



***Tivoli Storage Management
Leveraging New Technologies***

Information Integrity for your Business

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Tivoli

Forward-looking statements

- **Except for the historical information and discussions contained herein, statements contained in this release may constitute "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995. These statements involve a number of risks, uncertainties and other factors that could cause actual results to differ materially, as discussed in the company's filings with the Securities and Exchange Commission.**

Topics

- Backup Technologies
- Storage Area Networks
- Hardware Integration
- Compression
- Database HSM
- Tivoli Technologies

Backup Technologies

- **Multiple methodologies will co-exist**
 - File based
 - Progressive incremental
 - Rotation
 - Volume based
 - Application aware
 - Mobile
 - ...
- **Distinct and separate**

Future challenge

- **Expand flexibility of existing methodologies**
 - Satisfy the diversity of requirements
 - Integrate various methodologies
 - Provide multiple restore options
 - Allow users to select options for optimization
 - Eventually self-tuning capable

Tivoli Strategy

Storage Area Networks

- **Leverage Tivoli Global Enterprise Manager (GEM)**
 - Apply Tivoli Management Technology to SANs, providing a single enterprise wide management view across LANs, WANs, and SANs
 - Provide policy based SAN management aligned with company business policies
- **Exploit Tivoli Storage Management Technology**
 - Leverage strengths of current product offering
 - take advantage of intelligence and connectivity benefits of SAN devices
- **Integrate Technology with Key Partners**
 - Provide certified, “Tivoli Ready” SAN solutions and services
 - Compliment industry standard management initiatives



Tivoli Strategy

Storage Area Networks

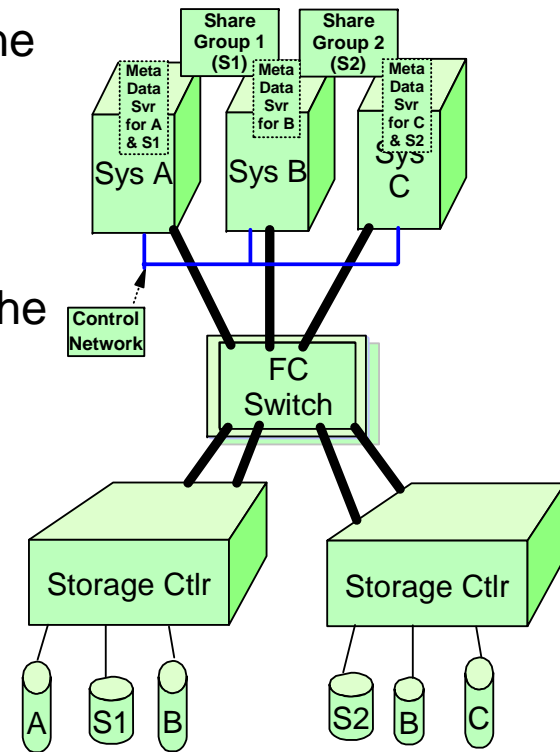
- **Key functionality we are developing**
 - Library and drive sharing
 - Lan-free data movement
 - Server-free data movement

- **What file systems will be prevalent in a SAN environment?**
 - Single system FS with block level API or reverse engineering.
 - Security and locking handled outside the file system
 - In-board shared file system.
 - Security and locking handled by file system extensions
 - Access by other systems using CIFS/NFS ...
 - Out-board shared file system.
 - New file system, native access by all systems
 - Integrated security and locking

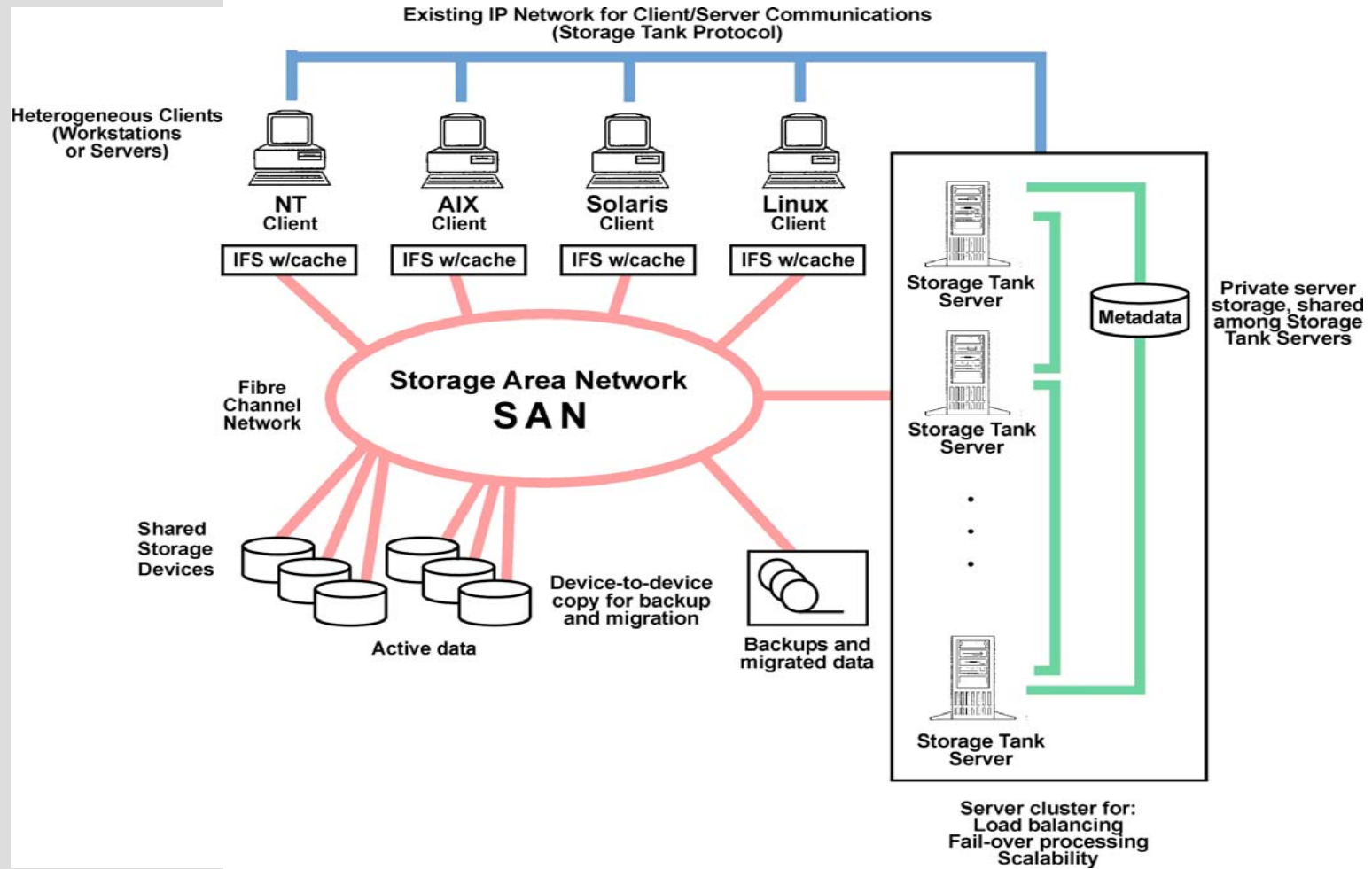


Description of Shared File Data on SAN

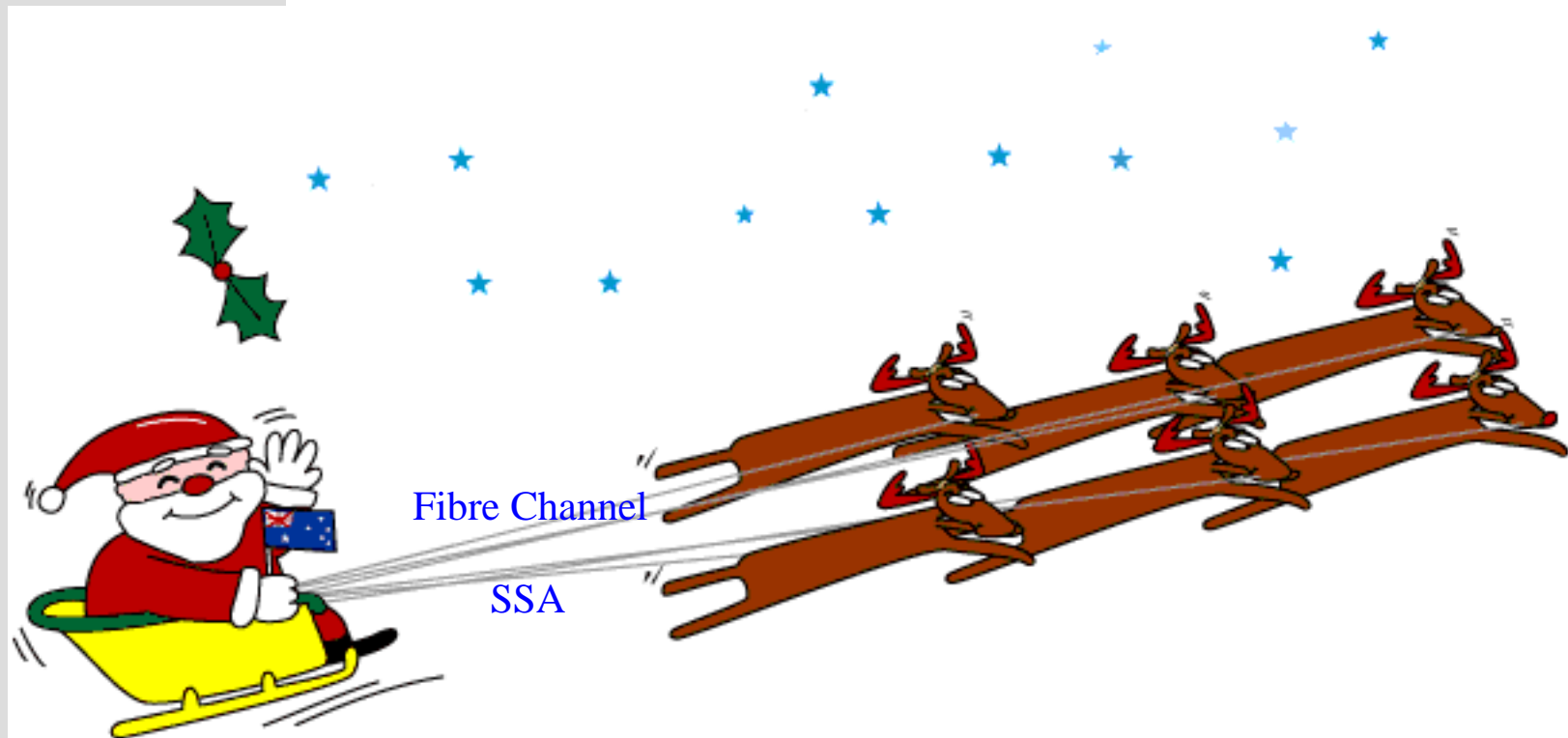
- A set of Storage configured into a File System is shared among different systems
- A Meta Data Server (MDS) is located on one of the Sharing systems that can natively access the File System being shared
- Other Sharing (Client like) systems send normal Network File Access Protocols (CIFS/SMB, NFS, etc.) to the system with the MDS, to handle:
 - ▶ Security (authentication & authorization)
 - ▶ Lock coordination
 - ▶ Directory functions
 - ▶ etc.
- A side messaging function is use to obtain Extents for I/O
- Normal Reads and Writes are done directly by the sharing "Client" system to the extents



Out-board file system

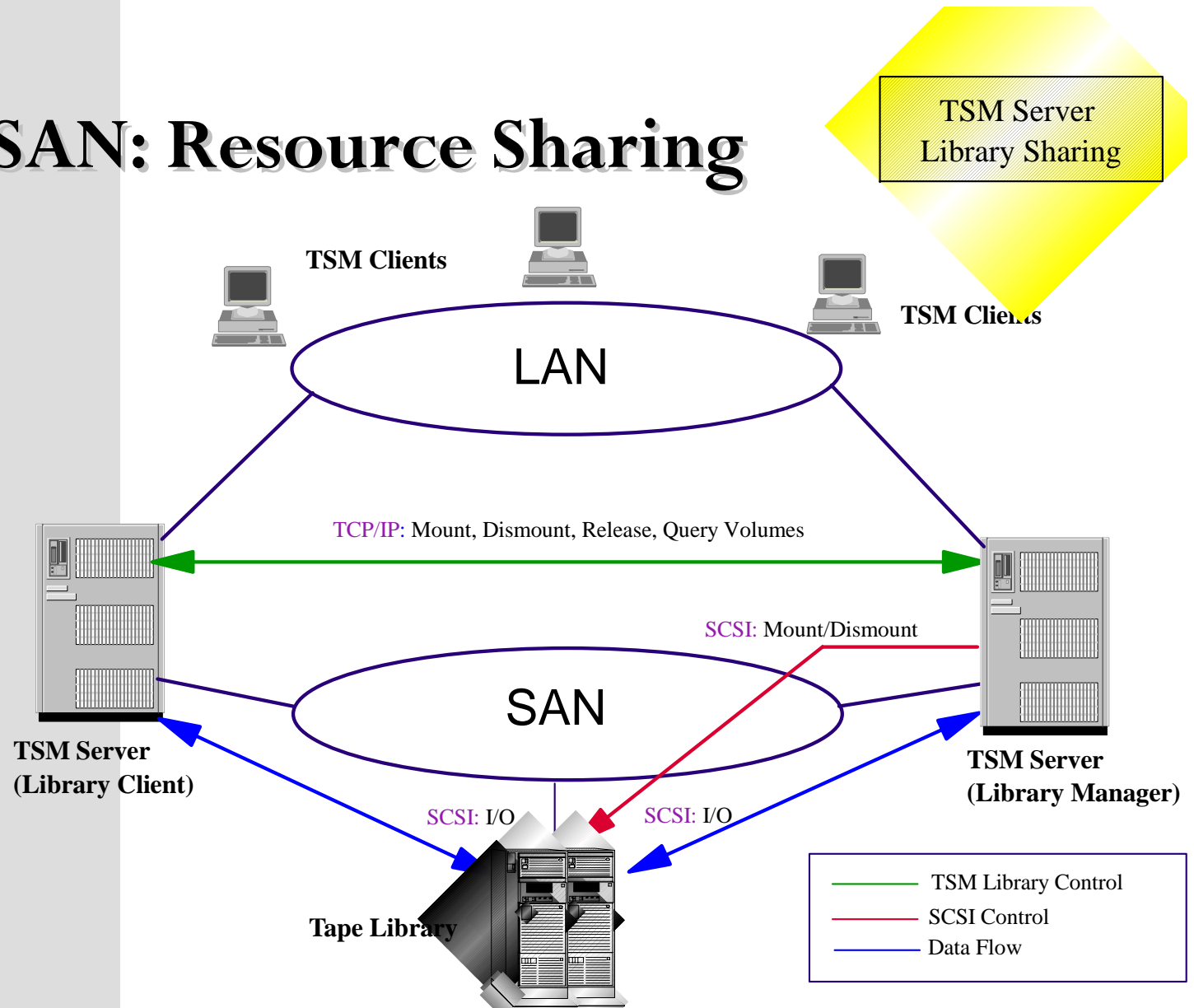


Storage-Area-Network-Transformed ADSM (Santa)

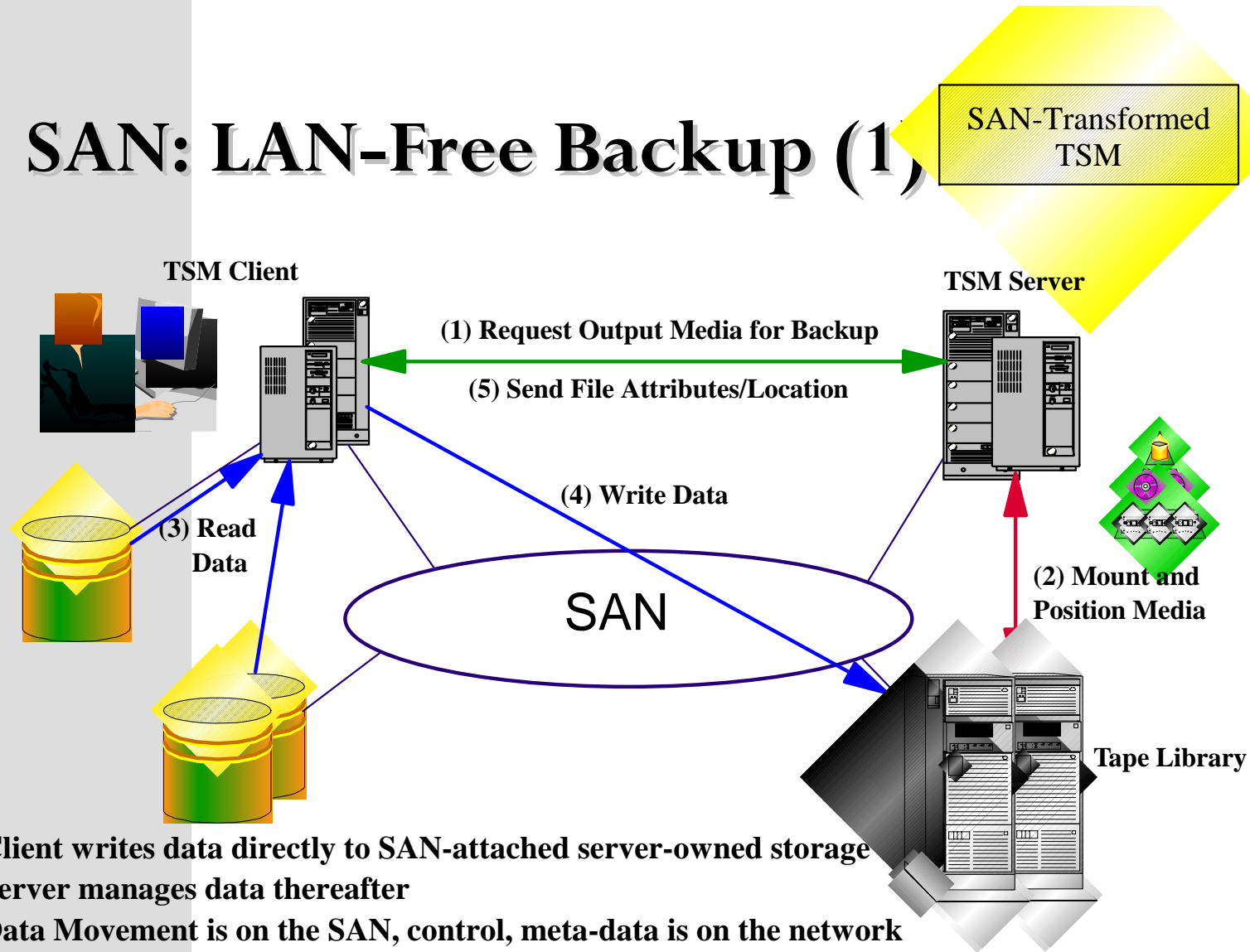


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SAN: Resource Sharing



SAN: LAN-Free Backup (1)

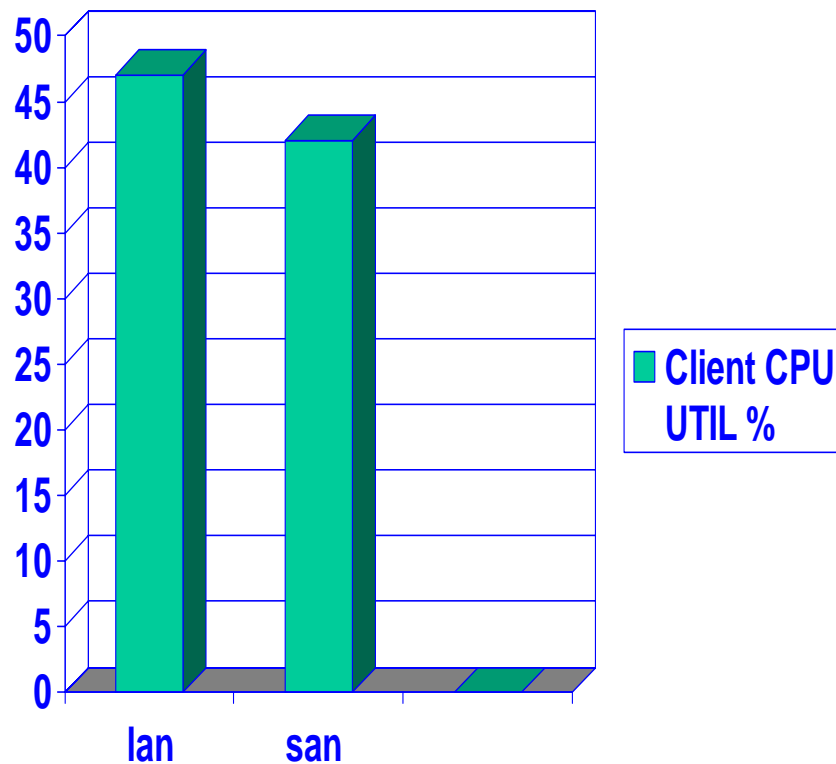
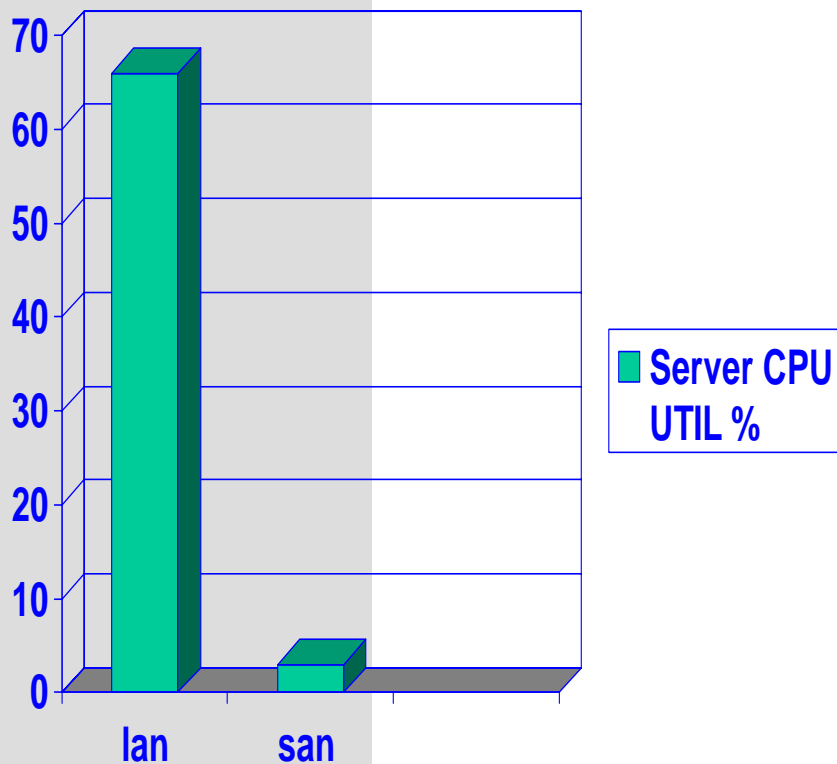


Client writes data directly to SAN-attached server-owned storage
Server manages data thereafter
Data Movement is on the SAN, control, meta-data is on the network
Improves server scalability (can handle more clients)

Goals/Issues

- **Fall back to network data transport when direct writes fail**
- **Interoperable with LAN-based backup/restore**
- **Adding a PVR module in the client for using locally-attached tape device**
- **Data is written in the same format as if the server writes it**

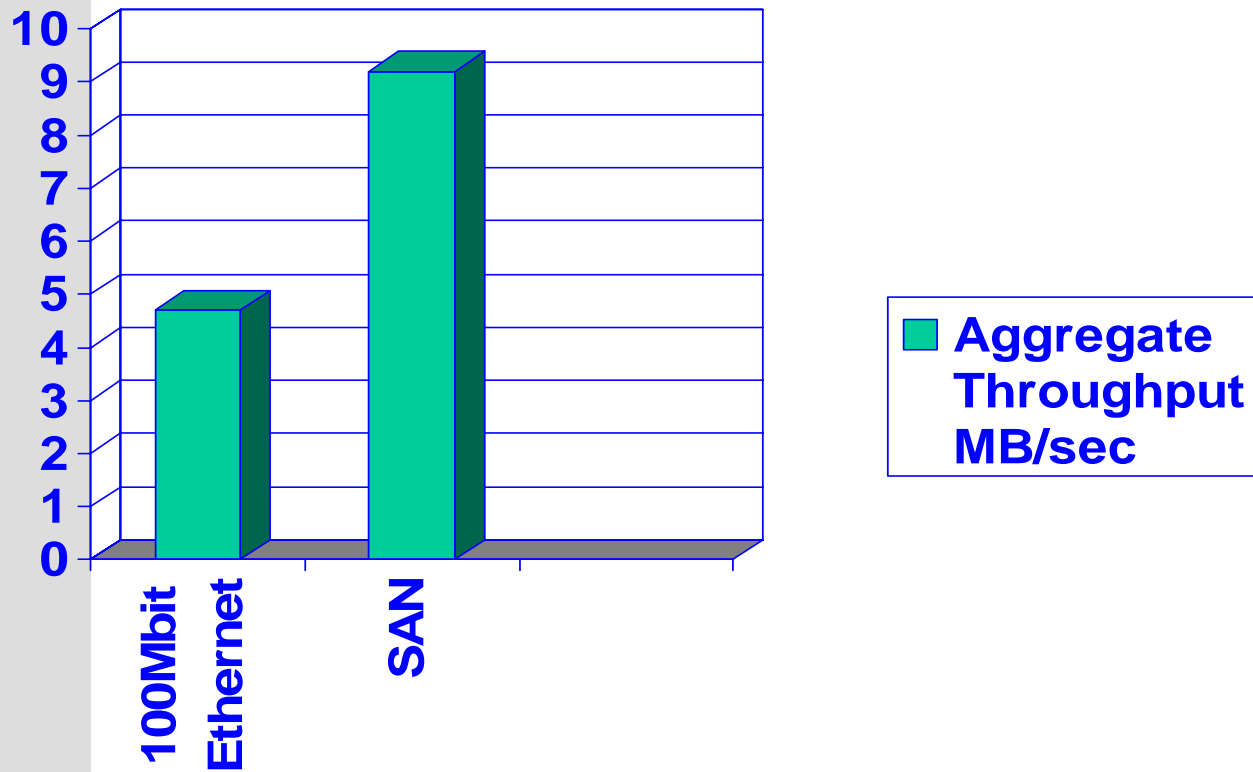
TSM Server/Client CPU Utilization



2 concurrent backup sessions, 1 to disk pool, 1 to tape pool, 700MB for SAN, 530MB for LAN



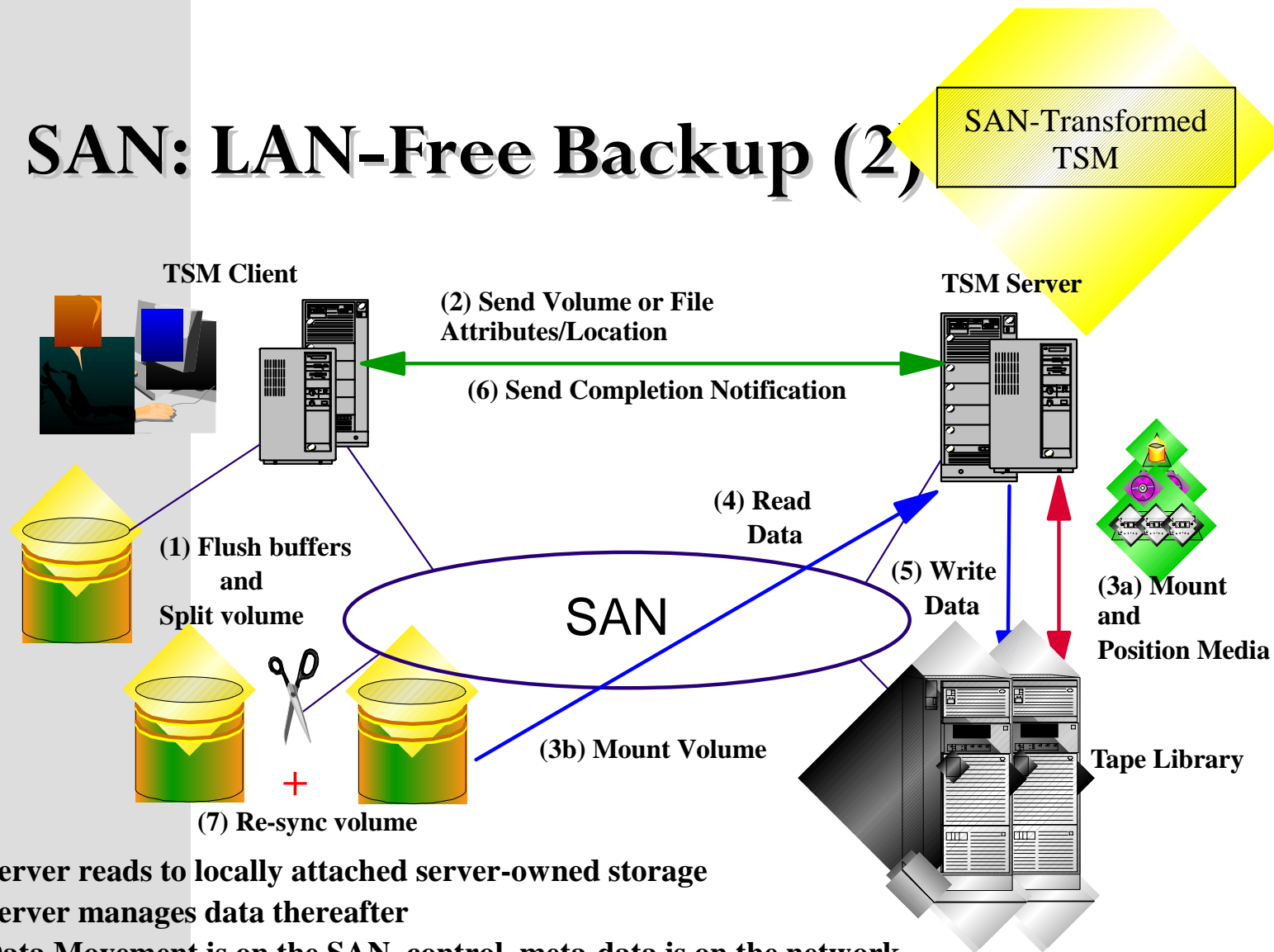
Constrained LAN Backup



2 concurrent backup sessions, 1 to disk pool, 1 to tape pool, 700MB for SAN, 530MB for LAN



SAN: LAN-Free Backup (2)



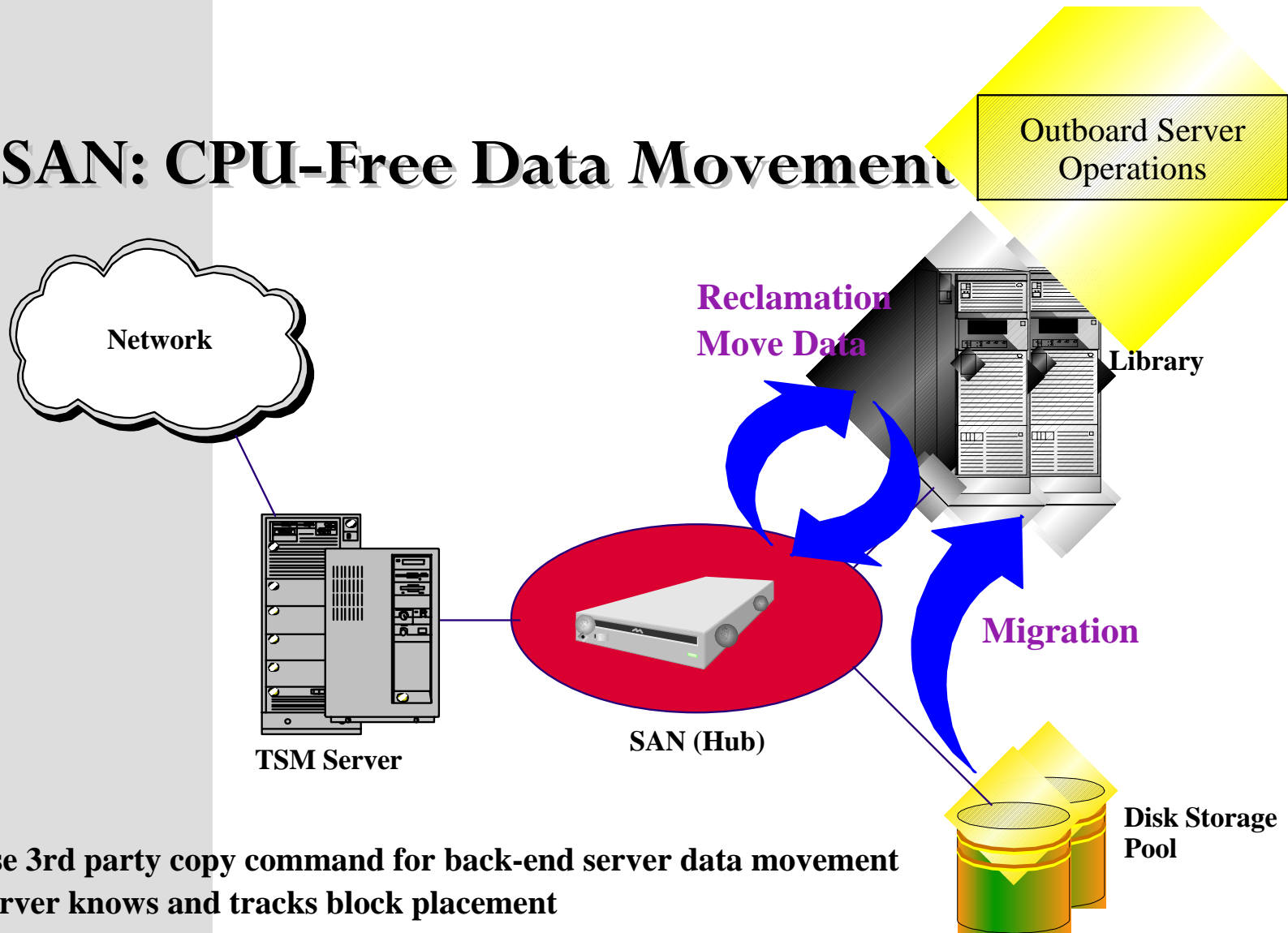
Server reads to locally attached server-owned storage

Server manages data thereafter

Data Movement is on the SAN, control, meta-data is on the network

Improves application server scalability and backup window

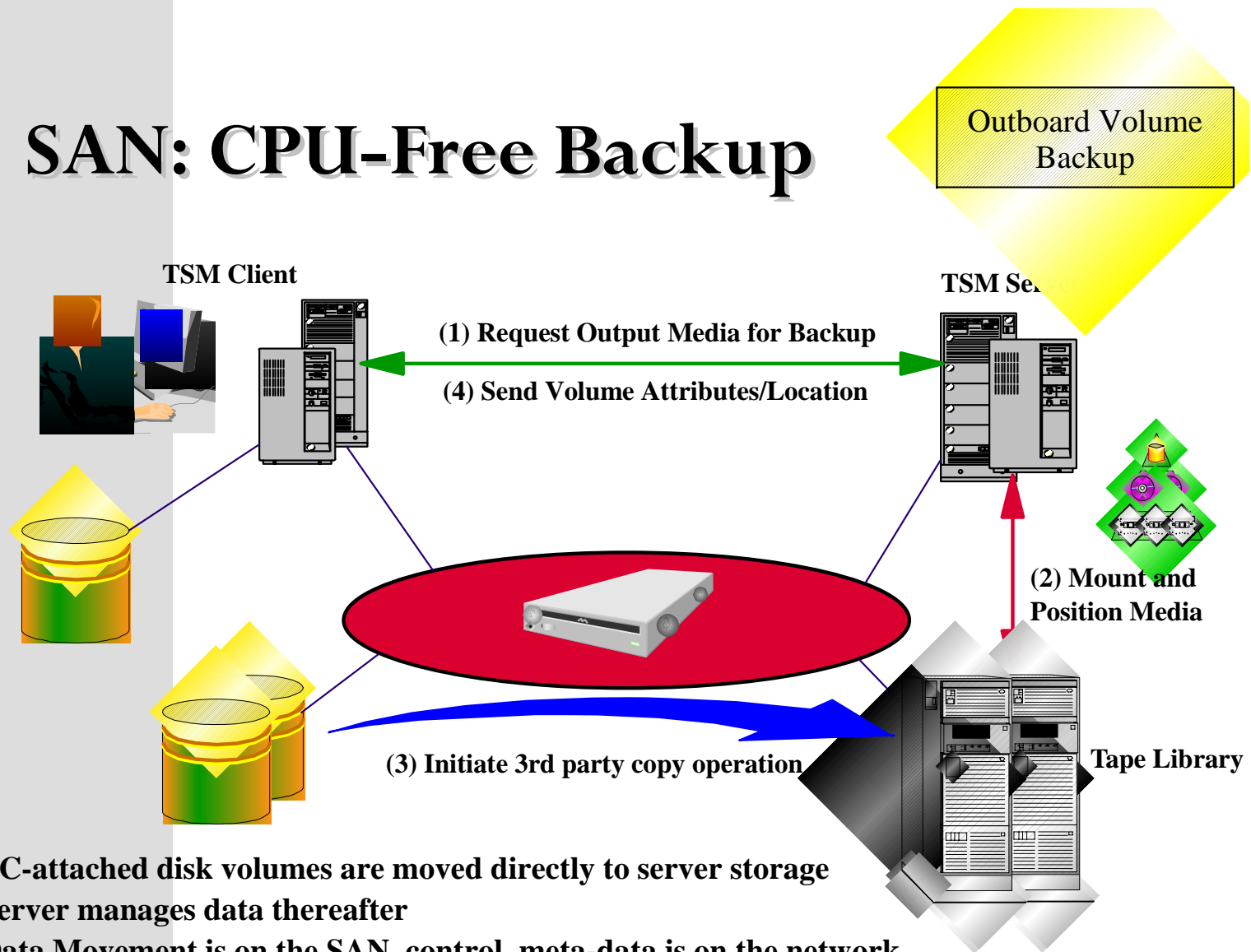
SAN: CPU-Free Data Movement



Use 3rd party copy command for back-end server data movement
Server knows and tracks block placement
Further reduces server CPU overhead and improves scalability



SAN: CPU-Free Backup



FC-attached disk volumes are moved directly to server storage
Server manages data thereafter
Data Movement is on the SAN, control, meta-data is on the network
Off-loads both the server and the client CPUs

Compression

- **Current options**

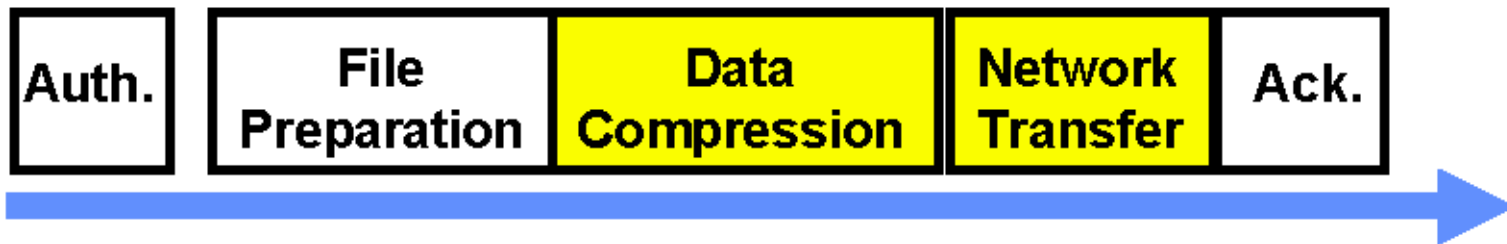
- None
- Software

- **Investigating adding support for H/W compression**

- For use in LAN environments where a SAN is not available

An ADSM Backup Operation

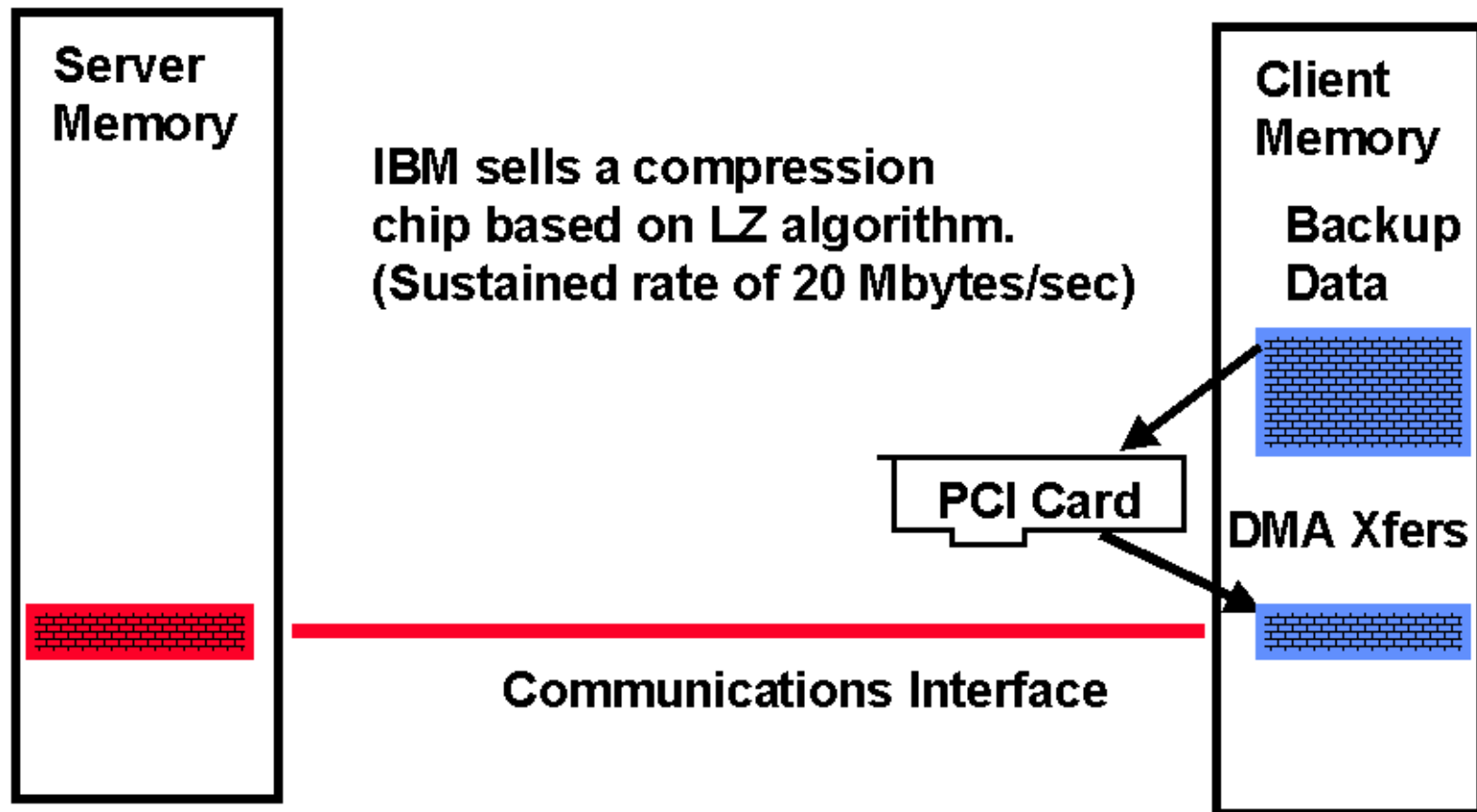
Network bandwidth is **NOT** solely responsible for ADSM performance.



Time

- Authentication is a per session operation.
- File preparation is metadata creation and copying the file to a staging area.
- First order effects are Compression and Network BW.
- The better the compression, the better any network looks.
- Compression runs at 2 Mbytes/sec in a 233 MHz PowerPC.
- Backup Acknowledgment is a function of disk writes.

Compression Accelerator Card



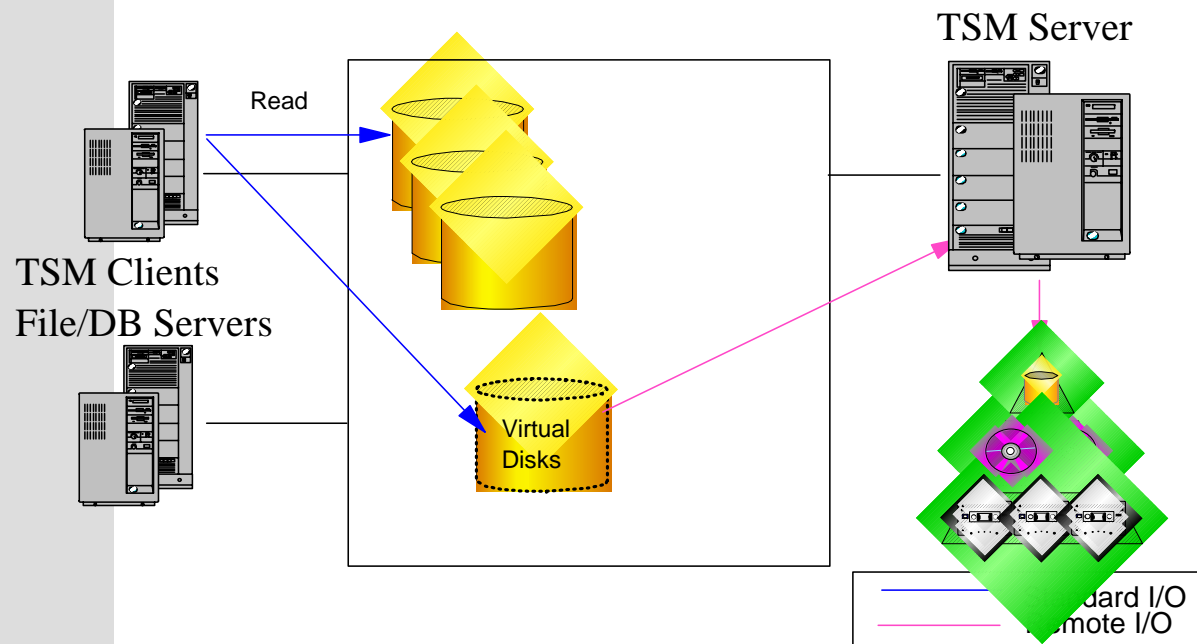
Hardware Integration

- **Some real exciting functionality from hardware vendors**
 - Split mirror non-disruptive (quasi) backup
 - Service offering available for SSA switch
 - Working with other H/W vendors
- **Volume incremental**
 - Block level vector mapping
 - Cumulative or since last increment
 - Easily used with rotation method or progressive incremental

Extending Volume Backups

Remote Volume Device Driver

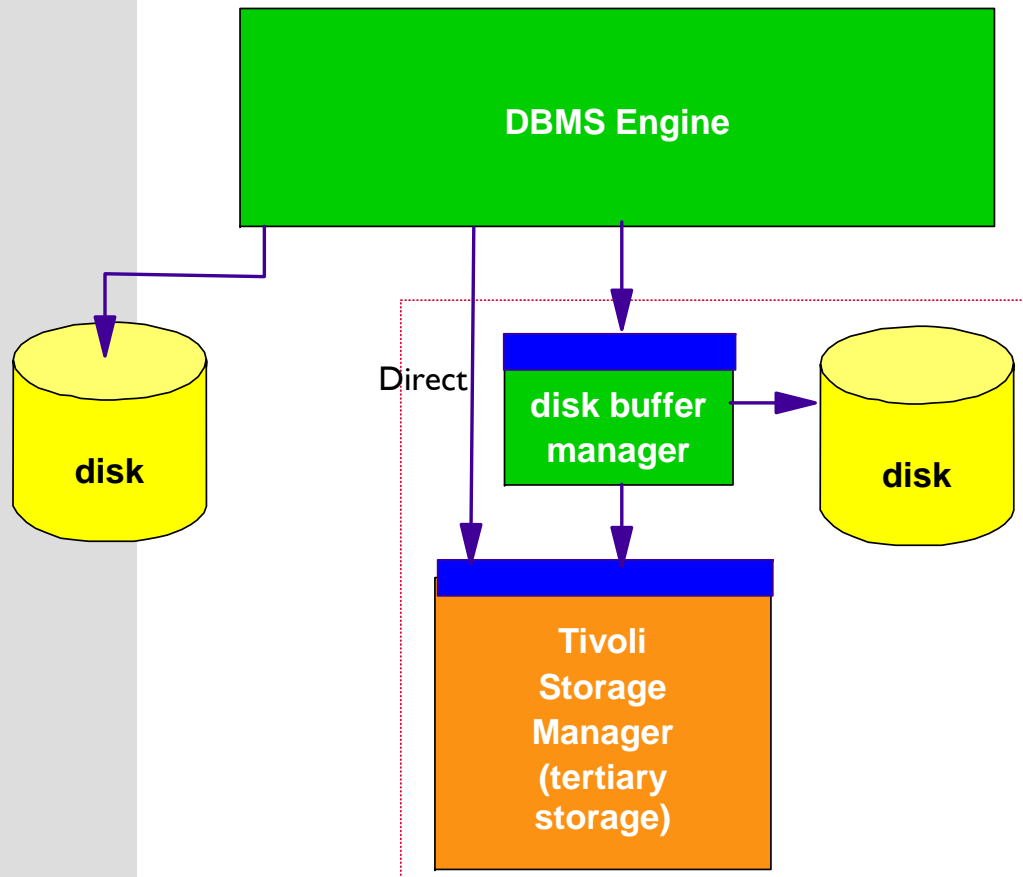
Create device driver layer to access objects in a Tivoli Storage Manager Server
Copy of index information kept in disk pool



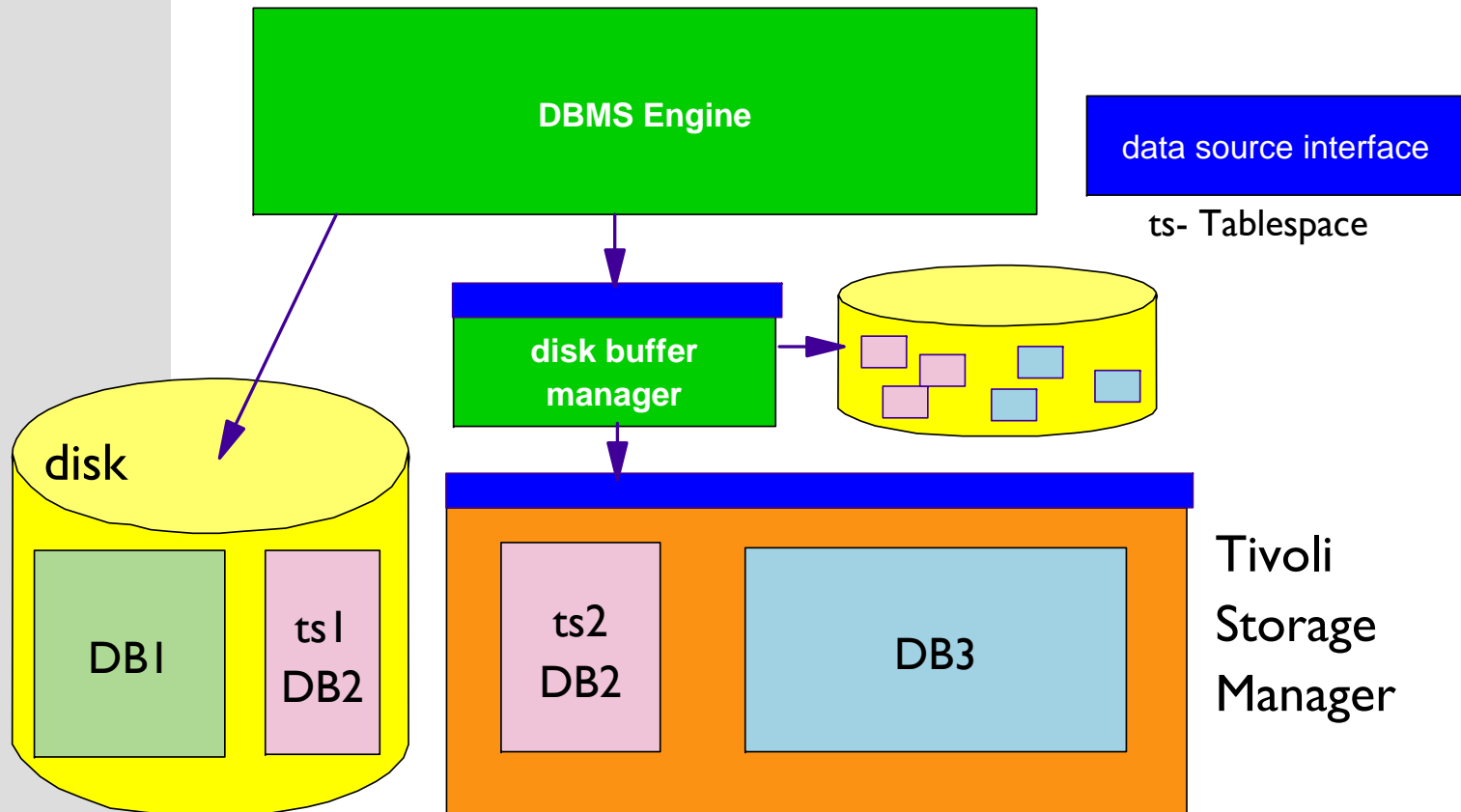
HSM for DBMS's

- Extends DBMS storage hierarchy:
cache - RAM - disk - HSM
- Can use current file level HSM or
- using DBMS integration
- Applications
 - history data management
 - decision support
 - data warehouse/mining
 - digital library
 - scientific datasets, experiment/sensor results

DBMS-HSM Architecture



Data Organization



Flexible Disk Caching

structured
columns

large object
columns

in secondary storage

in tertiary storage

Secondary	Secondary
Secondary	Secondary
Tertiary	Tertiary
Tertiary	Tertiary

Horizontal partition
history data, very large
table

Secondary	Tertiary
Secondary	Tertiary
Secondary	Tertiary
Secondary	Tertiary

Vertical partition
multimedia, digital
library

Secondary	Secondary
Secondary	Tertiary
Tertiary	Secondary
Tertiary	Tertiary

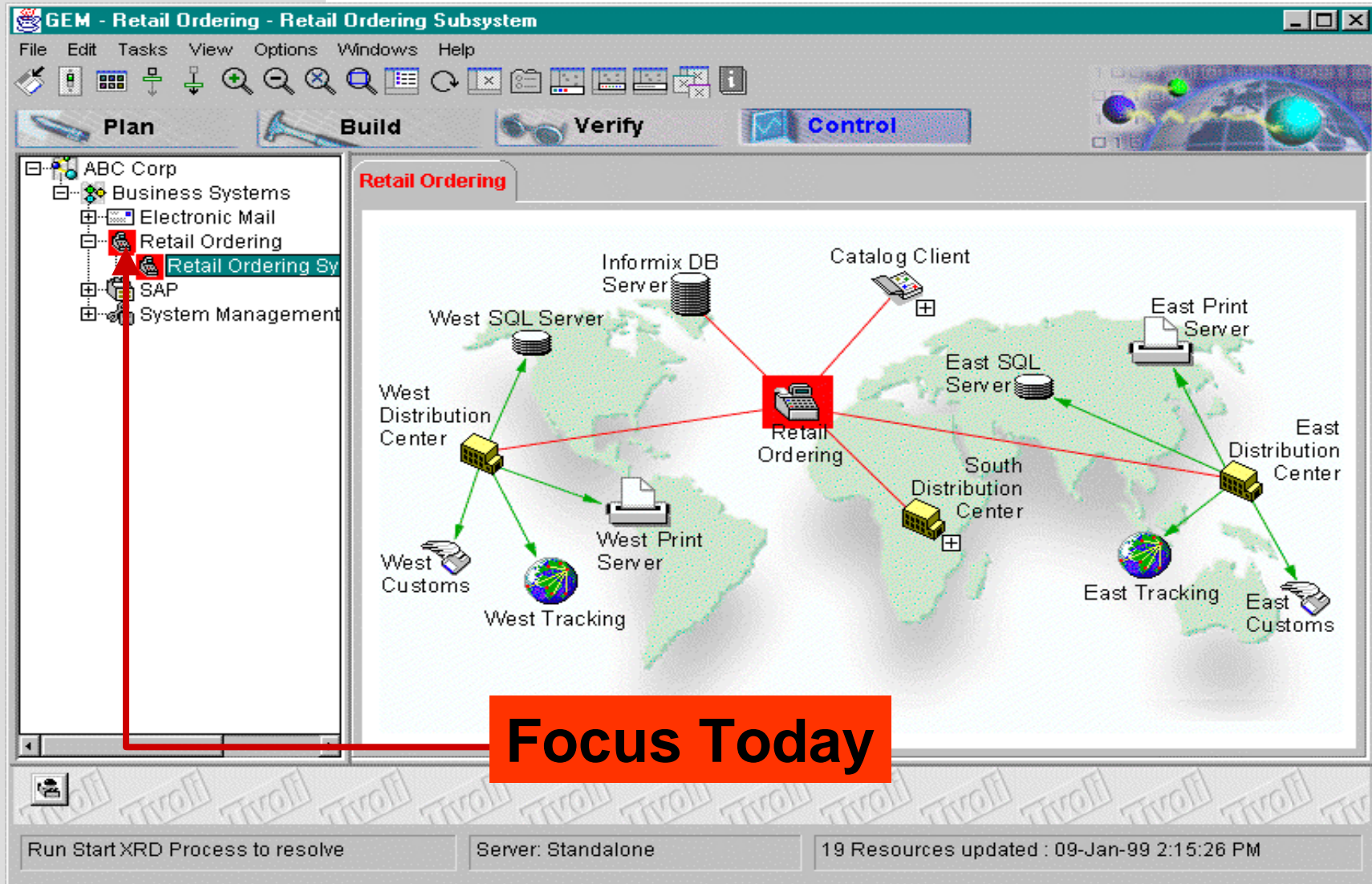
Flexible caching
support large structured
and LOB data

Tivoli Technologies

- **Leverage Tivoli Technologies so we don't have to develop our own**
 - GEM
 - Distributed monitoring
 - Event monitoring and trigger
 - TEC
 - Rules based event correlation
 - Decision support
 - Detailed reports, trends analysis
 - Software distribution
- **Focus our team on Storage Management**

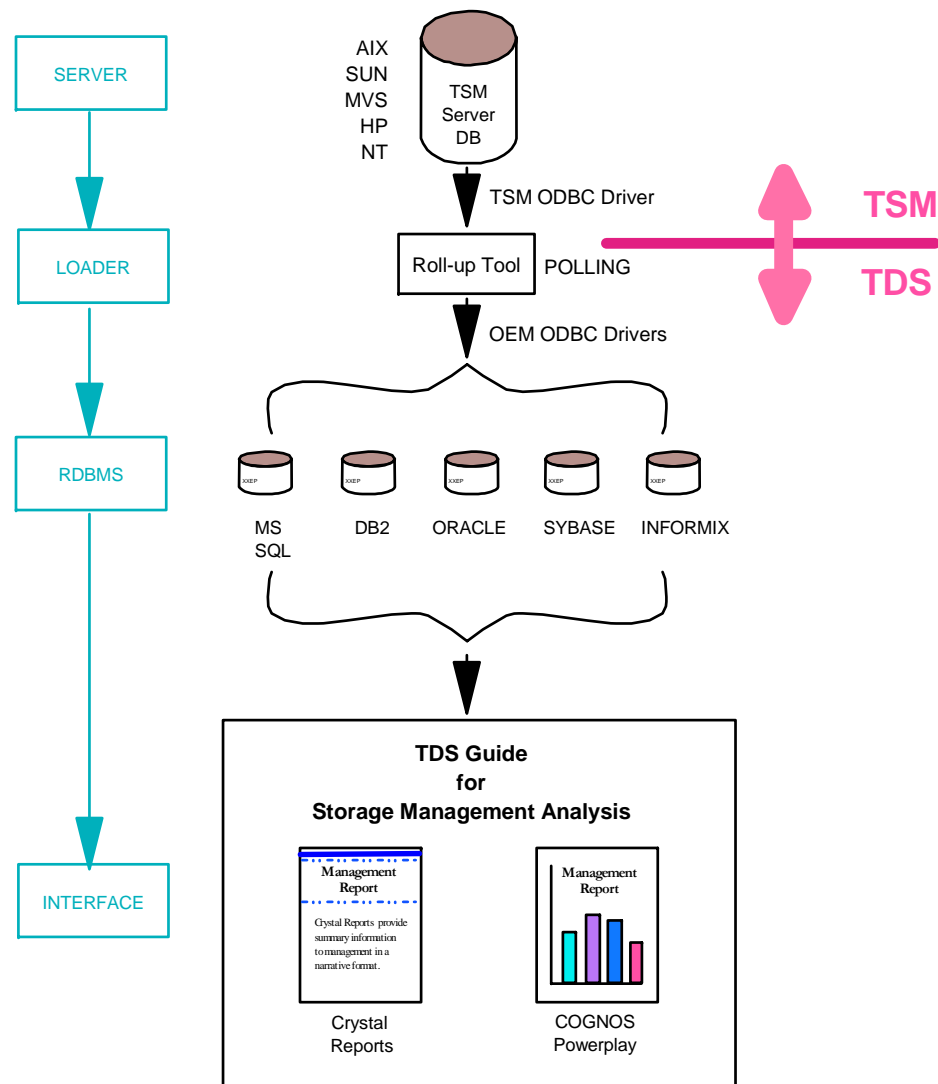


Leveraging Tivoli Global Enterprise Manager



Focus Today

TIVOLI Decision Support for Storage Management Analysis



Any questions?

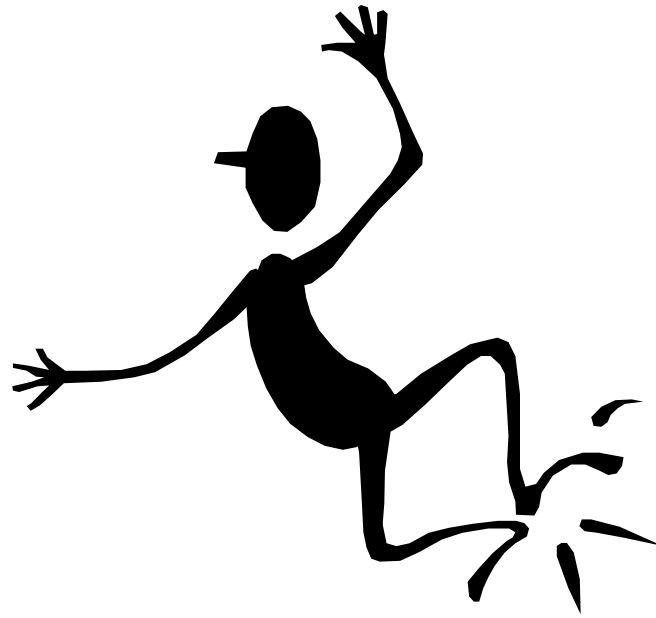


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Conclusion

If you want to contact me

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