

# Small Animal Imaging Center Information Management System

Steve Moore, Richard Laforest, Paul Koppel, Fred Prior  
Dept. of Radiology, Washington University in St. Louis, MO, USA

## ABSTRACT

Imaging research based on small animals will benefit from the same types of integrated information systems that are found in clinical operations (RIS, PACS) and in human-based imaging research (Research Management System, Image Archive). As part of an upgrade to the small animal imaging facility, we have designed and implemented a data management system that is tailored to the needs of investigators performing imaging studies on small animals. A web based system provides the basic functions of 1) imaging request by the principle investigator who may be a collaborator to the imaging lab, 2) scheduling the procedures on existing micro PET and micro CT scanners, 3) worklist management for technologists, 4) image storage/archive and 5) retrieve for processing by laboratory staff or principle investigator. A java application interfaces the proprietary imaging modalities to the system. We have relied on the DICOM Standard for information models for this project. Some of the extensions involved building an interface for the scanners that do not produce DICOM output, relaxed requirements because small animals do not have PHI governed by HIPAA and an information model that must include multiple subjects scanned simultaneously (side by side on a bed).

## SMALL ANIMAL IMAGING LABORATORY

The Washington University Small Animal Imaging Laboratory is composed of two small animal PET cameras, one small animal CT camera and other laboratory shared imaging instruments. This laboratory is the major component of the Washington University Small Animal Imaging Resource (WUSAIR, PI: J.Ackerman, Ph.D.) and the Siteman Cancer Center (SCC, PI: T.Eberlein M.D.). Laboratory faculty as well as external collaborators use the facilities for their research studies.

## ANIMAL IMAGING RESEARCH WORKFLOW

Workflow for animal imaging research has similarities to workflow for clinical imaging.

### Request

Researcher fills out a form to request an Imaging study for the subjects

### Approval

Staff member reviews requested protocol to ensure feasibility

### Schedule

Lab manager schedules experiment, coordinating with cyclotron schedule

### Scan/Store

Animals are scanned in microPET and/or microCAT devices and stored to a central device

### Retrieve

Images are retrieved from central location

### Measure

Researcher or lab member performs imaging measurements

### Post Process

Researcher may reprocess the original data

### Resubmit

Researcher may resubmit new images that were not in the original scan

## DIFFERENCES FROM CLINICAL IMAGING

### Reporting

No diagnostic report generated for a research procedure

### Billing

Rather than bill insurance companies for procedures and reports, research institutions charge grants for scanner time and staff effort

### Standards

The DICOM standard is long established in clinical scanners but undefined for small animal imaging. Small animal imaging systems use proprietary formats.

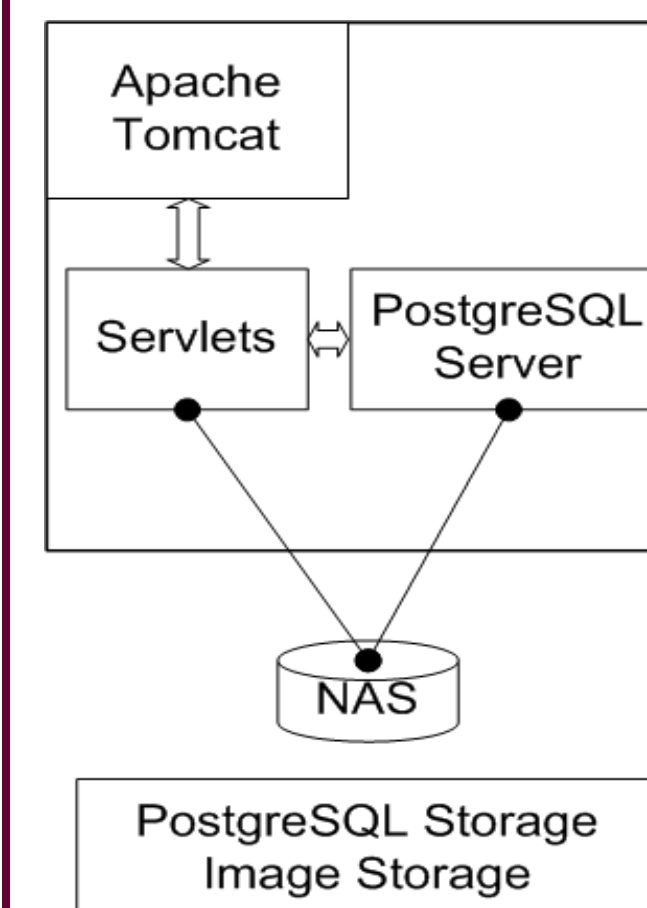
### Privacy

Animal subjects are not covered by HIPAA regulations. Investigators do want to keep their data private from other investigators until they decide to share or publish

### Identification

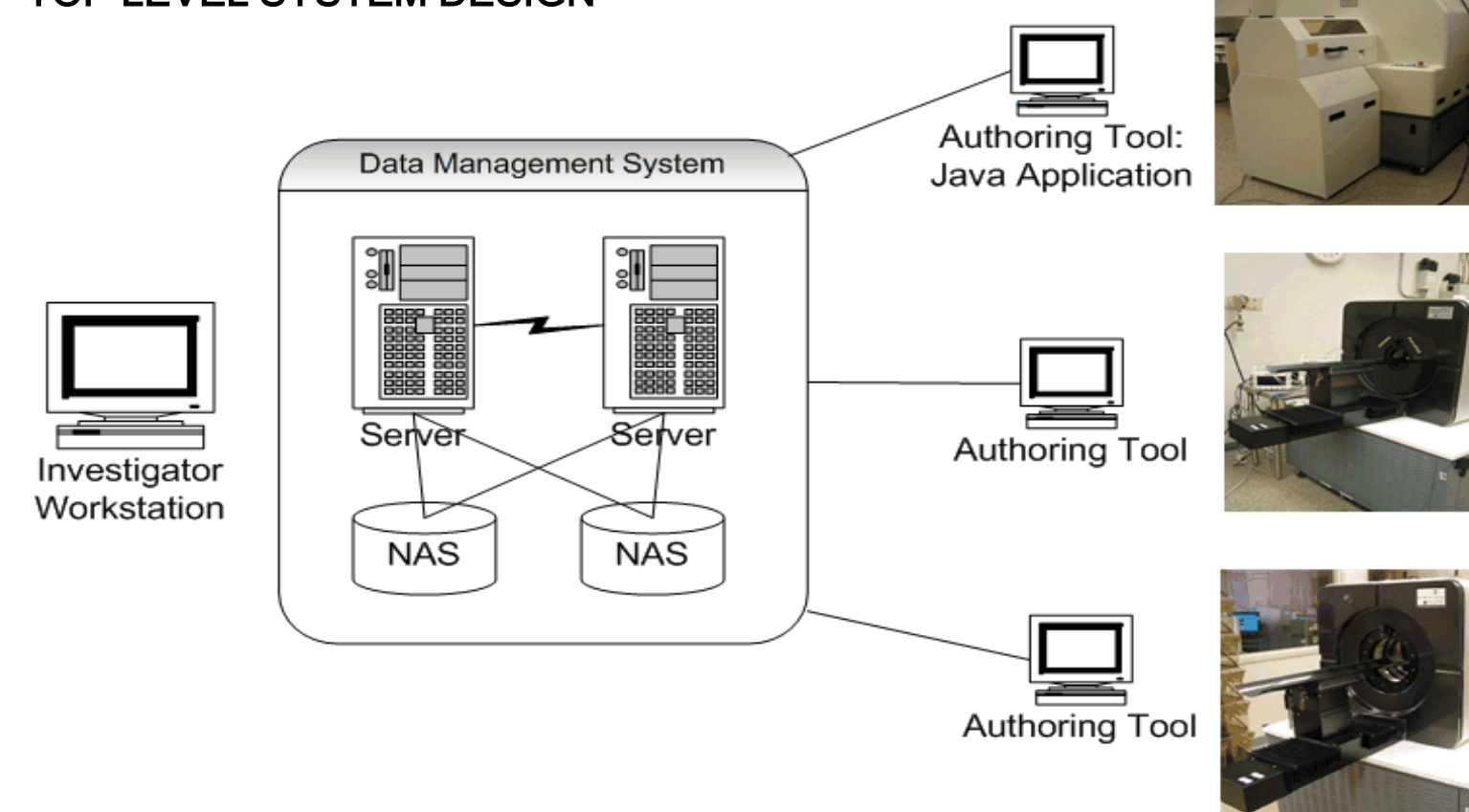
Subjects are usually short lived (weeks) and are identified more closely with a specific imaging exam (the PET study that was performed 22-May). The biggest difference is that several subjects can be placed on the same table and scanned simultaneously.

## SOFTWARE COMPONENTS



- An Apache Tomcat server hosts the Java servlets that provide the program control.
- The Java servlets control the management system. This includes the user pages for requesting studies, scheduling control by the administrators and image retrieval.
- A PostgreSQL server provides database functions.
- The PostgreSQL data and image data are both stored on a NAS device.
- Not shown is the authoring tool that provides the interface between the scanner and the Data Management System (DMS). This tool combines worklist information with the imaging data and stores that merged data into the DMS.

## TOP LEVEL SYSTEM DESIGN



- The existing scanners on the right (from top to bottom) are microCAT, microPET-Focus-F120, microPET-Focus-F220.
- A custom java program (Authoring Tool) provides the interface between the scanner and the Data Management System.
- The Data Management System consists of two Dell 1850 processors running Red Hat Enterprise Linux AS.
- The two Dell servers form a 2-node cluster using Heartbeat software which runs scripts at initialization and also when machines go up or down. Heartbeat provides IP address takeover using gratuitous ARP - so that our PostgreSQL server IP address remains constant even if one server goes down.
- Two Dell Network Attached Storage drives (NAS) provide redundant storage for the cluster.
- Investigators gain access to the system through a web browser to the cluster.

## CURRENT STATUS

- Investigators are able to use the web interface to request imaging studies for their subjects.
- The laboratory administrator uses the web interface to approve and then schedule the imaging study.
- Research staff use the authoring tool to retrieve the daily worklist from the DMS. As images are obtained, the staff members use the authoring tool to associate those images with the proper study and then upload the data into the system.
- Investigators can use a web interface to retrieve their data for review.

## REMAINING WORK

- Complete the work on identification of multiple subjects imaged during a single scan.
- Enable investigators to upload reconstructed data into the system from outside of the lab (i.e., a simple web interface without the authoring tool).

## ACKNOWLEDGMENTS

This work was funded by a grant from the NIH - Cyclotron Produced Isotopes in Biology and Medicine - 2-PO1-HL-13851-40