SOLHARIS

SOLvers for **H**eterogeneous **A**rchitectures
over **R**untime systems – **I**nvestigating **S**calability

Kickoff meeting

Bordeaux, 5 February 2020

Context

SOLHARIS is a followup of the SOLHAR (ANR-13-MONU-0007) and addresses the issues related to scalability in large, distributed memory systems

Duration: 4 years

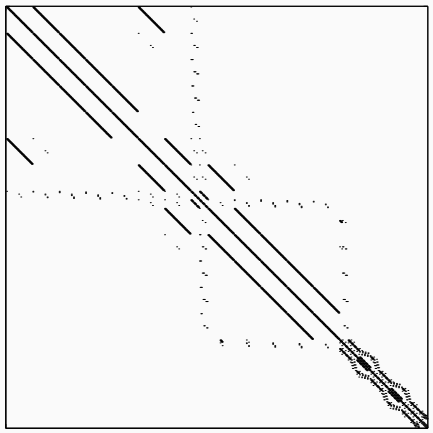
Consortium:

- **IRIT-CNRS**: expert in computational linear algebra and sparse linear solvers
- **Inria Bordeaux**: expert in computational linear algebra and sparse linear solvers, scheduling and runtime systems
- **Inria Lyon**: expert in computational linear algebra and sparse linear solvers and scheduling
- **CEA and Airbus**: expert in FEM-BEM methods in aero-acoustics and electromagnetics and in the development of parallel numerical software

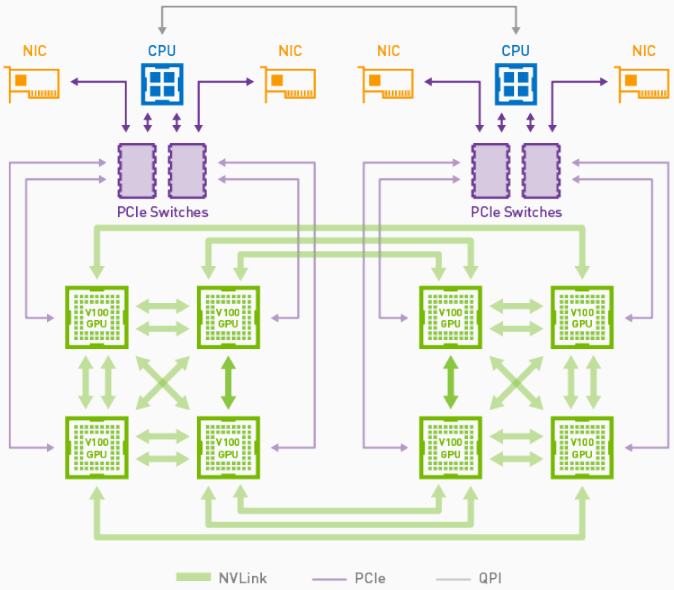
Subject at a glance

Solve large scale ($O(10^8)$ unknowns) sparse linear systems

$$Ax = b \quad \Rightarrow \quad \begin{cases} A \to LU \\ z = L^{-1}b \\ x = U^{-1}z \end{cases}$$



on large ($O(10^3)$ nodes) heterogeneous supercomputers



Challenges

- **Communications**: with nodes becoming more powerful, data transfers become increasingly penalizing
- **Data and work distribution**: achieve good load balancing while improving data locality, fairness
- **Memory consumption**: parallelism is commonly responsible for an increased memory consumption
- **Irregularity and heterogeneity**: both algorithms and architectures are irregular and heterogeneous

Organization

- **Task 1, Solvers**:
  - develop robust sparse direct algorithms which are scalable in time and memory
  - achieve scalable implementations that are based on task parallelism and modern runtimes
- **Task 2, Runtimes**:
  - improve the scalability of runtimes in time and memory
  - extend runtimes features and APIs in order to handle dynamic workloads and data/work redistribution
- **Task 3, Scheduling**:
  - static and dynamic scheduling methods to improve scalability through data locality, fairness and clustering
  - memory-aware scheduling algorithm which maximize parallelism within a prescribed memory budget
- **Task 4, Applications**: validate and integrate tools and methods within applications from CEA and Airbus

Odds and ends

- **Consortium agreement** : WIP
- **Plan de Gestion des Données** : due in March
- **Plenary meetings** : 2 per year (4 in Bordeaux, 2 in Lyon and 2 in Toulouse)
- **Mailing list** : `solharis@irit.fr`
- **Web page** : `https://www.irit.fr/solharis/`
- **HAL** : attach all the documents to the SOLHARIS project `https://aurehal.archives-ouvertes.fr/anrproject/read/id/50324`
- **Acknowledgments** : do not forget to acknowledge the project in your papers (grant # ANR-19-CE46-0009)
- **Recruitment** : Bordeaux? Lyon? Toulouse?