COVER PAGE

Title of Proposal: **XX: Collaborative ecosystems for mathematical research and software development**

Date of preparation: **October 8, 2014**

Participant no	Participant organisation name	Country
1 (Coordinator)	University of St Andrews	UK
2	Universit Paris Saclay	FR
3	Logilab	FR
4	Universit Bordeaux	FR
5	University of Kaiserslautern	DE
6	University of Oxford	UK
7	University of Washington at Seattle	US

Contents

♠**EC Commentary**: *Please follow the structure of this template when preparing your proposal. It has been designed to ensure that the important aspects of your planned work are presented in a way that will enable the experts to make an effective assessment against the evaluation criteria. Sections 1, 2 and 3 each correspond to an evaluation criterion for a full proposal.*

Please be aware that proposals will be evaluated as they were submitted, rather than on their potential if certain changes were to be made. This means that only proposals that successfully address all the required aspects will have a chance of being funded. There will be no possibility for significant changes to content, budget and consortium composition during grant preparation.

Page limit: The cover page, and sections 1, 2 and 3, together should not be longer than 70 pages. All tables in these sections must be included within this limit. The minimum font size allowed is 11 points. The page size is A4, and all margins (top, bottom, left, right) should be at least 15 mm (not including any footers or headers). If you attempt to upload a proposal longer than the specified limit, before the deadline you will receive an automatic warning, and will be advised to shorten and re-upload the proposal. After the deadline, any excess pages will be overprinted with a

Outline of Project (for Proposers)

♠**TO DO**: *This is the place for various READMEs not included in the final submission*♠

Mission statement for the grant

Our mission is to promote the next generation of community-developed open source software, databases, and services adapted to the needs of collaborative research in pure mathematics and applications.

Our research will cover a wide variety of aspects, ranging from software development models, user interfaces ♠**TO DO**: *virtual environments?*♠, deployment frameworks and novel collaborative tools, component architecture, design, and standardization of software ♠**TO DO**: *system?*♠ and databases, to links to publication, data archival and reproducibility of experiments, development models and tools, and social aspects.

It will consolidate Europe's leading position in computational mathematics and build on the remarkable success of the ecosystem of projects GAP, Python/Sage, Pari, Singular, LMFDB.

♠**TO DO**: *What do we meand by "new generation"*♠.

1 Excellence

1.1 Objectives

♠**EC Commentary**: Describe the specific objectives for the project, which should be clear, measurable, realistic and achievable within the duration of the project. Objectives should be consistent with the expected exploitation and impact of the project (see section 2).♠

From their early days, computers have been used in pure mathematics, either to prove theorems or, like the telescope for astronomers, to explore new theories. Major achievements include the proof of the four color theorem or ♠**TO DO**: *Nice flashy example?*♠. Usage has grown to the point that certain areas of mathematics now completely depend on experimental methods, with major efforts spent on software development. As the sophistication of the required computations increased, supported by the boom of the available computational power, it became vital to share those efforts at the scale of large research communities. European mathematicians have been pioneers and have grown a steady tradition of collaborative open source software development, with systems like GAP, Singular, or Pari/GP playing a major role for decades.

This project gathers European core developers of leading mathematical software (GAP, Pari, Sage, Singular, ...), databases (LMFDB, ...), and critical components (IPython stack), together with researchers in computer and social sciences, with mission to promote a new generation of community-developed open source software, databases, and services adapted to the needs of collaborative research in pure mathematics and its applications.

Our research will cover a wide variety of aspects, ranging from software development models, user interfaces ♠**TO DO**: *virtual environments?*♠ deployment frameworks and novel collaborative tools, component architecture, design, and standardization of software components and databases, to links to publication, data archival and reproducibility of experiments, development models and tools, and social aspects. It will build on the remarkable success of the open source ecosystem and consolidate Europe's leading position in computational mathematics.

♠**TO DO**: *How much more detail?*♠

1.2 Relation to the Work Programme

♠**EC Commentary**: *Indicate the work programme topic to which your proposal relates, and explain how your proposal addresses the specific challenge and scope of that topic, as set out in the work programme.*♠
♠**EC Commentary**:

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This is a synthesis of Antonios Barbas' slides describing the Call 3
Topic 9-2015 EINFRA-9: e-Infrastructure for Virtual Research Environment

See file:../Documentation/VirtualEnvironmentsWorkProgramme2014-2015.ppt

** Suggested EU contribution per proposal: 2 to 8 M ; Total budget: 42 M
** Dates: 14/01/2015
- H2020-EINFRA-2014-1 15/04/2014
- H2020-EINFRA-2014-2 02/09/2014
- H2020-EINFRA-2015-1 14/01/2015(tbc)
** European contacts: Antonios Barbas
   See file:Documentation/Contacts.docx
** Definition:
- Groups of researchers, typically widely dispersed, who are working
  together
- through ubiquitous, trusted and easy access to services for
  scientific data, computing and networking
- in a collaborative, virtual environment:
  > the e-Infrastructures
** Characteristics:
- Address the needs of specific scientific communities  in support of
  e-Science;
- Have users from both academia and industry;
- Involve bottom-up research and develop user-oriented services;
- Are based on e-infrastructures
** Specific challenge:
- Capacity building in interdisciplinary research
- through community-led development and deployment of service-driven
  digital environments
- for large-scale cross-disciplinary research collaboration and data
  interoperability
** Expected impact:
- More effective collaboration between researchers and increased
  take-up of collaborative research by new disciplines;
- Easier discovery, access and re-use of data, resulting in higher
  productivity of researchers;
- Accelerate innovation via access to integrated digital research
  resources across disciplines;
*** Scope: Proposals are expected to
Notations: [X]: easy to argue; [?]: we have some lead, but that will take some arguing
- [?] Integrate resources across all layers of the e-infrastructure
  (networking, computing, data, software, user interfaces) to foster
  cross-disciplinary data interoperability
- [?] Build on requirements from real use cases, i.e. integrate
  heterogeneous data from multiple sources and re-use tools and
  services from existing infrastructures
- [X] Target any area of Science and Technology, especially
  interdisciplinary ones, including ICT, mathematics, web science and
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social sciences and humanities
- [X] Use standardised building blocks and workflows, well-documented
  interfaces and interoperable components;
- [?] Define semantics, ontologies and metadata to enable data citation
  and promote data sharing, as to ensure interoperability;
- [X] Target easy-to-use functionalities; and indicate the number of
  researchers they target as potential users;
** Specific conditions for the Call on e-Infrastructures:
- [X?] Proposals should be structured around Networking, Service
  and Joint Research Activities
- [X] The Software to be developed needs to be open source
- [ ] A Data Management Plan to be developed enabling data preservation,
  on-line discoverability, authorisation and re-use of data
- [X] Clear Metrics (KPIs) to be proposed and used;
- [?] Open Access to Publications resulting from the project;
- [X] Usefulness of services to the end user community and
      financial sustainability to be ensured;
** Where should the emphasis be?
- [?] Services
- [X] Thinking innovation
      With both suppliers or users
- [X] Mainstreaming skills development
- [ ] Integration between data and computing
- [X] Business plans for financial sustainability
  ...and partnerships with the private sector
- [ ] Supporting policies
- [X] open data and software
- [X] Sharing basic operations services and building blocks
- [X] Monitoring performance (KPIs)
** Simplified funding model
    - Up to 100% for Research and Innovation
      - Flat 25% rate for indirect costs (overhead?)

♠

1.3 Concept and Approach

♠**EC Commentary**: *– Describe and explain the overall concept underpinning the project. Describe the main ideas, models or assumptions involved. Identify any trans-disciplinary considerations;*♠

♠**EC Commentary**: *Describe any national or international research and innovation activities which will be linked with the project, especially where the outputs from these will feed into the project;*♠

- DFG Priority Project SPP 1489: `computeralgebra.de` ♠WD [**WRITE HERE**:]♠ (in particular already may joint activities; see ...)

- IPython grant

- FLINT grant

- Sage-Combinat grant

♠**EC Commentary**: *– Describe and explain the overall approach and methodology, distinguishing, as appropriate, activities indicated in the relevant section of the work programme, e.g. Networking Activities, Service Activities and Joint Research Activities, as detailed in the Part E of the Specific features for Research Infrastructures of the Horizon 2020 European Research Infrastructures (including e-Infrastructures) Work Programme 2014- 2015;*
– Describe how the Networking Activities will foster a culture of co-operation between the participants and other relevant stakeholders.
– Describe how the Service activities will offer access to state-of-the-art infrastructures, high quality services, and will enable users to conduct excellent research.
– Describe how the Joint Research Activities will contribute to quantitative and qualitative improvements of the services provided by the infrastructures.
– As per Part E of the Work Programme, where relevant, describe how the project will share and use existing basic operations services (e.g. authorisation and accounting systems, service registry, etc.) with other e-infrastructure providers and justify why such services should be (re)developed if they already exist in other e-infrastructures. Describe how the developed services will be discoverable on-line.
– Where relevant, describe how sex and/or gender analysis is taken into account in the projects content.♠

1.4 Ambition

♠EC Commentary: – Describe the advance your proposal would provide beyond the state-of-the-art, and the extent the proposed work is ambitious. Your answer could refer to the ground-breaking nature of the objectives, concepts involved, issues and problems to be addressed, and approaches and methods to be used.
– Describe the innovation potential which the proposal represents. Where relevant, refer to products and services already available, e.g. in existing e-Infrastructures.♠

2 Impact

2.1 Expected Impacts

♠**EC Commentary**: *Please be specific, and provide only information that applies to the proposal and its objectives. Wherever possible, use quantified indicators and targets.*

Describe how your project will contribute to:

– the expected impacts set out in the work programme, under the relevant topic (including key performance indicators/metrics for monitoring results and impacts);

– improving innovation capacity and the integration of new knowledge (strengthening the competitiveness and growth of companies by developing innovations meeting the needs of European and global markets; and, where relevant, by delivering such innovations to the markets;

– any other environmental and socially important impacts (if not already covered above).

Describe any barriers/obstacles, and any framework conditions (such as regulation and standards), that may determine whether and to what extent the expected impacts will be achieved. (This should not include any risk factors concerning implementation, as covered in section 3.2.)♠

2.2 Measures to Maximise Impact

2.2.1 Dissemination and Exploitation of Results

♠**EC Commentary**: – *Provide a draft 'plan for the dissemination and exploitation of the project's results'. The plan, which should be proportionate to the scale of the project, should contain measures to be implemented both during and after the project.*
Dissemination and exploitation measures should address the full range of potential users and uses including research, commercial, investment, social, environmental, policy making, setting standards, skills and educational training.
The approach to innovation should be as comprehensive as possible, and must be tailored to the specific technical, market and organisational issues to be addressed
– Explain how the proposed measures will help to achieve the expected impact of the project . Provide a draft business plan for financial sustainability as stated in the Part E of the Specific features for Research Infrastructures of the Horizon 2020 European Research Infrastructures (including e-Infrastructures) Work Programme 2014-2015.
– Where relevant, include information on how the participants will manage the research data generated and/or collected during the project, in particular addressing the following issues: What types of data will the project generate/collect? What standards will be used? How will this data be exploited and/or shared/made accessible for verification and re-use (If data cannot be made available, explain why)? How will this data be curated and preserved?

– Include information about any open source software used or developed by the project.
You will need an appropriate consortium agreement to manage (amongst other things) the ownership and access to key knowledge (IPR, data etc.). Where relevant, these will allow you, collectively and individually, to pursue market opportunities arising from the project's results.
The appropriate structure of the consortium to support exploitation is addressed in section 3.3.

– Outline the strategy for knowledge management and protection. Include measures to provide open access (free on-line access, such as the green or gold model) to peer-reviewed scientific publications which might result from the project.
Open access publishing (also called 'gold' open access) means that an article is immediately provided in open access mode by the scientific publisher. The associated costs are usually shifted away from readers, and instead (for example) to the university or research institute to which the researcher is affiliated, or to the funding agency supporting the research.
Self-archiving (also called 'green' open access) means that the published article or the final peer-reviewed manuscript is archived by the researcher - or a representative - in an online repository before, after or alongside its publication. Access to this article is often - but not necessarily - delayed (embargo period), as some scientific publishers may wish to recoup their investment by selling subscriptions and charging pay-per-download/view fees during an exclusivity period.♠

2.2.2 Communication activities

♠**EC Commentary**: *Describe the proposed communication measures for promoting the project and its findings during the period of the grant. Where appropriate these measures should include social media and public events with user participation. Measures should be proportionate to the scale of the project, with clear objectives. They should be tailored to the needs of various audiences, including groups beyond the project's own community. Where relevant, include measures for public/societal engagement on issues related to the project.*♠

3 Implementation

3.1 Work Plan — Work packages, deliverables and milestones

♠**EC Commentary**: *Please provide the following:*

- *brief presentation of the overall structure of the work plan;*

- *timing of the different work packages and their components (Gantt chart or similar);*

- *detailed work description, i.e.:*

    - *a description of each work package (table 3.1a);*

    - *a list of work packages (table 3.1b);*

    - *a list of major deliverables (table 3.1c);*

- *graphical presentation of the components showing how they inter-relate (Pert chart or similar).*

♠

Overall Structure of the Work Plan

The work plan is broken down into XX workpackages as shown in Figure **??**: WP2 deals with ... In addition, there is one management work package (WP1) and one general dissemination work package (**??**). The Gantt chart on Page 11 illustrates the timeline for the various tasks for these work packages, including inter-task dependencies.

How the Work Packages will Achieve the Project Objectives

♠ALL [**WRITE HERE**: This needs to explain that we're actually going to meet the objectives. Needs to be done after objectives and WPs.]♠
The project objectives (Section 1.1, page 2) and the corresponding work packages that contribute to achieving those objectives are:

Objective	Purpose	WPs
Objective 1	XX	**WPX**

Work Programme for Objective 1: Objective 1 is covered by WPX, which will ...

Work Plan Timing: GANTT Chart showing Task Dependencies and Information Flows

Work package list

Work package No	Work package title	Lead partic. no.	Lead short name	Person months	Start month	End month
WP1	Project Management	1	**USTAN**		1	60
WP2	Emerging Technology					
WP3	Community Building and Engagement					
WP4	Component Architecture					
WP5	Standardization					
WP6	User Interfaces					
WP7	Supporting the Mathematical Process					
WP8	Development Models for an Academic Free Software Ecosystem					
WP9	Next generation Mathematical Databases	1	**USTAN**			
Total				**XXX**		

List of Deliverables

Del. no.	Deliverable name	WP no.	Lead	Type	Dissemi- nation level	Delivery date
D10.1	Requirements Analysis	WP?		R	CO	??

List of milestones

Milestone number	Milestone name	Related work package(s)	Estimated date	Means of verification (deliverables shown here + success criteria below)
MS1 MS3	Completed initial requirements analysis.	WPX WPX	1	**??**.

Milestone	Success Criteria	Contributes to Objective(s)
MS1 MS3	Completed requirements analysis (Deliverable **??**). XX	**1, 3.** **XX**

Work package description (WP1)

Work package number	WP1		**Start date or starting event:**		Month 1	
Work package title	**Project Management**					
Participant number	1	2				
Participant short name	**USTAN**	**UPS**				
Person-months per participant:	48	48				

Objectives: The objective of WP1 is to undertake all project management activities, including setting up joint infrastructure, organizing meetings, and producing overview reports.

Description of work:

This workpackage will perform ...

Deliverables:

- D1.1 (Month 1): Internal and external mailing lists.

- D1.3 (Month 1): Internal software repository.♠**TO DO**: *Needed?*♠

- D1.4 (Month 12): Project Periodic Report (first year).

- D1.5 (Month 24): Project Periodic Report (second year).

- D1.6 (Month 36): Project Periodic Report (third year).

- D1.7 (Month 48): Project Periodic Report (fourth year).

- D1.8 (Month 48): Project Final Report

Work package description (WP2)

Work package number	WP2		Start date or starting event:		Month 1		
Work package title	**Emerging Technology**						
Participant number	1						
Participant short name	**USTAN**						
Person-months per participant:	1						

Objectives: The objective of WP2 is to produce periodic reviews of relevant developments elsewhere and implications for our plans, including negotiating access or shared development when appropriate.
It will feed this information to the other work packages, in particular Component Architecture

Description of work:

This workpackage ...

Deliverables:

- **??** (Month 12): Year 1 report.

- **??** (Month 12): Year 2 report.

- **??** (Month 12): Year 3 report.

- **??** (Month 12): Year 4 report.

Work package description (WP3)

Work package number	WP3		Start date or starting event:		Month 1		
Work package title	**Community Building and Engagement**						
Participant number	1						
Participant short name	**USTAN**						
Person-months per participant:	1						

Objectives: The objective of WP3 is to further develop the community at the European scale, foster cross teams collaborations, spread the expertise, and engage the greater community to participate to the definition of the needs, and the implementation and use of the produced solutions.

Description of work:

We will organize regular open workshops (e.g. Sage Days, Pari Days, summer schools, etc.); some of them will be focused on development and coding sprints, and others on training.

This work package will also provide general travel budget to fund short to long term visits between the participants, to collaborate on specific features. A typical such visit would bring together an IPython developer with a GAP developer for a coupe day to implement a first prototype of notebook interface to GAP.

This work package will complement and lean on a parallel COST network whose role is to build and animate the greater community.

Deliverables:

- **??** (Month 12): Report on community needs

- Workshop 1 ...

- Workshop 2 ...

- Workshop 3 ...

- ♠**TO DO**: *make a list*♠

♠**TO DO**: *Milestones need to be discussed and then described here.*♠

3.2   Management Structure and Procedures

3.3 Consortium as a Whole

♠**EC Commentary**:

- *Describe the consortium. How will it match the project's objectives? How do the members complement one another (and cover the value chain, where appropriate)? In what way does each of them contribute to the project? How will they be able to work effectively together?*

- *If applicable, describe the industrial/commercial involvement in the project to ensure exploitation of the results and explain why this is consistent with and will help to achieve the specific measures which are proposed for exploitation of the results of the project (see section 2.3).*

- *Other countries: If one or more of the participants requesting EU funding is based in a country that is not automatically eligible for such funding (entities from Member States of the EU, from Associated Countries and from one of the countries in the exhaustive list included in General Annex A of the work programme are automatically eligible for EU funding), explain why the participation of the entity in question is essential to carrying out the project*

♠

♠**TO DO**: *Select some events from the list on* `computeralgebra.de` *to highlight the existing tight collaborations between the members.*♠

♠**TO DO**: *Explanation of why we want to include Seattle (sage-math cloud, is a key component; access to IP).*♠

3.4 Resources to be Committed

♠

Summary of staff effort

♠TO DO: *Update this once the list of parthers and the WPs are finalised.*♠

Partic. no.	Partic. short name	Work package									Total PMs
		WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	
1	USTAN										
2	UPS										
3	Logilab										
4	UB										
5	UK										
6	UO										
7	UWS										
Total PM											

Other direct cost items

	Cost (€)	Justification
Travel		
Equipment		
Other goods and services		
Total		

Management Level Description of Resources and Budget

♠TO DO: *This needs to be updated in line with the rest of the project.*♠

The project will employ XX person-months of effort over YY years, comprising ...

4 Members of the Consortium

4.1 Participants

♠**TO DO**: *Write a Participant template*♠ ♠**TO DO**: *Write a CV template*♠
♠SL [**WRITE HERE**: Saint Andrews]♠

Universit Paris Saclay

A merger of the Universit Paris Sud, Universit de Versailles-Saint Quentin and many world class research and higher education institutes (cole polytechnique, ...), the Universit Paris Saclay is the home of one of the largest group of Sage developers worldwide. The main participants have accumulated 15 years of experience of collaborative open source software development for mathematics leadership, and community animation.

Curriculum vitae

Nicolas M. Thiry

Publications, achievements

1. Lead of the Sage-Combinat software project.

2. Coauthoring of the open source book "Calcul Mathmatique avec Sage", the first of its kind comprehensive introduction to computational mathematics in Sage for education.

Previous projects or activities

1. Home of six week-long Sage Days workshops in Orsay.

2. Organizer of ♠**TO DO**: *XXX*♠ Sage Days.

3. Founder and regular organizer of a bimonthly Sage User Group meeting in the greater Paris area.

4. ♠**TO DO**: *XXX*♠

Significant infrastructure

The Universit Paris Sud hosts the lead developers of the open source cloud infrastructure `Stratuslab` and its reference infrastructure (♠**TO DO**: *XXX cores*♠). The participants are regular users of this infrastructure, and in close contact with the developers.

University of Kaiserslautern

Curriculum vitae

Publications, products, achievements

1. ♠WD [**WRITE HERE**: ...]♠

Previous projects or activities

1. ♠WD [**WRITE HERE**: ...]♠

Significant infrastructure

♠WD [**WRITE HERE**: ...]♠ ♠NT/FC [**WRITE HERE**: Logilab]♠ ♠DP/UM [**WRITE HERE**: Oxford]♠ ♠VD [**WRITE HERE**: Bordeaux]♠ ♠MK [**WRITE HERE**: University of Silesia]♠ ♠SL/WS [**WRITE HERE**: Seattle]♠ ♠JC [**WRITE HERE**: Warwick]♠
[**?**]

4.2   Third Parties Involved in the Project (including use of third party resources)

♠**EC Commentary**: *Please complete, for each participant, the table (see page 27 of "VRETemplate.PDF"), or simply state "No third parties involved", if applicable.*♠
No third parties involved.
♠**TO DO**: *Or Seattle?*♠

5 Ethics and Security

5.1 Ethics

5.2 Security

Please indicate if your proposal will involve:

- activities or results raising security issues: NO

- 'EU-classified information' as background or results: NO