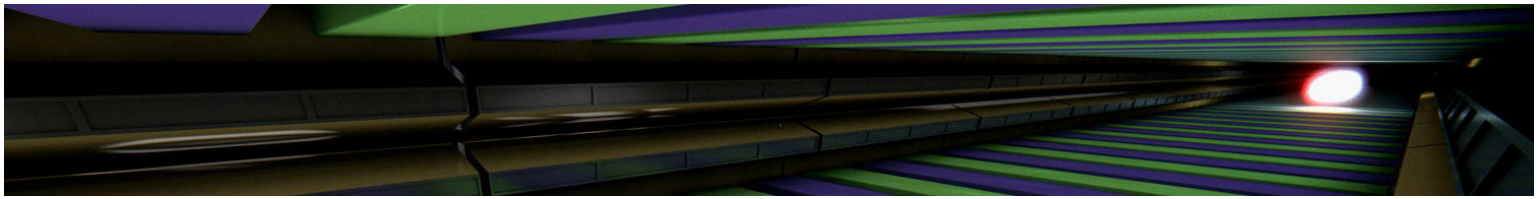


European XFEL

ESFRI & e-Infrastructure Collaborations, EGEE'09

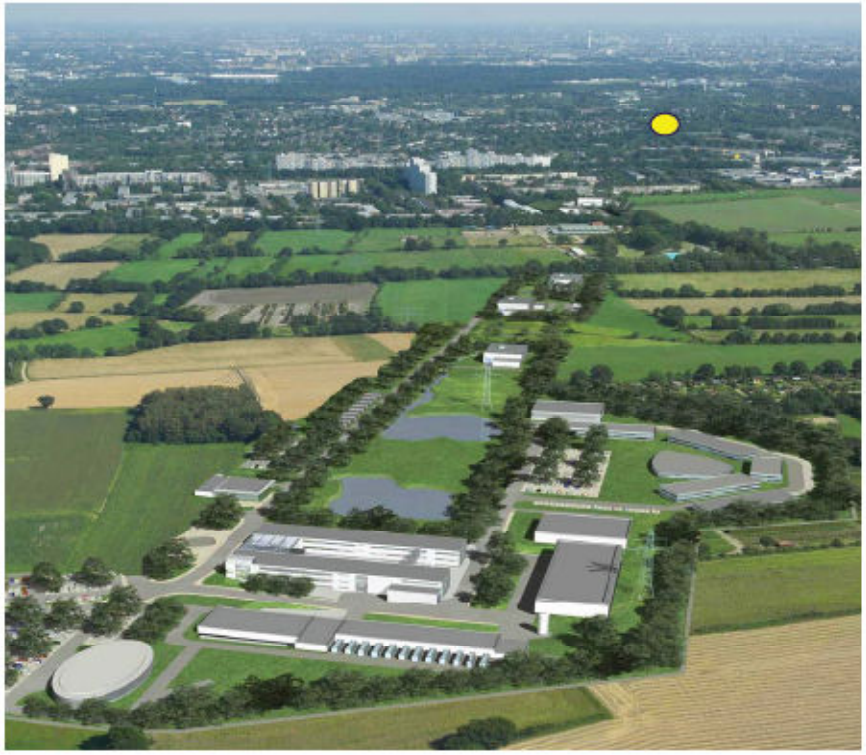
Krzysztof Wrona

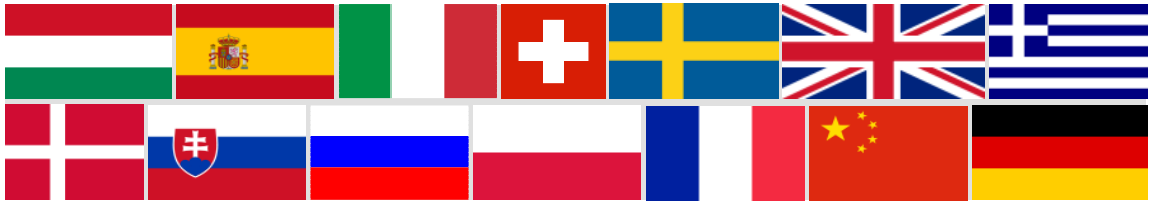
September 21st, 2009

European XFEL

The European XFEL

- X-ray Free Electron Laser, currently being constructed, located in Germany
- From 2014 on, XFEL will generate ultrashort X-ray pulses that will be utilized by various users communities in a broad range of scientific disciplines
- New research opportunities due to the unique photon beam characteristic:
  - High repetition rate (30000 pulses/s)
  - Ultrashort pulse duration (few – 100fs)
  - Extreme intensities
  - Coherent radiation





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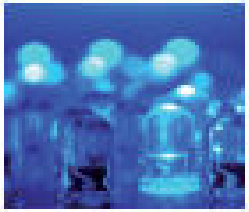
Science overview




The X-ray flashes will allow scientists...

... to decipher the structure of many more biomolecules and biological entities such as cells or membranes than is possible today.

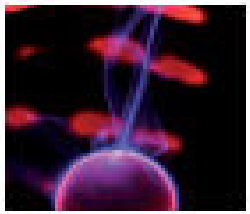
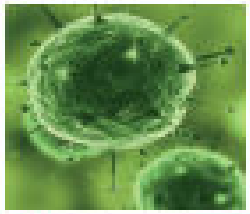
... to study biochemical reactions in action. Among other things, this will lead to a better understanding of viruses and will provide an important basis for future medicines.

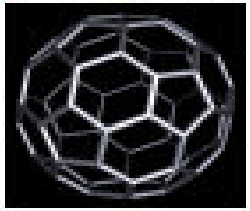
... to learn more about chemical processes such as catalysis, which plays an important role in nature and in the manufacturing of most chemical substances produced in industry.

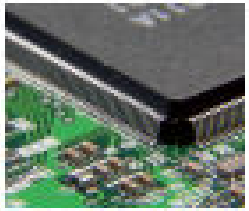
... to study new processes and materials that are required for harnessing solar energy.

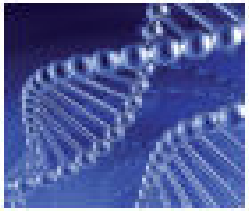
... to analyse the properties of various materials in order to develop completely new materials with revolutionary characteristics.

... to gain new insights into the nanoworld– for instance about components with specific electronic, magnetic and optical properties. This will lay the foundation for tomorrow's technologies.

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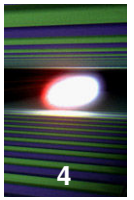
ICT vision



- ICT technologies are deeply involved in many aspects of the facility design, construction and operation
- The most challenging areas will cover:
  - **Control of the facility devices**
    - ➔ linear accelerator, photon beam systems, experimental stations, detectors, diagnostic devices
  - **Data acquisition**
    - ➔ High instantaneous data rates, multiple data sources, online data reduction
  - **Data management**
    - ➔ Data curation, archive and distribution
  - **Data Analysis**
    - ➔ Analysis technique very specific to a particular experiment

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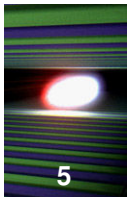
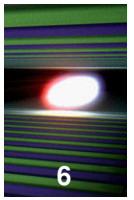
ICT requirements



- **Different experiments scenarios**
  - User driven data production
  - Continuous data taking mode vs. experiments requiring complex setup and slow feedback loops
- **High instantaneous data rates**
  - up to 10GB/s from a single detector
- **Large accumulated data volume**
  - Estimated to 10PB/year (2015)
  - Data archive scalable to accommodate ~100PB/year
  - Raw data needs to be stored at the facility for at least one year
- **Remote access to data and computing services**
  - Single sign-on service
  - Data protection – fine grain authorization scheme required
  - Services for data catalogs querying and data retrieval, web portals, lightweight client tools

ICT requirements



- **Support for diverse user communities coming from physics, material science, chemistry, biology, medicine,…**
  - Strong groups using advanced data analysis techniques
  - Small groups of scientists with minimal computing experience
- **Data analysis**
  - Support for scientific software repositories
  - Trivial parallelism (i.e. independent batch jobs) vs. complex MPI type of applications
  - Analysis techniques and algorithms still in development – no reliable CPU requirements yet
- **Network**
  - Reduced (or full) data samples need to be transferred to users
  - Many institutes with no connection to high bandwidth network
    - ➔ requires access to national level data centers

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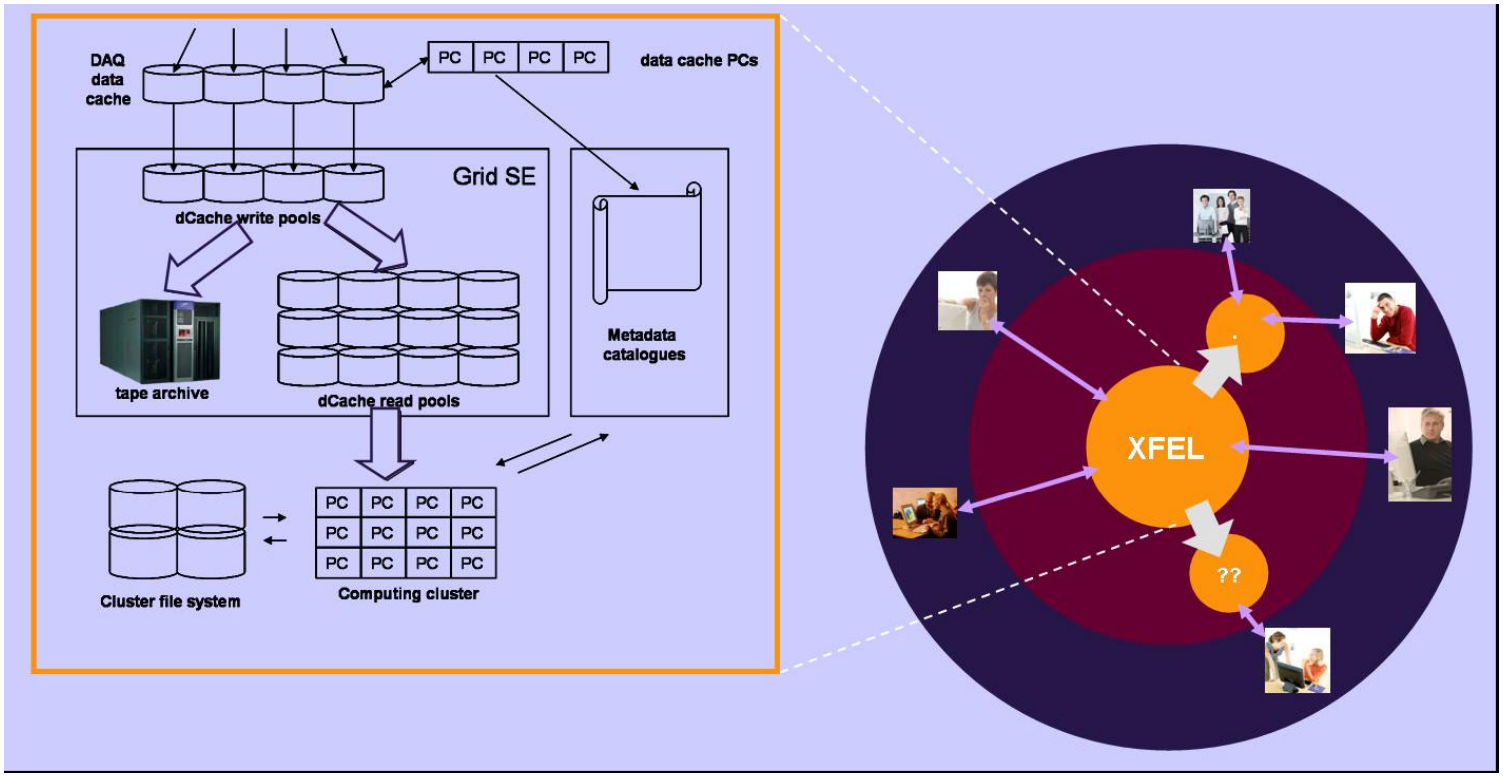
Proposed architecture



- Common infrastructure for all experiments
- Remote access to data and computing resources
- Build the data management services on top of the Grid infrastructure and VO services (xfel.eu VO already exists)
- Use high bandwidth network for data distribution (can we apply tiered model?)

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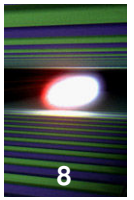
Current status & Timeline



- 2009 – Public release of the European XFEL Computing Technical Design Report
- 2010-2012 – evaluation, developments and testing
- 2013 – deployment and integration of DAQ and data management services
- 2014 – small scale, production quality system required for the photon beam lines commissioning
- 2015 – first full operation year of the facility – full functionality, production level

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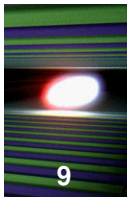
Challenges & Suggestions



- Perform bulk data processing on site using remote access
- Build the data management and data distribution services on top of the Grid middleware and VO services
- Support many small user groups with different demands (data protection, various analysis techniques)
- Use e-Infrastructure to strengthen our user communities and ensure access to computing and data storage resources on the national level
- The services must be reliable and easy to use by non computing experts, small initial overhead for new users