NordForsk

Nordic WLCG Tier-1 facility: Annual Report 2025

Content

Introduction

The Nordic Tier-1 (NT1) is an operational activity funded by the research funding agencies in **Denmark**, **Finland**, **Norway**, and **Sweden**, and hosted by **NordForsk**. It operates the Nordic Distributed Data Grid Facility (NDGF), one of the 14 regional computing centres of the Worldwide LHC[1] Computing Grid (WLCG) – the large international e-infrastructure created for distributed computing of data from the LHC experiments at CERN[2].

NT1 provides research computing and storage for high-energy physicists worldwide. The facility is unique in being distributed across four countries, Denmark, Finland, Norway, and Sweden. The collaboration in the Nordics began in the early 2000s, when the Worldwide LHC Computing Grid (WLCG) was launched in 2001 to support the computing needs of the LHC experiments. Nordic LHC physicists began exploring distributed computing because no Nordic data centres at the time were sufficiently large or available for international use.

The NorduGrid project (2001–2003) studied the concept and available software, demonstrating that distributed computing worked at the Nordic scale. The Nordic Data Grid Facility (NDGF) project (2003–2006) further expanded the effort, gradually establishing a distributed Nordic computing centre. The first host for NDGF was NORDUnet. Following a 2010 external evaluation, NordForsk became the host in 2012, initially within NeIC and, since 2025, as the independent organisation NT1 operarates as today.

Organisation

Management

Johnny Mogensen, NordForsk, NO	Director
Mathias Hamberg, NordForsk, NO	Special Adviser
Abdulrahman Azab, NO	Activity Owner
Vilma Häkkinen, FI	Administrative Coordinator
Mattias Wadenstein, SE	Activity Manager

The team

Christian Ulrik Søttrup, DK	Tier-1 Operations
Darren Starr, NO	Tier-1 Operations, Storage Developer
Erik Edelmann, FI	Alice Operations Contact
Jens Larsson, SE	Tier-1 Operations
Maiken Pedersen, NO	Developer, ARC Release Manager
Oxana Smirnova, SE	CERN Liaison
Petter Urkedal, DK	Tier-1 Operations
Ville Salmela, FI	Tier-1 Operations

[1] LHC = Large Hadron Collider

[2] CERN = The European Organization for Nuclear Research

The Funding Committee

Gitte Julin Kudsk, DK
Julian Conrad, SE
Marko Peura, FI
Mathias Hamberg, NordForsk, NO
Pål Sørgaard, NO

The NLCG (Nordic LHC Computing Grid) Committee

Farid Ould Saada, NO	Experiments
Håvard Helstrup, NO	Experiments
Jørgen Beck Hansen, DK	Experiments
Josva Kleist, DK	Infrastructure
Paolo Bientinesi, SE	Infrastructure
Jonas Strandberg, SE	Experiments
Sebastian von Alfthan, FI	Infrastructure
Tomas Lindén, FI	Experiments
Oxana Smirnova, SE	Ex officio, Secretary
Mattias Wadenstein, SE	Ex officio, Activity Manager
Abdulrahman Azab, NO	Ex officio, Activity Owner

Responsible science

Nordic Tier-1 implements NordForsk's strategic goals through enabling impactful, high-quality research and research collaboration that delivers Nordic added value. It stands by NordForsk's Gender Equality Policy[3], strongly supporting the importance of diverse and inclusive environments in achieving high performance and attracting the most talented staff.

As an operational activity, NT1 does not participate directly in research. Accordingly, the management of research data remains the responsibility of the researchers conducting the work. The data that NT1 stores and processes belongs to the ALICE and ATLAS collaborations and does not contain sensitive data or data about people.

[3] https://www.nordforsk.org/gender-equality-policy

Operational management report

During 2025, the Nordic Tier-1 activity continued to provide coordinated Nordic support for the Worldwide LHC Computing Grid, ensuring reliable data processing, storage, and analysis services for the Nordic LHC communities. The operational model remains based on close collaboration between the participating Nordic sites and continuous coordination through the NLCG committee.

Operational coordination was maintained through regular NLCG meetings throughout the year. These meetings served as the primary forum for monitoring service availability, reviewing operational issues, coordinating upgrades, and discussing resource planning for the Nordic WLCG infrastructure. The meetings also facilitated communication between site administrators, experiment representatives, and national infrastructure providers.

Throughout 2025, NT1 sites maintained stable service operations and continued supporting the data processing and storage requirements of the LHC experiments. Particular focus was placed on ensuring sufficient capacity and reliability in preparation for future increases in workload associated with Run-3 data processing and the upcoming High-Luminosity LHC (HL-LHC) era.

Operational topics discussed during the year included site service availability, storage management strategies, middleware upgrades, and coordination of software and infrastructure changes affecting Nordic WLCG resources. NT1 partners also continued discussions regarding future infrastructure models, including the balance among distributed resources within the Nordic region.

Another important topic during 2025 was the evaluation of different operational models for the Nordic WLCG infrastructure. This included discussions on how the existing distributed model provides value to Nordic LHC scientists and how potential future models could improve efficiency, service integration, and data access. These discussions form part of the broader strategic evaluation of the NT1 activity.

The NT1 activity also continued to strengthen collaboration between Nordic computing centres, ensuring alignment with both WLCG operational requirements and national e-infrastructure strategies. Coordination between Nordic sites remains essential to provide a coherent and efficient infrastructure for the Nordic LHC research community.

Overall, the NT1 activity successfully maintained stable operations during 2025 while actively engaging in discussions on future infrastructure evolution, ensuring that Nordic contributions remain aligned with the long-term computing requirements of the LHC experiments. NT1 contributions are acknowledged in every publication by the ALICE and ATLAS experiments, a total of 185 ALICE and 252 ATLAS papers in 2025 alone.

NT1 Pledges

For 2025, the Nordic sites participating in the NT1 activity continued to provide computing and storage resources to the LHC experiments. The pledges represent the Nordic contribution to the Worldwide LHC Computing Grid and are coordinated through the NLCG framework.

The pledged resources for 2025 consist of CPU capacity, storage resources, and network connectivity provided by the participating Nordic institutions. These resources support data processing, simulation workloads, and user analysis activities for the LHC experiments.

The NT1 model relies on a distributed set of data centres across the Nordic countries, each contributing resources that collectively form the Nordic WLCG infrastructure. This distributed approach allows Nordic researchers to contribute computing resources according to national commitments while benefiting from coordinated infrastructure planning and operations across the region.

The Nordic sites continued to fulfil their pledged contributions during 2025, ensuring that the Nordic region remains a reliable partner within the WLCG collaboration. Resource provisioning and usage are monitored regularly through the NLCG coordination structure to ensure that commitments to the experiments are met.

In addition to maintaining the pledged computing and storage resources, NT1 partners continued to evaluate future pledge models and infrastructure evolution. This includes considerations related to the potential introduction of more centralised services, shared storage models, and improved integration between Nordic computing facilities.

The continued fulfilment of NT1 pledges reflects the strong commitment of the Nordic countries to supporting the LHC experiments and contributing to the global computing infrastructure required for high-energy physics research.

Economy

The funding level of NT1 is defined in the Memorandum of Understanding. The funding parties – the Swedish Research Council, the Research Council of Finland, the Research Council of Norway, and the Danish e-infrastructure Consortium – pay their share annually.

Accounts for 2025

Financial summary

Item	Amount (MNOK)	Comment
Approved budget 2025	15.357	Annual NT1 budget
Income 2025	15.640	Income is 1.8% above budgeted due to some carry-over from 2024 to 2025
Total committed expenditure 2025	15.173	Includes paid invoices and estimated 2025 invoices that are not yet received
Variance	-0.184	Expenses are 1.2% below budgeted
Carry-over to 2026	0.467	Majority is due to invoice timing across financial year boundaries

Expenditure by activity area

Activity area	Budgeted for 2025 (MNOK)	Committed expenditure 2025 (MNOK)	Comment
Management and coordination	2.856	2.131	Includes supervision, administrative coordination, and activity management
Operations and service delivery	7.493	6.875	Core Tier-1 operations, including personnel, travel, and on-call duty
Development of operational services	1.428	1.452	Software and service development supporting NT1 operations

Central network and shared services	3.580	2.996	WLCG/NORDUnet costs
Prior-year invoices paid in 2025	-	1.719	Relates to 2024 activity
Total committed expenditure 2025		**15.173**	

Detailed explanation

The 2025 accounts are presented using *total committed expenditure*. This includes both paid invoices and estimated costs for work performed in 2025 but invoiced after the financial year was closed. This approach provides a more accurate representation of the actual activity level during the year than relying solely on paid invoices, as NordForsk receives invoices for NT1 from multiple partner organisations and at times with some delay.

The total committed expenditure for 2025 was **15.173 MNOK**, compared to an approved budget of **15.357 MNOK**, corresponding to a **variance of -1.2%**. This confirms that the budget level approved for NT1 in 2025 was overall well aligned with the actual needs of the activity.

Invoice timing and cross-year effects

In the NT1 operating model, all personnel effort is invoiced by partner institutions, either quarterly or on an annual basis and sometimes several months after the work has been performed. As a result, costs associated with one financial year may be recorded in another.

In the 2025 accounts, this effect is visible in two directions:

- **1.7 MNOK** of invoices relating to 2024 were paid in 2025. These costs correspond to approximately one FTE of operations personnel effort and associated on-call duty.
- At the same time, *some invoices relating to 2025 had not yet been received* at the time of financial closure. These costs are therefore included as estimates in the committed expenditure.

Income-side considerations

The funding contributions from Sweden and Denmark were received in full according to the agreed budget.

The contribution from Finland shows a small difference (~109 kNOK), which is due to the payment for 2025 being based on an earlier funding decision. This difference is expected to be corrected as part of the 2026 funding cycle and does not affect the overall financial balance of the activity.

Management and coordination

Costs related to supervision, administrative coordination, and activity management were lower than originally budgeted. The main reason for this is the delayed recruitment of the Administrative Coordinator, who started in mid-November 2025.

During the interim period, the required administrative and coordination functions were maintained to ensure continuity of the activity. The lower cost in 2025 should therefore be understood as a temporary effect related to recruitment timing, rather than a reduced structural need for management and administrative support. This is consistent with the NT1 operating model, where both governance and coordination functions are essential components of the activity.

Operations and service delivery

Operations and service delivery represent the largest cost component of NT1 and include distributed personnel effort across partner sites, travel and meeting costs, and on-call duty for maintaining service availability.

Overall costs in this area were slightly below budget. This is partly explained by the *on-call duty model*, where the 2025 budget was set to accommodate a potentially more complex and higher-overhead organisational structure. In practice, the service continued to operate using a more direct and efficient operational model without additional overheads, resulting in lower costs for the year.

It is important to note that this reflects a favourable operational setup rather than a reduced need for on-call capability, which remains a critical component of Tier-1 service reliability.

Development of operational services

Development costs were in line with the planned budget and reflect ongoing work on core NT1 software and services supporting operations, including middleware, storage systems, and accounting tools. Maintaining this development capacity is essential for ensuring long-term sustainability and scalability of the NT1 infrastructure, particularly in view of the increasing demands expected from future LHC data-taking periods.

Central network and shared services

Costs associated with WLCG and NORDUnet services were lower than budgeted in 2025. This is primarily due to a temporary reduction in costs, as NT1 benefited from existing central infrastructure funds that had already been paid off in previous years. The reported cost for 2025 (207,100 EUR = 2,995,918 NOK) is therefore lower than in previous years, but this reduction is temporary. For 2026, costs are expected to return to a higher, more typical level.

Overall assessment

Overall, the 2025 financial results show that NT1 operated *very close to its planned budget*, with a variance of only 1.2%. The differences observed within individual cost areas can be explained by:

- timing of invoices across financial years,
- delayed recruitment in administrative coordination,
- temporary operational efficiencies (e.g. on-call model), and
- short-term reductions in shared infrastructure costs.

These factors are either *one-off or timing-related* and do not indicate a reduction in the underlying funding needs of the activity. The accounts therefore support the conclusion that the current funding level remains appropriate for maintaining NT1 operations and supporting its role within the Worldwide LHC Computing Grid.