

# HCI in an OT Environment



*Landon Roeder - System Supervisor*



# Definitions

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- **HCI** – **H**yper-**C**onverged **I**nfrastructure
- **OT** – **O**perations **T**echnology
- **SCADA** – **S**upervisory **C**ontrol **A**nd **D**ata **A**cquisition
- **CIP** – **C**ritical **I**nfrastructure **P**rotection
- **Nutanix** – Our choice for HCI





# Old vs New

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**OLD - 1981**

Reliable  
Resilient  
Long-lasting

No data  
Require calibration



# Old vs New

**NEW - 2018**

Multifunctional  
Self-diagnostics  
Communications  
Data

Prone to failure  
Shorter lifespan



**IF IT AIN'T  
BROKE, DON'T  
FIX IT.**

QUOTEHD.COM

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# Traditional SCADA

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- Pizza boxes
- Physical server redundancy
- Local storage redundancy (RAID)
- Known server status
- Watchdog cabling
- Physical ports
- Obvious troubleshooting

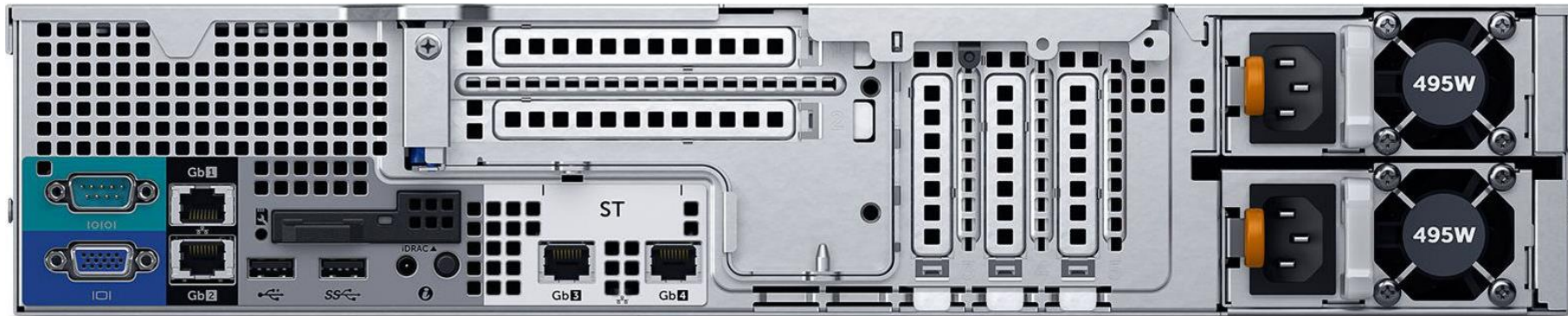




# Traditional Redundancy

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- 2 power supplies per server
- 2 NICs per server
- Spare drives in each server
- Independent serial ports
- 3 servers per application/role



# Traditional Shortcomings

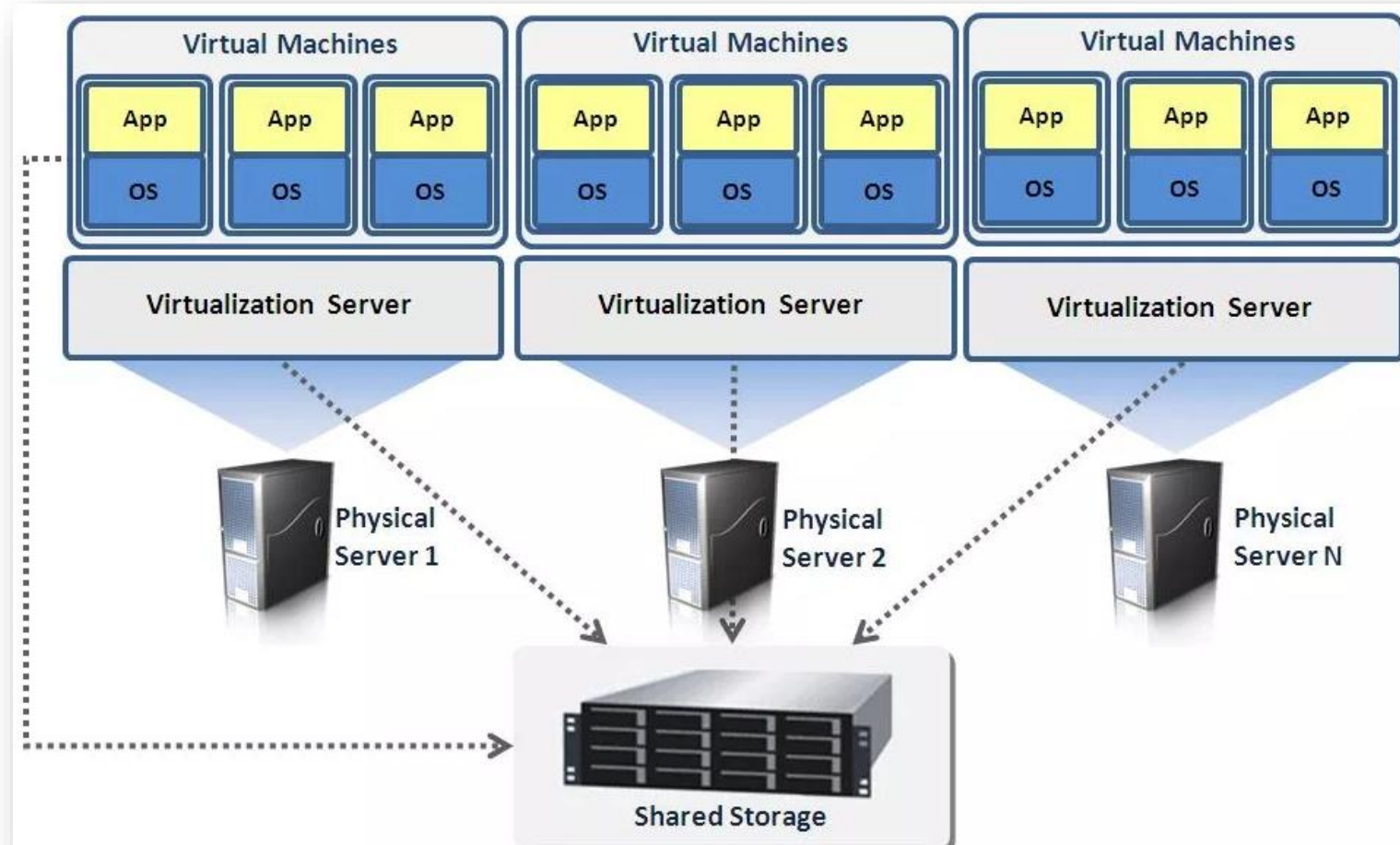
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- New hardware → new software
- Extended upgrade project timelines
- Onsite maintenance
- Slow backups
- Difficult recoveries
- Excess capacity



# Virtual Environment

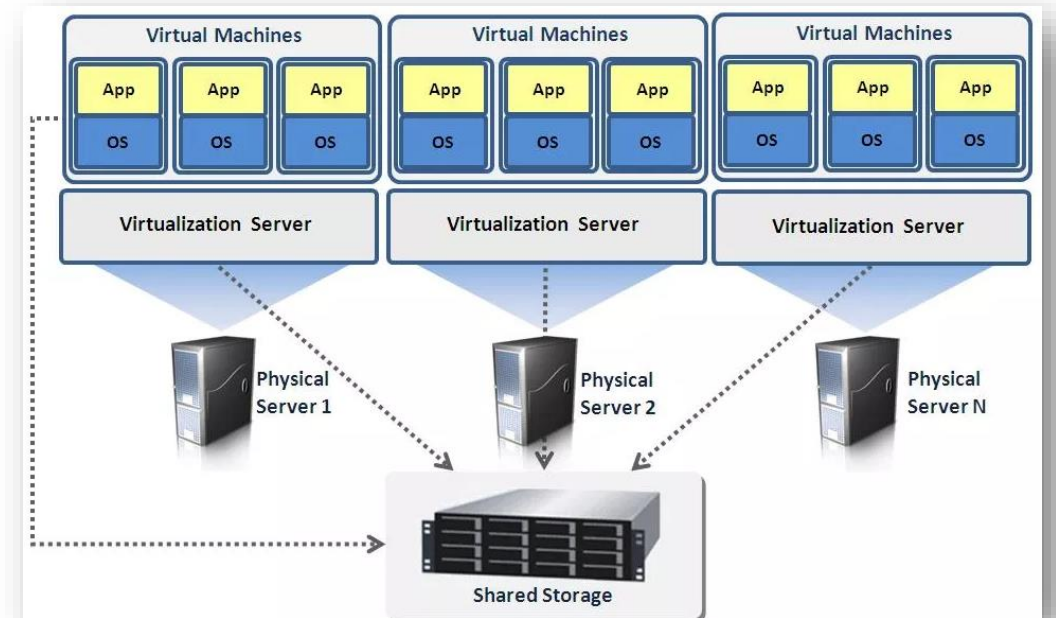
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# Virtual Environment Benefits

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- Optimized use of hardware → less hardware
- Hardware upgrade ≠ software upgrade
- Speed of backing up and restoring
- Ease of machine deployment
- Synchronous replication



# Hurdles of Traditional Virtualization

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# Compliance Truths

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- Standards are intended to improve something
- Standards must apply to big and small, old and new
- Standards must NOT endorse or promote a specific technology
- Standards are slow to change
- Standards typically lag behind technology





# NERC CIP Compliance Hurdles

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- Own or operate power equipment above 100 kV
- “Cyber Asset” = physical device
- Prescribed network architecture
  - Jump boxes
  - Protocol breaks
- Electronic Security Perimeter
  - Physical Firewalls
- Physical Security Perimeter
  - Layer 2 network extension
- BES CSI use/reuse/sanitation
- Shared Management Plane



# Other Hurdles

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- Cost
- Inefficient use of hardware
- Common chassis redundancy
- Workforce development
  - Hypervisor
  - Storage hardware
  - Compute hardware
  - Storage Area Network hardware

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# Hyper-Converged Technology

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Primary Data Center



Backup Data Center

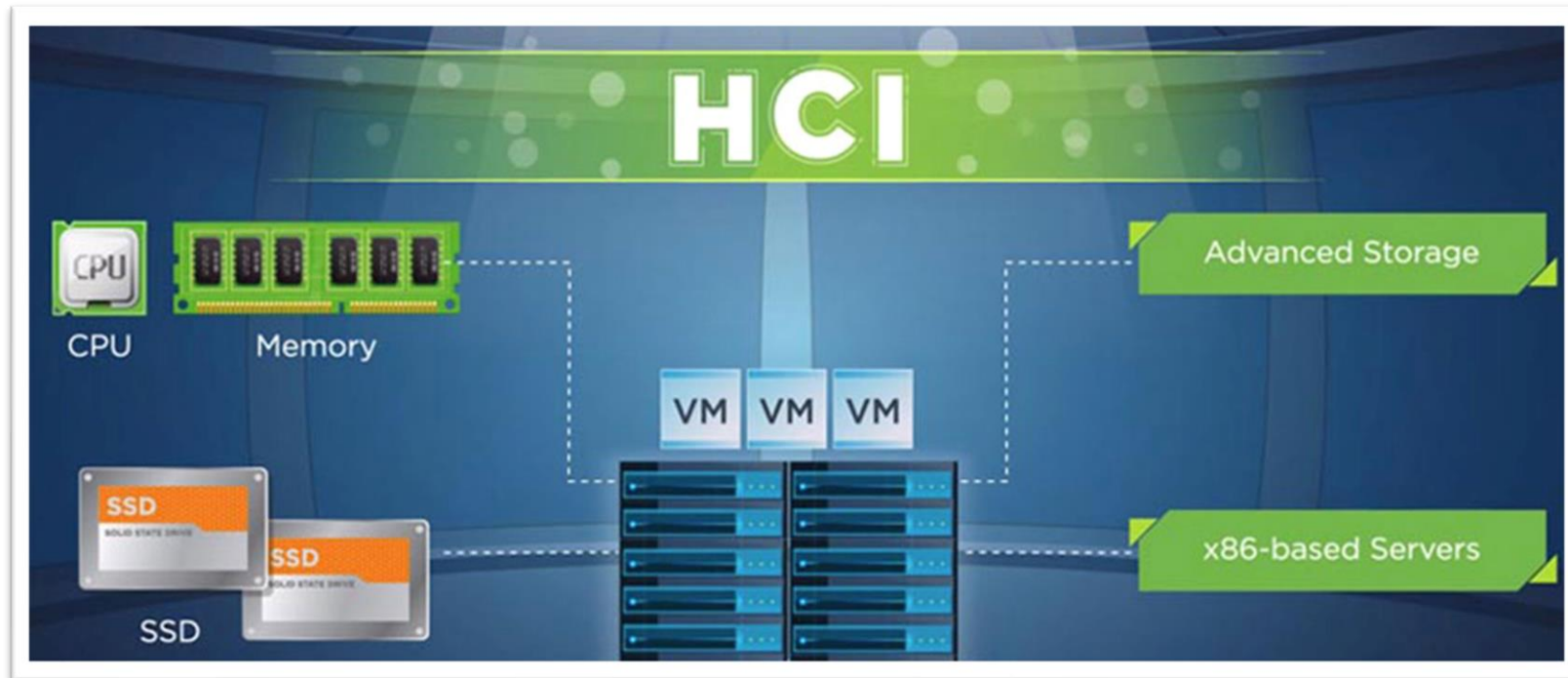


*Shown for one environment / domain.*

# Hyper-Converged Technology

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Converges compute, storage, storage networking, and virtualization



# HCI Benefits

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- Virtual Environment Benefits
  - Optimized use of hardware → less hardware maintenance
  - Ease of machine deployment
  - Speed of backing up and restoring
  - Software upgrades decouple from hardware upgrades
- Utilizes traditional server hardware
- Requires traditional networking skills
- Single system for administration\*
- Reduced number of servers

*\* Some HCI systems require the use of separate hypervisor-level interaction*





# Server Count Reduction

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## Primary Data Center

Frontend A

EMS A

Comm A

Historian A

Frontend B

EMS B

Comm B

Historian B



## Backup Data Center

Frontend D

EMS D

Comm D

Historian D

# Server Count Reduction

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## Primary Data Center

Frontend A

EMS A

Comm A

Historian A

Frontend B'

EMS B'

Comm B'

Historian B'



## Backup Data Center

Frontend A'

EMS A'

Comm A'

Historian A'

Frontend B

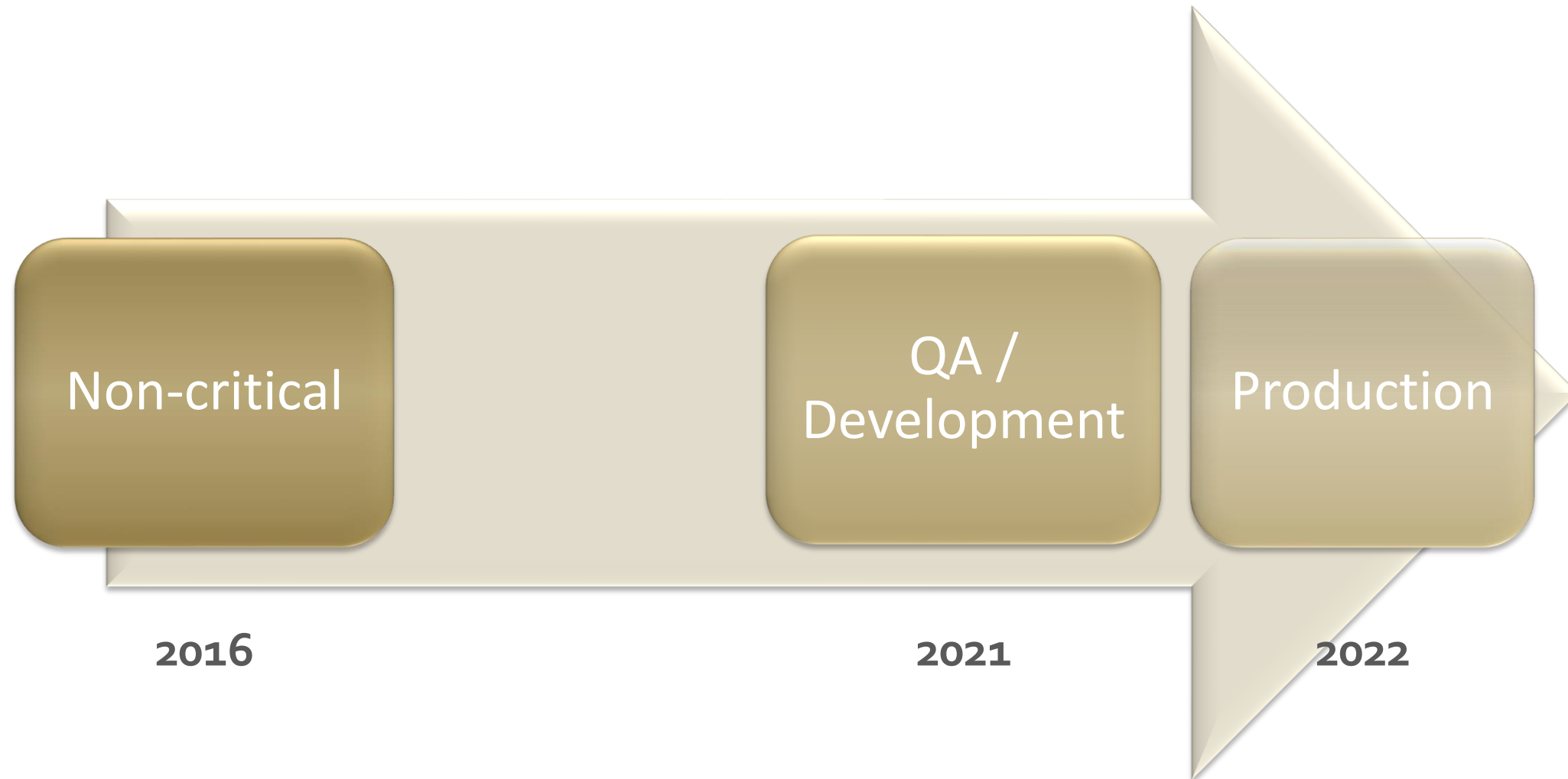
EMS B

Comm B

Historian B

# Deployment Process

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# Lessons Learned

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- An NTP clock is *very* important for synchronous replication.
- Engineers need to be convinced that VMs will ease their pain.
- Snapshots will break things.
- Build it, and more will come.
- Human relationships are still important.
- Some hypervisors are not supported for some virtual appliances.

