

Document Number:	CAG X-X
Document title:	Nordic end-to-end monitoring collaboration
Author	Otto J Wittner, Olav Kvittem, Olaf Schjelderup
Date & Time:	2021-08-26 12:52:28
Location:	VCONF

CAG X-X.1 Request:

(Executive summary)

The NORDUnet CAG is kindly requested to approve funding for the efforts required to scale up and generalize a next level and advanced network quality monitoring system already prototyped and value proved by Uninett. The system applies end-to-end monitoring to reveal undesirable drops in network dependability at both macro and micro scales. The tentative name of the system is *Microdep*. To our knowledge the system, with its ability to monitor high resolution aspects of end-to-end network quality important for modern online services, is not realized by any other product on the marked.

Further development and upscaling of the Microdep system will enable NORDUnet and all Nordic NRENs to utilize it and contribute to its improvement. As a first step to fuel necessary nordic collaboration we suggest to expand the measurement probe topology to include selected locations in NORDUnet and the NRENs as well as important external service providers. We also suggest adding simple multi-tenant features to give each NOC a tailored view of the measurement results, and further add a real-time routing monitoring feature, to assist NOCs in maintaining high end-to-end network quality for both general and critical connectivity for our customers.

The resulting system could be a candidate for further funding by for instance Geant, and potentially integrated into the perfSONAR platform. A lot of other future use-cases have been identified, which all would contribute to the continuous improvement of our network - touching possible limits of excellence.

Here we propose a pre-project for rest of 2021 to get a Nordic basic system up and running and kick-start a potentially long-term Nordic collaboration in this field. A total amount of **€39,909 in funding** is requested. A summarized project budget is given in Table 1 and more details in attachment 2. Work package descriptions in attachment 1 present context for the distribution of FTE hours and equipment costs.

Table 1: Summarized project budget (rough estimate, FTE hours could be adjusted between NRENs)

	FTE hours	Equipment €	Cost €	In-kind €	Funding €
Uninett	200	4,400	29,052	8,000	21,052
Funet	40	400	5,330	2,000	3,330
Sunet	20	400	2,865	1,000	1,865
DeiC	20	400	2,865	1,000	1,865
NORDUnet	60	5,400	12,796	1,000	11,796
Total requested funding					39909 €

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CAG X-X.2 Background

Uninett has for more than a decade developed and experimented with an end-to-end measurement system based purely on none-specialized hardware and open source software

The system, named Microdep, has by 2020 reached a small-scale production status at Uninett. The current running version is generating reports made available to Uninett's operational center. A map showing connectivity status is also available publicly via <https://iou2.uninett.no/microdep/>.

Uninett has presented results and findings from our experimental work with the system regularly/annually in numerous fora, including RIPE and IRTF meetings, GEANT workshops, TNC, and scientific conferences.

In Spring 2021 Uninett presented their latest version of the system for a NORDUnet consortium, with very positive feedback endorsing its usefulness for improving network quality, detecting connectivity issues in our blindness zone and hence potential for providing an even better customer experience. The partners present found the maturity level of the system to be such that a larger scale deployment in the Nordic countries core networks was of interest.

CAG X-X.3 Analysis

There are a number of challenges in designing, developing and tuning an active monitoring system. The more important of them are

- *Well balanced probe packet generation*
- *Accuracy aware timestamp management*
- *Robust and balanced measurement collection*
- *Long term storage routines for large scale data sets*

These challenges have been addressed repeatedly during the experimental phase of the development of Microdep. The current running version at Uninett incorporates a number of measures to handle the above-mentioned aspects. The efforts and experience incorporated into the system has significant value and could (and should) be made available to all the Nordic NRENS and NORDUnet (and other ISPs).

The Microdep system has been developed in parallel with the development of perfSONAR. Both systems have over time matured significantly, and an integration should now be within reach.

CAG X-X.4 Business Impact for NORDUnet/NRENS

The Microdep end-to-end monitoring system has already proven its value on several occasions for Uninett including issues originated in the NORDUnet network, e.g. suspiciously long routing convergence times for inter-domain routing have been detected and routers reconfigured, root causes for networking issues found to be inside data-center network rather

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than in core, daily 2-minute outages with a NORDUnet MPLS-transporter in the USA was revealed, and the more recent Aug 10th unintended side effects of a BGP reconfiguration in NORDUnet was detected and reported.

By scaling up the deployment and usage of Microdep inter-domain quality of service may be monitored more closely, and hence network stability and user satisfaction ensured and documented.

A prime function of the NREns is to provide highly reliable and high-capacity services to Big Sciences like CERN, Eiscat3d and scientific monitoring satellite services, where small outages can hamper transfer rate substantially. As the majority of legacy services offered to higher education institutions by the NREns rely much on data-center resources and services often located in other domain than the user's, ensuring efficient networking between the users and resources in these datacenters is crucial. NORDUnet acts, on behalf of the Scandinavian NREns, to a large extent as the peering partner to the "big players" of the Internet, e.g. Google, Facebook, Amazon, Microsoft - and in addition provide on-prem services (like Zoom) where it is important to localize and document failures and quality reduction. Hence monitoring and ensuring correct operation of end-to-end user connections across the NREns and Nordunet core networks is important, but also to other important networks and service domains on the internet in general. The Microdep system may assist the NREns and Nordunet with this challenge and contribute to continuous improvement.

Table 2 presents a SWOT analysis of the project proposal.

Table 2: SWOT of proposal

SWOT-analysis	
<p>Strengths</p> <ul style="list-style-type: none"> Increase awareness of micro outages Improve network service dependability Measure actual availability Runs on multiple Linux platforms Detect multidomain network service issues Detect unintended "side effects" of router re-configurations 	<p>Weaknesses</p> <ul style="list-style-type: none"> Currently operated by only one NREN/customer Lacks multi-tenancy support People too busy to engage
<p>Opportunities</p> <ul style="list-style-type: none"> An investment in even better network quality Improvement of network operation collaboration Improved customer experience Make it a Nordic strong-point internationally Strengthen the high quality of NREns Geant funding further down the road Getting adopted in a wider community 	<p>Threats</p> <ul style="list-style-type: none"> perfSONAR system architecture might not be ideal access to perfSONAR resources not clear Geant support dependent on available funds
<p>Summary:</p> <p>Strengths and opportunities clearly outweigh weaknesses and threats. Weaknesses may be handled given sufficient funding. Threats may slow development of next gen system, but not reduce value of the current system.</p>	

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CAG X-X.5 Work packages, Deliverables and Time-lines

The pre-project is structured into set of small work packages (WP):

- WP1: Teaming up Nordic NRENs and NORDUnet, preparing for initial roll-out.
- WP2: Clarify initial objectives regarding simple route monitoring and end2end network quality. Nordic pilot instrumentation/roll-out
- WP3: Foundation for upcoming main project
 1. Initial system architecture review
 2. PerfSONAR integration assessment
 3. Business opportunities and project plan for main project and roll-out 2022

A summary of deliverables including due dates and responsible person is presented in Table 3.

Further details for each WP are available in attachment 1.

Table 3: List of deliverables

ID	Description	Due date	Responsible
WP1	Monthly progress report	End of each month	(To be decided)
WP2-1	New operational version of system	2021-11-20	(To be decided)
WP2-2	Demo at NTW	2021-11-30	(To be decided)
WP3.1	Updated issues list	2021-11-15	(To be decided)
WP3.2	Integration plan ready	2021-10-15	(To be decided)
WP3.3	Draft project plan for main project	2021-12-31	(To be decided)

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CAG X-X.6 Attachment: 1 - Work package details

WP1: Teaming up Nordic NRENs and NORDUnet, preparing for initial roll-out.

Objectives:

- Ensure necessary coordination and admin resources is in place for pre-project.

Actions

- Ensure regular meetings
- Follow up resource usage
- Coordinate attendance and reporting at NTW

Deliverables

1. Monthly progress report til Nordunet CAG and Nordunet metric group

Start date: Sept 13, 2021

End date: Dec 17, 2021

FTE hours: 50

Equipment cost: 0

Lead: NORDUnet

Contributors: NORDUnet and Uninett

WP2: Nordic pilot instrumentation

Objectives:

- New operational version of Uninett's "Microdep" where all project partners are included.
- Adjusted/optimized measurement topology.
- Support for detection of abnormal routing changes.
- Improved near real-time support
- Shared cost of data center probes

Actions:

- Add and configure 2-5 new measurement nodes (probes) per partner
- Add new probes on premises of important Nordic services, e.g. Zoom, Kaltura, Media-site, Panopto.
- Include current data-center probes (i.e. Amazon, Azure and Google probes) in Nordic pool of probes, and transfer rental cost of commercial probe VMs to NORDUnet.
- Utilize and configure Microdep system to collect data from new probes.
- Enhance Uninett's Microdep map to provide tailored profiles/view for each partner
- Integrate Uninett's prototype routing monitor into system
- Improve real-time reporting of start of abnormal event

Deliverables:

1. New operational version of Microdep end-to-end at <https://microdep.net>

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2. Demo at NTW in Nov/Dec

Start date: Sept 13, 2021

End date: Dec 31, 2021

FTE hours: 110

Equipment cost: 10 Raspberry Pi 4 kits ~ € 2000, DC VMs for 1/2y ~ € 5000, Server side resources (CPU, storage) ~ € 4000

Lead: Uninett

Contributors: All partners

WP3: Foundation for upcoming main project

Three sub tasks are planned for this package.

3.1 System architecture review

Objectives:

- Well-structured architecture and code base for monitoring system
- Ensure firm foundation for upscaling and relevance to Geant community

Actions:

- Review of system architecture, code base and documentation

Deliverables

1. Updated issue list

Start date: Oct 15, 2021

End date: Nov 15, 2021

FTE hours: 50

Equipment cost: 0

Lead: Funet (a suggestion)

Contributors: Uninett

3.2 PerfSONAR integration

Objectives:

- Obtain agreement with PerfSONAR operations about Microdep integration
- Developed plan for integration

Actions:

- Lobby in Geant meetups. Vote for project.
- Dialog with PerfSONAR team
- Examine Microdep code base compatibility with PerfSONAR

Deliverables

1. Integration plan for upcoming main project

Start date: Oct 15, 2021

End date: Nov 15, 2021

FTE hours: 50

Equipment cost: 0

Lead: Uninett

Contributors: Mainly Uninett, but also other partners

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3.3 Business opportunities and plan for main project

Objectives:

- Awareness about future funding options
- Develop feature-list for next generation end-to-end monitoring system
- Prepared draft project plan for main project in 2022

Actions:

- Examine potential markets for Microdep system
- Study and suggest business models for system operations and up-scaling
- Collect feature requests from partners
- Based on results from all WPs compose draft plan for main project in 2022

Deliverables:

- Draft project plan proposal for main project 2022.

Start date: Dec 1, 2021

End date: Dec 31, 2021

FTE hours: 80

Equipment cost: 0

Lead: Uninett

Contributors: All partners

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CAG X-X.6 Attachment: 1 - Detailed Budget

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FTE costs per hour in €	
Uninett	123
Funet	123
Sunet	123
DeiC	123
NORDUnet	123

(Note: All costs are based on Uninett's FTE rate)

	Per NREN	FTE hours		
		WP1	WP2	WP3
Uninett	200	20	70	110
Funet	40		10	30
Sunet	20		10	10
DeiC	20		10	10
NORDUnet	60	30	10	20
Total	340	50	110	180

	Per NREN	Equipment costs €		
		WP1	WP2	WP3
Uninett	4,400	0	4400	0
Funet	400	0	400	0
Sunet	400	0	400	0
DeiC	400	0	400	0
NORDUnet	5,400	0	5,400	0
Total	11,000		11,000	

	Cost	In kind	Funding
Uninett	29,052	8,000	21,052
Funet	5,330	2,000	3,330
Sunet	2,865	1,000	1,865
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Summary

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