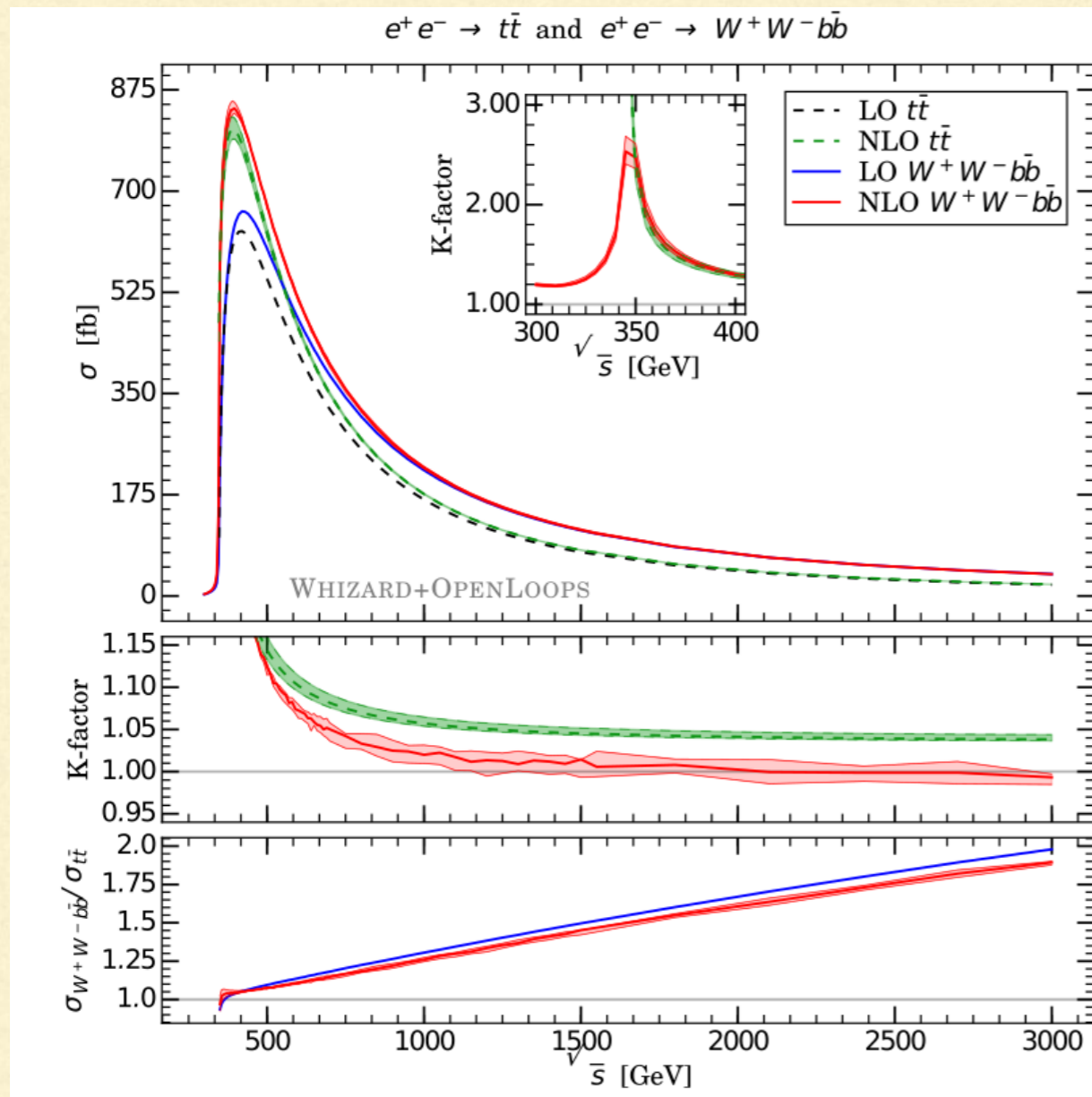

FROM TERASCALE TO EXASCALE

Christian Weiss, NEC Deutschland

DESY Prefit School Career Event, March 5th 2020, Hamburg

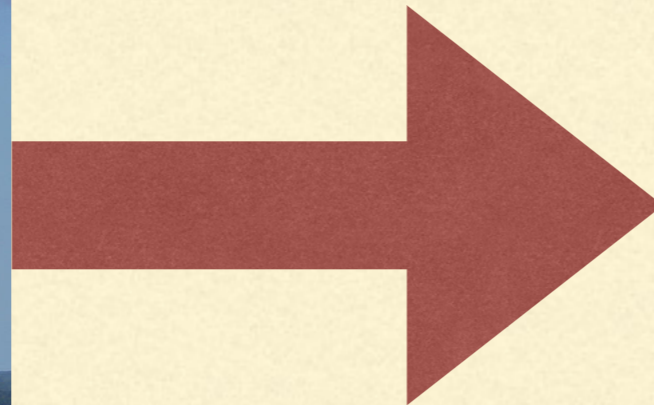
christian.weiss@emea.nec.com

MY TIME AT DESY

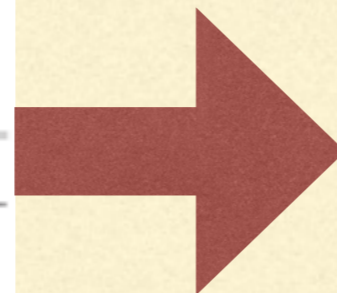
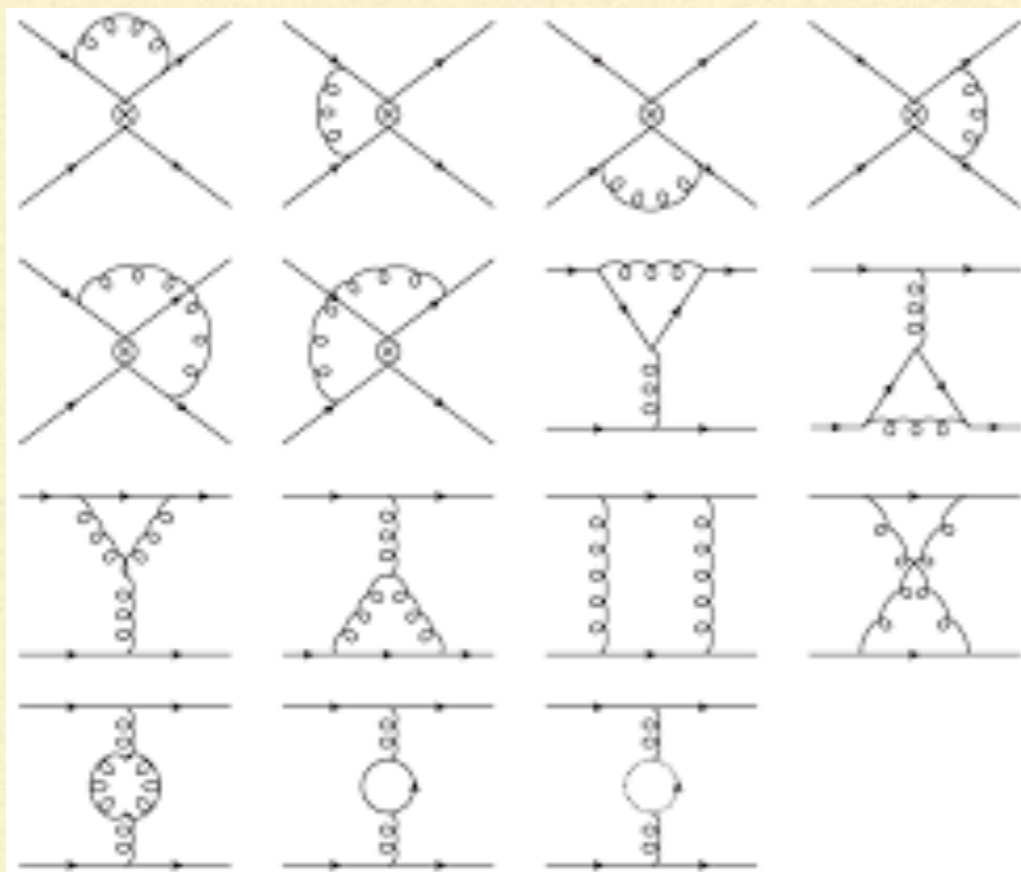


- Higher-order corrections in WHIZARD, with Jürgen Reuter & Bijan Chokoufé
- Phd Thesis: *Top-quark Physics as a Prime Application of Automated Higher Order Corrections*

FROM ELBE TO RHEIN....

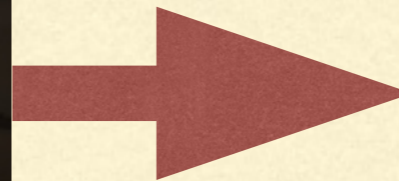


FROM LOOPS TO LOOPS....

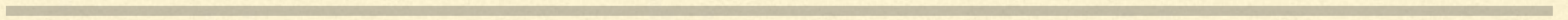


```
! it is faster to do the maxval search by hand
do j = 1, n
  ! initialize with the first element
  do i = 1, m
    a_s(i) = A(1,i,j)
  end do
  ! search can start from 2 because 1 is already in a_s
  do k = 2, o
    do i = 1, m
      ! check if an element is larger
      if (A(k,i,j) > a_s(i)) then
        ! save larger element
        a_s(i) = A(k,i,j)
      end if
    end do
  end do
  ! separate work loop from search
  ! apply computation in vectorized form
  do i = 1, m
    B(i,j) = B(i,j) - a_s(i)
  end do
end do
```

FROM TERASCALE TO EXASCALE



BUT HOW?



BUT HOW?

Sorry, no exciting story to tell here....

BUT HOW?

Sorry, no exciting story to tell here....

I just answered to an add on LinkedIn.

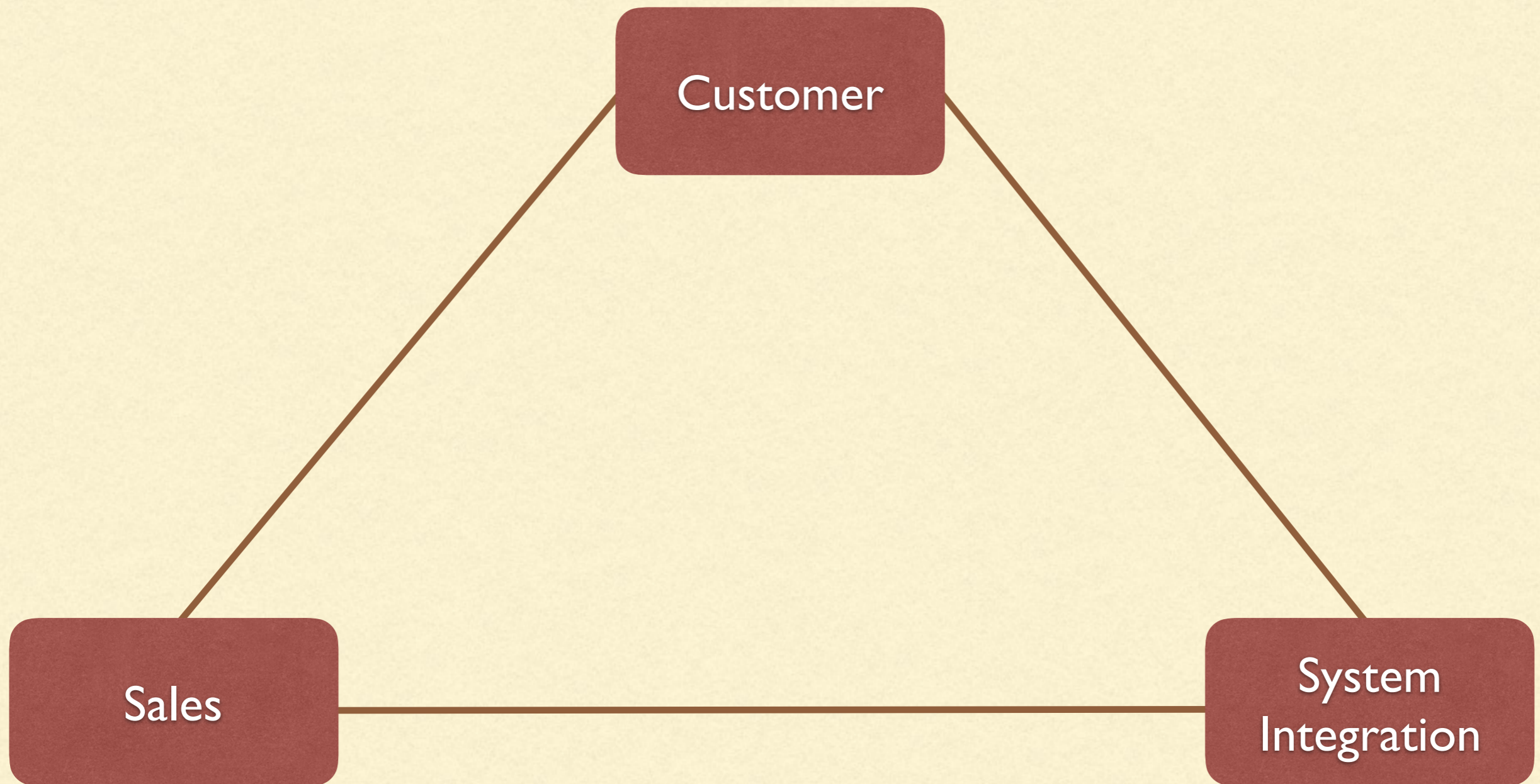


NEC DEUTSCHLAND

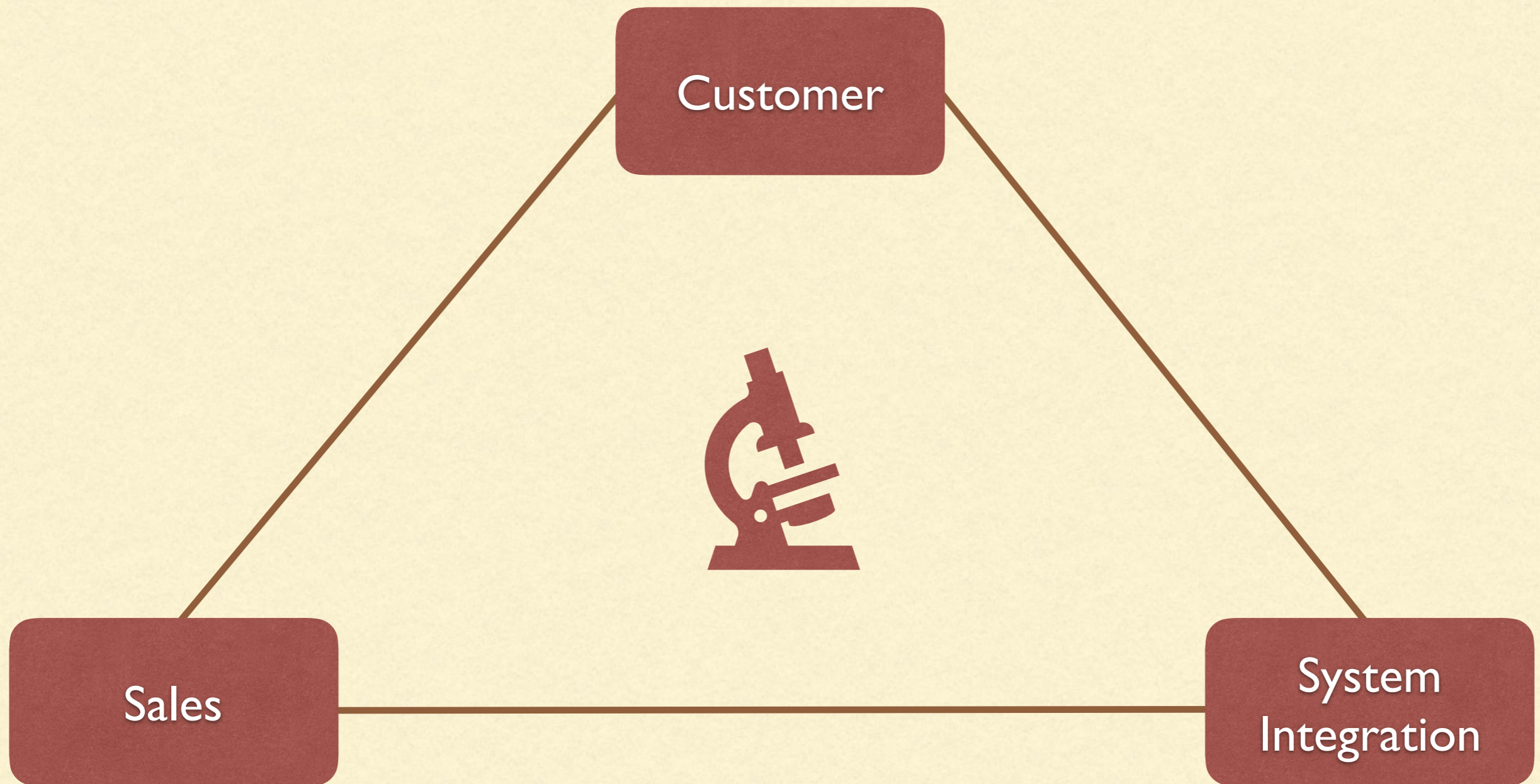
- Main business: High-Performance Compute Clusters
- Two branches: Standard x86 (Intel, AMD) and vector processors (SX Aurora Tsubasa)



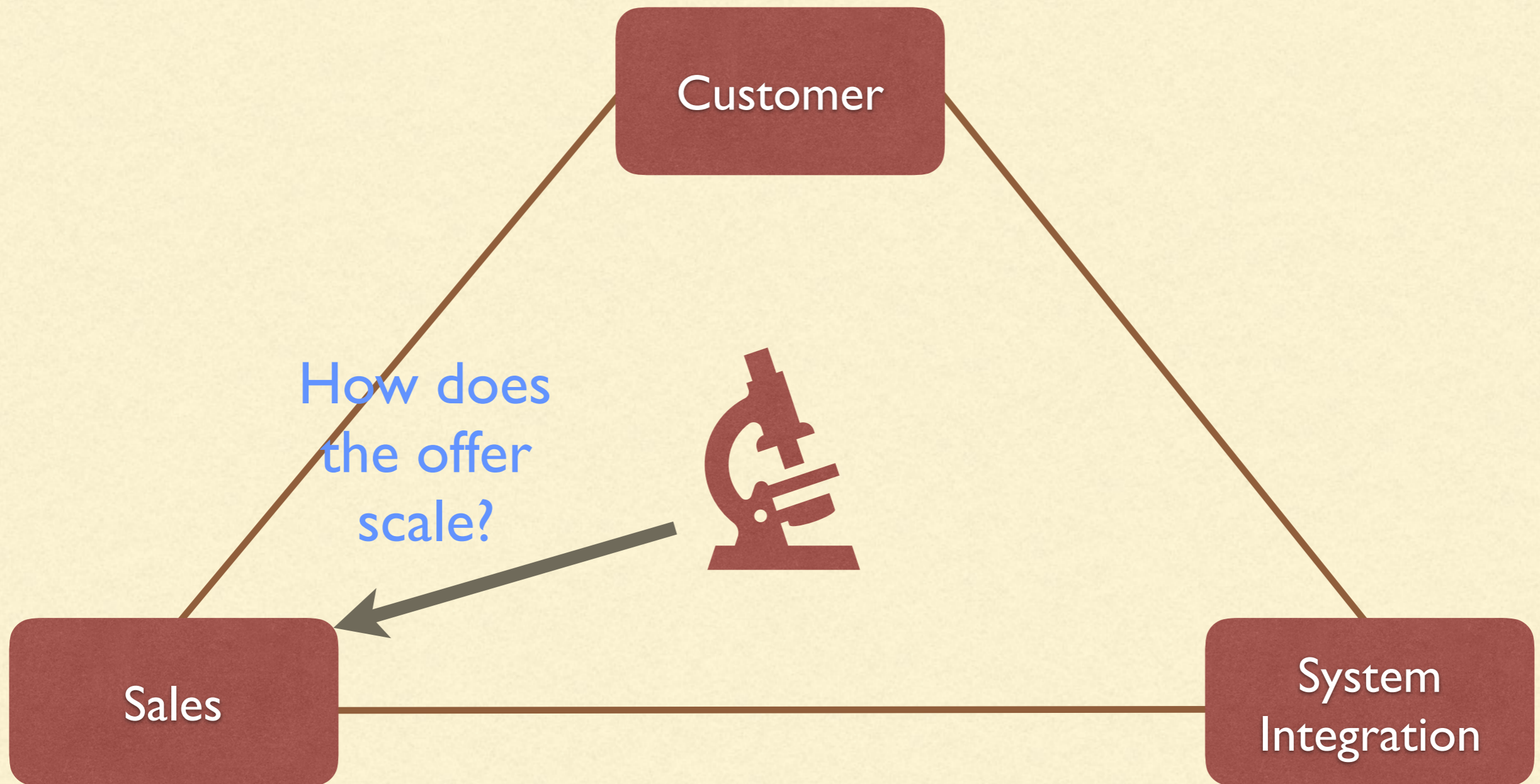
WHAT IS A BENCHMARK ANALYST?



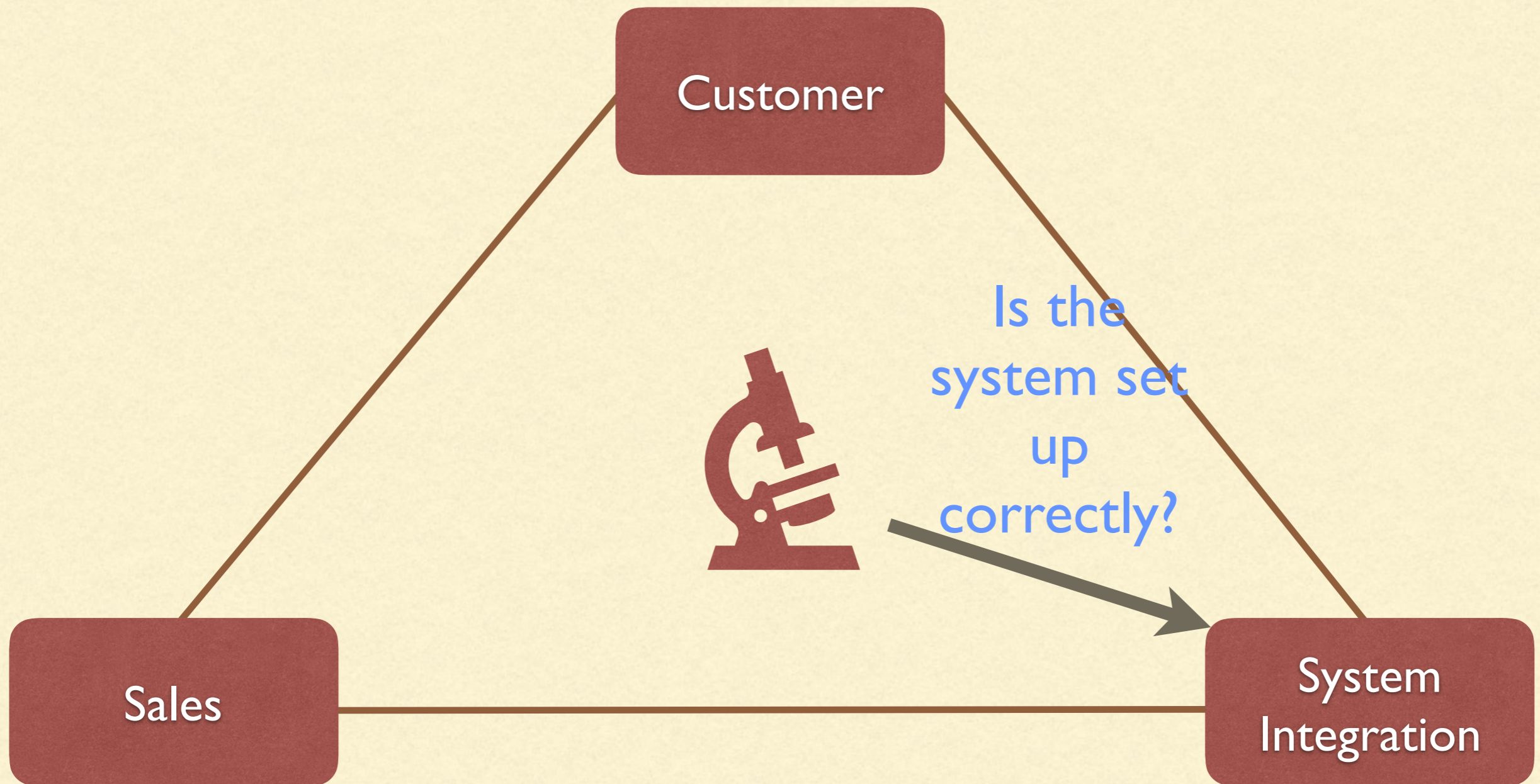
WHAT IS A BENCHMARK ANALYST?



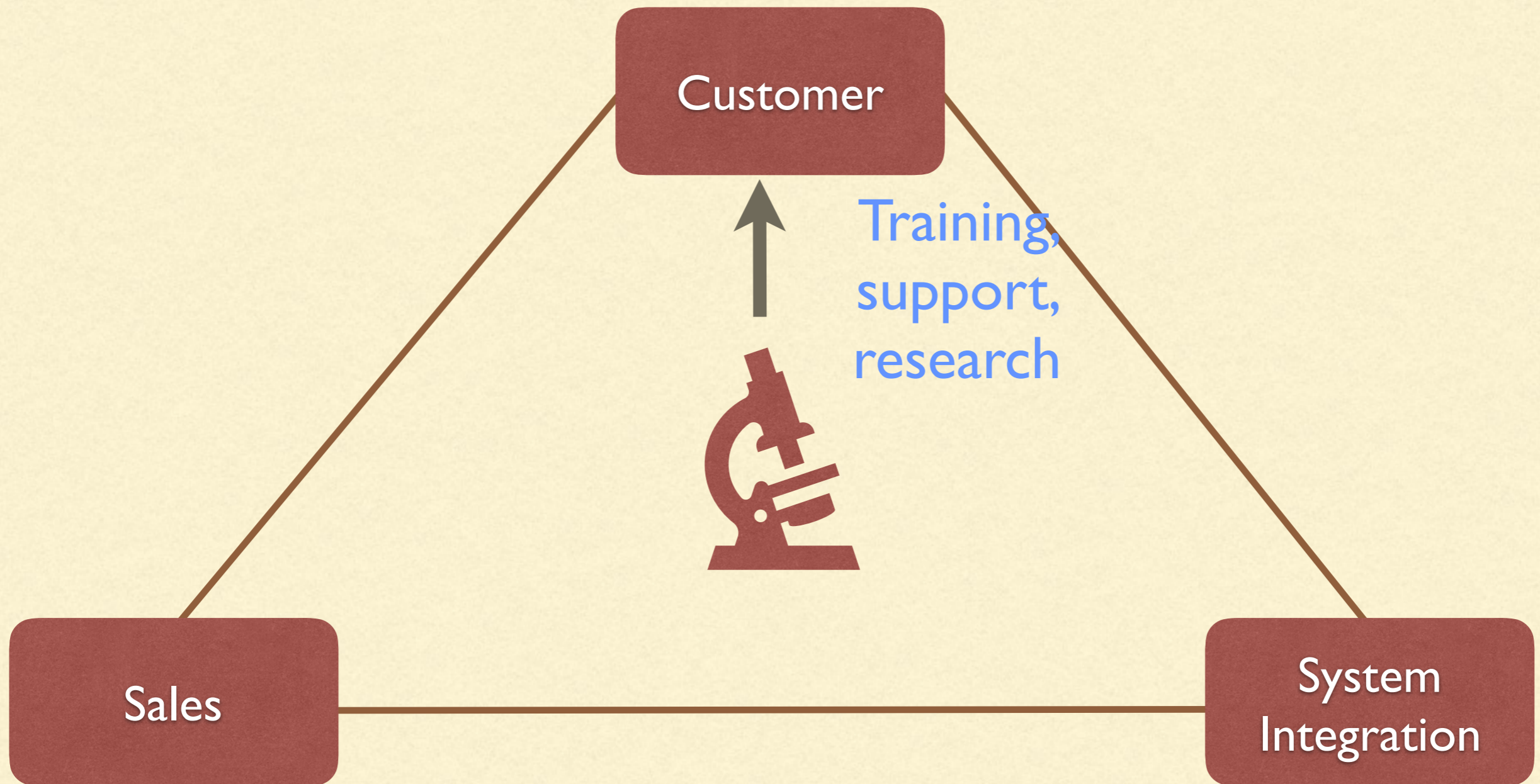
WHAT IS A BENCHMARK ANALYST?



WHAT IS A BENCHMARK ANALYST?

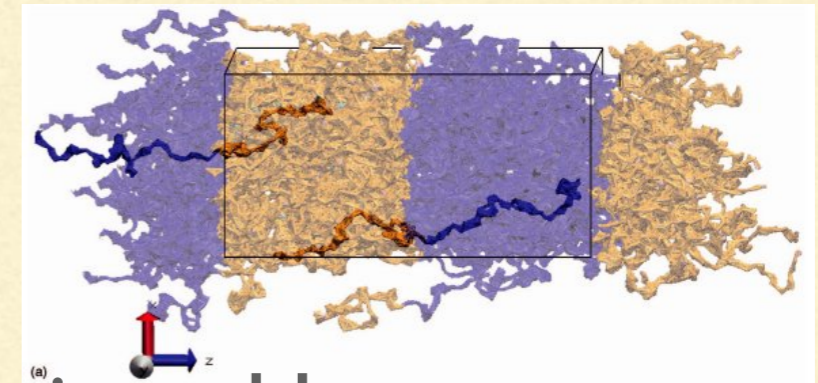
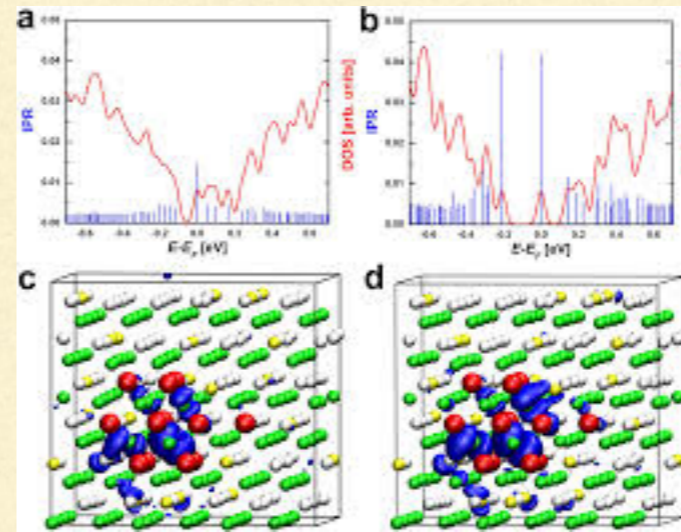


WHAT IS A BENCHMARK ANALYST?



CASE EXAMPLE: RWTH AACHEN

- Customer is a large university with users from various fields: Solid state physics, fluid dynamics, molecular dynamics.
- A versatile system is desired and necessary
- Six application benchmarks need to be performed.



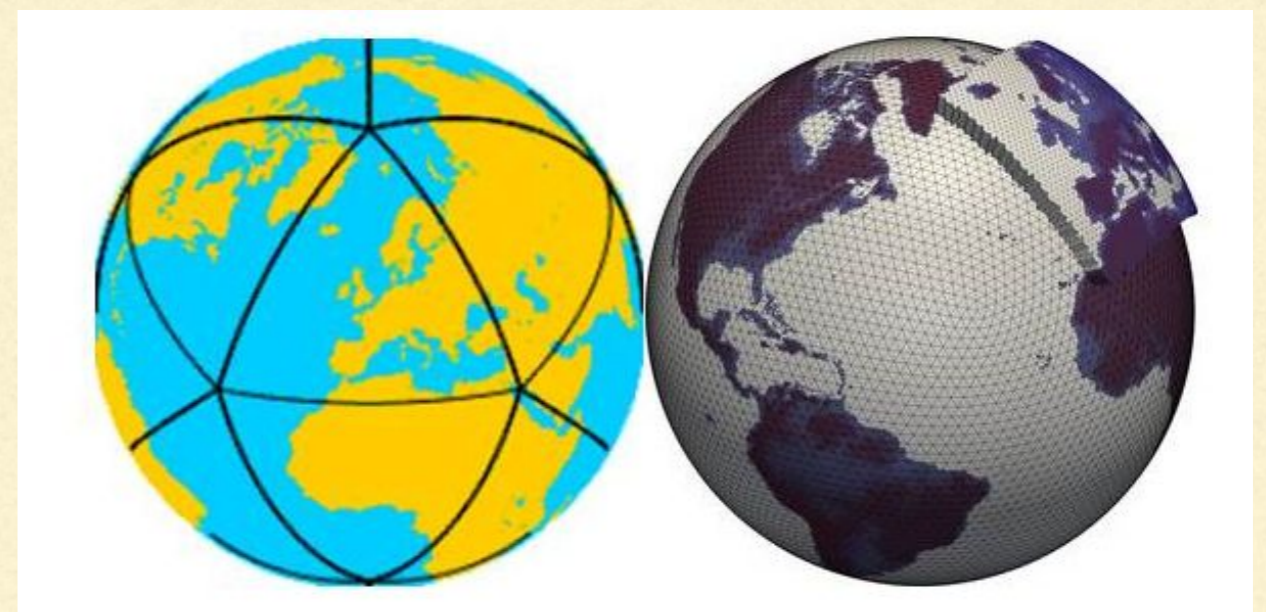
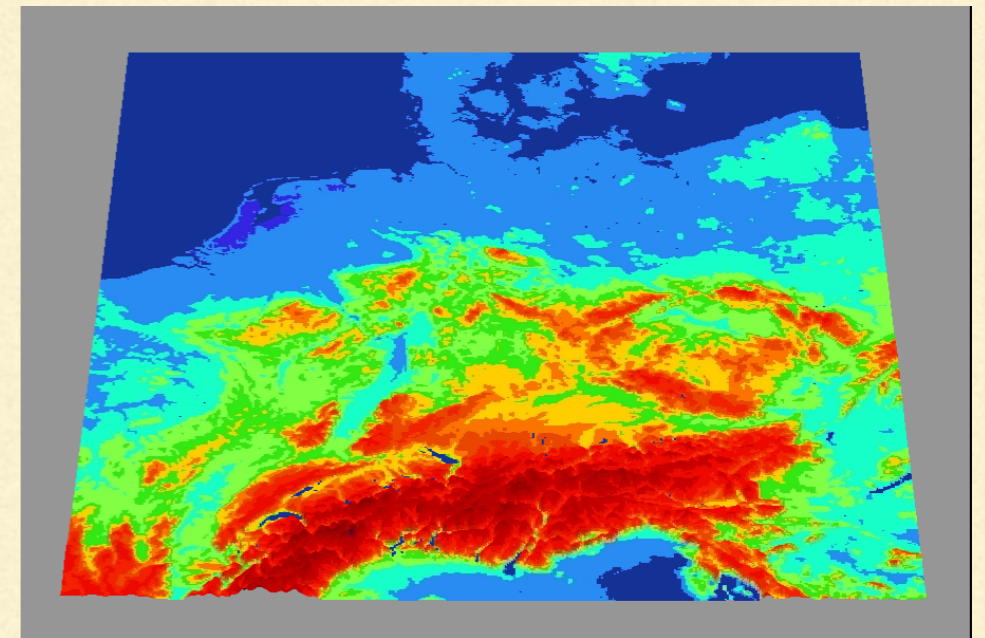
Core questions: How many nodes?
Which architecture? How to
connect? Which power
consumption?

CASE EXAMPLE: RWTH AACHEN

- Result: Procurement was won, RWTH got 1032 nodes Intel Xeon Platinum (48 nodes each) + 48 nodes with Nvidia Volta GPUs and Intel Omnipath Interconnect.
 - Cluster named "CLAIX2" was ranked on place 92 on the international Top500 list (June 2019) with a sustained performance of 2.48 PetaFlops.
 - Interesting fact: The HPL benchmark for the Top500 list revealed interesting complications between the operating system and the hardware architecture (caches) to overcome.
-

CASE EXAMPLE: DWD (GERMAN WEATHER SERVICE)

- Customer has only a small number of applications which need to run reliable and performant.
- Meteorological simulations are well suited for vector accelerators: Perfect case for SX Aurora Tsubasa!



CASE EXAMPLE: DWD

- The project was won with an offer of Aurora vector engines hosted on AMD nodes.
- Energy efficiency was a decisive factor.

Hardwareluxx > News > Hardware > Prozessoren > Deutscher Wetterdienst setzt auf Vektorbeschleunigung

Deutscher Wetterdienst setzt auf Vektorbeschleuniger von NEC

Veröffentlicht am: Mittwoch, 19. Juni 2019 um 09:37 von [Andreas Schilling](#)

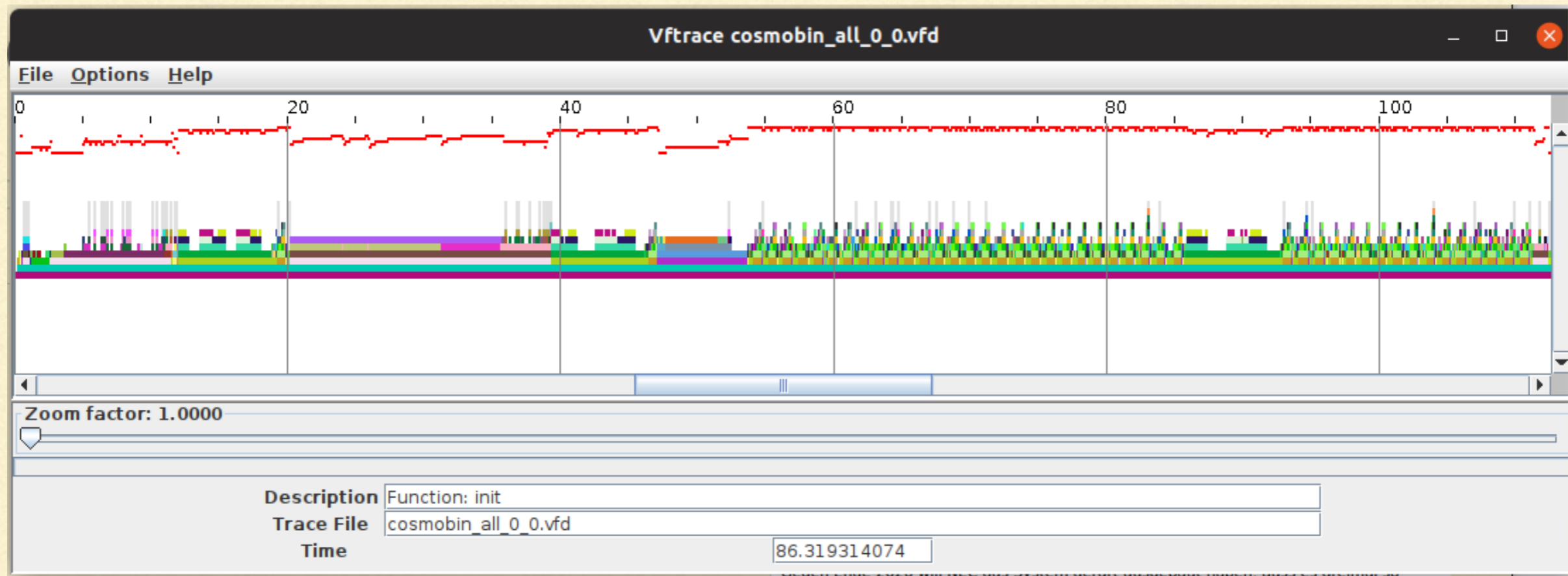


Zur International Supercomputing Conference gibt es eine interessante Ankündigung des Deutschen Wetterdienstes. Dort hat man einen über fünf Jahre laufenden Vertrag mit NEC unterschrieben und wird in diesem Zeitraum deren Vektorbeschleuniger namens NEC SX-Aurora TSUBASA nutzen, um die Vorhersagen zu verbessern, bzw. zu beschleunigen. Das Gesamtvolumen des Kaufs von NEC-Hardware beläuft sich auf 50 Millionen US-Dollar.

Gegen Ende des Jahres will NEC ein System mit den SX-Aurora-TSUBASA-Karten aufgebaut haben, welches gleichwertig zum aktuellen Supercomputer des DWD ist. Beim aktuellen Hauptsystem des DWD zum Einsatz kommen 1.296, bzw. 1.104 Intel Xeon E5-2670v2 respektive E5-2680v3 mit einer Rechenleistung von 1.459, bzw. 1.227 TFLOPS. Zum Vergleich: Damit gelänge gerade so der Einstieg in die [Top500-Liste der Supercomputer](#). Gegen Ende 2020 will NEC das System derart ausgebaut haben, dass es dreimal so leistungsfähig wie das aktuelle ist. In der finalen Phase in 2022 soll dann die nächste Generation der SX-Aurora-TSUBASA-Karten zum Einsatz kommen.



CASE EXAMPLE: VFTRACE



- Application performance analysis via function instrumentation.
- Open Source; Soon to be found on github!

HOW MUCH PHYSICS IS LEFT?

- 8 Benchmarkers: 5 physicists, 2 engineers, 1 chemist, 1 mathematician.
 - Physicists are known to be "Jack of all Trades".
 - I probably see about the same amount of numbers per week.
 - Physicists feel well in the customers' milieus, which both sides appreciate
-