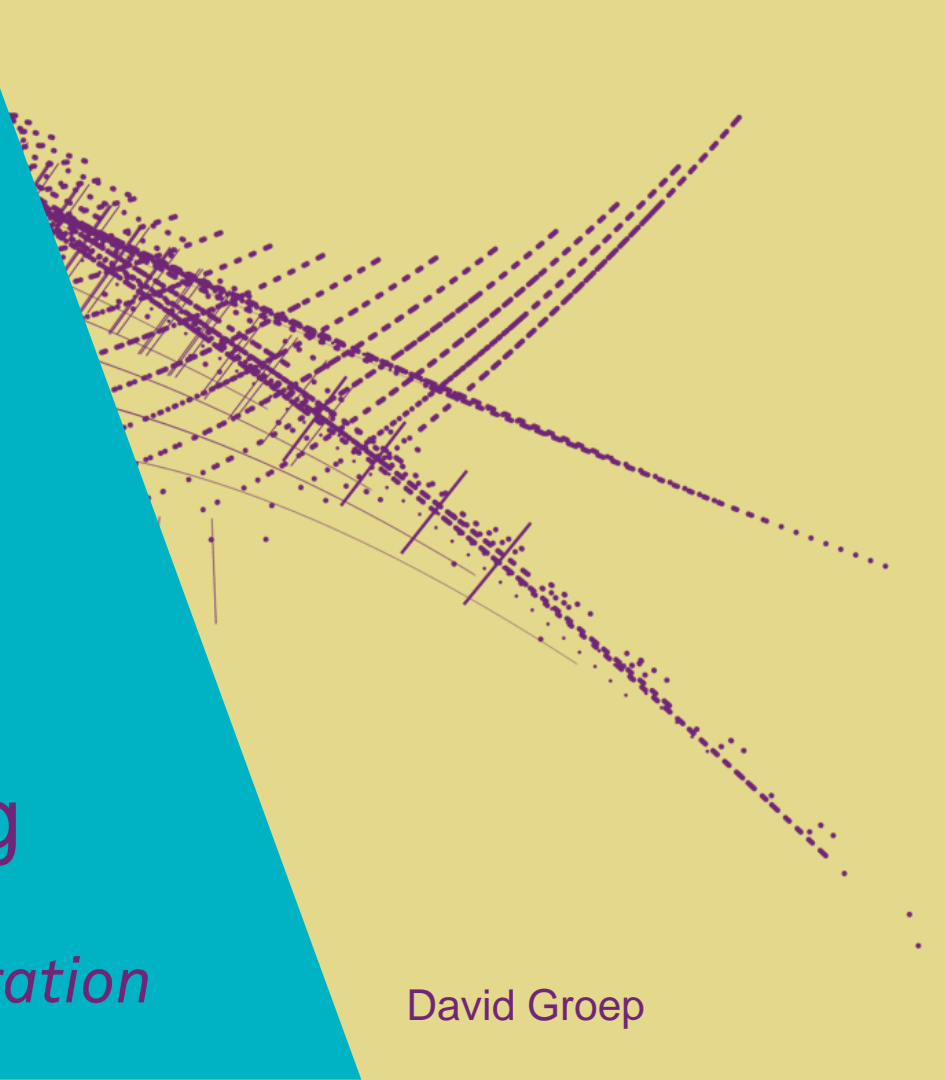Nikhef SAC April 2023

Physics Data Processing
accelerating 'time to science'
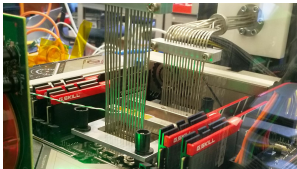*through computing and collaboration*

David Groep

The three pillars of Nikhef Physics Data Processing

Algorithmic design patterns and software

- designing software for (GPU) accelerators, new algorithms, high-performance processors
- software design patterns for workflow & data orchestration
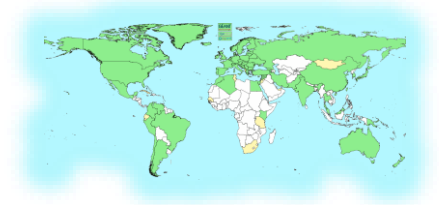

Infrastructure, network & systems co-design R&D

- building 'research IT facilities'
- co-design & development
- big data science innovation
- research *on* IT infrastructure

Infrastructure for trusted collaboration

- trust and identity for enabling communities
- managing complexity of collaboration mechanisms
- securing the infrastructure of our open science cloud

people: 3.6 FTE (2.6 staff + 1 postdoc)
+ ~ 7.5 FTE DevOps and research engineers from the Nikhef computing technology group

Efficient computing and 'accelerated results'

- FASTER: computing for HL-LHC & '4D' reco

- LHCb's Allen full-GPU trigger for HLT1
  - now adding HLT2 and CPU NN implementations

- NLeSC GPU acceleration in LHCb
  and parallel inference with ONNX+tensor ML libraries

- R&D roadmap for hybrid computing
  - link to infrastructure innovation & engineering with vendors
    alternative architectures: non-x86, watercooling, GPU+FPGA, hybrid dies
  - 'scaling and validation', collaboration with computer science (SLICES-RI) & ML algorithms (@UM + RU)
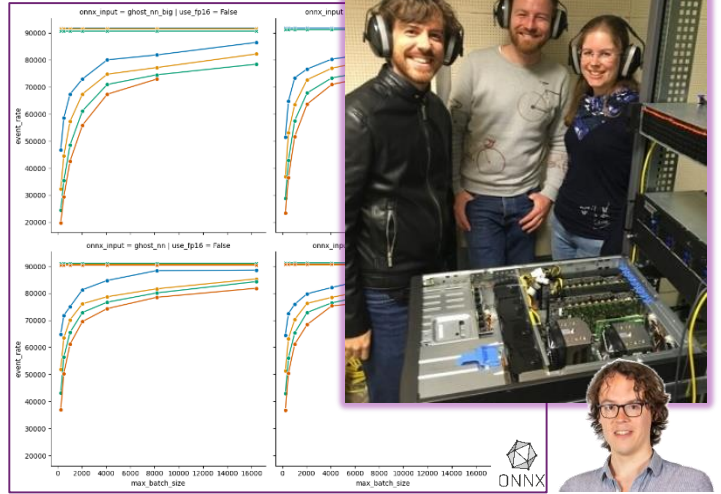
For the long term: Quantum Computing algorithms exploration
- in collaboration with our experiments (notably LHCb and GW), QuSoft (CWI, UvA, *et al.*), SURF, and IBM (Zürich) via Maastricht
- personal expectation: 'production' use far away (>2035?), but work on algorithms, even if ultimately not QC, very interesting anyway

Image: LHCb's *Allen* team: Daniel Campora (Nikhef & UM), Roel Aaij (Nikhef), Dorothea vom Bruch (LPNHE) (source: LPNHE). Graphs: Allen inference event rate vs batch size (NLeSC)
https://github.com/LHC-NLeSC/run-allen-run

PDP: accelerating 'time to science' through computing and collaboration

Infrastructure for Research

High-through compute (HTC) + HT storage

- National e-Infrastructure coordinated by SURF
- NL-T1, IGWN, KM3NeT, Xenon, DUNE
  + WeNMR, MinE, …
- 'Stoomboot' local analysis facility + IGWN cluster & 'submit node'

~ 12 000 cores, 13 PByte storage installed, with pretty competitive TCO!

Space Allocated

	current	percentage
alice-pools	604 TiB	28%
antares-pools	125 TiB	6%
atlas-pools	708 TiB	33%
auger-pools	51 TiB	2%
bfys-pools	149 TiB	7%
datagrid-pools	4 TiB	0%
default	0 B	0%
detrd-pools	25 TiB	1%
etseis-pools	51 TiB	2%
grawway-pools	25 TiB	1%
hisparc-pools	99 TiB	5%
km3net-pools	203 TiB	9%
test-pools	25 TiB	1%
theorie-pools	25 TiB	1%
unused	867 TiB	40%
xenon-pools	51 TiB	2%

unused	(4.7)
atlb	(37.2)
lhcbpil	(26.2)
alicesgm	(12.3)
atlaspil	(5.8)
enmr	(1.9)
ligo	(1.9)
auger	(1.7)
other	(8.3)

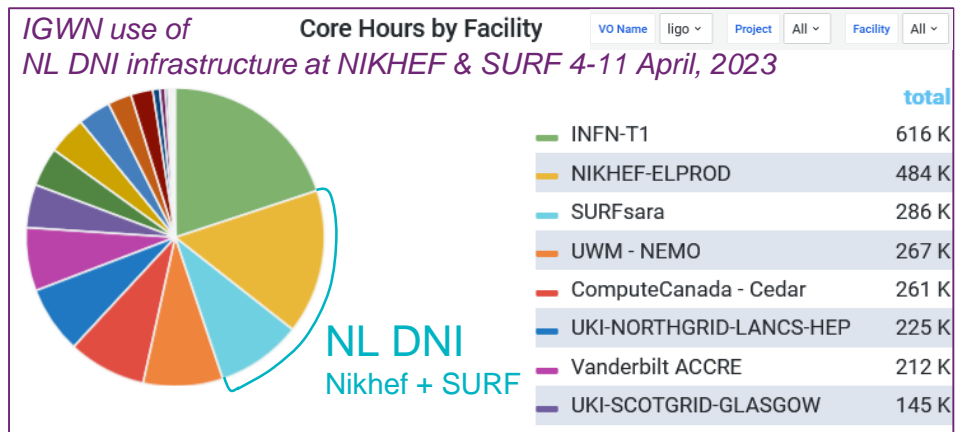| unused	(3.2)
lhcbpil	(40.3)
ligo	(27.4)
atlb	(9.2)
atlaspil	(7.3)
alicesgm	(6.9)
enmr	(2.0)
other	(3.7)

Occupancy: NDPF DNI processing facility. Faster processors (AMD Rome) allows processing in fewer cores using less power

Common solutions are essential for our 'national' facility

We promote alignment of general purpose e-Infrastructure and use by experiments (LHC, GW, KM3NeT, DUNE, Xenon, ...)

- *common solutions* since bespoke systems for each experiment do not scale for Nikhef (NL)

- needed for both efficient resource sharing and importantly: for our DevOps people

IGWN use of NL DNI infrastructure at NIKHEF & SURF 4-11 April, 2023

Core Hours by Facility

| VO Name | ligo | Project | All | Facility | All |

		total
INFN-T1		616 K
NIKHEF-ELPROD		484 K
SURFsara		286 K
UWM - NEMO		267 K
ComputeCanada - Cedar		261 K
UKI-NORTHGRID-LANCS-HEP		225 K
Vanderbilt ACCRE		212 K
UKI-SCOTGRID-GLASGOW		145 K

NL DNI
Nikhef + SURF

Continuation of our long-term strategy - from EU DataGrid onwards:
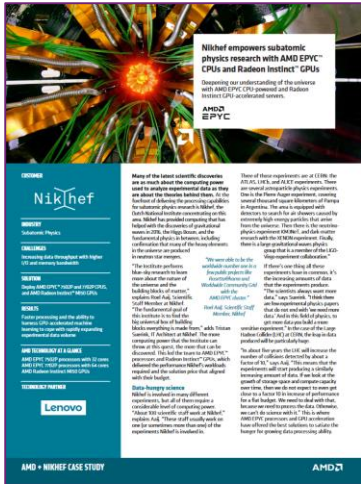
- drives collaborative efforts we work with for identity management and common protocols:
  ACCESS-CI and CILogon (US) – which are key players for LIGO, DUNE, and US-ATLAS
- common processing framework development (e.g. together with KM3NeT in its INFRADEV project)

Data on Tue April 11th 2023 from the OSG accounting for the LIGO VO for past week (with also SURFsara fully in production)
https://gracc.opensciencegrid.org/d/9u1-Q3vVz/cpu-payload-jobs?orgId=1&var-ReportableVOName=ligo&var-Project=All&var-Facility=All&var-Probe=All&var-interval=1d&from=1680566400000&to=1681257600000

PDP: accelerating 'time to science' through computing and collaboration

Innovation *on* infrastructure

- Network – systems integration
- Storage throughput & DPUs
- Systems design and tuning

798.49 Gb/s

$\oint$ FUNGIBLE

NIKHEF, SURF AND FUNGIBLE SET NEW BENCHMARK FOR THE WORLD'S FASTEST STORAGE PERFORMANCE

Companies Double Current Performance Record, Setting the New Bar at 6.55 Million Read IOPS

- early engineering engagement with vendors to build us suitable systems
- co-design of our national HPC systems ('Snellius')
- data-intensive compute with DPUs. Or on-NIC FPGAs?
- next-gen networks: >800Gbps (and 400G to CERN)

Image: Minister of Economic Affairs M. Adriaansens launched the Innovation Hub with Nikhef, SURF, Nokia and NL-ix, January 2023. Composite image from https://www.surf.nl/nieuws/minister-adriaansens-lanceert-testomgeving-voor-supersnelle-netwerktechnologie

PDP: accelerating 'time to science' through computing and collaboration
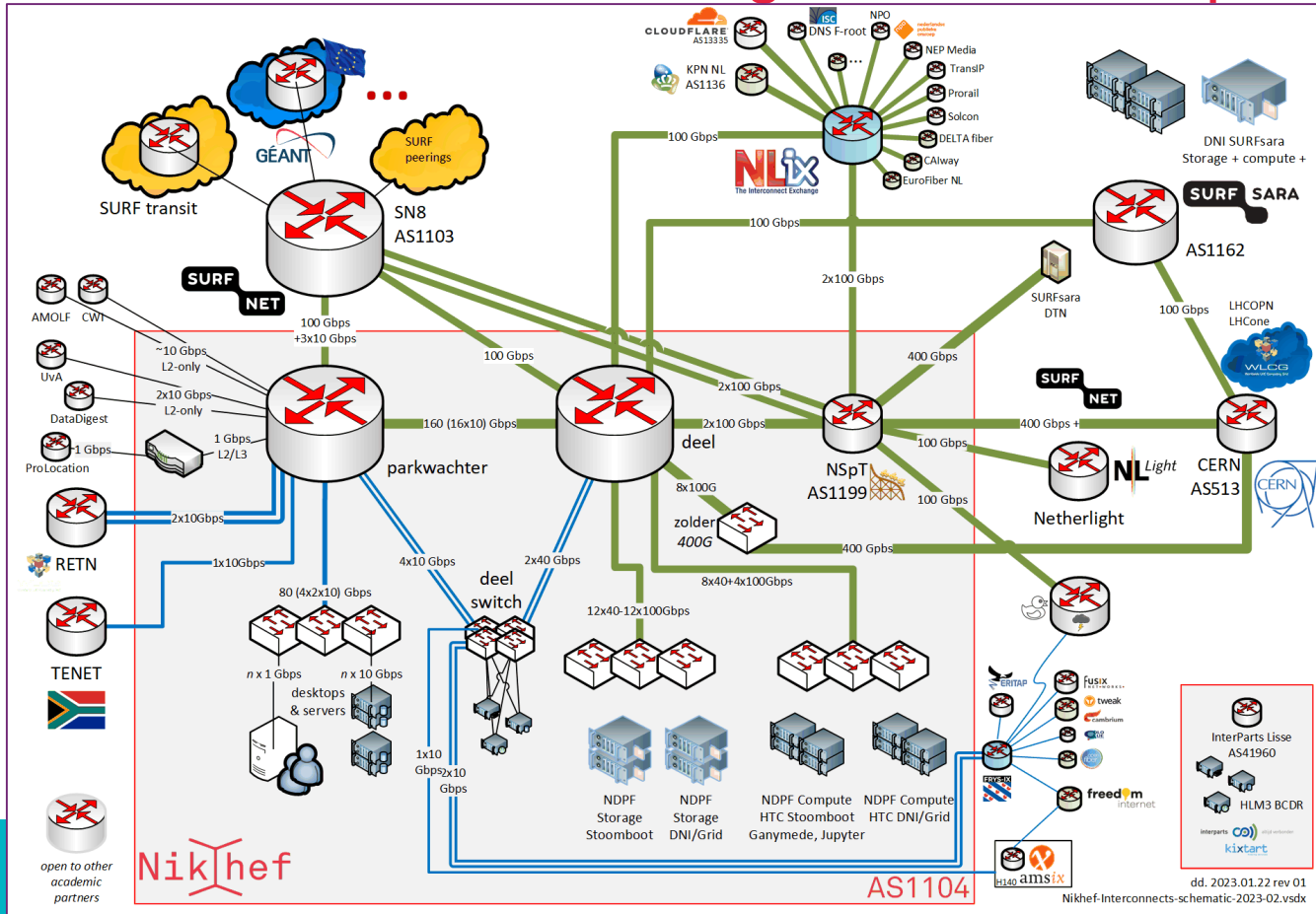
Our science data flows are somebody else's DDoS attack

Belastingdienst

Home > Actueel > ICT en informatievoorziening > De systemen testen dankzij een unieke samenwerking

Lees voor

De systemen testen dankzij een unieke samenwerking

Het begon in 2018. Een bijzondere samenwerking tussen overheden.

Belastingdienst

Home > Aanslagen > Ik heb een DDoS aanslag ontvangen - wat nu?

Ik heb een DDoS aanslag op mijn netwerk ontvangen - wat nu?

U ontvangt een DDoS aanslag op uw netwerk, bijvoorbeeld omdat u vergeten bent werkende tegenmaatregelen te nemen. Er staat dan een geschat aantal pakketten per seconde op uw monitoring.

Dinsdag 14 maart 2023 | Het laatste nieuws het eerst op NU.nl

NU+
Forse ddos-aanvallen en nerdgrapjes tijdens nachtelijke oefening overheid

Door Rutger Otto

12 feb 2023 om 05:02
Update: een maand geleden

202 reacties

... aanvallen en hoe de aanval uitgevoerd wordt. Het 'red team' is verantwoordelijk voor de aanvallen, het 'blue team' voor de verdediging. Een van de partijen die aan de avond meedoet is Nikhef ↗. Tristan, IT architect bij Nikhef, geeft aan "dat zij dit ...
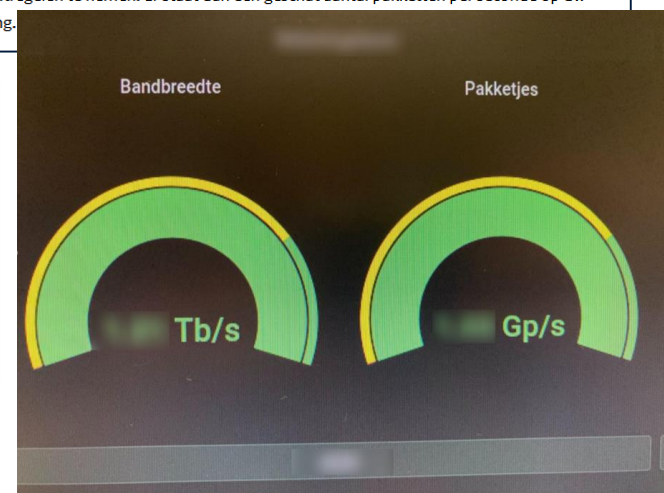
Bandbreedte — Tb/s   Pakketjes — Gp/s

Image sources: belastingdienst.nl, rws.nl, nu.nl, werkentegennederland.nl

PDP: accelerating 'time to science' through computing and collaboration

Infrastructure for Collaboration

Target high-impact specialized areas,
bridging policy & technical architecture for 'AAI' & 'OpSec'

- authentication & authorization for research collaboration
  - **AARC project & community**, GEANT GN5, REFEDS & eduGAIN, EOSCFuture, TCS & RCauth.eu, …
    and planned: EOSC Core, AARC-TREE, EOSC-Q, …
  - **policy for interoperability** for data protection, seamless service access, single-click acceptable use
  - continuous **technical evolution** driving IGWN, WLCG in line with the AARC BPA and global RIs

- embedding of data processing needs of our experiments in the EOSC landscape
  - **EOSC** Interoperability Framework
  - EOSC-A (AAI-TF), **EGI, GEANT community**

PDP: accelerating 'time to science' through computing and collaboration
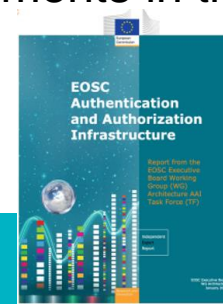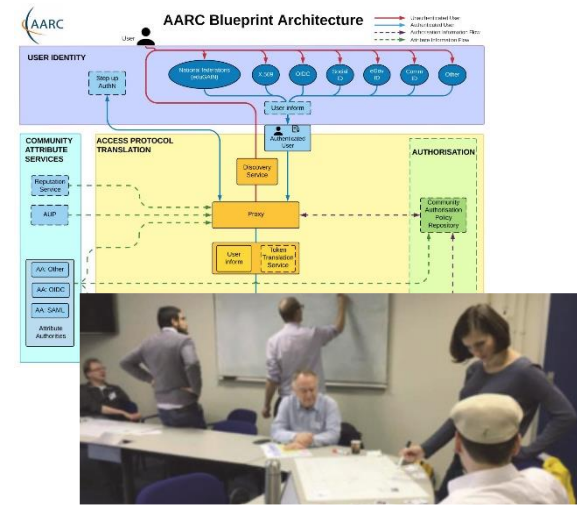
Collaboration: Research Data Management beyond 'FA'

FAIR for **live data and large volumes**, shifting gears towards the "I" and "R"'

- not *that* many disciplines with really **voluminous data**
  - so nationally join forces with those who do: ASTRON (SRCnet), KNMI (earth observation, seismology)
- work with those who care about ***software*** to bring data to life:
  - NLeSC, 4TU.RD/TUDelft, CWI, and with those who ensure the *infrastructure*: SURF
- for our own analyses and the local (R&D) experiments we work towards *continuous deposition* of **re-usable** data and software
  - NWO Thematic Data Competence Centre for the Natural and Engineering Sciences
  - develop Djehuty RDM repository software link to 'Stoomboot' analysis cluster storage
  - research data management is 'just' part of a good science workflow

NES blog
March 2, 2023
Workshop on FAIR for Physical Objects – Summary and Conclusions
Author: Esther Plomp On the first of March 2023, the…
Read article →

NES
February 22, 2023
Submit your idea for TDCC-NES project program funding
We would like to invite researchers in the scientific domain…
Read article →
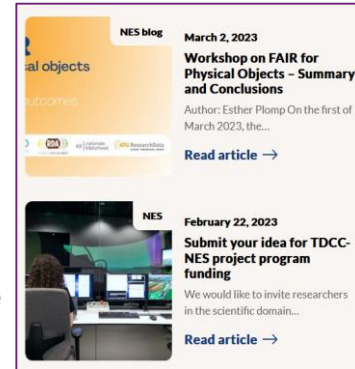
PDP strategic directions and their supporting projects

New initiatives and projects
- *strengthen* the strategic areas
- ensure *continuity* of research and infrastructure

planned project pathways include GN5-*, AARC-TREE, EOSC-Q, EOSC Core, LHC4D Roadmap, …

Public partner R&D engagement
AMD, Nokia, NVidia/MLNX, IBM, NL-ix, …
Dutch national government

Infrastructure R&D and system co-design

Research Software & Acceleration

Infrastructure for Collaboration

PDP: accelerating 'time to science' through computing and collaboration

Nikhef

Where do we plan to go from here?

Strategic focus areas for ~2030
- algorithm design patterns for processing & analysis
- infrastructure design for multi-messenger
- trusted global collaboration and data management

on this 'near term' timescale
- accelerators (such as GPUs and hybrid computing) – also in off-line processing and analysis
- *much* more machine learning – needing both learning and inference
- network bandwidths > 1Tbps, and to more destinations (SURF, CERN, ESnet, TENET, …)
- exploration of distributed processing (integrating trigger, processing, networking, and opportunistic capacity)
- changing collaboration technologies: industry augmenting our bespoke models
- significant changes in service delivery ('data lakes', multi-user workflow systems, science networks, EOSC)

and in due course, we ourselves and as a community will change
    executable papers, 'notebooks' for all Research Environments, 'beyond'-Open-Science workflows,
    'mobile-first' research computing, *and who knows what's more to come?*

PDP: accelerating 'time to science' through computing and collaboration

Because we can … does not mean it's the scalable way ☺
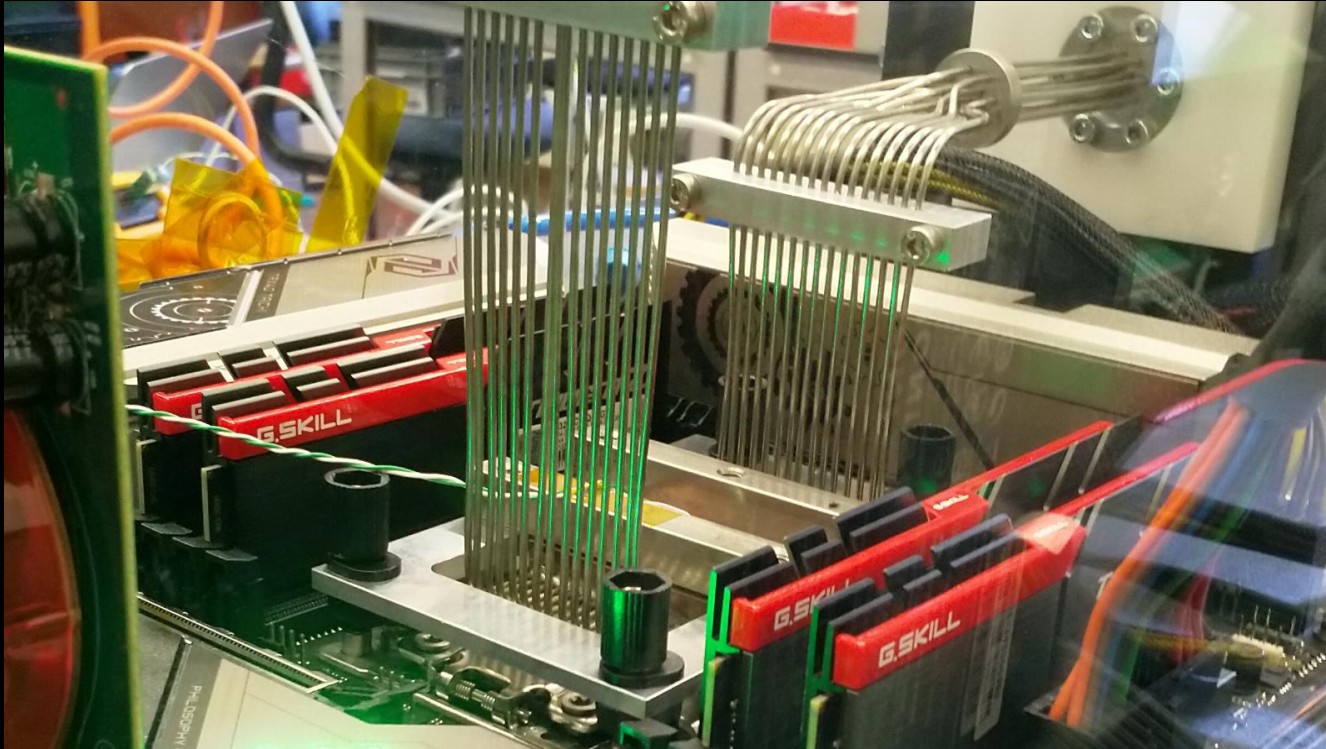
Physics Data Processing
towards results unconstrained by computing

David Groep
davidg@nikhef.nl
https://www.nikhef.nl/~davidg/presentations/
https://orcid.org/0000-0003-1026-6606
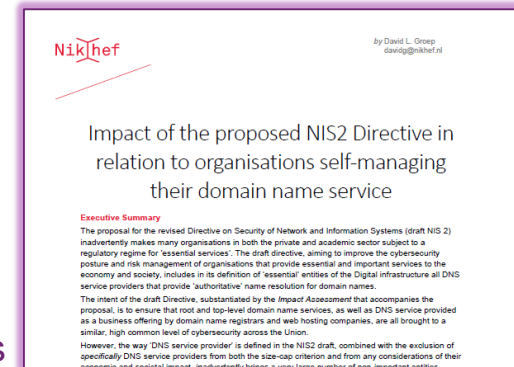
Policy development in ICT and our collaborative values

Our Research Infra (and Open Science) needs a *collaborative* 'values framework'
- frequently threated by increasingly 'corporate' approach to ICT services
- continuous remedial action needed at many levels: from European Commission and EP, down to even our 'own' centralized national institutes organization …

Continued vigilance on IT infra is part of PDP programme
to keep our research ICT infrastructure open, *e.g.* through:
- reviewed & improved NIS2 directive, with our Opinion taken up by the EP;
- watch carefully and continuously NWO's push to 'corporate IT' and its impact on academic integrity & freedom;
- promote trustworthy federated access via AARC (globally), SRAM (our SURF national scheme), promote trust & identity with our university partners
- build scalable security solutions rather than pay corporate 'ISO tick-box' providers

luckily many times in collaboration with GEANT, JISC, STFC, EGI, and our peer institutes in NL

Nik|hef

by David L. Groep
davidg@nikhef.nl

Impact of the proposed NIS2 Directive in relation to organisations self-managing their domain name service

Executive Summary
The proposal for the revised Directive on Security of Network and Information Systems (draft NIS 2) inadvertently makes many organisations in both the private and academic sector subject to a regulatory regime for 'essential services'. The draft directive, aiming to improve the cybersecurity posture and risk management of organisations that provide essential and important services to the economy and society, includes in its definition of 'essential' entities of the Digital infrastructure all DNS service providers that provide 'authoritative' name resolution for domain names.

The intent of the draft Directive, substantiated by the *Impact Assessment* that accompanies the proposal, is to ensure that root and top-level domain name services, as well as DNS service provided by specifically DNS service providers from both the size-cap criterion and from any considerations of their economic and societal impact, inadvertently brings a very large number of non-important entities

However, the way 'DNS service provider' is defined in the NIS2 draft, combined with the exclusion of specifically DNS service providers from both the size-cap criterion and from any considerations of their economic and societal impact, inadvertently brings a very large number of non-important entities

https://doi.org/10.5281/zenodo.4629136

UM   Nik|hef