PI System Tuning and Optimization

Presented By

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Agenda

- Types of PI Systems
  - Hardware, Virtualization, and Critical Resources
- PI Archive Performance
  - Exception & Compression: Myths and Mistakes
  - Archive Sizing and Reprocessing
  - Demo
- Performance Monitoring Tips
- Real World Scenarios
- Optimization Techniques
  - General, Interfaces, Servers, Data Access, Clients

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System Size… "YMMV"

- Point and Asset Count (S, M, L, XL, XXL)
  - 10K, 50K, 250K, 7
- Data Rates
  - Common R:W ratio
  - Heavy read worklo rt
  - Write-only systems AMS/Phasors
- Concurrent Users
  - Ranging from 1 to
  - Dashboards/report lytics/BI
- Server Applications
  - Batch, Performance Equations, Totalizer/Alarm
  - ACE, Notifications, MCN Health/IT Monitor
  - PI-to-PI Replication

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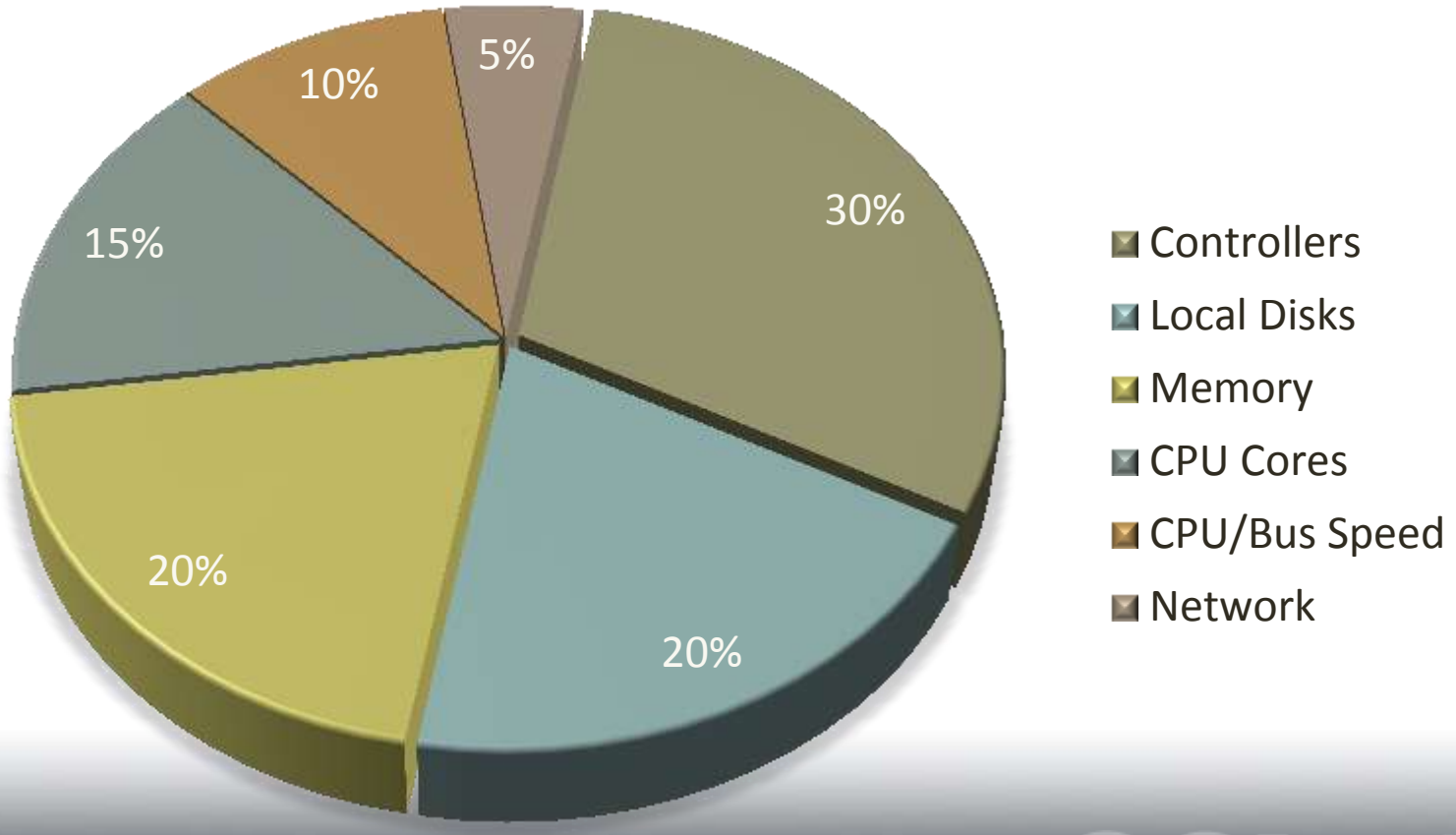
PI Server Hardware Allocation



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Hardware Recommendations

- 64-bit platform, Windows 2008 R2 recommended
- Memory: 2GB minimum, up to 8KB per point
- CPU: as many cores as possible, based on client load
- Network: dedicated NIC(s), latency is most important
- Disk Controllers/Interface: key factors are I/O capacity and latency over bandwidth
- Storage: could be multi-tier, est. 5-20 bytes per event
- HA: PI Collectives mix up well with virtualization*

(*) assuming different hardware hosts per collective member

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PI Server Virtualization

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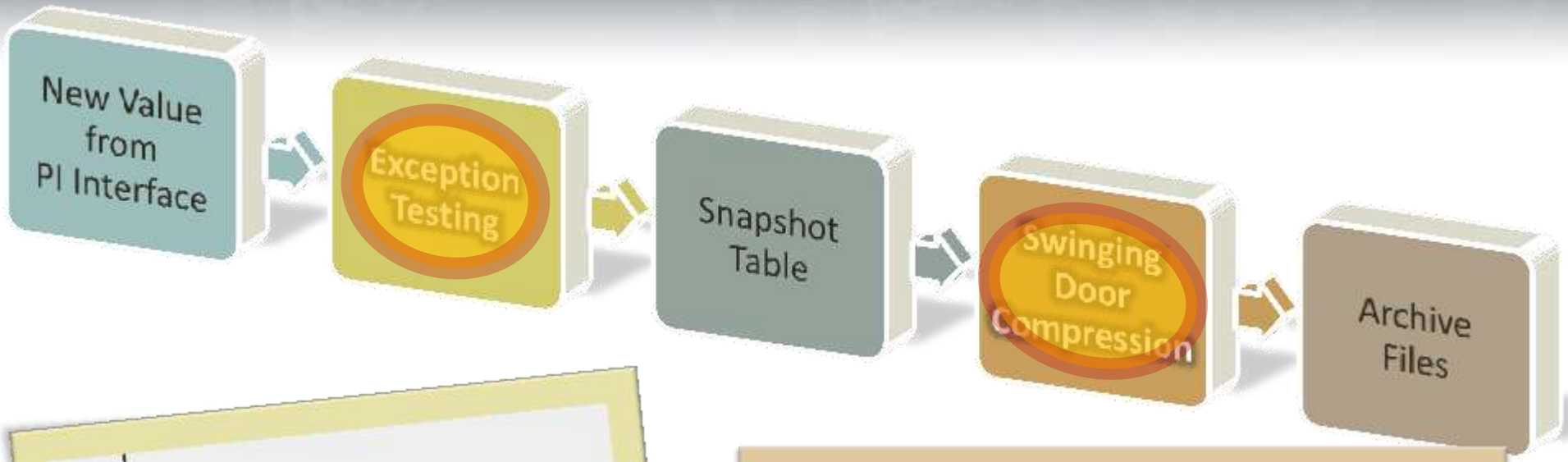
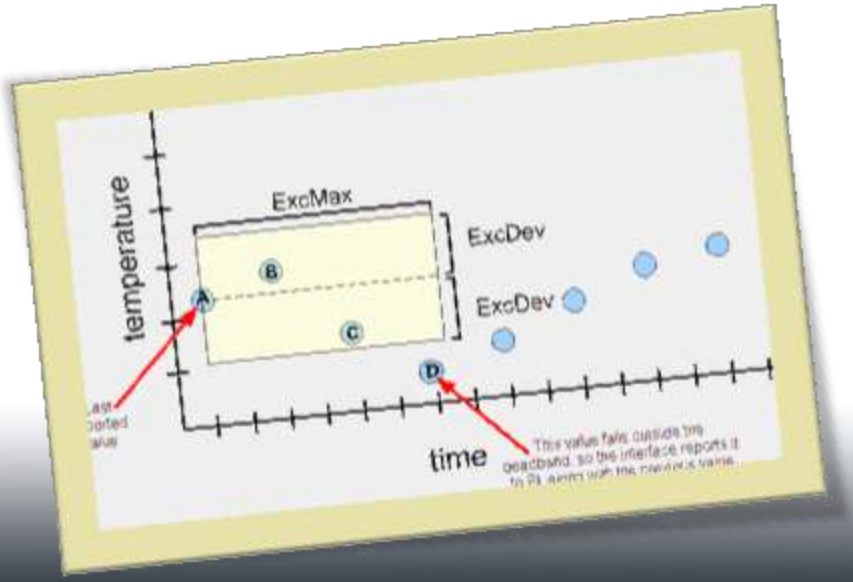
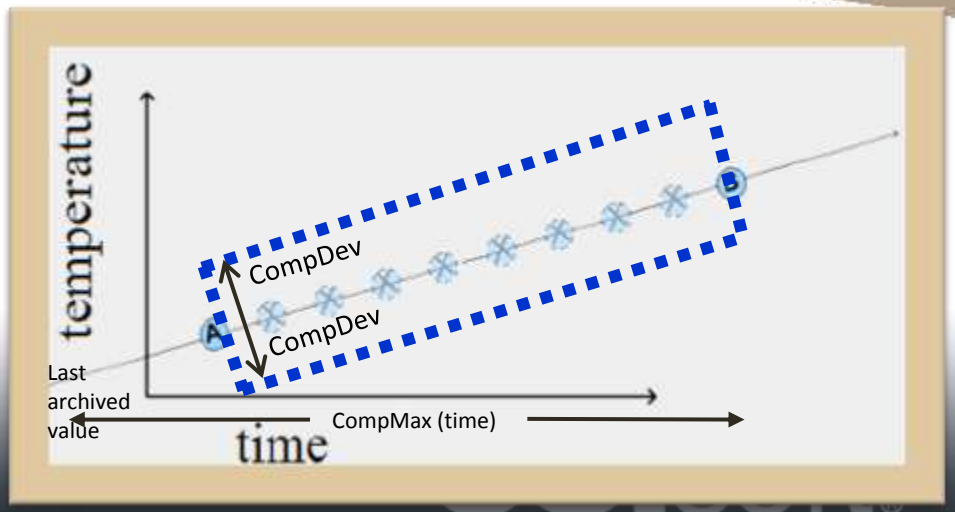
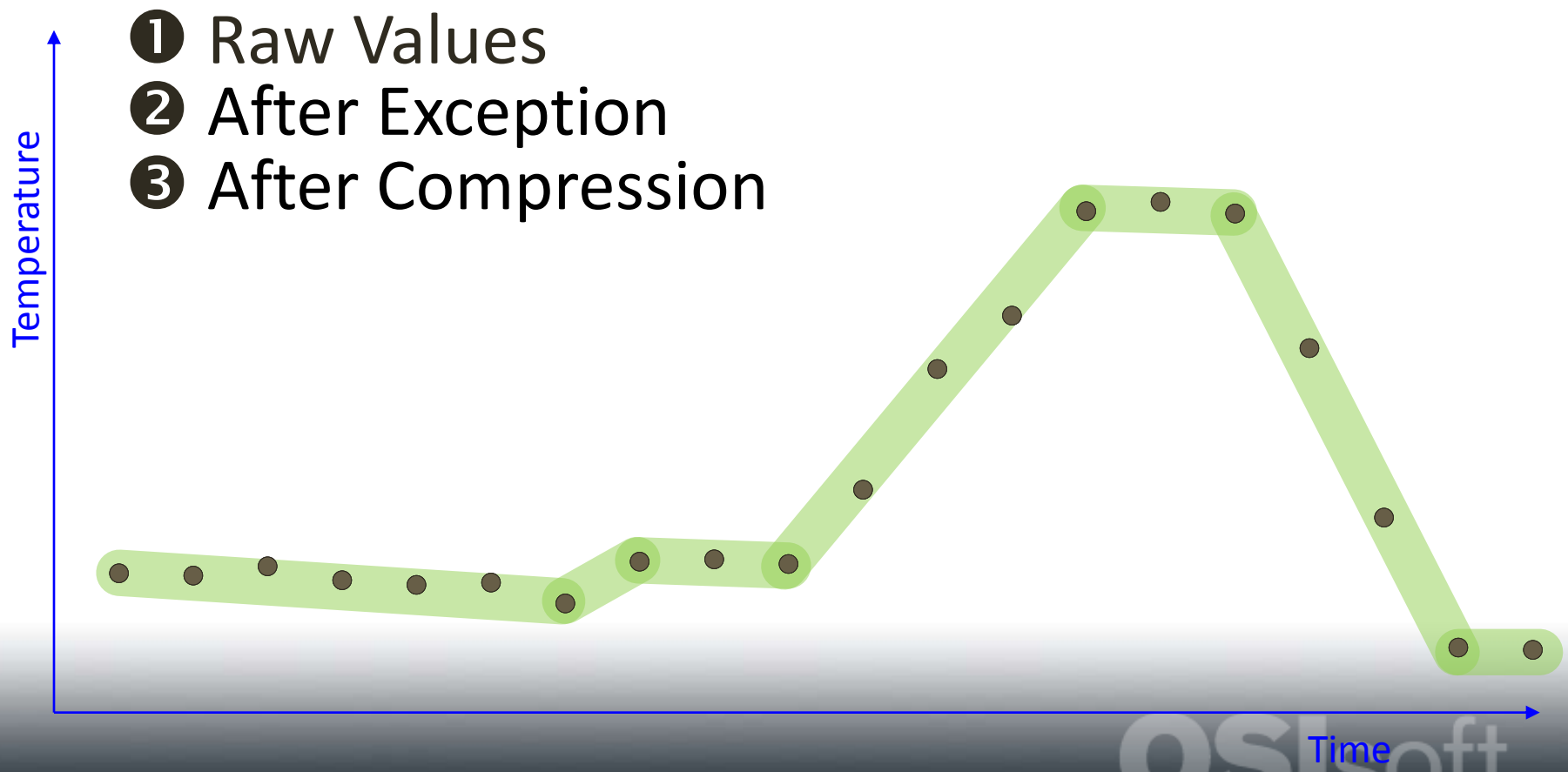
PI Archive Performance Tuning







Efficient Signal Processing



Exception & Compression

- Exception Processing (PI Interfaces)
  1. Eliminates Instrument Noise
  2. Conserves Network Bandwidth
  3. Conserves Server Resources
- Real-time Compression (Buffer/Snapshot Subsystems)
  1. Eliminates Process Noise
  2. Conserves Disk & I/O Resources
  3. Increases Overall System Performance

- High Fidelity & Efficiency
  - ☑ No Signal Averaging or Approximation
  - ☑ Preservation of all Minima/Maxima
  - ☑ No Additional Signal Latency

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Demo

- Benefits of Exception/ Compression Tuning

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Basic PI Server Tuning

- **Security – Auditing**
  - Authentication Protocols — Server_AuthenticationPolicy
  - Administrative PI Trusts — AutoTrustConfig (recommended: 0)
  - Audit Trail — EnableAudit
- **Archive/Queue Management**
  - Auto Archive Creation — Archive_AutoArchiveFileRoot
  - Event Queue Settings — Snapshot_EventQueuePath
Snapshot_EventQueueSize (MB)
- **Network Connections**
  - Stale Connection — MaxConnIdleTime (seconds)
- **Updates**
  - Don't Change These — MaxUpdateQueue
TotalUpdateQueue

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Archive File Sizing

- Fixed Size or Dynamic?
  - Fixed size, with “auto-dynamic” growth
    (Note: Fixed size required for automatic archive creation.)
  - Keep dynamic archives for backfilling jobs only
  - See KB Article # 2998OSI8

- Sizing Rule of Thumb
  - Size in MB ≥ 4,000 x (Point Count)
  - For instance: 50,000 points ⇨ 200MB
- Optimal Sizing
  - No points with more than ~10 index records

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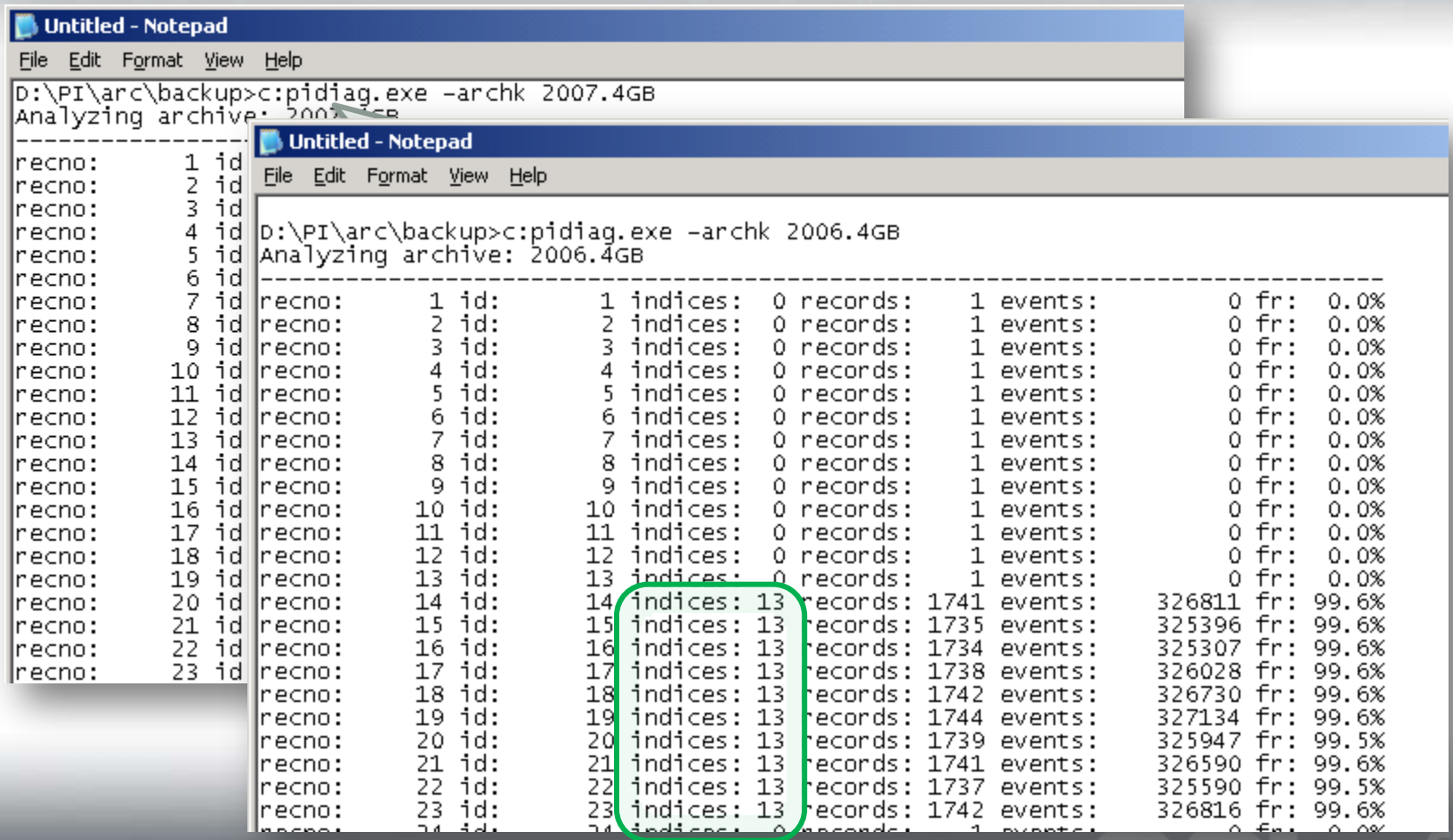
Archive Storage Map



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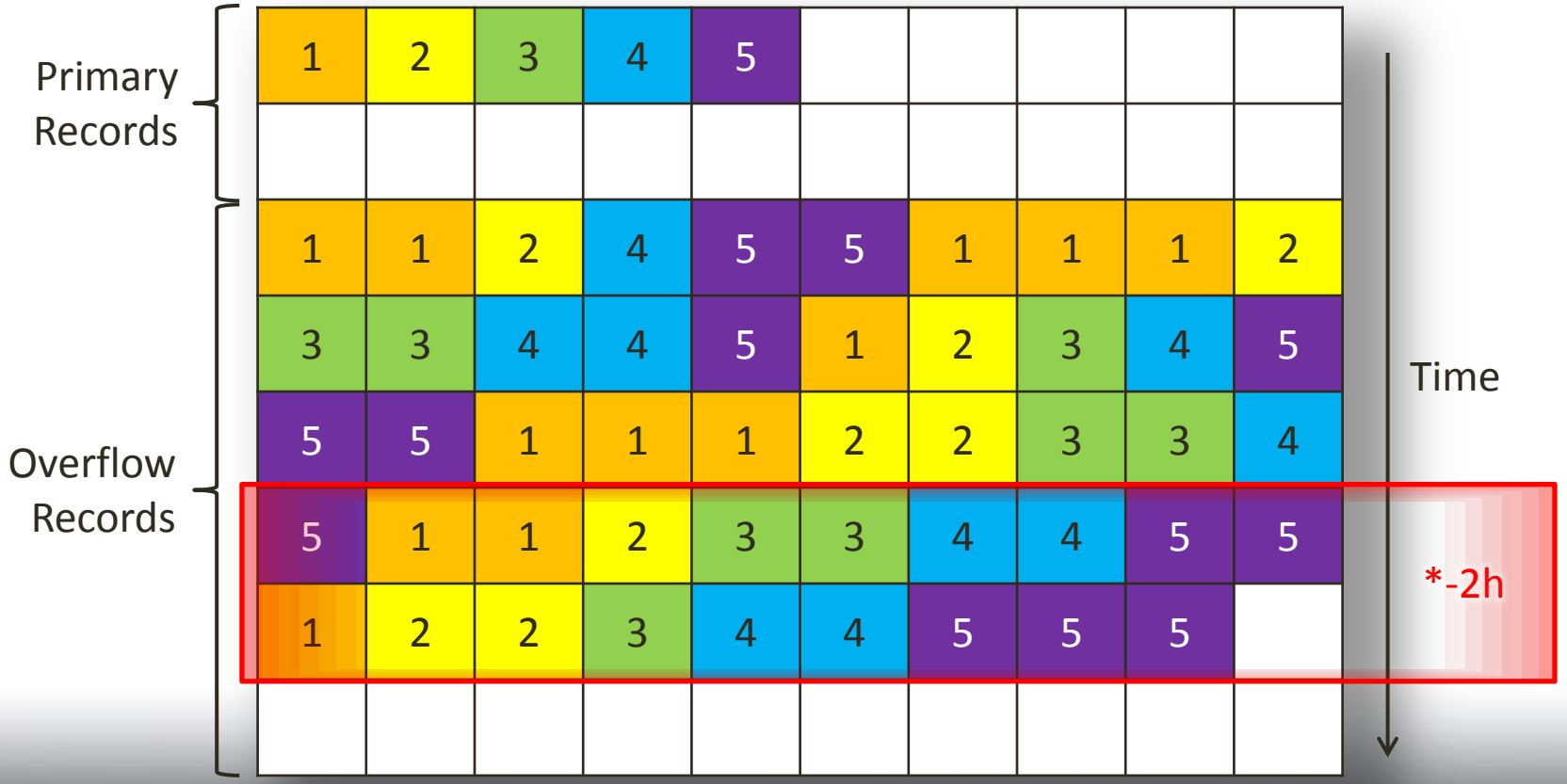
Archive File Contents



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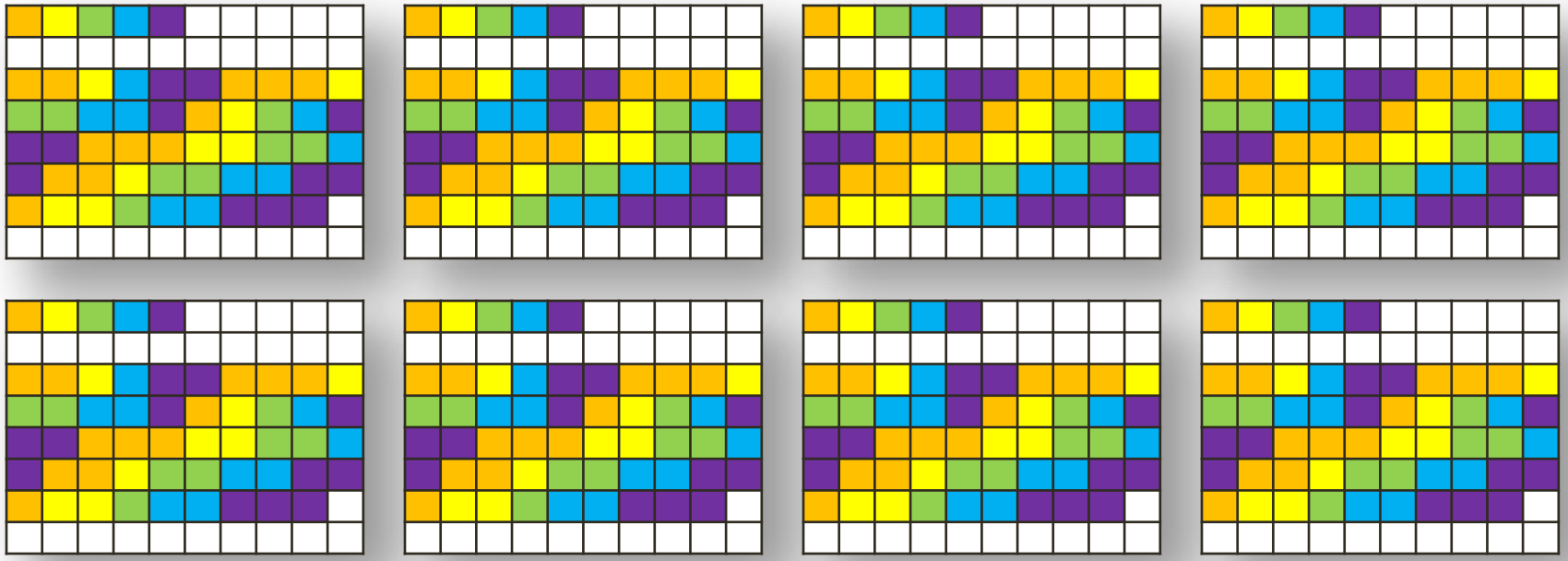
File System Cache Efficiency?



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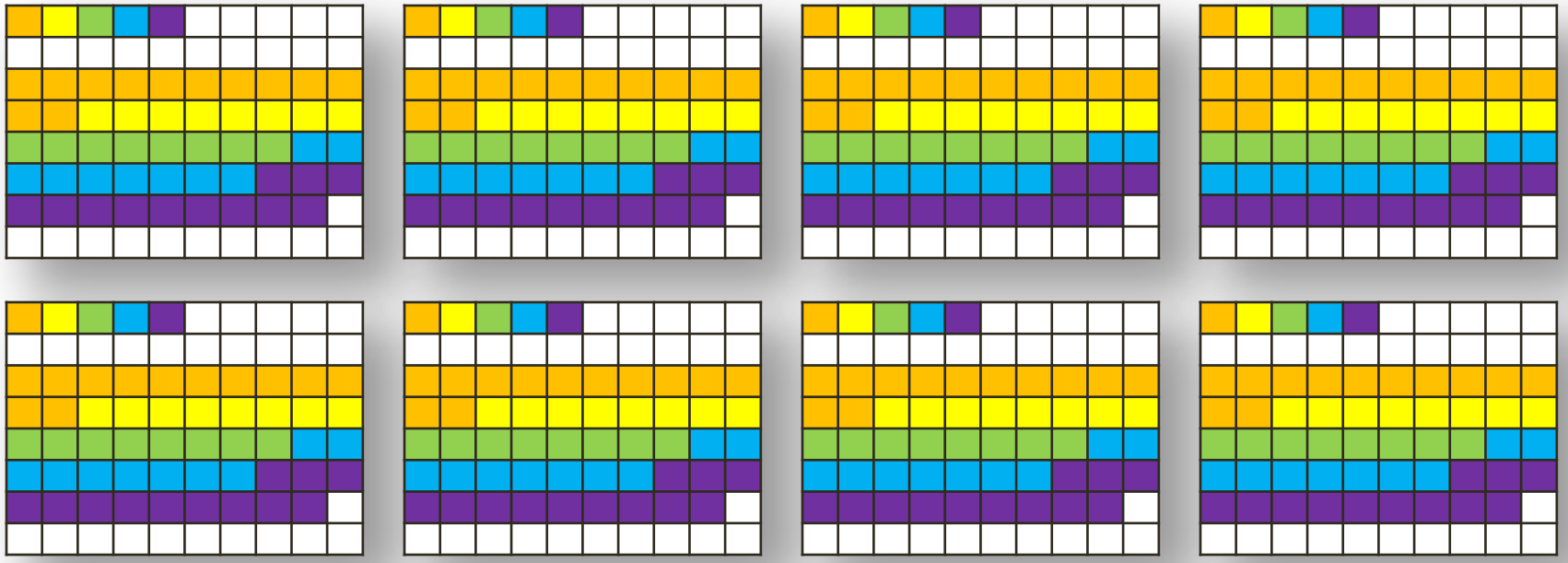
After Archive Reprocessing



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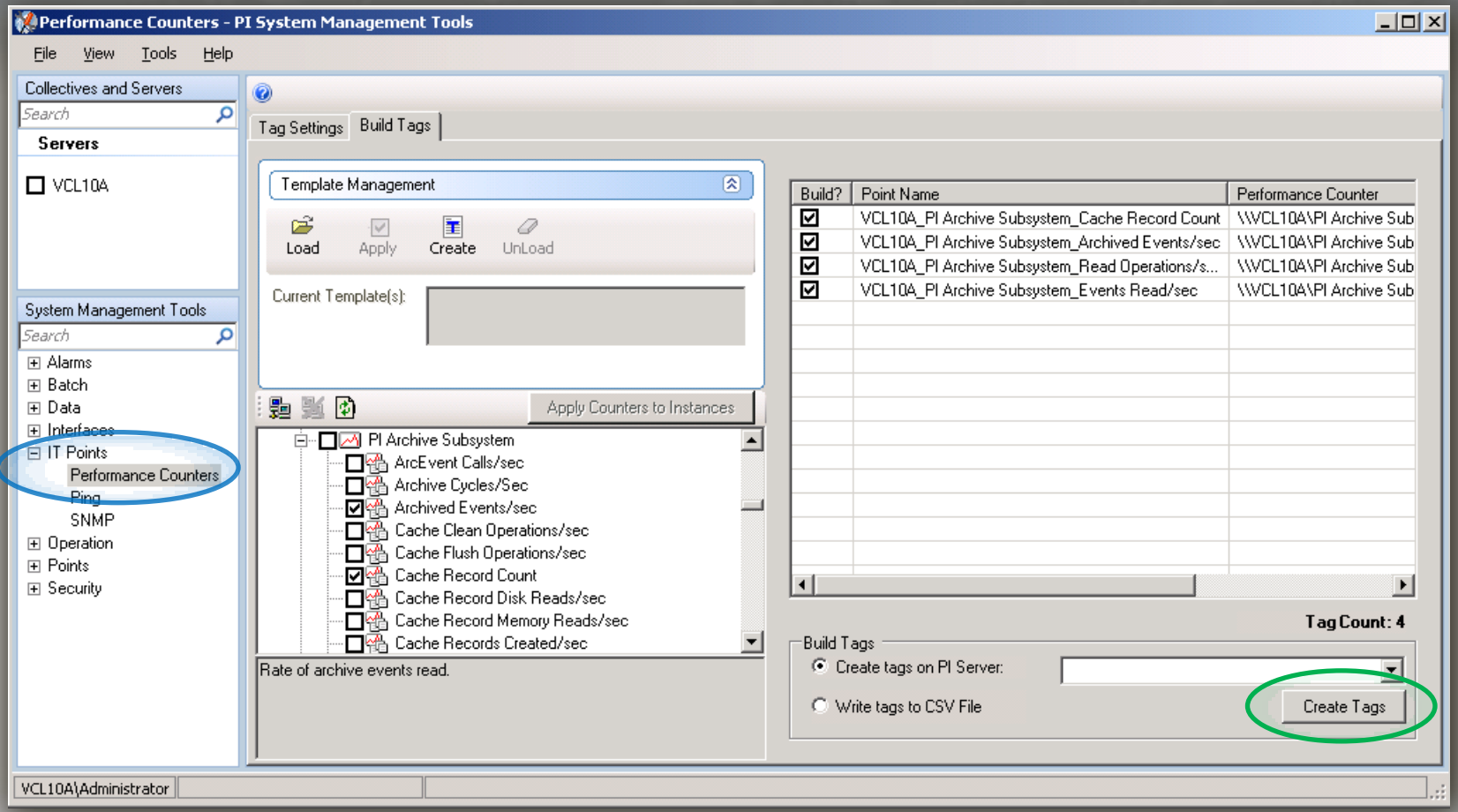
PI Server "KPIs"



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K²PIs

Windows Counters

- **Core Process Health**
  - Process(...)\Creating Process ID
  - Process(...)\%Processor Time
  - Process(...)\Private Bytes
  - Process(...)\Working Set
  - Process(...)\Page Faults/sec
  - Thread(...)\ID Process
  - Thread(...)\Context Switches/sec
- **Overall CPU**
  - Processor\% Processor Time
- **Overall Memory**
  - Memory\Pages/sec
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- **Overall Disk**
  - PhysicalDisk(...)\Avg. Disk Queue Length
  - PhysicalDisk(...)\Disk Transfers/sec
- **Overall Network**
  - Network Interface(…)\Bytes Total/sec
  - Network Interface(…)\Packets Received Errors

PI Server Counters

- **General Health**
  - PI Server Statistics(…)\Is Available
  - PI Server Statistics(…)\Is In Sync
  - PI Network Manager(_Total)\Connections
  - PI Network Manager(…)\Bytes Received/sec
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  - PI Snapshot Subsystem\OutOfOrderSnapshots/sec
  - PI Snapshot Subsystem\Queued Events/sec
  - PI Snapshot Subsystem\Events in Overflow Queues
  - PI Archive Subsystem\Archived Events/sec
  - PI Archive Subsystem\Total Unflushed Events
  - PI Archive Subsystem\Cache Flush Operations/sec
  - PI Archive Subsystem\Events Read/sec
  - PI Archive Subsystem\Current Cache Record Pool

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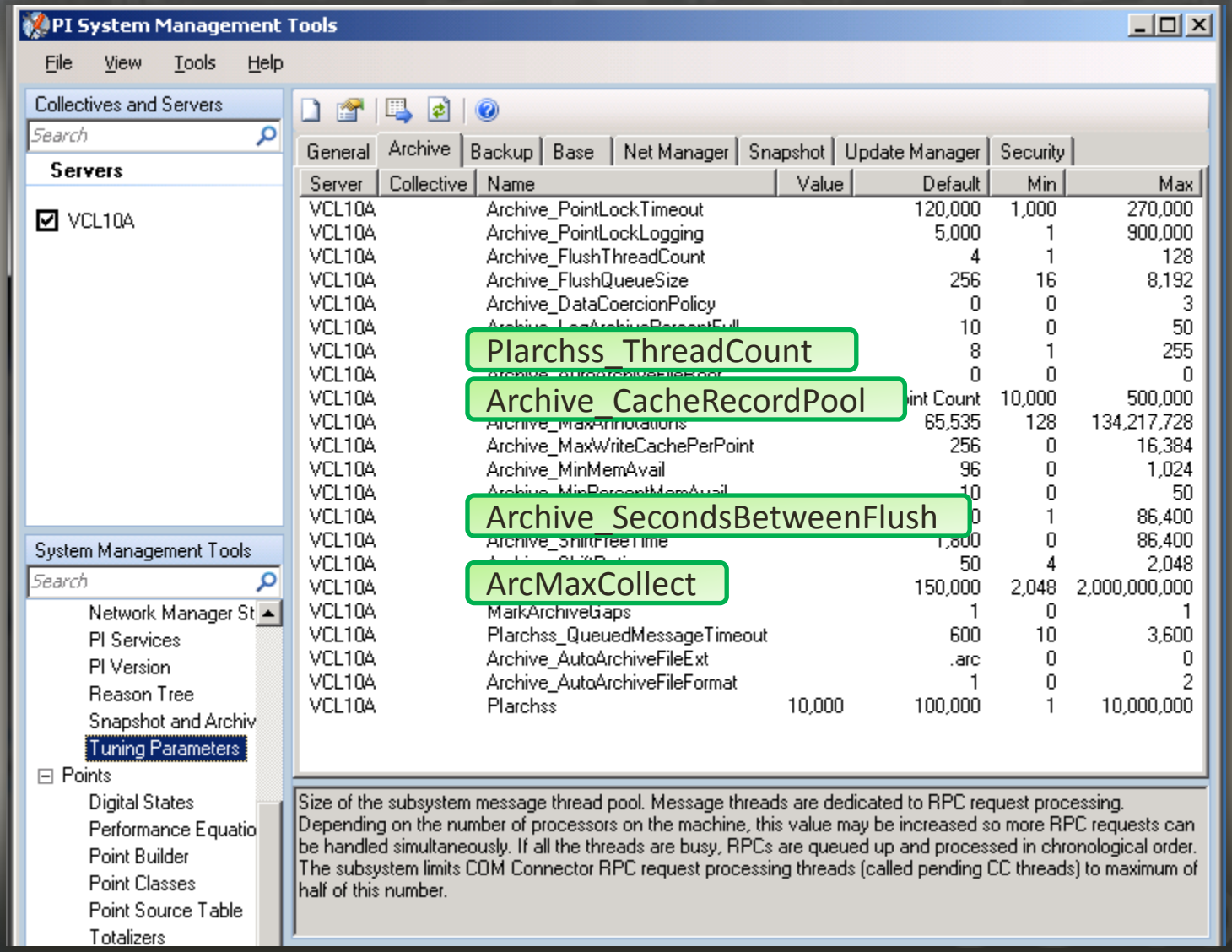
PI Archive Tuning



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PIarchss_ThreadCount

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Archive_CacheRecordPool

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Archive_SecondsBetweenFlush

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ArcMaxCollect

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Satellite or WAN Connection

Add HA Best Web Parts
Or Smaller PI Servers
(updates, caching,
connection pooling)

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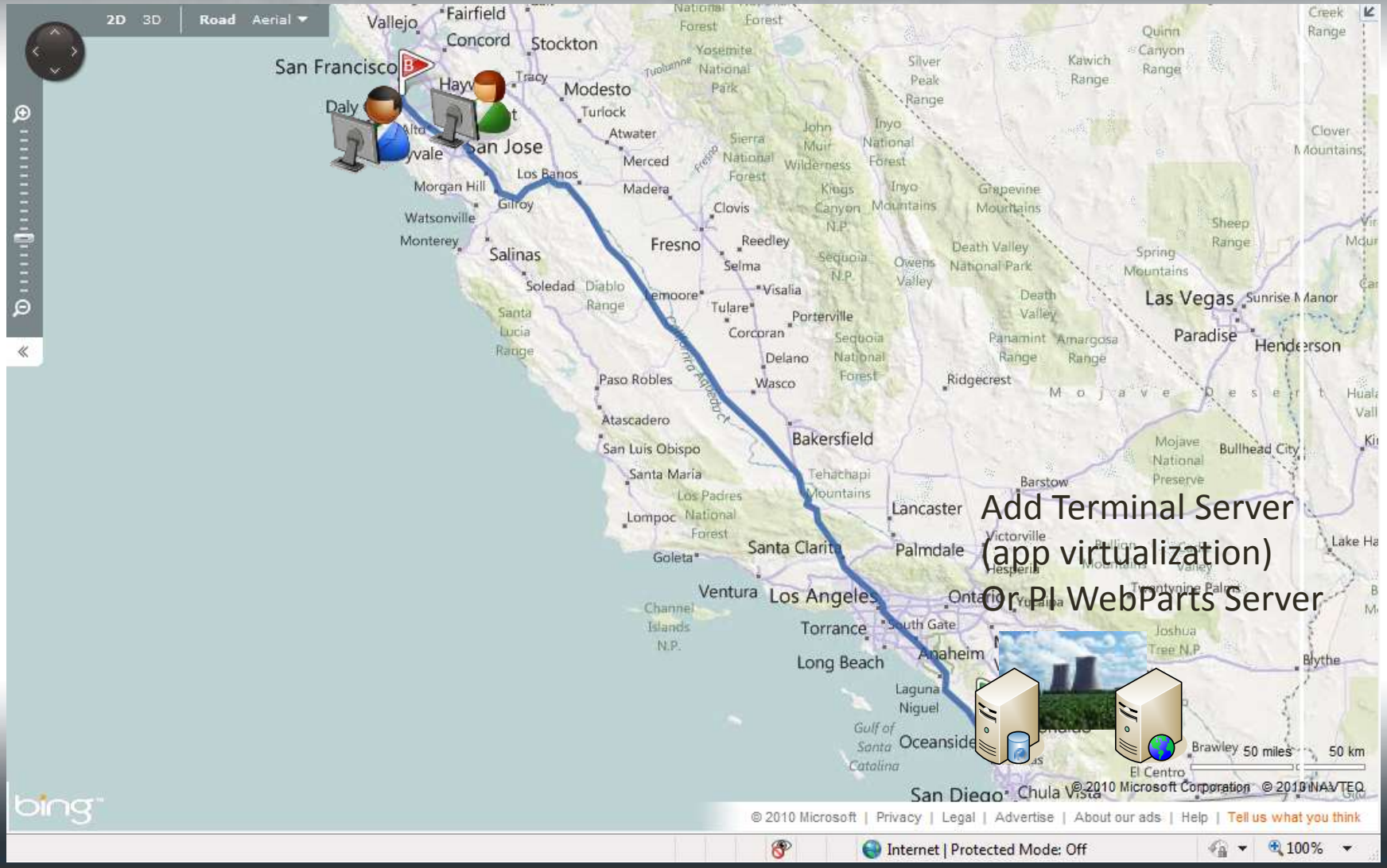
Geographical Distribution



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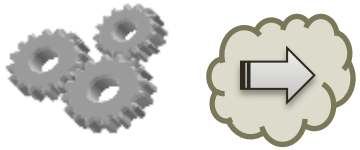
Collect Large Volumes of Data

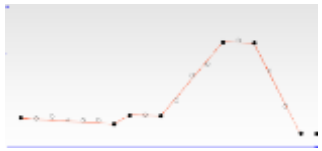
PI Interface

Poll interval
Or Advise (OPC)

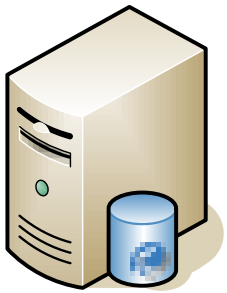
Buffering
(choose
pibufss)

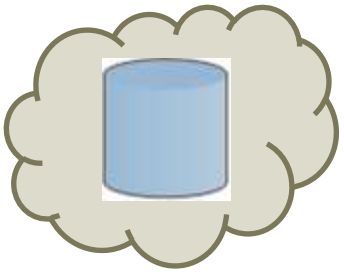
PI for StreamInsight
(edge processing)





Exception and
compression





Use high speed drives
(e.g. SAN, SSD)

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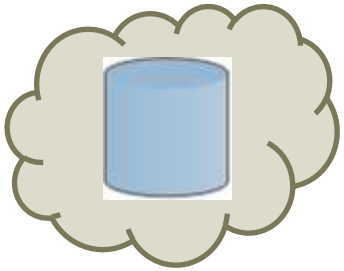
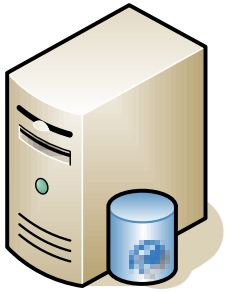
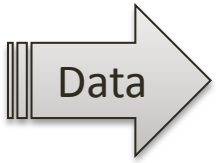
Access Large Volumes of Data



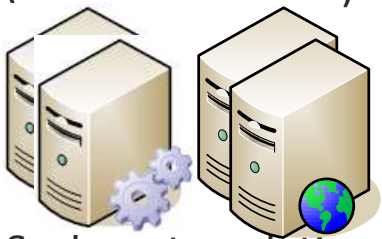
High speed drives
(e.g. SAN, SSD)



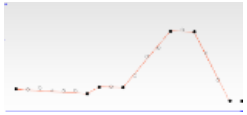
PE, Totalizer tags
(data aggreg.)



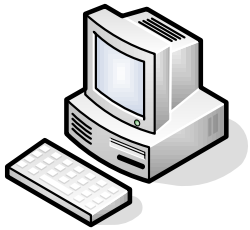
HA PI Secondary
(load distribution)

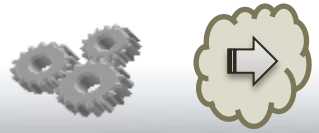


Scale out analytics
and data access



PI SDK techniques
(e.g. PlotValues)





PI for StreamInsight
(edge processing)

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Optimization Techniques: General

- Ensure system/virtual machine is sized appropriately
  - "Hardware and System Sizing Recommendations" spreadsheet on Tech Support site
- Disable unused services, e.g. IIS, Indexing, etc. or use Windows Server Core
- Clamp or prevent expensive queries
- Provide sufficient network bandwidth
- Choose an optimal deployment configuration
- Upgrade to latest releases of PI and Microsoft products
- Leverage High Availability (PI/AF/Notif, Interface failover, SharePoint server farms, etc.) to achieve higher uptime
- Tools to identify performance bottlenecks: MCN Health Monitor, PI/SDK Message Log, Visual Studio Profiler

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Optimization Techniques: Interfaces

- KB #00266 – “When using the PI to PI interface, is it better to push or pull the data?”
- Scale out (multiple instances) to handle more/faster data
- Use Buffering to minimize data loss
- Configure disconnected startup
- Choose appropriate scan times
- Separate instances for different scan times, output points
- Check for Stale or Bad points
- KB #00260 – “How does the number of Advise tags per group in OPC interface affect throughput?”

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Optimization Techniques: Servers

- "PI Server Performance Monitoring" White Paper on TS site
- KB #00159 – "What is the Offline Archive Utility (piarchss) and how do you use it to reprocess archives?"
- Apply multiple conditions to each notification (not 1:1)
- Increase periodic time rule (ACE, PI Notifications), or try natural scheduling (uses snapshot caching)
- Minimize number of COM Connector tags
- Aggregate data (using PE or Totalizer tags)
- Scale out (PI, AF, PE, ACE, Notifications) to handle more users/queries with High Availability functionality
- Separate heavy and casual users with HA functionality

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Optimization Techniques: Data Access

- "SQL Optimization" White Paper on TS site
- Use PI OLEDB and PI OLEDB Enterprise as in-process
- Break queries into smaller chunks (e.g. fewer tags/assets, shorter time ranges)
- Builder's Café Webinar on "Optimizing your PI SDK apps"
- Use bulk queries (e.g. PI SDK ListData functions, AF SDK elements), PlotValues, asynchronous calls, multithreading
- Choose appropriate binding for PI Web Services
- Leverage PI Data Access products that implement (and abstract) advanced techniques such as connection pooling, caching, and event pipes (e.g. PI Web Services)

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Optimization Techniques: Clients

- Move PI Calc/ODBC datasets to server (PE, AF, ACE)
- Minimize data loaded/displayed on startup – use drill down for more details
- Split large amount of data across multiple displays/pages
- Try HTTP Compression with PI WebParts
- Use SharePoint server farms, load balancing with WP
- Increase update interval (PB, DL, WP)
- Run PI Clients as close to data sources as possible – leverage application virtualization

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Thank You!

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