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OCP SUMMIT

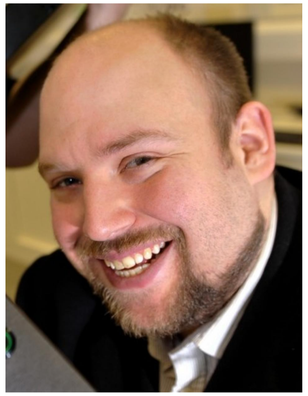




This research has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no 754337

EuroEXA – OCP Inspired HPC in the EU

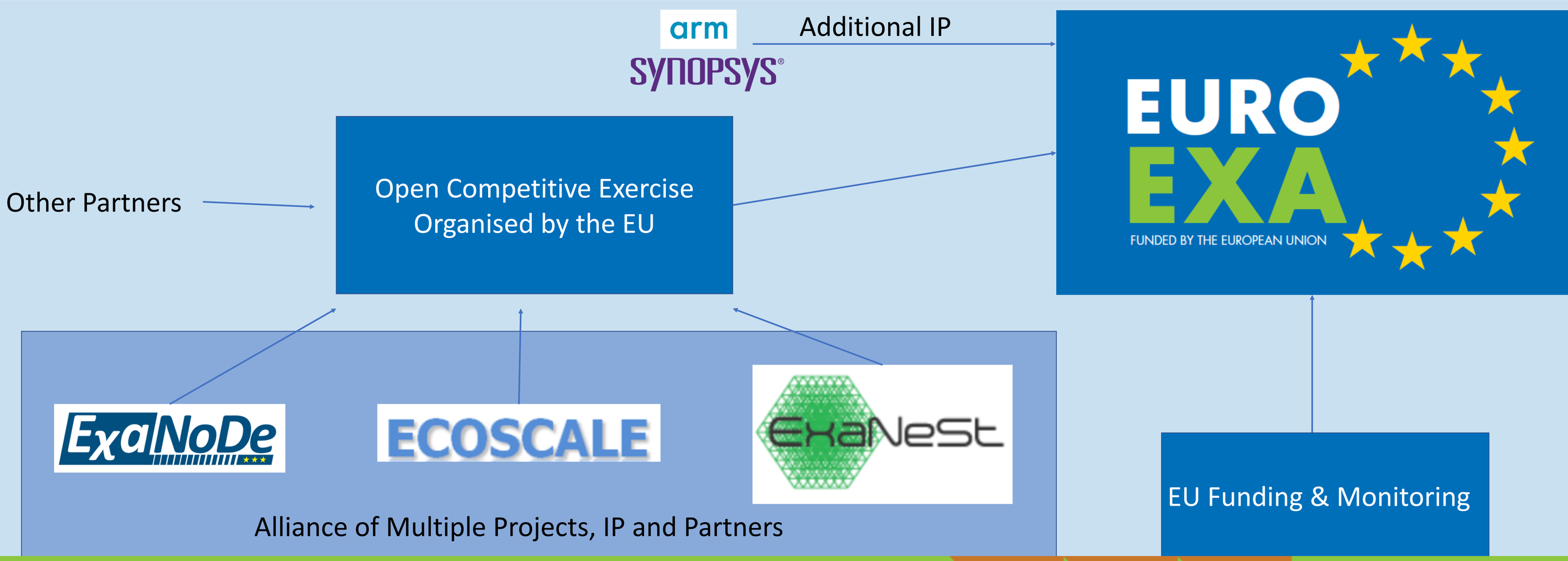
Peter Hopton – Dissemination Lead, EuroEXA
Founder, Iceotope
http://TheCoolingGuy.me



EuroEXA Presentation

1. Introduction to EuroEXA – Who Are We?
2. The Big Problem - Dr's Moore, Koomey, Shannon & Harley
3. Vision: A HUGE Computer, Made in Small Boxes - 'Modularity'
4. Turning OpenRack up to 11
5. Liquid Cooling 2MW Boxes
6. Management

What is EuroEXA?



Who Are EuroEXA

EURO EXA
FUNDED BY THE EUROPEAN UNION

Commercial Partners

ICEOTOPE
SYNELIXIS
arm
MAXELER Technologies
Maximum Performance Computing
ZeroPoint Technologies

Academic/Gov. Partners

ICCS
MANCHESTER 1824
The University of Manchester
INAF ISTITUTO NAZIONALE DI ASTROFISICA
Barcelona Supercomputing Center
Centro Nacional de Supercomputación
imec
FORTH
FOUNDATION FOR RESEARCH AND TECHNOLOGY - HELLAS
Fraunhofer
Hartree Centre
Science & Technology Facilities Council
ECMWF
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A European Master in Neuroscience
INFN
Istituto Nazionale di Fisica Nucleare

Supporters

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CRS4
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NYU School of Medicine
NYU LANGONE MEDICAL CENTER
Noldus
Information Technology
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SOLVAY
asking more from chemistry®

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Energy is King

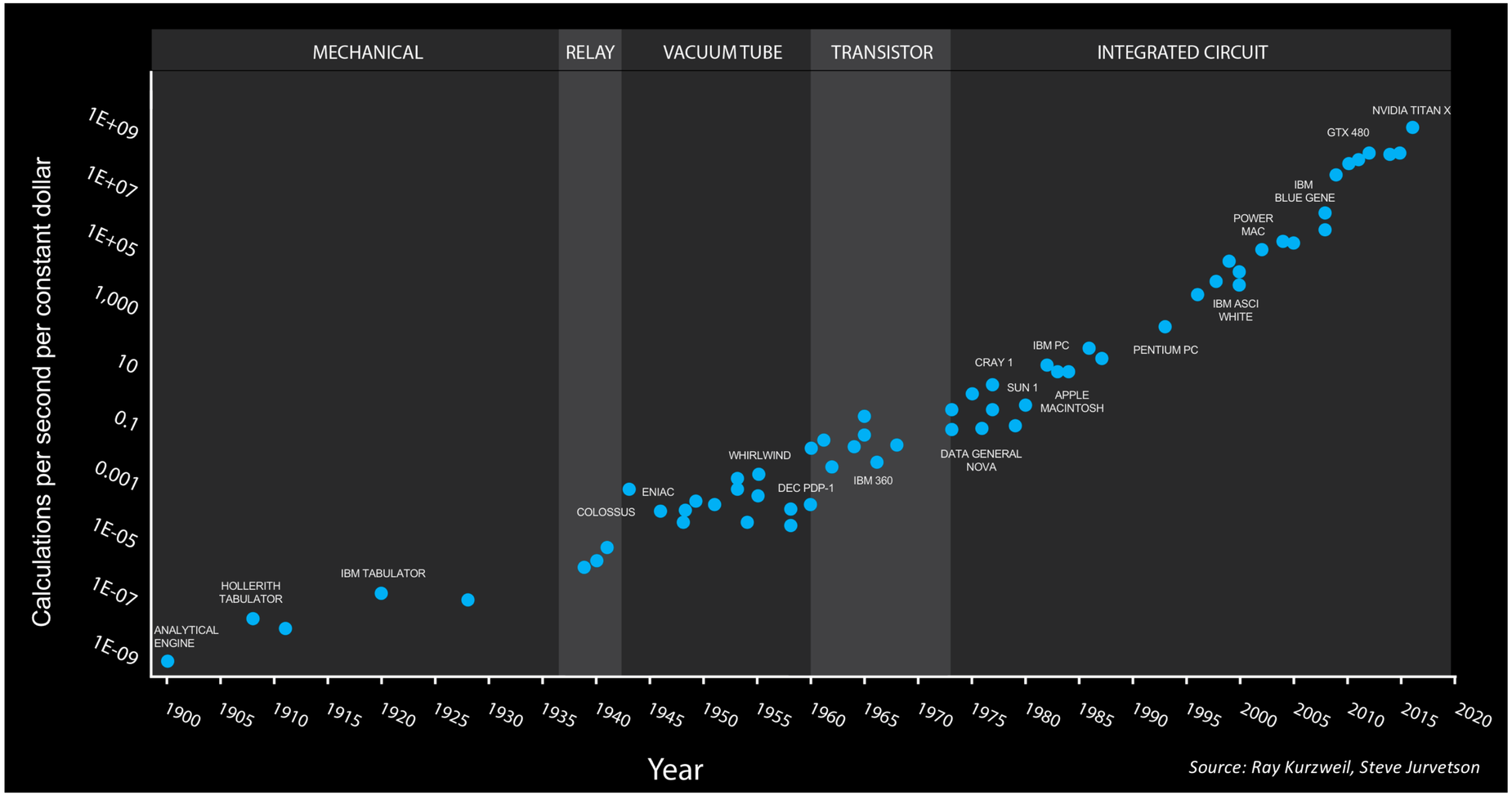
Dr Moore's Law – The observation that the number of transistors in a dense integrated circuit doubles about every two years

Dr Koomey's Law – Describes a long-term trend in the history of computing hardware. The number of computations per joule of energy dissipated has been doubling approximately every 1.57 years.

Dr Shannon & Dr Hartley - Describes bandwidth with respect to signal power and noise of a channel.

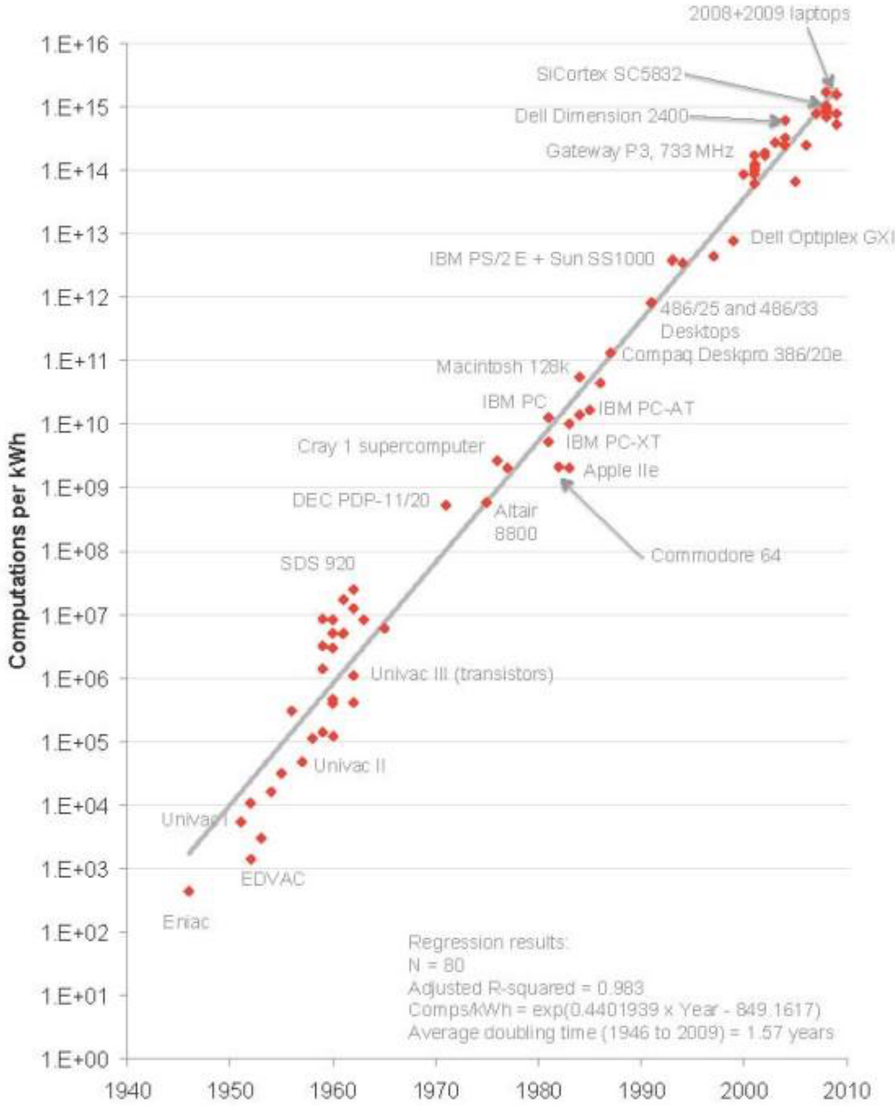
Dr Moore

The observation that the number of transistors in a dense integrated circuit doubles about every two years



Dr Koomey–

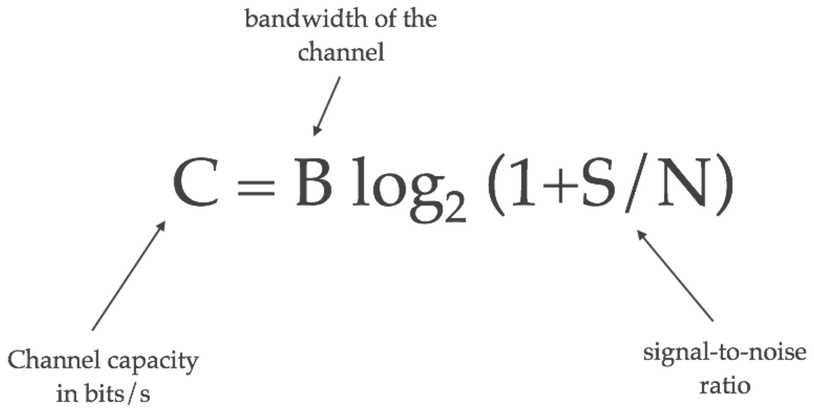
Describes a long-term trend in the history of computing hardware. The number of computations per joule of energy dissipated has been doubling approximately every 1.57 years.



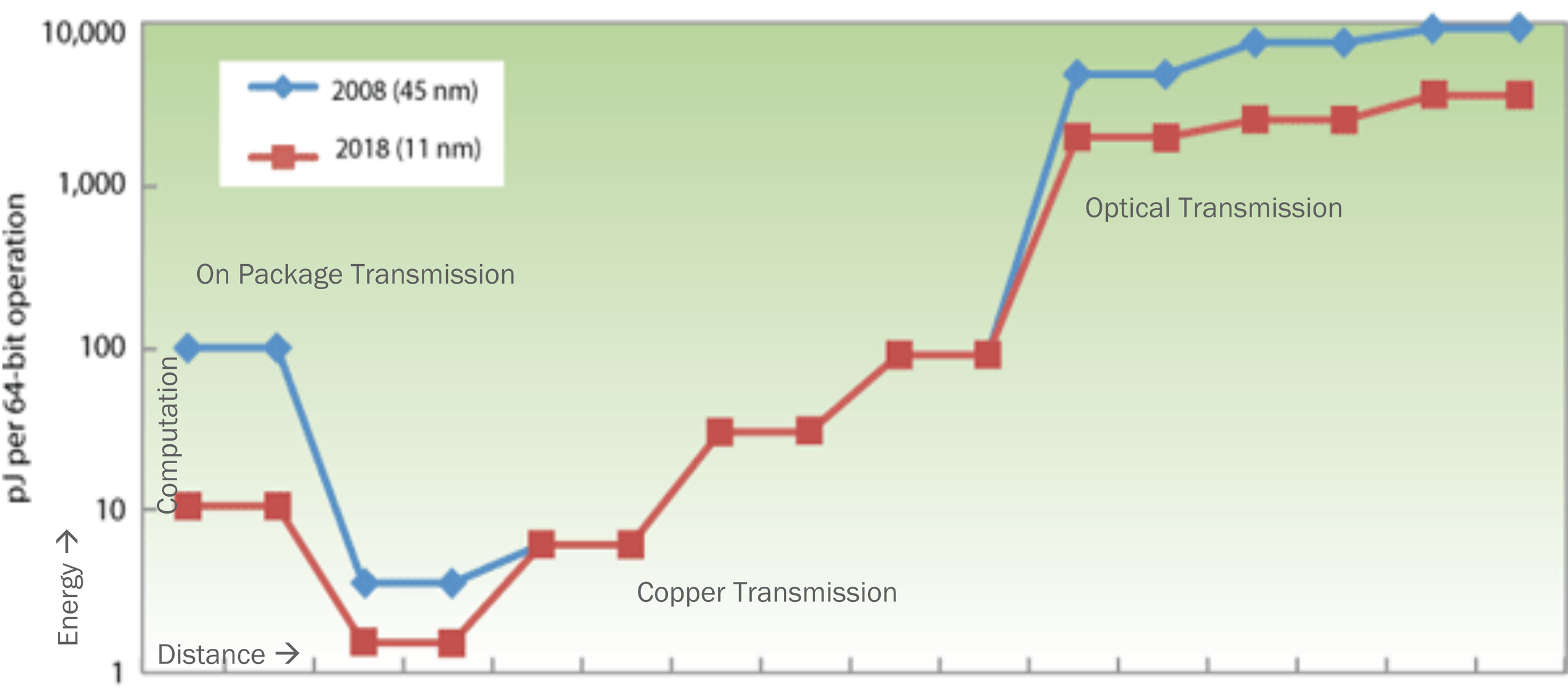
Dr Shannon & Dr Hartley–

1928/1948 Bell Labs

Describes bandwidth with respect to signal power and noise of a channel.



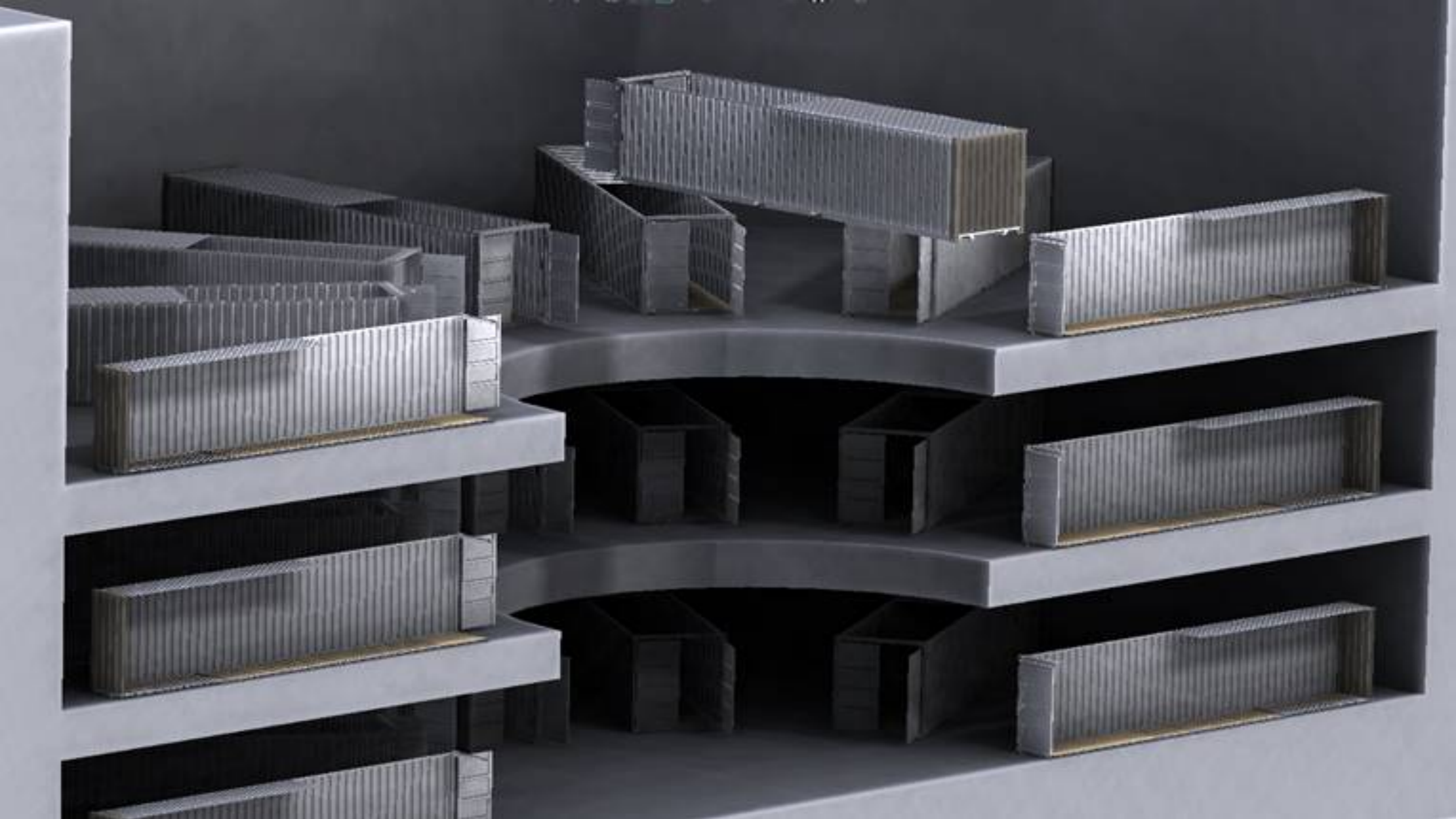
OR, it can be re-presented as the **minimum amount of energy** required to transmit a bit of data over a channel with an environment of noise.



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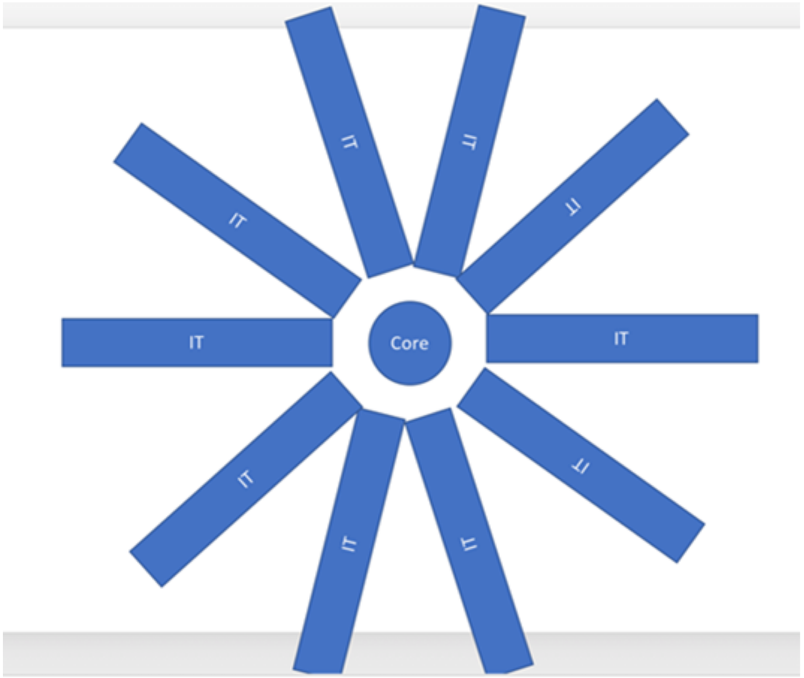
EuroEXA Presentation

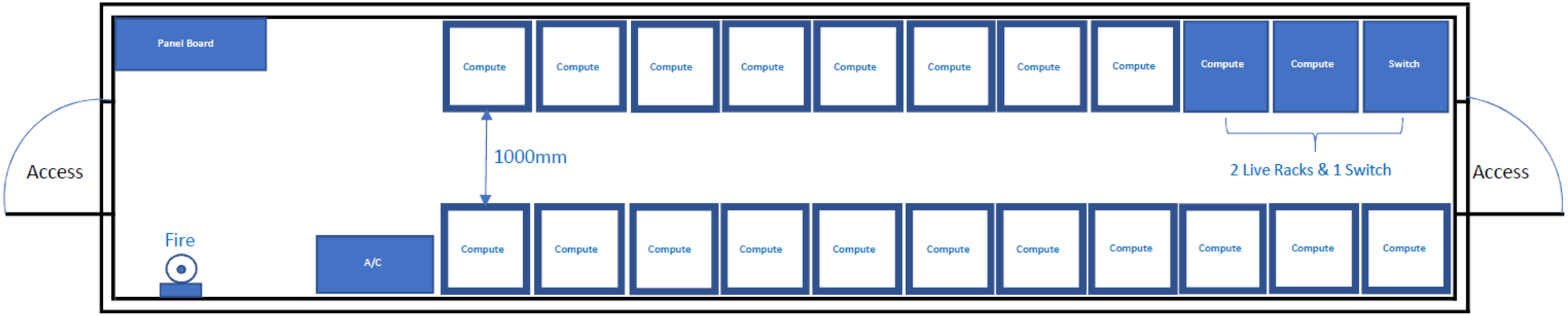
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60MW in 35m Diameter
10 40ft High-Cube ISOs per layer
3 Layers
2MW per ISO
Approx. 110kW per Rack

Prototype will feature 1 container, initially with 3 live Racks





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Turning it up to 11

- >100kW a cabinet needs liquid cooling solutions
- OpenRack *is perfect for liquid cooling* as it reduces wasted space and maximises density
- Distributed DC power enables consolidation of PSUs – also saving space

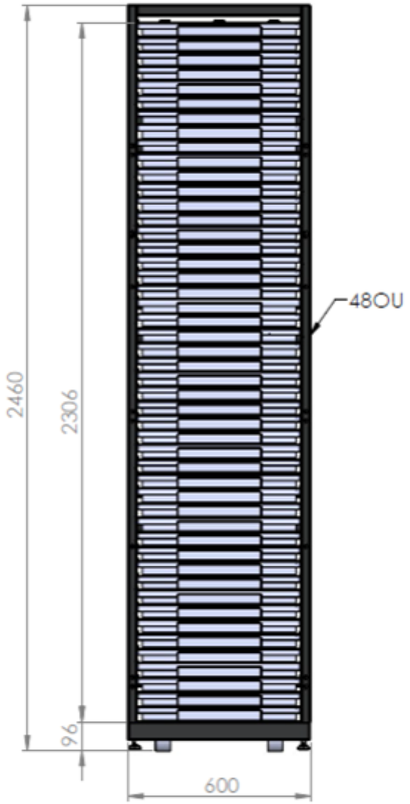


Rack Design Factors

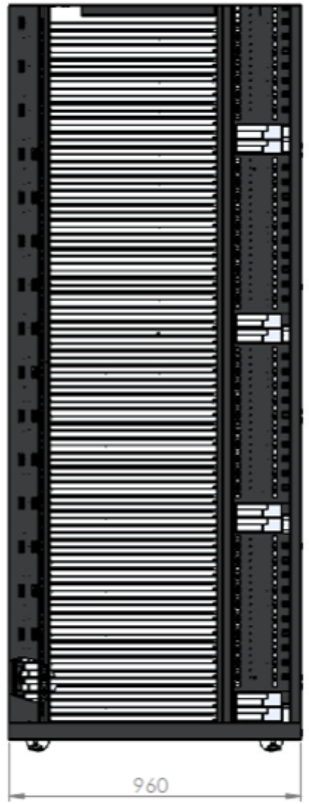
- Fitting 2 rows in a high-cube requires front access only and <960mm deep cabinets
- OpenRack is normally 1060mm, but 200mm is cable zone.
- Total Liquid Cooling enables zero airflow, so back to the wall is possible

Rack Design Factors

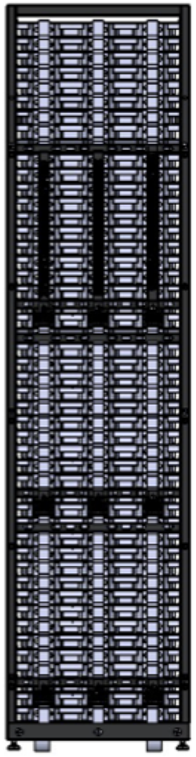
Shortening Cable Zone by 100mm enables 960mm depth, ensuring IT designed to fit this also fits in 1060mm



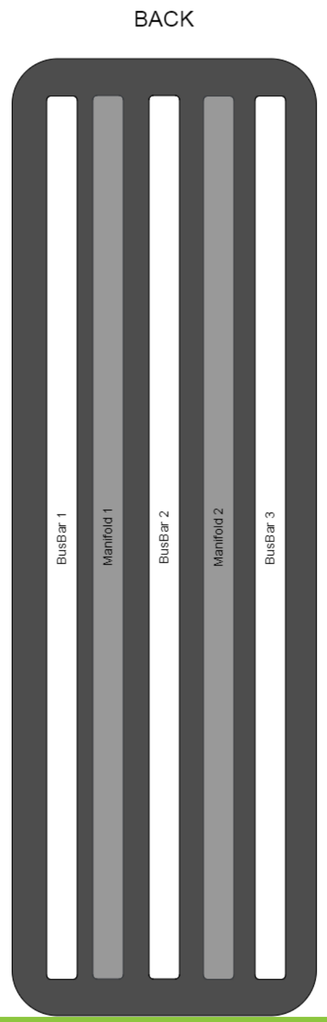
FRONT VIEW



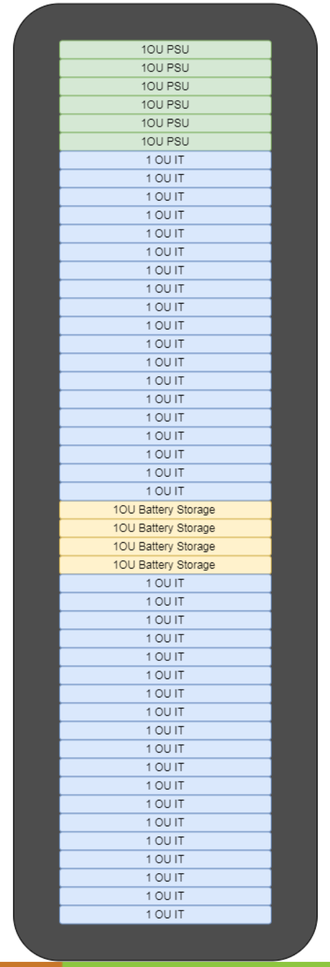
SIDE VIEW

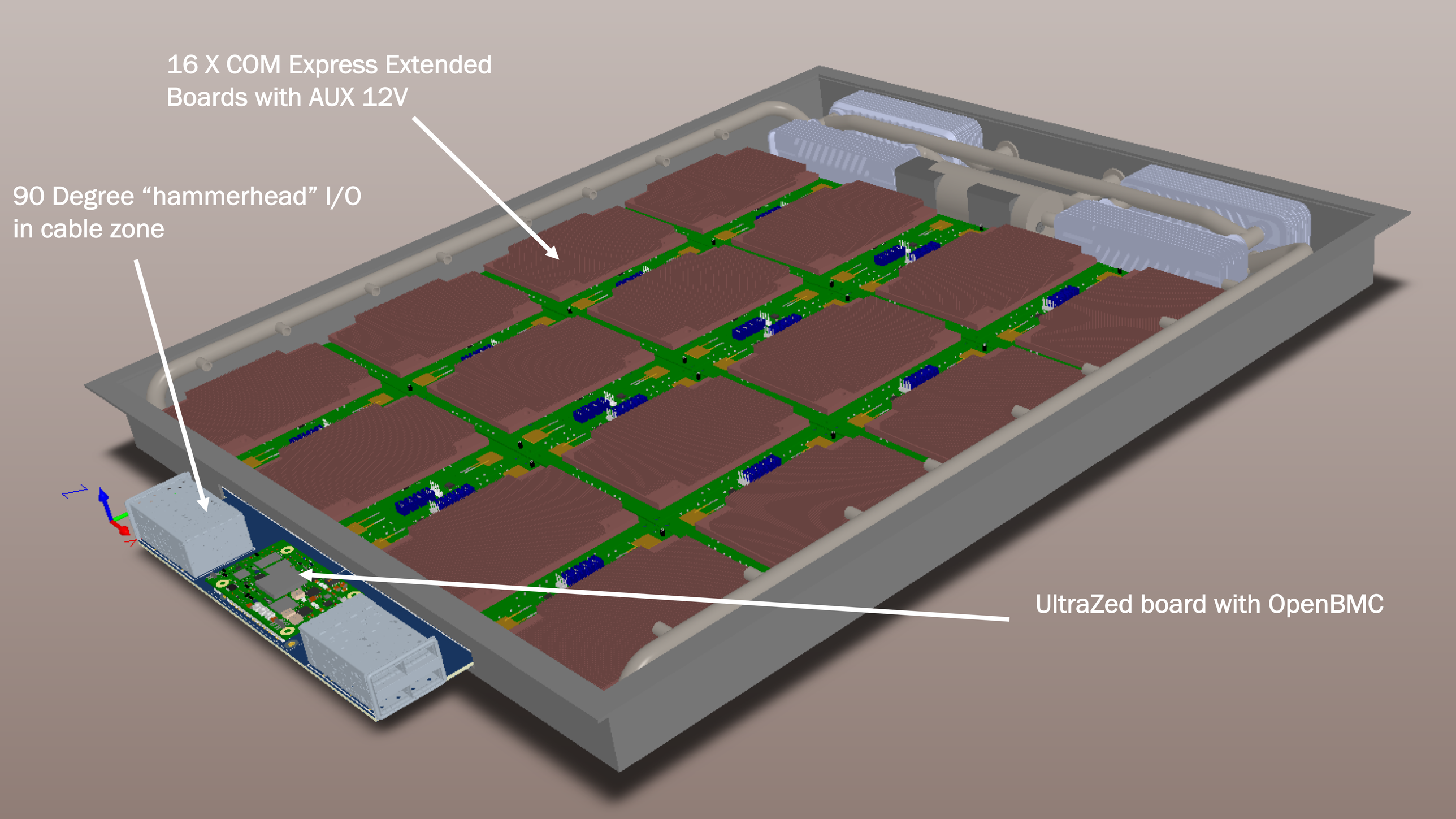

REAR VIEW

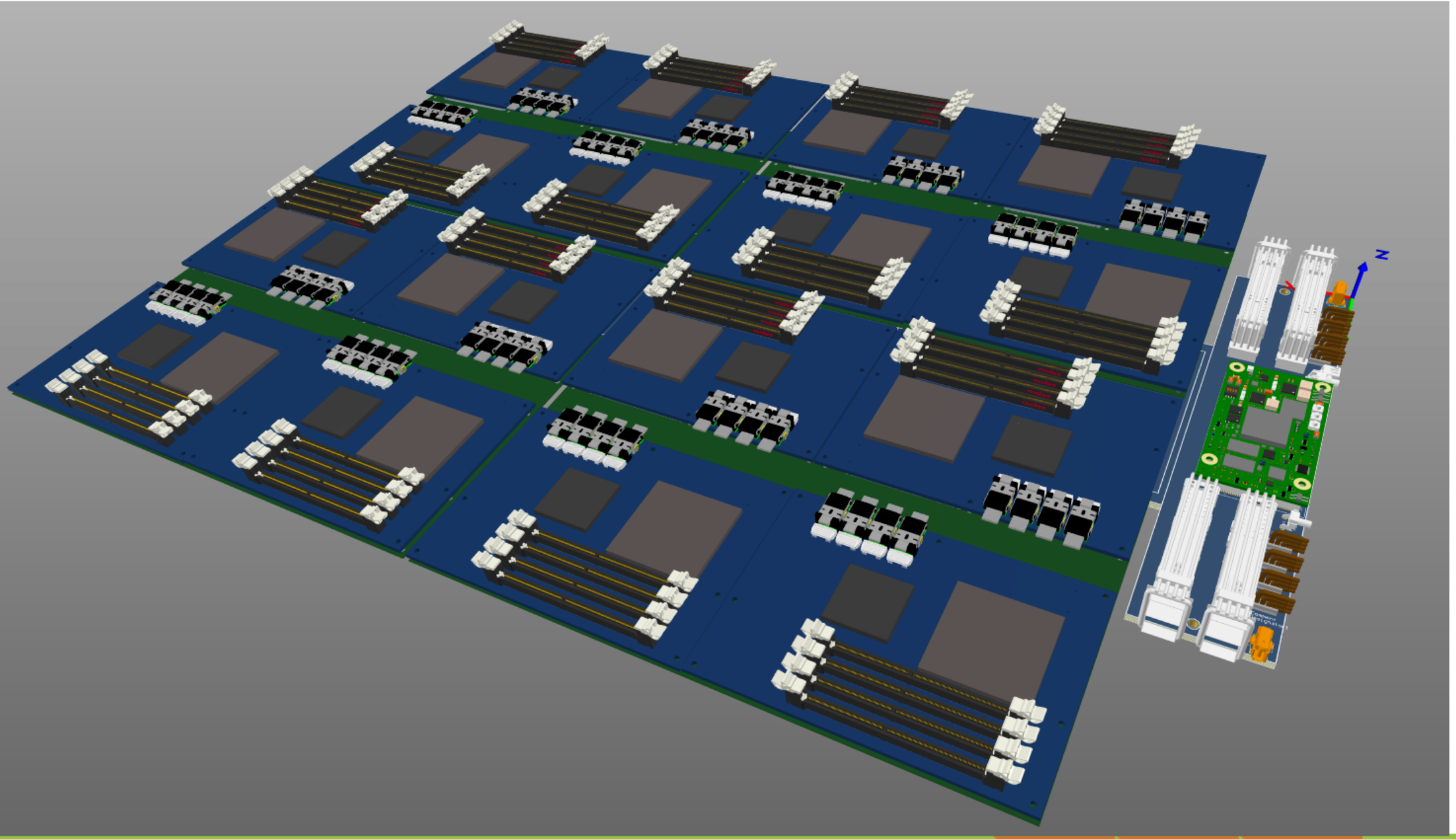
Rack Design Factors



- 3x 48v Bus Bars Enable power delivery
- Coolant Manifolds fit between bars
- Liquid Cooled PSUs deliver density in N+1 config in 60U




16 X COM Express Extended
Boards with AUX 12V
90 Degree “hammerhead” I/O
in cable zone
UltraZed board with OpenBMC



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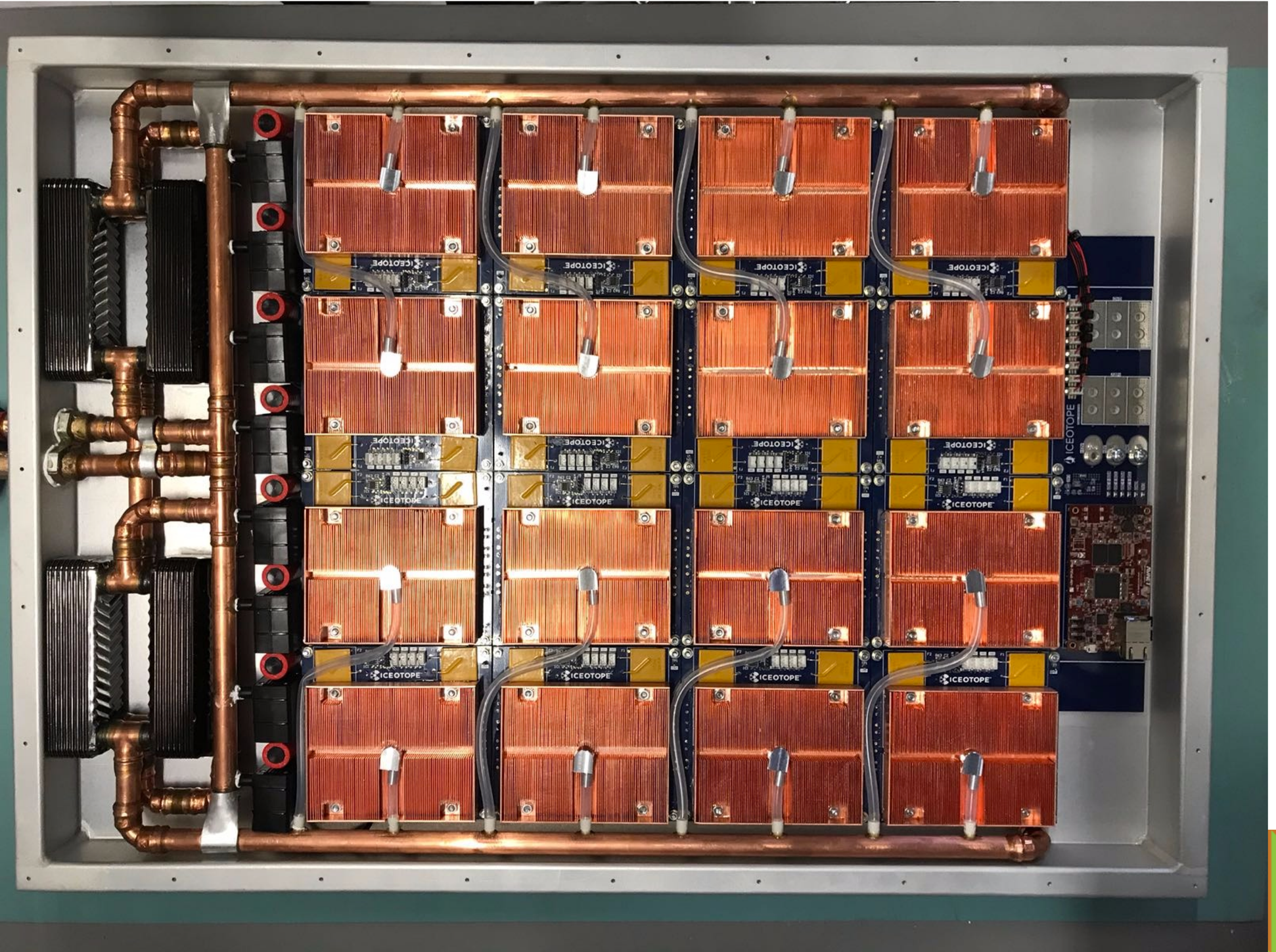
Liquid Cooling 2MW Boxes

To Truly Scale:

- We Needed Zero Airflow = immersion
- But immersion tanks are usually space inefficient
- The project used Iceotope technology “immersion without submersion”

Liquid Cooling Objectives

- 45C Inlet “Chiller-less” ASHRAE W4/W5
- Ultra-Low Risk Server Coolant System
  - PFPE Coolants, small quantity, non conductive, low dielectric constant.
  - Low Pressure Drop Heat Exchange
- Ultra-Low Risk Facility Coolant System
  - Sub Atmospheric Leak Prevention System



- TED – Test Rig
- Thermal-proxy Extra-high Density
- 4kW in 1oU test capacity
- 16 Little Modules

- Immersion without Submersion
- Achieved:
  47C inlet
  55C outlet
  @3.2kW/OU

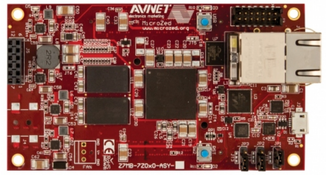


EuroEXA Presentation

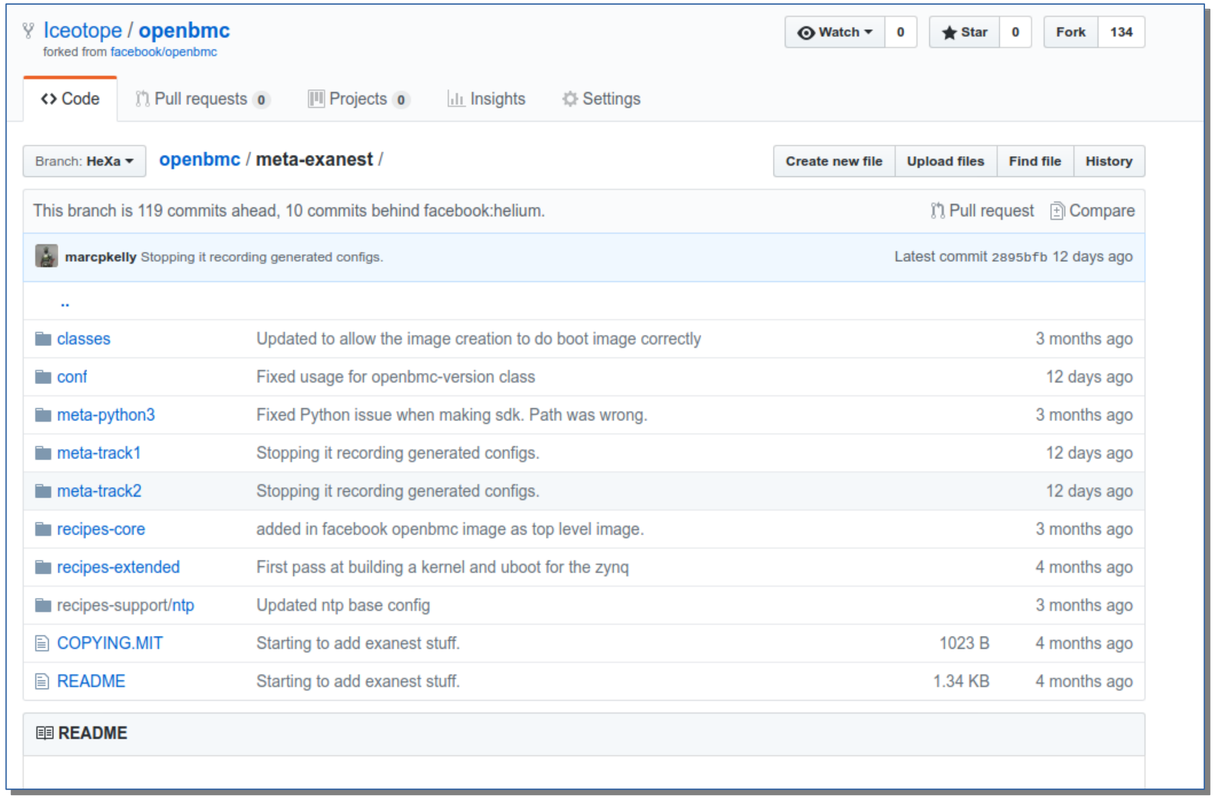
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Management

- Making OpenBMC (FB) Multi-Node and More Flexible Using FPGAs
- Existing prototype uses commercial AVNET MicroZed Board as it’s BMC.
- Migration path moves us to more powerful “UltraZed” as the project evolves
- Software design on FreeRTOS based and was used in TED



Multi-Noding OpenBMC



lceotope / **openbmc**
forked from facebook/openbmc

Watch 0 | Star 0 | Fork 134

Code | Pull requests 0 | Projects 0 | Insights | Settings

Branch: **HeXa** | **openbmc** / **meta-exanest** / | Create new file | Upload files | Find file | History

This branch is 119 commits ahead, 10 commits behind facebook:helium. | Pull request | Compare

marcpkelly Stopping it recording generated configs. | Latest commit 2895bfb 12 days ago

..

classes	Updated to allow the image creation to do boot image correctly		3 months ago
conf	Fixed usage for openbmc-version class		12 days ago
meta-python3	Fixed Python issue when making sdk. Path was wrong.		3 months ago
meta-track1	Stopping it recording generated configs.		12 days ago
meta-track2	Stopping it recording generated configs.		12 days ago
recipes-core	added in facebook openbmc image as top level image.		3 months ago
recipes-extended	First pass at building a kernel and uboot for the zynq		4 months ago
recipes-support/ntp	Updated ntp base config		3 months ago
COPYING.MIT	Starting to add exanest stuff.	1023 B	4 months ago
README	Starting to add exanest stuff.	1.34 KB	4 months ago

README

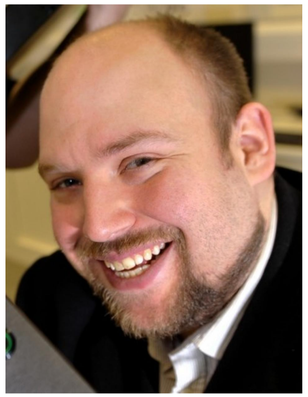
- Our port is up on Github!
- Original branch by Facebook is Helium, so our Branch is HeXa. He for Helium, Xa for ExaScale.
- Very much Work-In-Progress!
- We try to keep things in sync with the Facebook original, to avoid things diverging too much.





Thanks For Listening – Questions?

Peter Hopton – Dissemination Lead, EuroEXA
Founder, Iceotope
http://TheCoolingGuy.me



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