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PILOT 2021 2026

DELIVERABLE REPORT

WP10: TAS - TA programme support structures: Technical Liaison Network (TLNet) and pilot User Office Network (UONet)

D10.2

The NEP Technical Liaison Network (TLNet): implementation report

Due date

M12

This initiative has received funding from the EU's H2020 framework program for research and innovation under grant agreement n. 101007417, NFFA-Europe Pilot Project

PROJECT DETAILS

PROJECT ACRONYM	PROJECT TITLE
NEP	Nanoscience Foundries and Fine Analysis - Europe|PILOT

GRANT AGREEMENT NO:	FUNDING SCHEME
101007417	RIA - Research and Innovation action

START DATE

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WORK PACKAGE DETAILS

WORK PACKAGE ID	WORK PACKAGE TITLE
WP10	TAS - TA programme support structures: Technical Liaison Network (TLNet) and pilot User Office Network (UONet)

WORK PACKAGE LEADER

Roberto Gotter (CNR)

DELIVERABLE DETAILS

DELIVERABLE ID	DELIVERABLE TITLE
D – D10.1	The NEP Technical Liaison Network (TLNet): implementation report

DELIVERABLE DESCRIPTION

The deliverable presents the implementation of the service structure supporting the Open Access to NFFA-EUROPE, the Technical Liaison Network (TLNet): a centralized technical authority in charge to assess the technical feasibility and the best work-flow for the peer-review prioritised research. Concept, structure, terms of references, and IC tools developed for the TLNet operations are reported.

DUE DATE	ACTUAL SUBMISSION DATE
M12 (Month) 28/02/2022	28/03/2022

AUTHORS

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PERSON RESPONSIBLE FOR THE DELIVERABLE

Roberto Gotter (CNR)

NATURE

☒ R - Report

☐ P - Prototype

☐ DEC - Websites, Patent filing, Press & media actions, Videos, etc

☐ O - Other

DISSEMINATION LEVEL

☒ P - Public

☐ PP - Restricted to other programme participants & EC: (Specify)

☐ RE - Restricted to a group (Specify)

☐ CO - Confidential, only for members of the consortium

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3	14/03/2021	Orani	Drafting	Advanced draft
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5	28/03/2022	Orani, Gotter, MG	Final check	Final version

CONTENTS

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1. Executive Summary

The multidisciplinary research context requires an effective and reliable integration of different research infrastructures and academic facilities. NFFA-EUROPE is an interoperable multi-technique, multi-competence, multi-site distributed research infrastructure, offering a wide ensemble of tools for nanoscience and nanotechnology devoted to research and innovation, covering many TRLs, and therefore involving different competences. The Open Access to such a complex distributed research infrastructure is managed by a support service structure, the Technical Liaison Network (TLNet): a centralized technical authority, involving all nodes, in charge to assess the technical request/offer, and to establish the feasibility and the best work-flow for the peer-review prioritised research.

The full TLNet service, i.e. a widespread network of experts, rules of engagement and well defined technical evaluation procedures, and an efficient communication system, have been implemented with the objective to be us much as possible user-friendly for both (new) providers and (new) users, by making wide use of smart front-ends, interfacing with a huge database managed with a complex back-end, for creating a common platform to share data and exchange information among providers offering different competences, and between users and providers.

The TLNet has been implemented as a distributed network consisting of a Central coordinating TLNet node (at the Coordinator headquarters) and Local TLNet nodes at the providers, as established in June 2021. The network has been initially operative with a temporary IC platform hosted on the GARR network, ready for the 1st Call for proposals. Then, from the 2nd Call (technical evaluation in February 2022), a final set of online monitoring tools, directly implemented in the Single Entry Point, have been used, allowing the TLNet to reach a full perceptiveness on the access.

2. Need for a multidisciplinary integration of RIs

In a contest of a very fast progress, not only technology evolves, providing new products and services improving our well-being and a better sustainability of our activities, but also science changes leading to new paradigms. Multidisciplinarity is probably the most important keyword; even if other aspects like impact, sustainability, TRL play a fundamental role in science policy.

Today's technological challenges are defined down to the last links in the innovation chain, with direct impact on the society and on the production systems, thus giving rise to complex research and development paths, which appear to be articulated in different TRL levels and in different disciplines. At the same time, the amount of knowledge in each discipline has grown exponentially with respect to the last century, and will further grow at an increased pace. This has made scientists more and more specialised in specific sectors, and the amount of data of scientific results is becoming too difficult to handle in such a way to make them useful, exploitable and usable by each individual of the scientific communities. It is therefore mandatory to adapt the approach to science and access to scientific resources/data in such a perspective of inexorable growth of cross-linked activities.

In a multidisciplinary approach, researchers from several disciplines work together on a common problem, without altering their disciplinary approaches, and not always developing a common conceptual framework. When state of the art scientific methods are involved, an important role is played by research infrastructures (RIs), providing valuable services to the scientific communities in addressing their challenges. There are many relevant RIs open to external users, like Large Scale Facilities (synchrotron radiation and neutron sources), providing advanced instrumentation that is not otherwise available in academic and industrial research groups. There are also many valuable

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scientific resources and facilities (clean rooms, HPC, power laser) located at large research centres; these, however, are not open or only partially open to external users. There is therefore plenty of scientific and technological capabilities, fragmented in different sectors, with a certain capacity to be open to external users. In a scenario of multidisciplinary approach, the need of multidisciplinary research infrastructures, or more likely, a distributed integration among facilities and laboratories providing different competences, is evident.

NFFA-EUROPE has developed and implemented a novel approach to manage and provide open access to a complex distributed multidisciplinary infrastructure. Given a full research project, constituted of several steps referring to different competences/technologies, submitted by an external user team and accepted for granting by a third international scientific panel, the best work-plan to be carried out at properly chosen sites in a distributed network of many different facilities and diverse scientific competences, is identified and optimised.

The scheme here proposed for NEP (NFFA-EUROPE|PILOT) comes from, and further enhances, the experience gained in the H2020 Project NFFA-EUROPE (2015-2021). The NFFA (Nanoscience Foundries and Fine Analysis) distributed infrastructure has the mission to allow researchers to face complex nanoscience challenges that cannot be solved by accessing just any single research infrastructure alone. Combined access to resources of internationally competitive academic and research centre laboratories and Analytical Large-Scale Facilities (ALSFs) is made available in a unique combination of services and techniques for a broad academic user community & industries. The NFFA Europe research infrastructure integrates nano-foundries capabilities (synthesis, growth and manipulation of nanostructures) with fine analysis (characterisation of morphological, electronics, chemical and magnetic properties), theory and simulation, and with the possibility to scale-up systems and devices. Thanks to the wide spectrum of available techniques and services, researchers accessing the NFFA-Europe facilities can control and design the properties of materials from the nano- to the micro-scale, and even up to the macro-scale.

A key innovation of NFFA-Europe is the Technical Liaison Network (TLNet) that is the hub for users to formulate their research projects and the hub for the distributed facility providers to optimise Open Access work-plans and schedules. NFFA-Europe, through the creation of the TLNet, has the ambition to optimize the use of the research facilities of the Consortium and to create a benchmarking system that will identify and coordinate future upgrades and spread the best practices in operation.

3. The concept of optimised technical integration and interoperability for a multidisciplinary offer

At present, in NEP, 39 research infrastructures, located in as many provider sites around Europe, involving 26 European partners, provide about 180 experimental techniques and access to theory and simulation methods, involving more than 600 technique-access-points.

Taking into account that one technique-access-point may provide access to more laboratories (for instance more beamlines providing the XPS technique at the same synchrotron), and the fact that one access-point, EuroNanoLab, has indeed a structured network over 12 different research centres, the overall NEP offer provides access to more than 1500 laboratories (instruments).

These numbers clearly show a strong redundancy in the offer; indeed, only one third of the techniques are offered by a single provider as specific and highly specialised offer, while two thirds

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of the techniques are offered on average by 11 different instruments. For some techniques, even a standard service access mode is identified, in cases where remote access is provided to a set of instruments located in different locations offering the same type of service, again highlighting a high degree of interoperability between similar instrumentation at different research infrastructures. Such a redundancy allows to increase the feasibility success rate of the proposed experiments (the suitability of same technique can be based on different background expertise) and to optimise the access, from the point of view of the logistics related to the user work-plans as well as to the workload of the different providers.

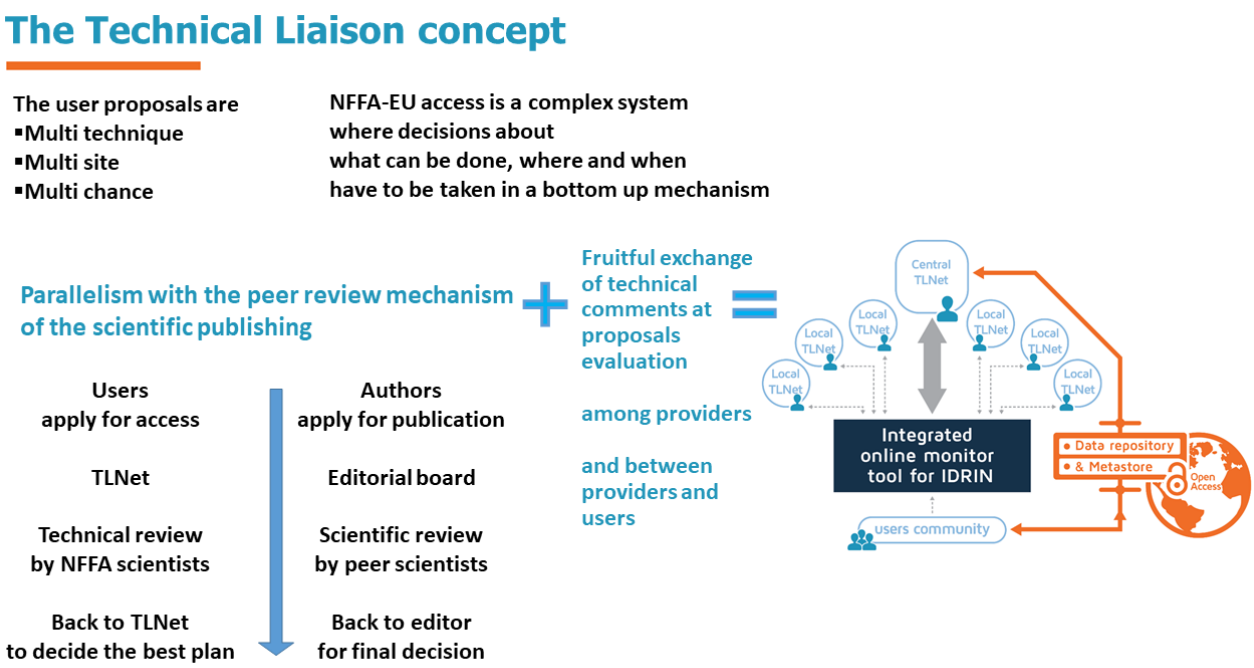
There is therefore a high degree of freedom in assigning a precise access-work-flow for a requested user-work-plan, which has to be exploited and managed efficiently.

Multi-site and multi-competence work-plans need to transfer samples or sample preparation procedures among different laboratories, even not co-located, thus demanding a reliable interoperability capability. This takes advantage from the high degree of redundancy, which will allow comparable working conditions or results to be verified.

The management of such a complex system requires:

1. a widespread network of committed experts
2. rules of engagement and well defined technical evaluation procedures
3. an efficient communication system.

This is indeed the concept of the Technical Liaison Network TLNet.



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4. TLNet structure and terms of references

User access to NEP facilities relies on the services of a central technical authority, the Technical Liaison Network (TLNet), a concept first developed within the NFFA FP7 Design Study and then implemented in NFFA-Europe as a unique platform for complying with the complexity of the multidisciplinary offer and of the proposals' typology, which implies the coordinated use of multiple installations (multi-site and multi-technique access).

The TLNet is thus the technical backbone of the distributed infrastructure that is in charge of the technical integration across the nodes, of the development of interoperability practices and their monitoring, and of the management of the technical offer. It acts as the technical neural system of the research infrastructure, sharing knowledge, protocols and best practices and training the staff to the highest performance of the integrated albeit distributed RI. It is the operative hub of NFFA-Europe, assuring dialogue with users, local desk-service, technical support, feasibility checks, and processing of the proposals.

One of the major commitments of the TLNet is to establish the technical feasibility of a given proposal through access to one or more nodes, to optimize the user work-plan, and to formulate the best work-flow and access sequence to the relevant nodes for executing the scientifically prioritised user projects, and finally to coordinate the interoperability of access to different providers.

A data base of all instruments and competences and their operational status are the basic reference for the feasibility analysis of the projects, but at the very end a detailed analysis at instrument level is necessary, where the technical feasibility for all the instruments potentially involved for all the steps of the proposal should be provided by the respective instrument scientists. This requires the intervention of many people who cannot be continuously committed for a long time to the TLNet operations: they should be contacted very quickly, on demand, possibly in groups of growing priority and in a very efficient way.

For such a reason, in order to limit the amount of personnel strongly committed in TLNet management, reaching anyway a widespread and capillary network of all the technical competences across the NFFA-Europe nodes, laboratories and instruments, the TLNet combines competences and scientific skills of the consortium in a single access service with a mechanism similar to the peer-review system of an editorial board that collects technical evaluations from the NFFA installations and nodes and formulates the best suited solution for the user project.

The TLNet is structured as a distributed network consisting of a Central coordinating TLNet node (at the Coordinator headquarters) and Local TLNet nodes at the premises of provider nodes. In case of big provider nodes, offering several installations with many techniques, Local nodes can be structured with more than one local contact, in charge of providing technical information and evaluations for a group or even single instruments. For instance, at CNR-IOM, co-located with the two large facilities Elettra and Fermi, a local TLNet coordinator has been appointed in charge of managing the TLNet contribution from all the CNR-IOM instrument scientists, who have direct access to the SEP platform to provide evaluations and technical contributions. The local coordination informs about deadlines, monitors the timeline of due contributions, and manages critical or negative assessments arranging new evaluations in order to provide timely alternative access by a dialogue with the other NFFA Local nodes.

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The Central node and one representative of each Local node constitute the TLNet team, equivalent to an editorial board, with the chief editor and the associated editors. The Central TLNet team collects, sorts, and passes the proposals to the involved Local nodes, with assignments grouped in priority bunches to be carried out with specific timing. The Local nodes then collect all the necessary technical evaluations by the individual instrument scientists, who are equivalent to the referees. The final work-flow of the user proposal, if evaluated feasible and subsequently accepted by the ARP, is optimised by a dialogue between the Central and the Local nodes, on the basis of technical, logistic and workload aspects and thus finally assigned to local providers. After the assignment, the Local TLNet nodes will be in charge of access scheduling, of user support before, during, and after the approved user project takes place, and of the collection of all the information necessary for the monitoring, the reporting and the analysis of the User Access activity. Beyond such an activity related to User Access, Local TLNet node representatives and contacts contribute to complete and keep updated the data entry to the SEP and the Digital Catalogue for all the instruments; they are thus asked in advance to provide the Data Management Plan, in parallel to the provision of technical information and specifications of the instruments. The TLNet team contribute also to support potential users during the proposal drafting.

The Terms of reference for the TLNet have been agreed by all nodes and include:

- technical feasibility has to be evaluated by the facility/instrument staff/responsible
- it must be evidence-based, complete, transparent, timely
- it must be shared using the dedicated e-tools and procedures among all the providers involved in the user proposal
- local autonomous management of activities by each Local TLNet node
- continuous alignment of best practices among the nodes

5. Online monitor tools

For an effective service of the TLNet support structure, beyond an adequate commitment of technical experts and scientific skills, it is of paramount relevance the use of an efficient communication system, i.e. a common IC platform to store and share information and to exchange comments and in-depth questions and answers between providers and users.

Logical schemes for a fully digital Work Flow have been identified in Deliverable 10.1 and the digital platform of monitoring tools integrated in the Single Entry Point is going to be developed, including each step in the integrated access workflow. This include:

- A tool for an easy and timely execution of the feasibility evaluation of the users' proposals. For each proposal, made of a sequence of "steps" involving a specific method or service, a graphical matrix display of the evaluation status for each step at the different available provider sites, is aimed to provide an holistic view of the technical evaluation, which should be easily updated by providers, users, and the TLNet, by entering technical comments and questions, answers, and formal decisions, respectively.
- A tool for a smart interaction between TLNet and ARP for the scientific evaluation of the proposals and, in case of acceptance, the final site assignments. Proposals, technical comments, partial and final evaluations will constitute a dataset directly available and managed on the platform.
- A tool to support and control the interaction between users and a set of providers as a multilateral communication, where the final multi-technique multi-site access schedule is achieved by few successive approximations driven by the availability of the several instruments required for the

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implementation of the research project. A mix between doodle forms and short dialogs allows to handle a short sequence of tentative scheduling and related comments.

- A tool to drive and to keep trace of the work carried out in each step of the users' proposals at the several involved NFFA sites. An electronic register in which the final amount of access (UoA) is precisely quantified and used as input in the information datasets for the real-time monitoring and for the final cost statements.
- A tool to monitor the quality of the provided access by collecting, directly on the platform, short user reports and questionnaires and short provider reports. Most of the evaluations will be given in terms of predefined variables, in order to be analysed in a quantitative way in real-time.

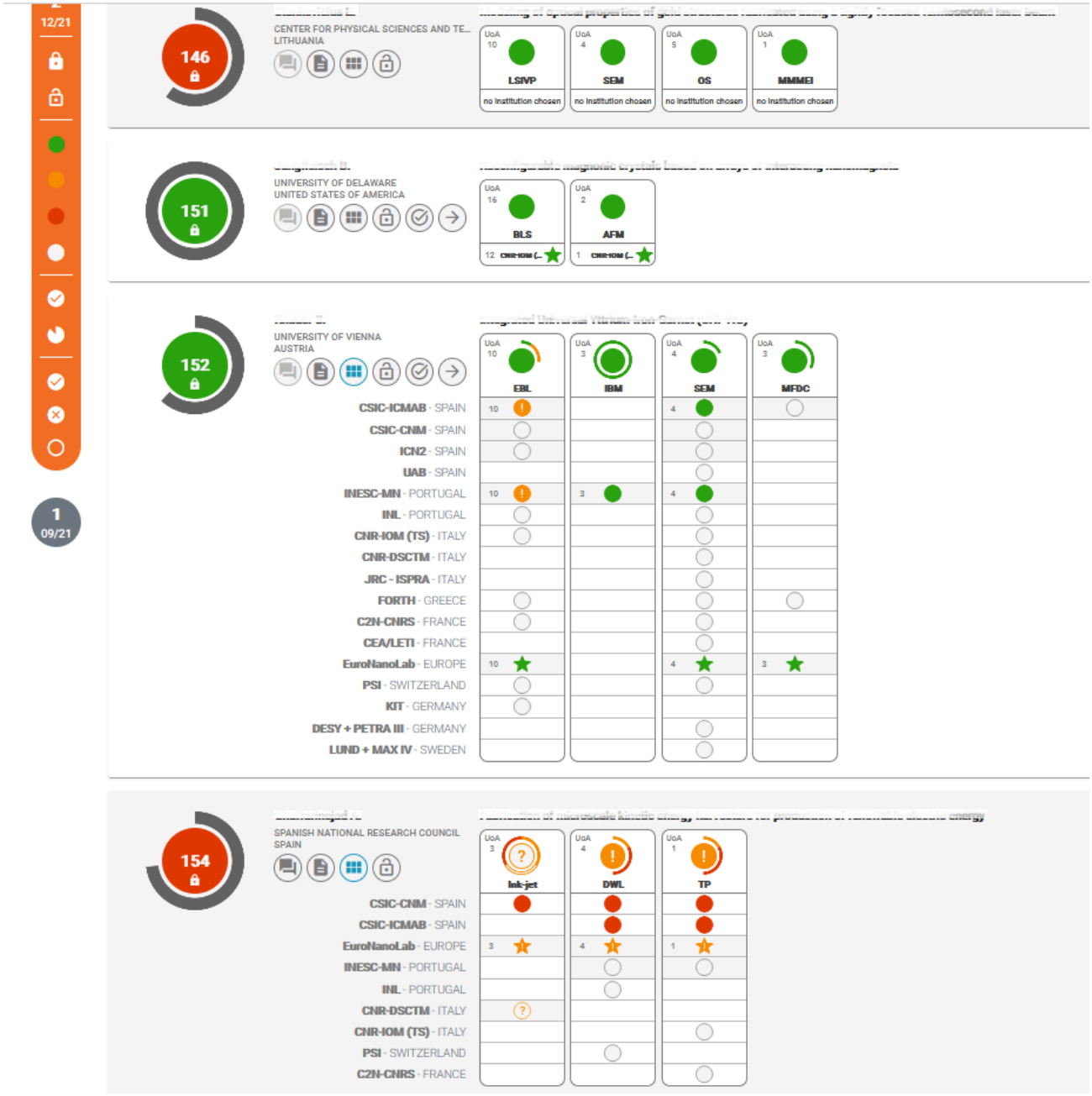

Figure1: the new feasibility tool

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As an example, two pictures showing the online tool for the two major TLNet activities, feasibility and scheduling, are reported; they are described in more details in Milestone MS4 report. The front-end of both tools make use of graphical objects, menu and tooltips, making the interface clear and user-friendly. Three meetings have been carried out to train the Local nodes representatives; one of the three has been recorded and made available to be consulted at any time by new Local contacts. By the 2nd Call for proposals, the full support structure has been completed: the whole TLNet network implemented, with the local contacts appointed, and the communication procedures and monitoring tools made operative.

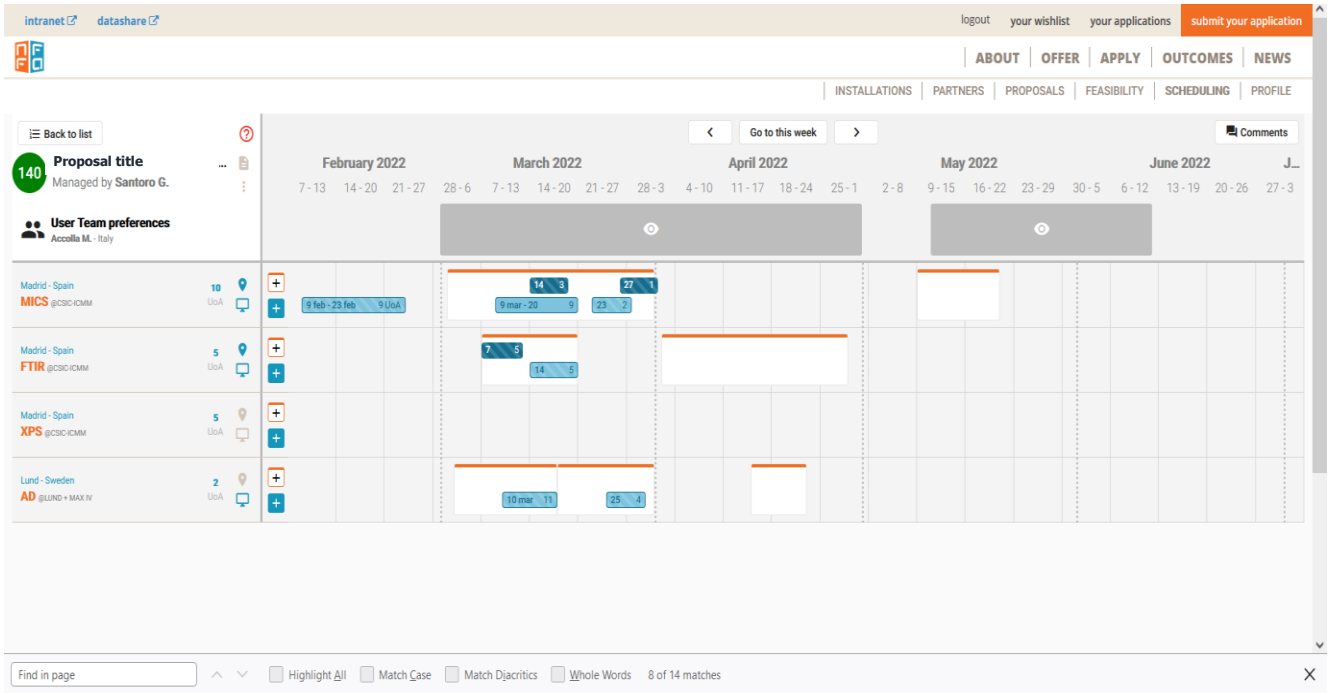

Figure 2: the scheduling tool

Waiting for the deployment of the new online monitoring tools here presented, for the 1st Call for proposals a temporary solution has been used on an institutional platform where to perform in a synchronized way technical evaluations (Feasibility Matrix) and other TLNet stuff (shttps://nep.workplace.garr.it/), in the same spirit as in the NFFA-Europe project, where a series of database-tables have been used, to share data and exchange info and evaluations. TLNet nodes have been invited to join the GARR workplace on 13 September, just at the submission deadline for the 1st Call in order to start the technical feasibility evaluation.

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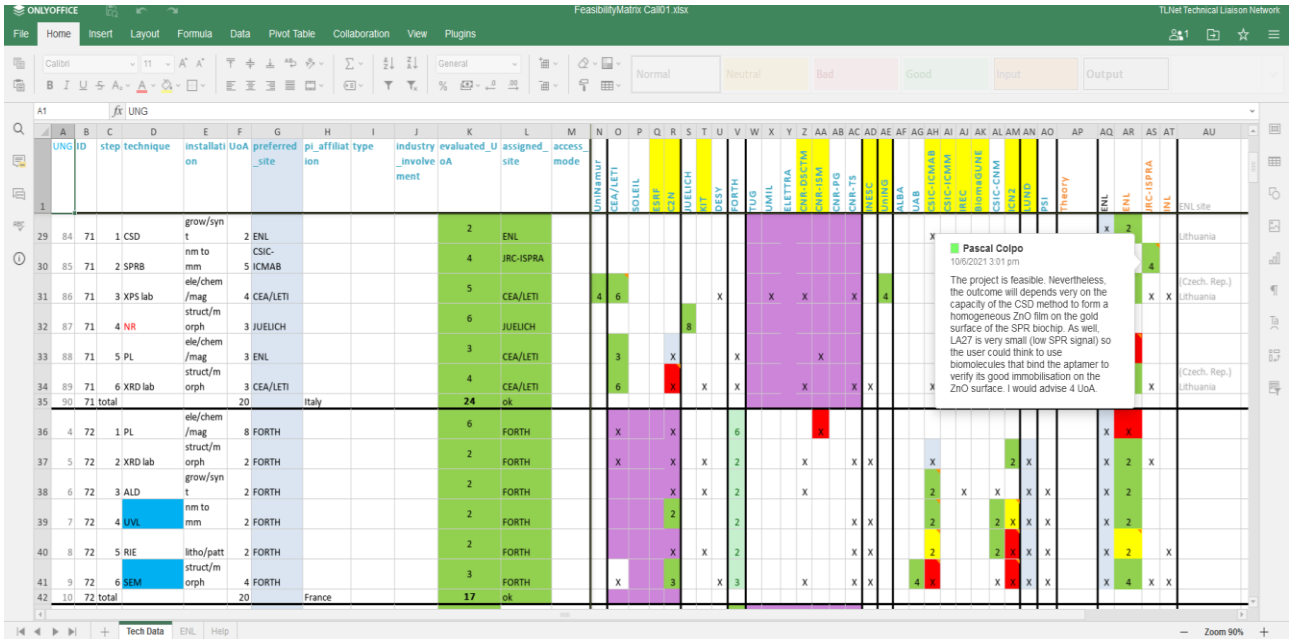

Figure 3: temporary feasibility matrix on the GARR workspace

6. Final implementation of the TLNet

On 10th June 2021, the Central TLNet invited the Local TLNet nodes to agree and share the TLNet overall structure and to provide local contacts and info. In the following days, the Central TLNet has received by the Local nodes the names (see Table 1), together with other information like email, telephone, and other quick media contacts, of the local TLNet node representatives and, in case, of the list of the local TLNet contacts associated to instruments or groups of instruments (see for instance in Table 2 del list of CNR-IOM).

From the initial TLNet implementation to the completion of the online monitoring tools on the SEP portal, some meetings have been convened, not only with the TLNet node, but also with the User Access Axis coordination board and with the IDRIN members, in order to share and to consolidate many aspects of the User Access, among which the detailed technical-scientific offer of the six distributed installations (Lithography, Growth, Structural Characterisation, Electronic-Chemical-Magnetic Characterisation, Theory, Nano-to-micro), including details on the catalogue and instructions for its update, the several access modes to be implemented in the feasibility/assignment tools (i.e. user in presence (hands-on/off), mail-in remote access, interactive remote access, remote control), and an overview on how limitations to assigned UOA and Transnational Access rules have to be complied.

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In more details:

- 18th May, first of a series of meetings with Central TLNet, Promoscience, ExactLab on IC platforms for the management of the User Access
- 14th June, at 14.30 CEST IDRIN node Officials - TLNet joint meeting: presentation of all the provider institutions at the different sites and the relative distribution of the TLNet local nodes; presentation of the User Access activities to be carried out in the TLNet framework
- TLNet start evaluation meeting 1: Thursday 16 September at 15.30 PM (CET)
  TLNet start evaluation meeting 2: Monday 20 September at 11.30 AM (CET):
  two editions of the meeting to inform and train on the "FeasibilityMatrix" created on the GARR platform, used for the technical evaluation of the 51 proposals received in the 1st Call, to be closed by the end of September
- Wednesday 13 October 2021, 9:00-13:00 (CET) NFFA-Europe Pilot: kickoff meeting
  11:30 The Transnational Access Support - TLNet and UONet - Roberto Gotter (CNR-IOM): presentation of TLNet and UONet in the NEP project – activity, tasks and organisation of the work.
- 1 December 2021, 10:00 AM (CET) User Access Coordination - TLNet joint meeting: joint meeting between the scientific responsibles of the user access axis and the central TLNet for a briefing about the how access technical information is handled, on the basis of which periodic deliverables will be drawn up.
- New feasibility tool - ed1 - Wednesday, December 15, 2021 15:00 PM - 16:00 PM (CET)
  New feasibility tool - ed2 - Thursday, December 16, 2021 11:00 AM - 12:00 PM (CET)
  New feasibility tool - ed3 - Friday, December 17, 2021 11:00 AM - 12:00 PM (CET)
  New feasibility tool - ed4 - Friday, December 17, 2021 15:00 PM - 16:00 PM (CET):
  four editions of the training meeting with Central and Local TLNet nodes for the use of the new feasibility tool implemented in the Single Entry Point (SEP) of the NFFA.EU portal

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Table 1: list of the TLNet team

TLNet nodes location	Partner affiliation	TLNet node representatives	assigned NFFA TA sites	Local contacts
Trieste (IT)	CNR	Daniela Orani	Central TLNet + CNR-IOM-TS	Roberto Gotter
				Daniela Orani
			CNR-IOM-PG	Gianluca Gubbiotti
			CNR-ISM	Stefano Turchini
			Elettra	Michele Bassanese
			DSCTM (distributed)	Alessandra Sanson
			UniNamur (BE)	Julien Colaux
MIlano , Trieste (IT)	UMIL	Paolo Piseri	UMIL	Paolo Piseri
Grenoble (FR)	CEA	Narciso Gambacorti	CEA/LETI	Narciso Gambacorti
	ESRF	Nhi Tran Caliste	ESRF	Nhi Tran Caliste
Paris (FR)	CNRS	Andrea Cattoni	C2N	Andrea Cattoni
			SOLEIL	Rachid Belkhou
				Clara Albert
				Frederique Fraissard
				Ana Valcarcel-Orti
			ENL (distributed)	Michel De Labachelerie
				Franck Chollet
				Jean-Claude Jeannot
Barcelona (ES)	CSIC	Miguel Zabala	CSIC-CNM	Miguel Zabala
			IREC	Alex Morata
			IREC	Federico Noris

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			CICbiomaGUNE	Sergio Moya
		Gonzalo Santoro	CSIC-ICMM	Gonzalo Santoro
		Laura Cabana	CSIC-ICMAB + ALBA	Laura Cabana
			ALBA	Marta Ávila Pérez
	ICN2	Gustavo Ceballos Mago	ICN2	Gustavo Ceballos Mago
	UAB	Cristina Navarro	UAB	Cristina Navarro
Hamburg (DE)	DESY	Thomas Keller	DESY + PETRA III	Thomas Keller
Munich (DE)	FZJ	Flavio Carsughi	JUELICH	Flavio Carsughi
Karlsruhe (DE)	KIT	Thomas Schaller	KIT	Thomas Schaller
		Susan Anson		Susan Anson
Heraklion (EL)	FORTH	Emmanuel Stratakis	FORTH	Emmanuel Stratakis
		Paraskevi (Evi) Kavatzikidou		Paraskevi (Evi) Kavatzikidou
		Eleftheria (Ritsa) Babaliari		Eleftheria (Ritsa) Babaliari
Braga (PT) - IO	LIN INL	Dmitri Petrovykh	INL	Dmitri Petrovykh
			INESC-MN	Susana Cardoso Freitas
Belgium (BE) - IO	JRC	Pascal Colpo	JRC	Pascal Colpo
Lund (SE)	ULUND	Luke Hankin	LUND + MAX IV	Luke Hankin
Villigen (CH)	PSI	Kazazis Dimitrios	PSI + SLS	Kazazis Dimitrios
Graz (AT)	TUGRAZ	Heinz Amenitsch	TUG	Heinz Amenitsch
				Barbara Sartori
Nova Gorica (SL)	UNG	Barbara Ressel	UNG	Barbara Ressel
				Alessandra Ciavardini
Theory	(distributed)	Simone Piccinin	CNR-IOM, CNR-ISM, CSIC-ICMAB, EPFL, FORTH, Juelich, ICN2, UMIL	Simone Piccinin

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Table 2: list of the CNR-IOM Local TLNet contacts (nl = nano-laboratory; lsf = large scale facility)

INSTALLATION	FAMILY OF TECHNIQUES	TECHNIQUE long	CNR (TS)	CNR (PG)	Contact person
litho/patt	Electron and ion beam lithography	Electron Beam Lithography, Focused Ion Beam, Inductively Coupled Plasma, NanoImprint Lithography, Reactive Ion Etching, Ultra Violet - Interference lithography	nl		Dal Zilio
grow/synt	Chemical depositions of thin films	Chemical Vapour Deposition	nl		Cepek Dal Zilio
grow/synt	Physical depositions of thin films	Molecular Beam Epitaxy	nl		Biasiol (HMBE), Rubini (MBE), Torelli-Vinai (OxMBE)
grow/synt	Physical depositions of thin films	Pulsed Laser Deposition, PVD sputtering	nl		Orgiani
grow/synt	Thermal treatments	Sintering processes, Solid State Reaction	nl		Orgiani
grow/synt	Thermal treatments	Thermal processes	nl		Dal Zilio
struct/morph	Electron and ion beam technologies	Scanning Electron Microscopy	nl		Ciancio Dal Zilio
struct/morph	Electron and ion beam technologies	Transmission Electron Microscopy	nl		Ciancio
struct/morph	Light and acoustic microscopy	Super resolution microscopy	nl		Lazzarino
struct/morph	Scanning probe microscopy	Atomic Force Microscopy	nl	nl	Lazzarino (TS), Andolfi (TS) Parisse (TS) Tacchi (PG)
struct/morph	Scanning probe microscopy	Scanning Tunneling Microscopy	nl		Africh Panighel Sala
struct/morph	X-ray analysis	X-Ray Diffraction	nl		Orgiani
ele/chem/mag	Electron spectroscopy	Angle Resolved Photoelectron Spectroscopy	lsf		Bondino-Magnano-Nappini (BACH) Vobornik (APE)
ele/chem/mag	Electron spectroscopy	Inverse PhotoEmission Spectroscopy		nl	Pedio
ele/chem/mag	Electron spectroscopy	Ultra Violet Spectroscopy	nl		Dell'Angela (ANCHOR-SUNDYN)
ele/chem/mag	Electron spectroscopy	Resonant Photoemission Spectroscopy/Diffraction	lsf		Floreano (ALOISA) Bondino-Magnano-Nappini (BACH) Torelli-Vinai (APE)

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ele/chem/mag	Electron spectroscopy	X-ray Photoelectron Spectroscopy	nl + lsf		Cepek (lab) Dell'Angela (ANCHOR-SUNDYN) Bondino-Magnano-Nappini (BACH) Torelli-Vinai (APE)
ele/chem/mag	Magnetic chracterisation	Magneto-transport	nl		Biasiol
ele/chem/mag	Magnetic chracterisation	Magneto-Optic Kerr Effect	nl	nl	Gubbiotti (PG) Torelli-Vinai (APE TS)
ele/chem/mag	Optical spectroscopy	Brilloiun Light Scattering		nl	Gubbiotti, Tacchi, Comez, Caponi
ele/chem/mag	Optical spectroscopy	Pump-probe	nl		Cucini Dell'Angela (ANCHOR-SUNDYN)
ele/chem/mag	Optical spectroscopy	Raman spectroscopy	nl	nl	Lazzarino (TS) Comez (PG) Caponi (PG)
ele/chem/mag	X-ray/soft-X-ray spectroscopy	In-operando spectroscopy	lsf		Torelli
ele/chem/mag	X-ray/soft-X-ray spectroscopy	X-ray Absorption Spectroscopy	lsf		Bondino-Magnano-Nappini (BACH) Torelli-Vinai (APE) Floreano (ALOISA)
ele/chem/mag	X-ray/soft-X-ray spectroscopy	X-ray Magnetic Circular/Linear Dichroism	lsf		Bondino-Magnano-Nappini (BACH) Torelli-Vinai (APE)
nm to mm	Biomolecules and biomaterials analysis	Optical Manipulation	nl		Cojoc
nm to mm	in vitro assays and cell analysis	Cell culture facilities	nl		Lazzarino Andolfi
nm to mm	in vitro assays and cell analysis	Digital holography	nl		Cojoc
nm to mm	Micro-fabrication	Electrochemical deposition, Standard chemical and physical deposition cleanroom/lab processes, Standard dry/wet patterning cleanroom/lab processes	nl		Dal Zilio
nm to mm	Micro-fabrication	UV-Soft lithography	nl		Dal Zilio
nm to mm	Micro-fabrication	Ultra Violet Lithography	nl		Dal Zilio
Theory		Atoms and molecules in motion			Piccinin

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