WP5: Cleopatra

ASTERICS General Assembly, February 11 2016, Schiphol

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1) Introduction

The activities in the work package CLEOPATRA (Connecting Locations of ESFRI Observatories and Partners in Astronomy for Timing and Real-time Alerts) aim at synergetic observing modes, and fast and reliable access to large data streams. These aspects are addressed in the following tasks:

1. Development of technology for the enabling of long-haul and many-element time and frequency distribution over fibre connections. This has the potential to increase the efficiency and affordability of all radio astronomy facilities (SKA, LOFAR, VLBI). Such developments are also highly relevant for astroparticle facilities (CTA, KM3NET) and can enable novel realtime multi messenger observations.
2. Developing methods for relaying alerts, which will signal transient event detections between the facilities and enable joint observing programmes. The focus will not just be on interchange formats but on scientific strategies and methods for joint observing.
3. Further development of existing data streaming software, building on the success of previous e-VLBI projects, and providing tools for robust and efficient data dissemination for all facilities in the user domain, including ESO facilities such as ALMA and the E-ELT.
4. Fostering the development of advanced scheduling algorithms, using AI approaches for optimal usage of the ESFRI facilities.

2) Partners, finances, deliverables

Participation per Partner	
Partner number and short name	**WP5 effort**
1 - ASTRON	36.00
2 - CNRS	24.00
5 - JIVE	72.00
11 - VU/VUmc	36.00
13 - UVA	24.00
14 - UGR	36.00
15 - FOM	30.00
16 - IEEC	24.00
GTD	12.00
20 - STFC	12.00
21 - DESY	18.00
22 - SURFnet	8.00
Total	332.00

Figure 1: Partners and person months in project

WP 5	ASTRON	CNRS	JIVE	UGR	FOM	STFC	SURFnet	IEEC	DESY	VU/VUmc	UVA	TOTAL
Man months	36,00	24,00	72,00	36,00	30,00	12,00	8,00	24,00	18,00	36,00	24,00	320,00
(A) Direct personnel costs	219.000,00	96.000,00	408.000,00	150.000,00	175.000,00	90.938,00	64.960,00	79.000,00	108.000,00	213.000,00	125.932,00	1.729.830,00
No of trips	12,00	2,00	24,00	6,00	4,00	2,00	2,00	2,00	2,00	6,00	2,00	64,00
Travel cost	5.760,00	960,00	11.520,00	2.880,00	1.920,00	960,00	960,00	960,00	960,00	2.880,00	960,00	30.720,00
Equipment			80.000,00		80.000,00							160.000,00
Materials												
Other												
(B) Other direct costs	5.760,00	960,00	91.520,00	2.880,00	81.920,00	960,00	960,00	960,00	960,00	2.880,00	960,00	190.720,00
(E) In kind contributions (not used on the premises)												
(F) Indirect costs	56.190,00	24.240,00	124.880,00	38.220,00	64.230,00	22.975,00	16.480,00	19.990,00	27.240,00	53.970,00	31.723,00	480.138,00
Subtotal	**280.950,00**	**121.200,00**	**624.400,00**	**191.100,00**	**321.150,00**	**114.873,00**	**82.400,00**	**99.950,00**	**136.200,00**	**269.850,00**	**158.615,00**	**2.400.688,00**
Audit certificate												
Sub-contract												
(C) Subcontracting												
(D) Financial support 3rd parties								94.950,00				94.950,00
(H) Total estimated eligible costs	**280.950,00**	**121.200,00**	**624.400,00**	**191.100,00**	**321.150,00**	**114.873,00**	**82.400,00**	**194.900,00**	**136.200,00**	**269.850,00**	**158.615,00**	**2.495.638,00**
(J) Maximum grant	280.950,00	121.200,00	624.400,00	191.100,00	321.150,00	114.873,00	82.400,00	194.900,00	136.200,00	269.850,00	158.615,00	2.495.638,00
(K) Requested grant	**280.950,00**	**121.200,00**	**624.400,00**	**191.100,00**	**321.150,00**	**114.873,00**	**82.400,00**	**194.900,00**	**136.200,00**	**269.850,00**	**158.615,00**	**2.495.638,00**

	Totals
(A) Direct personnel costs	1.729.830
(C) Subcontracting	
(B) Other direct costs	190.720
(D) Financial support 3rd parties	94.950
(F) Indirect costs	480.138
(H) Total estimated eligible costs	2.495.638
(K) Requested grant	2.495.638

Labour rate/wp:	6.083	4.000	5.667	4.167	5.833	7.578	8.120	3.292	6.000	5.917	5.247
Yearly rate:	73.000	48.000	68.000	50.000	70.000	90.938	97.440	39.500	72.000	71.000	62.966
Hourly rate:	42,44	27,91	39,53	29,07	40,70	52,87	56,65	22,97	41,86	41,28	36,61

Differences to WP-budgetsheets delivered by workpackage leaders: Impact:
WP5:

Figure 2: Cleopatra budget

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WP5 Deliverables

Deliverable nr	Deliverable title	Lead Benificiary	Type	Dissemination level	Due date (month)
D5.1	General design rules for implementation in existing optical networks	22 - SURFnet	Report	Public	14
D5.2	Multi-messenger alert handling design document	1 - ASTRON	Report	Public	18
D5.3	Qualification of WRE components under (harsh) realistic conditions	21 - DESY	Report	Public	24
D5.4	Hardware for maser-level time & frequency distribution in optical transport networks	11 - VU/Vumc	Demonstration	Public	26
D5.5	Data streaming software client	5 - JIVE	Other	Public	28
D5.6	Tolls and methods for delay calibration before installation and in situ	15 - FOM	Report	Public	30
D5.7	Time transfer in SURFnet/LOFAR network & general design rules for network implementation	11 - VU/Vumc	Report	Public	32
D5.8	Summary of workshop in alerting mechanisms with outside partners	13 - UVA	Report	Public	32
D5.9	Report on scheduling algorithms and standard interfaces for cross-facility scheduling	20 - STFC	Report	Public	36
D5.10	Software components multi-messenger event handling	1 - ASTRON	Report	Public	40
D5.11	Scientific study synergies of transient event observing	13 - UVA	Report	Public	42
D5.12	Multi-facility scheduling simulation and performance analysis software	16 - IEEC	Demonstration	Public	42
D5.13	Pilot multi-messenger event handling	2 - CNRS	Demonstration	Public	46
D5.14	Demonstration of VLBI synchronization via existing SURFnet/LOFAR network	5 - JIVE	Report	Public	48
D5.15	Advanced algorithms and WRE upgrade to 10 Gb/s capacity	14 - UGR	Demonstration	Public	48

Figure 3: Cleopatra deliverables

3) Progress

In spite of ASTERICS kicking off just before the summer period, Cleopatra got off to a good start. First personal contacts between the partners were made during the ASTERICS f2f kickoff meeting on the 26th of May, and the first WP-wide telecon took place on the 30th of June. A preliminary wiki was set up, as well as a Cleopatra mail exploder. After the summer, activities picked up, several more telecons were held and at several of the institutes the process of hiring of new staff started. Within some of the individual tasks, notably tasks 1 and 4, telecons and f2f meetings took place as well.

3.1) Task 5.1: Synchronization

Partners and person months: **VU** 36, ASTRON 12, JIVE 24, UGR 36, **FOM** 30, DESY 18, SURFnet 8

This task is centred around the White Rabbit Ethernet (WRE) technology, but with two quite

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distinct purposes. The first is to upgrade WRE to generic technology for deployment on long-haul public telecom networks, and to increase its frequency stability by three orders of magnitude in order to achieve the hydrogen maser level stability required by the SKA and other (commercial) applications. The second focuses on new calibration and characterisation tools for WRE equipment, providing a faithful and accurate timing source to the many element detector arrays of the CTA and KM3NeT, while at the same time upgrading WRE to 10Gbps data transport capability.

Consequently, the decision was made to split this task, with Koelemeij of the VU heading the first sub-package (5.1a), and Berge of FOM the second (5.1b).

Task 5.1a has made excellent progress. No new hires were needed, which meant work could start nearly immediately. Talks with SURFNet resulted in a choice of suitable hardware, and amplifiers and lasers were ordered. Design rules for fibre-optic time distribution are being defined, a choice of wavelengths for the timing distribution meant that the optical amplifiers could be assembled, noise-performance analysis of the WRE equipment is in progress.

Task 5.1b was slightly slower in the uptake, but here the speed is picking up. All needed hires were made, a hardware list was completed for about 50% of the available funds and a calibration board is under construction. Extensive tests are done on fibres from different manufacturers and different batches.

Close contact is being kept between the two sub-tasks, in order not to re-invent any wheels. A Cleopatra-WRE mail exploder was set up beside the general mail exploder, for technical discussion. A code repository was also created to facilitate the exchange of code between the various partners. A WRE workshop is being organised in Amsterdam at NIKHEF, in March, involving several other groups also working on WRE:

http://www.ohwr.org/projects/white-rabbit/wiki/Mar2016Meeting

All deliverables are on track, however there seem to be some issues with the contribution of DESY, which will be discussed at the GA.

3.2) Task 5.2: Synchronization

Partners and person months: **ASTRON** 24, CNRS-APC 24, JIVE 24, UVA 24

The aim of this task is to develop standards for the generation, dissemination, distribution, and reaction to multi-messenger events. This will take the form of a design document, leading to software being implemented for one or two facilities (LOFAR & EGO). A demonstration will be set up in which e.g. radio facilities follow-up an event generated by a gravitational wave detector. Part of the project will investigate potential scientific synergies for implementing methods for automated follow-up observations.

This task saw some activity, however a task-wide meeting was not held yet (but is scheduled

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for the 15th of this month). Originally, CNRS and UVA were planning their contribution to start in 2017, however both decided to move this forward to early 2016, because of developments within LIGO and CTA. Most of the hires have been made (or are just about to be made), and a detailed work plan will be forthcoming soon.

3.3) Task 5.3: Post-detection data streaming

Partners and person months: **JIVE** 24

This small task will address data-flow control issues relevant to all the ASTERICS ESFRI facilities, in addition to many other major telescopes e.g. ALMA.

With only one partner, and no hires needed, activity in this task has been limited to the definition of a high-level design and discussions with several NREN representatives wrt. protocol and architectures for a data transfer client.

3.4) Task 5.4: Scheduling of large astronomical infrastructures

Partners and person months: **IEEC** 24, STFC 24, GTD 24

This task will research how the SKA and CTA could maximise their science return with AI scheduling solutions. The programme will also incorporate multi-frequency, multi-messenger astrophysics at the scheduling level.

Also this task got off to an excellent start, with their first f2f meeting in July in Barcelona. As the deliverables occur quite late in the project, intermediate milestones were defined. One person was hired at GTD, and STFC is to make a hire early 2016. Several telecons took place, and the participants aim to have a second f2f meeting at the SPIE conference in Edinburgh in June. It was found that GTD had to change their status from third party to full member, and although this was not a problem in principle, in practice it is still not quite done, partly because of a bug in the EC portal software.

4) Conclusions

Overall, Cleopatra is in good shape. Some tasks got off to a flying start, others took a bit longer to ramp up, but none are falling behind. Hires have been and are still being made and money is being spent on hardware. The deliverables are on track. Communication is established, with regular general and task-specific telecons and meetings. All general meetings are minuted and the minutes placed on the wiki. Unfortunately I have not yet been able to convince all partners to place the minutes of their local meeting there as well. The only issue we may have is with DESY, but at the time of writing the seriousness of this issue was not clear yet.

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