1516
Best Practices for Consolidating SQL Server 2000 with Windows

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Goals for the Presentation

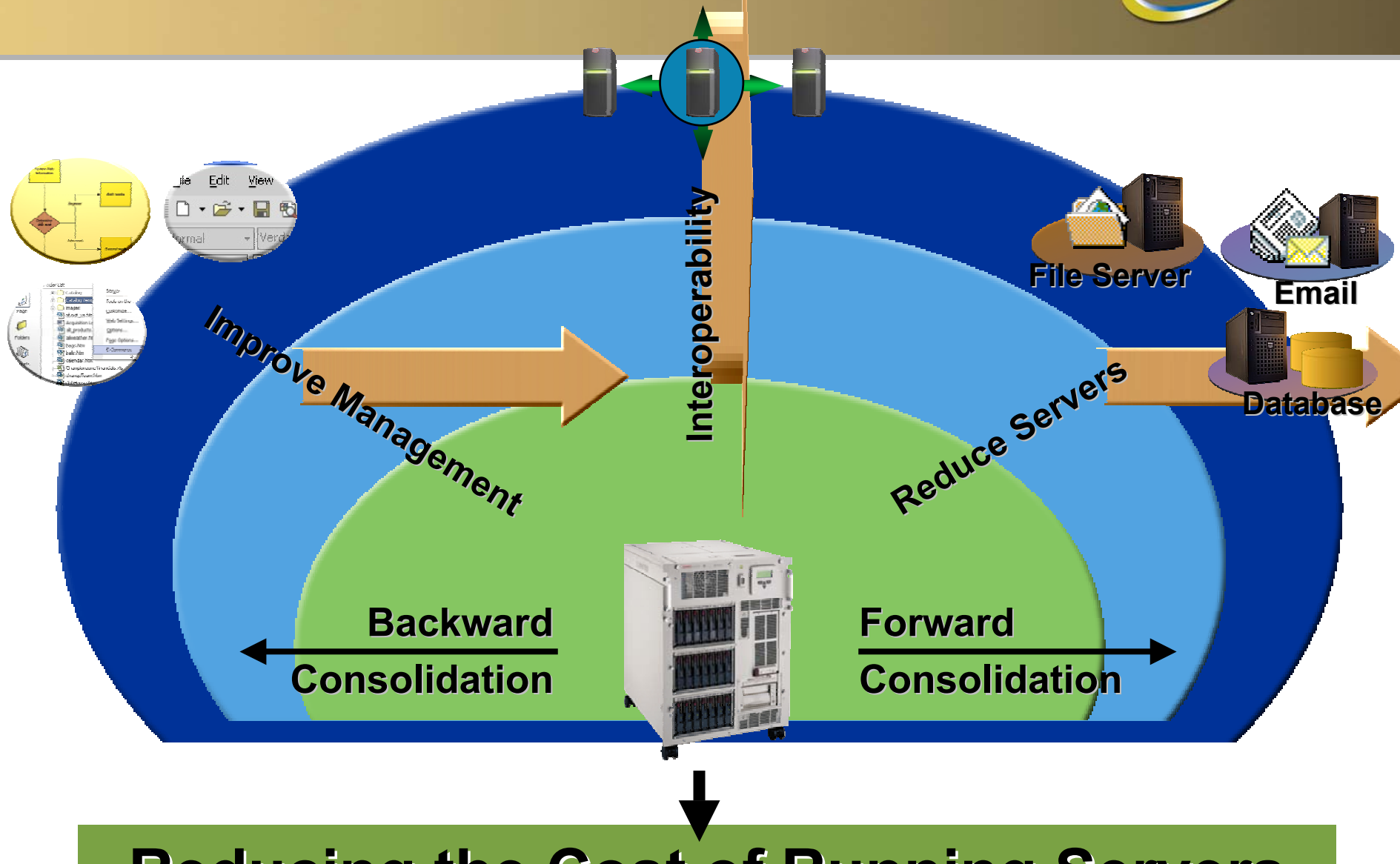
- Share both deep and broad technical information
- Share practical experience gained working with customers in USA, UK, and other countries
- Not all slides / content will be discussed
  - More material than can be covered
  - Mostly key messages will be discussed 
  - Skipped (or skimmed) content for off-line review
- Non-goal: Provide a prescriptive (one size fits all) solution
  - Each installation will be different requiring planning, customization, and testing

Topics Covered

- Consolidation: A Business Perspective
- High Level Planning and Considerations
- Technical Planning, Design & Implementation
- Technical Considerations, Issues and Potential Solutions
- Summary
- Appendix

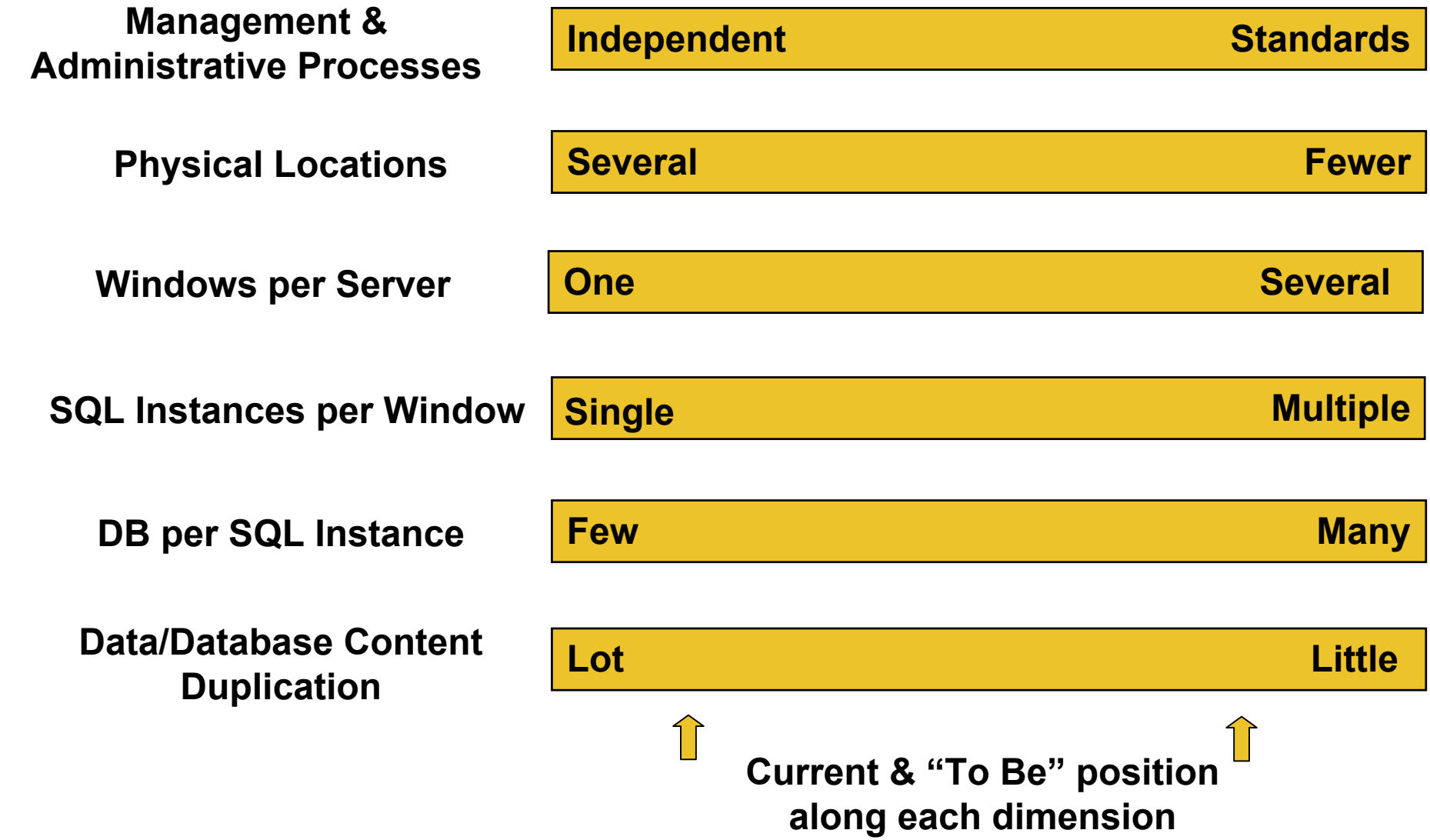
Consolidation: A Business Perspective

Server Consolidation Strategy



Reducing the Cost of Running Servers

Consolidation Dimensions



Potential Consolidation Benefits

- Reduced costs
  - Standardization
  - Better utilization of computing resources
  - Space, electricity, cooling
  - People costs – skill level? ⇐
  - License costs
  - Offsite storage – fewer tapes
  - Security costs – physical protection
- Better control of IT Processes
  - Consistent operations, backup/recovery, administration, security, help desk, service management, disaster recovery procedures
  - More flexibility with higher end servers
- Better Decision making / Shared Information
- Improved Business Integration

Business Value – Case Studies

- Case Studies
  - JetBlue http://www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=13932
  - Mike's Hard Lemonade http://www.microsoft.com/windows2000/datacenter/evaluation/casestudies/mag.asp
  - Minneapolis – City of Lakes http://www.microsoft.com/windows2000/advancedserver/evaluation/casestudies/cityofminn.asp

- Customers: Insurance, Finance, Manufacturing
  - Reduce number of Servers (cost)
  - Platform for future application deployment: containment
  - Proxy for standardization
  - Mandate for / from CIO - facilitated user involvement

High Level Planning and Considerations

Key Consolidation Considerations 1

- Strategy
  - Why: end goal(s)?
  - Need Consolidation Guiding Principles
  - Metric, Base Line: How well achieved?
- People
  - Potential change in the ownership (DBA Custodianship) of data
    - However, technically Database Ownership (DBO) can be retained
  - Ongoing support and change management
    - Likely System Administration role change
  - End Users impact and training
    - Consolidation may not be as transparent as desired
- Process
  - Administrative, Operational, Performance Monitoring/Tuning, Backup/Restore, Capacity Planning
  - Charge Back – may become a consideration
  - Tools: Internally developed and external

Key Consolidation Considerations 2

- Technology (covered later)
  - CPU process, memory management, I/O subsystem
  - Consolidation – Name Conflicts – Objects, Logins
  - Server wide configuration setting conflicts
  - Different Sort/collation sequence
  - Maintenance – Service Packs, SLA impact
  - SQL Mail, Extended Stored Procedures, Maintenance Tasks, Linked Servers
  - Security, Firewall port
  - Client access impact – remote versus local
  - And many more

People, Process, Technology Impact
Management focus is critical

SQL Server Instances Per Window Instance

- **Single Instance**
  - Less administrative work
  - Avoidance of fixed overhead of multiple instance
    - Fixed server memory structures
    - DLLs, .EXEs, etc.
  - Automatic server settings will work better in a single server
    - For instance, grab all available memory
    - Ease in using AWE
  - Offers more than before
    - Example: Column level collations
  - Some components are always shared anyway
    - MDAC, DTC, Microsoft Search

- **Multiple Instances**
  - Flexibility to separate databases/applications based on different Service Level Agreements (SLA) requirements
    - performance
    - backup / recovery
    - security
    - change control
    - Operational
    - upgrade
    - maintenance
  - More cache for procedures
  - Multiple development environments on single server

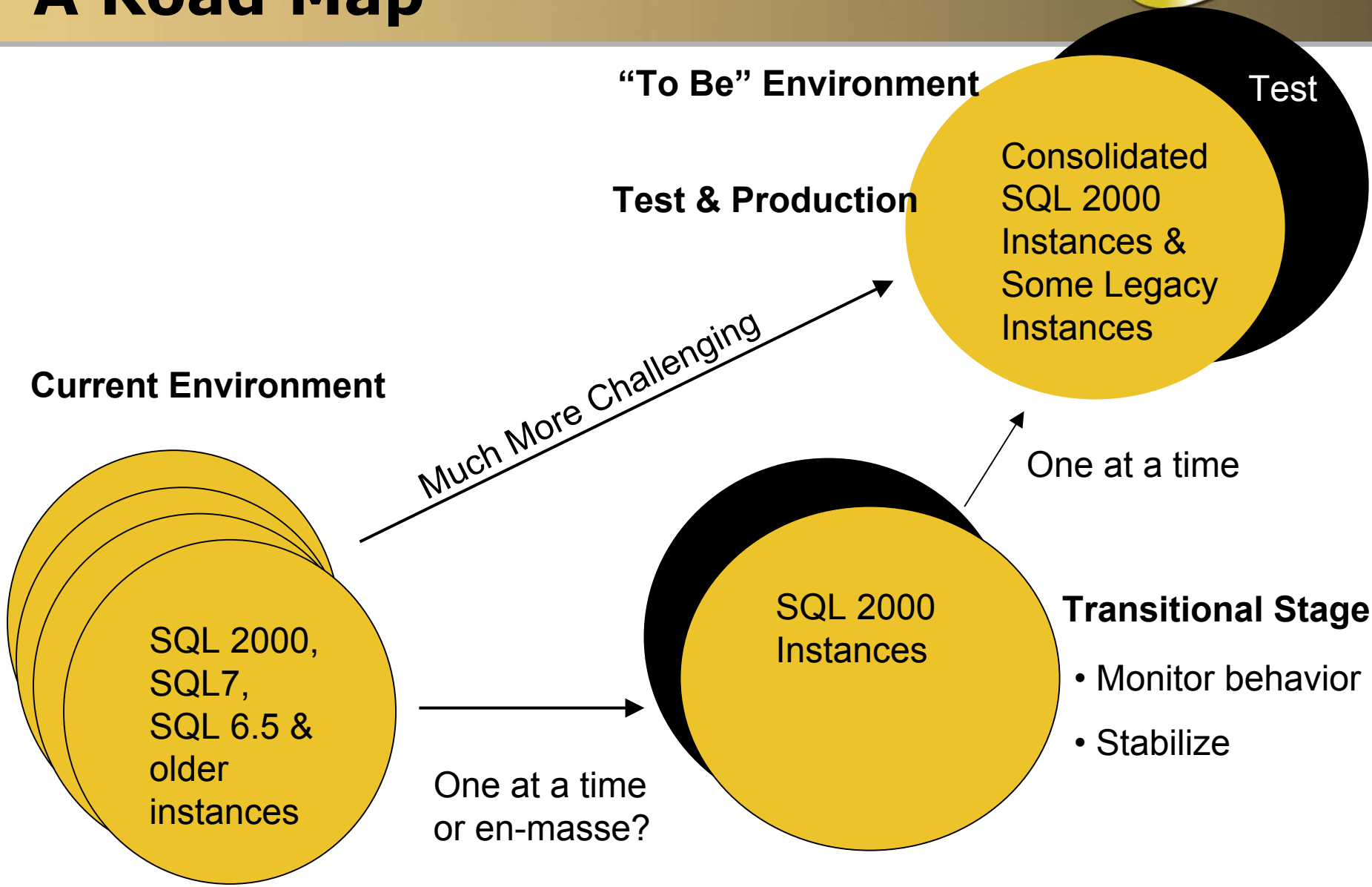
Several trade-offs and considerations – covered later

Single / Multiple Instance Adoption:

Field Observations

- Mixed Single & Multiple Instances per Windows instance
- Multiple SQL Server Instances
  - By Business Units / Departments
  - By geographic locations
  - For isolating unique applications
  - For minimizing consolidation effort
  - By Availability / Performance
- Consolidation within each instance

A Road Map


"To Be" Environment
Test & Production
Test
Consolidated SQL 2000 Instances & Some Legacy Instances
Current Environment
Much More Challenging
One at a time
SQL 2000, SQL7, SQL 6.5 & older instances
SQL 2000 Instances
Transitional Stage
• Monitor behavior
• Stabilize
One at a time or en-masse?

Consolidation Guiding Principles 1

- These are examples (not recommendations). Evaluate, Customize, and Adopt to meet the installation goals and environment
  1. We will consolidate only homogeneous SQL Server workload on a Window Instance. Corollary, other services like Exchange, File & Print Services will not be consolidated with SQL Servers.
  2. We will consolidate only non-mission critical workload initially. Corollary, initially mission critical load will not be consolidated
  3. We will first convert applications/databases to SQL 2000 before consolidating (Compatibility Mode is OK for us)
  4. We will not consolidate Transactional and Decision Support Work load on the same Window Instance
  5. We will consolidate work loads of similar characteristics into a multi-database SQL Server instance first. Corollary, at this time, we are not consolidating various data bases into fewer.
  6. We will use additional instances when dictated by capacity or use characteristics

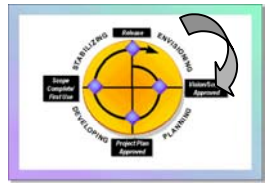
Consolidation Guiding Principles 2

- These are examples (not recommendations). Evaluate, Customize, and Adopt to meet the installation goals and environment

7. We will use multiple SQL Server instances to keep dissimilar work loads isolated
8. We will use multiple instances to isolate work loads where naming conflicts are significant
9. We will avoid the temptation to enhance the application/database functionality during consolidation
10. We will strive to maintain transparency in user experience when consolidating work load
11. We will use Consolidation Project to drive standardization in our administrative and support procedures

Technical Planning, Design and Implementation

Consolidation Steps: Envisioning 1



1. Current Environment Assessment
   - Topology – Geographic, network, servers
   - Resources: Servers, Processors, memory, disk, network
   - SLA, Support Infrastructure, Tools
   - Use profile: User Characteristics, Logins, applications, dependencies, user and transaction volumes, processor, disk utilizations
   - SQL Server feature usage: don't forget infrequently used
     - Linked servers, Extended SP, User SPs in Master, Modified MSDB,…
   - Minimal Base Line Data Collection Sheet included in the Appendix
2. Identify Target environment & develop Consolidation Principles
   - First cut "To Be" environment
   - Socialize (share), obtain feed back, revise target environment
   - Conduct a financial justification if necessary
   - Develop Consolidation Guiding Principles

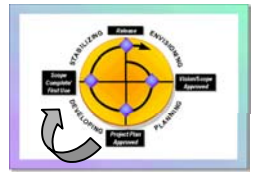
Consolidation Steps: Planning 2

3. Design “Future” Consolidated Service
   - Overall service design based on Guiding Principles
   - Design and document new Administrative, Operational, Performance Monitoring, Backup/Recovery, Charge Back, Disaster Recovery, Capacity Planning, Help Desk, and other procedures
     - Security: DBA and SA roles, firewall, authentication, logins
   - Acquisition and/or development plans for new and replacement tools
   - Design Review with Internal & External parties – include Microsoft PSS

Consolidation Steps: Planning 3

4. Service, User & Data Migration Planning
   - Logistics of moving to new service
     - Potential need for Intermediate Staging SQL Server 2000 Service
     - Potential SQL Server 6.5 and 7 migration issues isolated
   - Sequencing of Applications, Users, Data
   - Development / Document Change Impact and design appropriate solutions
     - Consolidation Name Conflicts – resolution
     - Potential changes to “user experience”
     - User Education
     - Business Process Impact
   - Design / acquire / (develop) scripts for migration
   - Watch for potential Scope Creep
     - “Server Consolidation” may mutate into “Application/Data Maintenance/Enhancement” project

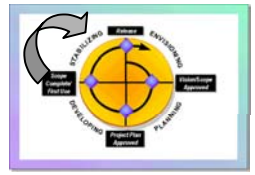
Consolidation Steps: Developing 4



5. Build new Consolidated Service “Test” environment
   - Test new procedures and tools
     - Server processors, AWE memory, etc., impact reboot time
   - Ideally “Capacity and Capability” same as “Production” Consolidated Service
     - Likely limited by budget and other constraints
   - Migrate and test application, database, user consolidation
     - Migration from “Transitional SQL 2000” system isolates issues related to only “consolidation”
     - Stress testing is highly recommended
   - Isolate, identify, fix defects or errors

Consolidation Steps: Stabilizing 5

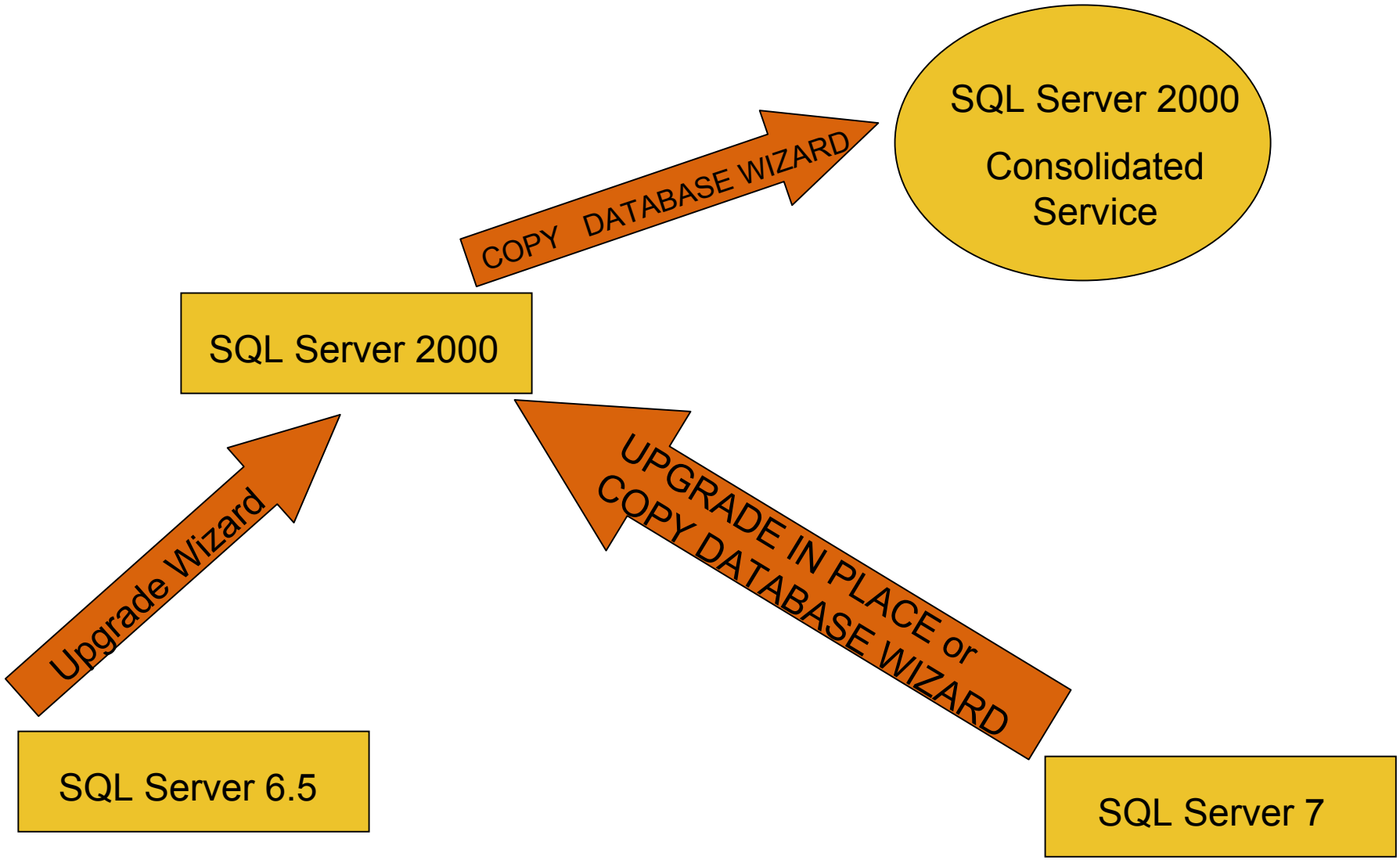
6. Build & deploy Production Consolidated SQL Service
   - "To Be" environment
     - Multiple databases per SQL Server instance
     - Multiple instances per Window instance
     - Multiple Windows instances per Computer
   - Deploy all tools, processes
   - Consolidate/move service incrementally
     - Measure base
     - Add incrementally (ONE at a time)
     - Stabilize
     - Measure again
   - Ideally Transparent "User Experience"



Total Man-Months ?
How many people?

7. Measure new Service
   - Compare with "old"
   - Document "enhancements" for next revision of "Consolidated Service"
   - Retire old Services

Migration Tools & Documentation 1



Migration Tools & Documentation 2

- SQL Server 6.5 to SQL Server 2000
  - SQL Server Upgrade Wizard
  - **mk:@MSITStore:C:\Program%20Files\Microsoft%20SQL%20Server\80\Tools\Books\instsql.chm::/in_overview_2xtf.htm**
- SQL Server 7 to SQL Server 2000
  - Upgrade in place
  - **mk:@MSITStore:C:\Program%20Files\Microsoft%20SQL%20Server\80\Tools\Books\instsql.chm::/in_upgrade_5jw3.htm**
  - Or, use Copy Database Wizard
  - **mk:@MSITStore:C:\Program%20Files\Microsoft%20SQL%20Server\80\Tools\Books\instsql.chm::/in_upgrade_6nqr.htm**
- SQL Server 2000 to SQL Server 2000 Consolidated Service
  - Copy Database Wizard
  - Based on detach / attach functionality
  - DTS package performs the actual copy or move
  - Logins, jobs, user-specific objects included
- Install the application anew to the SQL Server 2000 Consolidated service
  - May be easier in specific cases
  - Fresh Install may be preferred
  - Database detach / attach may be required
  - Backup / restore may be applicable
  - Import / Export Data
- How to move Databases between SQL Servers – Review KB Q314546 first
  - http://support.microsoft.com/search/preview.aspx?scid=kb;en-us;Q314546
- SQLDIAG –x –I –O to collect Server Information

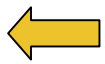
Migration Tools & Documentation 3

- Moving user databases
  - Backup and Restore
    - Full data base and transaction log backup. Simpler if no users
    - Restore database With Norecovery; Restore transaction log With Recovery
    - Destination and Source database same size
    - Restore With Move option if different file location
    - Remember to keep Database Options consistent between source and Consolidated Service
    - KB articles: Q221465 and Q304692
  - Detach and Attach Stored Procedure
    - Detach on source and copy mdf, ndf, & ldf files to target
    - Attach on destination Server

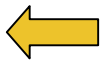
      KB articles: Q224071
    - SQL 2000 Server databases retain their collation sequence from Source Server. Destination MSDB, MODEL,TEMP,MSDB sequences may be different

Migration Tools & Documentation 4

- Moving user databases (Continued)
  - Stored Procedures and other objects that point to non-existent entities will not be identified by Backup/Restore or Detach/Attach procedures
  - Import and Export Data
    - Subset can be selected
    - Source may be in use. Normal locking/blocking
    - Destination character set, sort order, collation may be defined differently
    - Unused data space is not moved

- Logins and Passwords 
  - KB article: Q246133 – Transfer Logins and Passwords

Migration Tools & Documentation 5

- MSDB move includes 
  - Jobs, Alerts and Operators
  - Size: 45MB plus overage over 45MB of each instance + 10%
- If moving Jobs, Alerts and Operators
  - Generate scripts using Enterprise Manager
  - Execute on destination server
- DTS Packages
  - Source Server – Save packages in a file
  - Open on destination Server – probably need alterations
- Reset the server names and file path specification, if necessary

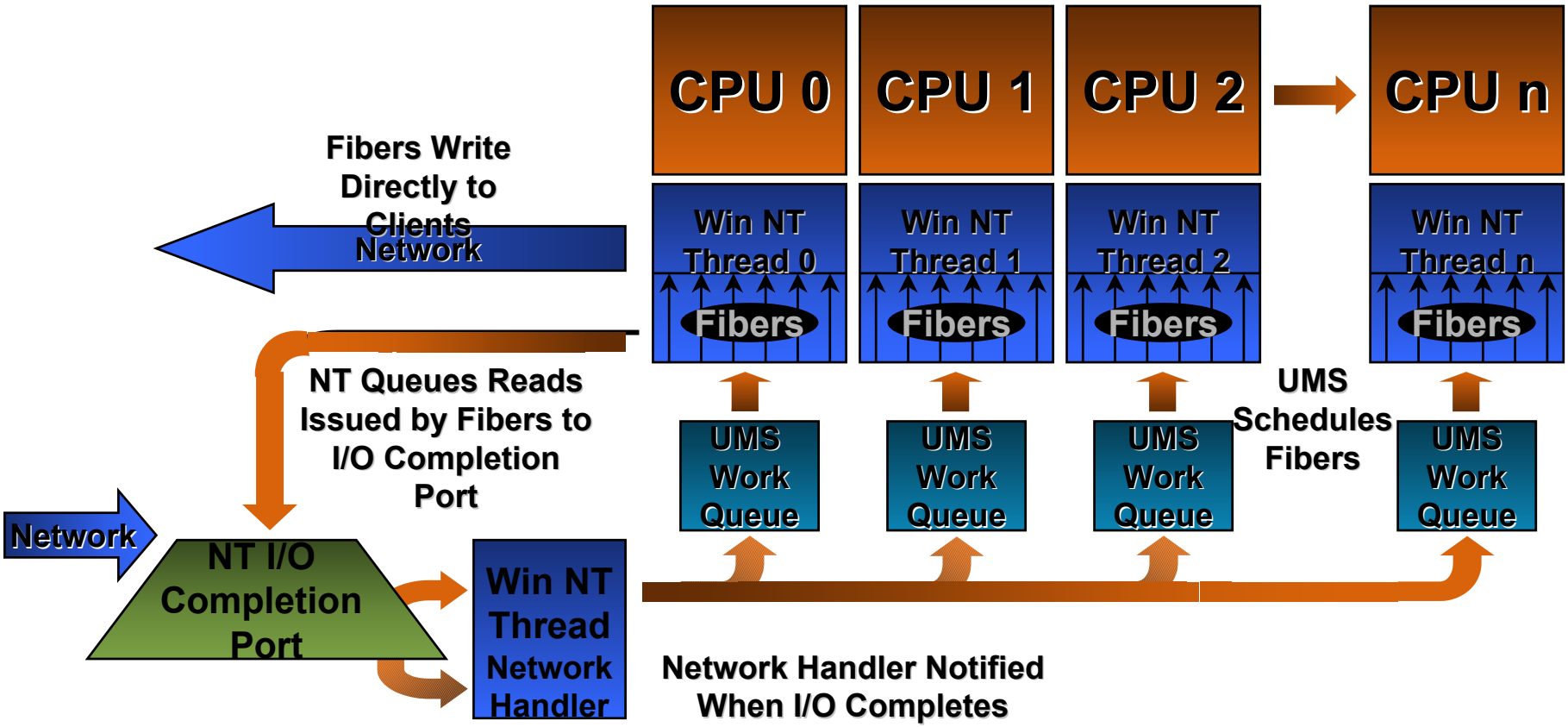
Migration Tools & Documentation 6

- Client Network Utility alias can be useful ⟸
  - Can delay the need to upgrade to MDAC 2.6
  - Could be useful for applications like ACCESS when the LAN-based server Database is consolidated to a remote SQL Server 2000 instance
  - To configure an alias using TCP/IP, provide the server name and the assigned TCP/IP port number
  - http://support.microsoft.com/search/preview.aspx?scid=kb;en-us;Q265808

Technical Considerations, Issues and Potential Solutions

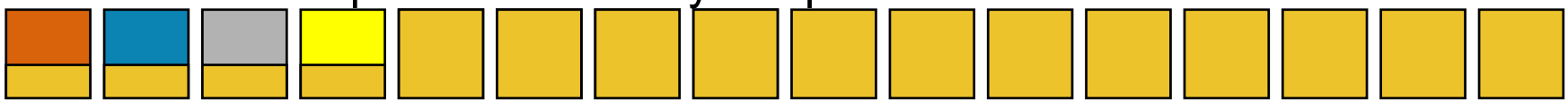
Process Management

SQL Server User Mode Scheduling



Process Management 2

- SQL Server 2K provides Processor, Connection, and I/O Affinities for managing resources
  - Consider work load characteristic, use only when appropriate
- Example: 5 SQL Server instances - 16-way
  - 4 instances use processor affinity – 1 processor each



  - 5th instance: no affinity
- Example: 5 SQL Servers instances – 8-way

  - 4 instances use processor affinity – on 4 processors
  - 5th instance: affinity to other 4 processors

Process Management 3

Windows Server 2003 Windows System Resource Manager (WSRM) and SQL Server 2000 multi-instance management

- WSRM can be used to manage CPU resource allocation on Enterprise and Data Center Editions of Windows Server 2003
  - Applicable where a set of busy instances require CPU resource bands within which they can function effectively
  - Relative distribution of CPU processing resource between multiple instances can be broadly controlled by setting target CPU allocation %s
- Use SQL Server 2000 Processor Affinity, if affinitization required
- Use SQL Server 2000 Configuration settings to manage memory allocation

Process Management 4

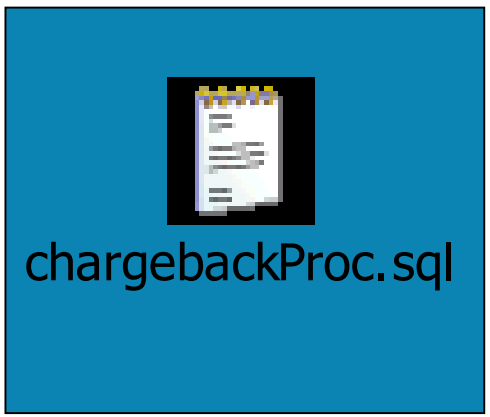
- Customers looking for technologies to better manage Windows 2000 resources may like to investigate solutions offered by Aurema Corporation - ARMTech
  - It is possible to down load their software using Microsoft's web site.
  - Microsoft SQL Server 2K has not done any testing with Aurema software
  - Non intrusive Monitor mode may be useful for Charge Back and Capacity Planning

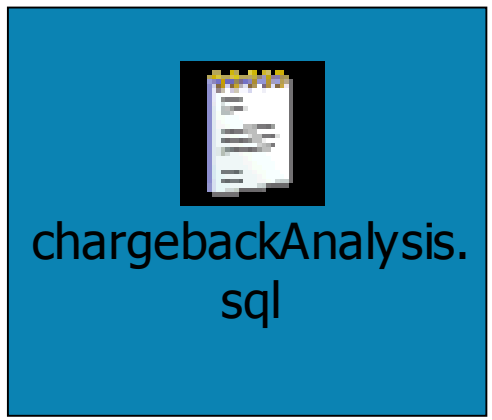
Charge Back

- Assuming CPU is used for charge back, options/tools include:
  - Allocation based on SQL Server Processor Affinity
  - Use of Windows System Resource Manager on Enterprise and Data Center Editions of Windows Server 2003
  - Use of Third party tools, e.g., Prism, ARMTech
  - Use of SQL Server Profiler Audit Log-out records
    - Refer to sample stored procedures
    - Be careful and watch overhead before putting in production
    - Some records missing if users have not logged-out

Charge Back - Example

- No Microsoft Support
- SAMPLE Stored Procedures – If interesting, develop your own
- Measure overhead before production implementation



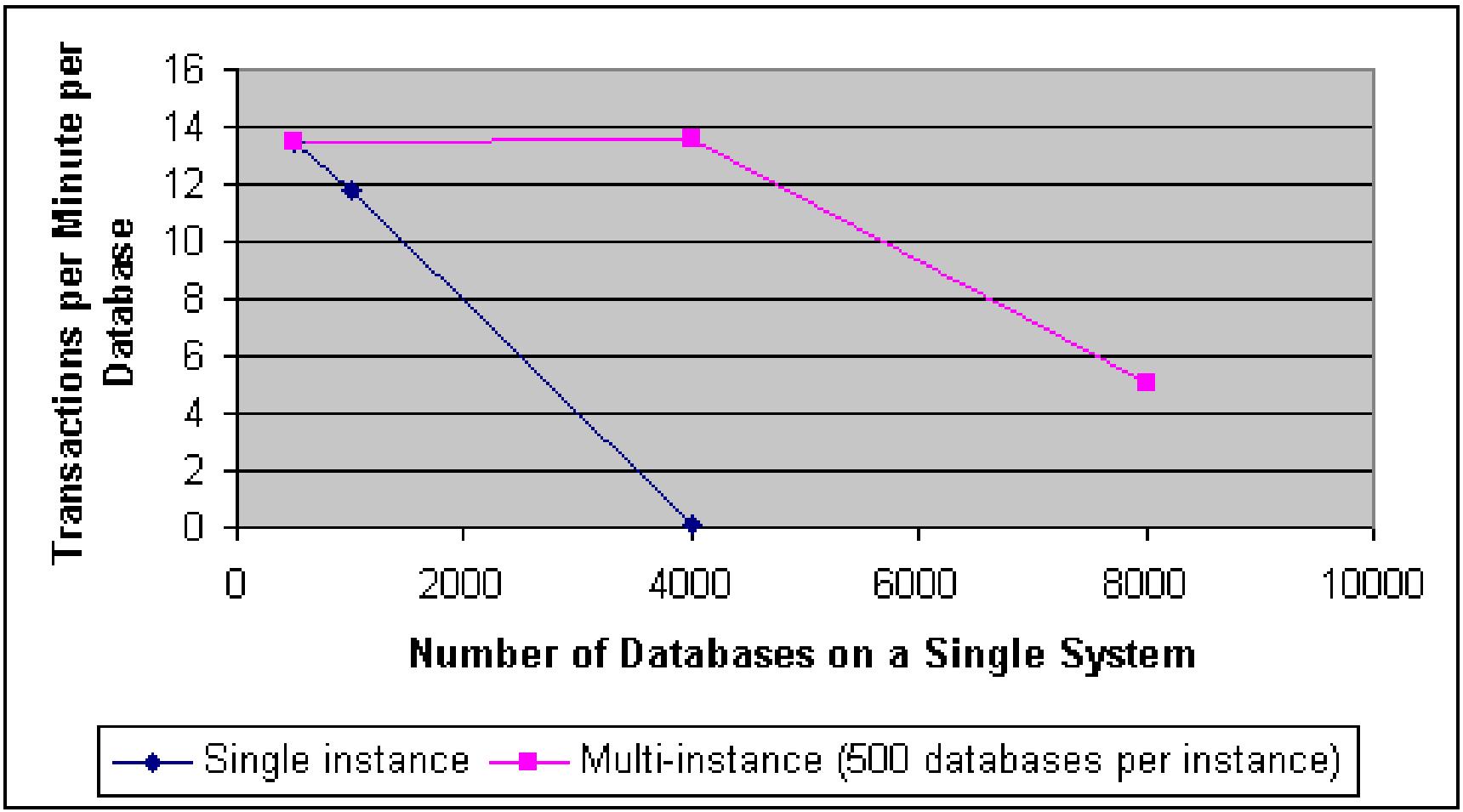


Memory Allocation Background

- With 64-bit Windows & SQL Server: Normal addressing. PAE, AWE and /3gb not relevant
- PAE – Physical Addressing Extension.
  - Feature permits 32 bit-OS to extend beyond 4gb limit
- AWE – Address Windowing Extension.
  - Allows SQL Server (an application) to address additional available memory
  - PAE not needed but makes AWE interesting
  - Makes SQL Server memory usage non dynamic – not released when other applications/system need
    - "Good citizenship" may require capping SQL Server maximum memory usage
- /3gb Switch
  - Allows SQL Server 2000 (a 32-bit application) to use 3gb of memory versus normal 2gb
- PAE, AWE, /3GB switch are independent, but interrelated

Procedure and Plan Cache Impact

Laboratory Benchmark



Memory Allocation

- Need for virtual memory for procedure and plan cache
  - # of DB, # of Procedures, Size of Procedure
  - Procedure cache limited to /3GB
- Using multiple instances relieves the pressure on memory
  - Availability of memory for services
- Static versus Dynamic Memory
  - Fixed tuned optimally – may be impractical with multiple SQL Server instances – provides predictability
  - Dynamic – Best when equilibrium reached – provides better utilization
  - No Fail-over Cluster
    - No AWE – Dynamic: Minimum per instance, let maximum default
    - With AWE – Fixed: Specify size
  - With Fail-over Cluster
    - Need to accommodate requirement of all potential instances
    - Consider SLA, past experience for simultaneous multiple fail-overs

      Dynamic. Optimizes hardware resources most of the time – Specify Minimum required. Understand Minimum Size behavior

      Fixed: If you must ensure that the failed over instances get their fair share right away, specify size accordingly - Not optimized for hardware utilization. Some memory waiting for fail-over instances

I/O Sub-system Consideration 1

- Planning time spent in I/O Configuration would have significant payback
- Normal I/O Performance guidelines apply
  - Minimally, size is the sum of all work load being consolidated including growth
  - DB and log growth without maximum specification may impinge on other usage when sharing disks
  - Consider dedicated disks for each database?
- Considerations
  - More spindles -> less the contention – With SAN additional considerations
  - Separate Log Files to reduce contention
    - From data, index, and other files
    - Separate disk for each database log file preferred
    - Example (2 drives – 14 data base logs – defeated the purpose)
  - Separate Data & Indexes from OS, SQL bits, and Page Files
  - For OLAP, separate tempdb. Can be heavy I/O
  - Tempdb needs to accommodate cumulative I/O activity – Striping and additional size may be necessary

I/O Sub-system Consideration 2

- Considerations
  - Raid 10 preferred
    Raid 5 is less costly initially, but lower performance
  - Keep disk Backup Files on separate spindles
  - Safeguard against Cache loss
    - Particularly for Log Devices
  - Watch cache read write usage settings
  - Using multiple channels if available

Logins and Passwords 1

- Allocate sufficient time for planning/execution
- Include service accounts, applications, infrequent jobs
  - Interviews, Profiler traces can help
- Potential considerations
  - Same user: different accounts
    - May be OK to bring over all: simpler, transparency, can handle different privileges (DBA on one, User on second). If SA on third, still a potential issue
    - May allocate just one if pruning various logins a goal
  - Different users: same account
    - More challenging: need a good communication plan for acceptance of new logins
  - Use of logins of previous employees, sharing of logins

Logins and Passwords 2

- Same User and Login but multiple passwords on different servers. Which one to bring over?
  - Assign new
  - Choose one and inform which server was selected
  - Ask users to try all till one matches
- What permissions to grant to public & guest since user population is larger
- Should Builtin\Administrator continue?
  - Some installations remove it currently
- Unused logins: Example – 500 active users, 10,000 configured logins, 4500 unique logins
    - Brought Logins only for migrated data bases
    - Add & drop logins stored procedures impact transaction logs. Pruned after every 500 logins

Miscellaneous Considerations 1

- Consolidation of master, model, msdb Name conflicts: identify & resolve 
  - Startup procedures: any conflicts.
    - Use sp_helpstartup in SQL 6.5
    - Use sp_procoption in SQL 2000
  - Any modifications to system tables?
  - Any conflicting modifications when consolidating
  - Any explicit references to server names, paths
  - Entries in MSDB still applicable?

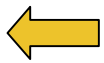
Miscellaneous Considerations 2

- Maintenance Tasks ⇦
  - Identify and resolve duplication in alerts, names, event_ids, message numbers, etc
  - Is Maintenance history to be abandoned ?
  - Potential reduction in maintenance window because of consolidation of applications from different servers
  - Observe MSDB growth rate: adjust purge frequency
  - Sqlmaint task: “for all databases” still applicable?
  - Need to reset the server names and file path specification

Miscellaneous Considerations 3

- Security considerations
  - Conflicts in current and “to be” server security model
  - Login names, person, functions, SIDs conflicts
  - Privilege to execute xp_cmdshell and its implications
  - Users with administrative privileges
    - Accommodation in the new security model
    - Consider use of SQL Server roles
    - mk:@MSITStore:C:\Program%20Files\Microsoft%20SQL%20Server\80\Tools\Books\architec.chm::/8_ar_da_3xns.htm
  - Consider installing under domain user account and use Access Control Lists (ACLs) to protect individual SQL Server libraries
- Collation and Sort Order sequences
  - Resolve if conflict between current and “to be” server
  - mk:@MSITStore:C:\Program%20Files\Microsoft%20SQL%20Server\80\Tools\Books\architec.chm::/8_ar_da_3xbn.htm
  - Easy to miss if DBA and Installation people are different
  - Example: Identified 45 data bases as an issue after a few weeks in production

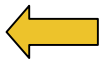
Miscellaneous Considerations 4

- Extended Stored Procedure 
  - Consider exposure in a consolidated environment
  - Are applications with similar needs
    - Candidates for a distinct Consolidated Instance?
    - Is a SQL Instance for a “Business Unit” indicated?
- Service Packs 
  - Consider potential impact on SLA
  - MDAC, DTC are common to all instances
  - Consider impact on “legacy” and other applications under updated SQL Server or MDAC, DTC, etc.

Miscellaneous Considerations 5

- Review applications
  - May be able to connect only to a Default Instance
    - Note that only one default instance per Window instance
    - Consider altering the application (scope creep?)
    - May be a default instance is indicated for applications that are difficult to alter
    - Hard coding of Server names
  - Hard coding of paths
  - Some existing applications may require SA privilege
- Normal application / database migration considerations apply. Fix errors prior to move
  - DBCC health check – Plan adequate time
  - Review Event and Error Logs entries
  - Statistics update after move
  - Preloading of cache prior to user logons
  - Impact of DBCC pintable command

Miscellaneous Considerations 6

- Server wide options 
  - Conflict between Current servers and target
  - Review, prune, revise Startup Procedures
  - To connect to a named instance of SQL Server 2000, MDAC 2.6 must be installed on the client computer
  - mk:@MSITStore:C:\Program%20Files\Microsoft%20SQL%20Server\80\Tools\Books\instsql.chm::/in_runsetup_60op.htm
  - See http://support.microsoft.com/search/preview.aspx?scid=kb;en-us;Q265808 for a workaround

Miscellaneous Considerations 7

- Degree of parallelism
  - Move to a bigger SMP may alter query execution plan
- One MSSearch application per Windows 2000 instance
  - Application comprises Full-Text Indexes and metadata
- Network topology and traffic
  - Monitor capacity and response
  - Use of Multiple NICs
- Linked Servers consolidation impact
- Investigate third party tools / licensing implications

Summary

SQL Server Consolidation Summary 1

1. Assess Current Environment
2. Identify Target environment & develop Consolidation Principles
3. Design “Future” Consolidated Service
4. Plan Service, User & Data Migration
5. Build new Consolidated Service “Test” environment
6. Build & deploy Production Consolidated SQL Service
7. Measure new Service

SQL Server Consolidation Summary 2

- Importance of good planning and a comprehensive test environment cannot be over emphasized
  - People, process, technology: all are impacted
- Not all instances are candidates for consolidation
  - Some may be best left alone
- Carefully evaluate and specify
  - Memory allocation specifically with multiple instances. Consider fixed minimum, dynamic maximum
  - Processor Affinity with multiple instances to facilitate coexistence
  - Log files location and separation from data / index files

Appendix...

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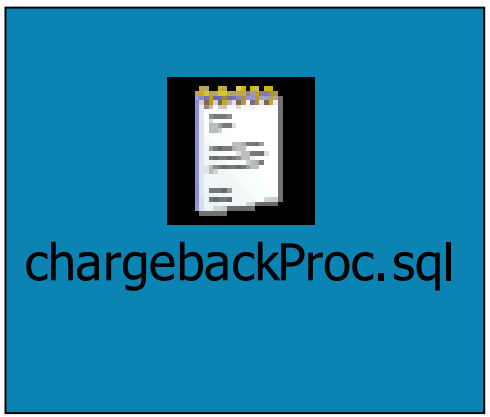
Minimal Base Line Data

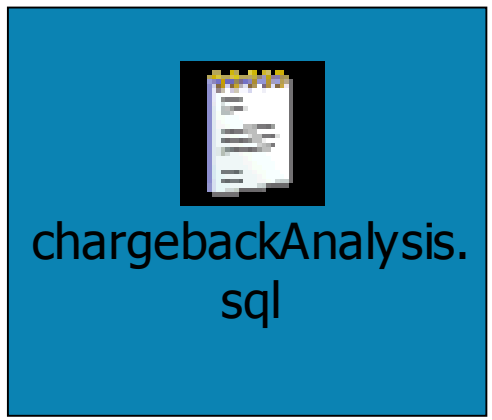
Minimum Base Line Data

Physical Server										
Location	Physical Server Name	Make	Model	Num of CPUs & Speed	Memory	Disk Space	Netwrok Cards	Clustered	Services	Comments & Observations
Window Instance										
Physical Server Name	Windows Instance Name	Edition, Version	Service Pack	Services	Comments & Observations					
SQL Server Instance										
Windows Instance	SQL Server Instance Name	Editon, Version, Service Pack	Processor Affinity	Average & Peak Utilization	Memory	Disk Space	Primary Use: OLTP or OLAP	Major Features Used	Major Applications & Users	Comments, Observations, & Features Used (e.g., SQL Mail, Extended SP, Full Text Indexing, Replication, Log Shipping, etc.)
SQL Server Application										
SQL Server Instance	SQL Server Application Name	Data Bases	Availability Requirements	Performance Requirements	User Characteristics	Application Vendor	Application Version	Service Level	Dependencies	Comments & Observations

Charge Back

- SAMPLE Stored Procedures – If useful, develop your own
- Measure overhead before production implementation





Additional References

- http://www.microsoft.com/technet/treeview/default.asp?url=/technet/itsolutions/Consolidation/default.asp
- http://www.microsoft.com/servers/consolidation/
- http://www.microsoft.com/windows2000/datacenter/evaluation/features/aurema/default.asp

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