

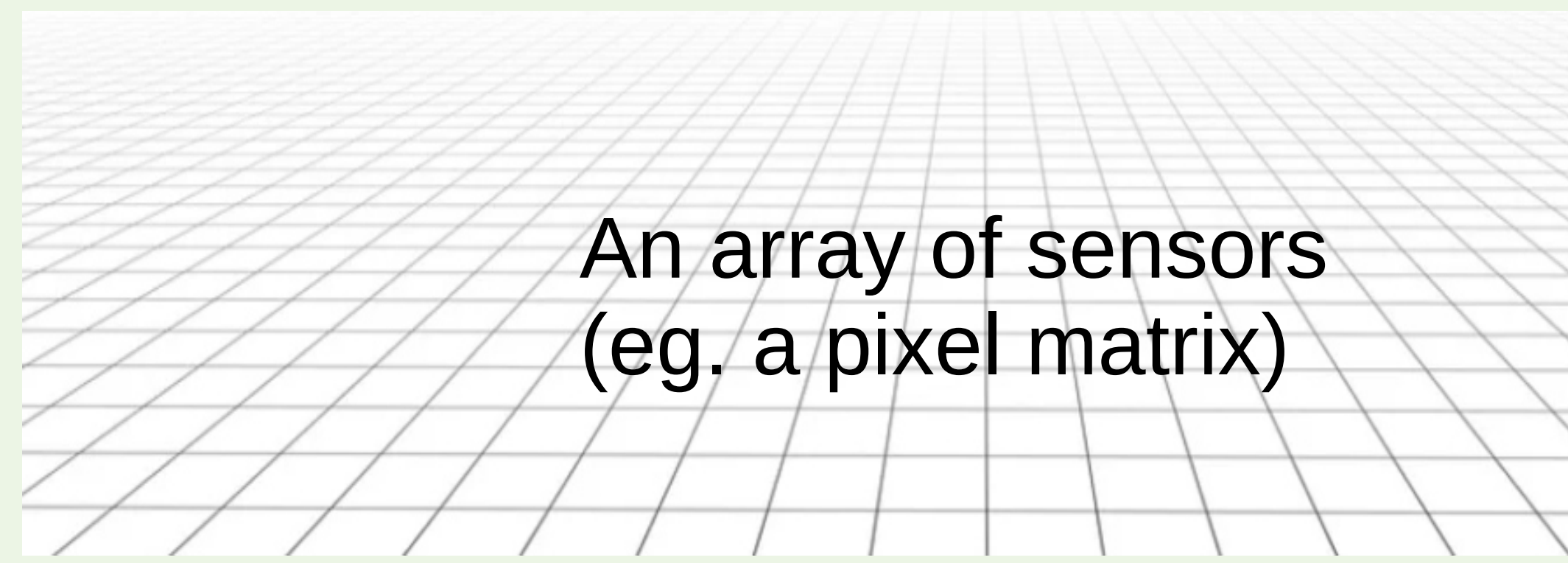


Network Intelligence Fault Tolerance is NIFTY

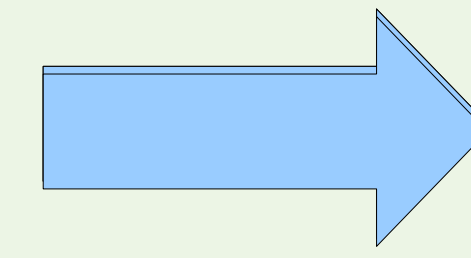
¹LBNL, ²UT Arlington

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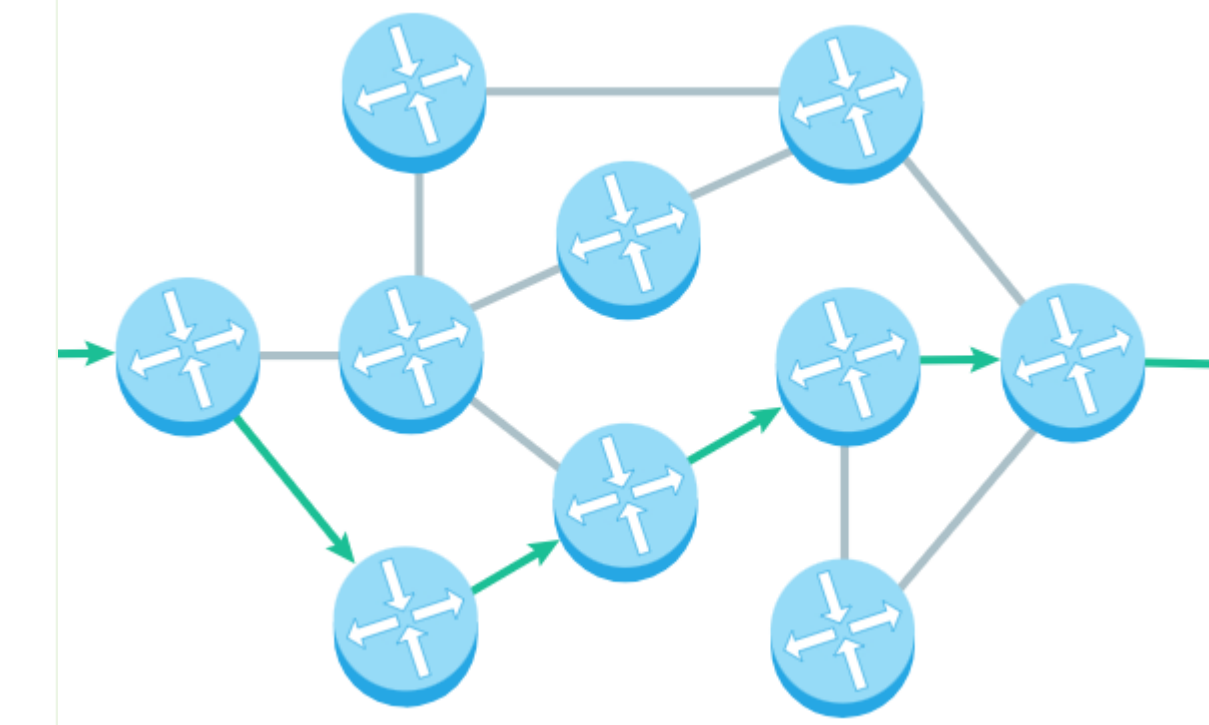
- Hard-wired data flow
- Bandwidth bottlenecks
- Vulnerable to single point failures



An array of sensors (eg. a pixel matrix)

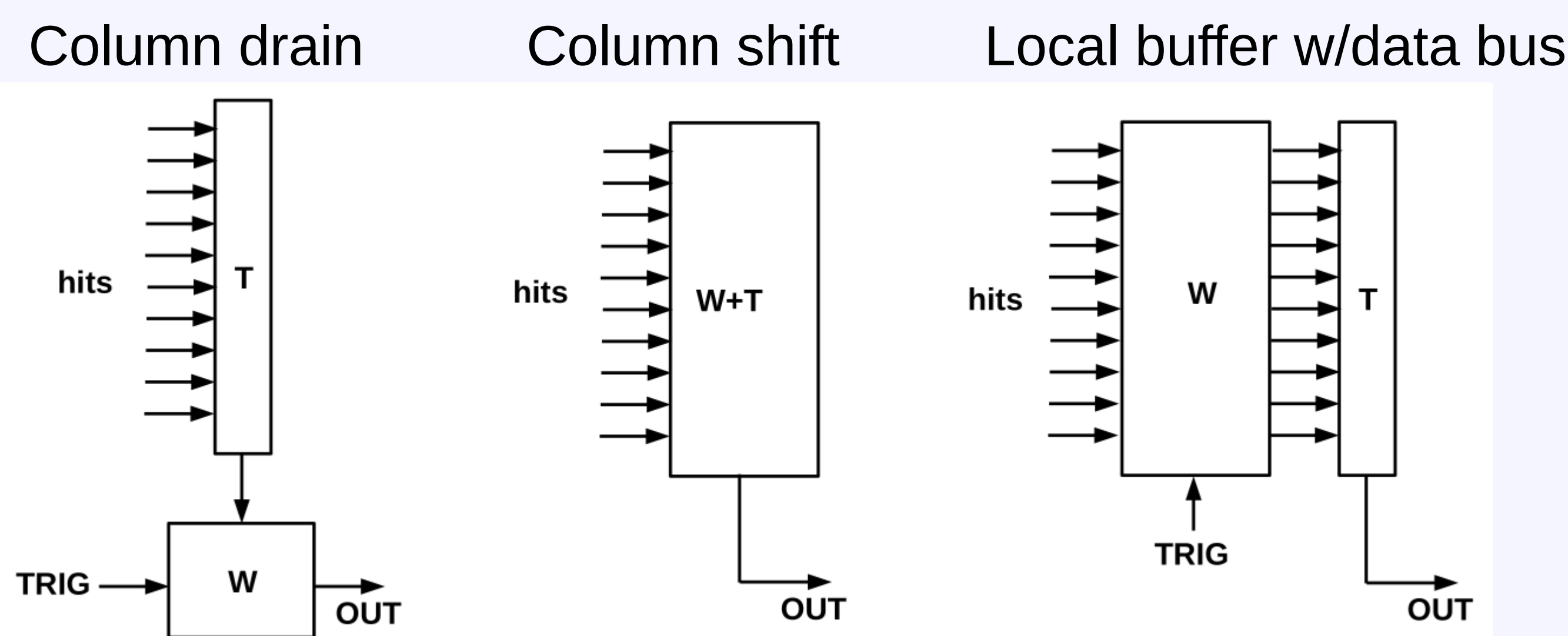


A network of sensors

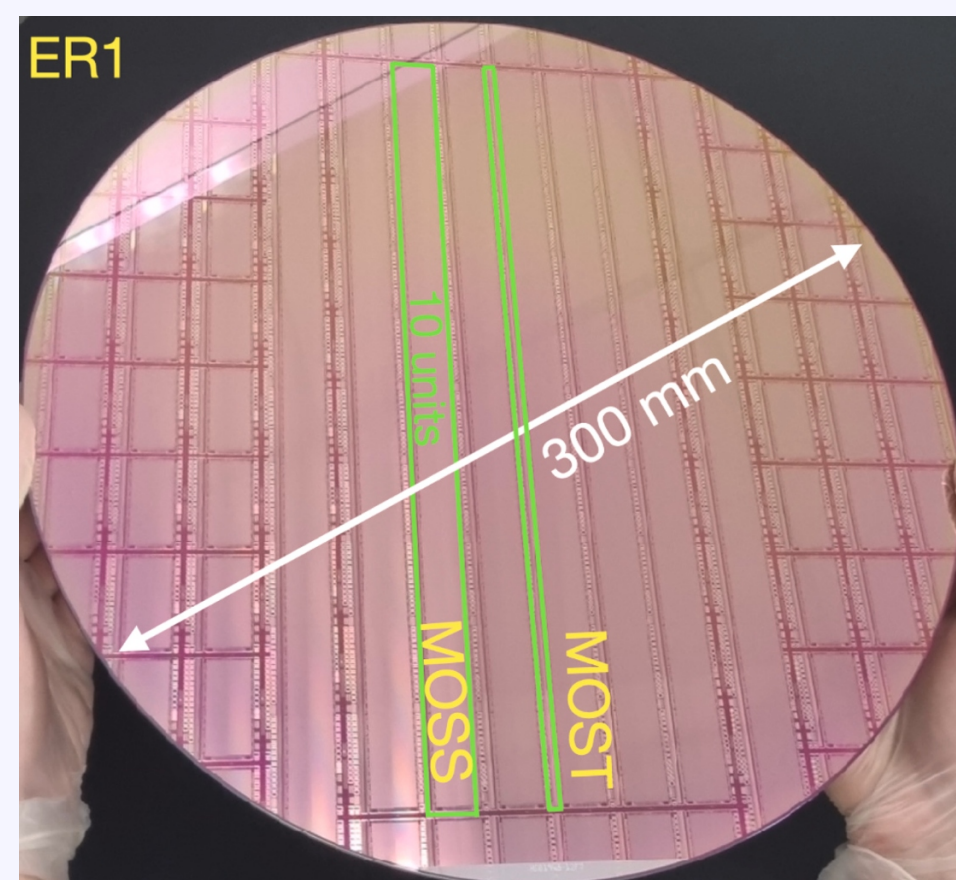


- Adaptable data flow
- Balanced bandwidth utilization
- Can withstand single point failures

Pixel matrix readout state of the art and issues



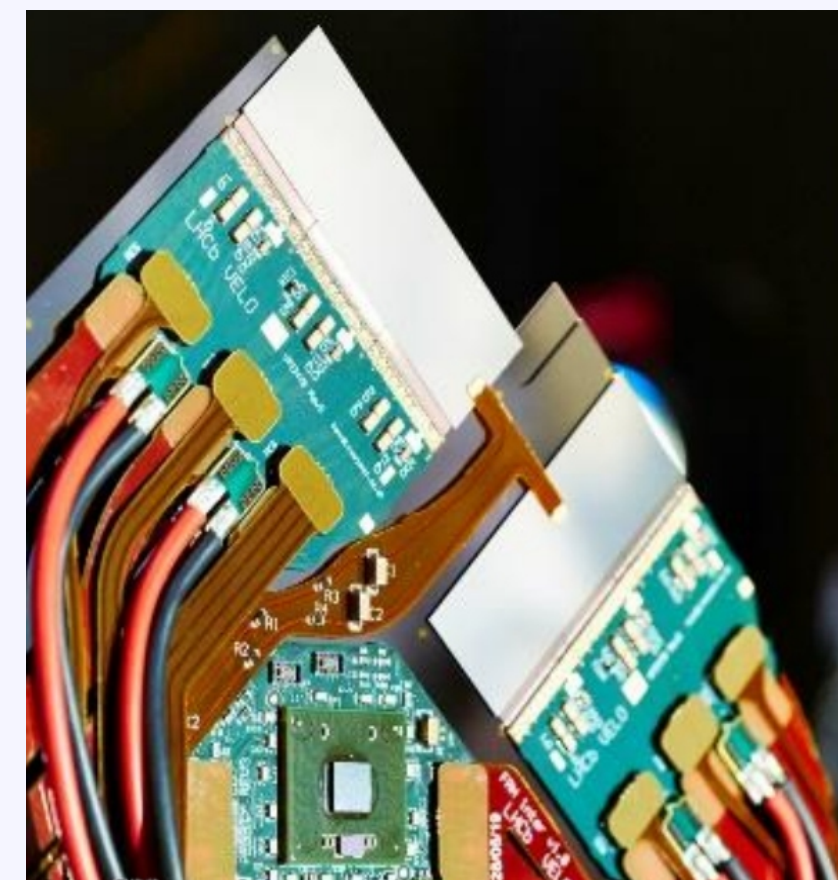
Wafer scale maps (ALICE)



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- Featured Issue:
- Manufacturing yield

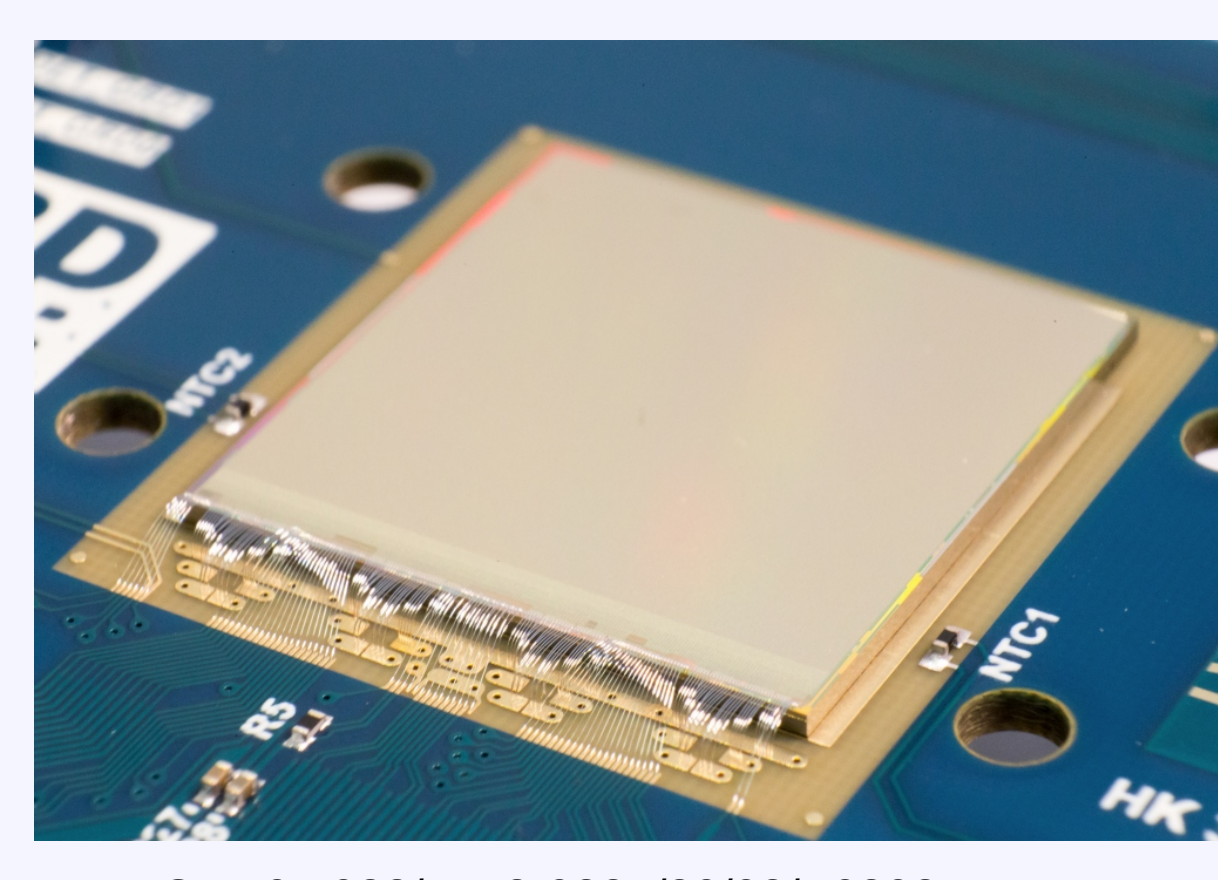
VeloPix (LHCb)



DOI: 10.1016/j.nima.2024.170028

- Featured issue:
- Data bandwidth

RD53 (ATLAS, CMS)



DOI: 10.1088/1748-0221/20/03/P03024

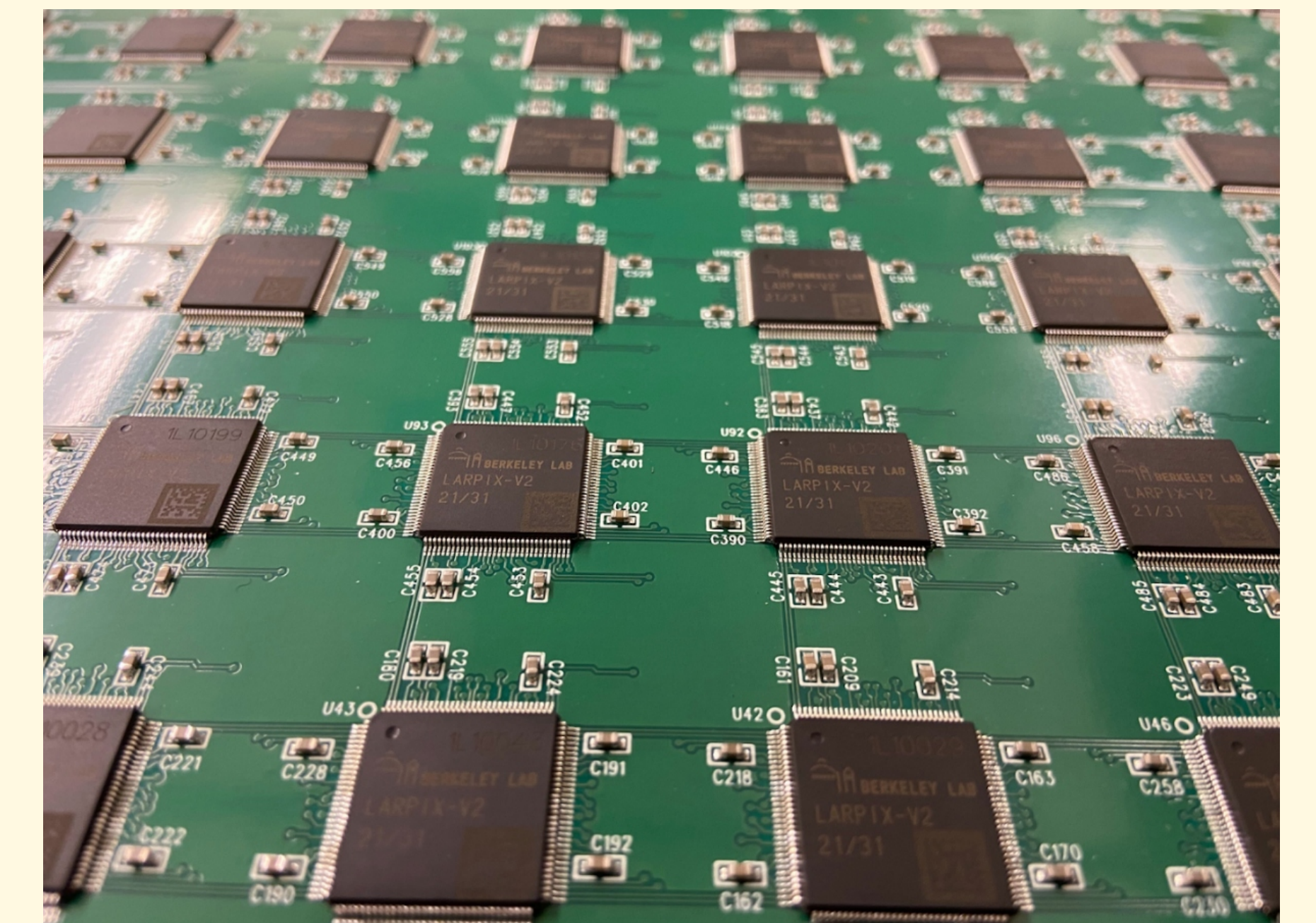
- Featured Issue:
- Single point damage during assembly

- Single point failures and radiation-induced single event effects affect all

HYDRA network for DUNE LArPix System

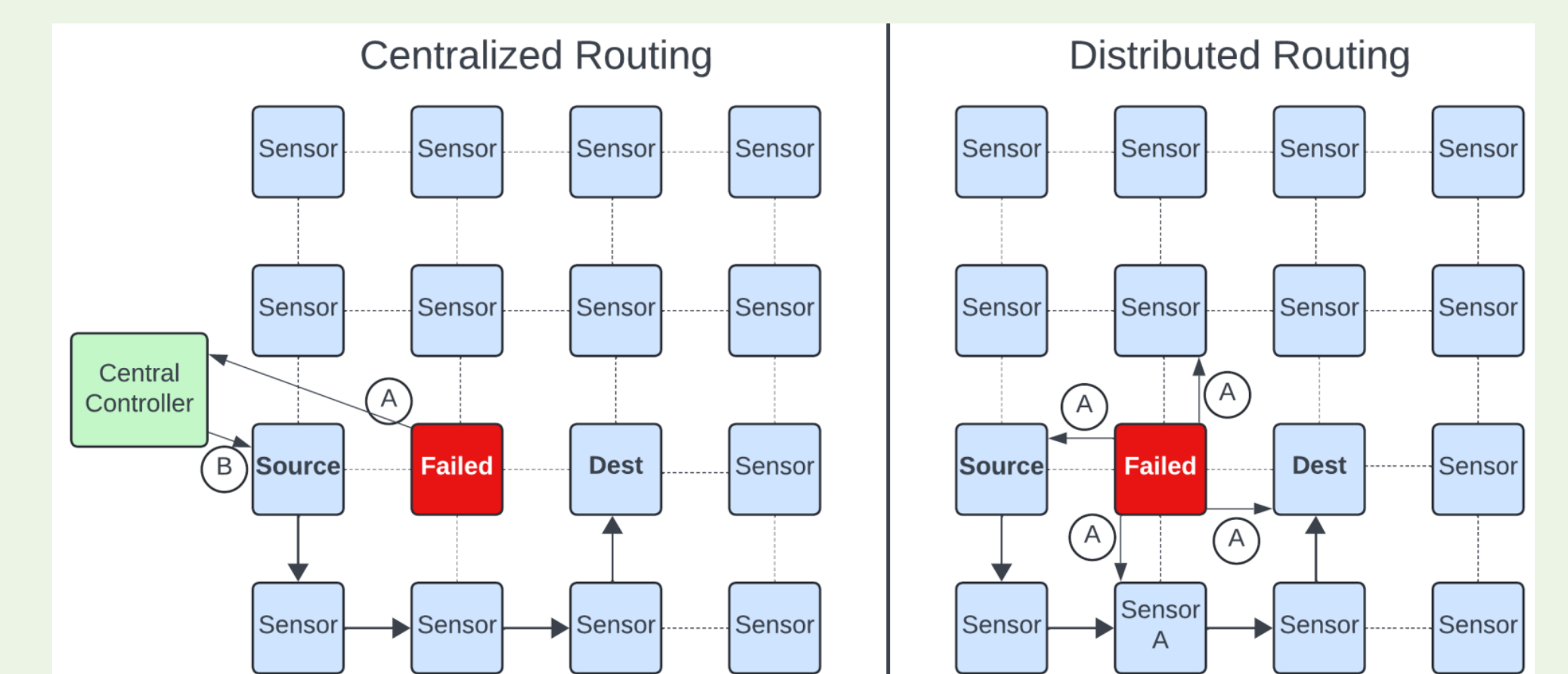
- Developed to achieve:
- Highly multiplexed readout
- Low power
- Robust against single point failures (critical because for the high multiplexing)

Static network configuration:
Does not address data load balancing
Can't react to transient faults



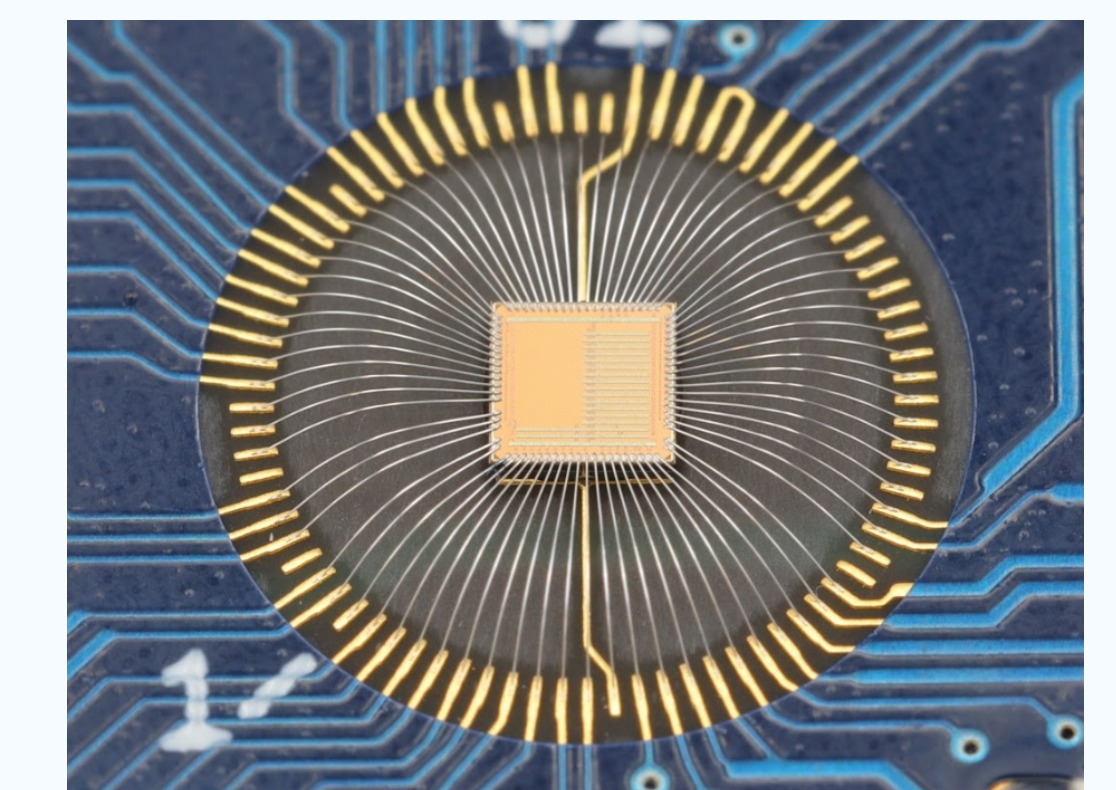
Intelligent HYDRA

- Develop on-chip routing decision making engine
- Monitors local network traffic
- Exchanges network traffic info with neighbors
- Decides which way to route data



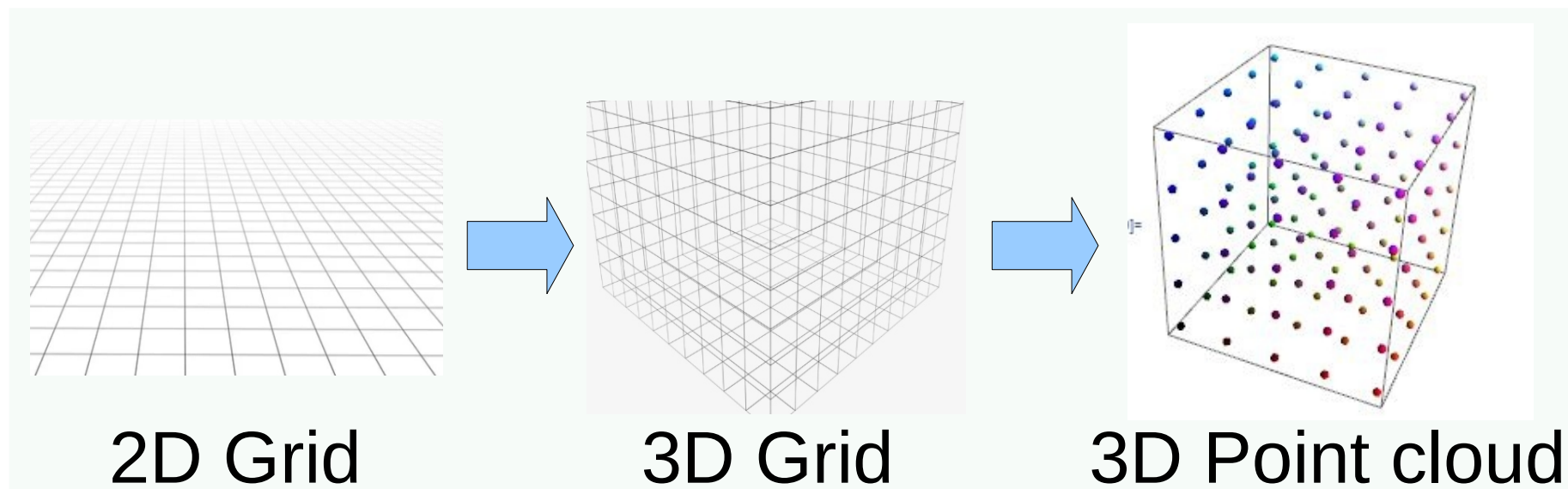
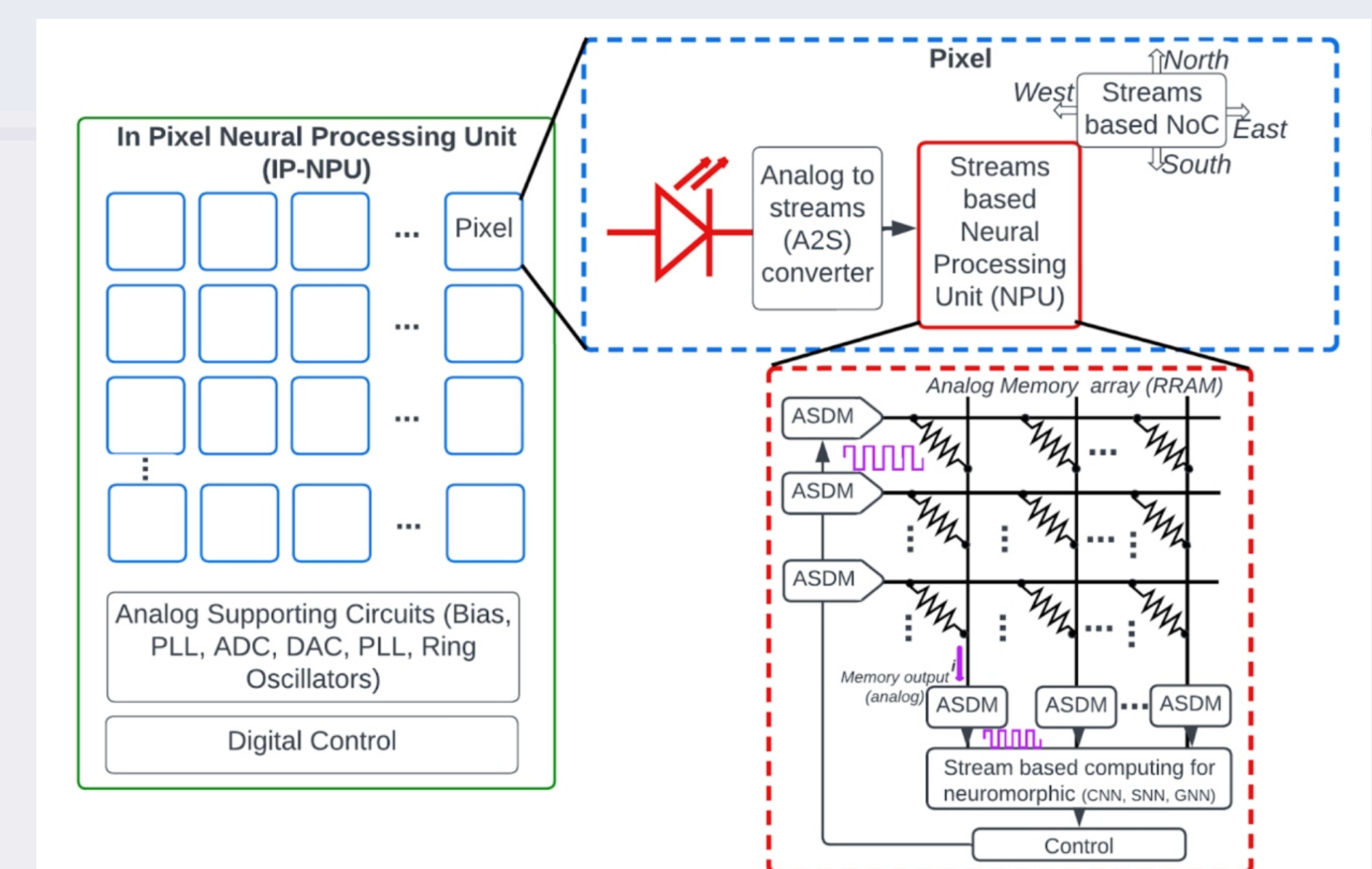
Network on Chip (NOC) pixel chip

- Develop network architecture on pixel chip
- Adopt decision making from above as possible (severe space and power constraints in pixel matrix)
- Show this solves s.p. failure mechanisms of RD53 chip
- Integrate with 4D tracking pixel chip prototype in 28nm CMOS



Neuromorphic spiking NOC

- Investigate addressing above power and space constraints with spiking neural network approach
- Analog domain network implementation, whereas above is all digital.
- Prototype in small test chip



Smart Dust for Particle Tracking

Yuan Mei, UTA
Maurice Garcia-Sciveres, LBNL

We propose to develop a novel particle tracking/photodetector technology based on "Smart Dust"—a wireless particle tracking detector that can be conformally deployed to surfaces of arbitrary shape or dispersed in 3D volumes. Smart Dust means very small (sub mm³)

- Study generalization to arbitrary network
- Low power wireless communication protocol
- Node addressing, data routing policy and decision making



We're hiring for this work. Apply here:

Poster prepared for CPAD 2025 workshop, University of Pennsylvania, Oct. 7-10