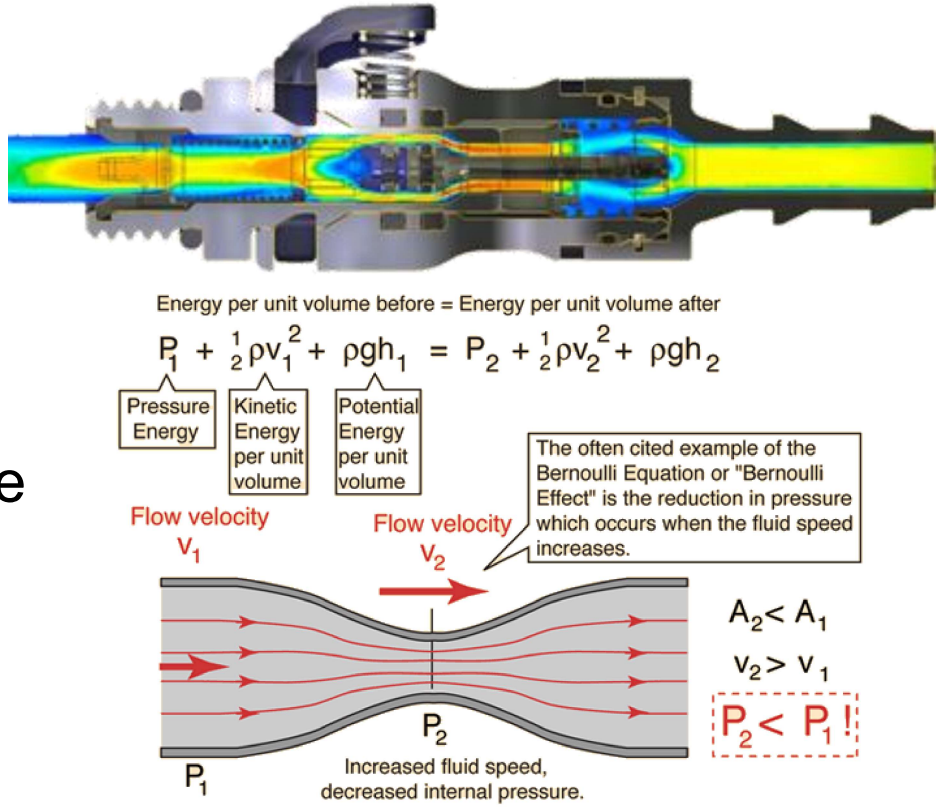
Consider all materials within wetted fluid loop, and interactions they may have

Configurations

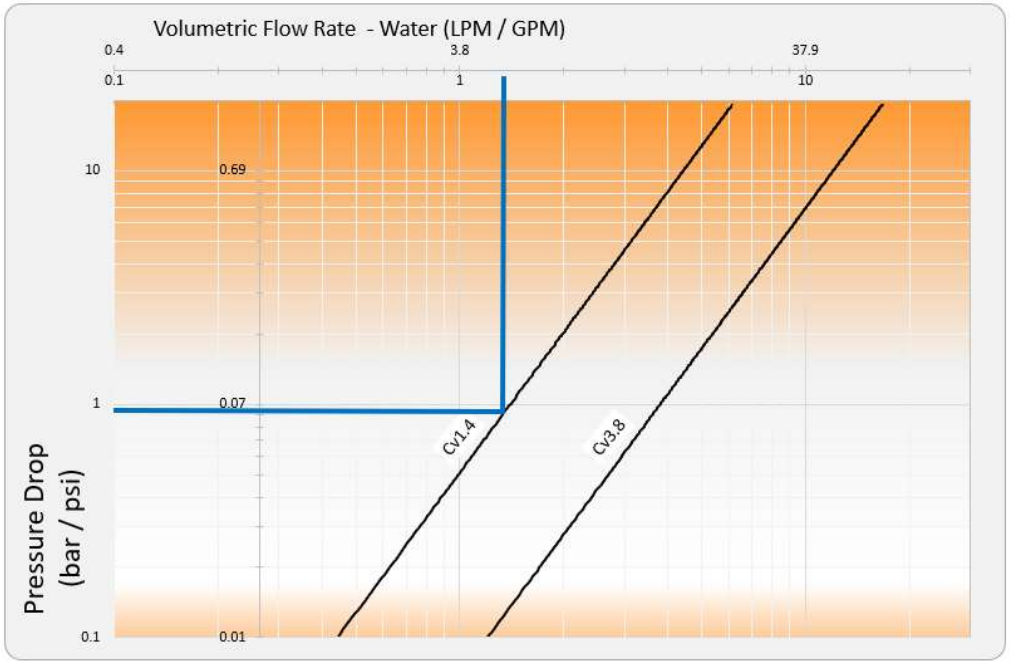
- Blindmate vs. handmate
- Ball vs. latch
- Non-spill vs. wet break
- Terminations

QD flow sizing

- Achieve increased cooling efficiency with properly spec'd devices throughout the system
- Sizing a QD for optimal performance – reduce pressure loss, consider physical size



FLUID FLOW & PRESSURE LOSS



Flow coefficient – Cv

- Volumetric flow rate for 1psi loss

Balance flow and pressure for optimal performance and efficiency

$$Q = C_v\sqrt{\frac{\Delta P}{SG}}$$

Published and catalog Cv is typically reported with water (SG = 1)
Use correction factors and correct SG when using coolants other than water

QD FUNCTIONAL REQUIREMENTS

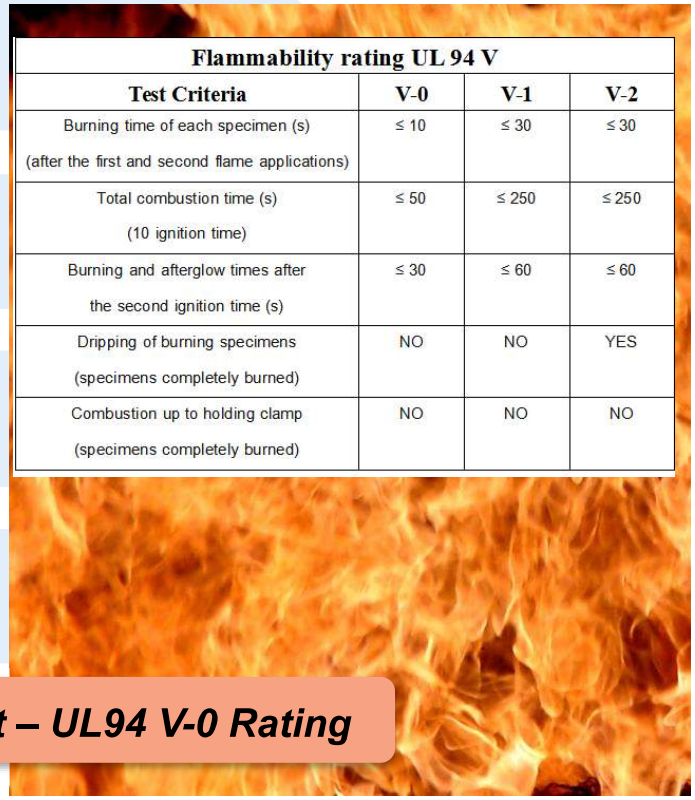
Spillage	•Volume of fluid upon disconnect
Inclusion	•Volume of air introduced into fluid loop on connection
Leaks	•Unintentional fluid discharge •Potentially catastrophic

Multi-lobed seals (vs. standard o-rings) for redundant protection against leaks

QD FUNCTIONAL REQUIREMENTS

Temperature	• Resistance and stability
Flammability	• UL94V
Conductivity	• Metal QDs can be hot to the touch • Consider location and operator interaction
Chemical Compatibility	• Wetted materials in fluid loop • Long-term service and exposure

Flammability rating UL 94 V			
Test Criteria	**V-0**	**V-1**	**V-2**
Burning time of each specimen (s) (after the first and second flame applications)	≤ 10	≤ 30	≤ 30
Total combustion time (s) (10 ignition time)	≤ 50	≤ 250	≤ 250
Burning and afterglow times after the second ignition time (s)	≤ 30	≤ 60	≤ 60
Dripping of burning specimens (specimens completely burned)	NO	NO	YES
Combustion up to holding clamp (specimens completely burned)	NO	NO	NO



PPSU is flame retardant – UL94 V-0 Rating

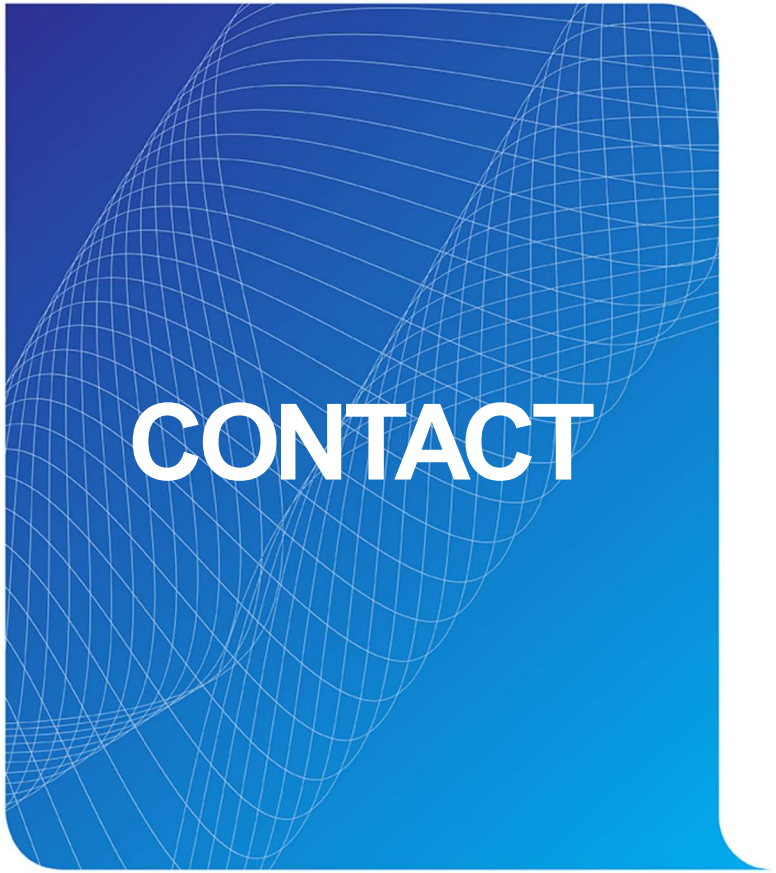
SUMMARY

Parameter	Metrics
Flow Rate	L/min, gpm
Flow Coefficient	Kv, Cv
Operating Pressure	Pa, psi
Burst Pressure	Pa, psi
Pressure drop	Pa
Spillage (liquid expunction)	mL, cc
Inclusion (air introduction)	mL, cc
Temperature – Operating, Storage / Shipping	°C, °F
Connection Force	N, lbf
Connection Cycles	Mechanical cycles / connect and disconnect
QD style and hydraulic diameter	Inches (eg. Blind mate, hand mate, threaded, mounting configuration)
Terminations	Barbed, compression style, threaded

Parameters of Importance – ref OCP ACS Cold Plate Liquid Cooling Requirements

- Recommendations
- System requirements locked
- Engage with experts early

FOR MORE INFORMATION



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What questions do you have?