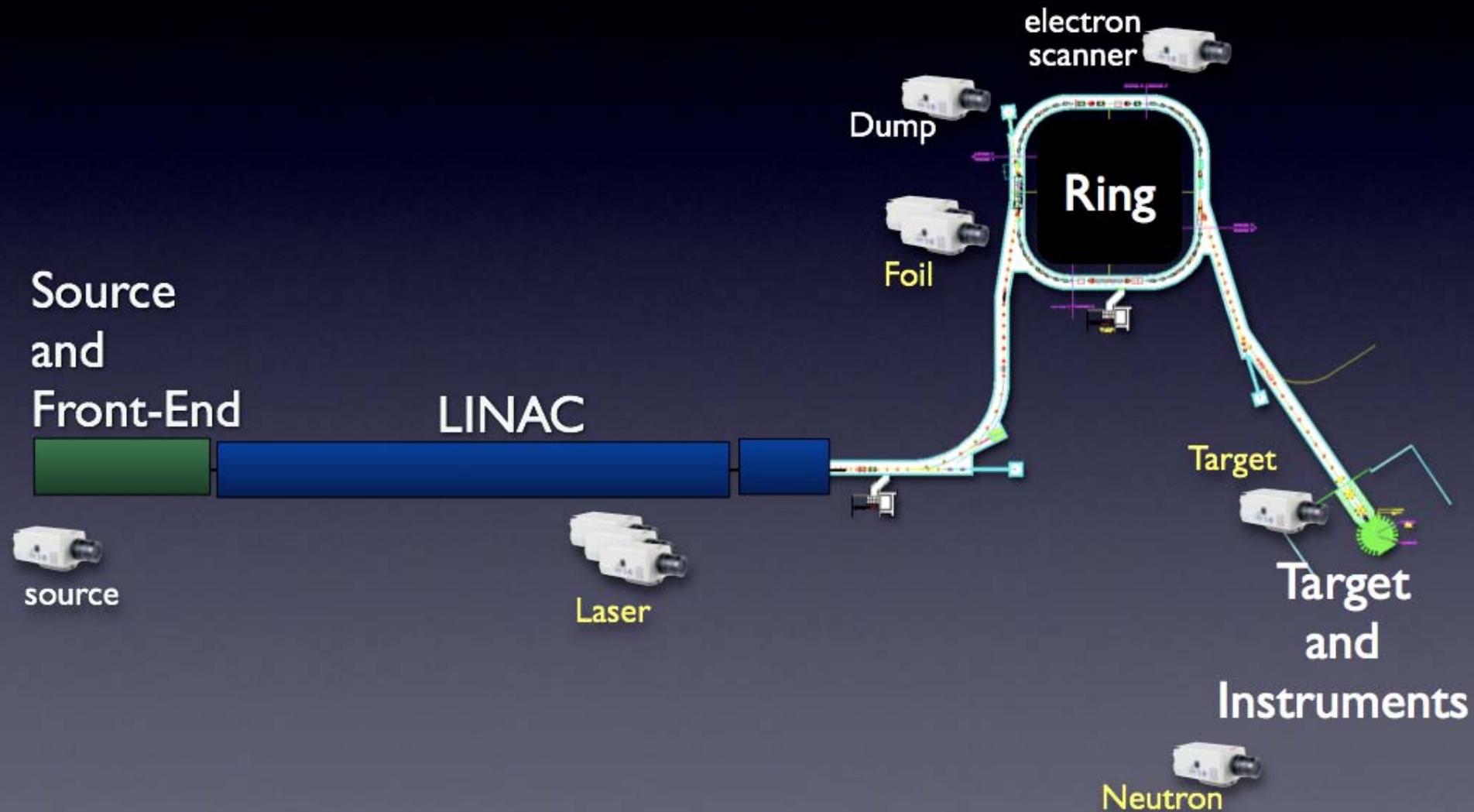# Imaging System Integration at the SNS

Tom Shea, Willem Blokland, Tom Pelaia (ORNL)
Callie Goetz (Middlebury College)
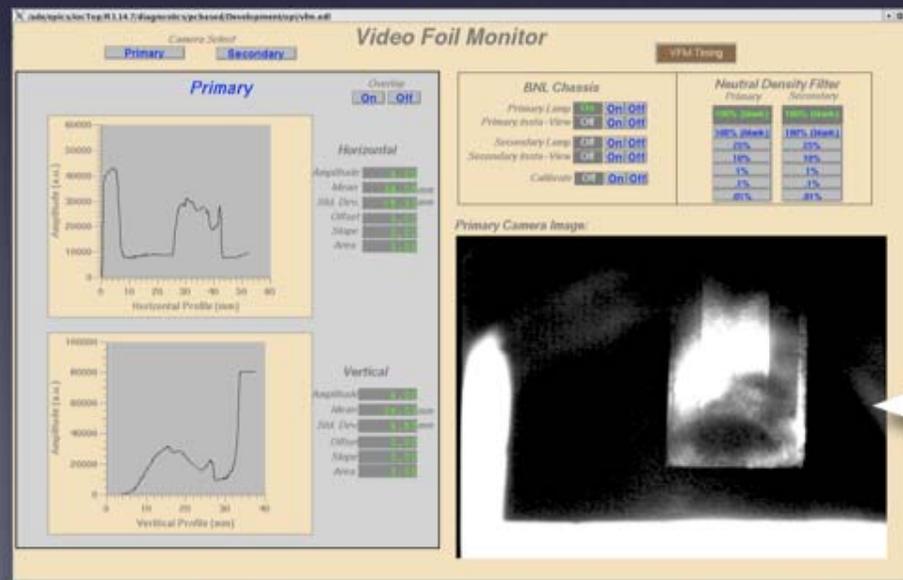
Systems developed by instrumentation and controls staff at BNL, LANL, and ORNL
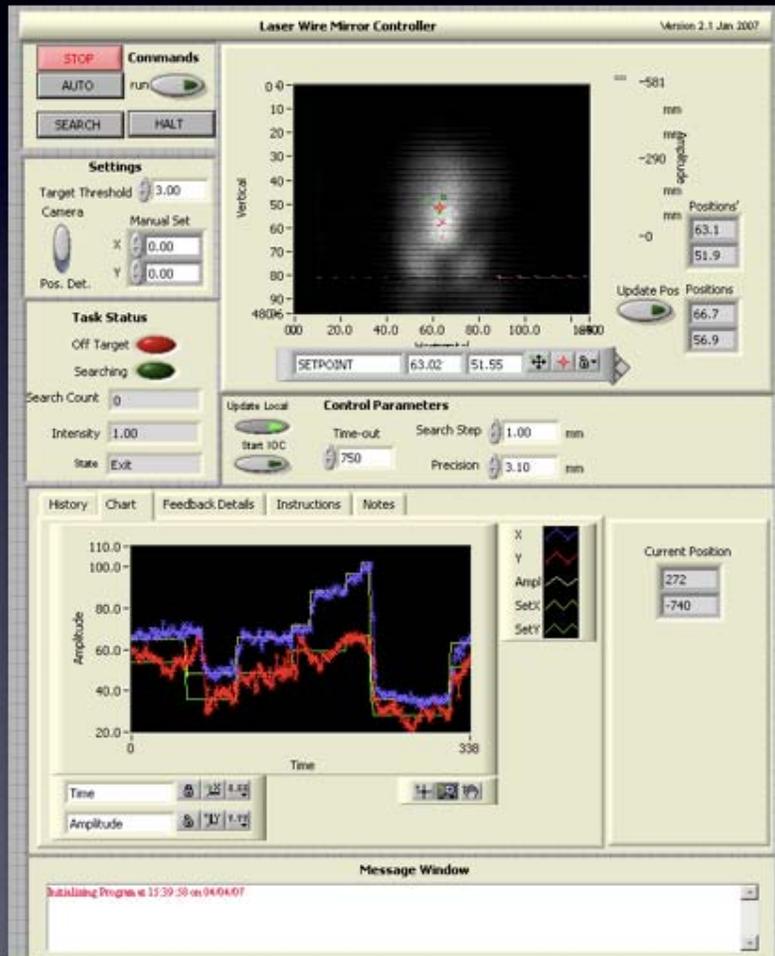
Camera Locations

Ring Injection Foil

- Foil positioning and beam imaging at high radiation ring injection point

- 2 Rad-hard all-tube (yes, tubes) cameras

- NI framegrabber - Labview - shared memory - IOC - EDM
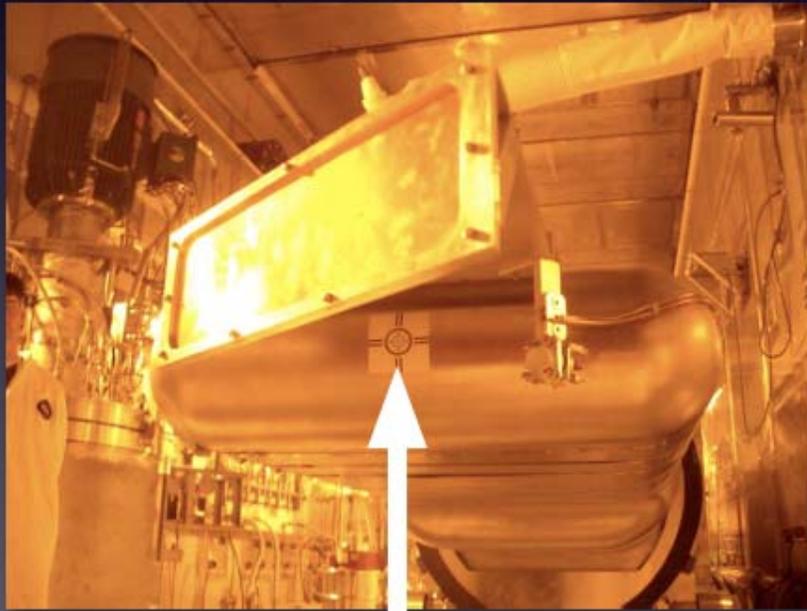

The BNL/ Diamond/ ORNL EDM widget
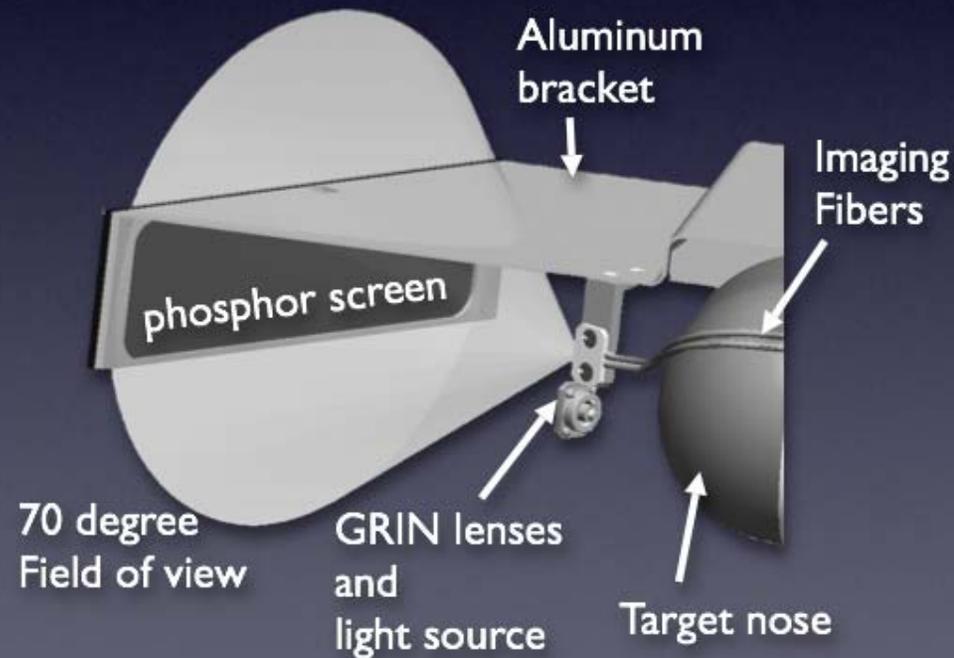
Laserwire Stabilization

- Analog CID cameras in linac radiation environment

- Interactive user interface to allow selection of desired laser beam position

- Feedback algorithm maintains desired position by actuating upstream mirror

Temporary Target Viewscreen

- Dose on on fiber tip: ~ 1 GigaRad
- Imaging fiber allowed use of rad-soft Firewire camera

Over one megawatt goes here

Aluminum bracket

Imaging Fibers

phosphor screen

70 degree Field of view

GRIN lenses and light source

Target nose

On-line Analysis

- Non-linear geometric mapping to correct for optical distortion, screen angle, screen offset

- Normalization using real-time data stream from Beam Current Monitor

- Calculate projections, centroids, RMS widths

- Calculation and strip chart display of horizontal and vertical centroid and RMS width of beam distribution

- Labview, datasockets, global timestamps, live webpage - but no EPICS integration for this temporary system
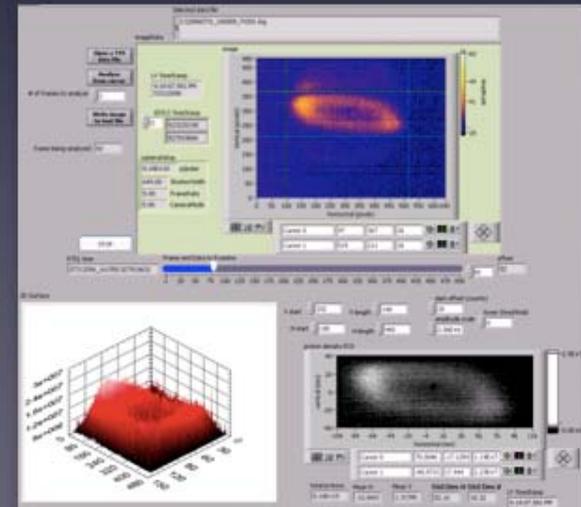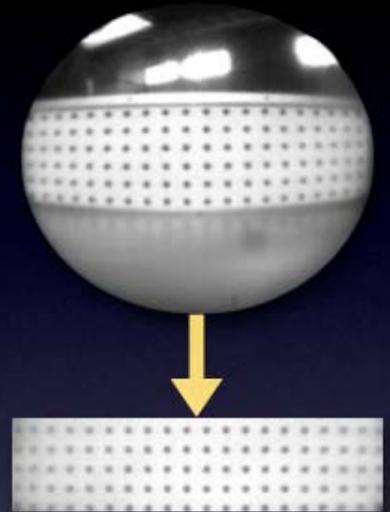
# Future Target Viewscreen

- Transition radiation or Helium scintillation may demand specialized low light cameras

- Use imaging fiber and reflective optics to allow rad-soft camera

- Integrate with EPICS
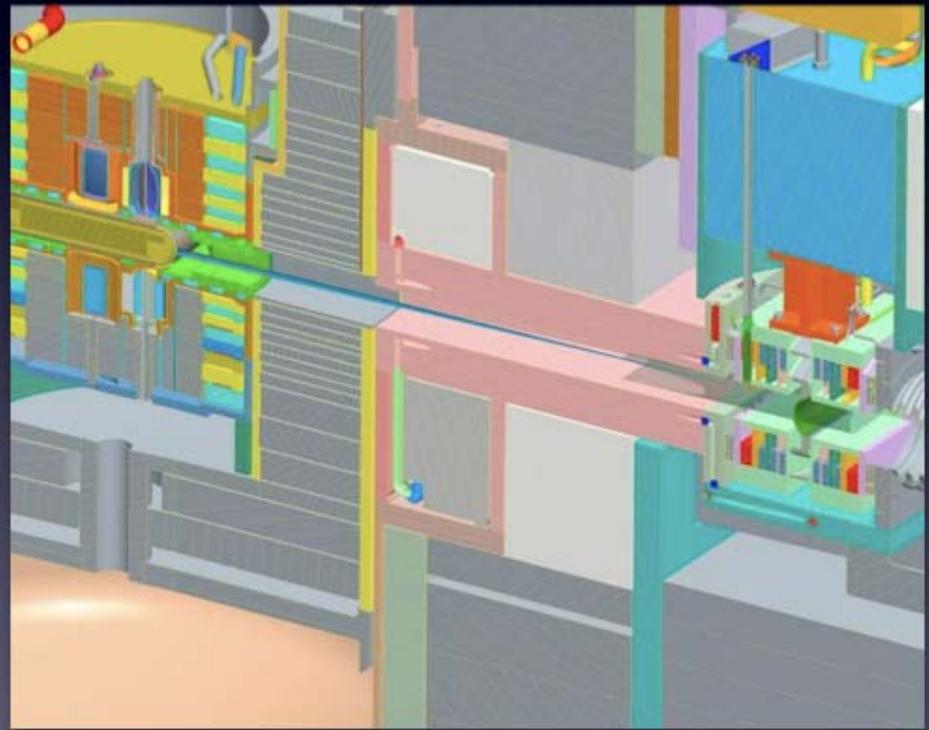
Neutron Beam Imaging

- Low photon intensity from scintillator (similar to future target viewscreen options)
- Cooled astronomical camera, proprietary USB interface

30 second integration
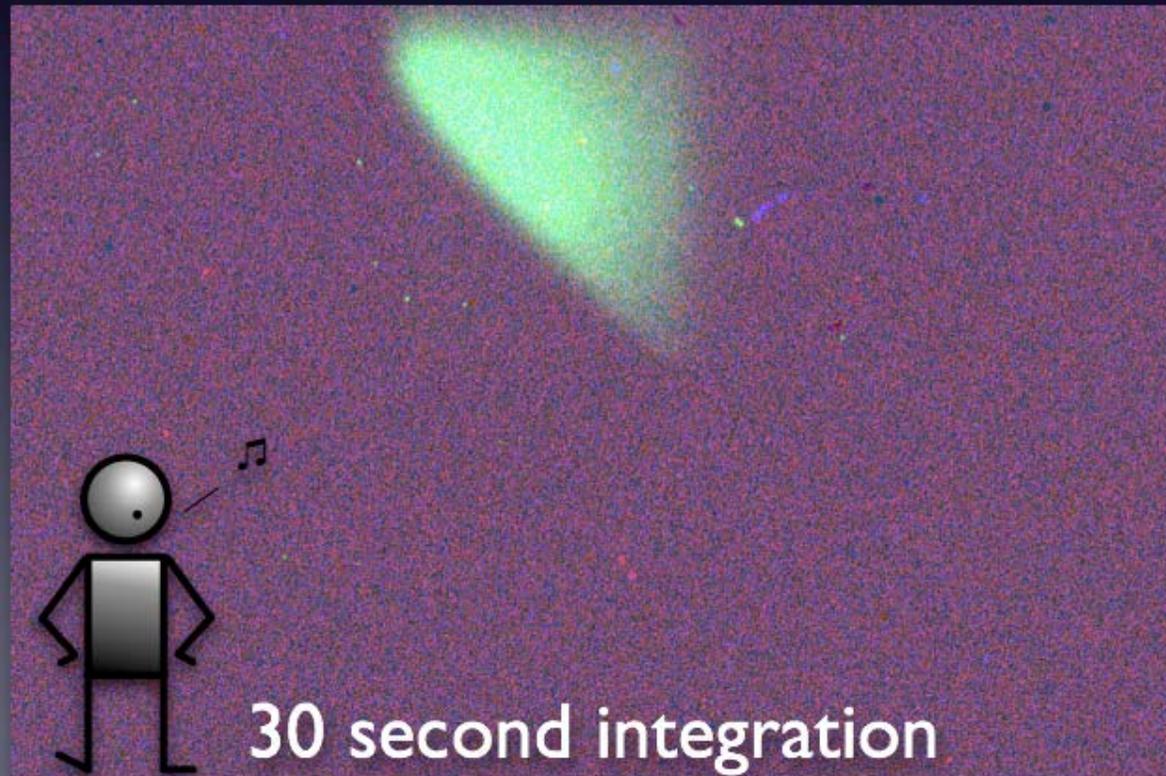
Interfaces

- Prefer GigE, but all are supported at SNS via Labview
- Most are interfaced to EPICS via shared memory

System	Interface	Comments
Source	RS-170	low radiation, intensity trigger
Laser	RS-170	radiation, in feedback system
Injection	RS-170	high radiation
Linac Dump	GigE	remote camera via fiber
Electron scanner	GigE	future system
Target	Firewire/USB	remote camera via fiber, future low light option
Neutron	Firewire/USB	low light, MCP, EMCCD

Multicast Demo

- **Broadcaster**: PV arrays to MPEG4 (CPU: 20% for 10 Hz frame rate)
- **Streaming Server:** RTSP multicast (CPU: <1%, network: <100kb/s)
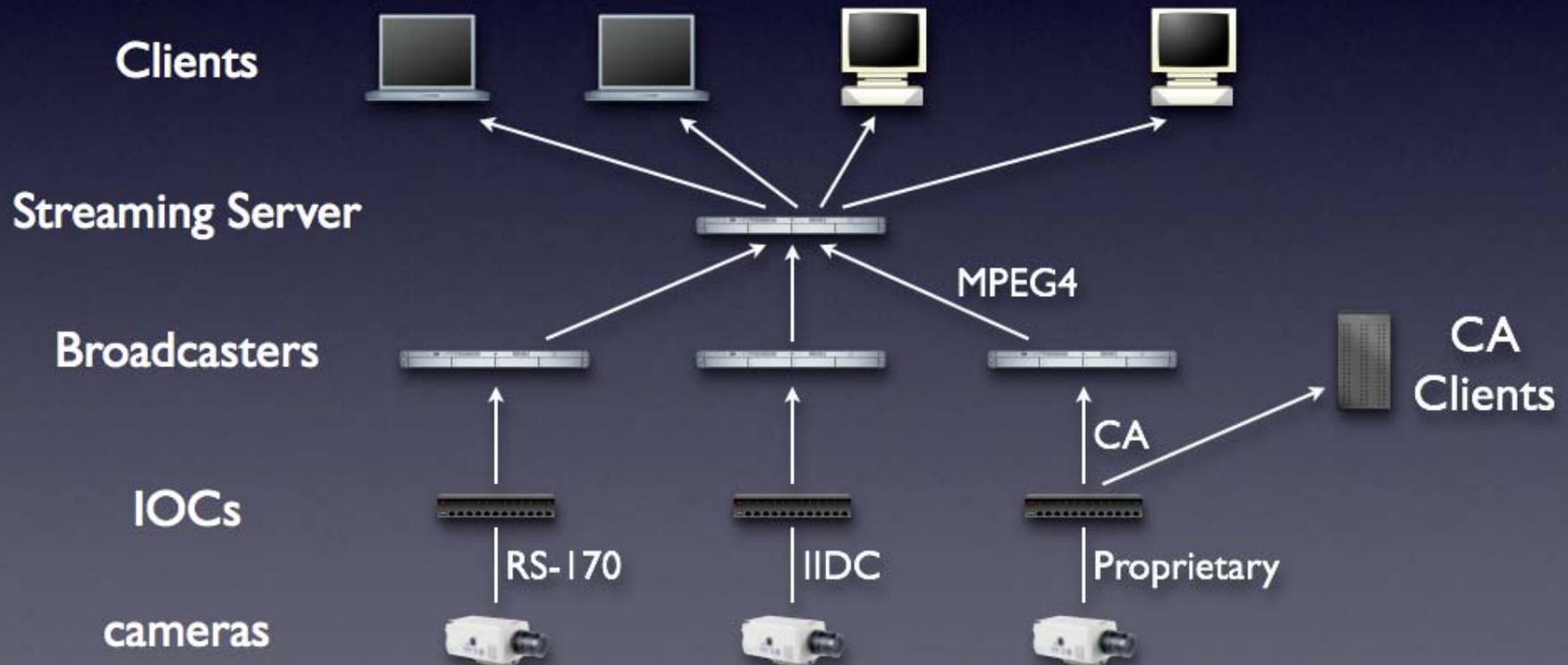
Video on the Network

Technique	Advantages	Disadvantages
EPICS Channel Access over TCP with frame as Array PV	Integration with: archiver, EDM, etc; easy correlation via EPICS timestamp; lossless	high network utilization; does not scale to many clients; no industry standard tools/clients
MPEG-4 over RTSP	Low network utilization; scaleable; industry standard; many standard clients	time correlation still not implemented; challenging integration with EPICS tools; lossy

Summary

- Radiation environment leads to nifty 1950s technology and complex optics

- Performance requirements lead to unique camera interfaces

- Commercial software used to handle variety of interfaces and image processing requirements

- Via shared memory DLL, imaging subsystems successfully integrated with EPICS toolkit

- Multicast streaming technologies are being assessed