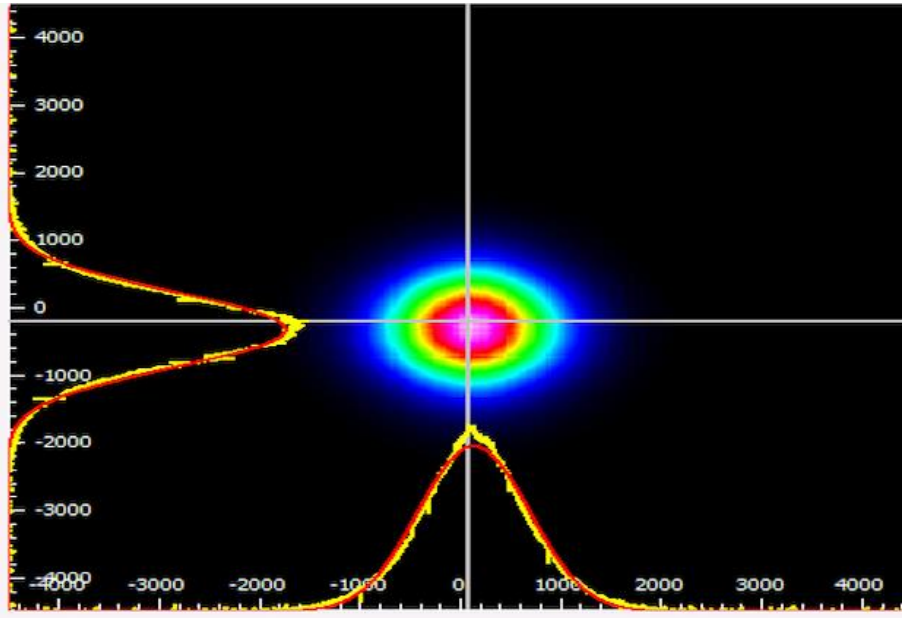
# Addressing Scalability Challenges of 2D Detectors

Sandeep Malu
Tata Institute of Fundamental Research, Hyderabad

# Use of 2D Detectors

- 2D detectors help in the precise **alignment** of the laser and target system, ensuring that the laser pulse interacts correctly with the target material.
- 2D detectors capture the **spatial profile** of the laser beam, providing information about its size, shape, and divergence
- Real-time imaging can be used to adjust and optimize the laser parameters to achieve desired acceleration outcomes.



# Challenges

- Data Throughput and Storage
- Network Limitations
- Processing Overhead
- Real-Time Control Challenges
- Data Archiving
- Gateways

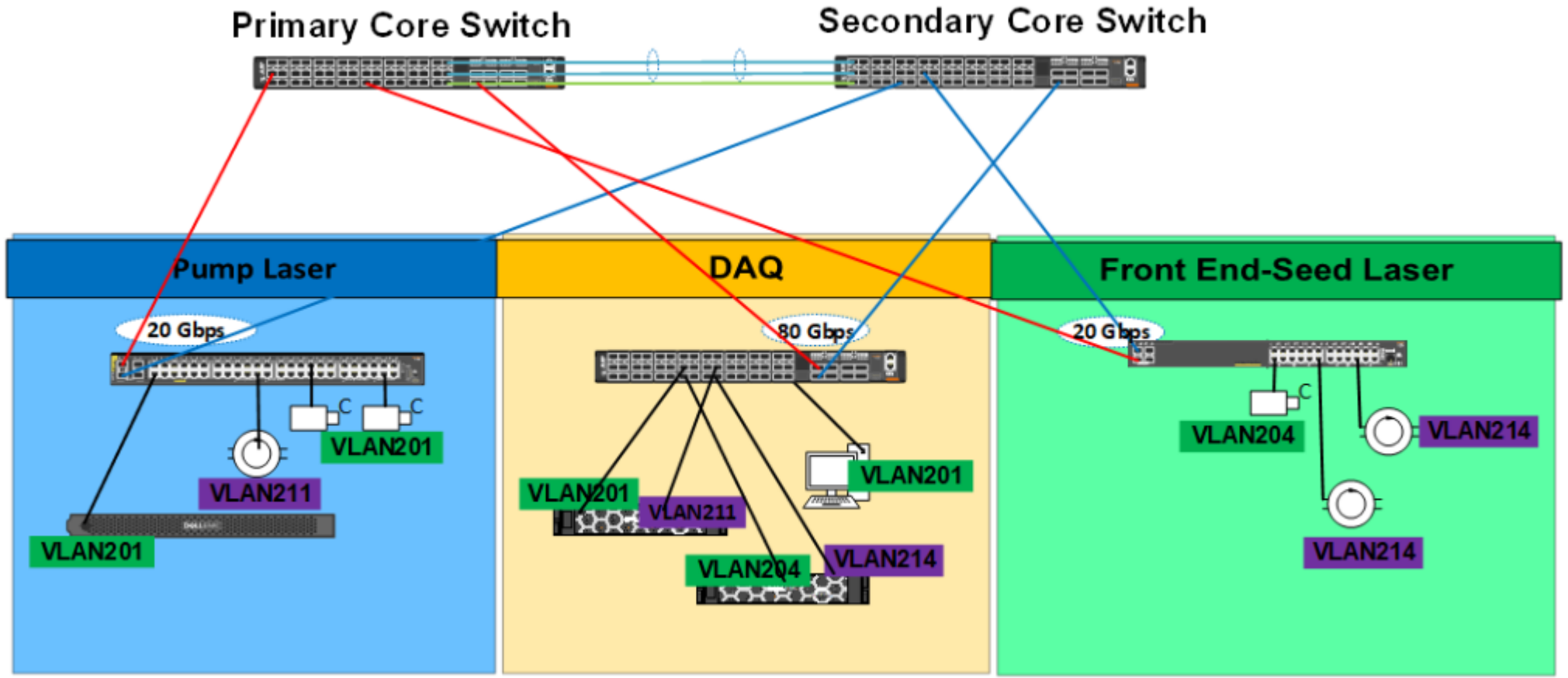
# 2D Detectors in Laser Facility

# Requirements in Laser Facility

Camera Network [b/s] = X_SIZE * Y_SIZE * PIXEL_DEPTH_BITS * FPS

- The model used is the AVT Mako G234 which is 1936 * 1216 * 16* 10 f/s ~ 400 Mbps
- @10 Hz: For 25 cameras per server, the rate required is ~ 10 Gbps (10 Gbps capable interface)
- @10 Hz: For 40 cameras per section, a Lab PC requires ~ 16 Gbps (25 Gbps capable interface)
- @10 Hz: For 200 cameras, centralized control room PC requires ~ 80 Gbps (100 Gbps capable interface)

# Network Layout



# EPICS AreaDetectors

- AreaDetector provides a modular, flexible, and scalable solution for integrating a wide variety of imaging devices into EPICS-based control systems.
- It uses a modular, plugin-based architecture, allowing users to extend functionality with additional features such as image processing, data compression, and file saving.
- AreaDetector is optimized for high-speed data acquisition, making it suitable for applications requiring fast frame rates and large data volumes.

# EPICS IOCs

- Distributed Architecture with approx 20 Camera IOC per server having a network interface card of 10G each
- CPU usage of 45-50 % and network utilization of approx 3.5G

# User Interface

- Front End - R204
  - Picosecond Pump (PSO)
    - [ ] All
    - [x] FE-204-PSO-1-D-CAM-1-NF
    - [ ] FE-204-PSO-1-D-CAM-2-FF
    - [x] FE-204-PSO-1-D-PU-CAM-1-NF
    - [ ] FE-204-PSO-2-D-CAM-1-NF
    - [ ] FE-204-PSO-2-D-CAM-2-FF
    - [ ] FE-204-PSO-2-D-PU-CAM-1-NF
    - [ ] FE-204-PSO-3-D-CAM-1-NF
    - [ ] FE-204-PSO-3-D-CAM-2-FF
    - [ ] FE-204-PSO-3-D-PU-CAM-1-NF
  - Picosecond Stretcher (PSS)
  - Nanosecond Stretcher (NSS)
  - Nanosecond Pump (NSO)
  - Energy Control (EC)
- Pump Laser - R201
  - Seed
  - 10J
  - 100J
- Ti Sapphire - R202
  - 100J Beam Transport (HJ-BT)
  - Front End Beam Transport (FE-BT)
  - Ti:Sa Pump Infrared (TSP-IR)
  - Ti:Sa Pump Green (TSP-GR)
  - Ti:Sa Multi-Pass (TSM)

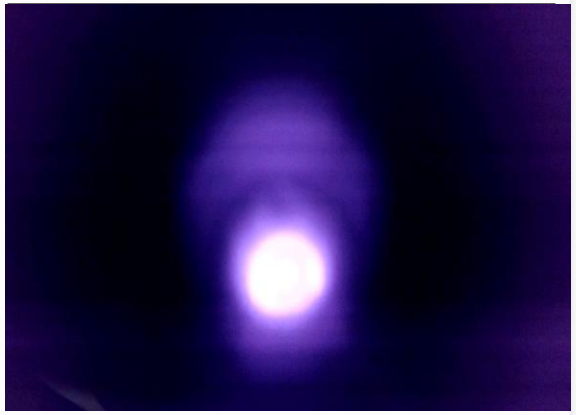
Toggle Sidebar

Press and hold CTRL + Left-click to drag and drop dashboard panes.

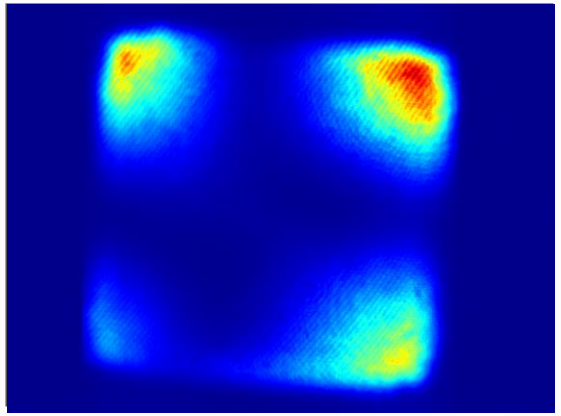
**Picosecond Pump (PSO)**

Press and hold CTRL + Left-click to drag and drop dashboard panes.

**FE-204-PSO-1-D-CAM-1-NF**



**FE-204-PSO-1-D-PU-CAM-1-NF**



# Operational Issues

- Sometimes Image Frame Drop issues when all cameras are triggered at the same time due to spike in Network Traffic
- Memory buffers may become a bottleneck, especially with concurrent data streams from multiple detectors.
- Any mismatch in "Jumbo packet"
- The Camera IOC needs re-start because the IOC gets frozen after 4/5 days of streaming the images

# Enhancements

- Use of Image Compression to lower Network traffic
- Use of PVA over CA for better network and infrastructure usage

EPIC
Extreme Photonics Innovation Centre

central laser facility

# Thank You !

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UKRI Science and Technology Facilities Council