DE LA RECHERCHE À L'INDUSTRIE

CExA: Technical Roadmap

19 / 09 / 2023

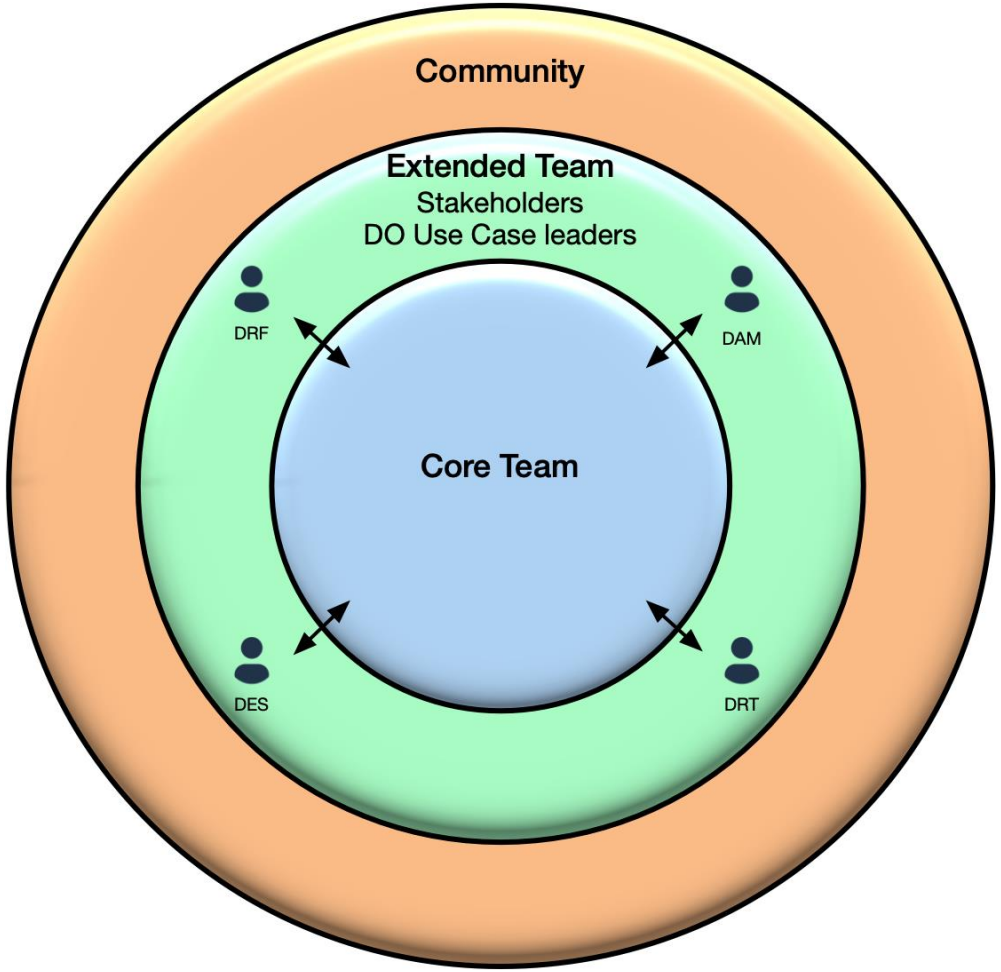
Kick off

Objectives

- Technologies are means, not ends

- CExA:
  - Technology for Technology (middleware)
    - Software Platform for new capabilities
    - Kokkos enhancements
  - Use Cases to demonstrate values (short term)
    - KPIs (metrics) improvement
    - System port to new platforms(GPU, Exascale..)
  - Ecosystem and future systems (longer term)
    - Community (CEA -> France -> EU -> WW)
    - Communication & Support

Core Team



- Mission :
  - Execute against roadmap
  - Perform co-design / implementation tasks
  - Support and implement Use Case refactoring
- Composition :
  - N10 CEA employees already working with HPC
  - N10 CEA employees interested in developping with Kokkos / C++ libraries
  - N20 from HPC ecosystem

Core Team: Focus

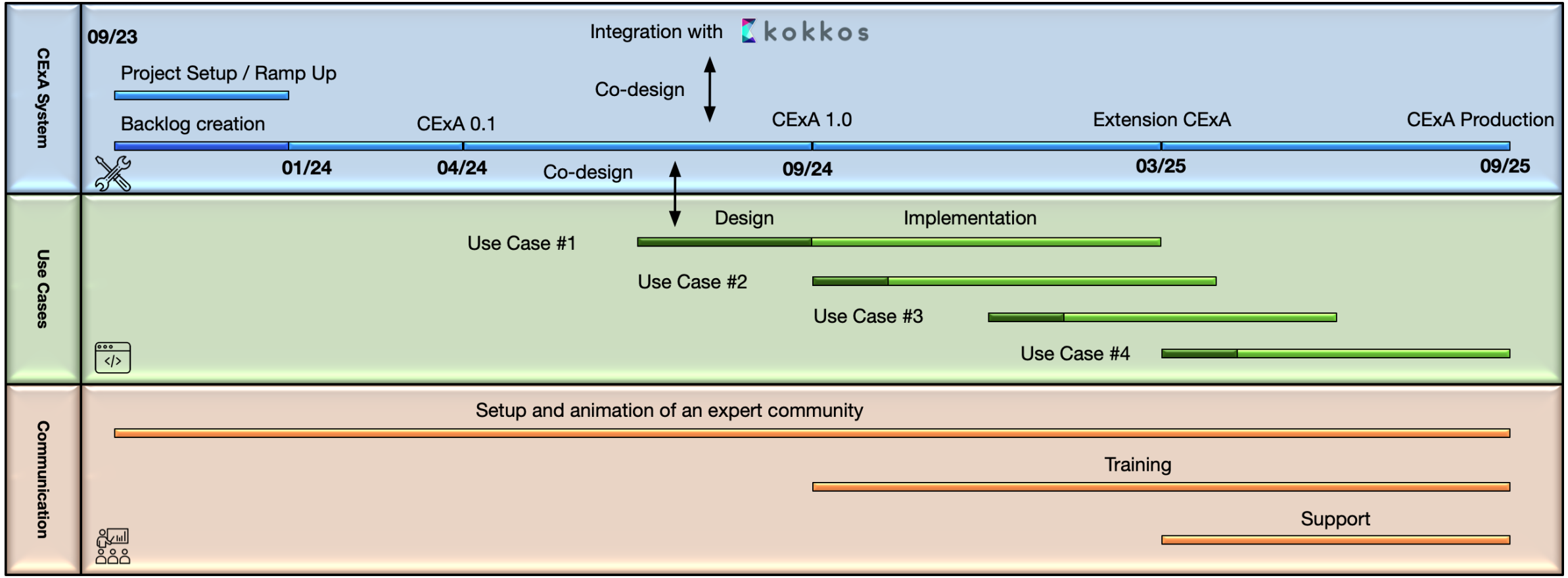
N10

- Julien Bigot DRF
- Thomas Padioleau DRF
- Mathieu Lobet DRF
- Cedric Chevalier DAM
- François Letierce DAM
- Rémi Baron DES
- Ansar Calloo DES
- Fabien Baligand DRT
- ...

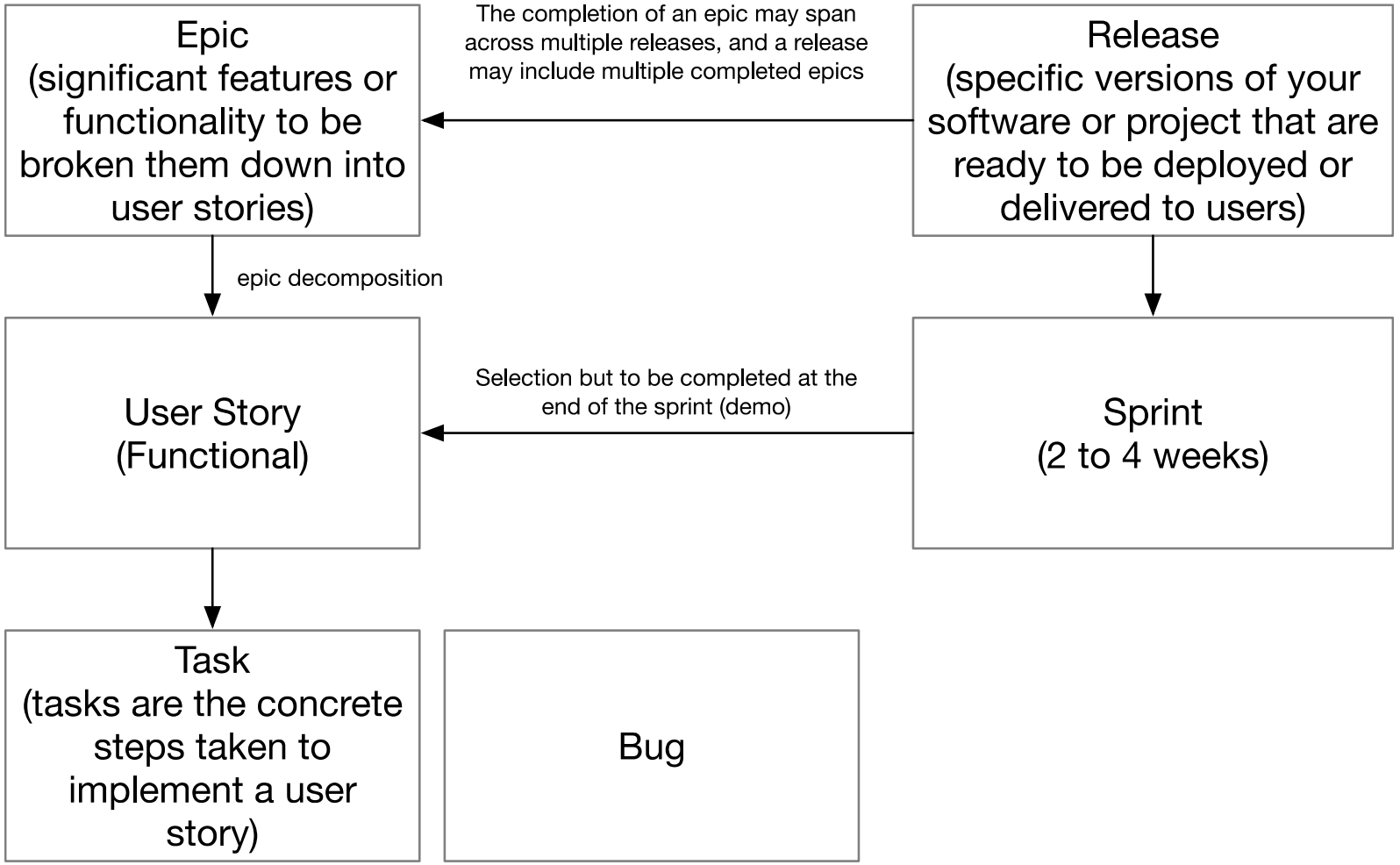
N20 (target : 6 ; currently hiring ; organic growth)

- Paul Zehner (12/23)
- ...

Methodology: Co-design



Methodology: Agility



A first draft of epics : Disclaimer

- Co-design only with use case teams for now
- HPC experts provided relevant enhancements
- Co-design with Kokkos yet to come

=>Epics and User Stories identification

- No prioritization yet

A first draft of epics [1/4]

- Introduce physical variables management to write more robust simulation applications
  - Introduce properties and operate directly on such views
  - Kokkos view manager (ease to develop, readability, Maintainability)
  - Perform batching on physical variables
  - Filter on properties

- Facilitate port legacy of applications to accelerators hardware (GPU)
  - Commonly used libraries/frameworks (e.g. Linear Algebra) (bridge CPU modules to operate on Kokkos structures)
  - Automatic memory copy to GPU when required
  - Diagnostic management (Code Profiling)

A first draft of epics [2/4]

- Offer support to advanced and state of the art 3rd party functions/libraries (each vendor has its own library, plug to the right library via Kokkos level interfaces/adapters)
  - Integrate FFT (via CExA adapter / support Kokkos compatible API)
  - Integrate Spline (redevelop using Kokkos, and integrate)
  - Connect to AI libraries (e.g. PyTorch)
  - Solve Linear Algebra problems with Kokkos

- Make full use of current and future European Exascale architectures
  - Adapt to unique memory architecture
  - Improve interoperability and performance between Kokkos and distributed parallelism (e.g. GPU direct, Remote Space, MPI, etc.)
  - Improve performance and execution on ARM based technologies for HPC (Grace ARM cpu (SVE vectorization), RHEA ARM cpu, A64FX cpu)
  - Improve performance on x86 cpu (vectorization)

A first draft of epics [3/4]

- Extend programming model to cover more usage scenarios
  - Multi-device management (abstract multi GPU) In one node: 1 CPU process can send information to all GPUs of the node
  - (Heterogeneous hardware, e.g. AI specific GPUs / NPUs)

- Improve scientific applications Development by introducing Continuous Integration Facility
  - CI / CD facilities installation
  - Methodology
  - GitOps implementation

A first draft of epics [4/4]

- Use Cases improvements (KPIs)
  - Performance Improvements / Ports
  - Readability / Maintainability
  - Tooling (code profiling)
  - Robustness (Unit tests)

- Support CEA Technical Community
  - Community (Web site with all libraries that exist)
  - Tests / Investigations ? State of the art (Bibliography, experimental libraries, features that come with Kokkos)

Follow up

- Initialize discussions with Kokkos team
- Groom backlog (refine with Use Case members, operational directors)
- Prioritize first tasks
- Inter DO interactions
- N20 Hiring efforts (organic growth)

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Thank you

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