# DLC стучится в дверь

Алексей Солодовников
управляющий директор
в России и СНГ

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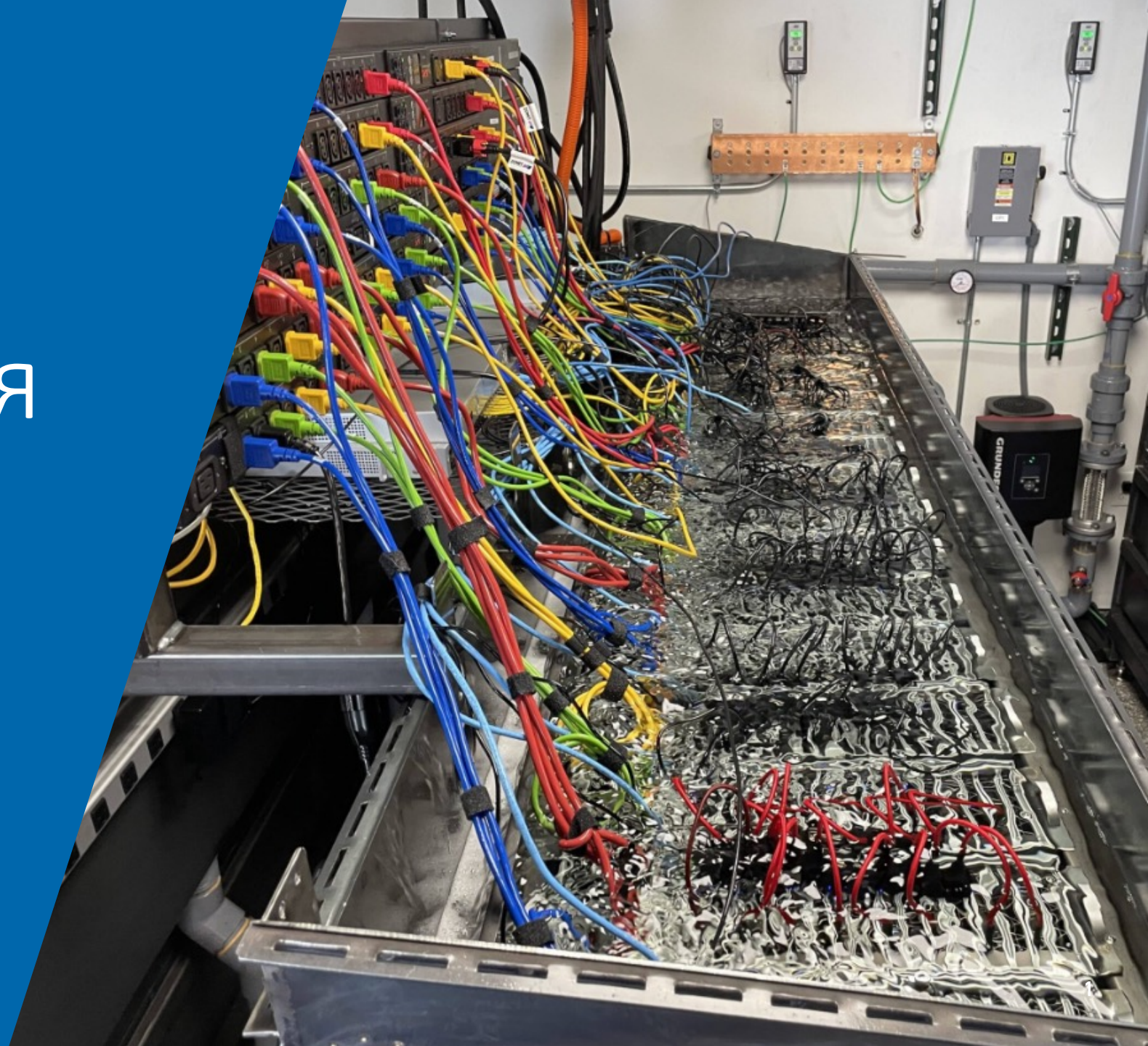

- DLC: какое оно бывает.  Краткая классификация
- Какие технологии DLC выбирает сегодня мировой рынок? Результаты трёх лет наблюдений Uptime Institute
- Что делать, если у вас появляются стойки высокой плотности?

# DLC: немного классификации

## Cold Plate

- Вода
- Диэлектрическая жидкость

## Full Immersion – полное погружение

- Однофазное
- Двухфазное

## Partial Immersion – частичное погружение

## Direct-to-chip

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~~RDHx~~

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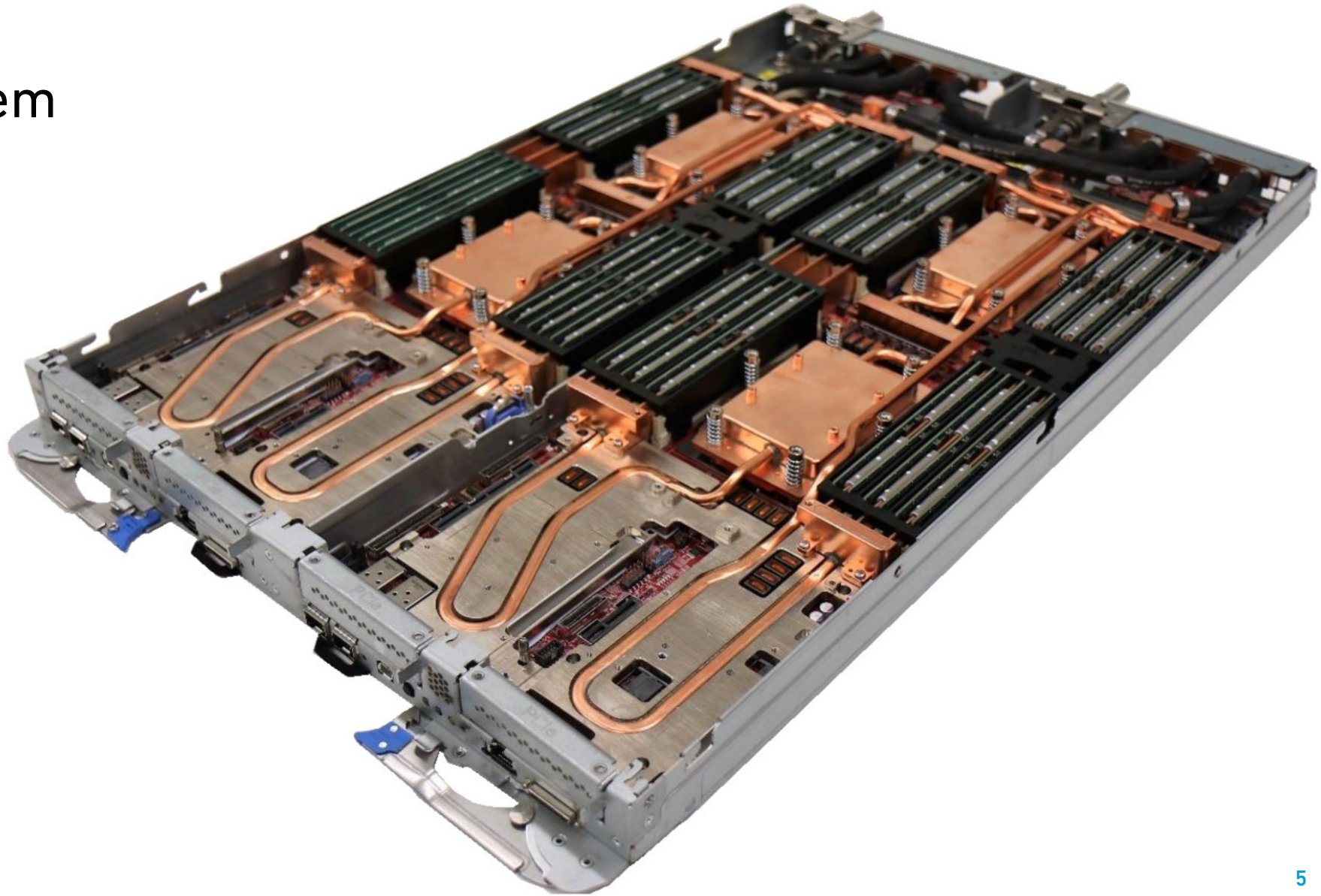
# Cold Plate

## Lenovo ThinkSystem

### SD 665 V3



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# Cold plate. Dell PowerEdge R6715

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# Сервер-лезвие РСК Торнадо TDN531

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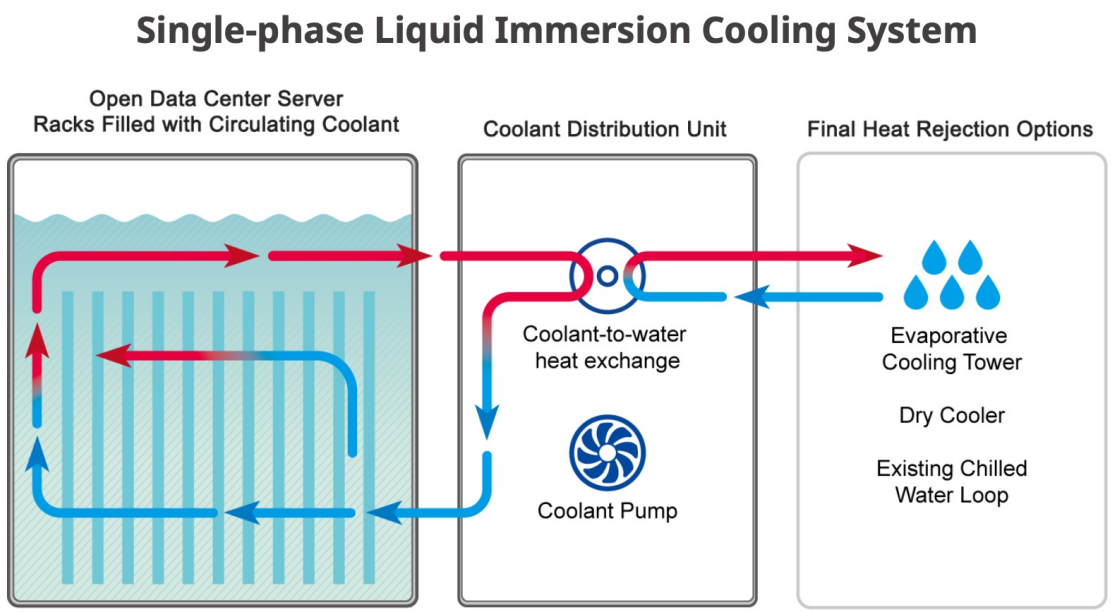
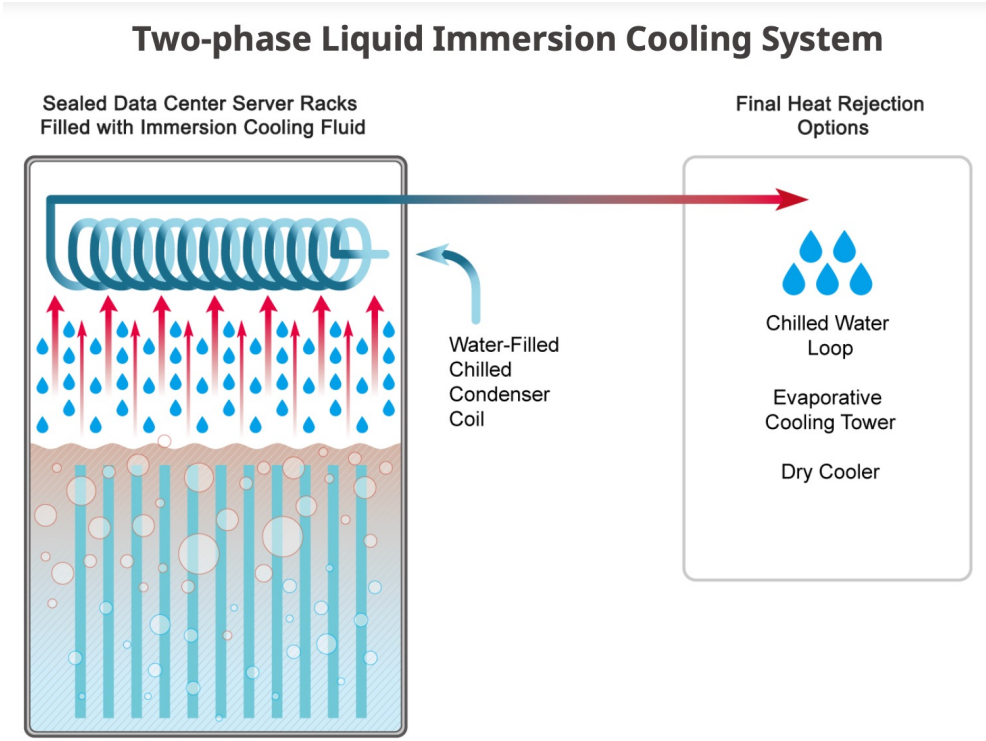
# Full immersion – полное погружение

## 1-фазное




## 2-фазное

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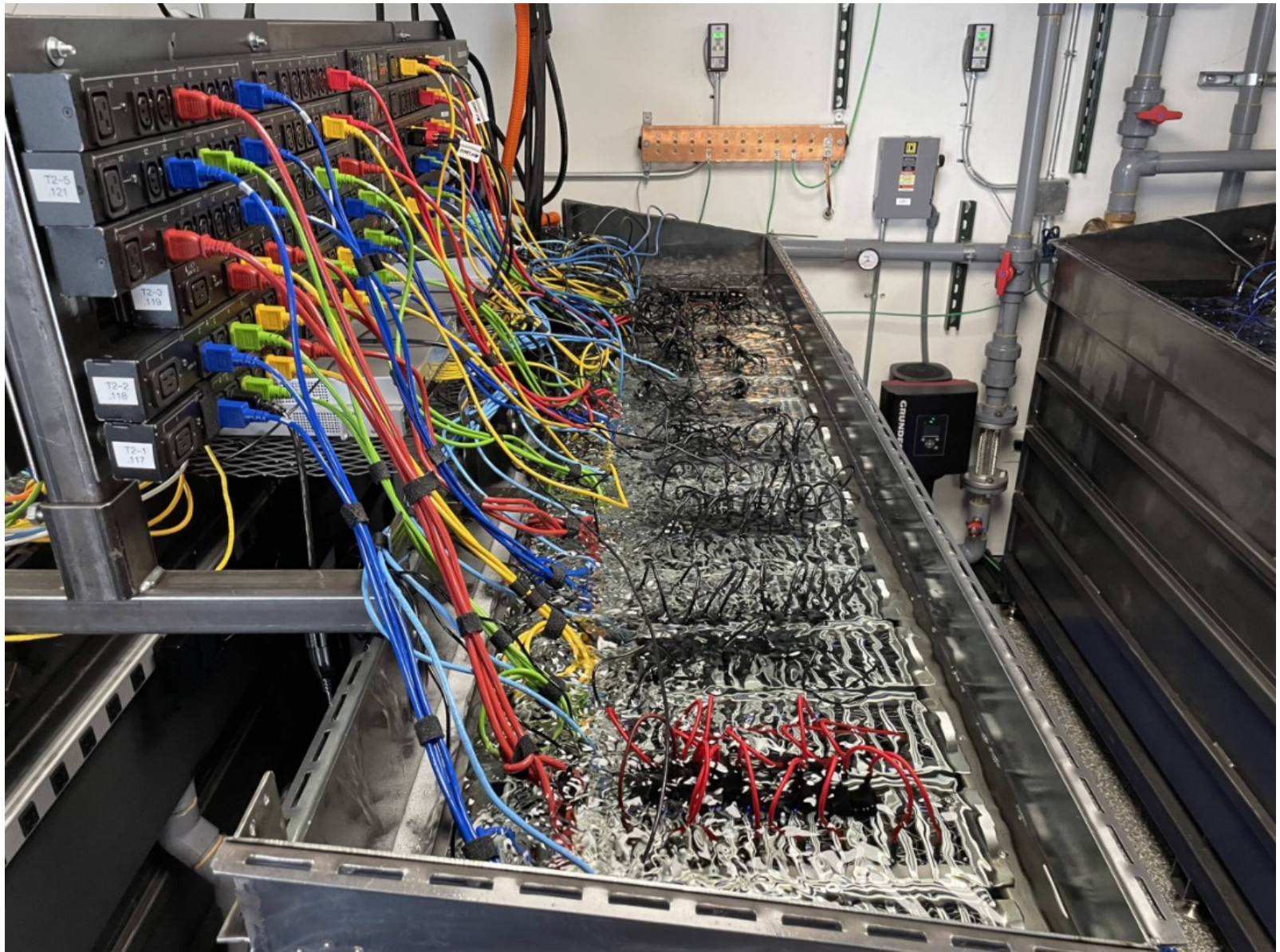
# Full immersion - примеры

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# Full immersion - примеры

**San Jose, Calif., June 30, 2025 –**

**Industry First -- Supermicro Systems Certified by Intel for an Immersion Cooling Solution**

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# Full immersion – примеры. 2 фазы

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# Full immersion – примеры. 2 фазы

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# 2025 Uptime Institute Cooling Survey: некоторые наблюдения

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# Более 100 вопросов:

Co-lo; Enterprise + Cloud; пользователи co-lo

Региональный разрез

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# Давайте-ка проголосуем:
# Cold plates vs. full immersion

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# Вопросы всем респондентам – владельцам/операторам ЦОД

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# Q14: Which types of IT cooling does your organization use in its data centers? Choose all that apply.

| | Total (n=512) | DC Owner/Ops (n=401) | Colo Providers (n=81) | Cloud Providers (n=30) |
|---|---|---|---|---|
| Perimeter air cooling (CRACs, CRAHs, fanwalls) | **75%** | 75% | 82% | 67% |
| Close-coupled cooling (e.g., door heat exchangers, in-row coolers, in-rack coolers) | **32%** | 32% | 30% | 27% |
| Fresh air cooling (direct) | **29%** | 30% | 19% | 47% |
| Indirect air cooling (air-air heat exchangers) | **26%** | 25% | 28% | 30% |
| Direct liquid cooling (e.g., "direct to chip," cold plate, immersion systems, "sidecar" radiators) | **22%** | 18% | 33% | 33% |
| Don't know | **2%** | 2% | 1% | 3% |

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All Owner/Operator Respondents

## Q56. Direct liquid cooling (DLC) can include cold plate, direct-to-chip, and immersion systems that circulate liquid cooling in contact with IT components. Which types of direct liquid cooling do you use in this data center? Choose all that apply.

| | 2025 (n=79) |
|---|---|
| Water cold plates | 56% |
| Dielectric cold plates (single-phase) | 39% |
| Full immersion systems (single-phase) | 25% |
| Dielectric cold plates (two-phase) | 15% |
| Full immersion systems (two-phase) | 9% |
| Partial Immersion systems | 5% |
| Other (please specify) | 0% |
| Don't know | 5% |

All owner operators respondents who selected "direct liquid cooling" to Q52 were eligible to answer this question.

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All Owner/Operator Respondents

# Q57. In this data center, what portion of IT racks would you estimate use some form of direct liquid cooling?

| | 2025 (n=77) |
|---|---|
| 1%-9% | 22% |
| 10-19% | 12% |
| 20-29% | 16% |
| 30-39% | 12% |
| 40-49% | 10% |
| 50-59% | 8% |
| 60-69% | 1% |
| 70-79% | 3% |
| 80-89% | 5% |
| 90% or greater | 12% |

All owner/operator respondents who selected "direct liquid cooling" to Q52 were eligible to answer this question.

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All Owner/Operator Respondents

# Вопросы только для владельцев/операторов собственных ЦОДов (без Colo провайдеров)

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# Q23: Do you currently use, or are you considering using, any direct liquid cooling technology in your owned data centers?

| | 2025 Total (n=388) | Europe (n=104) | U.S. and Canada (n=108) | Asia-Pacific (n=56) | Middle East & Africa (n=76) | Latin America (n=44) |
|---|---|---|---|---|---|---|
| We currently use direct liquid cooling, and plan to expand its use | **13%** | 17% | 17% | 13% | 7% | 7% |
| We currently use direct liquid cooling, but have no plans to expand its use | **5%** | 4% | 5% | 5% | 5% | 5% |
| We do not use direct liquid cooling, but would consider using it in the future | **62%** | 61% | 57% | 70% | 70% | 55% |
| We do not use direct liquid cooling, and would not consider using it in the future | **20%** | 18% | 21% | 13% | 18% | 34% |

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Data Center Owner/Operator Respondents Only
(Not Including Colocation Providers)

# LONGITUDINAL COMPARISIONS: Q23. Do you currently use, or are you considering using, any direct liquid cooling technology in your owned data centers?

| | 2023 (n=340) | 2024 (n=367) | 2025 (n=387) |
|---|---|---|---|
| We currently use direct liquid cooling, and plan to expand its use | 16% | 15% | 13% |
| We currently use direct liquid cooling, but have no plans to expand its use | 6% | 5% | 5% |
| We do not use direct liquid cooling, but would consider using it in the future | 57% | 62% | 62% |
| We do not use direct liquid cooling, and would not consider using it in the future | 21% | 18% | 20% |

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Data Center Owner/Operator Respondents Only
(Not Including Colocation Providers)

# Респонденты, рассматривающие использование DLC, но не использующие его на данный момент

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# Q28: Which types of direct liquid cooling is your organization considering for your enterprise data centers? Choose all that apply.

| | 2025 Total (n=235) | | Europe (n=62) | U.S. and Canada (n=62) | Asia-Pacific (n=38) | Middle East & Africa (n=51) | Latin America (n=22) |
|---|---|---|---|---|---|---|---|
| Water-cooled cold plates | **40%** | | 52% | 44% | 37% | 35% | 18% |
| Dielectric cold plates (single phase) | **26%** | | 15% | 34% | 32% | 29% | 18% |
| Dielectric cold plates (two phase) | **24%** | | 15% | 34% | 24% | 22% | 27% |
| Full immersion systems (single phase) | **17%** | | 15% | 15% | 32% | 18% | 0% |
| Full immersion systems (two-phase) | **11%** | | 10% | 10% | 11% | 18% | 5% |
| Partial immersion systems | **9%** | | 8% | 10% | 11% | 10% | 9% |
| Other (please specify) | **4%** | | 5% | 3% | 0% | 8% | 0% |
| Do not believe liquid cooling is viable | **6%** | | 0% | 5% | 16% | 4% | 14% |

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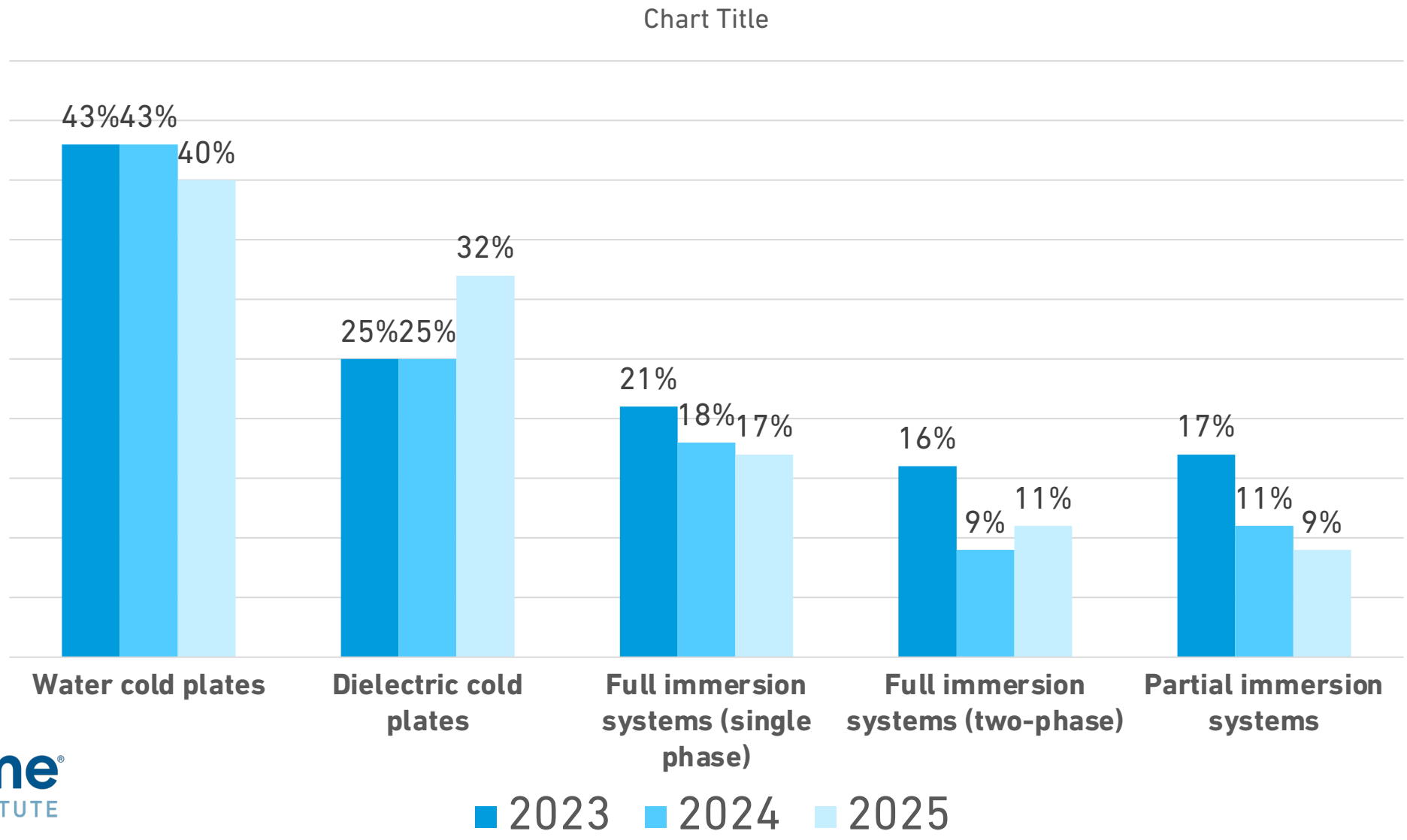
Only Data Center Owner/ Operators who said "We do not use direct liquid cooling, but would consider using it in the future" to Q23 were eligible to answer this question.

Data Center Owner/Operators Only (Not Including Colo Providers): Considering but Not Using Direct Liquid Cooling

# То же, в динамике за 3 последних года

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# Q29: Which of the following best describes the typical IT workload you expect to support with liquid cooling in the future in your owned data centers? Choose no more than three.

| | 2025 Total (n=232) | Europe (n=60) | U.S. and Canada (n=62) | Asia-Pacific (n=38) | Middle East & Africa (n=50) | Latin America (n=22) |
|---|---|---|---|---|---|---|
| Generative AI model training (LLMs and other) | **45%** | 50% | 48% | 50% | 36% | 45% |
| Generative AI model inference (LLMs and other) | **45%** | 50% | 45% | 39% | 38% | 45% |
| Enterprise server applications (e.g., database engines, analytics, general consolidation) | **39%** | 38% | 42% | 34% | 46% | 27% |
| High-performance technical / scientific computing (engineering, research) | **38%** | 30% | 37% | 50% | 38% | 36% |
| Mainframe workloads | **11%** | 10% | 8% | 13% | 10% | 18% |
| 3D rendering/video processing | **10%** | 8% | 6% | 13% | 12% | 14% |
| Virtual desktop infrastructure | **8%** | 7% | 6% | 5% | 12% | 14% |
| All other machine learning (not generative) | **22%** | 25% | 18% | 32% | 20% | 14% |
| Other (please specify) | **0%** | 0% | 0% | 0% | 2% | 0% |
| Don't know / my team does not have access to this information | **18%** | 17% | 18% | 11% | 28% | 14% |

Only Data Center Owner/Operators who said "We do not use direct liquid cooling, but would consider using it in the future" to Q23 were eligible to answer this question.

Data Center Owner/Operators Only (Not Including Colo Providers): Considering but Not Using Direct Liquid Cooling

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# Q25: Which of these best describes the typical IT workload supported by your liquid-cooled racks in your owned data centers? Choose no more than three.

| | 2025 (n=65) |
|---|---|
| High-performance technical / scientific computing | 63% |
| Generative AI model training | 42% |
| Enterprise server applications | 35% |
| Generative AI model inference | 35% |
| Mainframe workloads | 15% |
| Virtual desktop infrastructure | 14% |
| 3D rendering/video processing | 12% |
| All other machine learning | 22% |
| Other (please specify) | 6% |
| Don't know | 2% |

Only Data Center Owner/ Operators who said "We currently use direct liquid cooling, and plan to expand its use" OR "We currently use direct liquid cooling, but have no plans to expand its use" to Q23 were eligible to answer this question.

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Data Center Owner/Operators Only (Not Including Colo Providers): Currently Using Direct Liquid Cooling

DLC: какое оно бывает.  Краткая классификация

Какие технологии DLC выбирает сегодня мировой рынок?
Результаты трёх лет наблюдений Uptime Institute

**Что делать, если у вас появляются стойки ОЧЕНЬ высокой плотности?**

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Спокойствие, только спокойствие! (©)

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# Пределы работоспособности технологий охлаждения

| Cooling methods | Typical rack power |
|---|---|
| **Air cooling** | |
| Perimeter cooling *(CRAHs with containment system or fan walls)* | Up to 20 kW to 25 kW per rack |
| In-row | 10 kW to 50 kW per rack |
| RDHx | 20 kW to 50 kW per rack |
| **Hybrid air and liquid cooling** | |
| Sidecar (<70% DLC) | 40 kW to 70 kW per rack |
| DLC (<70%) and perimeter cooling | 50 kW to 70 kW per rack |
| DLC (<70%) and RDHx | 70 kW to 150 kW per rack |
| DLC (>90%) and perimeter cooling or RDHx | 150+ kW per rack |
| **Total liquid cooling** | |
| 100% DLC coverage | 150+ kW per rack |
| Single-phase immersion | 50 kW to 150+ kW per vat |
| Two-phase immersion | 50 kW to 150+ kW per vat |

*CRAH: computer room air handlers; DLC: direct liquid cooling; RDHx: rear-door heat exchanger*

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*CRAH: computer room air handlers; DLC: direct liquid cooling; RDHx: rear-door heat exchanger*

# Что делать, если у вас одна-две-три ОЧЕНЬ горячих стойки с Cold Plates?

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# Что делать, если у вас одна-две-три ОЧЕНЬ горячих стойки с Cold Plates?

Вам поможет Sidecar!

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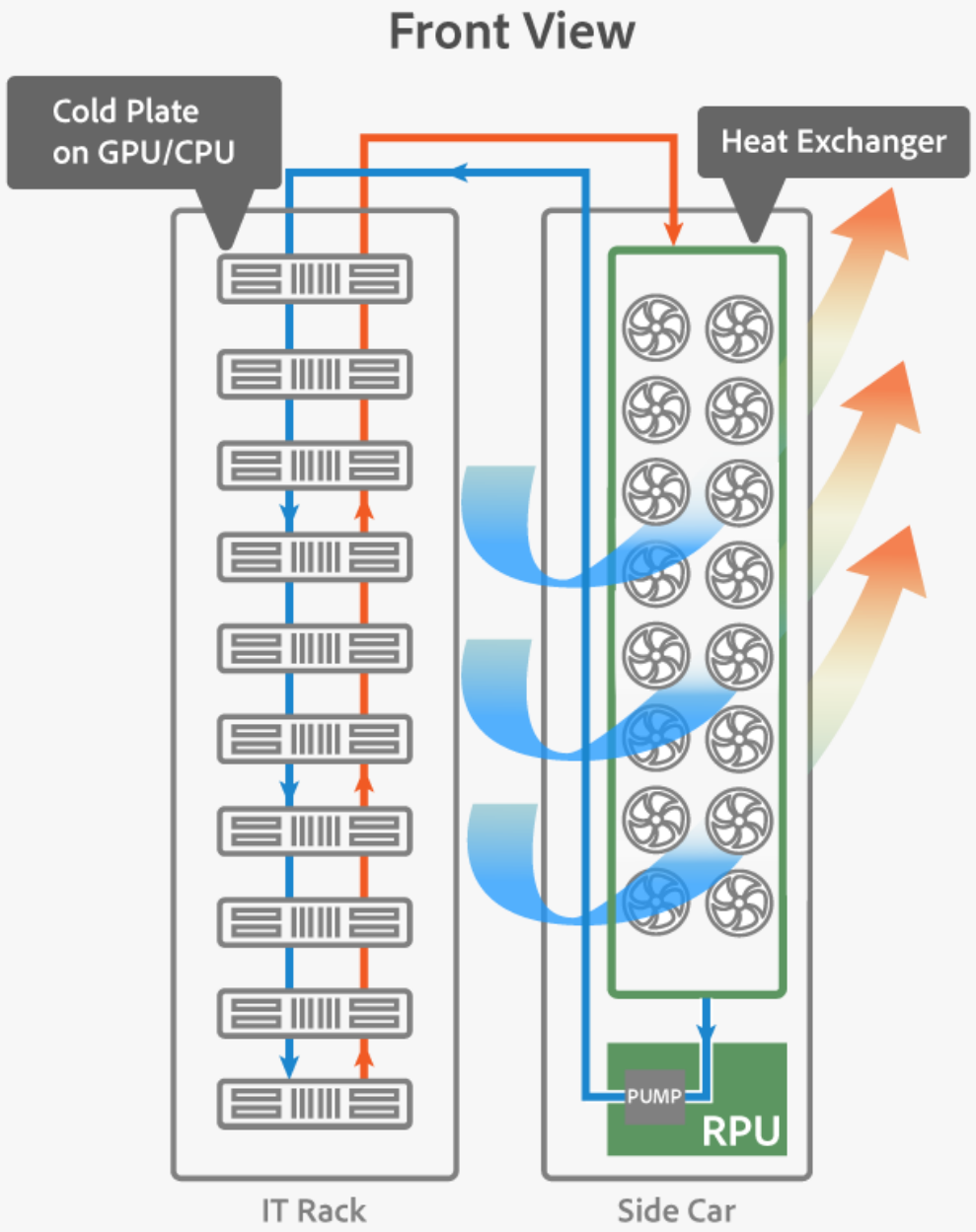
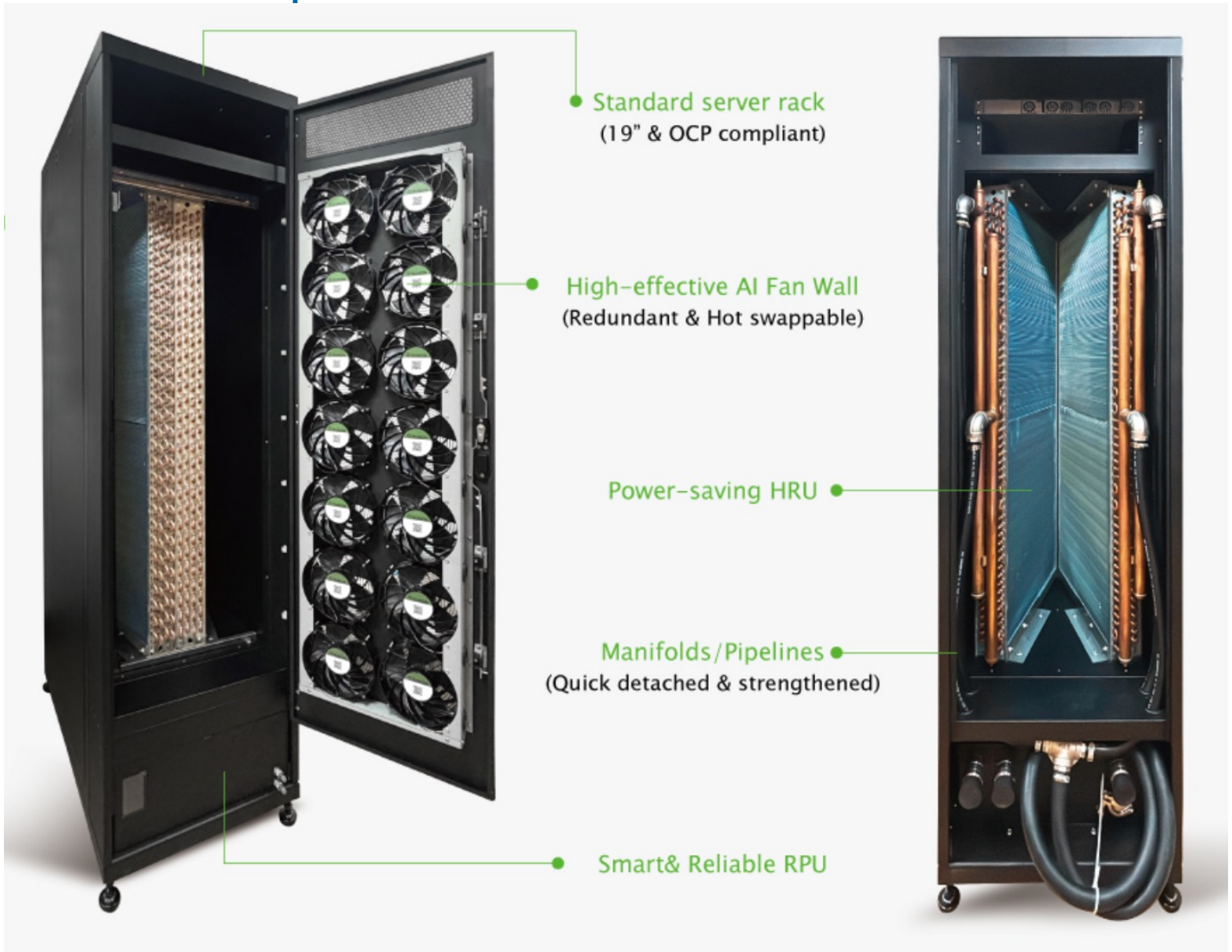
# Sidecar




*RPU (Reservoir and Pumping Unit)

# «Фанкойл наоборот»

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# Выводы

1. DLC стучится в дверь, но пока не слишком громко. Оно по большей части всё ещё на пороге машзала
2. Лидер симпатий – cold plates (до 150 кВт/стойку в сочетании с InRow, RDHx и т.п.). Быстрее всех набирают очки 2-фазные cold plates с диэлектрической жидкостью
3. Спокойствие, только спокойствие (©). Из привычных воздушных технологий можно выжать до 50 кВт/стойку. Если нужно заметно больше и в заметных масштабах – тогда вам нужно DLC

# В заключение

- Вряд ли нам стоит ожидать формирования в ближайшие годы консенсуса по поводу «наилучшей из технологий DLC»
- Многие операторы будут реализовывать пилотные проекты, пробуя и сравнивая разные виды DLC, внимательно изучая опыт первопроходцев
- Популярные сегодня технологии вовсе необязательно окажутся наилучшими как с технической точки зрения, так и с экономической
- Любая DLC-система должна быть экономически эффективной для поддерживаемой ей ИТ-задачи; предлагать адекватную надёжность и отказоустойчивость; быть понятной в эксплуатации. Всё это требует опыта и времени

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# Спасибо за внимание!

## Вопросы?

asolodovnikov@uptimeinstitute.com

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