Cold Plate Work Stream Meeting Notes 2019

Advanced Cooling Solutions- Cold Plate Work stream - Monthly Calls
Wed 10:00am - 11:00am ET (June 12, 2019 and onward)

Please join my meeting from your computer, tablet or smartphone.
https://global.gotomeeting.com/join/986673557

You can also dial in using your phone.
United States: +1 (312) 757-3121
Access Code: 986-673-557

As a reminder, the call-in details are also available on the OCP project calendar

OCP Project meetings are open, collaborative meetings and may be recorded. Company Confidential material should not presented. Please assure than all material presented during the calls are not marked confidential.

Cold Plate Work Stream

Purpose: Generate an open specification and supporting documents focusing on standardization and definition of critical interfaces, operational parameters, and environmental conditions that enables interoperability of non-proprietary, multi-vendor supply chain of liquid cooled solutions.

Approach: Determine and define 1. Critical interfaces 2. Wetted materials 3. Cooling fluid types and operational parameters, 4. Metrology for heat extraction performance in TCS (CDU to IT equipment), FWS (Chiller to CDU), CWS (Cooling tower to Chiller)

Near-term focus:

- **Create specifications that focuses on TCS fluid loop:**(ASHRAE terminology: TCS - Technology Cooling System: fluid loop from CDU to rack, through manifold, and IT equipment, and then back through the manifold to the CDU)
- Connectors
- Wetted Materials
- Rack manifold spec and/or keep out definition for rack

Agenda Items and Meeting Notes

OCP Cold Plate Work Stream, December 11, 2019

Agenda:

- Opens
- Manifold focus group
    - Status and time targeted for initiation
- OCP Cold Plate Submissions for Global Summit
    - March 4-5 in San Jose, CA
- ACS Cold Plate Requirements Document:
    - Status
    - Process

Meeting Notes:

In the previous meeting next topics were discussed and determined the next focus group to generate

Manifold focus group

- Manifold design to Open Rack V3 - best practices
    - Specification/Requirements for hoses and couplings
    - Hoses and couplings - Best known methods
    - Standard test methods
- CLAs being reviewed. Pushing out the formal CLA by end-of-this week. Target to kick off meeting on Monday Jan 9, 2020
- Some work has been done with suppliers by Glenn and John Fernandez, but most suppliers want to wait for the CLAs to be in place before starting the efforts. The focus group will start with weekly meetings. The group will be focusing on interconnects.
- Focus group will be led by Glenn Charest (gpcharest@fb.com) . Please contact Glenn if you are interested in joining the focus group

OCP abstract submissions for Global Summit:

- ACS received 25 abstracts
- Abstracts are currently being reviewed

- Speakers with abstracts approved will be notified Dec. 16-20 (via Linklings tool)
    - First presentation draft is due no later than Jan 24 @ 5 pm (PST) – the presentation draft will be reviewed
    - Final presentation is due no later than Feb 14 @ 5 pm (PST)

ACS Cold Plate Requirements Document

- Status: Gone through the Incubation Committee
    - Clarifications being added in the document: how it will be used and the process for using it
    - Clarification of Requirement document, not the same as a specification
    - A checklist will be generated from the requirements document that any cold plate specification and product need to adhere to
- Process: The checklist will be peer-reviewed by subject matter experts before proposed for submission to the Incubation Committee

OCP Cold Plate Work Stream, November 13, 2019

Agenda:

- Opens
- OCP Cold Plate Submission for Global Summit
    - March 4-5 in San Jose, CA
- ACS Cold Plate Requirements Document:
    - Incubation Committee (IC) Nov 7
    - Scheduled to update the document every 6 months
- Next topic discussion:
    - Manifold design to Open Rack V3 - End of Q4, beginning of Q1 - best practices
        - Specification/Requirements for hoses and couplings
        - Hoses and couplings - Best known methods
        - Standard test methods
    - Leakage mitigation & intervention
    - Standard test methods
    - Specification for procurement (alignment with CSI)
    - Alignment with ACS work streams/Rack & Power/Data Center Facility
    - Alignment with ACS and OCP Redfish

Meeting Notes:

If you have something that you want to share and contribute to OCP, please contact me (Jessica) to let me know. We are about to start soliciting presentations/contributions for the Global Summit 2020, which will be held in March 4-5 in San Jose, CA.

ACS Cold Plate Requirements Document was presented at the Incubation Committee (IC) Nov 7. The IC will come back with feedback in the next 2 weeks. The requirements document is scheduled to be updated every 6 months (if need be). The document is an umbrella document with minimum requirements for using cold plate cooling focusing on the TCS cooling loop.

Next focus area for the cold plate work stream is manifold design for the Open Rack V3. This focus group will be setup in the end of this year or beginning of next year at the latest. From that focus group, the scope and plans will be developed for the different sub focus areas:

- Specification/Requirements for hoses and couplings
- Hoses and couplings - Best known methods/best practices
- Standard test methods

Please send me (Jessica) an email: jessica.gullbrand@ocproject.net if you want to participate in this new focus group.

OCP Cold Plate Work Stream, October 9, 2019

Agenda:

- Opens
- OCP Regional Summit, Sept 26-27, 2019
    - https://www.opencompute.org/events/past-summits
- ACS Cold Plate Requirements Document
    - Outline:
        - Introduction
        - Terminology
        - Liquid Cooling Technology Definitions
        - Cooling Components Selection and Parameters of Importance
        - Liquid Cooling Requirements
        - References (TBD)
- Universal Quick Disconnects Update

OCP Cold Plate Work Stream, August 14, 2019

Agenda:

- Opens
    - Meeting info on wiki calendar: https://www.opencompute.org/projects/rack-and-power
    - If need be, additional meetings will/can be scheduled
    - Last meeting July 10 in Milpitas, workshop to align between Advanced Cooling Solution (ACS) work streams, Rack & Power Project, and Data Center Facility Project.
- Suggested changes to the cold plate document: https://www.opencompute.org/wiki/Rack_%26_Power/Advanced_Cooling_Solutions
- Updates to the ACS Cold Plate Requirements Documents
    - Outline:
        - Introduction (April 17 & May 29)
        - Terminology (May 15)
        - Liquid Cooling Technology Definitions (April 17 & June 12)
        - Cooling Components Selection and Parameters of Importance (May 15 & June 12 & **August 14**)
        - Liquid Cooling Requirements (**August 14**)
        - References (TBD)

OCP Cold Plate Work Stream, June 12, 2019

Agenda:

- Opens
    - Meeting invite updated to monthly work stream meetings (every 2nd Wedn of the month at 8 am PST) - Make sure you have the correct invite!
        - If need be, additional meetings will/can be scheduled
- Suggested changes to the cold plate document
- Updates to the ACS Cold Plate Requirements Documents
    - Outline:
        - Introduction (April 17 & May 29)
        - Terminology (May 15)
        - Liquid Cooling Technology Definitions (April 17 & **June 12**)
        - Cooling Components Selection and Parameters of Importance (May 15 & **June 12**)
        - Liquid Cooling Requirements (TBD)

- References (TBD)

OCP Cold Plate Work Stream, May 29, 2019

Agenda:

- Opens
- Liquid cooling terminology by ASHRAE
- Suggested changes to the cold plate document
- Updates to the ACS Cold Plate Requirements Documents
    - Outline:
        - Introduction (April 17 & **Today's topic**)
        - Terminology (May 15)
        - Liquid Cooling Technology Definitions (April 17)
        - Cooling Components Selection and Parameters of Importance (May 15 & **Today's topic**)
        - Liquid Cooling Requirements (TBD)
        - References (TBD)

OCP Cold Plate Work Stream, May 15, 2019

Agenda:

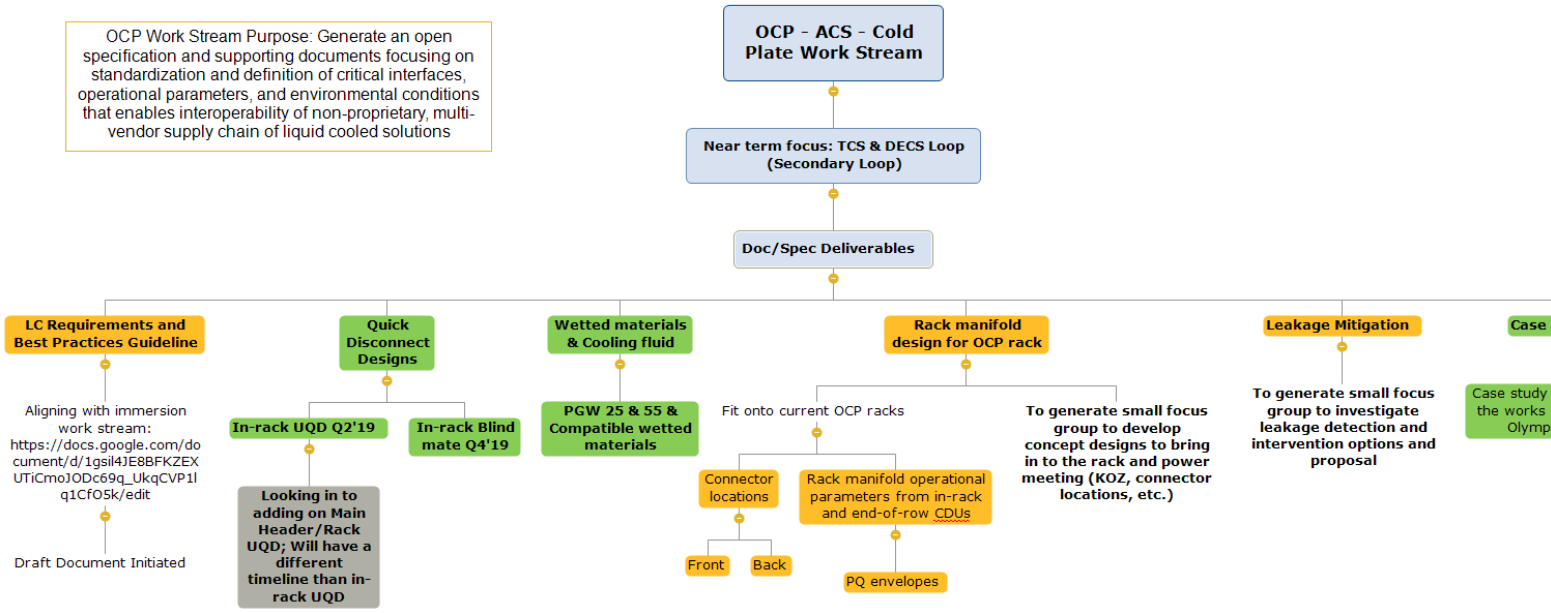
- Opens
- Cold Plate Meeting to be monthly (Wedn 8 am PST every 2nd week of the month)
- Liquid Cooling Cold Plate Requirements & Best Practices - Draft
    - Outline:
        - Introduction (April 17)
        - Terminology (Today's topic)
        - Liquid Cooling Technology Definitions (April 17)
        - Cooling Components Selection and Parameters of Importance (Today's topic)
        - Liquid Cooling Requirements (TBD)
        - References (TBD)

OCP Cold Plate Work Stream, April 17, 2019

Agenda:

· Cold Plate Meeting time changes to 8 am PST to facilitate multi-region call-in

- Overview of cold plate work stream
- Liquid Cooling Cold Plate Requirements & Best Practices – Draft
- Next Step



Overview of cold plate work stream

Liquid Cooling Cold Plate Requirements & Best Practices - Draft

- Definition discussion of
  - liquid cooling cold plates
  - cold plates
  - hybrid cooling
  - full liquid cooling
  - single- and two-phase cooling liquids
  - Cooling Distribution Unit
  - Rack manifold
  - Quick Disconnect Connectors
- Quality and Safety Requirements
  - Certification markings
  - Pressure safety requirements

Next step is to generate a small focus group, where everyone is contributing to the “LC requirements and best practices”. The focus group will then present progress at the OCP cold plate meeting. Contact Jessica if you want to contribute and be part of the focus group.

OCP Cold Plate Work Stream, March 20, 2019

Agenda:

- Introduction
- Update from the OCP Summit
- Contribution discussion
- Manifold – operational parameters
- Leakage mitigation discussion

Introduction:

- Several additional work stream participants have signed up to participate in the cold plate work stream meetings – Introduction

- **Purpose:** Generate an open specification and supporting documents focusing on standardization and definition of critical interfaces, operational parameters, and environmental conditions that enables interoperability of non-proprietary, multi-vendor supply chain of liquid cooled solutions.

- **Near-term focus: create specifications that focuses on DECS and TCS fluid loops:** (ASHRAE terminology: TCS -

Technology Cooling System (CDU to rack) & DECS – Datacom Equipment Cooling

System (within the rack))

  - Connectors
  - Wetted Materials
  - Rack manifold spec and/or keep out definition for rack
  - PQ envelopes

- **Ongoing discussions:** manifold location and leakage mitigation

Update from the OCP Summit:

- Three presentations were given in regards to cold plate work stream:

- *Liquid Cooling Trends and Requirements for Racks and Servers* – Microsoft: Husam Alissa & Brandon Rubenstein
- *Direct Contact Liquid Cooling Performance on a Project Olympus Server* – CoolIT: Cam Turner
- *Eco-system enabling of liquid cooling ingredients* – Intel: Mark Sprenger & Jessica Gullbrand

Presentations recorded and can be watched at: https://www.opencompute.org/events/past-summits. Slides are or will become available in the next two weeks.

Contribution Discussion:

- Intel to contribute wetted materials list and supplier info/cooling fluid names that are compatible with that list
  - Cooling fluid: Propylene glycol 25 and 55 (PG 25 and PG 55)
    - PG 25 for operational fluid
    - PG 55 for storage and shipping
    - Both fluids from two different suppliers are globally available. The fluid chemistry is proprietary to each supplier and is NOT interchangeable.
  - Wetted material list includes: elastomers, plastics, and metals.
    - Currently ongoing testing for brazing materials, and will be added to the list when evaluated.
  - Expected to provide supplier info and fluid names in the next couple of months
- *Is any participants willing to contribute similar type of data/information for water with additives and/or dielectric fluids?*

- Quick Disconnect Design: Interchangeability by the Universal Quick Disconnect.
  - UQD availability ~Q2'19.
  - Next steps: Blind mate designs: ~Q4'19

- Several liquid cooling designs (rack, manifolds, fluid connectors, cold plates, …) shown on the demo floor. *Are or will any of these designs be contributed to OCP?*

Manifold Operational Parameters:

- Last meeting we discussed manifold placement for the OCP rack
    - Initial discussion showed importance to have manifold options for both front and back of the OCP rack
    - Additional feedback since last meeting from rack v.3 proposal at the OCP Summit of keep-out-zones for manifold contribution

Rack Manifold Operating Parameters

The values for each of the CDU options below depend on the particular CDU and operating point for the system. The values are meant to provide a general overview of what can be found from different CDU suppliers.

In-rack CDU

- *Cooling power: ~40-80 kW; replaced with approach temperatures?*
- Max flow rate: ~70-80 lpm (16 – 21 gpm)
- Nominal flow rate: ~50 lpm (13 gpm)
- Max pressure: ~30 psi = 210 kPa
- Size: 4-5U
- Potentially: 1-2 units/rack
- Max outlet cooling fluid temperatures:

In-row CDU

- *Cooling power/CDU: 150 - 400 kW*
- Max flow rate/CDU: ~ 230 - 360 lpm = (60 - 95 gpm), 360 lpm = 95 gpm
- Nominal flow rate/rack: ~ 45 lpm = 12 gpm (for 8 racks)
- Max pressure: ~70 psi = 480 kPa
- Size: Rack
- Potentially: 8 – 20 racks

Virtual CDU (potentially remove the VCDU, since it is facility dependent)

The values here depend on the facility installation/capability.

- *Cooling power/vCDU: ~400 kW*

- Max flow rate/vCDU: ~ 900 lpm = (240 gpm)
- Nominal flow rate/rack: ~ 115 lpm = 30 gpm (for 8 racks)
- Max pressure: ~80 psi = 550 kPa
- Size: -
- Potentially: 8 – 20 racks

Leakage Mitigation:
Robust leak prevention design strategy is assumed. Discussion around:

Is leakage detection and intervention a concern?

At what level is leak detection a concern
- CDU level
- Rack level
- Chassis level
- Node level

Some of the intervention options are:
- Notification and manual intervention
- Automatic electrical intervention
- Automatic electrical & fluid intervention
- Automatic CDU intervention

Yes, leakage mitigation is of importance. Create subteam to look at different options.

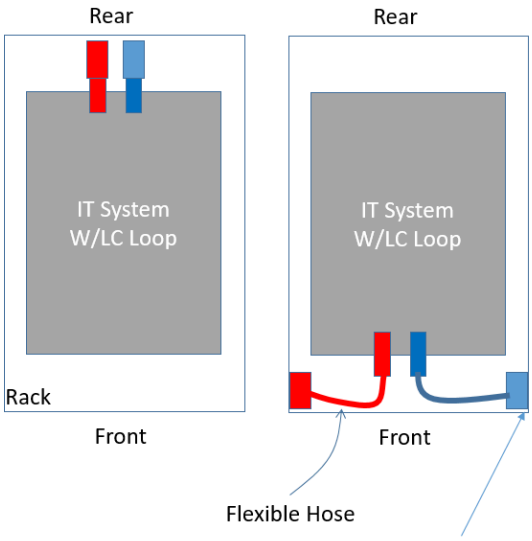
March 6, 2019

Agenda:
- Manifold design options
- Leakage mitigation discussion
- Case Study Intro - Cam Turner

Reminder: Global Summit March 14-15, 2019, San Jose

Manifold design options:
- High level design concepts for placement of manifold and liquid connection to the IT equipment were discussed.

IT System Liquid Interface to Rack – Manifold to IT System



Positioning of Manifolds effects IT System Fluid Loop Design

Manifold Placement	Connection type	
Rear	Blind Mate	IT system fluid connection fixed location (One sided, centered, spread), Positional accuracy by specification
Mid	Blind Mate	Deeper cabinet style
Front	Hand Mate	Provides design flexibility for IT system, position not as critical as with blind mate, some cabinet do not allow for much spacing

- The design preference within OCP is serviceability from the front of the rack.
- There is a need to align efforts with rear-door heat exchanger (RDHX) work stream, since they are considering a hybrid cooled solution (cold plate & RDHX)
- The idea is to generate a keep-out-zone for the manifold and to specify location in relation to the IT equipment (while not being tied to the current board design). Two fluid connection options are being considered:
    - Blind-mate connectors at the rear of the rack
    - Manual connectors on the front of the rack

Leakage Mitigation:

Robust leak prevention design strategy is assumed. Discussion around:

· Is leakage detection and intervention a concern? Answer: Yes

· At what level is leak detection a concern: Not a clear answer...
    - CDU level
    - Rack level
    - Chassis level
    - Node level

· Some of the intervention options are:
    - Notification and manual intervention
    - Automatic electrical intervention

- Automatic electrical & fluid intervention
- Automatic CDU intervention

Case Study:

- Collaboration between Microsoft and CoolIT investigating liquid cooling of an Olympus server. The investigation involves different operating parameters, thermal benefits, and power savings. It will be presented at 8 am on March 15 at the Global Summit.

February 6, 2019

Agenda:

· Opens
· Cooling Fluid
· CDU parameters

Opens:

- Please see purpose of the work stream above. Both specification and white-papers will be generated. The white-papers will contain educational material and example installations.

Cooling Fluid:

- The wetted materials list was shared and discussed.
  - Concern was brought up that there will be several different places that wetted materials list will be given, for example by ASHRAE.
  - ASHRAE is focusing on water cooling fluid only, while OCP is not specifying but will allow several different cooling fluid types
  - OCPs target is interchangeability and multi-vendor global supply
  - Operational temperatures: concern was brought up in regards to enforce a shipping temperature down to -40C.

CDU parameters:

- Comments that no pump manufacturer will be able to provide L10 expectancy for the users particular installation.
- It is agreed that the CDU parameters are of importance but that is is hard to determine them.

See separate document in wiki for cooling fluid material

January 23, 2019

Agenda:
· Quick Recap
· Quick Disconnects
· Wetted Materials
· Opens

Quick Recap

Cold Plate Work Stream

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Near-term focus: create specifications that focuses on DECS and TCS fluid loops:
(ASHRAE terminology: TCS - Technology Cooling System (CDU to rack) & DECS – Datacom Equipment Cooling System (within the rack))

· Connectors
· Wetted Materials
· Rack manifold spec and/or keep out definition for rack
· PQ envelopes

Liquid Cooling Specification for liquid loop from server to CDU

Connectors (drip-less focus)

- Connector Locations
    - **Server to rack**
    - Rack to CDU (in rack or outside of rack)
- Connector Types
    - **Manual**
    - Blind mate
- **Connector sizes and terminations**
    - PQ dependence (CV parameter)

Wetted materials in ingredients

- Manifold
- Connectors
- Server fluid loop (including piping and cold plates)
- CDU (either inside and outside the rack)

Meeting notes:

Comments on the UQD:

- In the discussion you mentioned that the UQDs are limited to a 1U size. Can the size be increased? Yes, it can. The sizes mentioned in the documentation represents our starting point. The goals is for the industry to work with suppliers on the sizes that they need.
- There is a follow on part to the UQD project, which is focusing on blind mate connectors
- In the UQD Figure, seals are not pointed out. It is important to include.
- You are referencing drip-less, but what does that mean? We are working with the suppliers on the requirements for how much liquid is allowed for being called drip-less. These numbers are still being worked with the suppliers, and will be share at a later time.
- When will the UQDs be available? The target is for customers to be able to buy UQDs from several different suppliers by end of Q1'19. Timeline target might slip a little.
- Parameters of importance:
  - Suppliers to provide CV values for their full designs. Intel is planning on providing information for UQD connections of parts from two different suppliers.
  - Connection force and cycles. Suppliers will be providing this info as well. We will add the parameters on the write-up. Intel is testing for 5,000 cycles, while several suppliers are using 10,000 cycles.

Comments on Wetted Materials approach:

Suggestion:

- OCP to not limit the cooling fluid options, and allow options such as: water based, Propylene Glycol Water (PGW), and dielectric fluids. Use fluid suppliers to provide an example of wetted materials list that is compatible with a specific fluid. ASHRAE's wetted material list can be referenced for commonly used materials in the DECS/TCS cooling loop.