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Fourth ASTERICS DADI Technology Forum

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Abstract

The Fourth ASTERICS DADI Technology Forum was held in Edinburgh, 16-17 April 2018. The goals of the forum were to share information on technical activities between partners and to prepare for the May 2018 IVOA Interoperability Meeting. The forum began with a review of ASTERICS DADI and of the status of the IVOA and was followed by sessions with contributed presentations. The detailed discussions and the hack-a-thon sessions fulfilled the role of the forum as a working meeting. The hack-a-thon sessions allowed the participants to get into detailed discussions of topics of common interest. The meeting provided a lively view of the technological activities performed by DADI teams, in particular in the Work Package priority areas, with feedback from implementation of the multi-dimensional standards and further discussion of time domain. Topics to be raised at the international level during the next IVOA meeting were identified.

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II. DELIVERY SLIP

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III. DOCUMENT LOG

Issue	Date	Comment	Author/Partner
1	24 April 2018	V0.1 shared with the co-authors	F. Genova, CDS/CNRS, D. Morris, UEDIN, M. Allen, CDS/CNRS, K. Noddle, UEDIN
2	26 April 2018	V0.2 including first set of comments sent to co-authors	F. Genova
3	27 April 2018	V0.3 including all co-authors' comments sent to the Project Manager	F. Genova
4	30 April 2018	Final version taking the Project Manager's comments into account	F. Genova

IV. APPLICATION AREA

This document is a formal deliverable for the GA of the project, applicable to all members of the ASTERICS project, beneficiaries and third parties, as well as its collaborating projects.

V. TERMINOLOGY

ADQL: Astronomical Data Query Language

AIDA: Astronomical Infrastructure for Data Access

Aladin: Sky atlas and discovery tool

ASTERICS: Astronomy ESFRI & Research Infrastructure Cluster

Astropy: A community Python Library for Astronomy

CADC: Canadian Astronomy Data Centre

CDS: Centre de Données astronomiques de Strasbourg

CNRS: Centre National de la Recherche Scientifique

CoSADIE: Collaborative and Sustainable Astronomical Data Infrastructure for Europe

CTA: Cherenkov Telescope Array

DaCHS: Data Center Helper Suite (German VO)

DADI: Data Access, Discovery and Interoperability (ASTERICS Work Package 4)

DAL: Data Access Layer

Datalink: IVOA's linking of data discovery metadata to other resources

Docker: a software container platform

ELT: Extremely Large Telescope (was E-ELT)

ESFRI: European Strategy Forum on Research Infrastructures

Euro-VO: European Virtual Observatory

GAPS: Global Architecture of Planetary Systems

ICE: International Cooperation Empowerment

INAF: Istituto Nazionale di Astrofisica

INTA: Instituto Nacional de Técnica Aeroespacial

IVOA: International Virtual Observatory Alliance

KM3NeT: A multi-km³ sized Neutrino Telescope

LSST: Large Synoptic Survey Telescope

MOC: Multi-Order Coverage

OBELICS: OBservatory E-environments Linked by common ChallengeS (ASTERICS Work Package 3)

ObsCore: Observational Core Data Model

pgSphere: Spherical data extensions for PostgreSQL

PostgreSQL: Postgres « after Ingres » SQL (relational database management system)

PROV: W3C Provenance recommendations

PyVO: Package providing access to VO data and services using Python

RDA: Research Data Alliance

SIA: Simple Image Access (SIAV2: SIA Version 2)

SKA: Square Kilometre Array

SME: Small Medium Enterprise

SODA: Server-side Operations for Data Access

SQL: Structured Query Language

STC: Space-Time Coordinates

STILTS: Starlink Tables Infrastructure Library Toolset

STOA: Script Tracking for Observational Astronomy

TAP: Table Access Protocol

TOPCAT: Tool for Operations on Catalogues and Tables

UEDIN: University of Edinburgh

UHEI: Ruprecht-Karls-Universität Heidelberg

UMR: Unité Mixte de Recherche

VizieR: Database of astronomical catalogues, published tables and other data

VO: Virtual Observatory

VOEvent: Standard information packet for representing, transmitting, publishing and archiving information about a transient celestial event

VO-TECH: The European Virtual Observatory – VO Technology Centre

W3C: World Wide Web Consortium

WP: Work package

A complete project glossary is provided at the following page:

<http://www.asterics2020.eu/glossary/>

VI. PROJECT SUMMARY

ASTERICS (Astronomy ESFRI & Research Infrastructure Cluster) aims to address the cross-cutting synergies and common challenges shared by the various Astronomy ESFRI facilities (SKA, CTA, KM3NeT & ELT). It brings together for the first time, the astronomy, astrophysics and particle astrophysics communities, in addition to other related research infrastructures.

The major objectives of ASTERICS are to support and accelerate the implementation of the ESFRI telescopes, to enhance their performance beyond the current state-of-the-art, and to see them interoperate as an integrated, multi-wavelength and multi-messenger facility. An important focal point is the management, processing and scientific exploitation of the huge datasets the ESFRI facilities will generate. ASTERICS will seek solutions to these problems outside of the traditional channels by directly engaging and collaborating with industry and specialised SMEs. The various ESFRI pathfinders and precursors will present the perfect proving ground for new methodologies and prototype systems.

In addition, ASTERICS will enable astronomers from across the member states to have broad access to the reduced data products of the ESFRI telescopes via a seamless interface to the Virtual Observatory framework. This will massively increase the scientific impact of the telescopes, and greatly encourage use (and re-use) of the data in new and novel ways, typically

not foreseen in the original proposals. By demonstrating cross-facility synchronicity, and by harmonising various policy aspects, ASTERICS will realise a distributed and interoperable approach that ushers in a new multi-messenger era for astronomy.

Through an active dissemination programme, including direct engagement with all relevant stakeholders, and via the development of citizen scientist mass participation experiments, ASTERICS has the ambition to be a flagship for the scientific, industrial and societal impact ESFRI projects can deliver.

VII. EXECUTIVE SUMMARY

The Fourth ASTERICS DADI Technology Forum was highly productive event, which enabled in-depth technical discussion of many developments performed by the DADI teams. The meeting was organised with the well-established structure of formal presentations followed by informal working ‘hack-a-thon’ discussions, which as usual was effective for exchange of information, enabling lively discussion, and leading the project into the next steps, in particular in preparation of the May 2018 IVOA meeting, which will be held in Victoria (Canada). The current status of IVOA standards for multi-dimensional data and time domain, the two priority areas of DADI and IVOA, was assessed, with emphasis put on feedback from implementation for the former, which were completed in May 2017, and discussion of convergence and open questions for the latter. The Provenance IVOA standard, one of DADI highlights, was also discussed, in relation in particular with the relevant W3C recommendation. Among the other topics, the evolution towards provision of Platforms allowing users to run their code near data, an emerging IVOA priority, was also addressed.

The Fifth Technology Forum, the last one scheduled in the framework of the ASTERICS project, is planned to be held in March 2019 in Strasbourg.

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1. Introduction

The European Virtual Observatory initiative began to organise regular “Technology Forums” during the VO-TECH Design Study (2005-2009). VO-TECH was led by the University of Edinburgh (UEDIN). These meetings gathered the European teams involved in the development of the VO framework of standards and tools to disseminate information about technological activities and expertise, to build collaborations, to discuss future activities and to coordinate European participation in biannual International Virtual Observatory Alliance (IVOA) “Interoperability” meetings. The astronomical Virtual Observatory is an international endeavour, and the IVOA leads the development of the interoperability standards, in which European teams have been playing a key role since the beginning.

The usefulness of these meetings was immediately obvious, and they were continued by all of the follow-up projects funded by the European Commission in the e-Infrastructure framework during FP7: the Integrated Infrastructure Initiative Euro-VO Astronomical Infrastructure for Data Access (EuroVO-AIDA, 2008-2010), as well as the two small Coordination Actions on which the coordination of European VO activities relied from 2010 to 2015: Euro-VO

International Coordination Empowerment (EuroVO-ICE, 2010-2012) and Collaborative and Sustainable Astronomical Data Infrastructure for Europe (CoSADIE, 2012- 2015).

Coordination of technological activities has been identified as one of the three pillars of the European Virtual Observatory¹, together with the support given to data providers to publish their data in the VO, and to astronomers in their usage of the VO. It was clear, when the *Data Access, Discovery and Interoperability* Work Package was set up for the ASTERICS proposal, that regular gatherings of the technical teams in the work package would be necessary. The Forums are thus part of ASTERICS WP4 Task 4.3 “Update of the VO framework from feedback and requirements”, co-led by UEDIN and CNRS/UMR7550-CDS.

ASTERICS Deliverable 4.11 “Fourth ASTERICS DADI Technology Forum”, organised by UEDIN in Edinburgh on 16 & 17 April 2018, was the tenth event organised by ASTERICS WP4 (these events also include Schools, “ESFRI Forum and Training Events” and “European Data Provider Forum and Training Event”). The ASTERICS Technology Forum series is shown in Table 1. The first one was organised a few months after the beginning of the project, and was used as DADI kick-off, to start discussion and collaboration between VO and ESFRI teams engaged in the work package. The second was more centred on Technology Forum proper aims, discussing technological work and collaboration and preparing European contribution to the following IVOA meeting. The next ones, including the fourth, were then organised with the same aim on a yearly basis.

D4.1	First ASTERICS DADI Technology Forum	Strasbourg, 17 & 18 September 2015
D4.4	Second ASTERICS DADI Technology Forum	Edinburgh, 7 & 8 March 2016
D4.7	Third ASTERICS DADI Technology Forum	Strasbourg, 22 & 23 March 2017
D4.11	Fourth ASTERICS DADI Technology Forum	Edinburgh, 16 & 17 April 2018

Table 1 : ASTERICS DADI Technology Forums

The option to set up a six-monthly schedule was discussed at project mid-term, but it was decided to retain the yearly events and to continue to organise focused meetings on specific topics when appropriate. The relevant specific meetings organised since the Third DADI Technology Forum are listed in Table 2.

¹ Genova, F., Allen, M.G., Arviset, C., Lawrence, A., Pasian, F., Solano, E., Wambsganss, J. : Euro-VO – Coordination of virtual observatory activities in Europe, [Astronomy & Computing, Vol. 11, pp. 181-189, 2015](#), [ArXiv 1506.06567](#)

1	"Provenance Day"	Montpellier, 3 & 4 May 2017
2	GAPS Time Series face-to-face	Padova, 22 June 2017
3	Strasbourg Time Series Data Meeting	Strasbourg, 5 & 6 December 2017
4	Provenance discussion	Potsdam, 20 March 2018

Table 2: DADI specific meetings relevant to technological activities held between the Third and Fourth Technology Forums

Participation in the Fourth Technology Forum is described in Section 2 of this document. The meeting programme was organised to disseminate relevant information, in addition to technical discussions. This programme is presented in Section 3, and a record of the event is provided on the Wiki at:

<https://www.asterics2020.eu/dokuwiki/doku.php?id=open:wp4:wp4techforum4> (Figure 1)

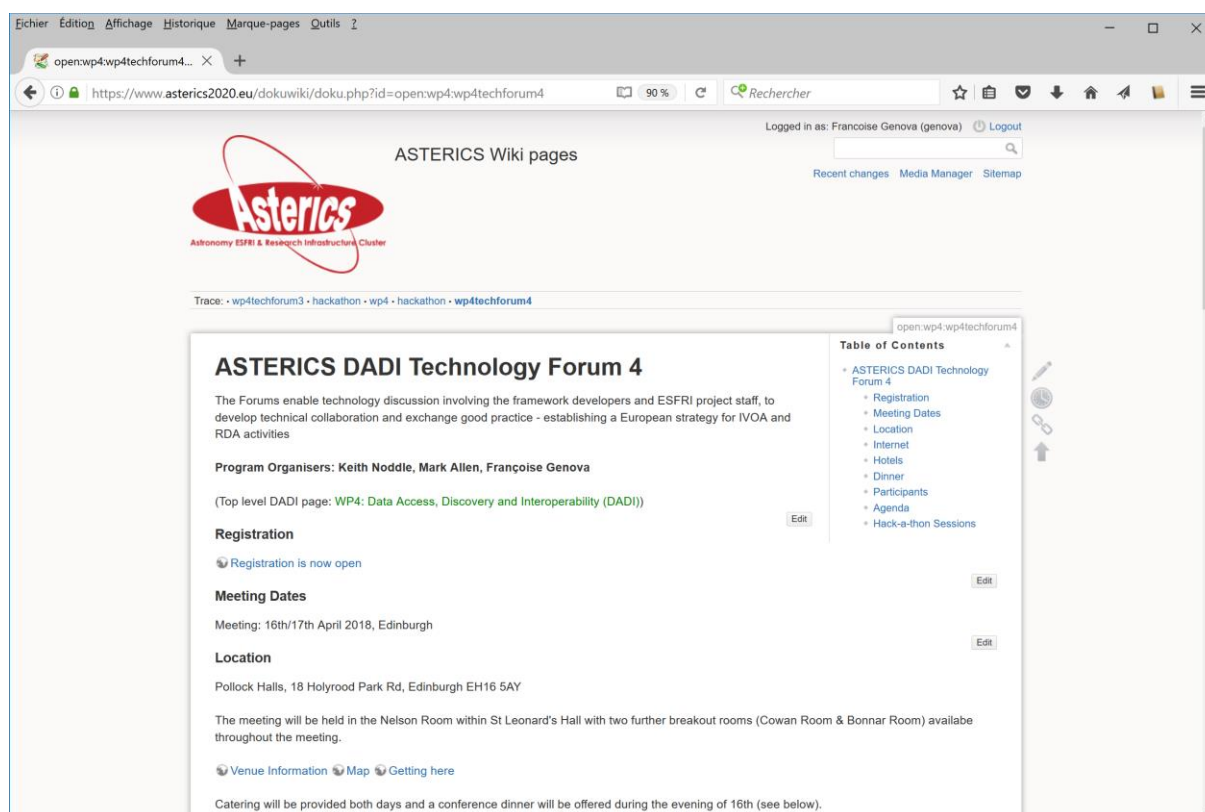


Figure 1: Meeting web page

The proceedings and results are analysed in Section 4. The conclusions and next steps are given in Section 5. Meeting photographs are shown in Annex.

2. Participants

21 participants from UK, France, Germany, Italy and Spain attended the meeting. The distribution of participants from different countries is shown in the pie chart below (Figure 2). As usual, the professional profiles of the participants includes a mixture of scientists and software engineers working on VO.

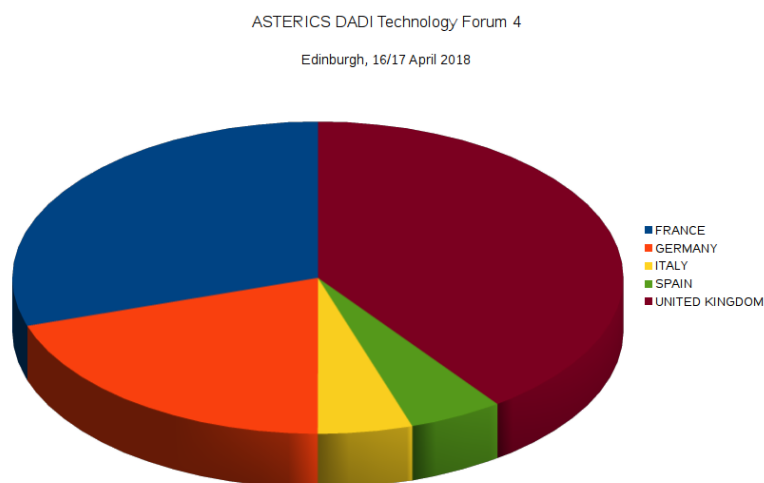


Figure 2: Participant countries of origin

The meeting was advertised within the project, and the associated partners were also informed. In addition to the ASTERICS wiki, an INDICO system was also used for managing the registration of participants.

The top level INDICO registration page² is shown in Figure 3 below.

² <https://indico.astron.nl/conferenceDisplay.py?confId=154>

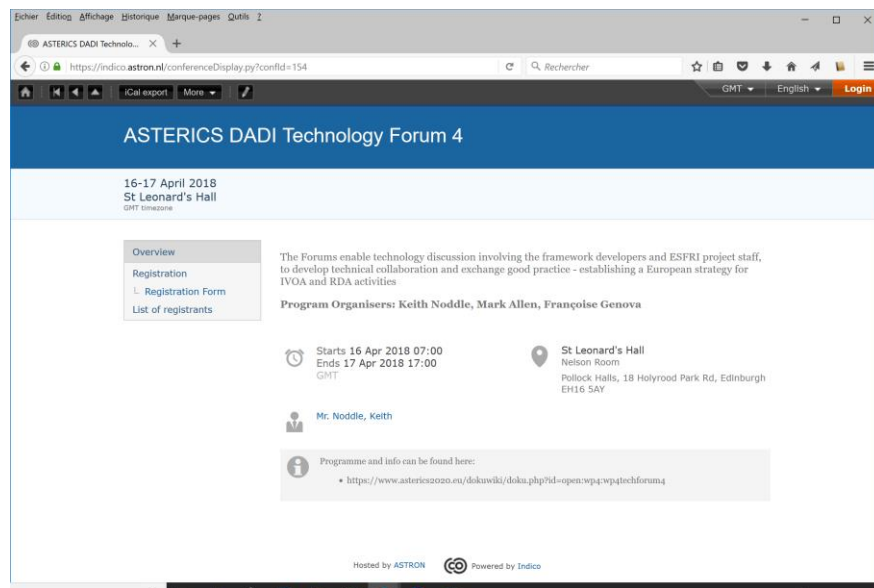


Figure 3: Technology Forum 4 registration website

3. Programme

The structure of the program followed the pattern used for the previous Technology Forums with an introduction followed by a set of presentations on current topics, and sufficient time for the informal hack-a-thon sessions. The program of presentations was built from the proposed contributions submitted by the participants when they registered for the meeting, and in addition a number were solicited to make sure that priority areas were fully covered. The program was developed by the chairs of the meeting. It included presentations of different technical developments of interest for DADI partners performed by the DADI teams, with particular emphasis on the priorities, VO for multi-dimensional data and time domain, provenance, and datalink which was pointed at as very interesting for the ESFRIs in previous DADI meetings: on Day 2, a series of talks presented feedback from implementation of the multi-dimensional data standards and datalink; two talks discussed aspects linked to Time Domain. Time Domain activities in the IVOA have two aspects: one is to gather requirements from projects dealing with diverse kinds of time series to develop standards to model and access time data in the VO; the other one is to update the existing VOEvent standard, which is already widely used to represent, transmit, publish and archive information about a transient celestial event, in particular to upgrade it to deal with LSST data.

Two hack-a-thon sessions were scheduled, each one with a main topic, Provenance for the first one and Time Domain for the second, with rooms available for discussion of other topics in parallel. The other hack-a-thon topics arose from talks presented during the meeting, namely the use of TAP-Autocomplete, datalink requirements in TOPCAT, and modular, message driven resource publishing solutions. Another session was added at the end of Day 1

for gathering feedback from implementation of the IVOA multi-dimensional standards and datalink, to enable the people involved in the other main themes to participate. The feedback gathered during that hack-a-thon session was presented during the relevant plenary session on Day 2. The other hack-a-thon discussions were presented in the last plenary session of the meeting and are summarized in the hack-a-thon web page³.

The program is available on the wiki with links to all of the presentations.

Monday, April 16th

09:30	<i>Arrivals & coffee</i>	
10:00	Welcome	Andy Lawrence
10:10	ASTERICS DADI status / Connection with IVOA	Françoise Genova / Mark Allen
10:45	Break	
11:15	Latest pgSphere developments	Markus Nullmeier
11:45	Implementing ADQL 2.1	Markus Demleitner
12:10	ADQL 2.1 progress report & what's next	Dave Morris
12:35	IVOA provenance metadata : Data Model and services	Mireille Louys
13:00	<i>Lunch</i>	
14:00	Enabling STC-based discovery in the Registry	Markus Demleitner
14:25	Describing Science Platform Services	Dave Morris
14:45	Firethorn Python client / Auto-complete library	Stelios Voutsinas
15:05	Use of Docker and Docker Compose	Dave Morris
15:30	<i>Break</i>	
16:00	Hack-a-thon Session One	
17:30	Additional hack-a-thon session	
19:00	<i>Working dinner</i>	

Tuesday, April 17th

09:30	Publishing tools and Authentication & Authorisation	Marco Molinaro
09:45	IVOA Time Series / Time Domain	François Bonnarel
10:00	Time series and VOEvent, progress report	Dave Morris
10:25	Datalink, SIAV2, SODA Feedback after a few years of implementation	François Bonnarel / Marco Molinaro
10:45	<i>Break</i>	
11:15	Datalink	Carlos Rodrigo Blanco
11:40	Datalink in TOPCAT and STILTS	Mark Taylor

³ <https://www.asterics2020.eu/dokuwiki/doku.php?id=open:wp4:wp4techforum4:hackathon>

12:05	New features in Aladin for DAL servers: ADQL Join and SODA Asynchronous	Chaitra
12:30	Workflow management system for interferometry data	Peter Hague
13:00	<i>Lunch</i>	
14:00	Hack-a-thon Session Two	
15:30	<i>Break</i>	
16:00	Hack-a-thon Reports	
16:30	Meeting Wrap-up	Francoise Genova
16:40	<i>Meeting close</i>	

4. Proceedings and Analysis

It was decided to have only two short introductory talks, to leave a maximum of time for the technical exchanges which are the aim of the Technology Forums. As an introduction to the meeting, DADI status was briefly presented by the Work Package lead, F. Genova (CNRS/CDS), who reported on the deliverables submitted since the previous Technology Forum, the IVOA and RDA meetings, and the specific meetings organized by DADI. She also listed the deliverables due until the end of the project. M. Allen (CNRS/CDS), who is currently vice-chair of the IVOA Executive Board, completed the introduction by discussing more specifically IVOA priorities and strategy, including the emerging topic of Science Platforms/Portals and Computing near data which completes the multi-dimensional data and time domain priorities, which are also DADI priorities. The initial version of the set of multi-dimensional standards was completed in May 2017, and implementation and feedback are now the core activity, with significant DADI contribution which reflected in the Technology Forum agenda. The IVOA Time Domain Interest Group is very active, under the leadership of A. Nebot (CNRS/CDS) and D. Morris (UEDIN) who are both fully involved in DADI. Science platforms were also a topic for the Forum. M. Allen concluded with a word about the EOSC and the relevant Calls for Proposals.

The following talk, presented by M. Nullmeier (UHEI), described the latest developments of pgSphere at Heidelberg Astronomisches Rechen-Institut. pgSphere is widely used in the background of the VO in many data archives and services, to deal with spherical coordinates and indexing in PostgreSQL relational database management system. The new features, including MOC management and indexing, fast cross-match capacities (with translation of ADQL into SQL) and packages for Linux distribution, were described, as well as future plans. These developments aim in particular at enabling the usage of pgSphere in the VO context.

A sequence of two talks discussed then the Astronomical Data Query Language (ADQL), a new version of which (2.1) is currently a proposed recommendation (the current version of the standard was adopted as an IVOA recommendation in 2008). The first talk, presented by M. Demleitner (UHEI), reported in details his findings from V2.1 implementation in UHEI DaCHS

data publication tool. He listed the welcome, acceptable and problematic aspects of the standard from his point of view. Then D. Morris (UEDIN), who is the editor of ADQL 2.1, presented the current status of the standard. He noted that there is good feedback (including the one described in the previous talk), and that the grammar is gradually fixed. He listed the points that remain to be resolved, in particular the different possibilities to deal with coordinate systems, and identified suggestions which should be eventually taken into account in the next version (3.x), and those which should be taken into account as “good enough” for version 2.1. He also addressed the key question of validation tests. This led to the suggestion to implement an issue tracker in the IVOA standardization process (he currently uses GitHub to keep track of outstanding issues). This is a general issue which should be discussed by the IVOA Technical Coordination group (TCG).

The next topic dealt with the IVOA Provenance data model, which is developed from diverse use cases with a significant contribution of the DADI CTA members and more generally of European teams working together with the support of DADI. M. Louys (CNRS/CDS) explained how the results from the W3C PROV recommendations are reused in the IVOA development, allowing reuse of the W3C visualization tools, codes and libraries, and serialization formats. She described the IVOA Provenance Data Model, and how the W3C model is enriched by adding new classes. The IVOA Provenance Data Model is currently described in a Working Draft, which will be split into several more focused documents, including a Proposed Recommendation, an implementation note and access protocol proposals for TAP and DAL. She also described lessons learnt from multiple implementations performed in different contexts, and the connection with the Research Data Alliance (RDA), in particular the RDA Provenance Patterns Working Group⁴ to which it is planned to provide a use case. The RDA Group is more oriented towards ontologies/RDF, which is not at the core of the IVOA Provenance work, but they are very interested by our practical use of PROV and the way we customize it for our own needs. Possible topics for discussion during the hack-a-thon session later in the afternoon were also listed.

This talk concluded the first morning of the meeting. The afternoon talks addressed several of topics of interest for DADI technical teams.

M. Demleitner discussed the usage of STC (Space-Time Coordinates) in the IVOA registry of resources. The original definition of coverage was with the STC-X version of the standard, but it is not really used. For spatial coverage *footprint* is used but it does not provide spectral nor temporal coverage, and there is an extra harvesting step (url to a MOC). He referred to the IVOA note “Roadmap for space-time discovery in the VO registry” published in January 2018, and presented a proposal to include the MOC coverage in the registry itself, for which he developed a searchable prototype and listed open questions. Solar System will be an interesting use case.

⁴ <https://www.rd-alliance.org/group/provenance-patterns-wg/wiki/prov-patterns-wg-collaboration-tools>

D. Morris then launched a discussion about the parameters relevant to describe a Platform service allowing users to run code “in a data centre environment”, in close proximity to the data, with high bandwidth and bulk access to the data, and how to measure them. One of the aims is to help users and software to choose the platform which would be “the best” for them, but the discussion demonstrated that it is not easy to define what “the best” is. The question is timely because of the growing usage of Astropy and PyVO by the community, and the way people use the VO is changing, with the Platform theme getting momentum as an emerging priority as described earlier by M. Allen.

S. Voutsinas (UEDIN) presented and demonstrated the UEDIN implementation of a Python library to access their datasets via Firethorn, a Java-based middleware application. The source code is available. He then described and demonstrated the Javascript autocomplete library he developed for TAP services, which provides keyword suggestion list and syntax highlighting. The presentations led to discussion of possible reuse during the hack-a-thon.

The final plenary talk of the afternoon was given by D. Morris who presented and demonstrated UEDIN use of docker and docker-compose to build and run services, the environment they use, the basic firethorn components, and the fact that their system allows them to handle “secrets” (i.e. to hide passwords from code). A single command can be used to launch the set of services.

The first day of the meeting was concluded by two successive hack-a-thon sessions and the working dinner.

The second day begun with a presentation of M. Molinaro (INAF) on publishing tools, which discussed DAL Reference Implementations, and the difficulties encountered by users and providers. Trieste implemented a “modular”, message-driven solution, and he suggests to move from “reference implementations” to a “out of the box/re-usable” model. He also presented a short report on on-going work on federated identities at VO level, in collaboration with CADC – this problem is not solved, especially on the global scale. The discussion of the modular, message-driven resource publishing solution continued during the hack-a-thon.

The next topic was Time Series/Time domain. F. Bonnarel (CNRS/CDS) first reported in details the wealth of current activities at CDS and more generally in DADI, which is clearly triggering and leading IVOA activities in the domain. The work relies on a collection of use cases, including planetary data and the very diverse VizieR catalogues which contain time information. Metadata are being defined for discovery and other purposes, with a core consensus, in particular on the fact that most of the ObsCore standard is fine. , Discussion of some elements to allow different discovery modes is on-going. The way the IVOA Data Access Layer and Data Model Working Groups tackle the question was presented, including the different proposals for serialization. The discussion which followed the talk highlighted the need to have the simplest possible VO compliant representation of light curves, but also to be able to deal with complex cases. D. Morris, the vice-chair of the IVOA Time Domain Interest Group, presented the next possible steps. He proposed to develop validation toolkits for key

use cases as a way of meeting the requirements for two complete reference implementations. This would allow to check and compare the structure and semantics of data provided with different serializations. D. Morris then discussed the evolution of VOEvent in response to community feedback, in two steps, first with minor changes (version 2.x), including those required to use VOEvent for planetary sciences, and then the next generation (version 3.x), taking in particular LSST requirements into account. Those have to be closely monitored since they seem to be evolving. The Time Domain discussion continued during the hack-a-thon.

The four next talks discussed feedback from implementation of the multi-dimensional data standards and of datalink. As an introduction to the next talks, which presented feedback gathered from specific implementations, F. Bonnarel reviewed the feedback gathered, including during the hack-a-thon held the previous evening, mostly on datalink (recognition of a datalink by clients, with a discussion of possible solutions, semantics field, relationship between description/descriptors and tables). He also listed feedback gathered from implementation of SIAV2 and SODA. C. Rodrigo Blanco (INTA) detailed the feedback from datalink implementation for the Spanish VO stellar libraries, their requirements on tool functionalities and for datalink semantics. M. Taylor (University of Bristol) explained how he provides “Activation Actions” in TOPCAT (TOPCAT’s term for configurable per-row actions), how the activation window is evolving, and how he implements datalink in a specific window and as an Activation Action. He described STILTS datalink validator and detailed datalink implementation feedback. Chaitra (CNRS/CDS) provided an update on and a demonstration of the implementation of SIAPV2/SODA/datalink and TAP in Aladin. This includes the implementation of SODA asynchronous mode, the capacity to make customized ADQL joins using TAP, and the implementation of template TAP and ObsCore TAP clients.

The session final talk was presented by P. Hague (University of Cambridge), who participates in the Data Integration and Data Analysis tasks of OBELICS, with the aims to develop Script Tracking for Observational Astronomy (STOA) to prototype workflow systems for future projects, and the next generation source finding and characterization for radio astronomy. STOA includes a process management system that runs scripts on multiple sets of data, each time with different parameters and a different environment. STOA also includes collaboration features (it can flag and annotate data and products), and interfaces with existing astronomy software such as TOPCAT.

Participants reconvened for the final plenary session after the second day hack-a-thon. The session was mostly devoted to reports from the hack-a-thon splinter meetings, which had allowed further discussion of many of the topics addressed during the talks. Reports of these discussions are available as explained on the meeting hack-a-thon page.

Provenance and Time Domain both plan to issue updated IVOA documents before the May IVOA meeting. More generally, the discussion of all the topics related to standards which exist or are being prepared will continue during that meeting.

5. Conclusions and next steps

Like the previous ones, the Fourth ASTERICS DADI Technology Forum completely fulfilled its purpose of sharing information between DADI members and served to prepare input for the following Interoperability Meeting. The Forum enabled high quality and in-depth technical discussion of many aspects of IVOA standards and tools, including lots of time for reports on implementation in plenary and hack-a-thon sessions. It will bring significant contributions to the coming IVOA Interoperability meeting and more generally to the IVOA standardization process. General suggestions which will have to be discussed at IVOA level.

The next step will then be the May 2018 IVOA Interoperability meeting, which will be held in Victoria, Canada, 27 May – 2 June. The meeting web site, <http://wiki.ivoa.net/twiki/bin/view/IVOA/InterOpMay2018>, is progressively updated with information on the agenda when this document is being written. It will give access to all the slides presented during the meeting. The “European” talks presented during the meeting will also be listed and linked to in ASTERICS DADI Repository of products⁵ (D4.8/D4.15).

The next DADI event will be the Second European Data Provider and Training Event⁶ (D4.13), which was initially foreseen for December 2018 but will be held in Heidelberg 27-28 June 2018, with in addition a newcomer session on 26 June and hands-on consulting sessions on data publication on 29 June. It will be followed by the Fourth ASTERICS DADI School (D4.12), which will be held in Strasbourg 20-22 November 2018. The final event organized by DADI will be the Fifth Technology Forum, which will be held in Strasbourg in March 2019. It will be the occasion to celebrate the excellent collaboration enabled by the Work Package, and to summarize the results.

⁵ <https://www.asterics2020.eu/dokuwiki/doku.php?id=open:wp4:dadiproductrepository>

⁶ <http://www.g-vo.org/edp-forum-2018>

Annex: Photos taken during the meeting

