NEESgrid: System Overview

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The Role of the NEESgrid System Architecture

- Define the core capabilities of NEESgrid
- Facilitate interoperability, extensibility and scalability
- Provide a foundation on which the diverse NEES usage scenarios can be supported
  - Not single point solution

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Architecture Approach

- Common infrastructure that can used across all NEES applications
  - Balance generic mechanisms, extensibility for future growth, efficiency for application specific tasks
- Validate against user requirements
  - Input from user requirements analysis
  - MOST, EBD build on proven technology base

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NEESgrid and the Grid

- Grid is infrastructure to support
  - Data sharing, numeric simulation, remote observation and control, collaboration
- Maps well into NEES requirements
  - Similarity of problem space and objectives
- Synergistic with many other projects
  - E.G. SCEC, ETF, …
  - Minimizes risk

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Open Grid Services Architecture

- Builds on Web Services technology
  - A Grid service is a Web service with extras
- Significant industry buy in
  - IBM, HP, Oracle, SGI, …
- High-quality open source implementation
  - Globus Toolkit®

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NEESGrid and NSF Middleware Initiative

- CISE program to harden, test and support national middleware infrastructure
- Significant NMI presence in Grid space
- Plan to eventually fold NEES specific services into NMI releases

Software Components

- Extant software
  - particularly significant elements of the NSF Middleware Initiative (NMI) software system
- Custom software to address general NEESgrid issues
  - Produced by SI team
- Site-specific, and application specific software
  - to be produced by the equipment sites, other NEES participants, or other sources.

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Physical Elements

- A moderate number of *equipment sites*,
- A moderate number of *resource sites*,
  - data repositories and/or computer systems
- A potentially large number of *users*
  - including earthquake engineers, students, and others.
- Campus and wide area *networks*
- An *operations center*,
  - provides monitoring and diagnostic facilities for NEESgrid as a whole

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NEESgrid Core Capabilities

- Tele-control and tele-observation of experiments
- Data cataloging and sharing
- Remote Collaboration and visualization tools and services
- Simulation execution and integration

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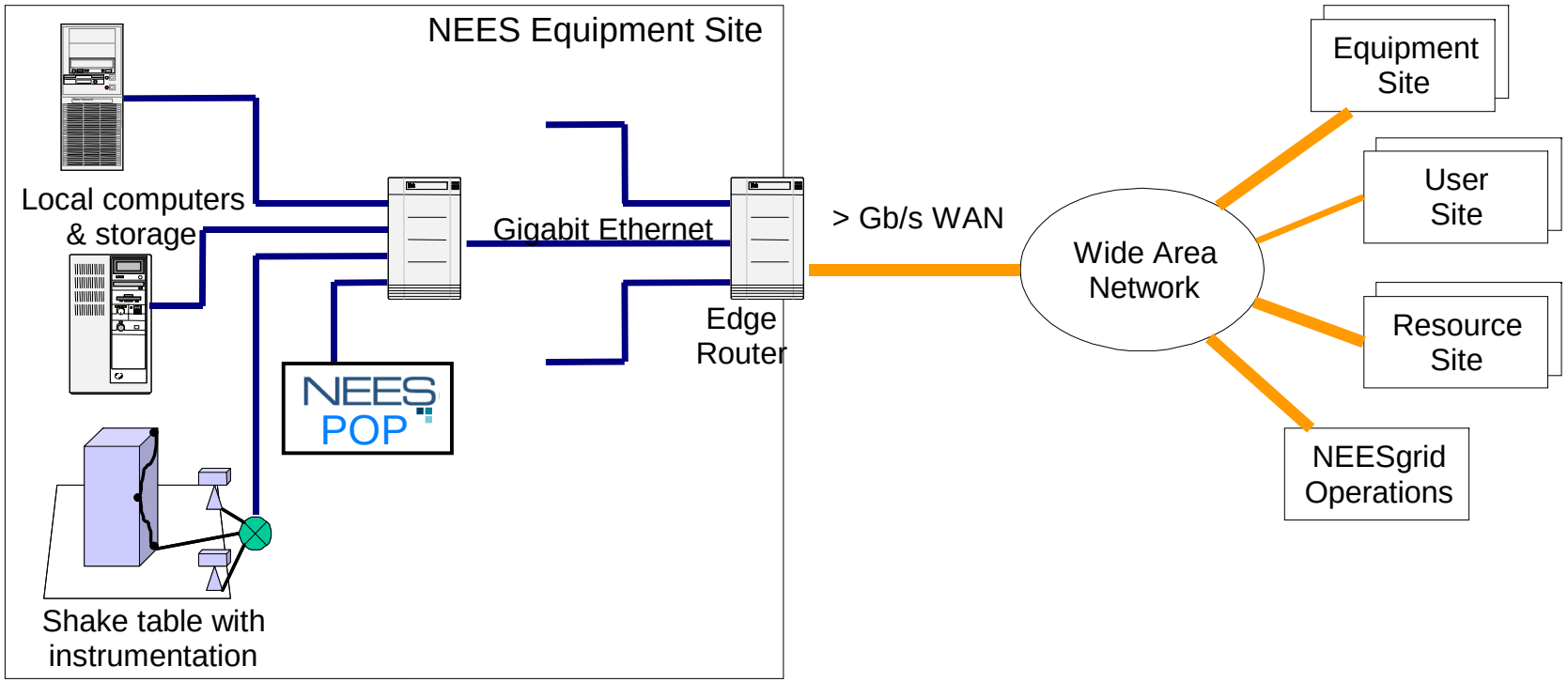
NEESgrid High-level Structure



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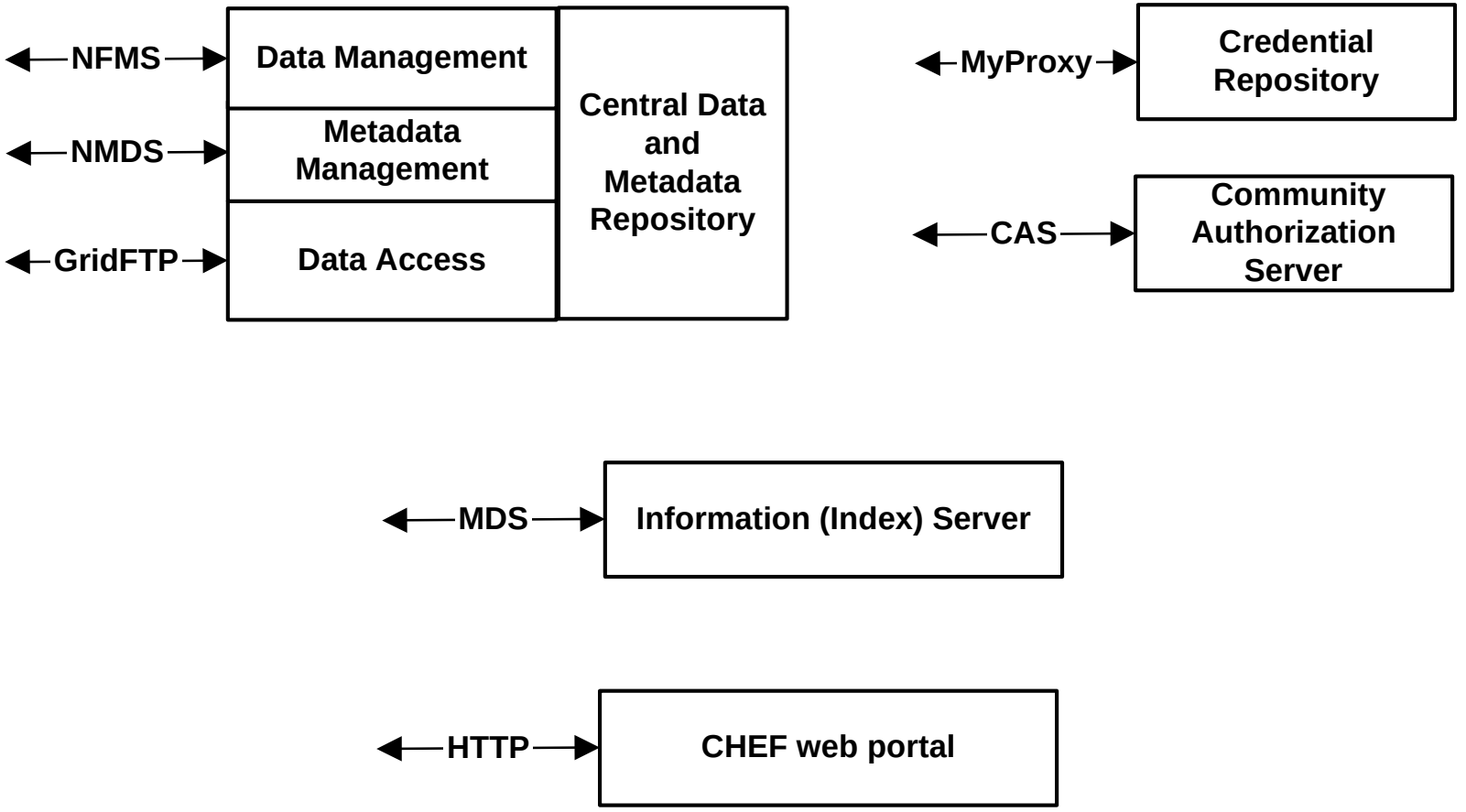
Centralized NEES-Wide Services



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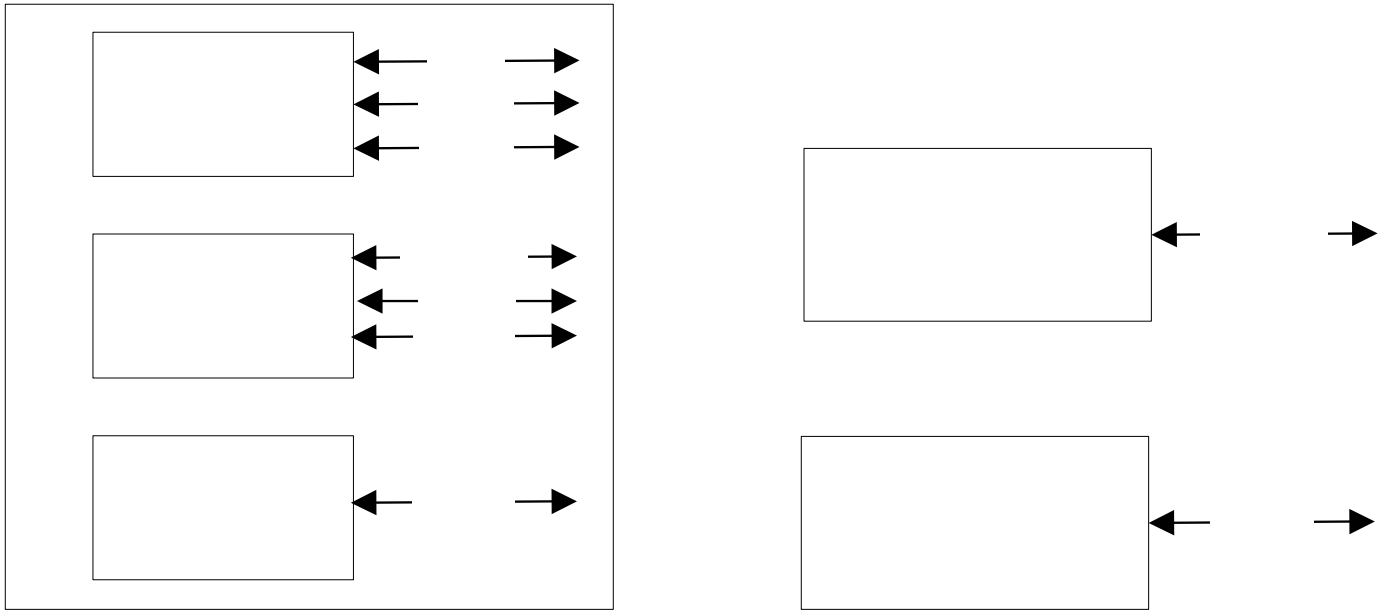
Non-Centralized NEESgrid Services



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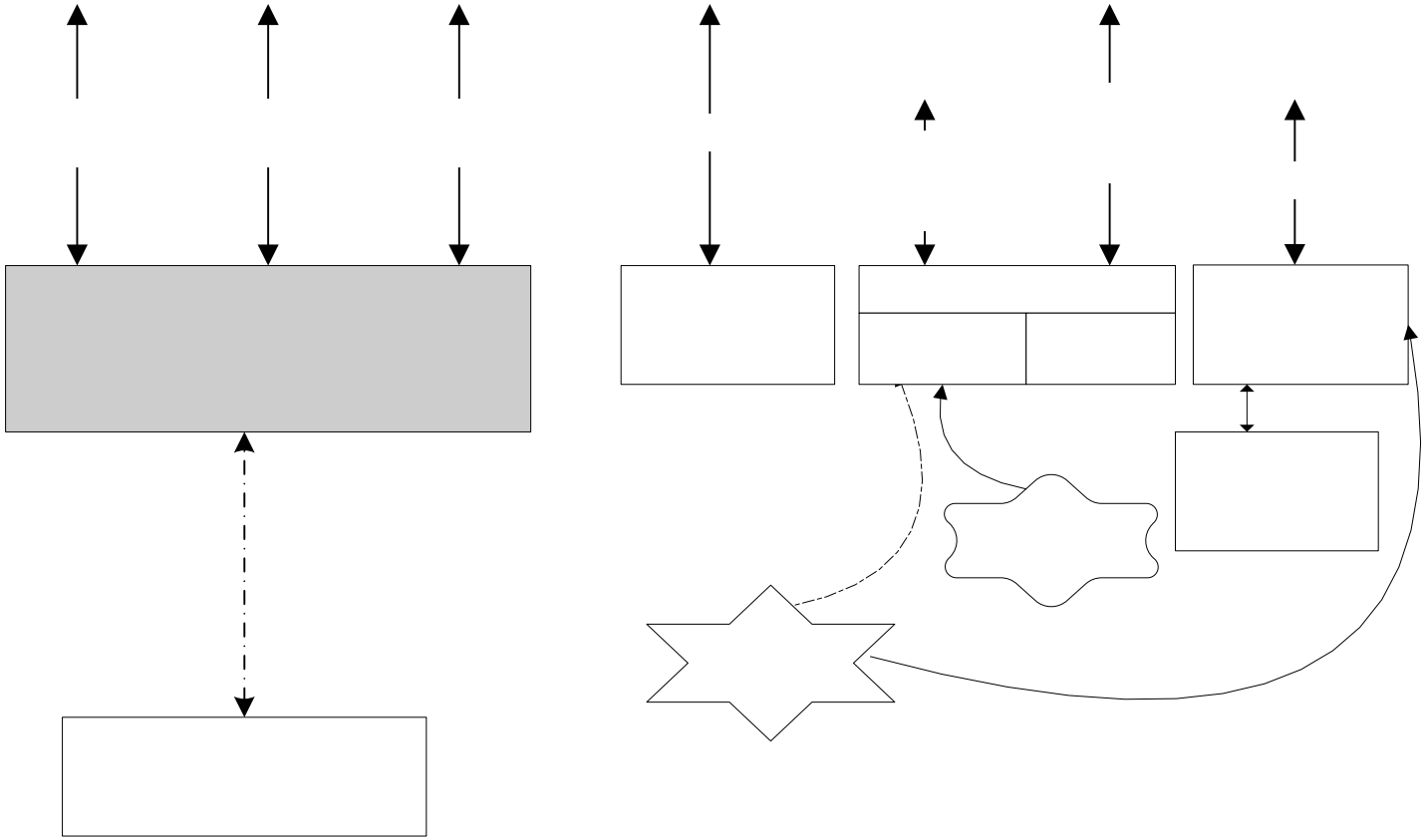
Architecture of NEESgrid Equipment site.



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Globus Toolkit V3

- High quality open source OGSI implementation
  - Developed by The Globus Alliance
- Commercial support available
- Globus services include:
  - Security
    - Authentication and authorization
  - Status and configuration
  - Resource management
  - Data services
    - Data movement
    - Data access

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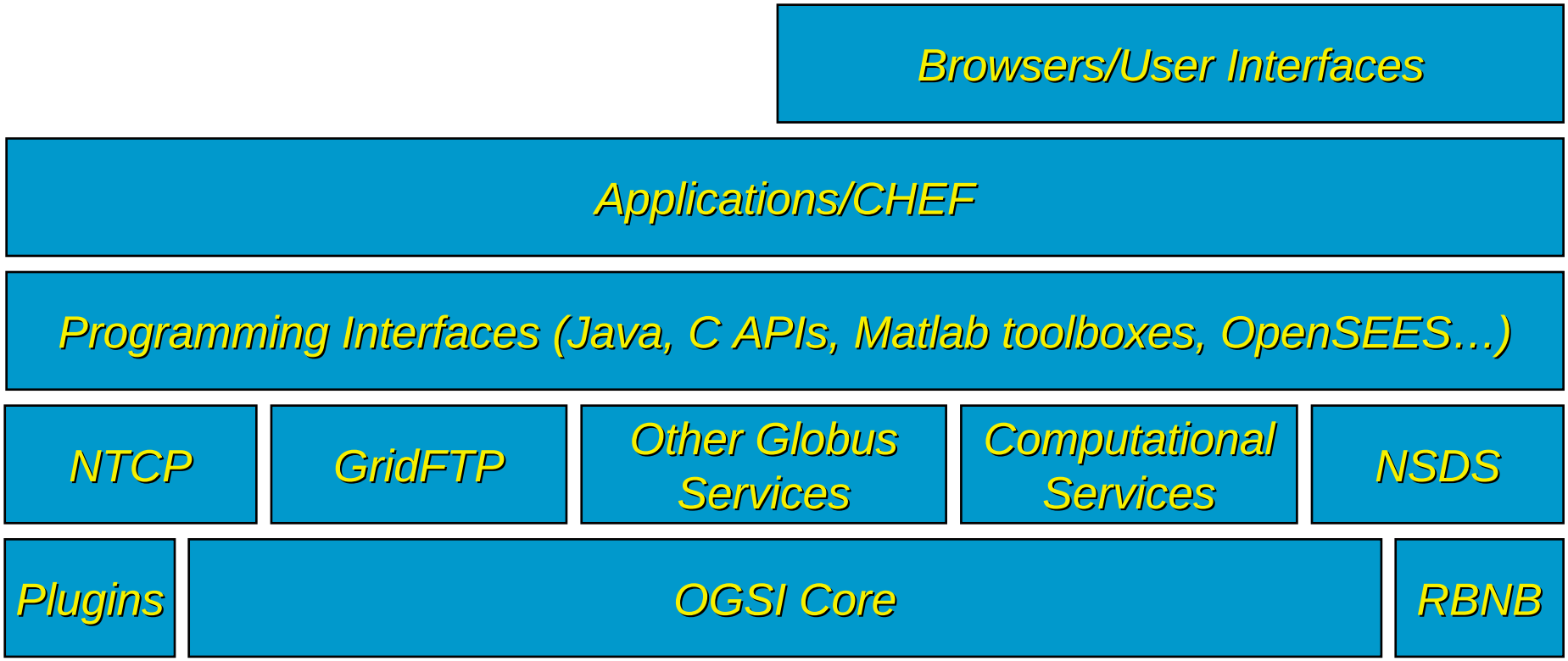
NEESgrid Software Stack



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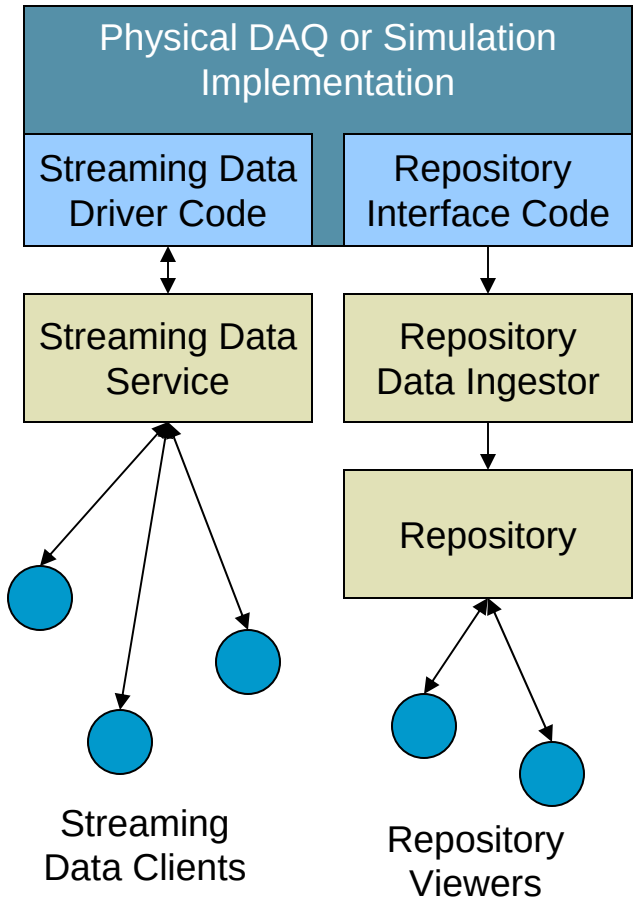
NEESgrid Core Data Transfer Components

- NEESgrid data transfer for *both experiments and simulations* is achieved through a forked data path.
  - Streaming Data (for live viewing during events)
  - Transfer to Repository (for guaranteed storage and retrospective access)
- The “Transfer to Repository” path is well-defined and in place; equipment sites are installing and customizing our implementation through our EBD process.
- The “Streaming Data” path is currently being redesigned following successful implementation and use in early experiment and EBD activities.



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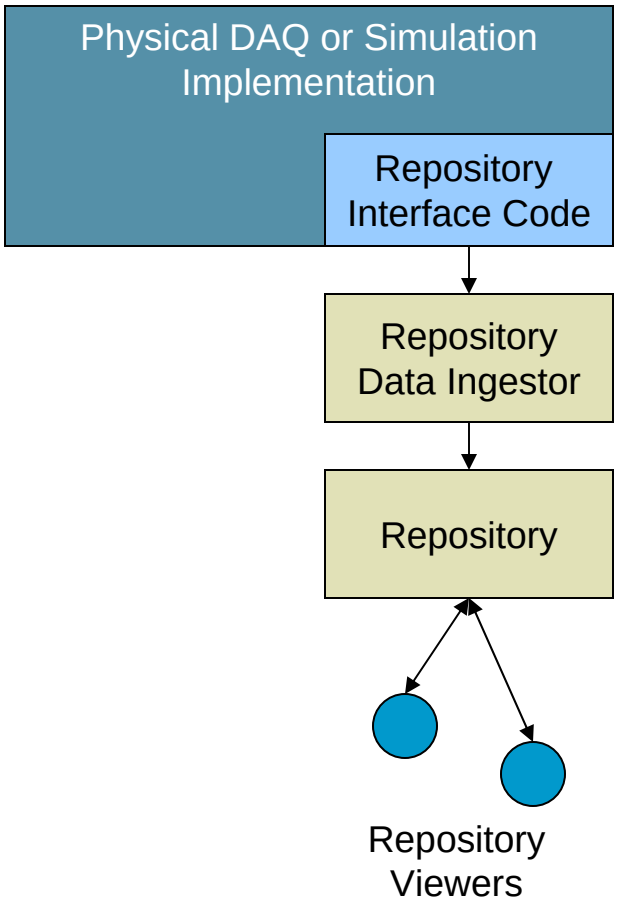
Transfer to Repository

- The NEESgrid Repository (running on the NEES-POP) mandates conventions for data collection from simulation components and physical DAQ implementations.
  - Shared filesystem (e.g., NFS, Samba)
  - File location and naming conventions
  - File format conventions
- The Repository's Data Ingestor detects new files and ingests them into the repository with appropriate metadata.



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Tele-Control Services

- A single, transaction-based protocol and service (NTCP) to control physical experiments and computational simulations.
- OGSI based implementation (GT3.0)
- Plug-ins to interface the NTCP service
  - A computational simulation written in Matlab
  - Shore Western control hardware
  - MTS control hardware (via Matlab and xPC)
  - Labview
  - C
- Security architecture, including GSI authentication and a flexible, plug-in-based authorization model.

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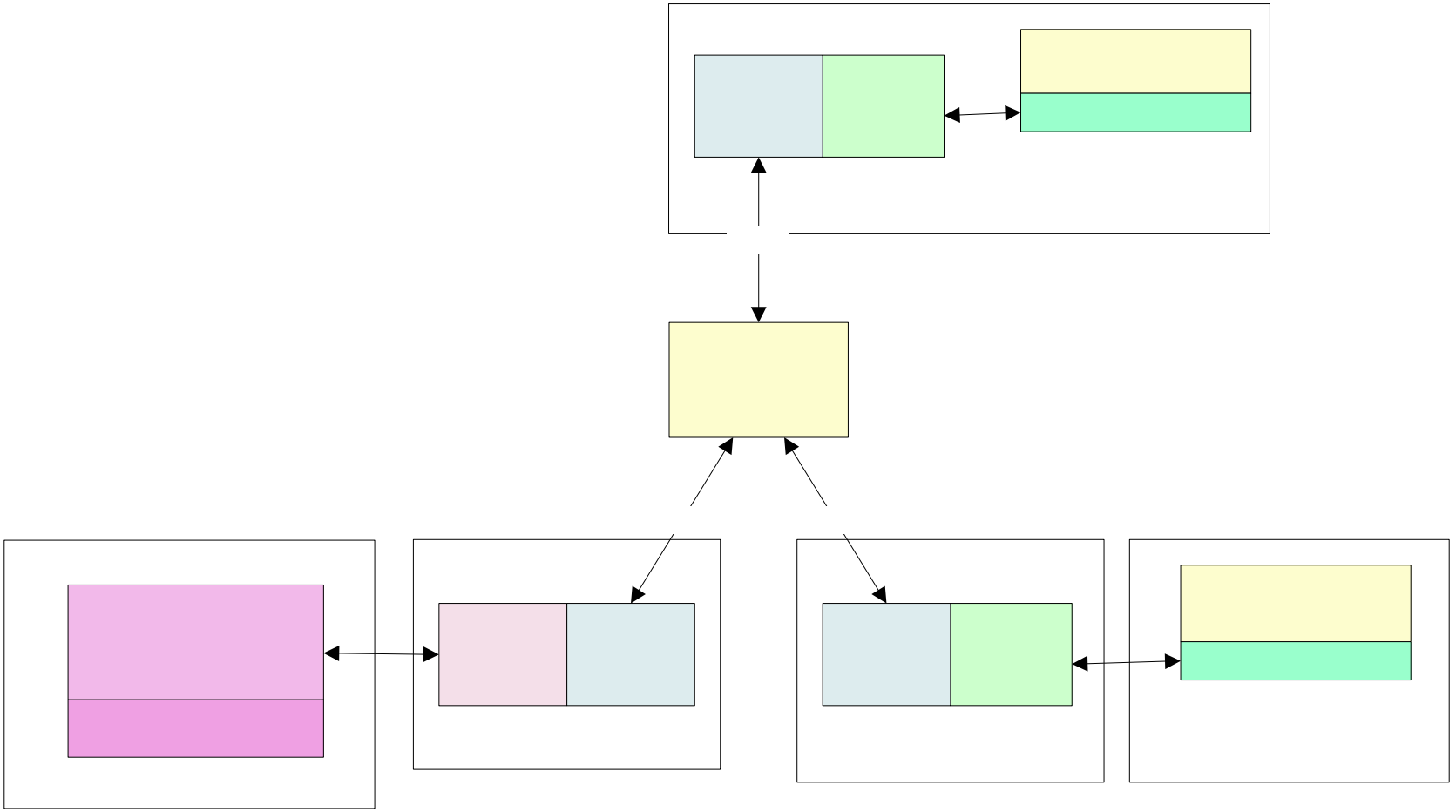
Plug-in approach



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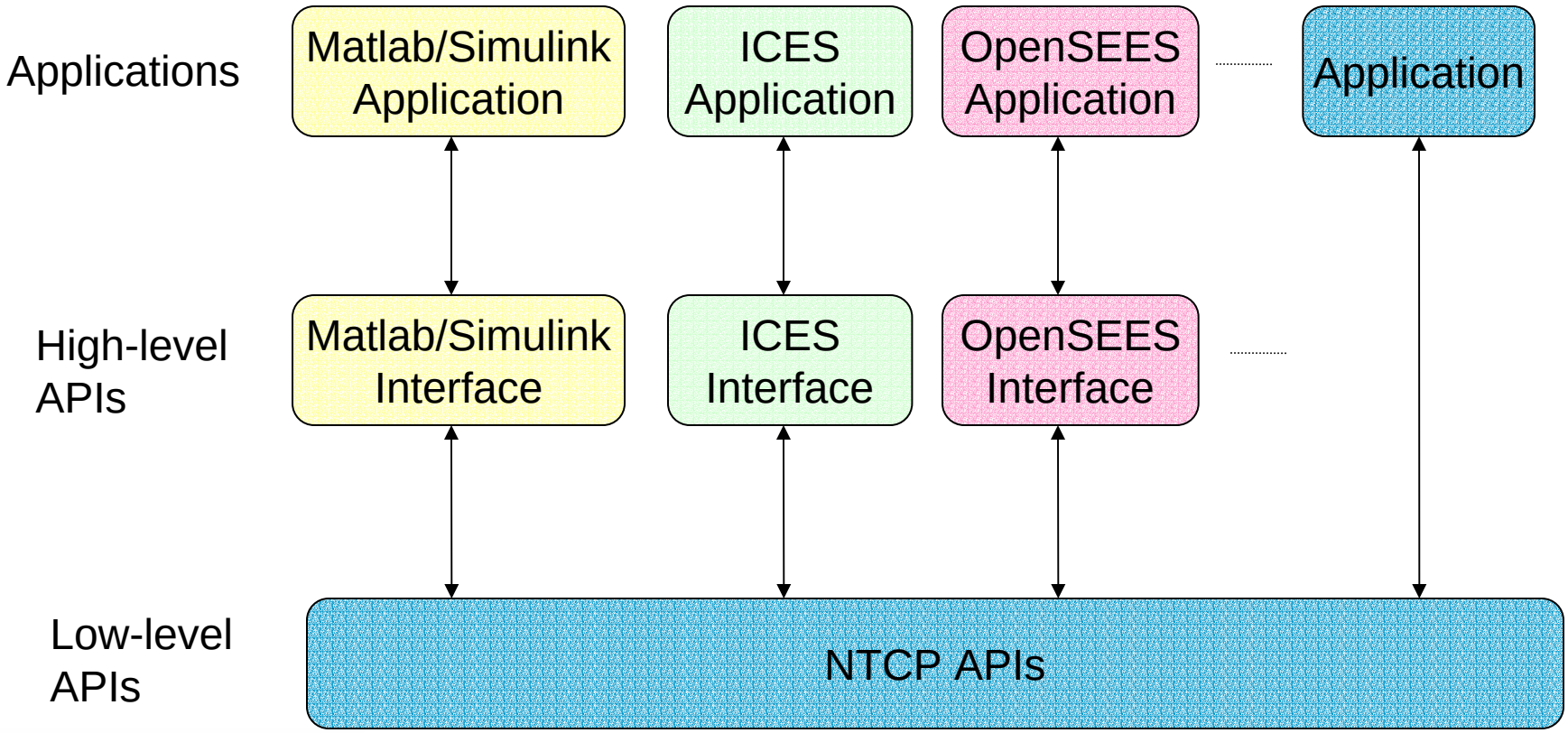
Programming Interfaces



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NEESgrid System Summary

- Data, simulation, collaboration, visualization, teleoperation/control, delivered via
  - APIs and tools for users
  - Services and interfaces at equipment sites
  - Services and interfaces at resource sites
  - Management services for operation
- Demonstration via MOST and EBD
  - Used to evaluate and refine capability
- System software converging on versions for handoff to consortium

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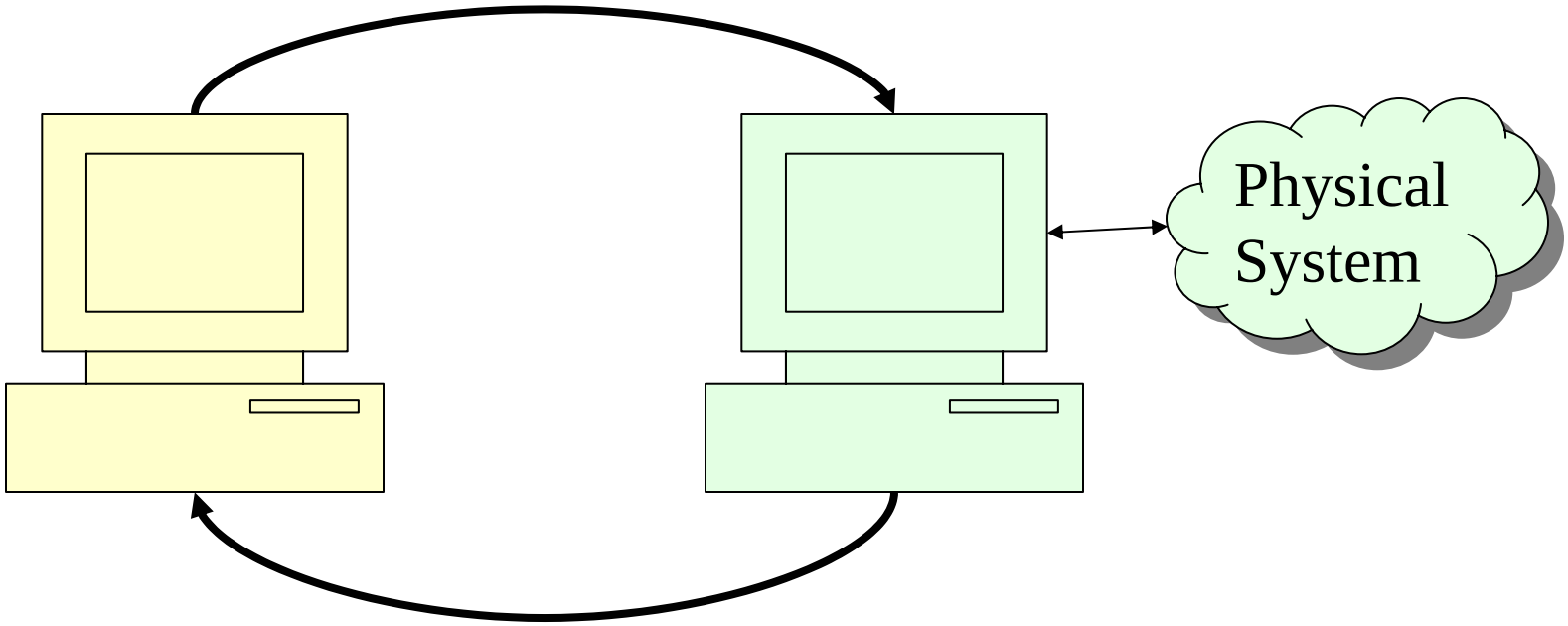
Hybrid Experiments



Computational
Simulation

Control / Data
Acquisition System

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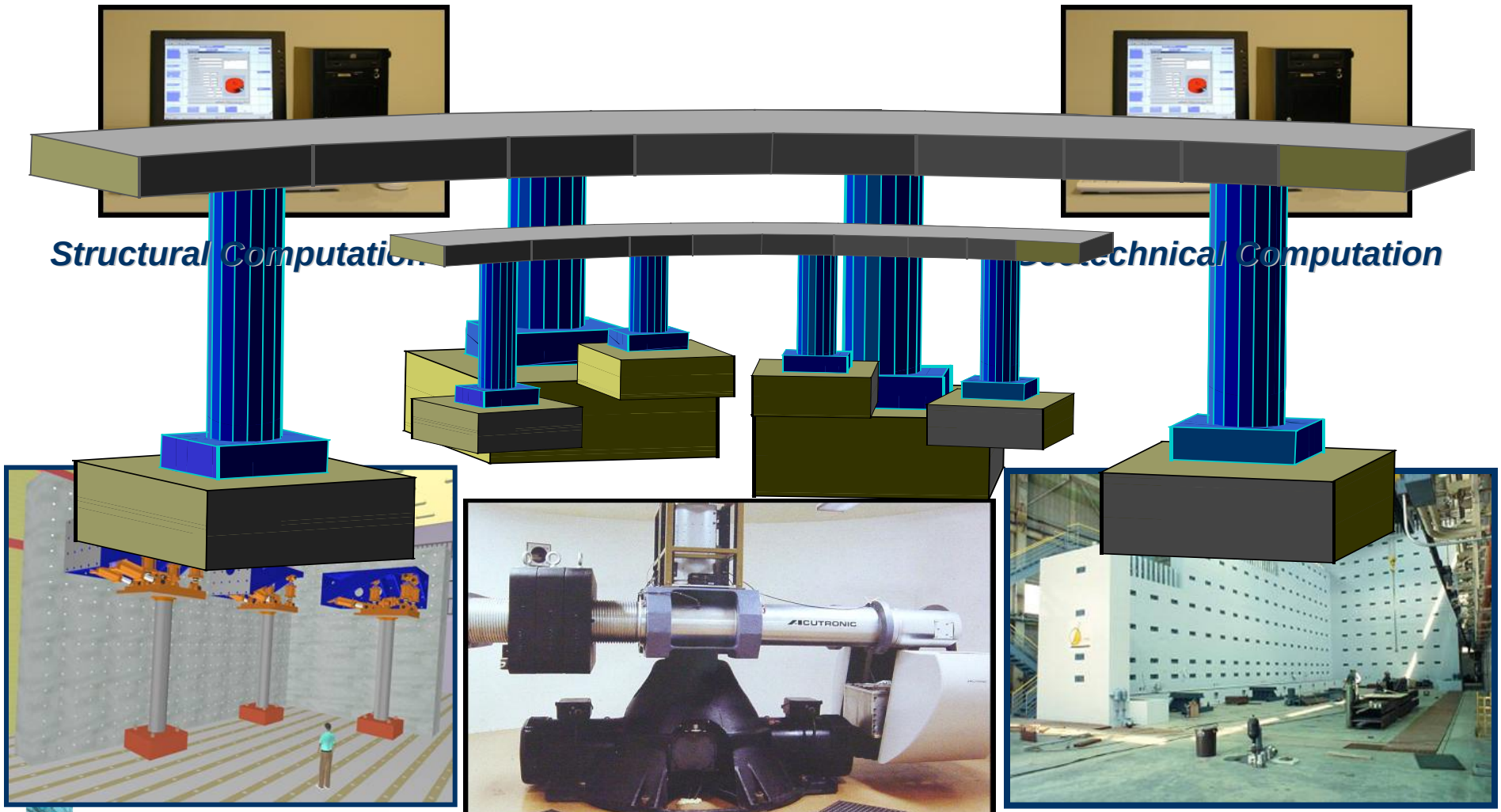
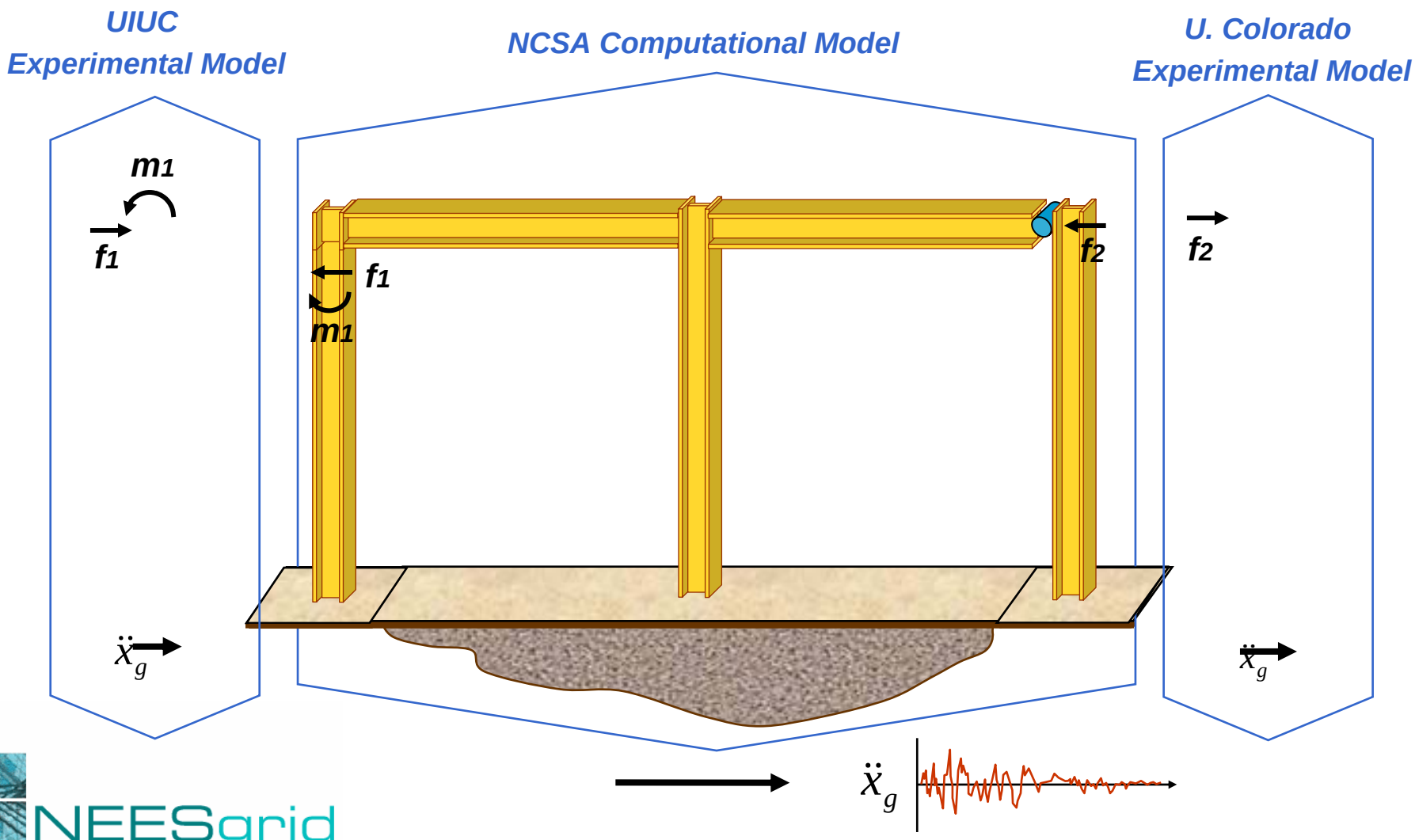
Soil-Structure Test



The MOST Substructures



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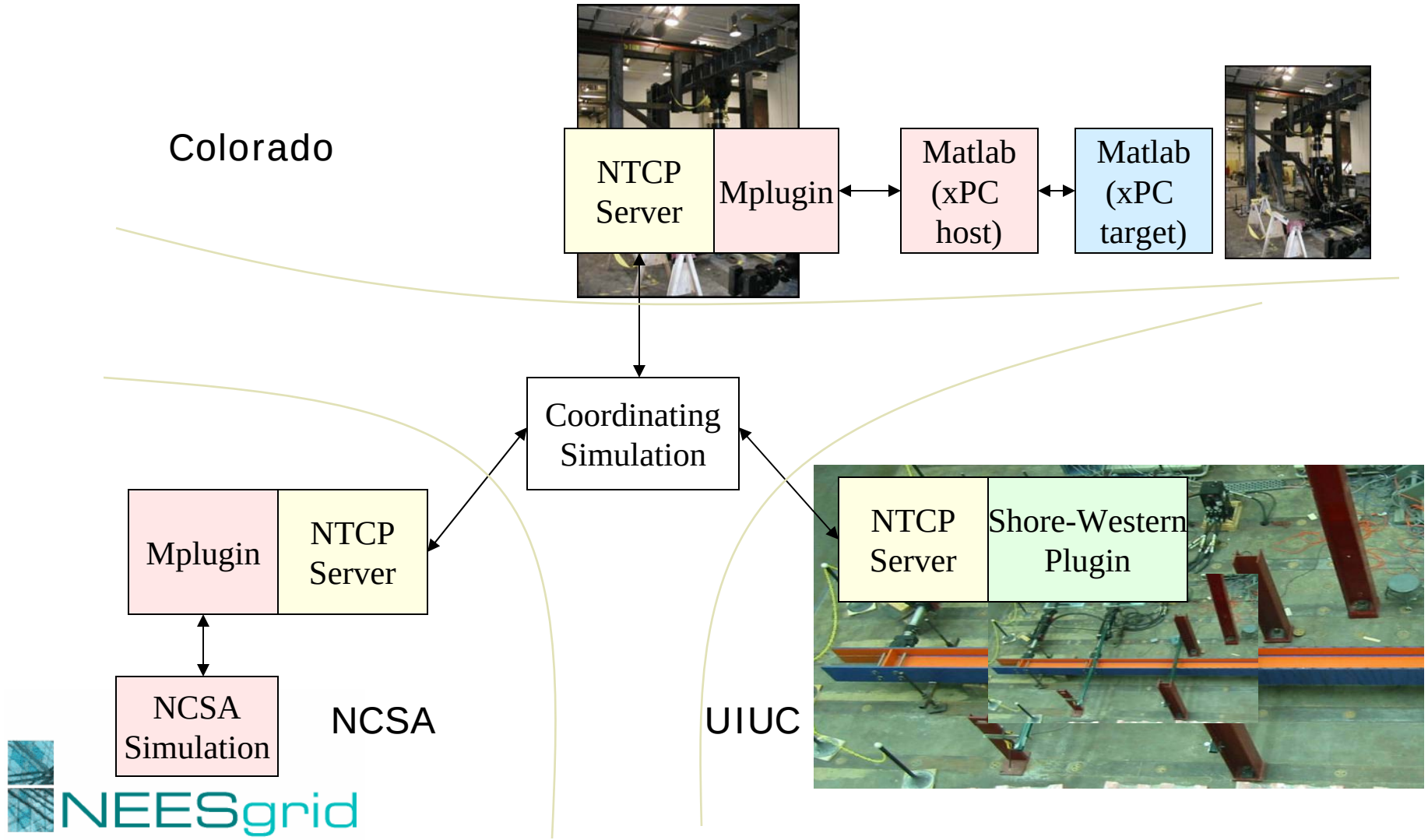
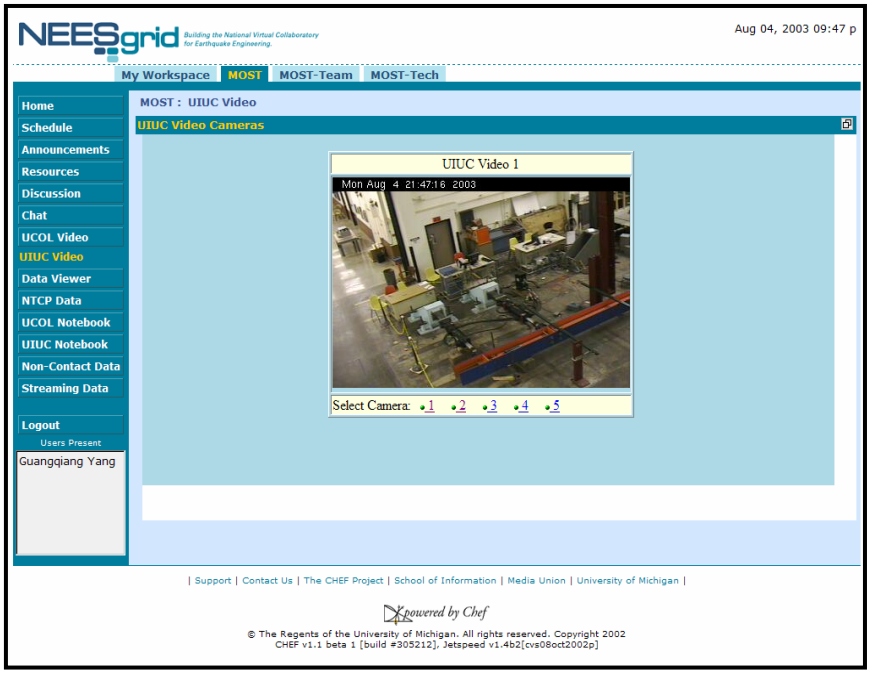
Slide courtesy of Bill Spencer and Narutoshi Nakata, UIUC

MOST Components



The MOST Event



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