EUROPEAN
SPALLATION
SOURCE

ESS Linux

Yocto based linux on MTCA CPUs

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Agenda

1	Intro: ESS and Yocto
2	Why Yocto?
3	ESS Linux at ESS
4	Fixed Issues and Current Status
5	Next Steps

What is ESS Linux

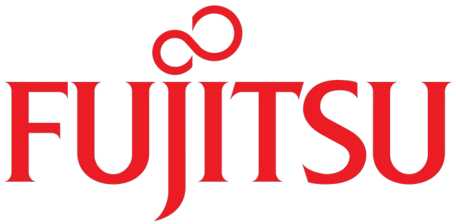
And Yocto Project

ESS Linux is a Linux Distribution based on Yocto Project tailored for ESS's MTCA Platform.

Yocto Project, or just Yocto, is a framework to build tailored Linux Distribution regardless of the hardware architecture.

Who runs Yocto?

Yocto is part of Linux Foundation the project is **maintained by a vast community** from industry to non profitable organizations. Some examples are: **Qualcomm, Intel, ARM, Cisco, AMD, Boeing, Fujitsu.**



Why Yocto?

- **Lightweight and Purpose-Built**: Designed for embedded systems, delivering only what is essential for our applications.
- **Highly Configurable**: Enables fine-tuned customization, from specialized software to kernel-level features, such as PCI board hot-swapping.
- **RealTime Image:** Needed for our motion systems
- **Optimized for Performance**: Vendor-specific configurations and hardware optimization flags included in the Yocto SDK ensure maximum efficiency.
- **Architecture-Agnostic Flexibility**: Supports diverse hardware platforms, including IFC14xx and Concurrent CPUs, enabling uniform builds across devices.

Where we use ESS Linux

- Machine Protection
- RF Systems
- Beam Diagnostic Systems
- Timing
- Motion Systems (ethercat based)

Where we use ESS Linux

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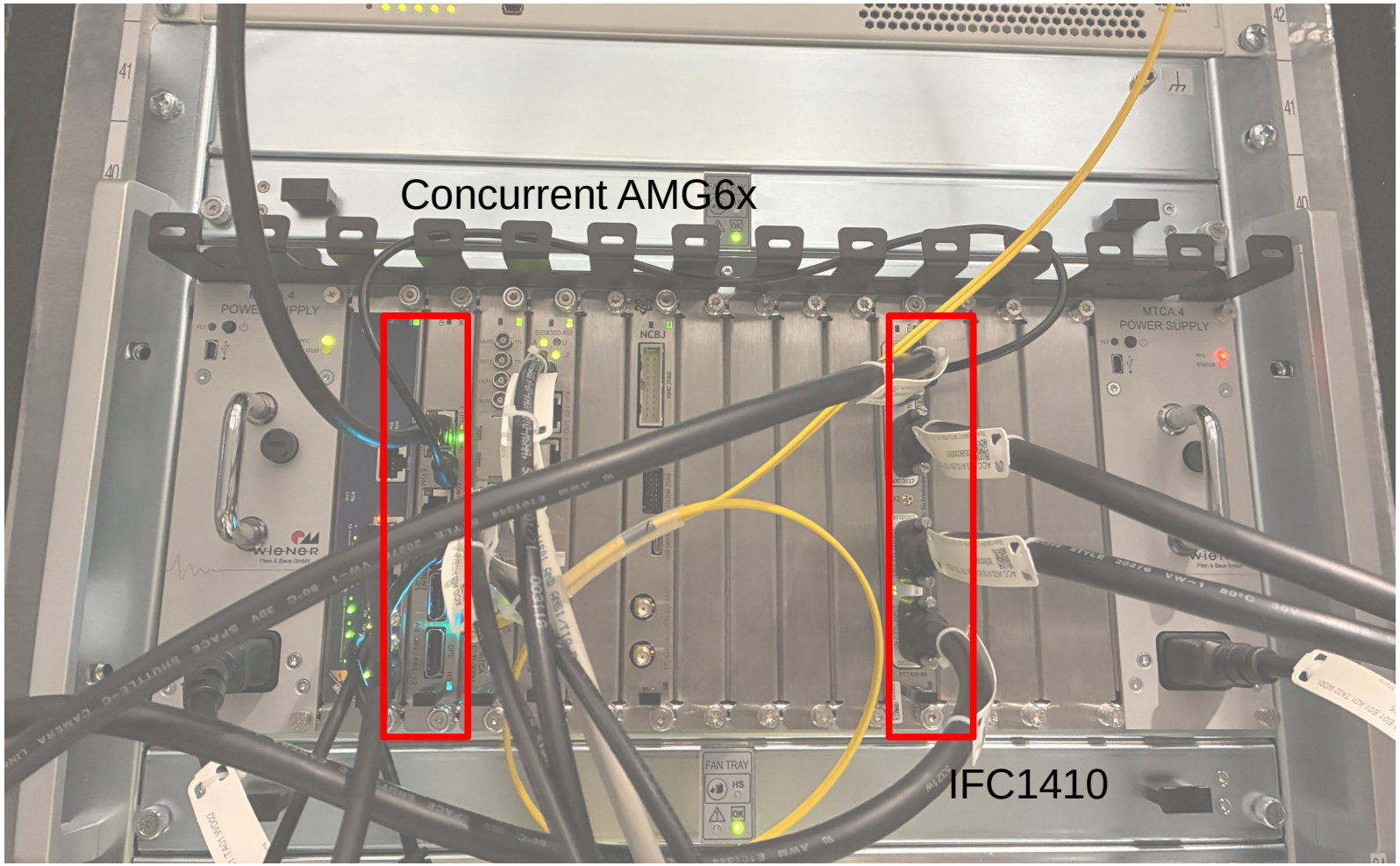

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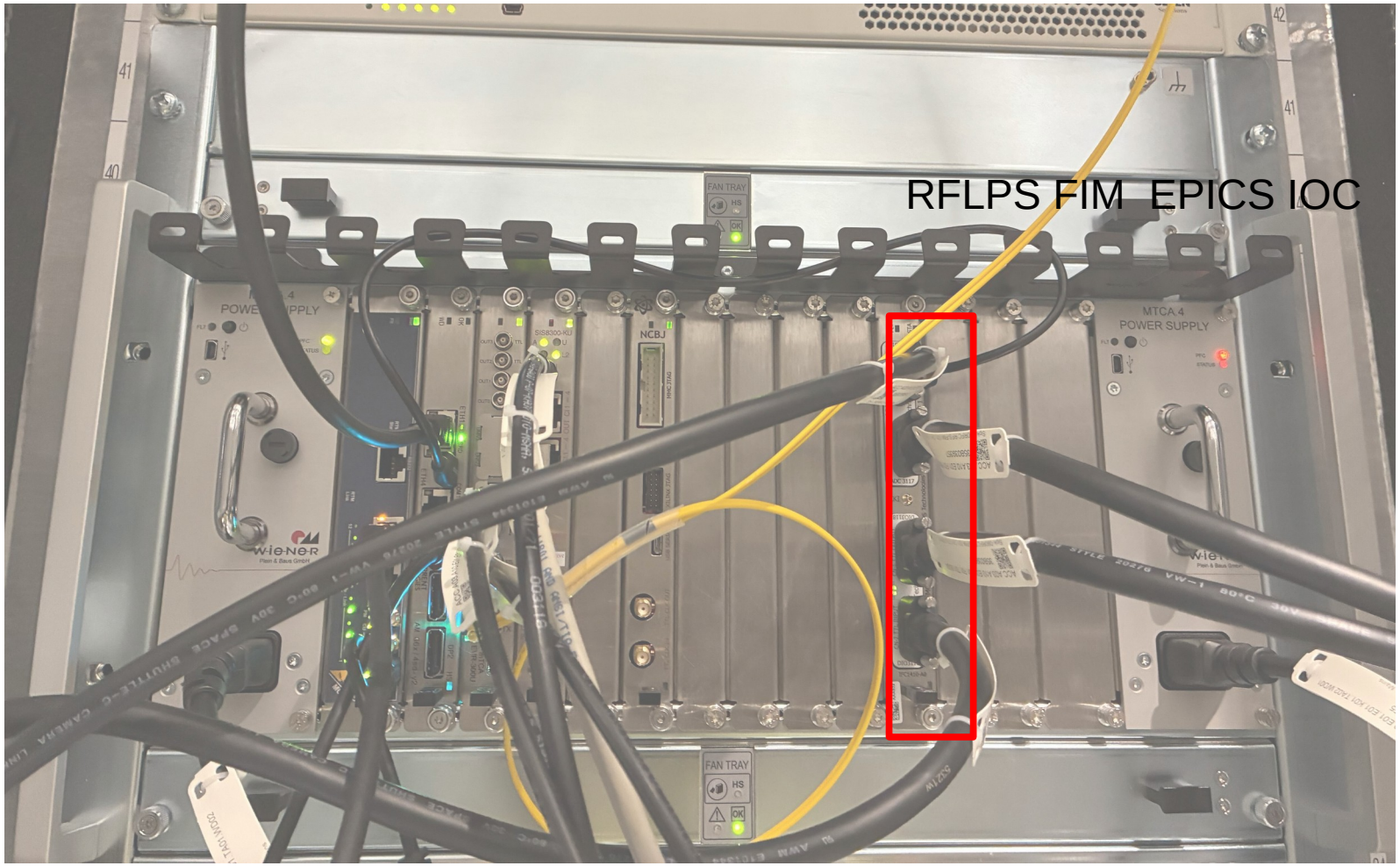

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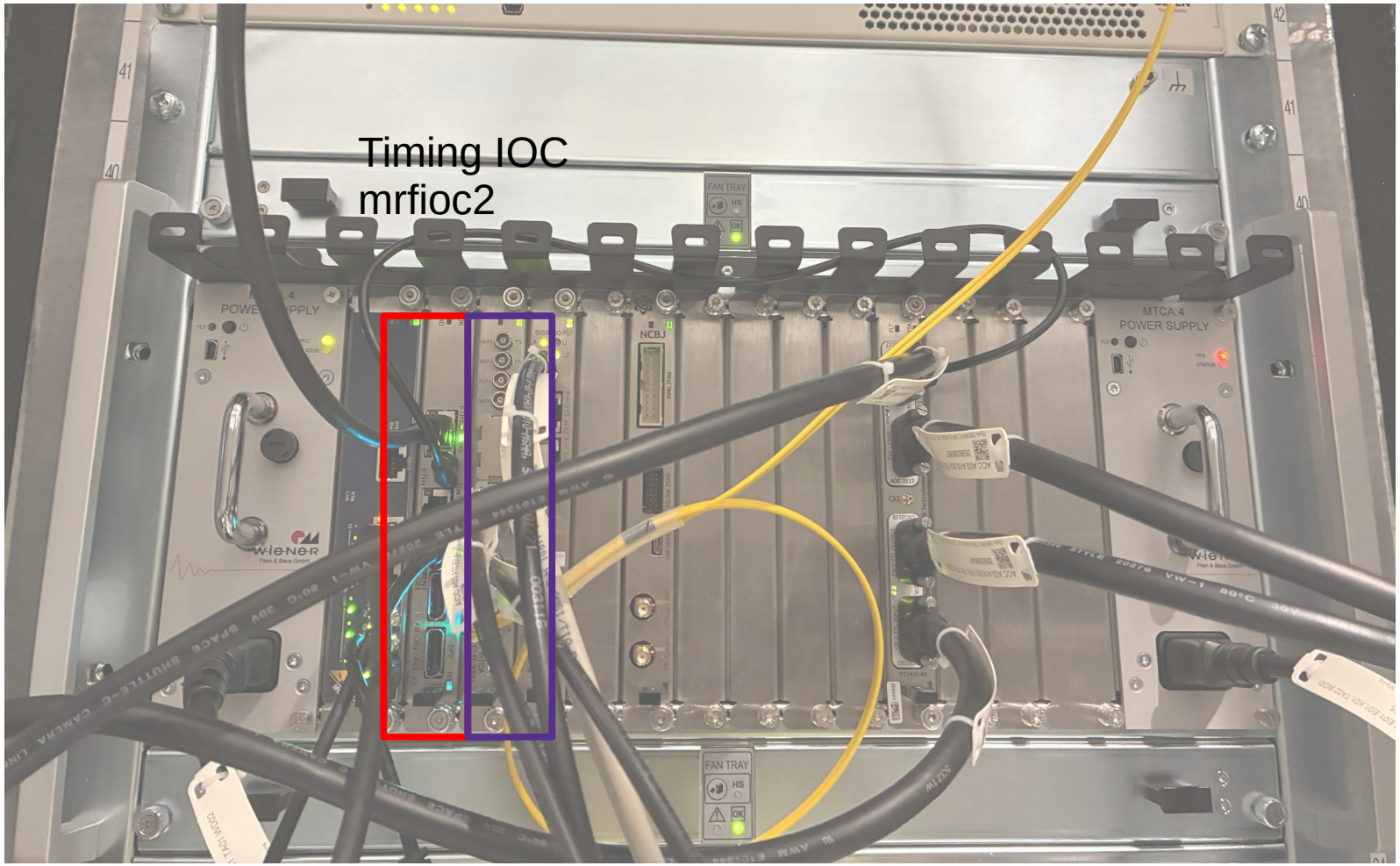

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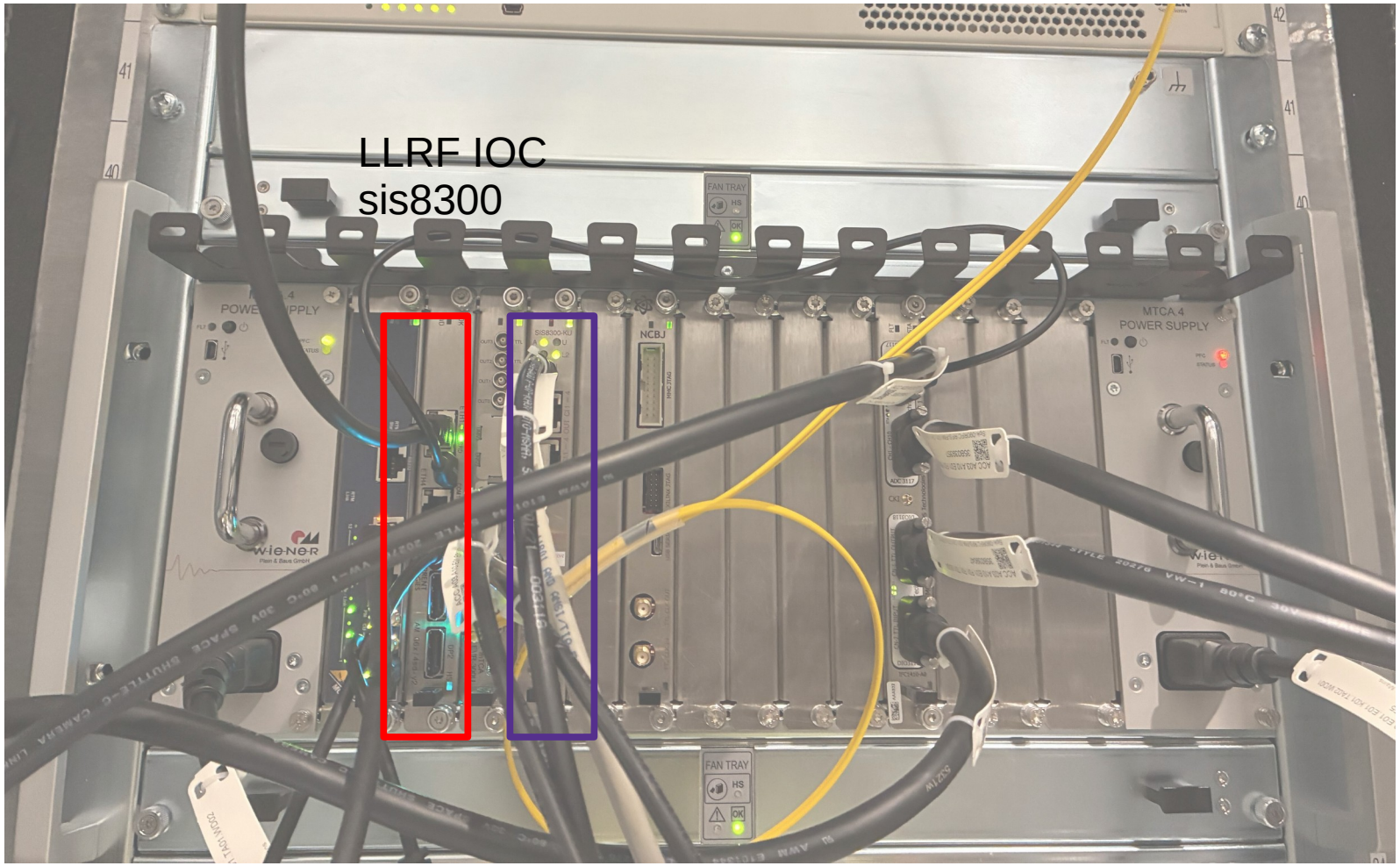

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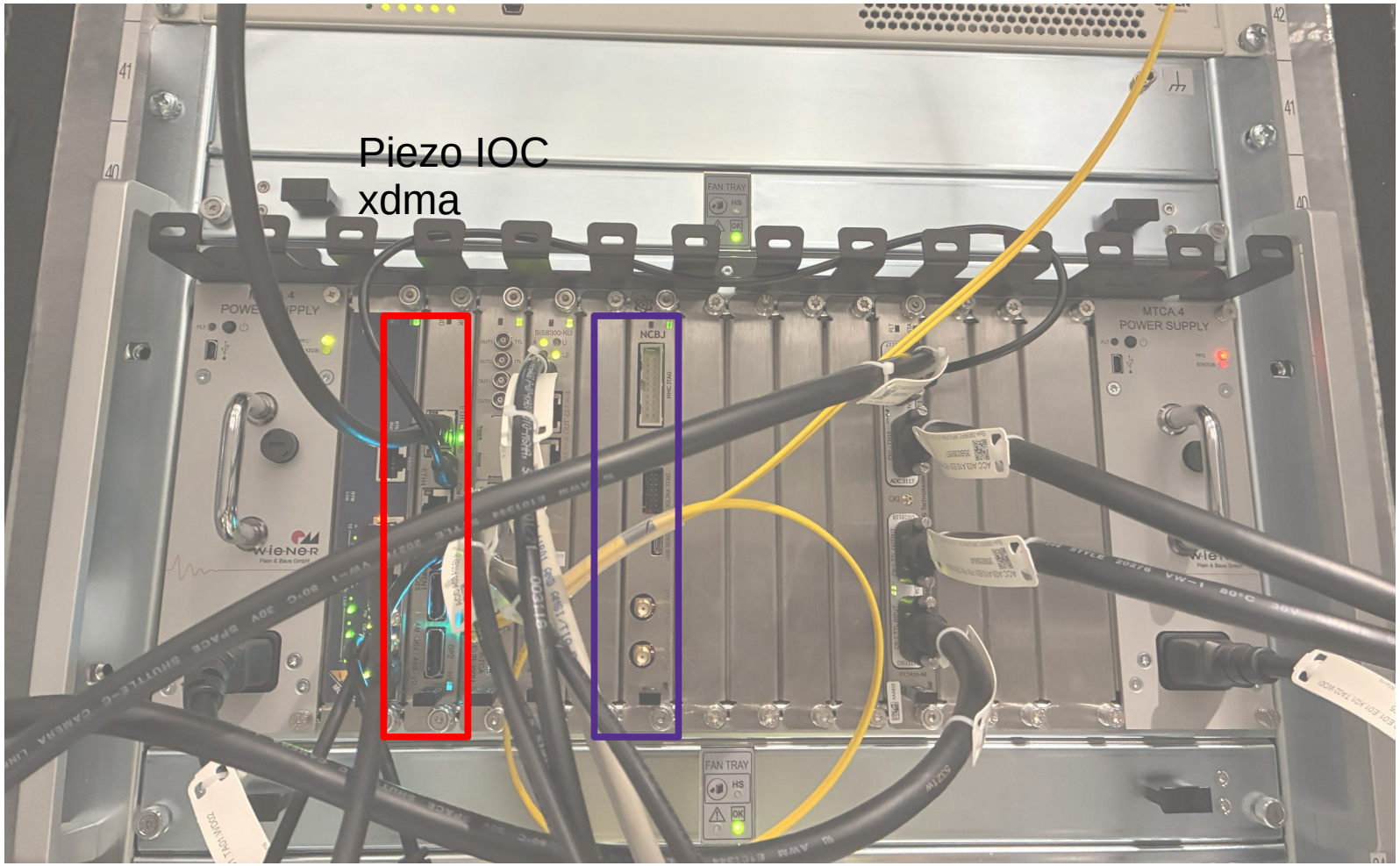

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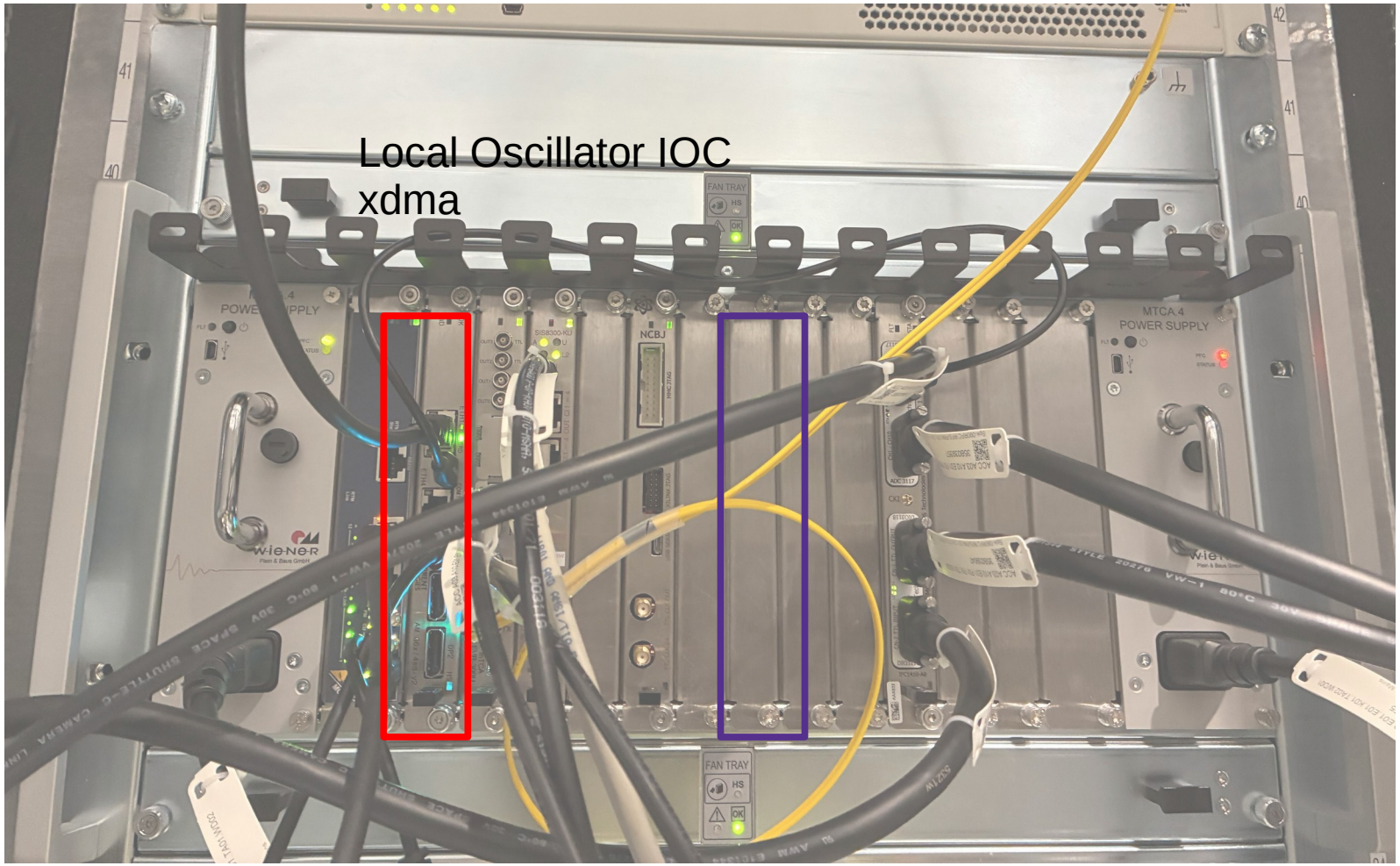

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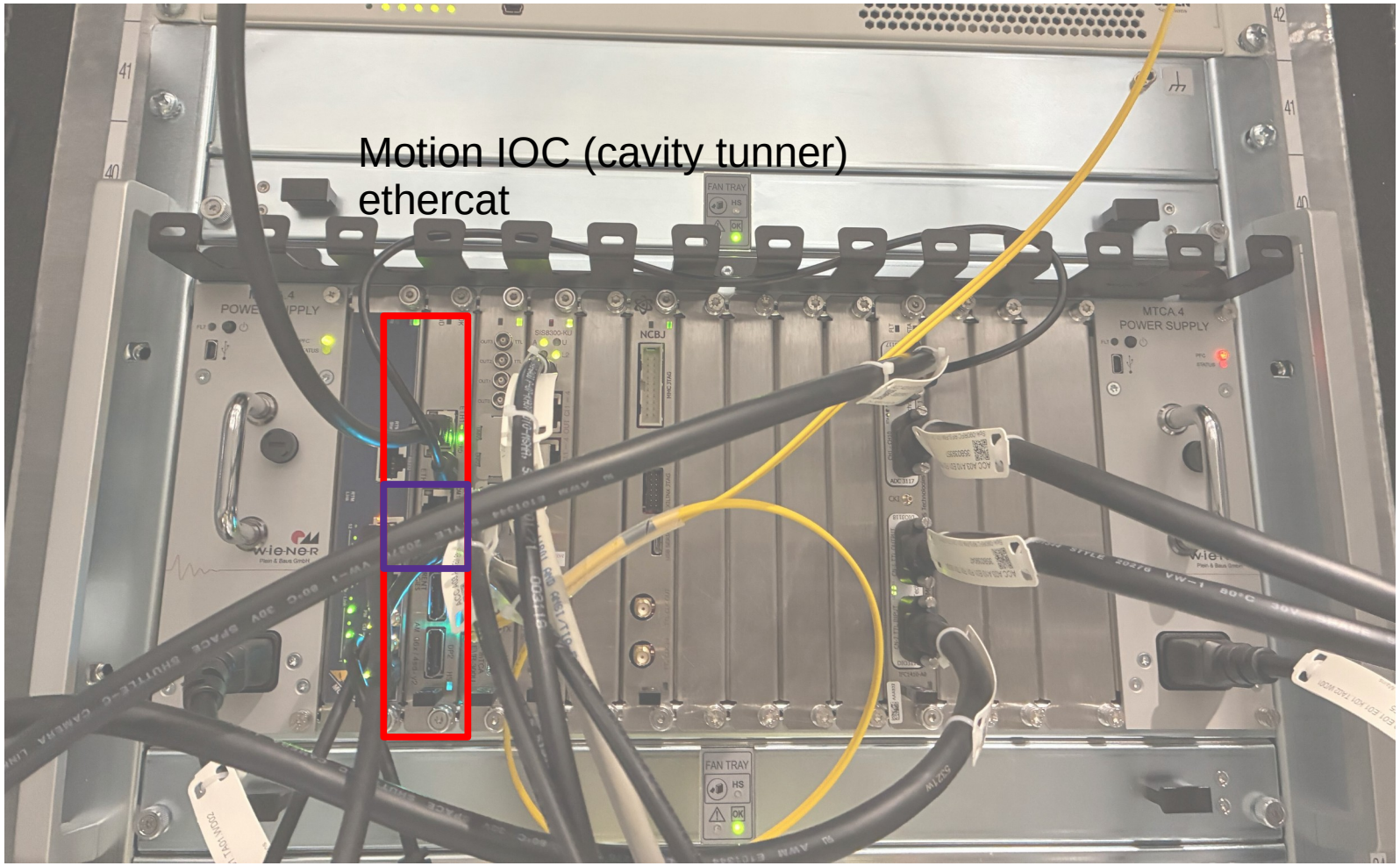

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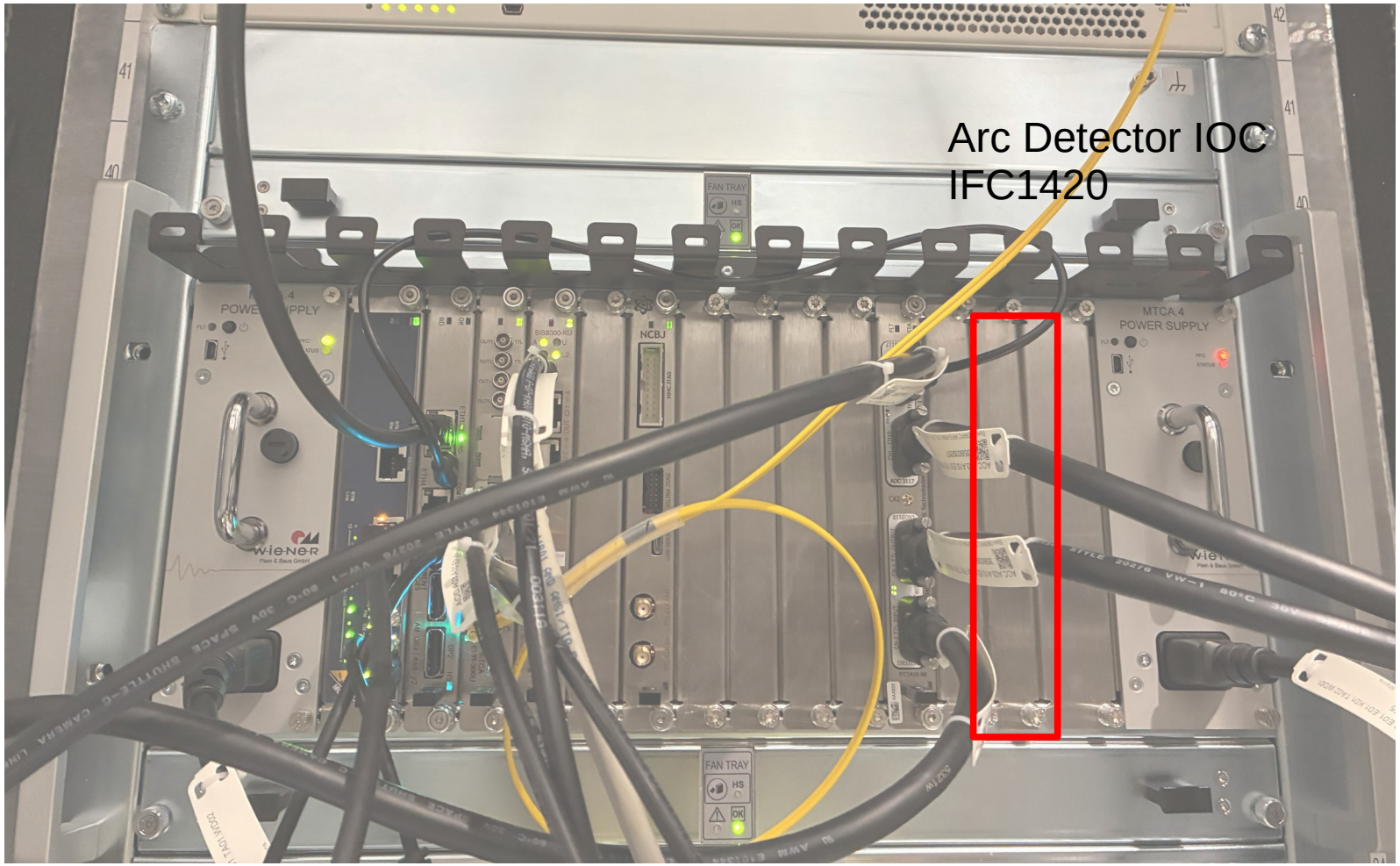

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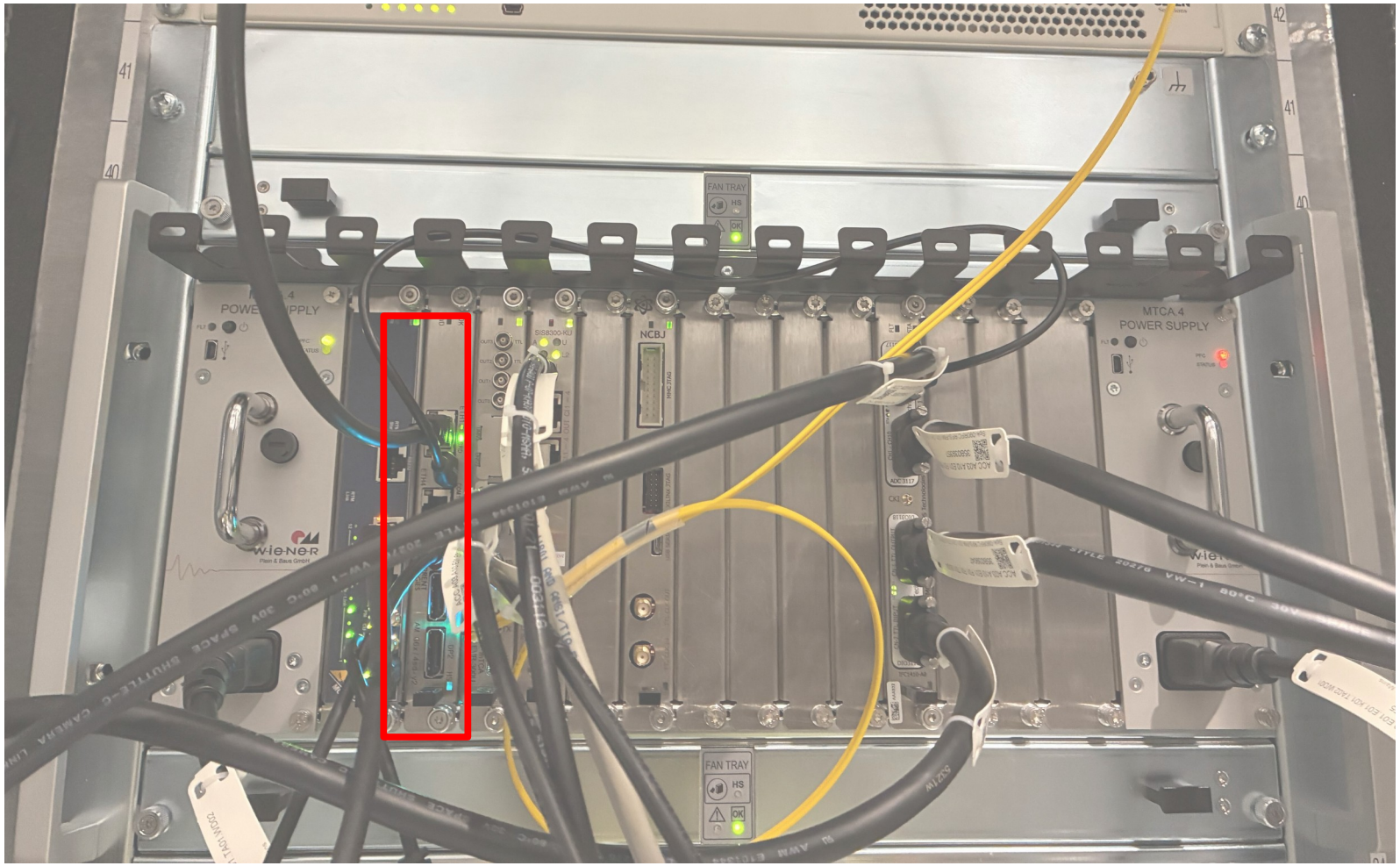

EPICS Infra
node_exporter
syslog_ng

Where we use ESS Linux

Different CPU models

- Concurrent CPU - x86_64
  - AMC90x
  - AMG6x
- IFC14xx – PowerPC (e6500) diskless

Operating Systems requirements

- Data Acquisition systems
  - sis8300 (struck sis8300)
  - xdma (struck, ifc14xx, and others)
  - mrf
  - tsc
- Motion – ethercat- RT kernel
  - igb
  - e1000e

Improvements with ESS Linux

- Smaller image : 150 Mb
- Quicker deployment – no need of extensive post configuration
- Kernel optimization

Fixed issues with the ESS Linux

On Concurrent CPU

- Random Freezes on MTCA Concurrent CPUs (AMC90x)
- Persistent monitor output issue
- PCI Hot-Swap working (for sis8300 and mrf drivers)
- Motion instability on Concurrent
- Better performance on BPM IOC

Current status

Almost full adoption

- All of our IFC14xx cards (~250 units)
- 85% of our Concurrent CPUs (~200 out of 230)
- First systems running for more than 6 years (on IFC1410)
- Concurrent CPUs used on previous Beam Commissioning (1 year ago)

Current status

Images

- X86_64 – Kernel 5.15
- X86_64 RT – Kernel 5.15
- Ifc14xx – Kernel 5.10
- Ifc14xx RT – Kernel 5.10
- Vmboxx86_64 – Kernel 5.15

Next steps

- Finish implementation of full automated tests with real hardware
- Graphical stack for development environment
- Upgrade Yocto version
- Add support for other CPUs (FPGA)

Useful work to be shared

- Kernel drivers recipes (sis8300, mrf, xdma, tsc, ethercat)
- Tools for EPICS control system (procServ, conserver)
- Python EPICS libraries (pyepics, p4p)

Questions ?

Used Layers

Name
..
meta-ess
meta-freescale @ `c525e0c1`
meta-freescale-distro @ `d5bbb487`
meta-intel @ `bb7c7b0f`
meta-openembedded @ `52ecd668`
meta-security @ `353078bc`
poky @ `bba60774`

Migration Challenges

From CentOS 7 to ESS Linux

- System Owners
- Changes to fit our network infrastructure and other auxiliar systems
- Deployment and Batch deployment

Our infrastructure

- Gitlab CD/CI for build
- Artifactory
- PXE server
- Ansible playbook to post-install configuration

Yocto challenges

- Harder to find engineers
- Cross compilation necessary
- Not possible to develop within it
- Depends on vendor layers
  - When NXP stop maitaining IoXoS baseboard, we will need to continue it