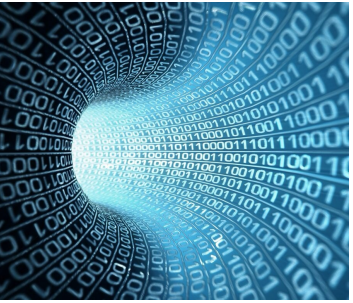

Review on distributed computing

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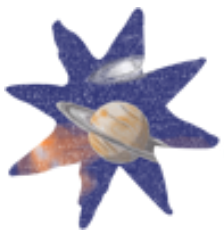
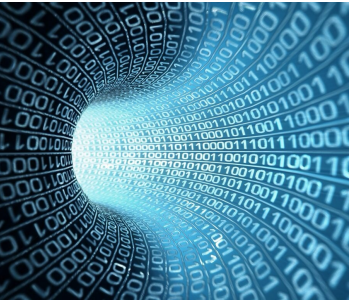
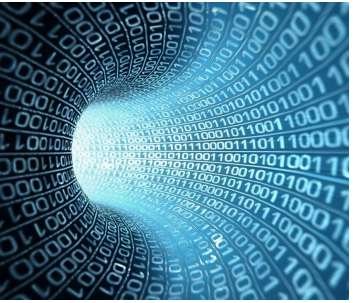


December 10, 2015



Plan



Distributed computing

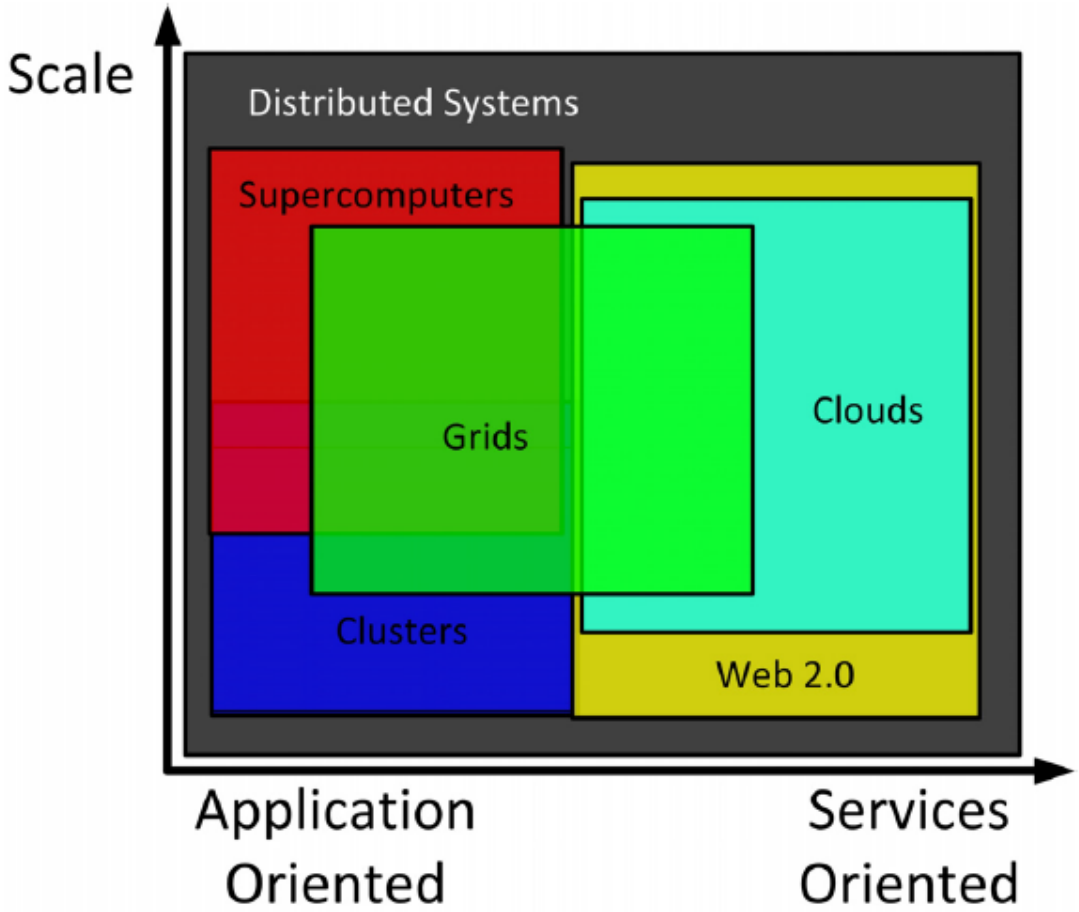
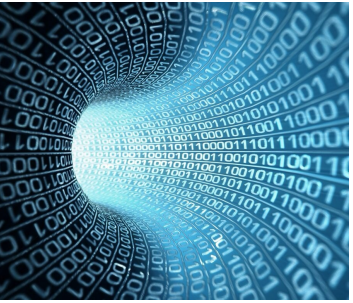


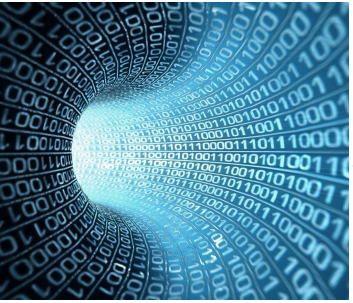
Figure: Distributed computing infrastructures @Foster.



Infrastructure

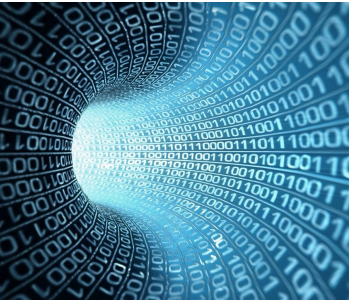
Common properties:

- parallel computing.
- scalability.
- commodity hardware.
- heterogeneous resources: server age, multi-core (CPU/GPU), memory, storage.
- fast network and performance file system.
- open-source softwares.
- resource managers and middlewares.



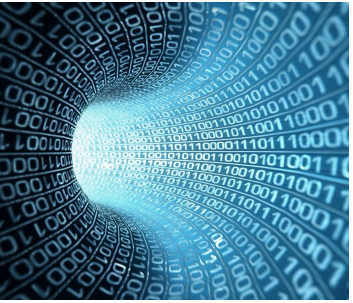
Job

- Computing:
  - Simulation, parametric study ➟ **HPC** (High Performance Computing).
  - Data analysis ➟ **HTC** (High Throughput Computing).
- Job:
  - sequential.
  - massively distributed (embarrassingly parallel).
  - parallel.
- Data:
  - I/O.
  - volume ➟ Big Data.



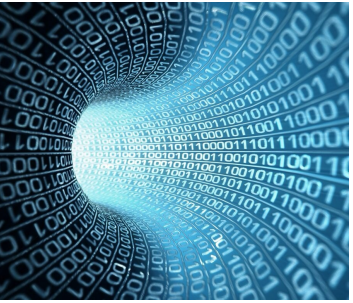
Cluster

Figure: Arago cluster @FACe, APC.



Cluster types

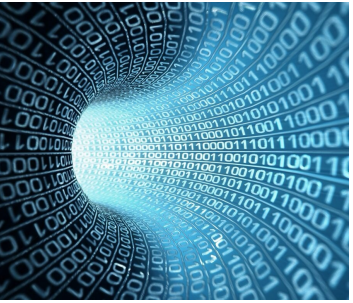
- **Beowulf cluster**:
  - since 1994.
  - distributed computing, distributed storage on separate bay, shared memory.
- **Hadoop cluster**:
  - since 2006.
  - distributed computing and storage located on the same nodes, shared memory.



Cluster description

Components:

- node: 1 master, several workers.
- Resource and Job Management Systems (RJMS): Torque/Maui, HTCondor, SLURM, YARN...
- file system: NFS, GlusterFS, GPFS, Lustre, HDFS...
- network: GbE/s, InfiniBand (low latency, high bandwidth).
- ressource middleware: Open MPI and MPICH (MPI, distributed memory); OpenMP and Cilk (shared memory); Spark (cached memory).
- user: batch or interactive.



Providers

- Laboratory: Arago@FACe (local infrastructure).
- Mésocentres.
- National centers:
  - HPC: IDRIS, CCRT, TGCC, CINES.
  - HTC: CC-IN2P3 (Centre de Calcul de l'IN2P3).

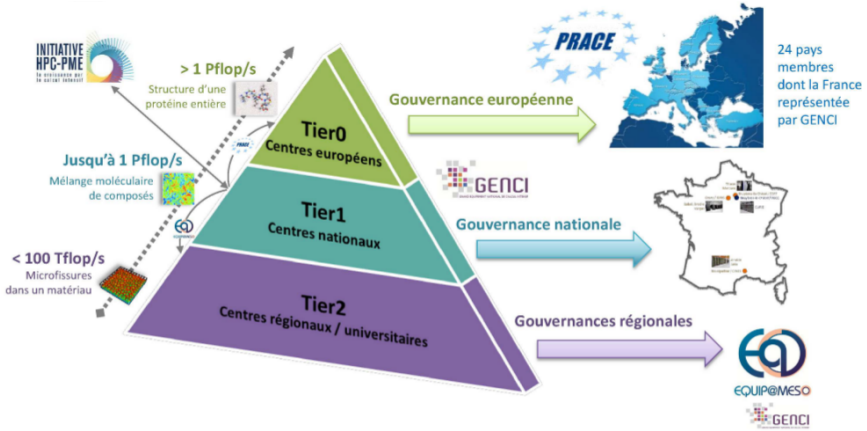
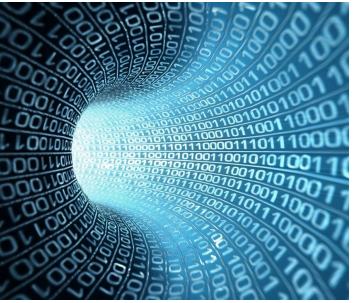
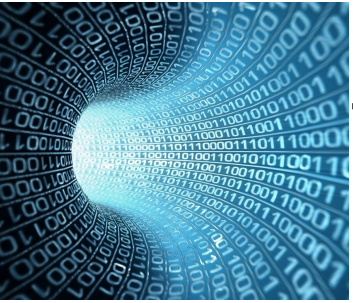


Figure: @GENCI.

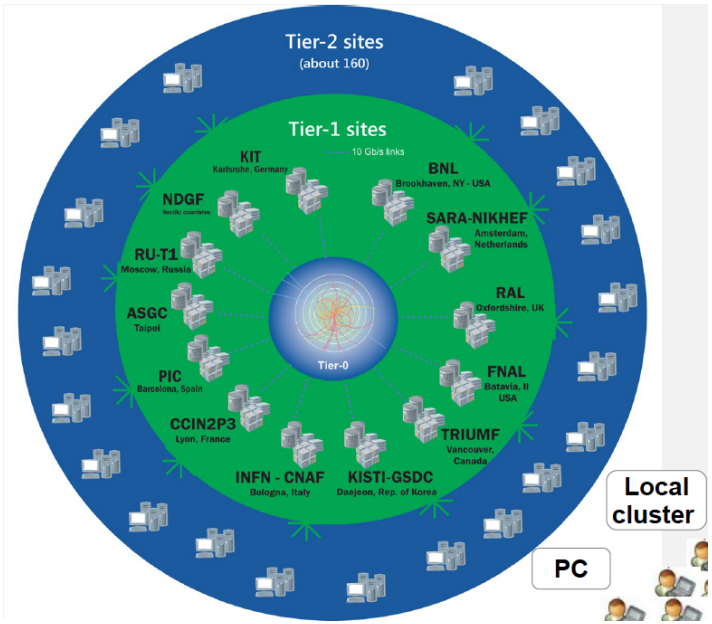


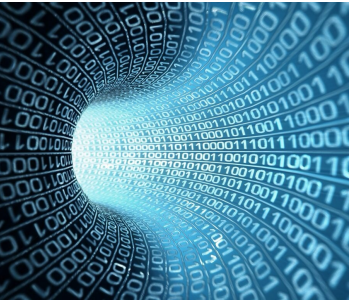
Grid



Types

- Particle physics (CERN) impulsion:
  - since 1999.
  - tier structure.

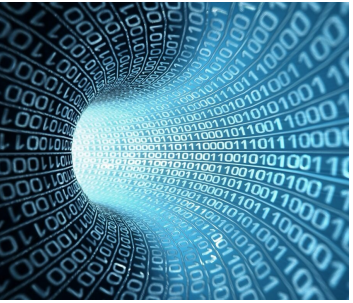




Description

Components:

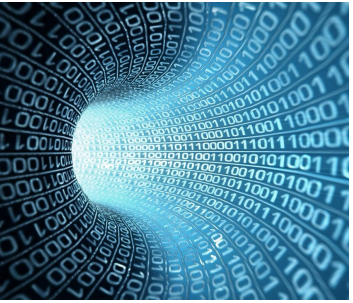
- node: grid of CE (Computing Element) and SE (Storage Element).
- geographically dispersed.
- complexe ressource middleware: gLite (until 2012), EMI (until 2014), UMD.
- user:
  - certificat.
  - VO (Virtual Organisation).
  - proxy.
  - UI (User Interface).
- tool: DIRAC.



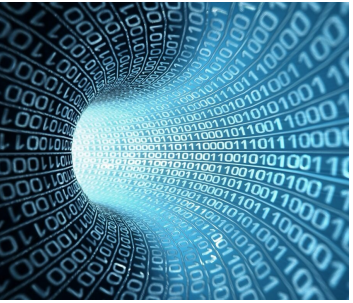
Providers

WLCG
Worldwide LHC Computing Grid

- CERN: WLCG (World Lhc Computing Grid).
- Europe: EGI (European Grid Infrastructure), EGEE before.
- France: France Grilles.
- Locally: GRIF (Grille Îles-de-France).



Cloud



Cloud types

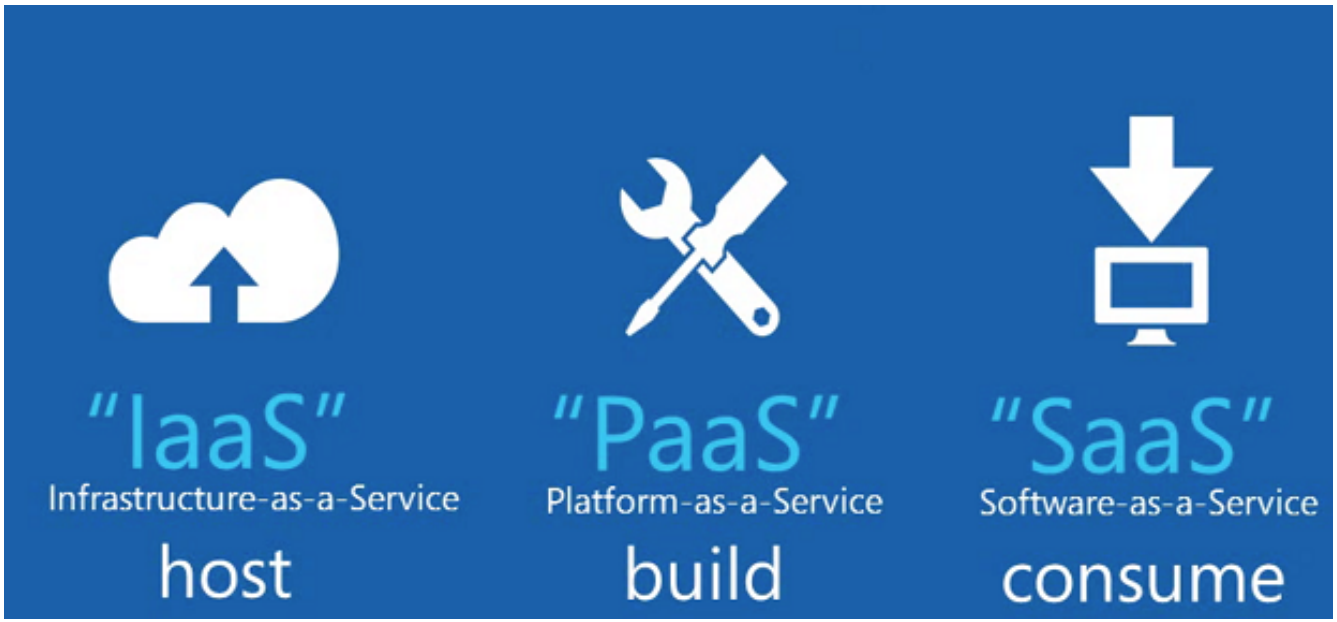
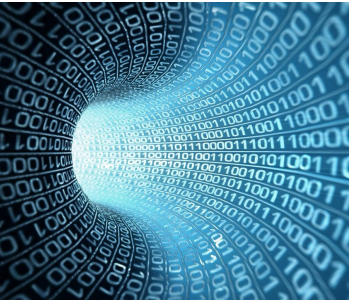


Figure:

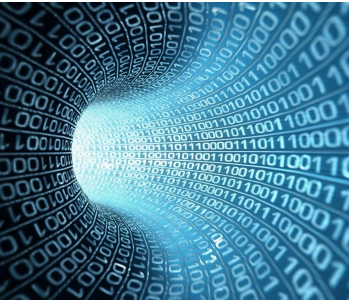
`http://fr.slideshare.net/clintedmonson/windows-azure-jumpstart`.



Cloud description

Components:

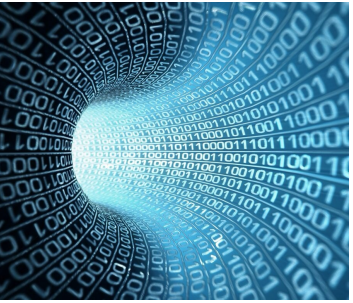
- solution (resource manager):
  - academic: StratusLab, OpenStack, OpenNebula...
  - commercial: AWS, Google Cloud Platform, CloudWatt...



Cloud description

Components:

- node: 1 front-end, several hypervisors ➡ VMs (Virtual Machine) with on-demand virtual resources (OS, CPU, memory, storage, network).
- storage: iSCSI, Ceph
  - virtual disk (persistent or volatil) based on block storage.
  - long term storage based on object storage.
- network: GbE/s.
- user: command-line, dashboard, HTTP protocol.
- tool: SlipStream.



French academic cloud providers

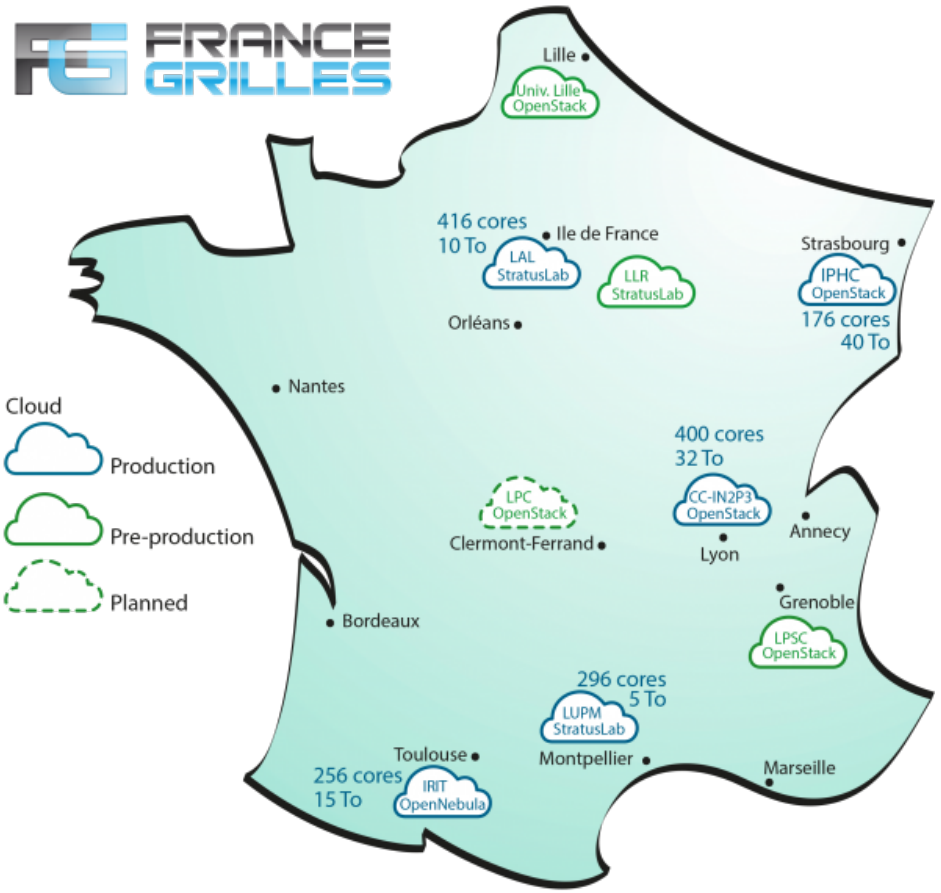
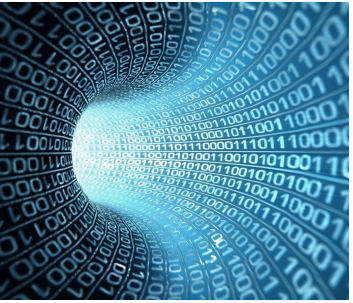
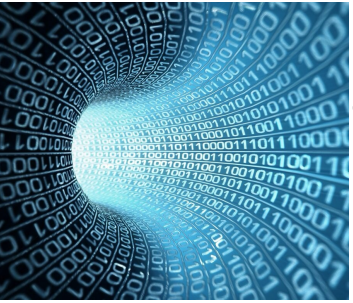


Figure: @France Grilles.



Conclusion

- Cluster: all applications (simulation, parametric study, data analysis).
  - scalability: supercomputer.
- Grid: all applications.
  - weak point: computing access (proxy), data management, sotware access.
- Cloud:
  - generic applications:
    - prototyping.
    - management of computing peak.
    - applications with specific resources.
  - weak point: very generic hardware.



Thank you for your attention.