



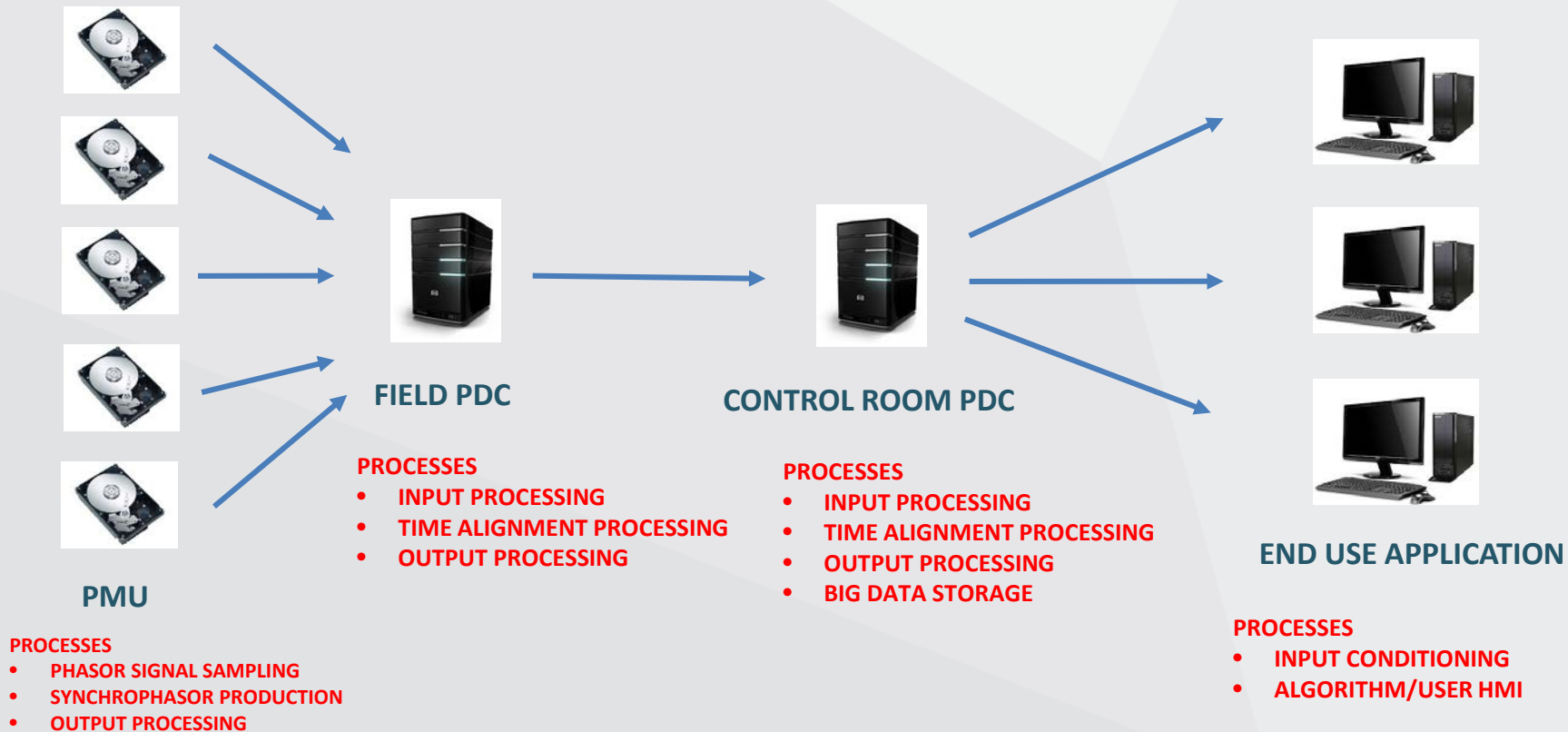
PingThings

A Simplified Data Architecture for PMU Data

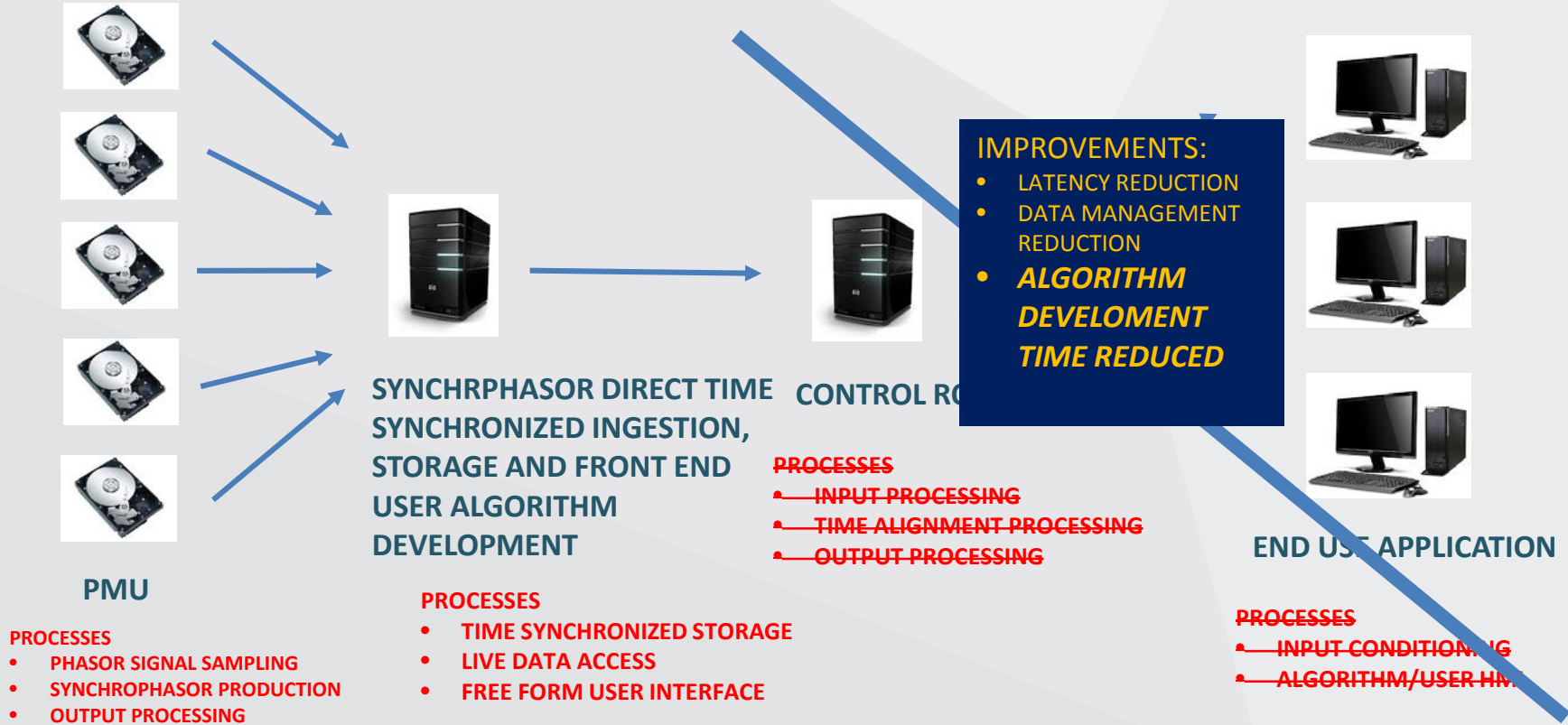
Jerry Schuman, Sean Murphy – Ping Things
Matthew Rhodes – Salt River Project

NASPI April 24, 2018

EXISTING NETWORK ARCHITECTURE



NEW NETWORK ARCHITECTURE



Phasor Data Concentrator

- Router?
- Gateway?
- Firewall?
- Database Server?

In reality a Phasor Data Concentrator is a store and forward system very much like SMTP email servers.

In Case You Were Wondering

Bytes (8 Bits)

Kilobyte (1000 Bytes)

Megabyte (1 000 000 Bytes)

Gigabyte (1 000 000 000 Bytes)

Terabyte (1 000 000 000 000 Bytes)

Petabyte (1 000 000 000 000 000 Bytes)

Exabyte (1 000 000 000 000 000 000 Bytes)

Zettabyte (1 000 000 000 000 000 000 000 Bytes)

Yottabyte (1 000 000 000 000 000 000 000 000 Bytes) Named after Yoda

Xenottabyte (1 000 000 000 000 000 000 000 000 000 Bytes)

Shilentnobyte (1 000 000 000 000 000 000 000 000 000 000 Bytes)

Domegemegrottebyte (1 000 000 000 000 000 000 000 000 000 000 000 Bytes)



What Does this Mean?

- 500 PMUs
- 40 Streams/Channels
- 30Hz



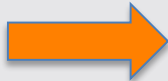
302 TB/year

or

18,934,560,000,000 points/year

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- Ignoring memory bandwidth constraints, Intel's i7-8700K (32 Gflops) Hexacore Processor would take 10 minutes to add a single number to each data point



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1. **Don't move the data, move the calculations.**
2. **We are going to need a bigger [machine(s)].**

Abstraction



Distributed

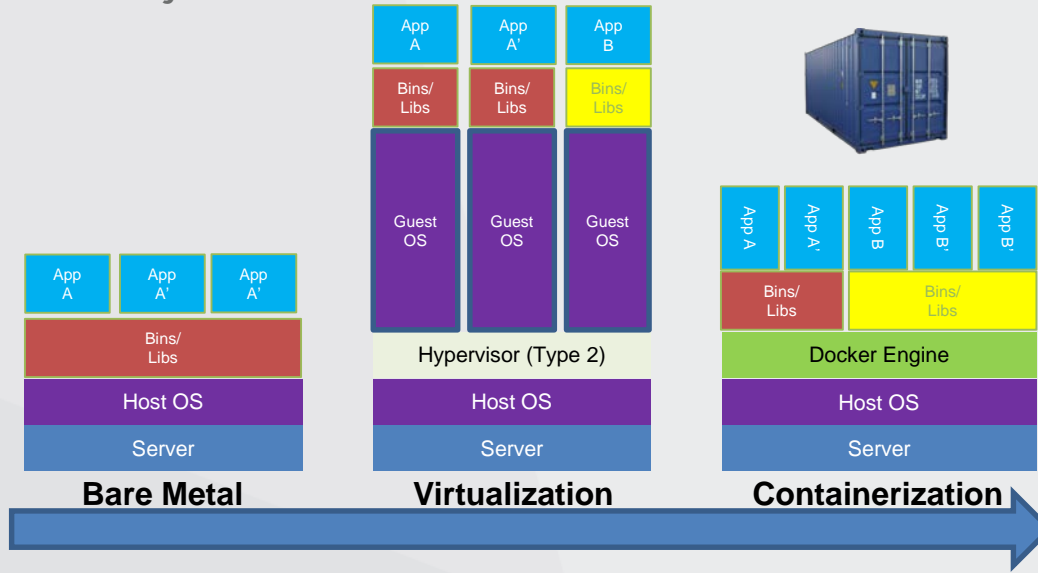
From Monoliths to Micro-services and Containers

“Because well-designed containers and container images are scoped to a single application, managing containers means managing applications rather than machines.”*

“This shift of management APIs from machine-oriented to application-oriented dramatically improves application deployment and introspection.”*

Containerization Enables:

- Polyglot services to use the right language for the job
- Enhanced resiliency and stability
- Rapid application development
- Portability across computer architectures
- Version control and component reuse
- Simplified maintenance
- Easier horizontal scalability
- Faster deployments
- **Move from machine orientation to application focus**



*Burns, B., et al, Borg, Omega, and Kubernetes: Lessons learned from three container-management systems over a decade. ACM Queue, 3/2016, V14, 1.

