

IT Operations and Cyber Infrastructure

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NHERI Lehigh EF



Overview

- IT Infrastructure and Equipment
- Hardware/Software Capabilities
- User Training and Testing
- Cybersecurity and Risk Mitigation



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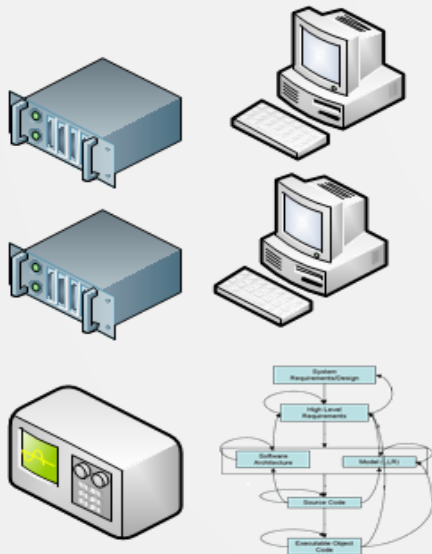
IT Experiment Support Start to Finish

1. Researchers and NHERI Lehigh team work together on training, development of experimental protocols, instrumentation, control and safety plans
2. Create project storage and collaboration space on DesignSafe-CI Data Depot
3. Design control configuration through numerical and hydraulics off simulations for validation
4. Configure data acquisition system for sensors
5. Configure video acquisition system for cameras
6. Configure data stream for local and remote data viewing
7. Initiate safety protocols and run experiment
8. Data is locally archived and synced with Project Warehouse
9. Research team processes data locally and stored in Data Depot at DesignSafe-CI into data model. Tools available to process data available locally and on DesignSafe-CI

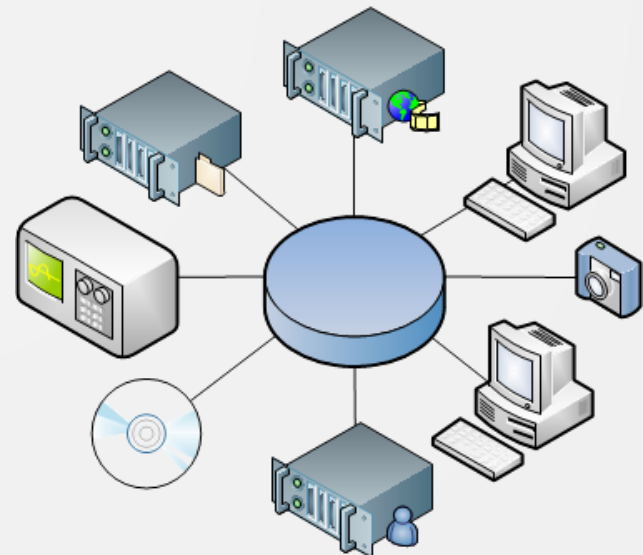
IT Mission

- Design IT Architecture from the ground up
- Complete control of all IT aspects to facilitate all types of required simulation techniques

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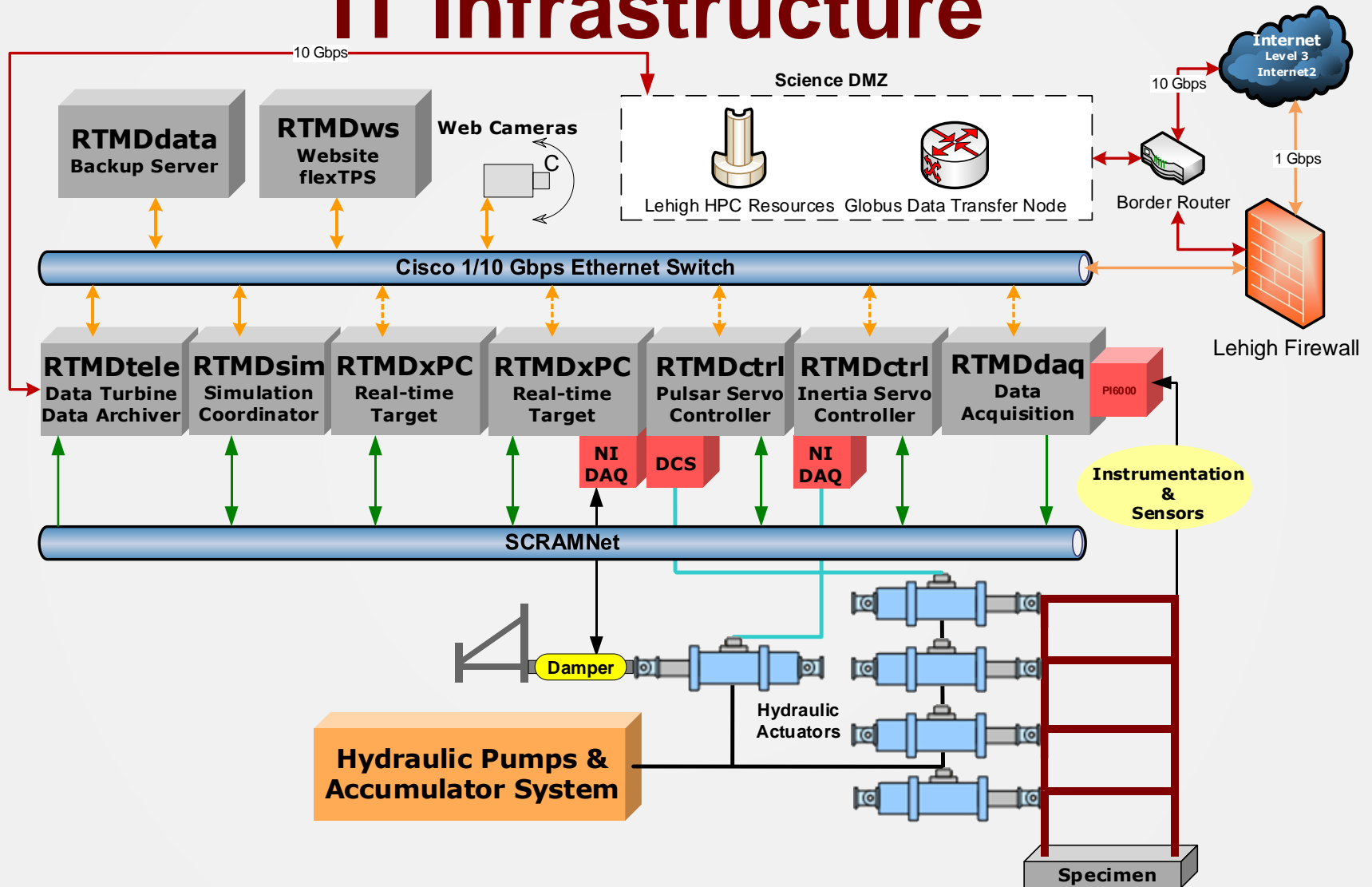


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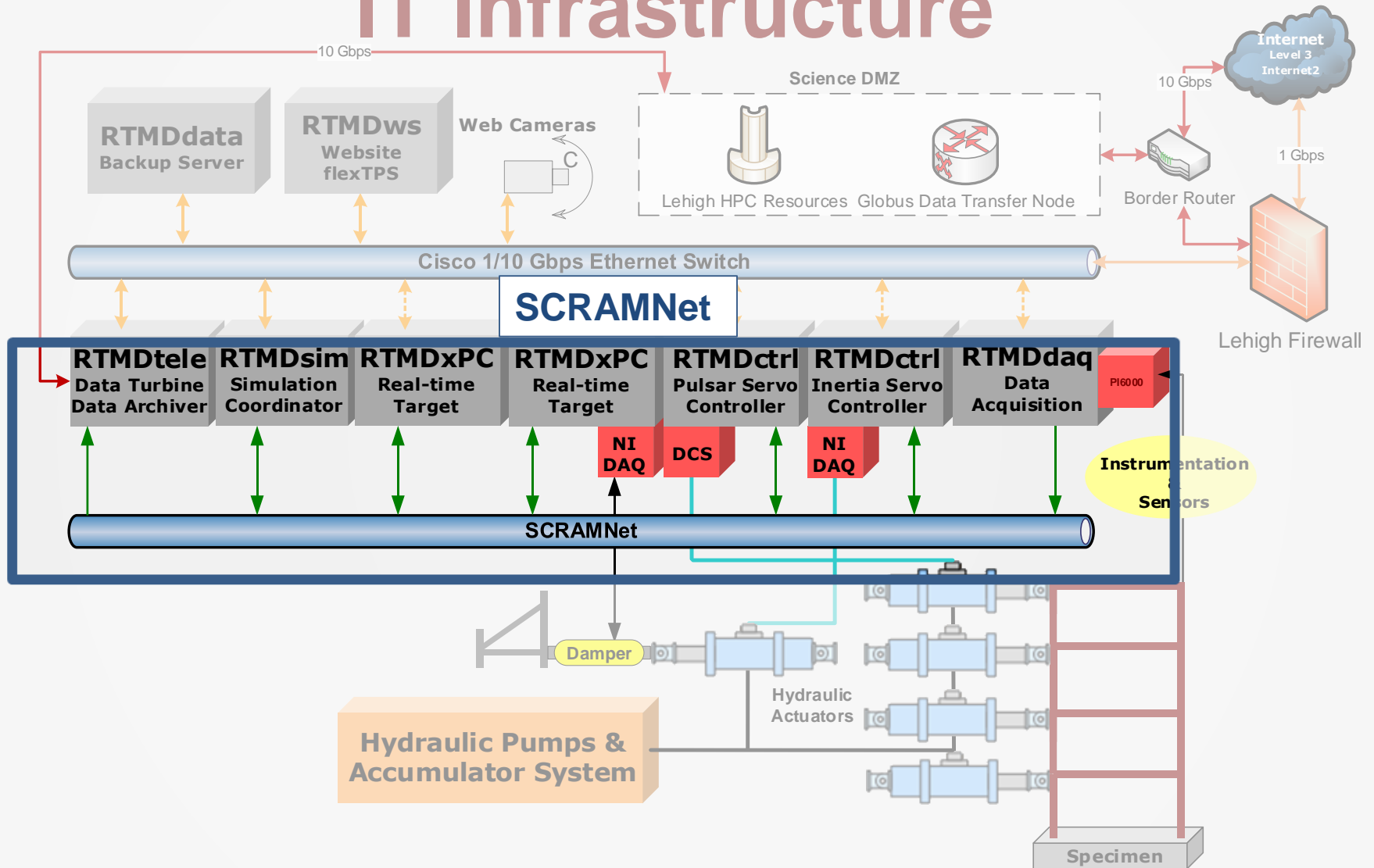


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IT Infrastructure



IT Infrastructure



SCRAMNet GT

- Replaced EOL SCRAMNet+ equipment
- Increased throughput and reliability
- Expanded vendor compatibility
- Maintenance contract



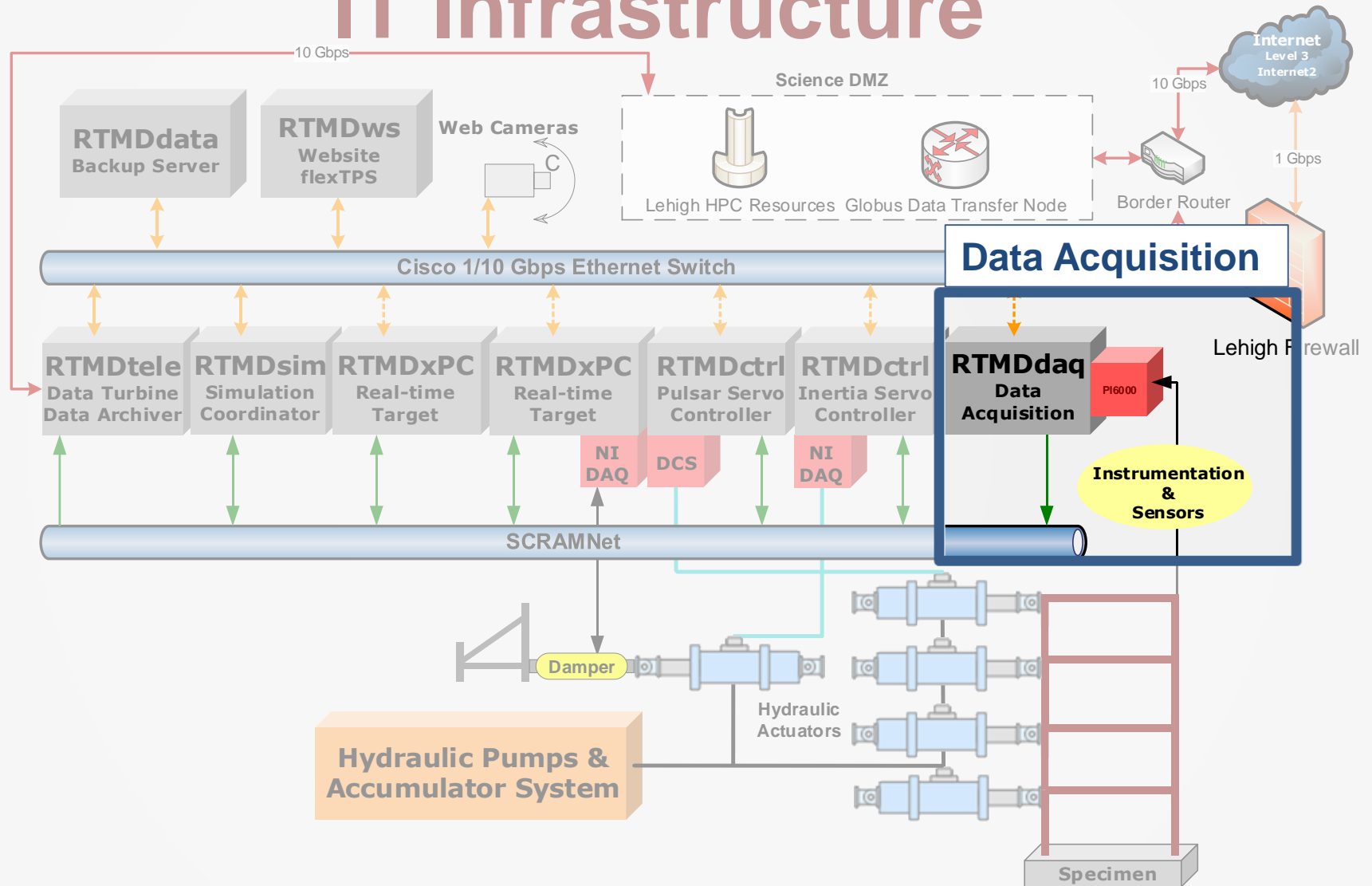
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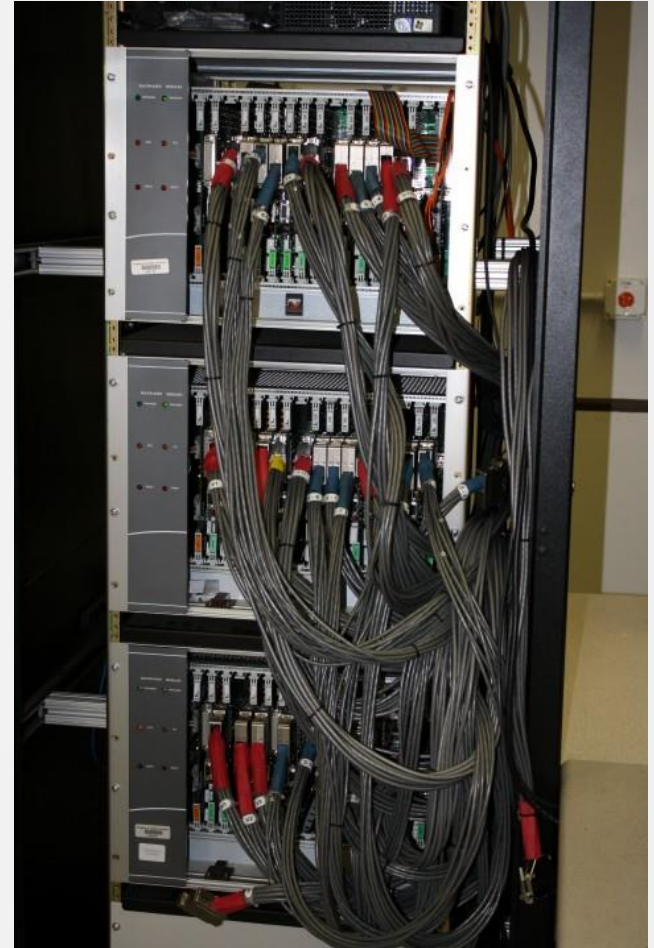


IT Infrastructure



RTMDdaq

- Pacific Instruments 6000 Data Acquisition System
 - 304 channels, 384 expandable
 - Voltage, Strain, Thermocouple
 - Variable sampling rates
 - 4 kHz for Real-time Testing

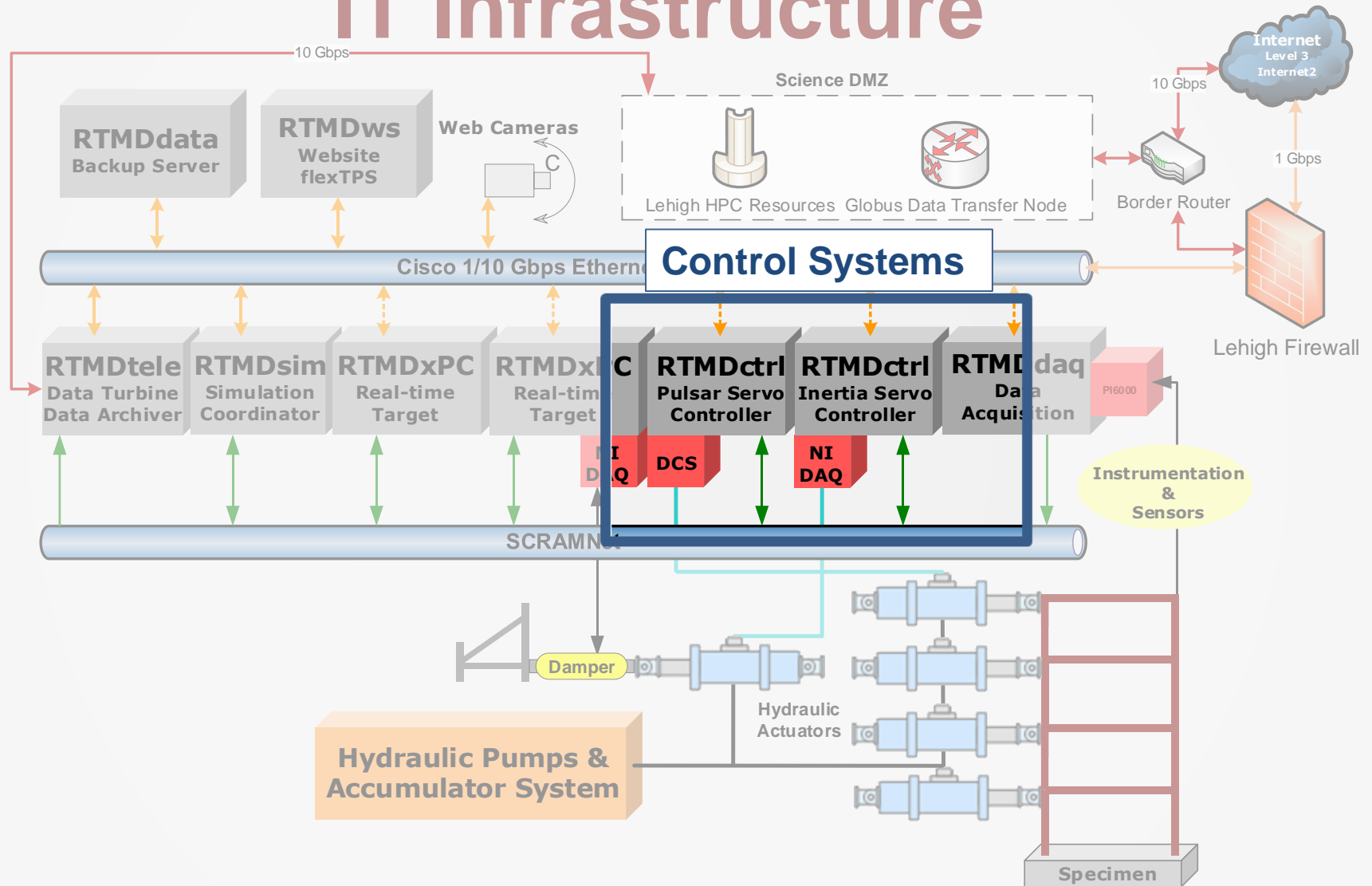


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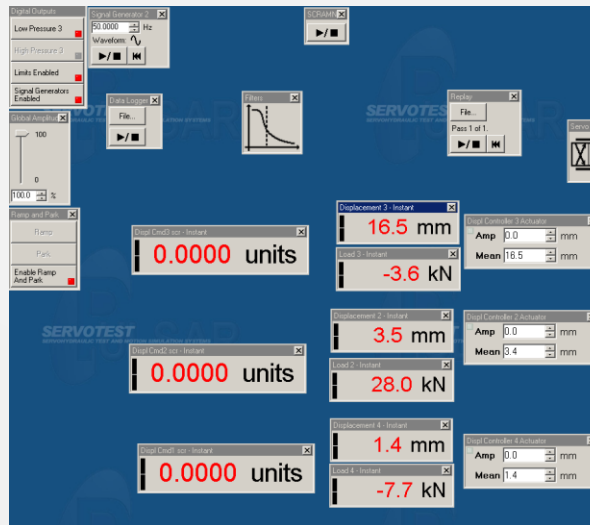
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RTMDctrl

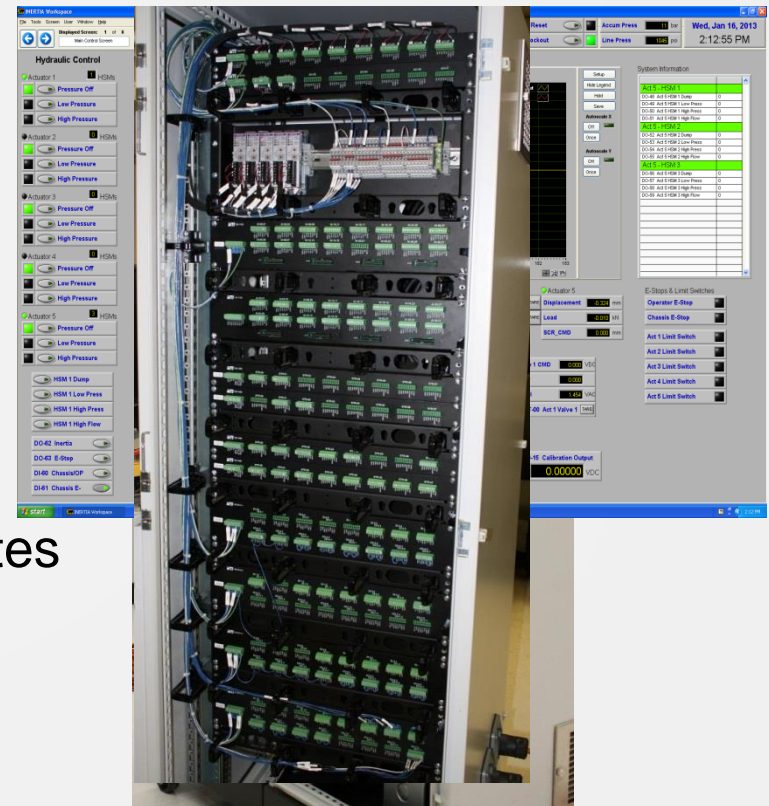
- Servotest Pulsar Hub Control System
 - Configurable servo-control system for hydraulics actuator PID control
 - 2048Hz or higher control rate
 - Wide vendor support
 - Customizable interface



RTMDctrl

- Wineman INERTIA Control System

- Unlimited multi-mode closed-loop control
- Integrated test editor
- Integrated with various NI modules
- Integrated PID control loop tuning
- Complete access to tuning system variables
- Programmable control and DAQ rates

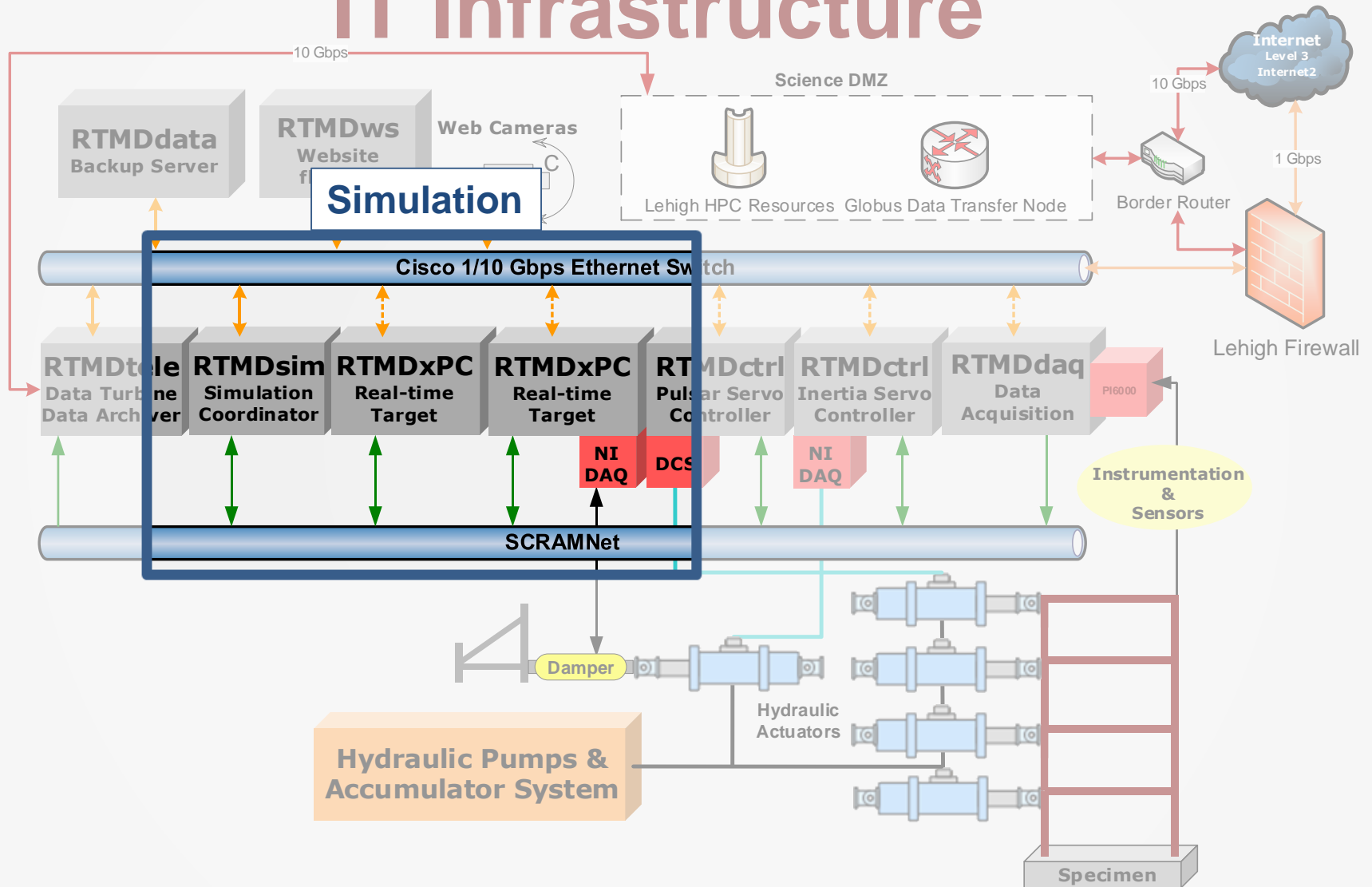


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IT Infrastructure



Simulation – RTMDsim/RTMDxPC

- Host-Target configuration
 - Real-time and custom applications
- Dell i7 Precision Workstation
 - High power workstation for execution and processing
- Speedgoat Targets (Simulink Real-time)
 - Dedicated Intel i7 4Ghz real-time systems
- Multiple Targets
 - Defined roles
 - Parallel processing for larger, more complex models



RTMDsim

- Workstation/Host
 - Mathworks suite
 - Coordinator of synchronized control and data acquisition
- Hydraulics on/off testing – numerical simulation for safety, validation & training
- Process and analyze data



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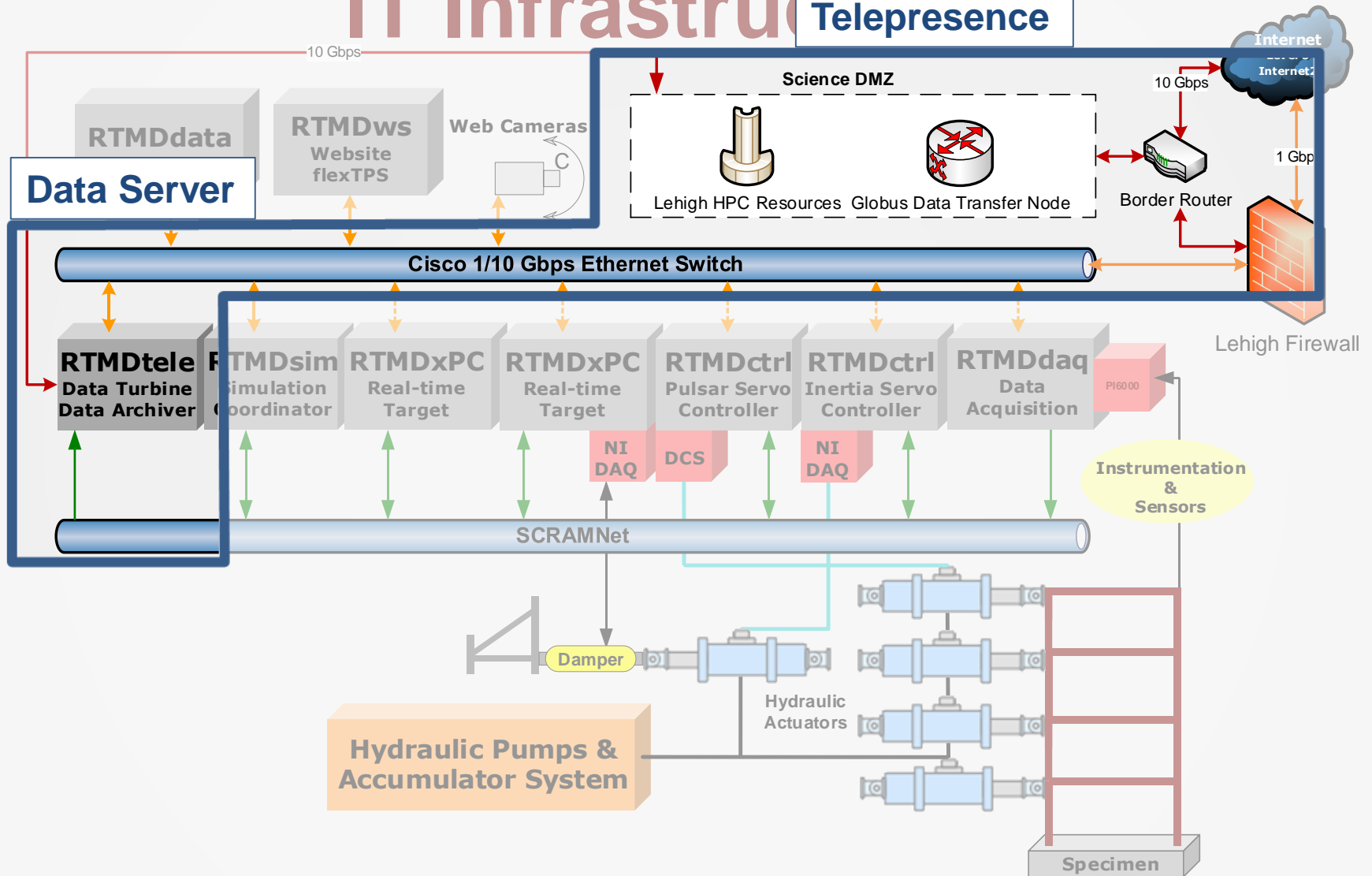


RTMDxPC

- Speedgoat systems, CPU performance up to 4 GHz
- Industrial quality design for robustness
- Multi-core support for parallel processing
- Daisy chaining
- Available modules for DAQ and control
- Simple interface with Simulink and S-Functions
- Quick prototype turnaround

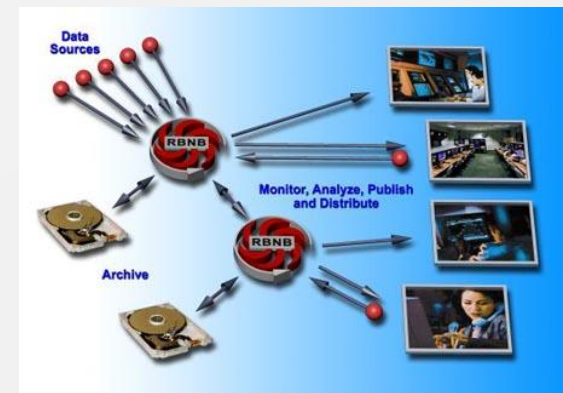


IT Infrastructure Telepresence



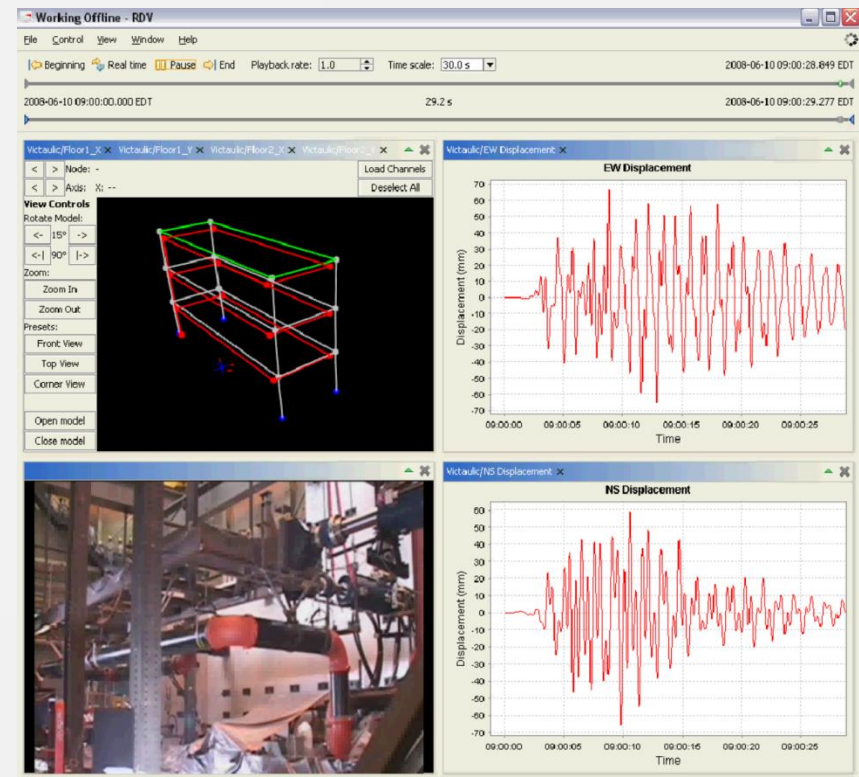
Telepresence

- Data Turbine (RBNB) (dataturbine.org)
 - Aggregates data from SCRAMNet using RTMD tools to define channel list, sample rate and duration
 - Streaming of data and images locally and remotely
 - Additional storage archive of test data



RDV

- Real-Time Data Viewer (RDV)
 - Connect from anywhere on any system
 - Invaluable tool for visualizing Real-Time Hybrid Simulations

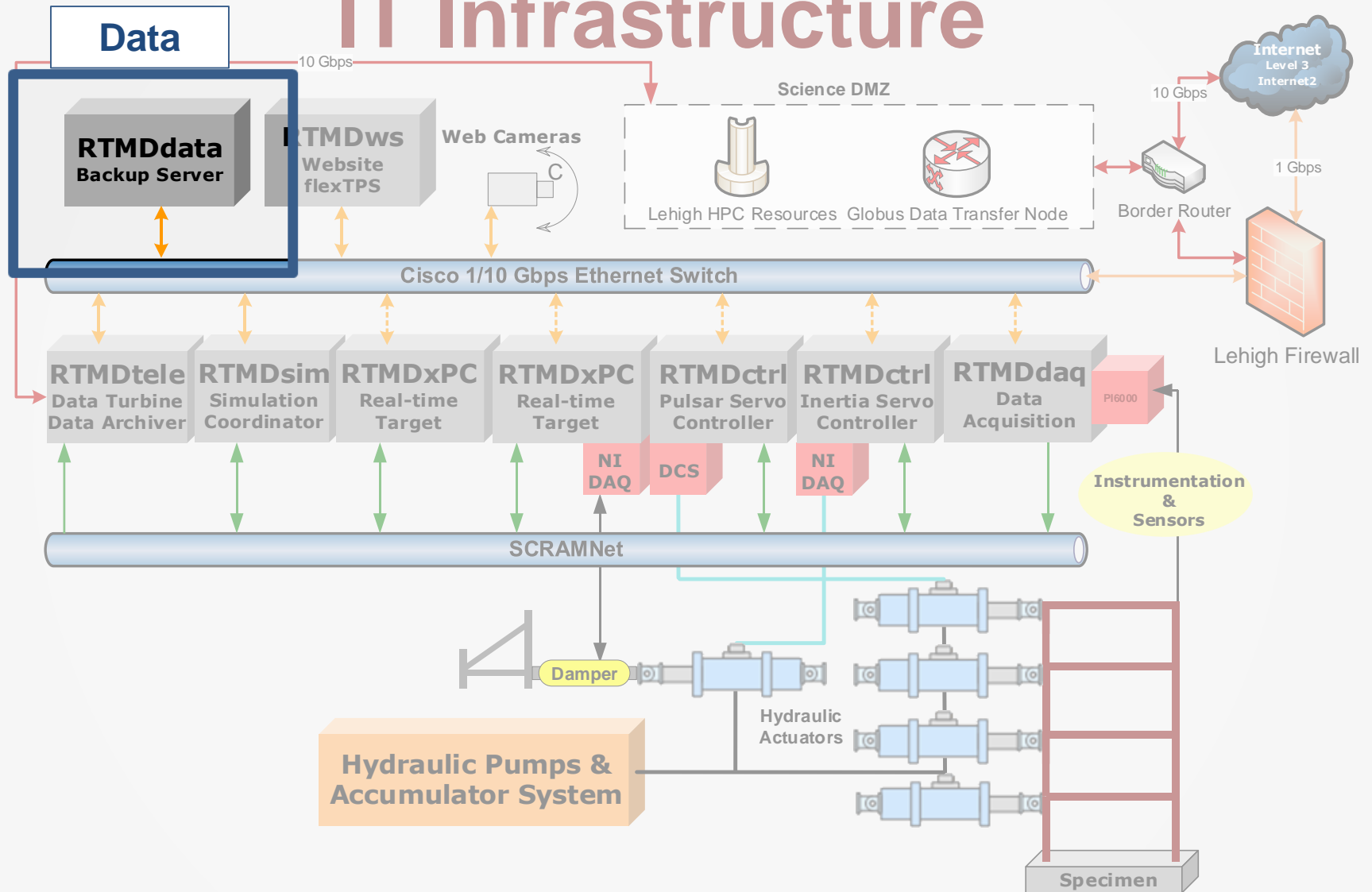


Video

- Video/Imaging systems
 - (24) Amcrest Bullet/PTZ IP Cameras (up to 8k)
 - (4) Sony SNC-EP550 HD (720p HD)
 - (9) GoPro Hero 3 Black camcorders (1080p60 HD)
 - (2) Sony SNC-RZ30N network cameras (SD Security)
 - Nikon D70 D-SLR camera
 - HD camcorders available upon request through Lehigh
- Blue Iris Servers
 - Portal for all users to access and control web cameras
 - Archived video available for previous experiments



IT Infrastructure



RTMDdata

- Synology DS 1817
 - 8 hard drive slots, 96 TB capacity up to 216 TB
 - 10Gb Connection
- Dual-disk Redundancy
- Network Attached Storage
- Public and Private storage



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Data Management Plan

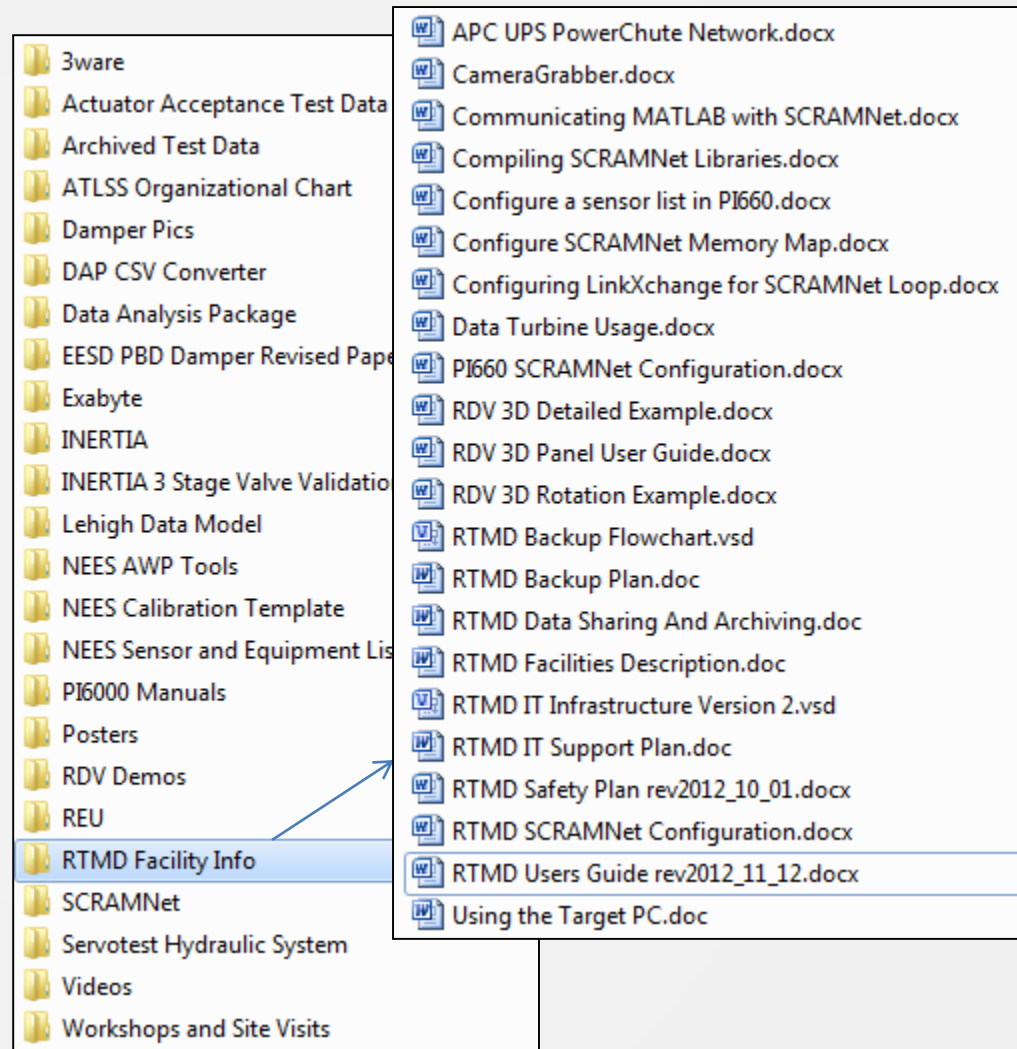
- Local repository for data storage managed by NHERI Lehigh with offsite backup risk mitigation through DesignSafe-CI
- Unlimited Google Drive space through Lehigh University
- Locally stored data adheres to the Lehigh University records retention policy or extended by the ATLSS Center IT management
- Included under NHERI Lehigh data management umbrella:
 - Unprocessed and RAW data from experiments
 - Converted and derived data sets using computational software
 - Experimental photos and videos
 - Computational models and analytical data sets
 - Scripts and software developed for project tasks
- Local curation utilizing folder/file structure
 - Project/Date/Task Description/Data Set; format “testname_date”
- Automated Globus Project data upload
- DesignSafe-CI curation through Data Depot and Data Model

Software Capabilities

- Components for simulation coordination
 - MATLAB, Simulink (RT)
 - Lehigh HybridFEM through Matlab, Simulink
 - LabVIEW RT/VeriStand (Wineman Inertia)
 - OpenSEES via OpenFresco

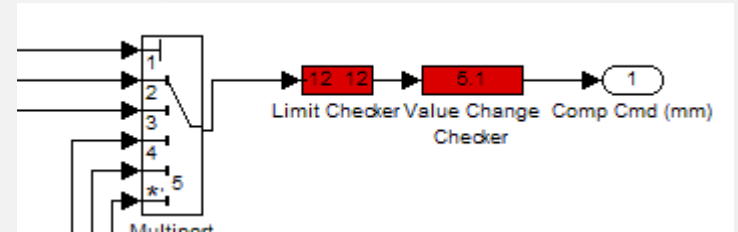
Training: Documentation

- User's Guide
- Repository of technical documents, demos and video tutorials
- Available to all users



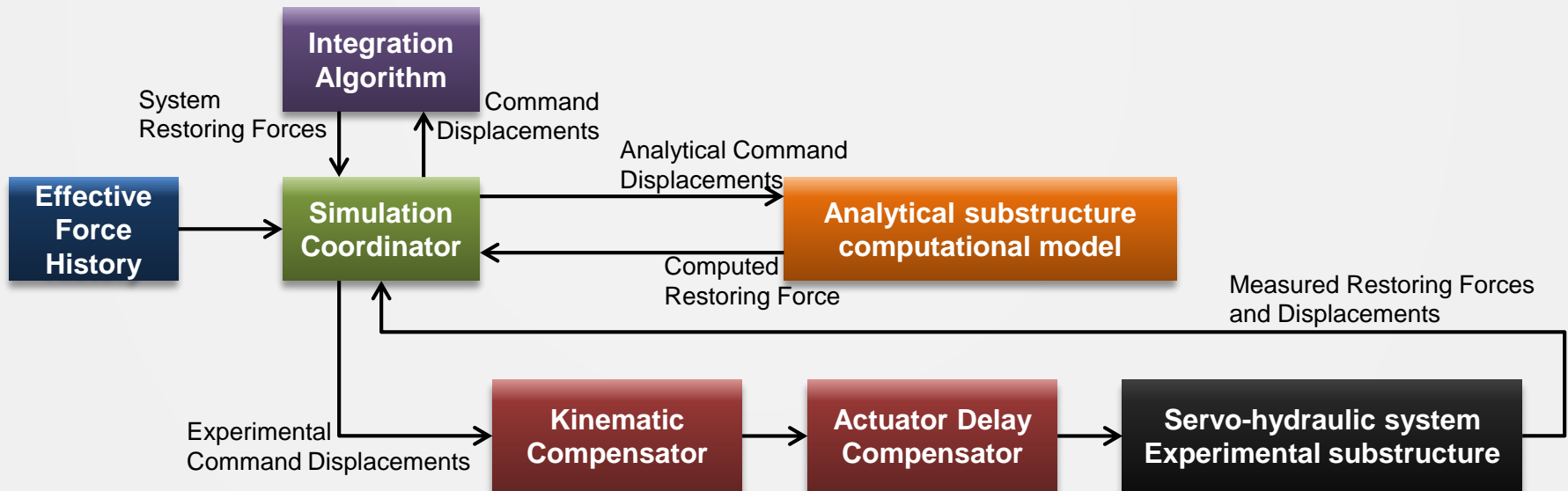
Simulation Safety

- Command software limits
 - Bound and rate limits
- Controller software limits
 - System trip and shutdown
- Hardware displacement limit switches
- E-Stop buttons

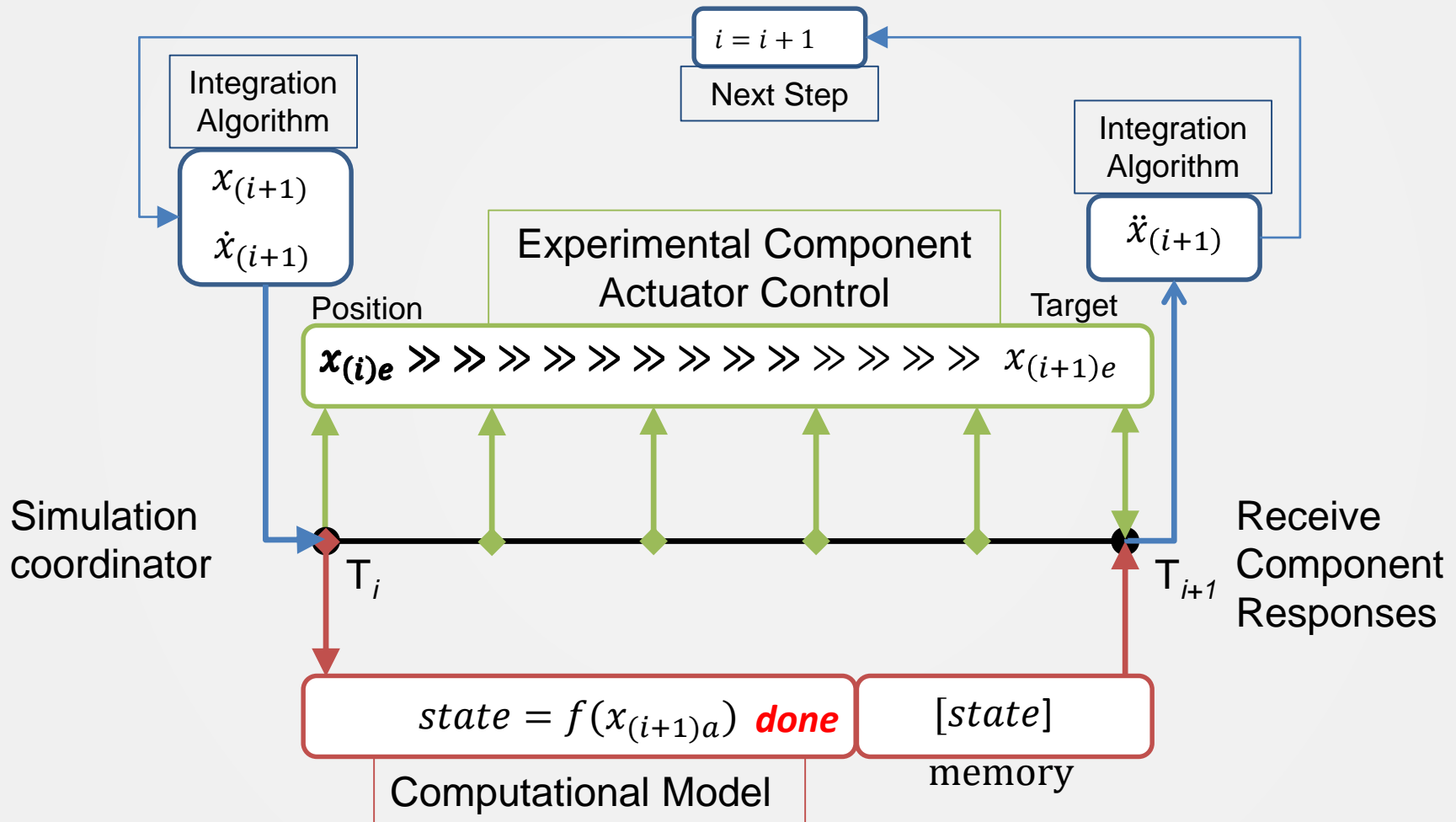


Hybrid Simulation Components

- Simulation coordinator
- Integration algorithm
- Computational model of analytical substructure
- Kinematic error compensator
- Actuator delay compensator
- Experimental substructure

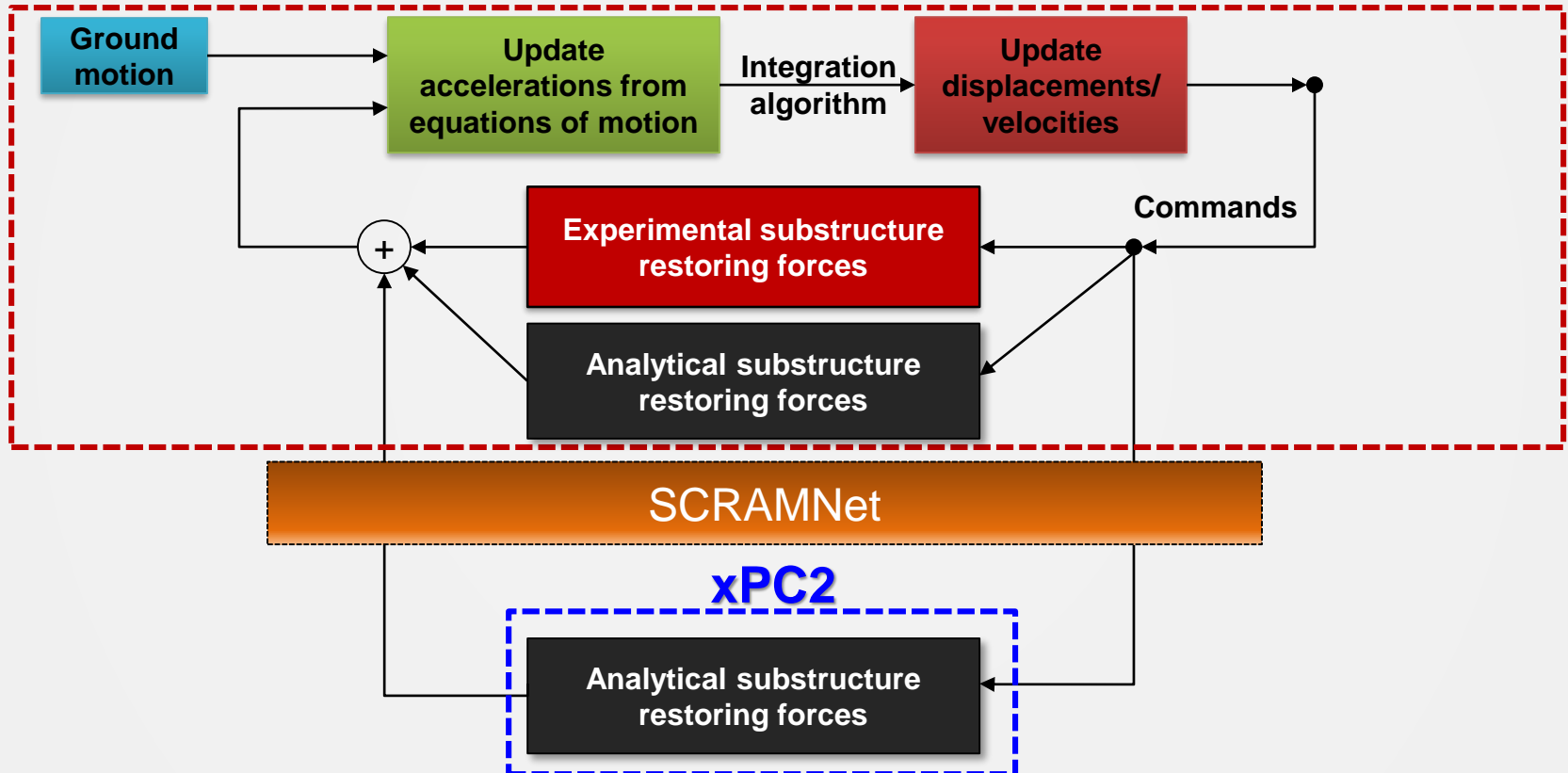


RTHS: Model Flow



RTHS: Multiple Targets

xPC1



Example Projects and Demos

Thank you!



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RTMD
REAL-TIME MULTI-DIRECTIONAL SIMULATION
NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE



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