How Oracle Came to Rule the Database World
NYOUG – 2007

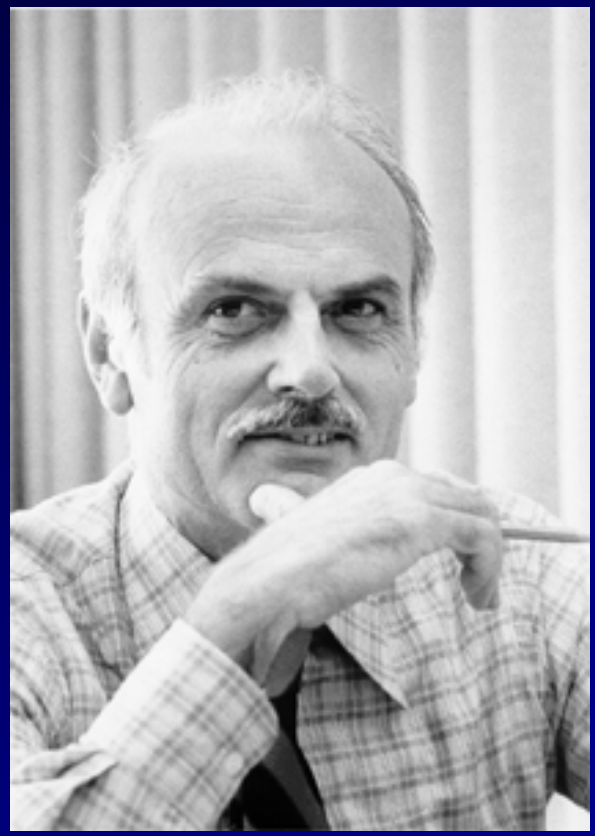
Rich Niemiec, TUSC

(Special Thanks: Andy Mendelsohn, Michael Olin, Paul Dorsey, Caryl Lee Fisher & Pat Holmes)

Overview

- The Paper that started it all – E. F. Codd
- System-R & Ingres
- Oracle is Founded as SDL
- V1-V10g
- Why did Oracle win?
- Future market direction
- Summary

1968: E. F. "Ted Codd" Invents Relational Theory in his mind



"The SEQUEL/DML paper got accepted to 1974 SIGMOD. Several years later I got a call from a guy named Larry Ellison who'd read that paper; he basically used some of the ideas from that paper to good advantage."

– Don Chamberlin, then IBM (SQL Reunion, 1995)

1970: Codd's Famous Paper

- In 1969, E.F. Codd publishes the internal version of his famous paper internally to IBM.
- June 1970: Edgar "Ted" F. Codd publicly publishes the paper: A Relational Model of Data for Large Shared Data Banks (Pgs. 377-387)
  - Information should be stored in tables
  - IBM refuses to implement his model to preserve revenues of IMS/DB
  - Customers pressured IBM to build it (System-R project) and a relational language SEQUEL (Structured English Query Language - later SQL). Oracle used pre-launch conference papers to write their own SQL & launched it first.

1970: Codd's Famous Paper

A Relational Model of Data for Large Shared Data Banks

E. F. Codd

Reprinted from *Communications of the ACM*, Vol. 13, No. 6, June 1970, pp. 377-387.

- 1. Relational Model and Normal Form

1.3. A Relational View of Data

The term *relation* is used here in its accepted mathematical sense. Given sets *S*1, *S*1, ···, *Sn*, (not necessarily distinct), *R* is a relation on these *n* sets if from *S*1, and so on. We shall refer to *Sj* as the *j*th domain of *R*. As defined above, *R* is said to have degree *n*. Relations of degree 1 are often called *un*

For expository reasons, we shall frequently make use of an array representation of relations, but it must be remembered that this particular representati represents an *n*-ary relation *R* has the following properties:

1. Each row represents an n-tuple of *R*.
2. The ordering of rows is immaterial.
3. All rows are distinct.
4. The ordering of columns is significant - it corresponds to the ordering *S*1, *S*1, ···, *Sn* of the domains on which *R* is defined (see, however, remark
5. The significance of each column is partially conveyed by labeling it with the name of the corresponding domain.

The example in Figure 1 illustrates a relation of degree called supply, which reflects the shipments-in-progress of parts from specified suppliers to sp

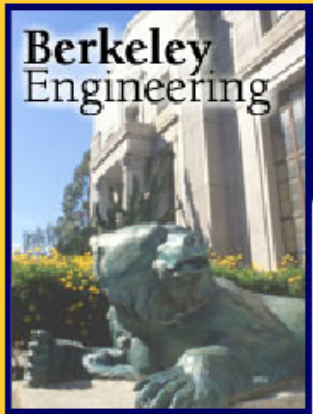
supply (supplier part project quantity)

1	2	5	17
1	3	5	23
2	3	7	9
2	7	5	4
4	1	1	12

Figure 1. A relation of degree 4

One might ask: If the columns are labeled by the name of corresponding domains, why should the ordering of columns matter? As the example in Figur

INGRES – 1974
INteractive Graphics Retrieval System



Volume 3, Issue 8
October 2003

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In This Issue

Lab Notes

Research from the College of Engineering, University of California, Berkeley

1974: The release of INGRES and the birth of the database industry
by David Pescovitz

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At the dawn of the digital age in the 1960s, large corporations began to migrate from paper records to digital files. The problem was that there was no easy way to find what you were looking for in the massive amounts of data stored. In the mid-1970s, UC Berkeley engineers pioneered a system to organize and access data that, in turn, spawned a $7 billion dollar industry now driven by companies like Oracle, Microsoft and IBM.

Michael Stonebraker, co-inventor of the relational database.

In 1970, IBM researcher E. F. Codd published a seminal paper outlining a novel way to organize and access data. Codd's "relational model of data for large shared data banks" called for information to be stored in tables that could be searched using a high-level language. Instead of searching through one record at a time, the user could specify a single query that would be performed across all of the data. For example, the new approach would enable

1974: INGRES

- 1972 Michael Stonebraker got a grant for a geo-query database system that would become INGRES
- Michael Stonebraker, Eugene "Gene" Wong & others including students coming and going work on INGRES
- Used QUEL instead of SQL
- In a 1976 paper at ACM, Stonebraker, Wong, Kreps & Held wrote a paper: "The Design and Implemenation of INGRES."
- Some hostility between Berkeley and IBM group.

1974: POST-INGRES

- Berkeley students Jerry Held and Karel Youseffi went on to build NonStop SQL (Tandem) based on Ingres.
- Robert Epstein (chief programmer at Berkeley) along with students Paula Hawthorne, Mike Ubell and Eric Allman formed Sybase.
- Sybase was licensed to Microsoft in 1992 and re-branded SQL Server.
- Postgres (PostgreSQL - 1996) is another Stonebraker project started in 1985. He decided to build a Post-Ingres database, again at Berkeley. The code base for Ingres & Postgres started and remain separate.

Somewhere along the way... 1976

- "Larry called up from SDL. He had heard about the System R prototype and he wanted to make sure that his product was fully compatible with it, right down to the error code values. We went and asked Frank, if we can give our error codes to this guy Ellison and he said 'No' – those are IBM Confidential"
  - Don Chamberlin, then IBM (SQL Reunion, 1995)
- "I remember until 1979 we were publishing everything that would come to our mind either implemented or not implemented, or dreamed of; and then all of the sudden there was a barrier."
  - Franco Putzolu, then IBM (SQL Reunion, 1995)

Somewhere along the way… 1976

- "People should know that patents were basically prohibited. Patents at this time were prohibited by the company and the Supreme Court. Software patents."
  - Mike Blasgen, then IBM (SQL Reunion, 1995)
- "If we had not published those papers, it (SQL/Relational) would have failed. Now the reason it would have failed is that IBM would have ignored it."
  - Mike Blasgen, then IBM (SQL Reunion, 1995)

"I think there is a world market for maybe 5 computers."

- Thomas Watson, IBM Chairman '43

1977: Oracle Begins as SDL
Software Development Laboratories

"In fact, when I started Oracle, the goal was never to have a large company. At best, I hoped we would have fifty people in the company and make a good living. About five years into the company, it became pretty clear that the horizons were unlimited. The only limitations were us."

– Larry Ellison (Nicole Ricci Interview, 1998)

1977: Relevant Pre-Oracle Events

- Prior to forming a company, Bob Miner & Larry Ellison were working for Ampex on a CIA project code-named "Oracle." Larry decided Bob Miner should be his boss since he didn't like his current boss.
- Ed Oates (the third founder) was walking by Bob's office when Larry mentioned his wife's name and it turned out to be Ed's lab partner in high school.
- Larry went to Precision Instruments and found out about a 400K project which was subsequently landed by the founders.
- When the company Software Development Labs (SDL) was formed, Bob Miner was the President as Larry was still at Precision Instruments. Bruce Scott (then 24 years old) was the first developer hired.
- They finished 90% of the work of the two year project in the first year and used the money to write the Oracle database in the second year.

1978: Relevant Pre-Oracle Events

- Bob wanted to use the 200K they had saved on an ISAM product for the PDP11. He thought an access layer was needed. Larry wasn't interested in that and had been following the System-R papers as well as E. F. Codd's original paper.
- Larry brought a paper on SEQUEL/2 and asked if Bob & Bruce could code it. They thought it would be easy enough.
- Bob Miner and Bruce Scott coded the new product while Ed finished the consulting project.
- In 1978, The CIA is first customer, yet the product is not released commercially as of yet.
- SDL changes its name to Relational Software Inc. (RSI)

"Why was Oracle Successful?"

"I've thought about this a lot. I really think that it was Larry. There were a lot of other databases (like Ingres) out there that we beat. It was really Larry's charisma, vision, and his determination to make this thing work no matter what. It's just the way Larry thinks. I can give you an example I tell people that exemplifies his thought process: We had space allocated to us and we needed to get our terminals strung to the computer room next door. We didn't have anywhere to really string the wiring. Larry picks up hammer, crashes a hole in the middle of the wall and says there you go. It's just the way he thinks, make a hole, make it happen somehow. It was Larry, the right thing and the right time."

- Bruce Scott (Select Magazine Interview with Rich Niemiec, 2001)

The greater the difficulty, the more glory in surmounting it. **Skillful pilots gain their reputation from storms and tempests.**
-- Epictetus, Greek philosopher (c. 55-c. 135)

Version 1

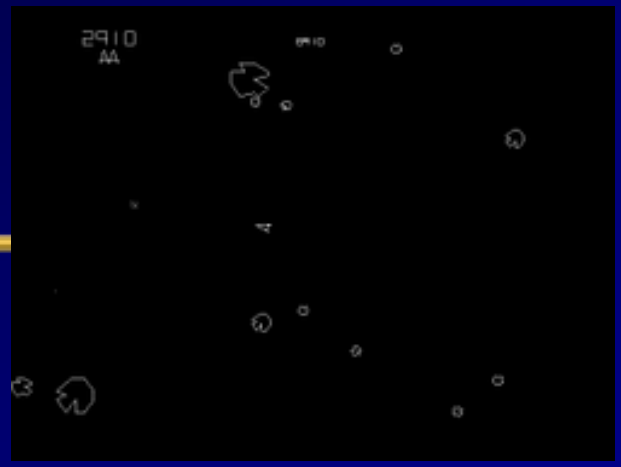
- There was no Version 1!
- There was never a plan for a Version 1.
- Larry didn't believe people would buy version 1 of a product.

1979: Oracle Version 2
Competing with Hierarchical Databases

Does anyone ever ask for their money back? No, but they used to ask us for their DATA back.

- Larry Ellison (answering question during the early versions of Oracle)

1979: Version 2



- Written in Assembler Language for PDP-11.
- The first commercial version of the database is sold to Wright-Patterson Air Force Base in 1979.
- It would be the first commercial version of any relational database sold.
- 1982 – RSI changes its n
(OSC) and then simplifie
- 1981 – The first tool, Int
which is a predecessor to
created.
- 1982 - Sohaib Abbassi is
and heads the Developer
(Oracle has 30 employee

1979/1980: SIGMOD Conference

"I remember seeing the Oracle system running for the first time. Larry knew about System R and about our work and he gave me a little demo. I was impressed, because it was obviously simple. It seemed fast. He loaded the database, queried it, and updated it, all in a few seconds. It was - I don't know how many - maybe five-hundred records. And it loaded instantly. The thing that impressed me the most was that it ran on a little PDP-11. The machine looked to be the size of a carton of cigarettes. It must have been an LSI-11 version of the machine, if my recollection of the size is correct. And System R at the time in most of our joint studies and at IBM was running on 168s. Now a 168 is only maybe the power of a 486DX2 or something, but the fact of the matter is it was a huge machine which would probably not fit in this room (water cooled)."

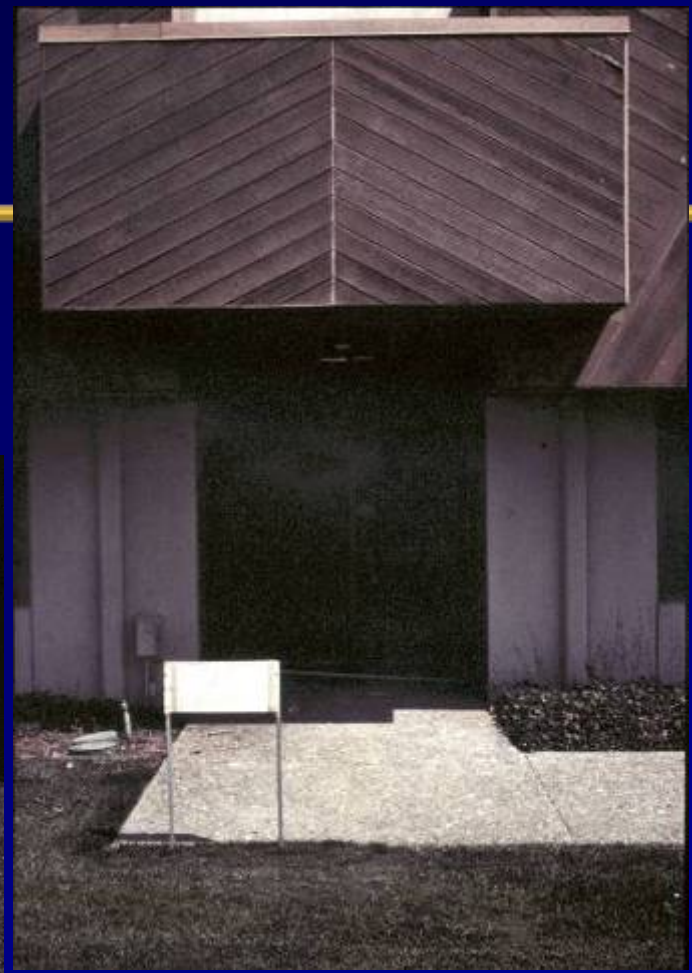
- Mike Blasgen, IBM System-R Team

1979/1980: SIGMOD Conference

“I thought, "Simple, fast, cheap; that's neat. People will buy it."

- Mike Blasgen, IBM System-R Team

1983: Version 3
Rewrite to C



We had our first user conference which drew 25-50 people and I thought...It's beginning to catch on."

- Bruce Scott (scott/tiger)

1983: Version 3

- Written in C for portability.
- Bob Miner is focused mostly on fixing a buggy Version 2 which is gaining customers.
- Bruce Scott is the main coder converting to C.
- The conversion is done but is very buggy.
- Bruce Scott leaves and co-founds Gupta.
- Bob Miner is left to support Version 2 and finish fixing and writing Version 3.
- Version 3 is the FIRST 32-bit RDBMS.

1984: Version 4
Adding new tools

1984: Version 4

- Version 4 is the FIRST RDBMS with read consistency.
- Oracle is becoming stable and well known
- Oracle ported to PC - Ashton Tate DBASE a huge competitor on PC.
- The forms product (IAP/IAG) includes a series of questions that are answered which generates a file which can be edited.
- Editing the .INP is a must & continues for several versions after the first despite a not so friendly user interface.
- Oracle is preparing for an IPO.
- Derry Kabcenell improves performance; Beats Ingres on WI benchmark

"And so I went to work at Oracle. It was funny, because when I got there, I'd come from IBM and Esvel, where the customer's data's sacred. The first day, walking down the hall, Ed Oates, one of our early employees, said "Oh, so-and-so's database got hosed again."

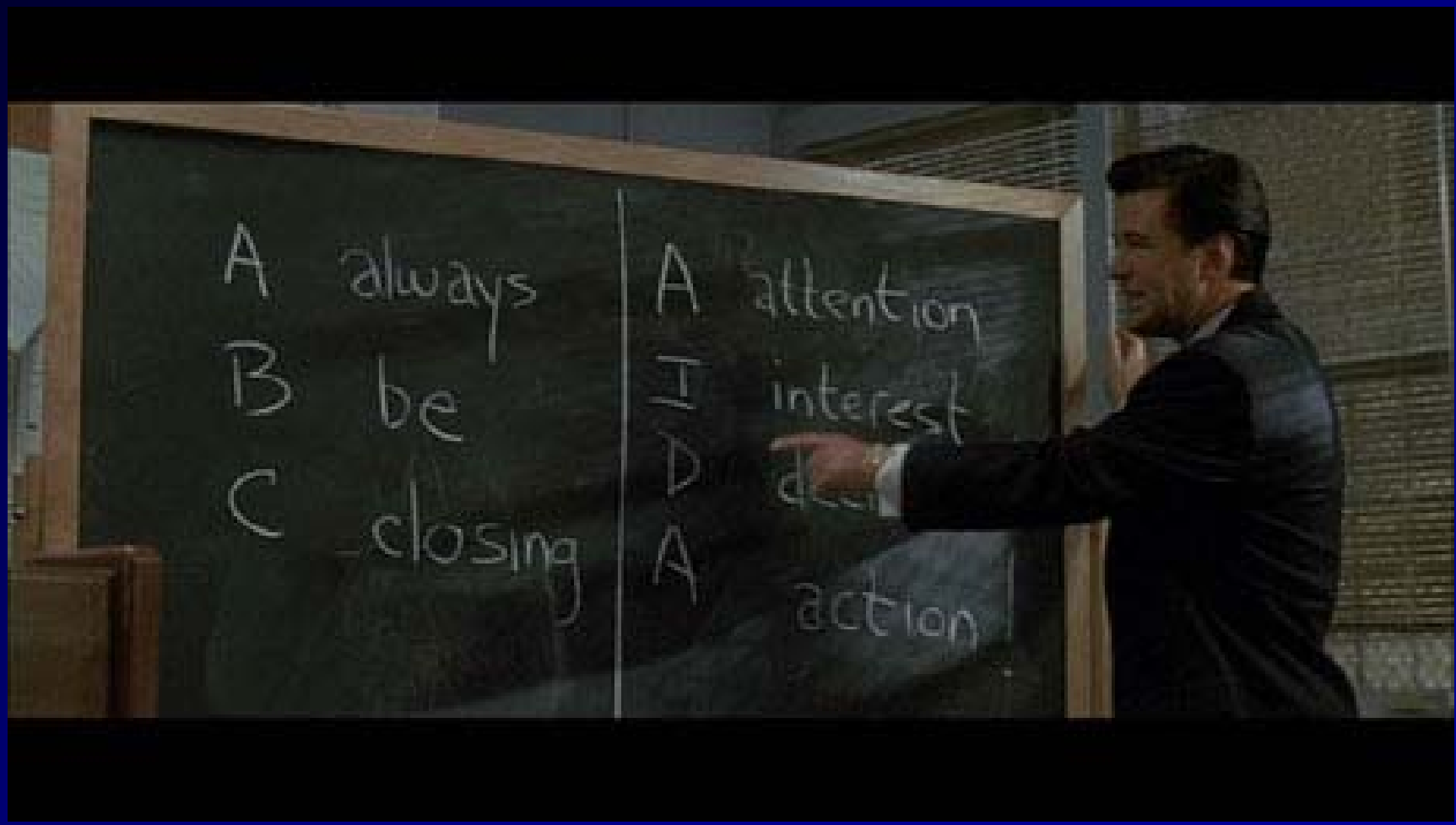
- Roger Bamford, (first day at Oracle 1984)

On Sohaib Abbasi

- "They hired this guy - this is typical Oracle, actually - they hired this guy straight out of school; a smart guy; he'd done a little programming. And the first thing he did was the UFI thing, and then he built IAP, which is this forms-based application. Nobody at Oracle was held back by lack of experience."

- Roger Bamford, Oracle lead designer V6

1985: Oracle Version 5: Last version released before IPO



1985: Version 5

- Derry Kabcenell is the lead developer.
- Oracle is becoming mainstream on some platforms.
- Distributed Database & Decision Support
- 5.1 (1986) is the FIRST Distributed database on VMS/VAX (first hint of RAC thought process)
- The BI (Before Image) file for rollbacks.
- CCF (Create contiguous file) to add a DB file
- IOR W (Warm start the database)
- Oracle goes public in March 1986 after this release and has revenues of $55M USD.

1986: 8 Great Days to Invest in IPO's

March 4, 1986 – Sun (Stanford University Network)

March 12, 1986 – Oracle

ORCL IPO:
Open:15
Close:20.75
Up 38%

March 13, 1986 – Microsoft

8 Days to Invest in IPO's

- Did the proximity of these IPO's make a difference?
  - They were all pushing non-proprietary, open systems eventually that battled the mainframe.
  - Sun and the wave of other UNIX vendors certainly put wind in Oracle's sails.
  - Microsoft and Oracle had an eventual common foe in IBM.
  - Oracle was the common thread between all of them!

1987: Oracle Applications Practice

- It was a good year!
- Oracle is the now the largest DBMS company.
- Oracle Applications group started.
- First SMP (symmetrical multiprocessing) database introduced.
- Rich Niemiec along with Brad Brown and Joe Trezzo join Oracle and implement the first production client/server application running Oracle for NEC Corporation. It is a "souped-up" 286 machine with memory boards stacked on top of each other which require fans mounted on the wall blowing on the computer at all times.

1988: Version 6
Total Rewrite for Transaction Processing

"There were user conferences where I thought I needed to wear a bulletproof vest. People were really upset with us."

- Randy Baker, Head of Oracle Support

1988: Version 6

- "Rows in Versions 3 and 4 and 5 were concatenated in blocks - you know: byte, byte, byte, byte, byte, byte, byte ... with no index or anything. So if you wanted row sequence number twelve, you'd start at the beginning of the block, and you'd start scanning over columns, and rows ...; and eventually there'd you'd be, right where you were looking for. So how do you update a row and make one of the columns bigger? Well, you shift the rest of the block to the right ..."

  - Roger Bamford, Oracle lead designer V6

1988: Version 6

- Roger Bamford / Derry Kabcenell are co-lead developers.
- First version of V6 is a disaster, but later versions took the market by storm.
- Oracle is mainstream and in many major companies
- PL/SQL is introduced / Hot backup introduced
- Row Level Locking (Roger writes read consistency)!!!
- B-Tree indexes implemented (Andy Mendelsohn)!
- Oracle moves from Belmont to Redwood Shores
- First version of Clustering DEC/VMS only (V6.2)
- Oracle restates earnings and has to do layoffs (1990)
- Oracle hires Jeff Henley and Ray Lane (1990)

Oracle passes the "ACID" test

- Atomicity (for a transaction - it all succeeds or it all fails)
- Consistency (transaction at a legal state when it begins & ends); can't break integrity constraints or rules.
- Isolation (Nobody sees changes in another session until those changes are committed – "serializable")
- Durability (Once committed, it stays committed! even if the database crashes – fast commits implemented by a quick write of transaction commit record to redo logs)

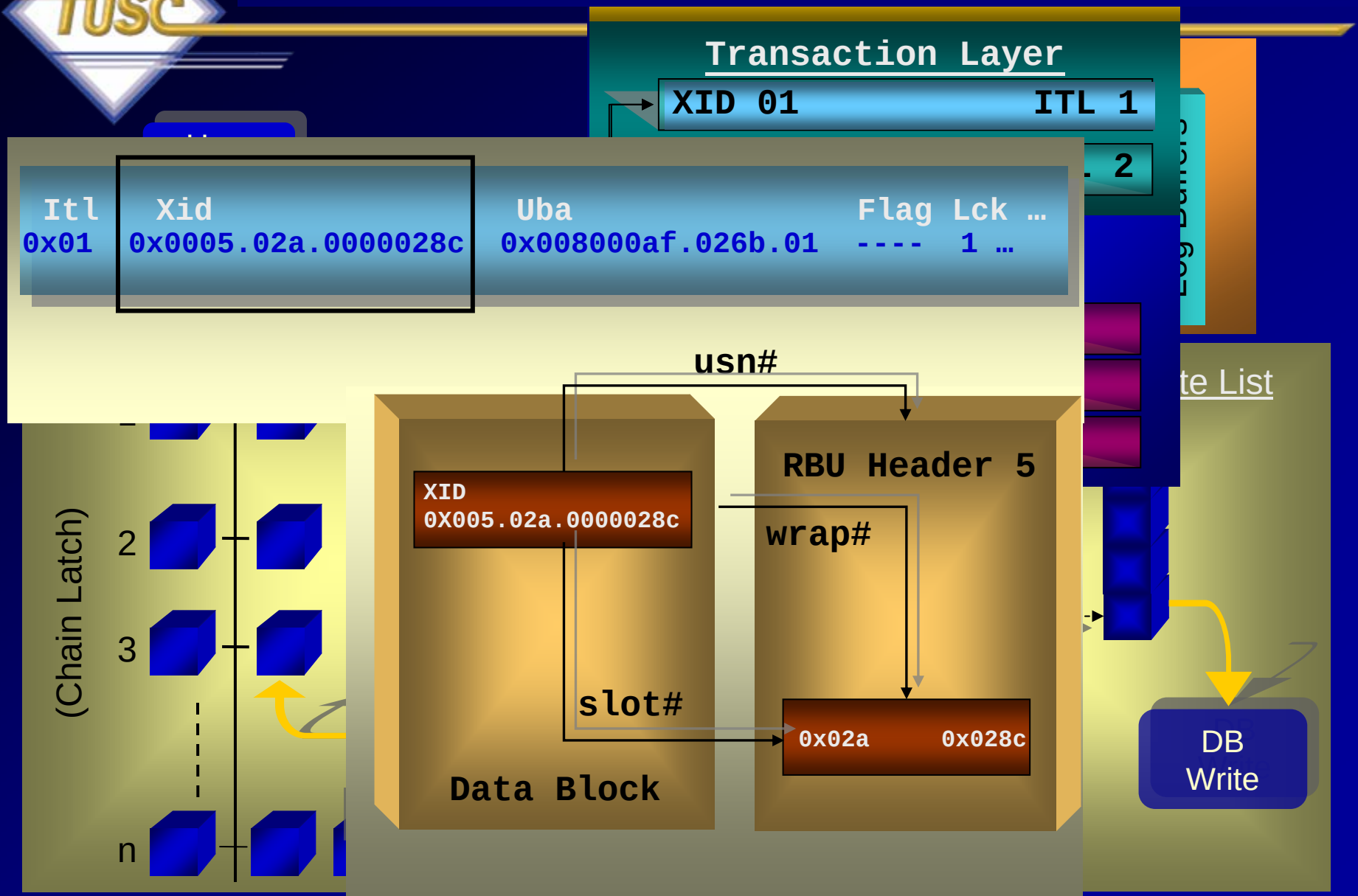
Oracle does not allow dirty reads (uncommitted data), the isolation level is "read committed."

Oracle passes the "MVCC" test
Multi-Version Concurrency Control

- Multi-Version Concurrency Control allows for concurrent access to the database.
  - The ITL handles a lot of the DML coordination
  - Transaction ID's & SCN's are key to this process
  - No read/write conflicts

- Main Databases with MVCC or (MCC)
  - Oracle
  - SQL Server 2005
  - MySQL with InnoDB tables, PostgreSQL
  - Readers don't block writers, writers don't block readers

Transaction Identifiers



1992: Version 7
Parallel Query, Triggers & Stored Procedures

"I admire risk takers. I like leaders – people who do things before they become fashionable or popular. I find that kind of integrity inspirational."

LAWRENCE J. ELLISON | *Chairman & Chief Executive Officer, 2003*

1992: Version 7

- Stored Procedures
- Triggers
- Declarative Referential Integrity
- Security Features
- Parallel Query (7.3)
- Ellison announces the Network Computer (1995) and the internet as a key Oracle strategy.

1993-1996: Version 7 to 7.3

- 1993 – Oracle GUI client/server development tools introduced.
- 1993 – Oracle Applications moved from character mode to client/server.
- 1994 – Bob Miner, the genius behind the Oracle database technology, dies of cancer.
- 1995 – FIRST 64-bit database.
- 1996 - Oracle7.3 released.

1998: Version 8i: The Internet Version

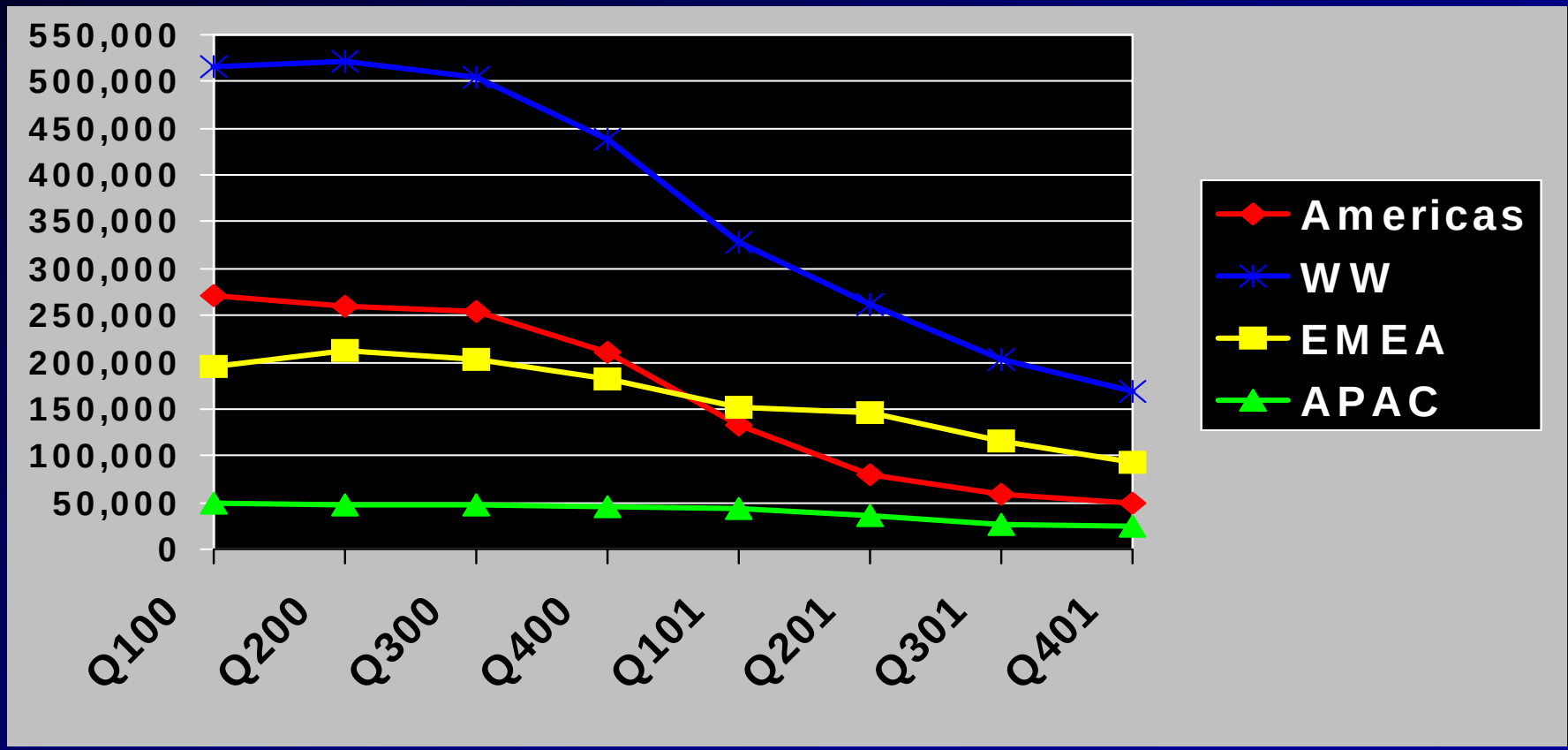
"If the internet turns out not to be the future of computing, we're toast. But if it is, we're golden."

- Larry Ellison, 1998

1997-1998: Version 8.0/8i

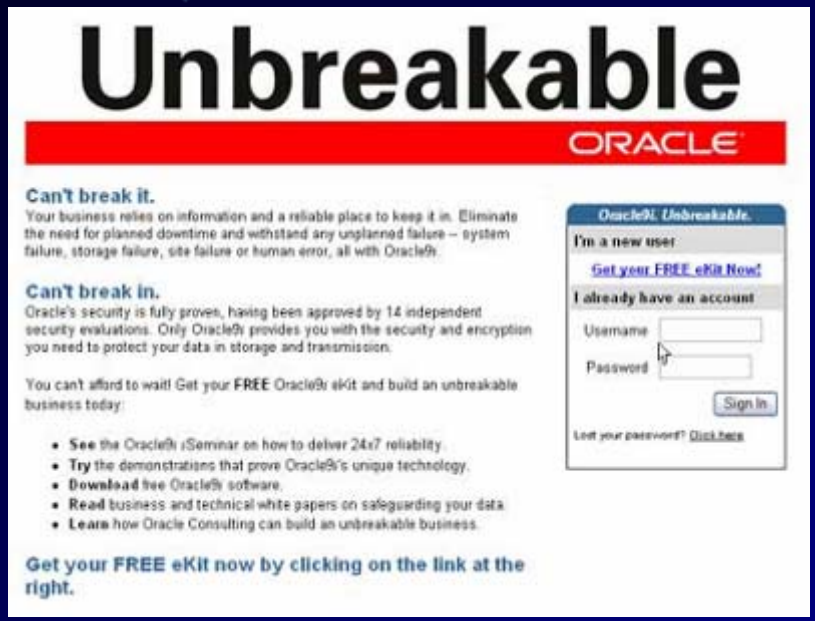
- Two HUGE years
- **Oracle's strategy shifts toward the internet and browser based development.**
- 1997 – Oracle Application Server is introduced. Applications for the web introduced.
- Oracle is the FIRST web database.
- Oracle BI tools like Discoverer are introduced for data warehousing. Tools have native Java support.
- 1998 – First major commercial RDBMS (Oracle8) ported to Linux.
- 1998 – Applications 11 shipped.
- 1998 – Oracle is the FIRST database with XML support.
- 1998 – Oracle 8i released.
- Integrates Java/XML into development tools. Oracle is the first database with native Java support.

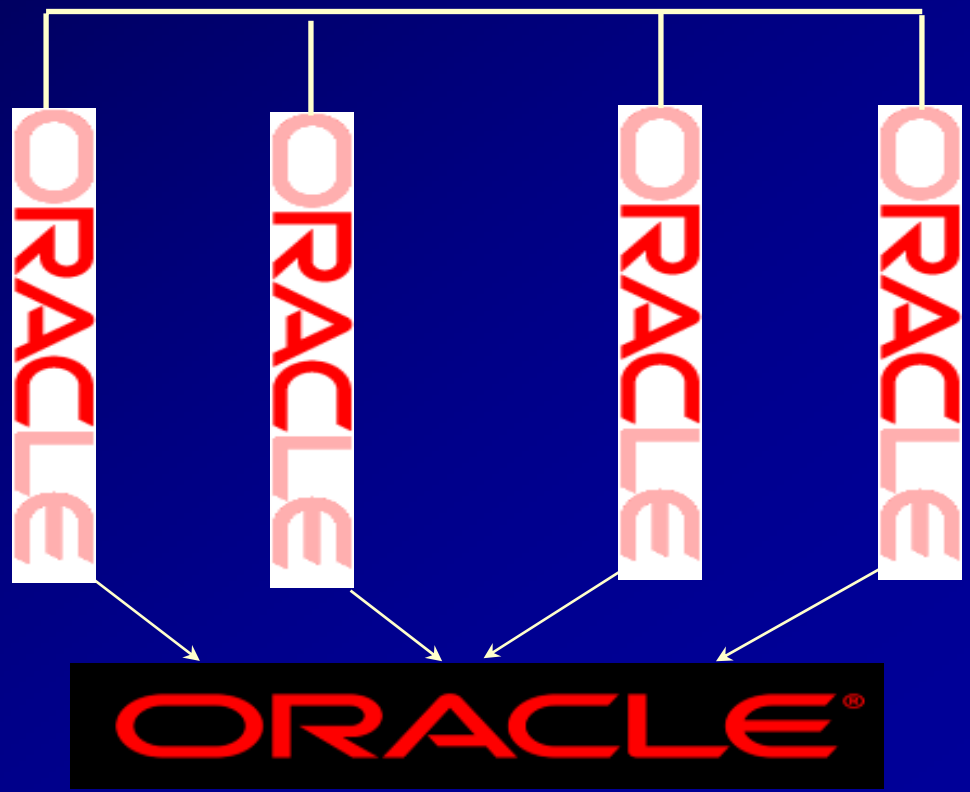
Metalink Takes Off!



- **Phone TAR Volumes are decreasing at 20% a Quarter**

2001: Version 9i: Unbreakable & RAC



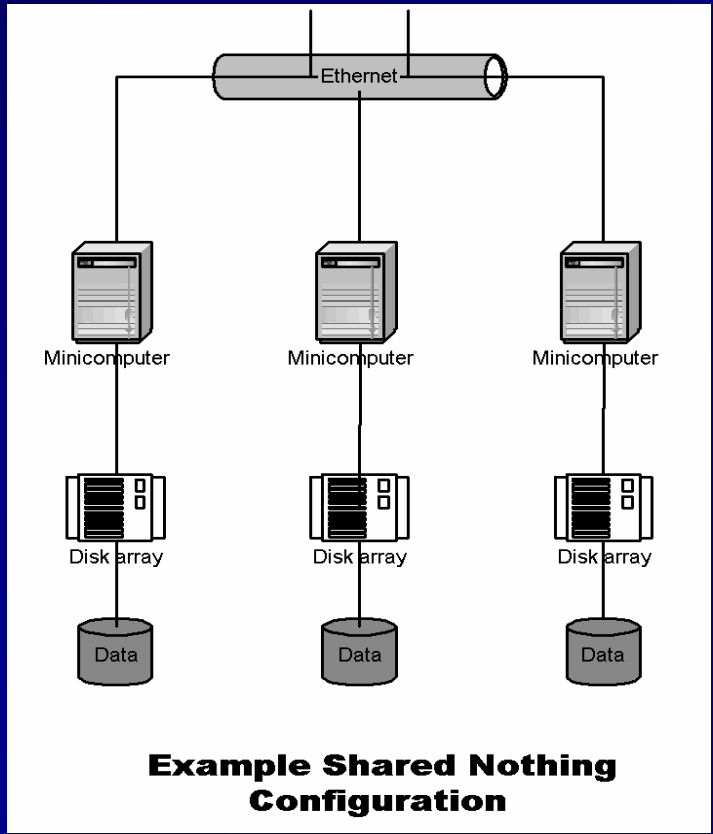


2000-2002: Version 9.0 - 9i (9.2)

- 2001 – Oracle9i (9.1) released
- 2000 – Oracle9i Application Server released at Oracle becomes the first database with middle-tier cache.
- Oracle launches E-Business Suite
- Wireless database with OracleMobile
- Oracle9i Application Server Wireless and Internet File System (iFS).
- Oracle is the first database with Real Application Clusters (RAC)
- 2001 – Oracle announces it saved $1B USD using its applications
- 2002 – Oracle9i Release 2 (9.2) released

Introduction to RAC

- IBM drove the Shared Nothing Architecture in its cluster solution.
- Others that use this:
  - Teradata
  - Netezza
  - Google



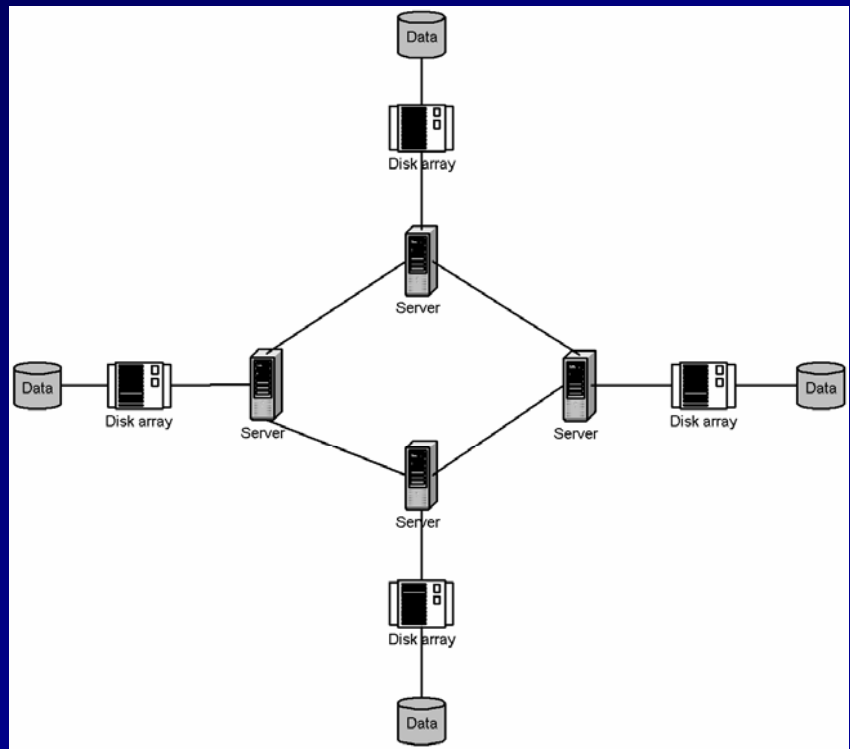
Example Shared Nothing Configuration

Introduction to RAC

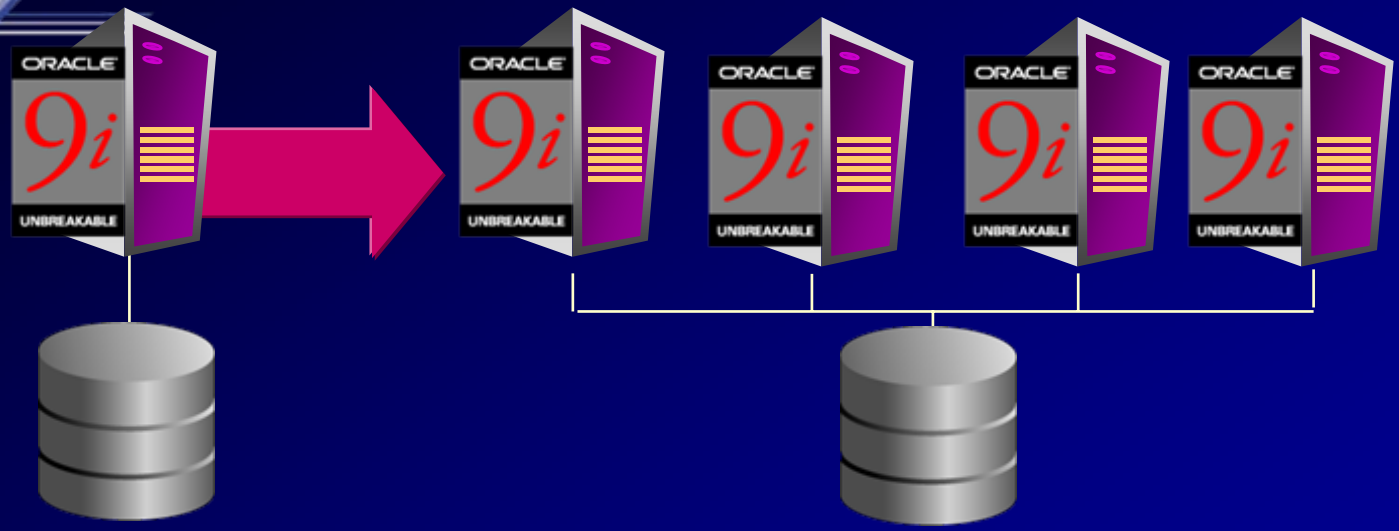
- Shared nothing architecture uses data partitioning where each server has independent memory and disk architectures
- The problems are:
  - Loss of a node loses that nodes data
  - Adding a node means the database must be re-organized
  - Backups are complex
  - Suffers from convoy effect (only as fast as the slowest member)
  - Requires complex two-phase commit architecture for referential integrity (similar to Oracle6)

Introduction to RAC

- Federated Databases (Microsoft based Architecture)
- Similar to shared-nothing

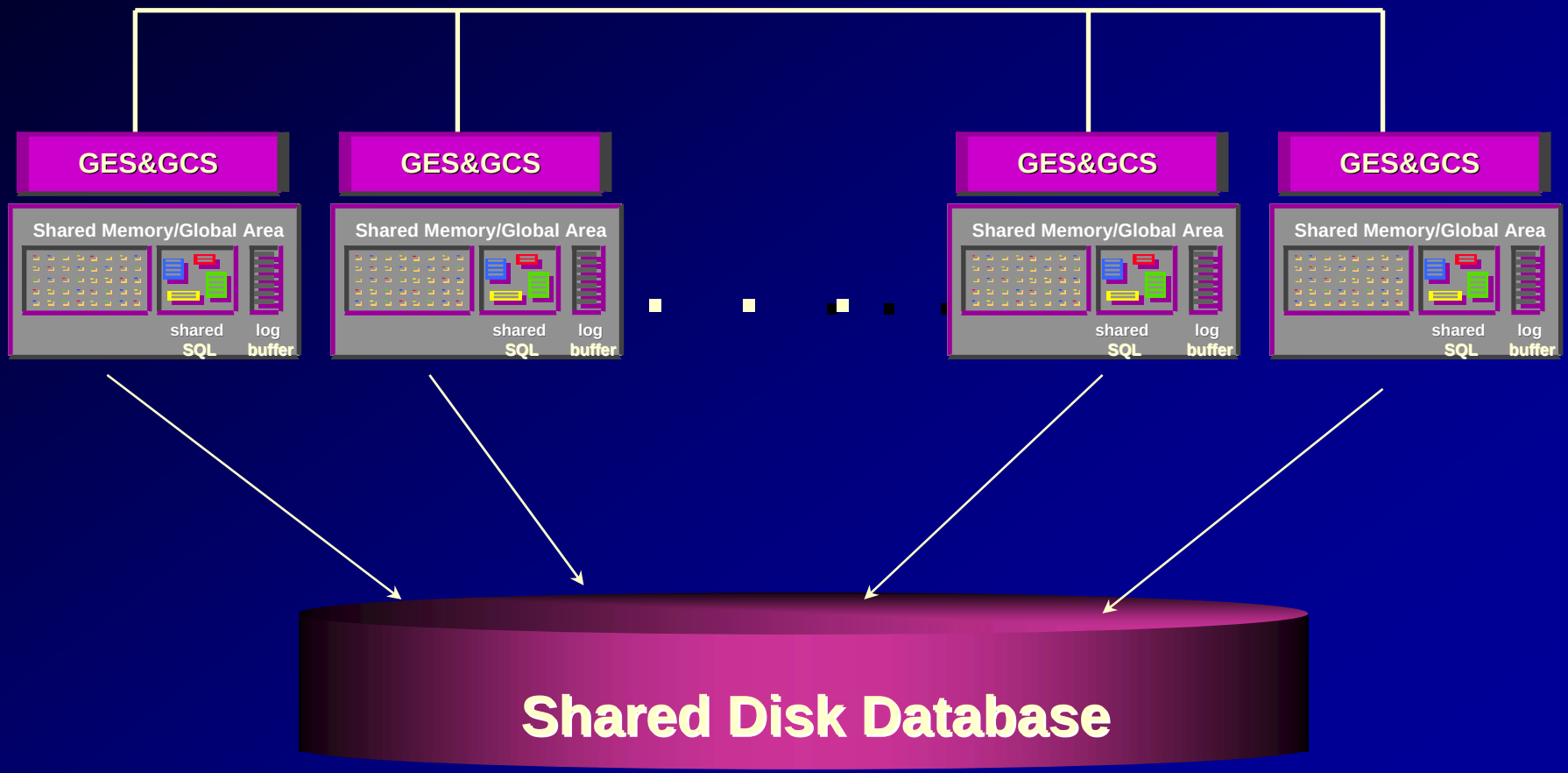


Introduction to RAC

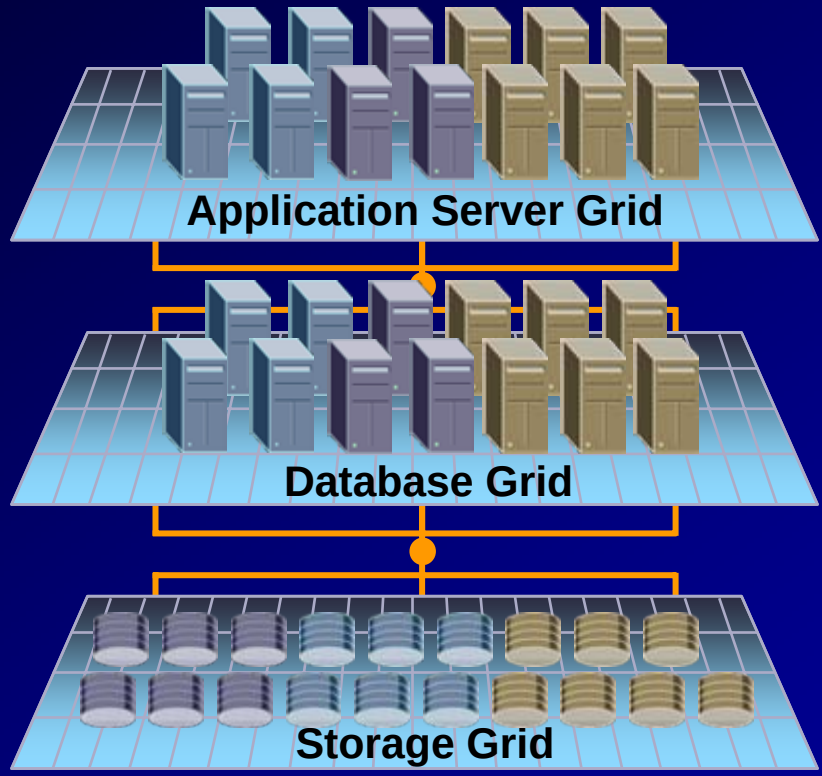


- Start small, grow incrementally
- Scalable AND highly available
- NO downtime to add servers and disk
- OPS was the beginning in Oracle6 for Digital only. In Oracle8i it was expanded to other platforms. OPS was 95% rewritten to RAC in Oracle9i & expanded for Grid Computing in 10g.

Introduction to RAC
Shared Data Model / Mega-SGA



2004: Version 10g Grid Computing



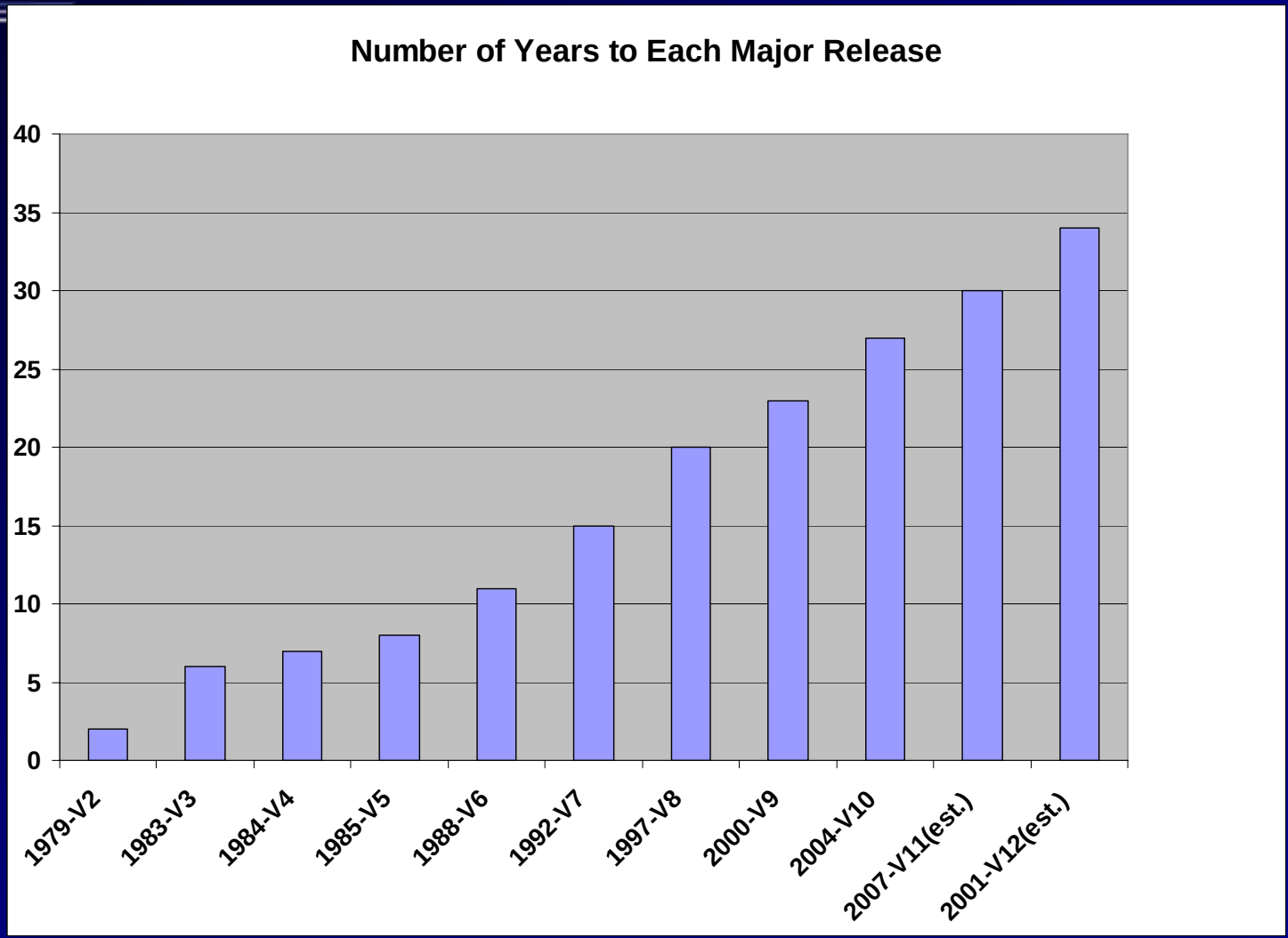
"Forrester estimates that there are more than 1,200 customers who are currently using RAC in production, and this is likely to double in the next 12-18 months…"

- Forrester, Oracle RAC Gains Momentum - 9/15/05

2004: Version 10g

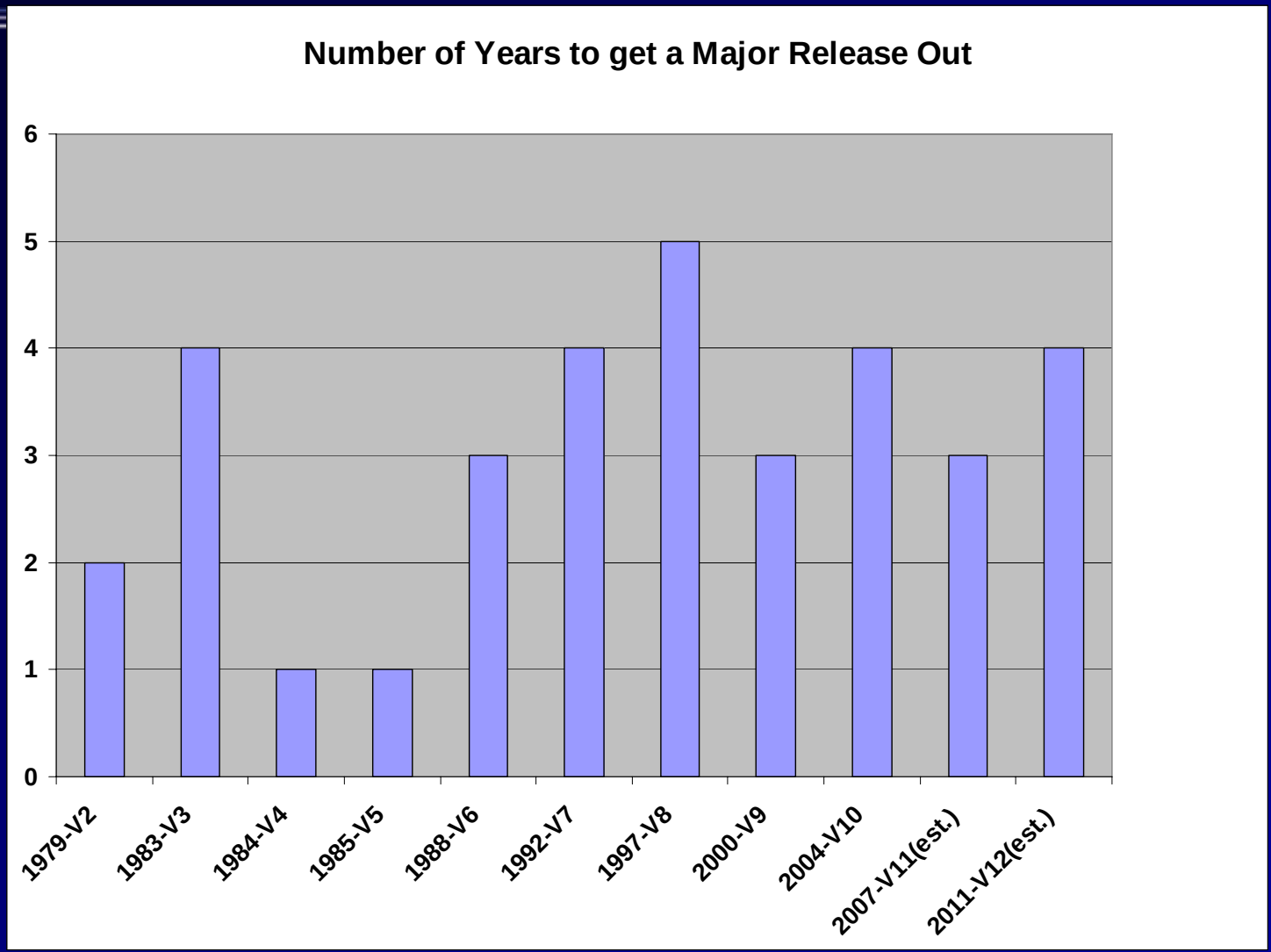
- Grid is the Focus
- Andy Mendelsohn is the database head (Heard about Oracle from Derry Kabcenell at MIT – came later from ESVEL)
- Many "key" developers are still with Oracle since version 5 or earlier.
- Automated Storage Manager (ASM) Introduced
- Flashback everything (Database, Table, Drop)
- Automatic Tuning and a great Enterprise Manager
- Recycle Bin
- Transportable tablespaces more flexible

Years that it took to release V2-V10
V2 in 2nd year (1979), 10g in 27th year (2004)



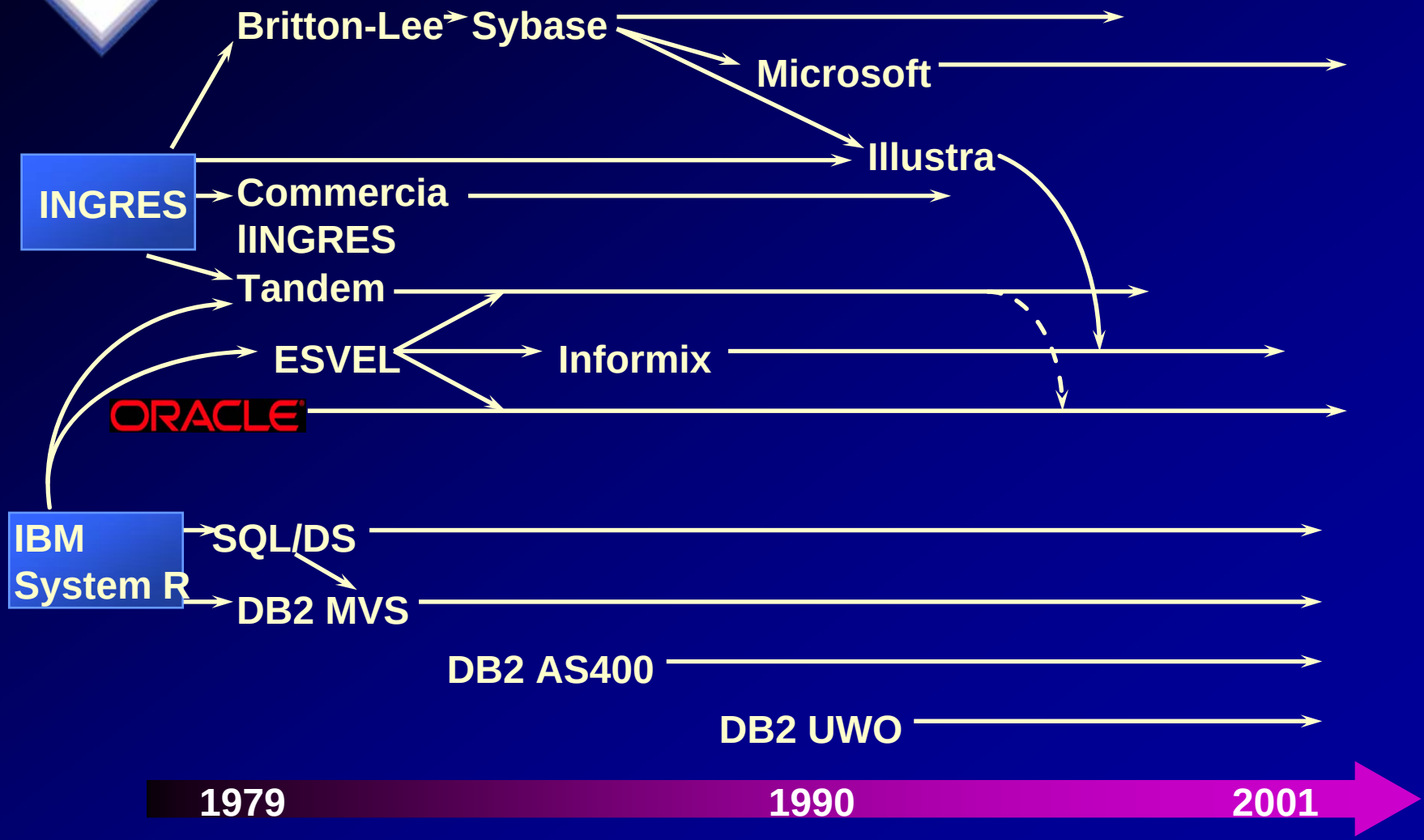
Note: V7.3 (1996) & V8i (1998)

Years to get a Release Out
V2 took 2 years, 10g took 4 years



Note: V7.3 (1996) & V8i (1998)

Genealogy of Commercial Products



Source: Andrew Mendelsohn

I asked a lot of "Oracle Old Timers" (those with over a decade or so working with Oracle) on why Oracle Won the Database Market.

Why did Oracle Win?
Ordered by largest responses

- Sales & Marketing
- Superior & Complete Product (specifically read consistency at a critical juncture)
- Larry Ellison initiative, drive and risk taking
- Many Partners especially UNIX partners
- Early support for client-server & distributed databases
- Solid kernel and superior locking scheme
- They fixed problems quickly & they never look back
- They were open: Multi-platform & UNIX early on
- Great recruiting, incentives (penalties) & HR benefits

Why did Oracle Win? From a Sybase Observer

- I remember is that Oracle 7 was released around the same time as Sybase System X. Sybase was quickly gaining ground on Oracle, but System X was an absolute disaster. You had one archive log & you had to manually check and offload when it reached a certain threshold of fullness, no row-level locking, and you had to run database consistency checks (dbcc's) every night to ensure your database pointers were all intact (and oftentimes they were not). People quickly realized that Oracle was much more reliable and easier to administer, and developers loved the capabilities.

Why did Oracle Win? From an Informix Observer

- Inform
- Inform into th know a
- TPC b
- The CE earning and In
- Oracle

Why did Oracle Win? From a DB2 Observer

- I think DB/2 wasn't as big of a competitor because client/server technology was hot, and people wanted to move their skills away from mainframe technologies. DB/2 was certainly fast but lacked a lot of the features developers need, like outer joins. IDMS was (and maybe still is) many times faster than Oracle, but was difficult to create ad-hoc queries against the data.

Why did Oracle Win? From a SQL Server Observer

- Microsoft was not interested in databases
- Microsoft was only about low cost (where they did win)
- They were not willing to be on anything but Windoze
- There is no "killer application" running on Windows
- SQL Server will feel the most pressure from open source databases in the next few years
- Of course Microsoft could get back in the game if they bought SAP.

Why did Oracle Win? From a Developer Perspective

- Completeness of the developer tools
  - PL/SQL, Forms, Reports, and now the Java tools.
- ADF framework for Java restores productivity lost with the advent of Java and its 2GL language.
- Oracle supplies the complete toolset for Java development
- Oracle seems to be in tune with how its database product is being used in the real world
- 90% of the time Oracle can do it, and it can do so with features and capabilities that already in existence.
- Very rarely must client look beyond the Oracle products

Why did Oracle Win?
My Reasons…

- Oracle is First at everything
  - First Relational, 32-bit, 64-bit, client/server, browser based apps, Web database, first to 30K TPC, first to 100K TPC, RAC/Grid
- Oracle creates the bend in the road (other vendors build products around Oracle's/Larry's vision)
- Oracle technology is better at the block level (record level locking and manipulation of data)
- Owns the top meaningful benchmarks (owns every top TPC-H benchmark 300G+)

Why did Oracle Win?
My Reasons…

- Simplifies & Consolidates IT (two of the top CEO/CIO priorities every year)
- Multiple choices even within Oracle
  - Forms, Portal, JDev, HTML-DB, OWB, Reports, Discoverer
- Technology stack covers everything
  - Grid Control, Data Guard, Flashback, Online Redefinition, Storage (ASM), HA is solid!
- Apps stack covers everything including several hundred products (Financials, Manufacturing HR & CRM to name a few). Starting to take Verticals!

Why did Oracle Win?
My Reasons...

- Productivity Tools (Enterprise Manager, Work Flow products, Packaged Applications)
- Recruiting at top universities
- Maintains an operating margin between 30 and 40% and will do this for acquired companies as well (Wall Street Darling)
- Listens to customers via user groups and CABs as well as regularly surveying customers
- Great Users Groups (international, national, regional, local, SIGs)

Why will Oracle Win in the Future? My Reasons…

- It's not about the database anymore, now it's about the Applications. When it is about the database, security and high availability are issues where Oracle excels.
- Made acquisitions at the right time in the market
- Oracle has Great Developers who love what they do
- Oracle has Great Sales & Marketing that's maturing
- I believe Oracle will do well with or without Larry down the road, but Larry's creative mind and risk taking is not as easy to replicate in a Fortune 500 CEO. Other CEO's might be too willing to benefit Wall Street first versus benefit Oracle (long term). It would be a loss.

Future Market Direction – Why Oracle Wins: Continued Consolidation

"I think there is a world market for maybe 5 computers."

- Thomas Watson, IBM Chairman '43

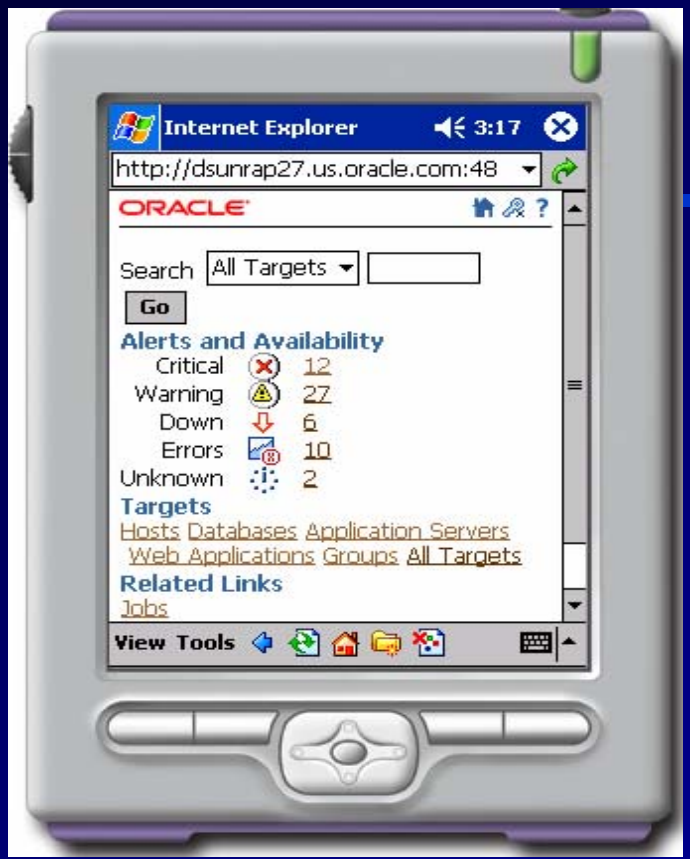
Oracle DB 10g ULDB – Store ALL Your Data

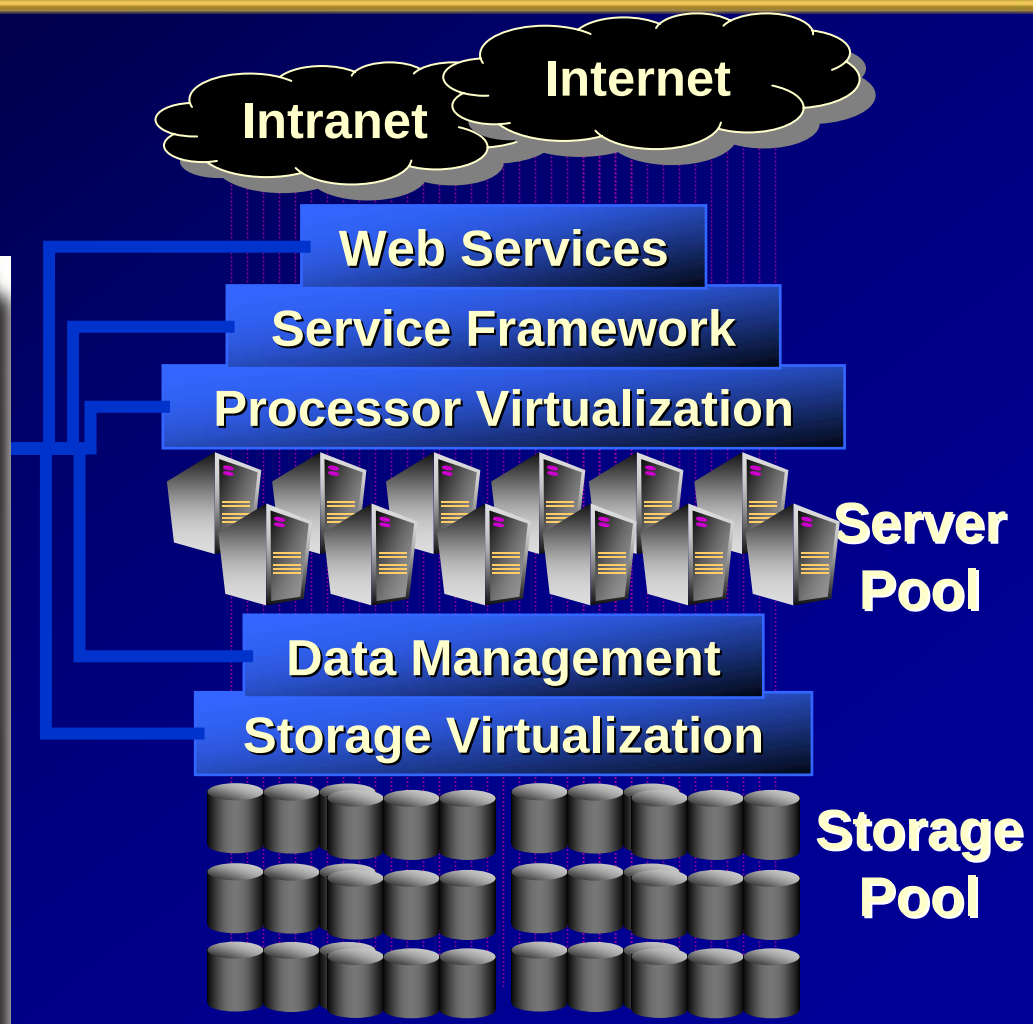
- Database size limit raised to is 8 Exabytes (8 EB), which is 8 million Terabytes
  - 5 Exabytes (5 EB)= Every word ever spoken!
  - 8-12 Petabytes (.012 EB) = Entire Internet

In ONE oracle Database you could fit:

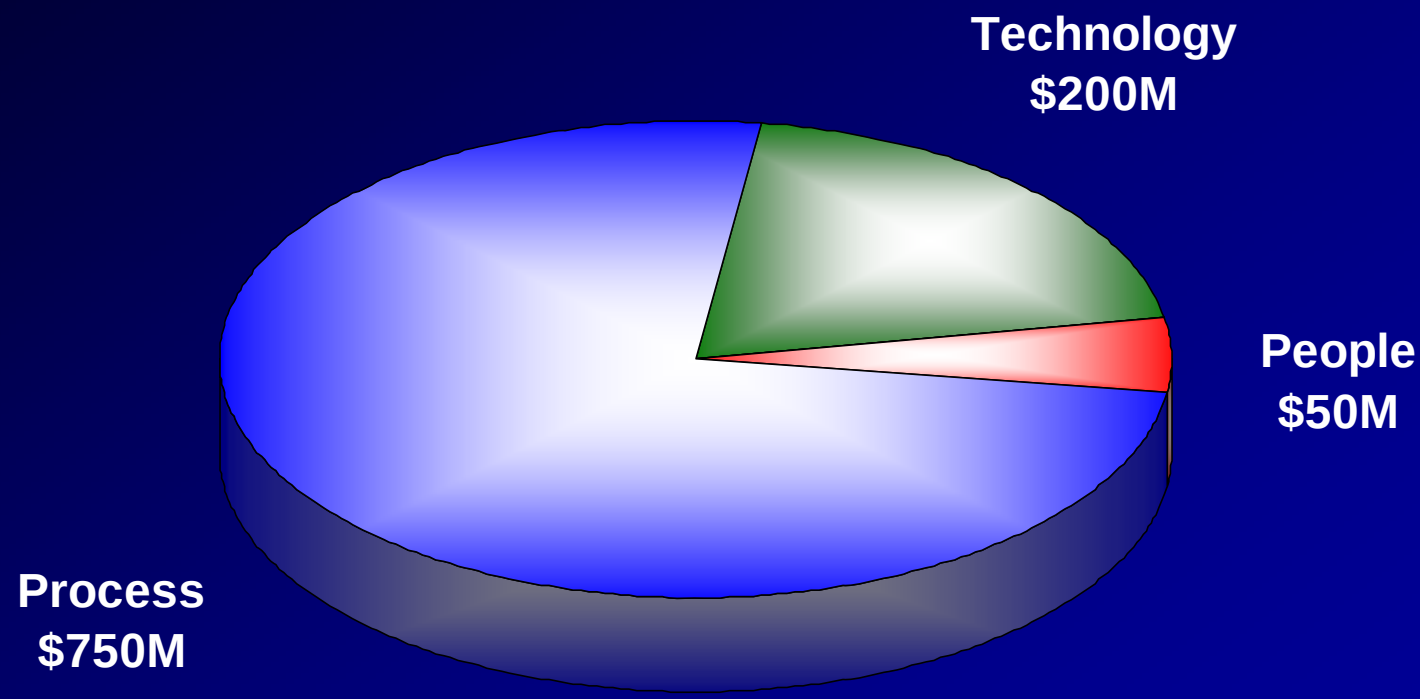
- 1000 Internets (8P each) or
- 400,000 Libraries of Congress (20T each and 17-18 million books in each) or
- 2 Billion DVD Movies on CD (4 G each) or
- 1 Mount Everest filled with Documents (approx.)

The Future ….
Manage end to end



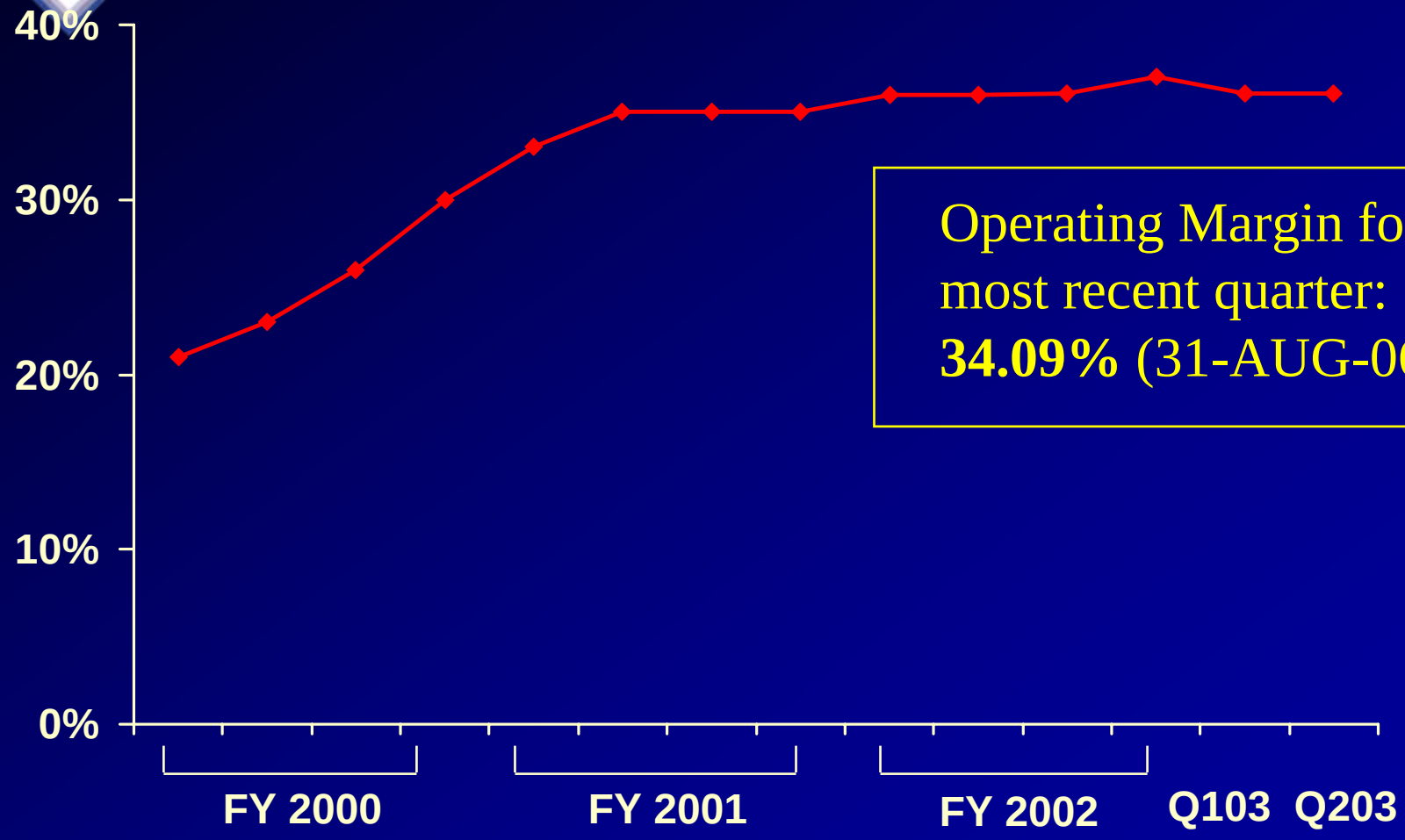


How Oracle saved $1B: CONSOLIDATION! & Process



Operating Margin Improvement

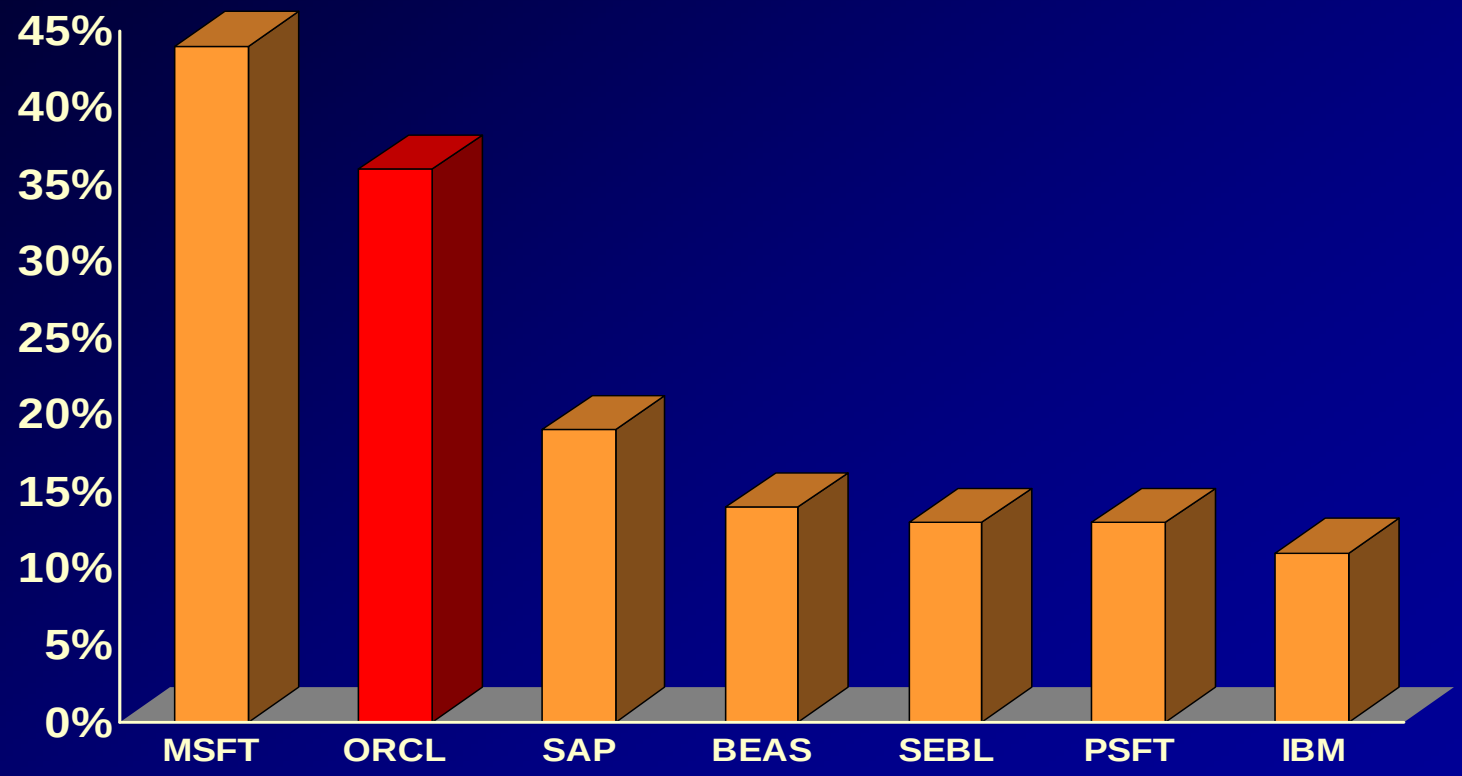
Trailing 12 Month Operating Margin Trend



Note: Oracle Corporation - Ending November 2002

I saw this in a Jeff Henley Talk in 2003

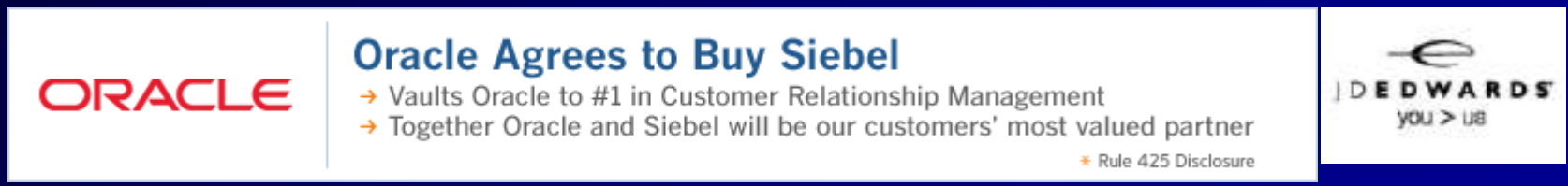
Trailing 12 Months



Last updated December 18, 2002

PROJECT FUSION
Protect, Extend, Evolve
Your Applications Investment

Future Goal is to do this for Others:



Not to be confused with… Fusion Middleware/BI Acquisitions:

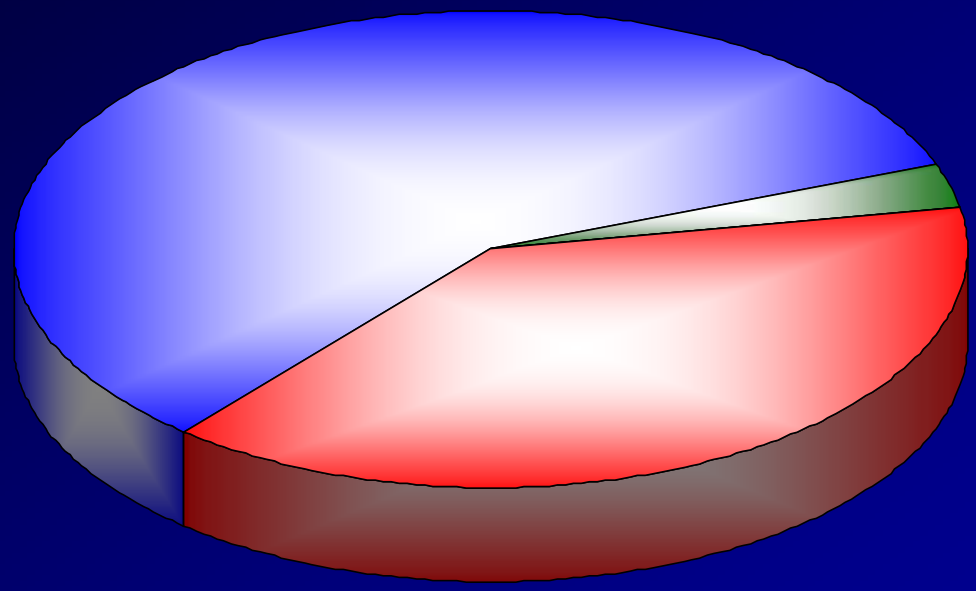
Oracle's Shift Toward Linux & Grid

"First they laugh at you,
then, they ignore you,
then they fight you,
and Then you win."
- Mahatma Ghandi

Why Linux Helps RAC/Grid?

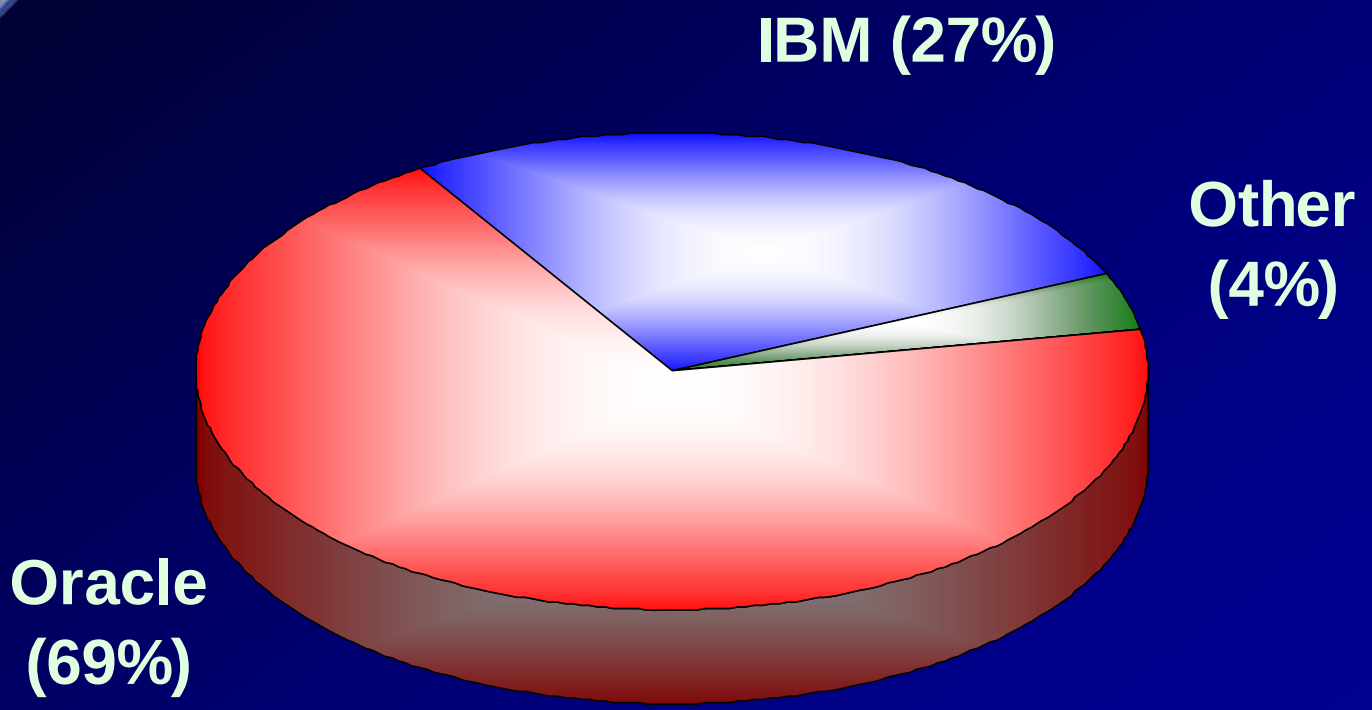
- Performance via Grid
- Availability via Grid
- Stability via Grid
- Security via Oracle
- Cost Savings via Smaller Servers (Grid)
- Larry says so:
  - Companies start building, supporting and creating once Larry charts a bend in the road.

Commercial Linux Database Market 2002



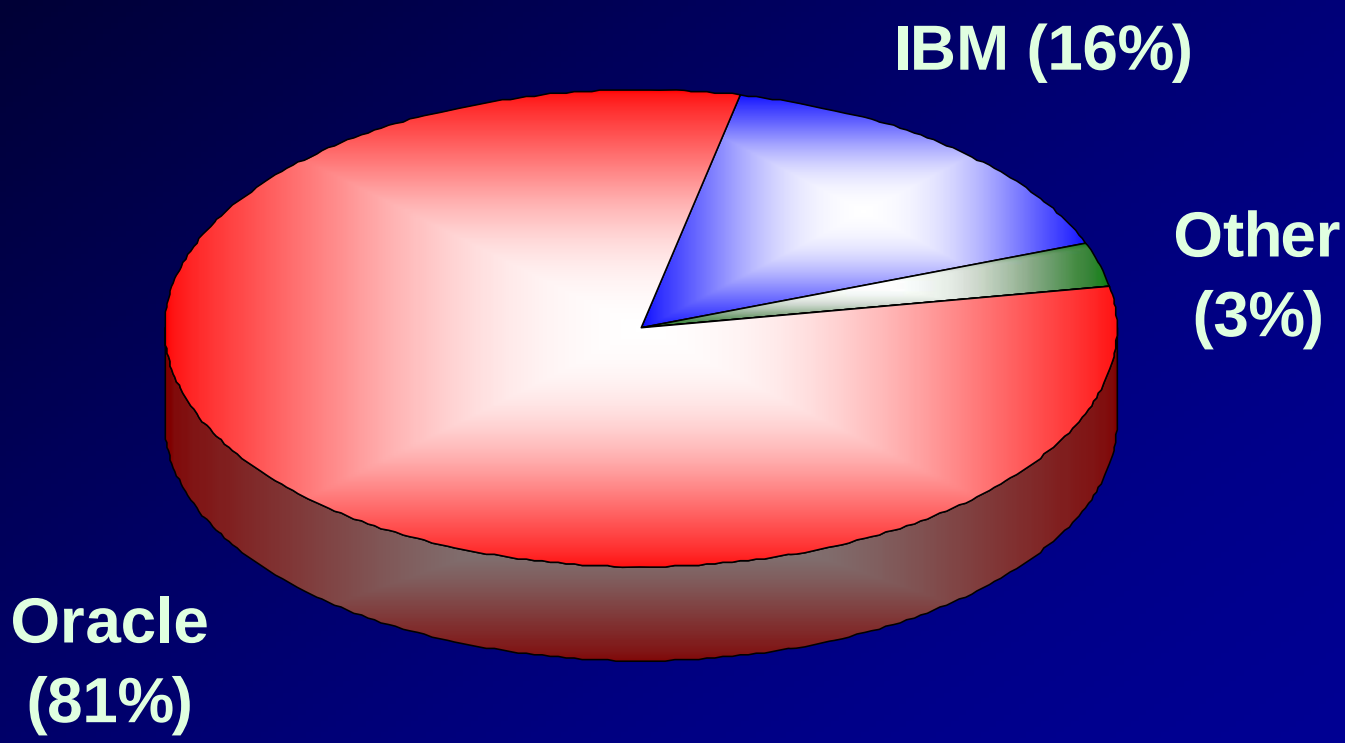
Source: Gartner, May 2005

Commercial Linux Database Market 2003



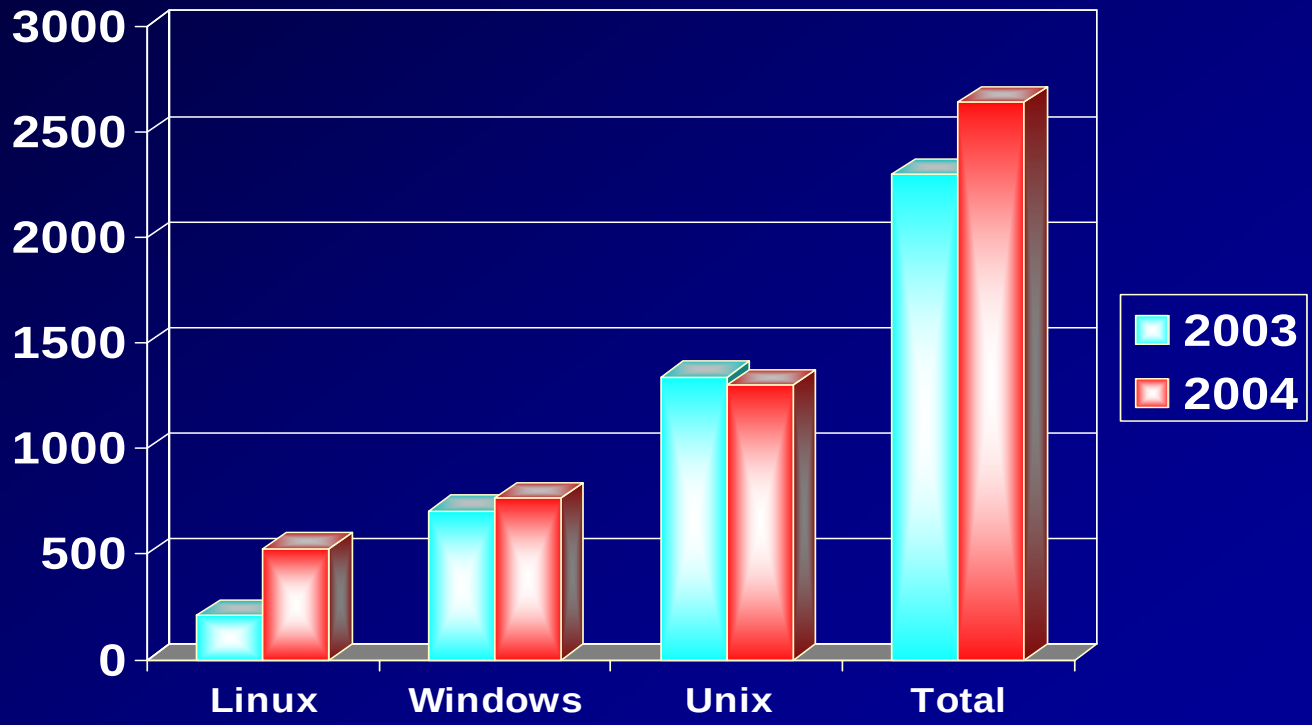
Source: Gartner, May 2005

Commercial Linux Database Market 2004



Source: Gartner, May 2005

Oracle Sales Market 2003/2004



Source: Gartner, May 2005

Future Trends – Open Source Presence

Berkeley DB is the leading open source developer database in the world with over 200 million deployments

JBoss Next??
Guess Not!

Future Trends – Open Source Presence

bizjournals.com

Red Hat to buy JBoss for up to $420M

Monday April 10, 10:35 am ET

Red Hat Inc. on Monday said it plans to purchase a software firm in a cash-and-stock deal worth as much as $420 million.

The Raleigh-based Linux provider, which posted fiscal 2006 revenue of about $230 million, has signed an agreement to buy JBoss for $350 million up front, plus as much as $70 million in performance-based milestone payments.

Future Trends – Open Source Presence

bizjournals.com

Report: Oracle mulled, rejected Novell purchase

Monday April 17, 1:05 pm ET

Oracle Co
operating

Oracle Ch
expand int
respond to

bizjournals.com

Oracle may launch a version of Linux

Monday April 17, 2:35 pm ET

Oracle Corp. is considering launching its own version of Linux and has looked at buying one of the
two

Oracle CEO targets Red Hat with half-price offer

Wed Oct 25, 2006 4:44pm ET

Email This Article | Print This Article | Reprints

Oracle said to be planning support for open source MySQL

By John Letzing
Last Update: 1:46 PM ET Jan 31, 2007

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SAN FRANCISCO (MarketWatch) -- Oracle Corp. has suggested it may offer support for open source database softw
from closely-held MySQL AB, MySQL Chief Executive Marten Mickos said in Computer Business Review interview
Tuesday. An Oracle spokesperson declined to comment. Such an offer would be the second time Oracle (ORCL : 17.
+0.37, +2.2%) in recent months has undercut smaller, open source competitors by making its own services available
products that are not its own. In October, Oracle said it would begin offering affordable support for open source softwa
from RedHat Inc., as part of its 'Unbreakable Linux' program. Mickos also said in the interview Tuesday that MySQL is

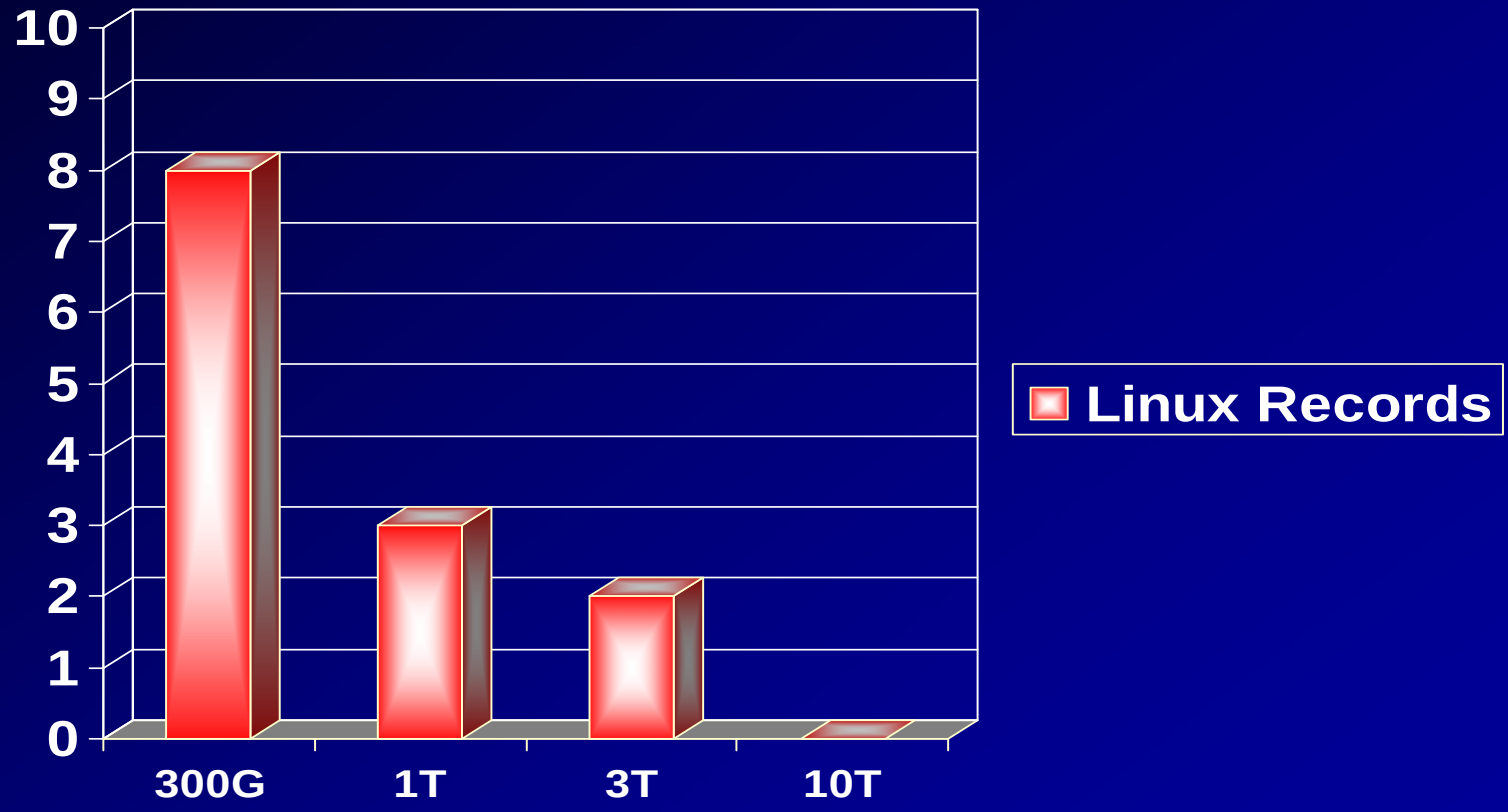
Fastest Database - TPC-H

Size	Database	Hardware	CPU/OS	Cost
300G	Oracle 10g	Dell 6800	8/RHEL	460K
1T	Oracle 10g	HP/Superdome	64/HP UX	4.0M
3T	Oracle 10g	Sun/E25K	72/Solaris	5.8M
10T	Oracle 10g	Sun/E25K	72/Solaris	5.8M

"The performance metric reported by TPC-H is called the TPC-H Composite Query-per-Hour Performance Metric(QphH@Size). The TPC Benchmark™H (TPC-H) is a decision support benchmark. **It consists of a suite of business oriented ad-hoc queries and concurrent data modifications.** The queries and the data populating the database have been chosen to have broad industry-wide relevance. This benchmark illustrates decision support systems that examine large volumes of data, execute queries with a high degree of complexity, and give answers to critical business questions."

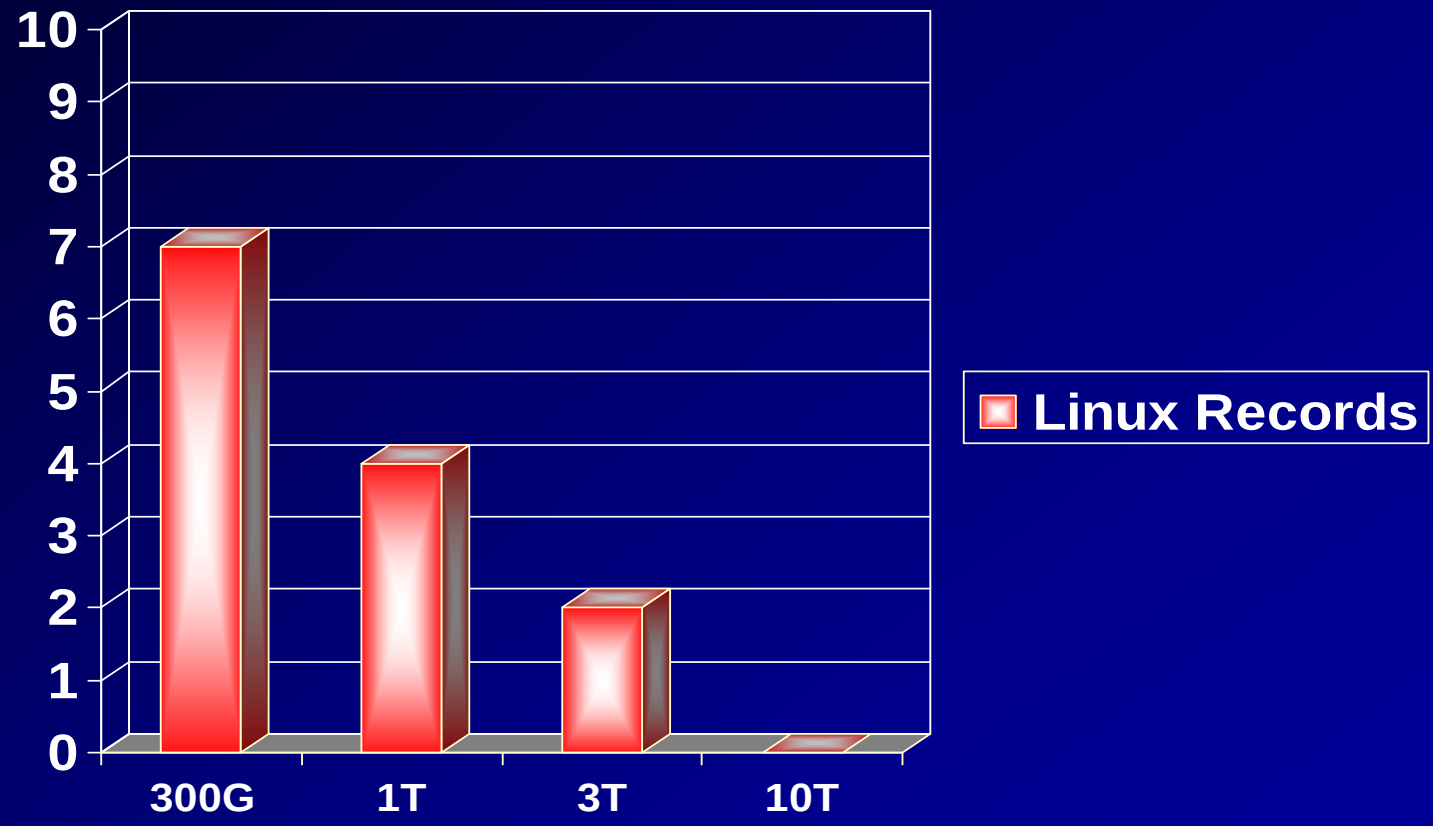
Source: www.tpc.org (As of May 30, 2006)

Records in Top 10 – TPC-H



Source: www.tpc.org (As of May 30, 2006)

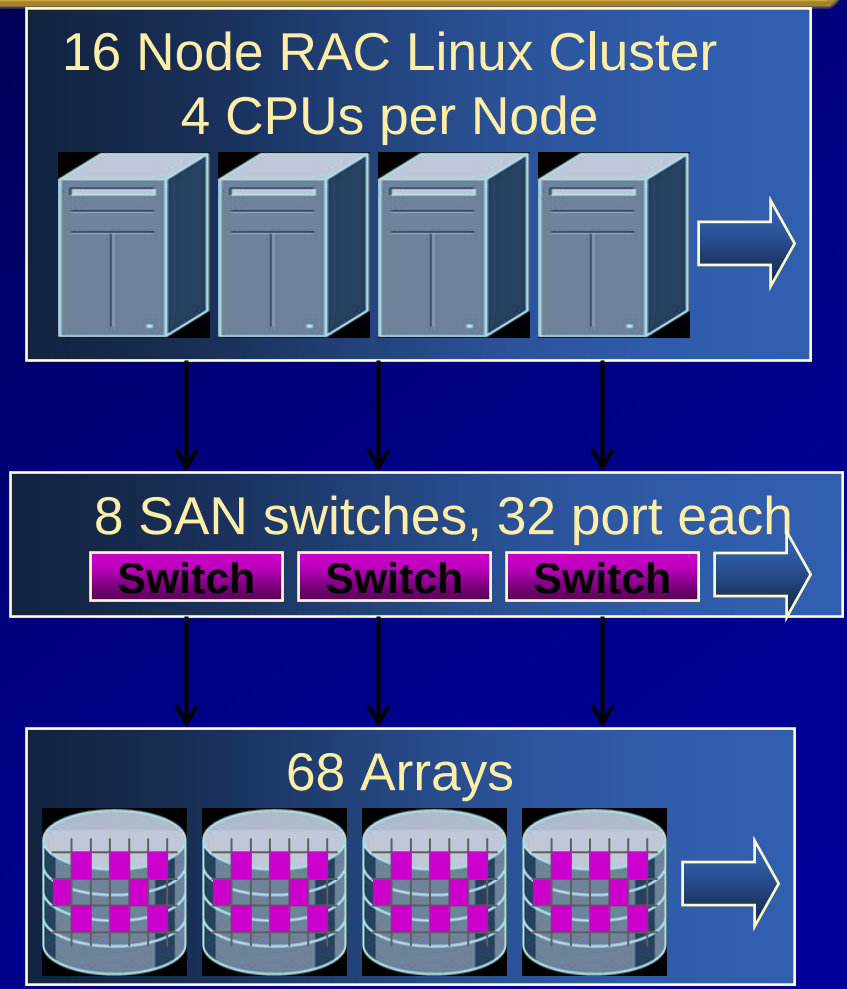
Records in Top 10 – TPC-H



Source: www.tpc.org (As of November 1, 2006)

Amazon.com Data Warehouse

- 25 TB database
  - 15 TB row data
- 9*i*R2 using one Oracle Cluster File System per storage array
- Services 50,000 complex queries per week
  - 2 to 3 gigabyte (byte, not bit) per second table scan throughput
- Listed in top ten (6th) largest Warehouses in 2005 Winter Survey and only RAC system.
  - In 2003, Amazon was #5 with 13T.
  - Yahoo was #1 in 2005 with 100T of data (triple the #1 of 2003) and they had 385 trillion rows on Oracle!
  - Teradata had 4 of the Top 10 databases in the 2003 survey, yet has zero in the 2005 survey



WINTER CORPORATION
TOP TEN PROGRAM

2003 TopTen Award Winners

Winter Corporation recognizes these organizations and their vendors for their achievements in the 2003 TopTen Program.

Download a PDF with all the winners

Pick an Award Category:

Category: Database Size | Platform: All | Usage: DSS

Display

Database Size, All, DSS

Company/Organization	Database Size (GB)	DBMS	System Arch.	DBMS Vendor	System Vendor	Storage Vendor
France Telecom	29,232	Oracle	SMP	Oracle	HP	HP
AT&T	26,269	Daytona	SMP	AT&T	Sun	Sun
SBC	24,805	Teradata	MPP	Teradata	NCR	LSI
Anonymous	16,191	DB2 for Unix	MPP/Cluster	IBM	IBM	IBM
Amazon.com	13,001	Oracle	SMP	Oracle	HP	HP
Kmart	12,592	Teradata	MPP	Teradata	NCR	LSI
Claria Corporation	12,100	Oracle	SMP	Oracle	Sun	Hitachi
Health Insurance Review Agency	11,942	Sybase IQ	Cluster	Sybase	HP	Hitachi
FedEx Services	9,981	Teradata	MPP	Teradata	NCR	EMC
Vodafone D2 GmbH	9,108	Teradata	MPP	Teradata	NCR	LSI

2005 TopTen Award Winners

Winter Corporation recognizes these organizations and their vendors for their achievements in the 2005 TopTen Program.

List of all the winners Frequently Asked Questions

Pick a TopTen Award Category:

Metric: Database Size Platform: All Environments Usage: DW

Display

Database Size, All Environments, DW *

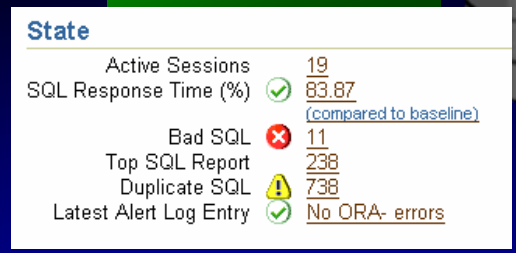
Company/Organization	Database Size (GB)	DBMS	Platform	Architecture	DBMS Vendor	System Vendor	Storage Vendor
Yahoo!	100,386	Oracle	UNIX	Centralized/SMP	Oracle	Fujitsu Siemens	EMC
AT&T	93,876	Daytona	UNIX	Federated/SMP	AT&T	HP	HP
KT IT-Group	49,397	DB2	UNIX	Centralized/Cluster	IBM	IBM	Hitachi
AT&T	26,713	Daytona	UNIX	Federated/SMP	AT&T	Sun	Sun
LGR - Cingular Wireless	25,203	Oracle	UNIX	Centralized/SMP	Oracle	HP	HP
Amazon.com	24,773	Oracle RAC	Linux	Centralized/Cluster	Oracle	HP	HP
Anonymous	19,654	DB2	UNIX	Centralized/MPP	IBM	IBM	EMC
UPSS	19,467	SQL Server	Windows	Centralized/SMP	Microsoft	Unisys	EMC
Amazon.com	18,558	Oracle RAC	Linux	Centralized/Cluster	Oracle	HP	HP
Nielsen Media Research	17,685	Sybase IQ	UNIX	Centralized/SMP	Sybase	Sun	EMC

Enterprise Manager for the Grid

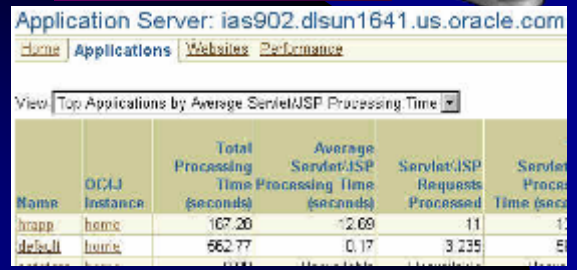
Grid Control

Host and Hardware

Database



Oracle9iAS



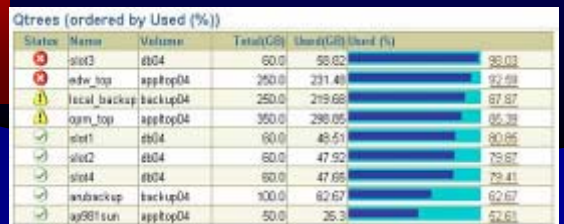
Network and Load Balancer

Administration
Monitoring
Provisioning
Security

Enterprise Manager

Applications

Storage



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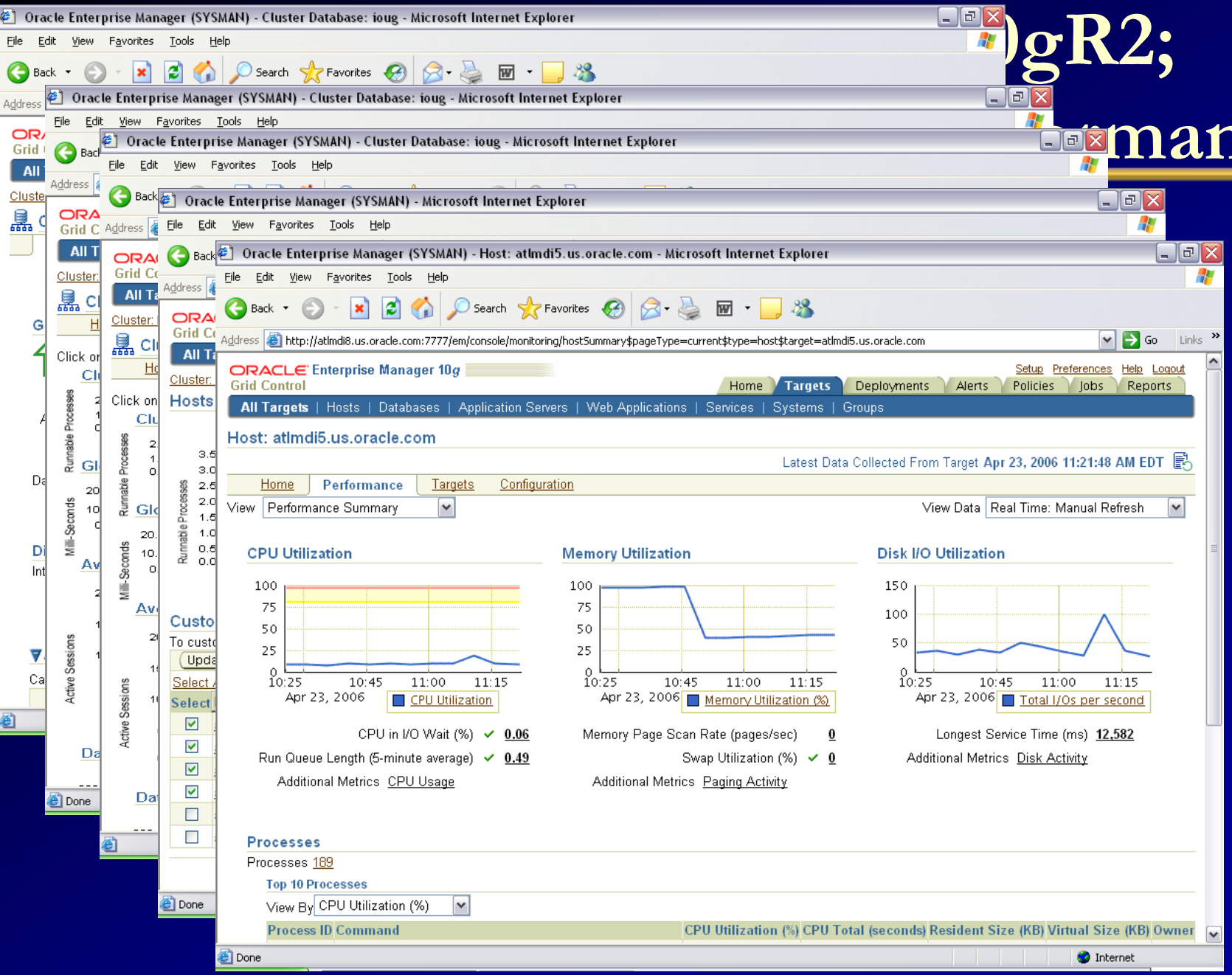
Oracle Enterprise Manager (SYSMAN) - Host: atlmdi5.us.oracle.com - Microsoft Internet Explorer
http://atlmdi8.us.oracle.com:7777/em/console/monitoring/hostSummary$pageType=current$type=host$target=atlmdi5.us.oracle.com
ORACLE Enterprise Manager 10g
Grid Control
Setup Preferences Help Logout
Home Targets Deployments Alerts Policies Jobs Reports
All Targets | Hosts | Databases | Application Servers | Web Applications | Services | Systems | Groups
Host: atlmdi5.us.oracle.com
Latest Data Collected From Target Apr 23, 2006 11:21:48 AM EDT
Home Performance Targets Configuration
View Performance Summary
View Data Real Time: Manual Refresh
CPU Utilization
Memory Utilization
Disk I/O Utilization
Apr 23, 2006
CPU Utilization
Memory Utilization (%)
Total I/Os per second
CPU in I/O Wait (%) 0.06
Run Queue Length (5-minute average) 0.49
Additional Metrics CPU Usage
Memory Page Scan Rate (pages/sec) 0
Swap Utilization (%) 0
Additional Metrics Paging Activity
Longest Service Time (ms) 12,582
Additional Metrics Disk Activity
Processes
Processes 189
Top 10 Processes
View By CPU Utilization (%)
Process ID Command CPU Utilization (%) CPU Total (seconds) Resident Size (KB) Virtual Size (KB) Owner
Done
Internet

Future Competitors – Continuation of Open Source Movement

"The pure and simple truth is rarely pure and never simple."
– Oscar Wilde

Ingres – Today
(Focus is on FREE)

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Search:

CA sets Ingres database free

By Martin LaMonica
Staff Writer, CNET News.com
Published: November 1, 2004, 8:03 AM PST

TalkBack | E-mail | Print

Computer Associates International on Monday kicked off its entry into open-source software with the release of its Ingres r3 database.

The company said that Ingres r3 for Linux and Windows is available under an open-source license called CA Trusted Open Source License. The license allows others to view the source code of the database, download the software for free, and incorporate it into other software bundles that are licensed under CA's open-source license.

Michael Stonebraker
Now Teaching at MIT

Ingres – Tomorrow (Post-Ingres)
Postgres (The Elephant in the Room)

Focus is on Features (V6/V7.3 Oracle)

What's New in 8.1:

- **Database Roles added**
- **Two-Phase Commit** (2PC): allows ACID-compliant transactions across WAN.
- **Bitmap Scan:** indexes dynamically converted to bitmaps in memory when appropriate.
- **Table Partitioning:** Constraint Exclusion - Similar to the Table Partitioning
- **Shared Row Locking:** Shared locks will improve insert and update performance
- **Integrated Autovacuum:** PostgreSQL's database maintenance daemon improved
- **Faster Aggregates:** added indexing optimizations for MIN() and MAX().

Postgres (The Elephant in the Room)

- Postgres is Oracle's best competitor from a feature standpoint and is a better competitor than DB2, SQL Server or MySQL (IMHO).
- **Features are best open source comparison to Oracle**
- **Speed is still an issue**
- **Completeness seems to be another issue**
- **Support is an issue**
- They are at a similar position in the market from a feature standpoint as Oracle was in the early 90's around 7.3
- It will be tough to close the gap.

MySQL

Focus is on Features & Client List (Oracle5/6)

What's New in 5.0:

- ***ACID Transactions*** to build reliable and secure business critical applications
- ***Stored Procedures*** to improve developer productivity
- ***Triggers*** to enforce complex business rules at the database level
- ***Views*** to ensure sensitive information is not compromised
- ***Information Schema*** to provide easy access to metadata
- ***Distributed Transactions*** *(XA)* to support complex transactions across multiple databases
- ***Archive Storage Engine*** for historical and audit data

MySQL

- MySQL is Oracle's best Open Source competitor from transaction performance standpoint.
- Oracle buying InnoDB is a severe blow.
- **MySQL has the best customer list of open source DB's**
- **Speed is not as much of an issue as PostgreSQL**
- **Features are very lacking**
- **Best for technically simple systems**
- They are at a similar position in the market from a feature standpoint as Oracle was in the late 80's with V5/V6
- It will probably not close the feature gap, but may not even try as the goal may be pure speed for simple applications.

DB2 UDB 8.2

- **DB2 UDB 8.2 Enterprise Server Edition (ESE)** is designed to meet the relational database server needs of mid- to large-size businesses. It can be deployed on Linux, UNIX, or Windows servers of any size, from one CPU to hundreds of CPUs. DB2 ESE is an ideal foundation... ISVs building... Business Intelligence, Content Management, e-Commerce, ERP, CRM, or SCM. Additionally, DB2 ESE offers connectivity, compatibility, and integration with other enterprise DB2 and Informix data sources.

DB2 UDB 8.2

Focus on the business vs. features (Oracle8i/9i)

- Close to Oracle 8i / 9i – Perhaps Oracle's closest feature competitor that is always moving forward.
- At one time was ahead of Oracle with its intelligent optimizer
- Focus still more the hardware vs. software
- Focus is also on the Business Applications
- Integration of WebSphere often noted
- O/S Support now includes AIX, HP UX, Linux, Solaris and Windows (who would've thought).
- Focus is on redefining the role of the DBA to installing and designing versus maintaining and monitoring.
- Hosting/Outsourcing is also a focus (give IT to them)

SQL Server 2005 (Yukon)

Focus is on Xbox, Windows (Oracle 6/7)

- I rarely ever hear Bill Gates or Steve Balmer mention the word database.
- Only runs on Windows (Linux someday?)
- When they are focused on something, they really do go after it completely, so you can never rule them out.
- Databases are getting bigger not smaller and they are not getting good at big at the same rate.
- Oracle continues to support Windows albeit sometimes one of the later ports it seems.
- Manageability, XML, BI and Availability are focus areas
  Table and Index partitioning added in Yukon
- Non-blocking read operations

FREE Software but limited by hardware and/or development use.

Oracle Database 10g Express Edition (XE) - Uses 1 CPU, 1G RAM, 4G Database but can be installed on any size machine.

- SQL Server 2005 Express – Maximum allows 1 CPU, 1G RAM, 4G Database.

- DB2 Express-C – Development and limited production use – 2 CPU, 4G RAM on Linux and Windows only.

Oracle10g Database - ensures business information is always available

Unplanned Downtime

- System Failures → **Grid Control** — *Continuous Availability for all Applications*
- Data Failures & Disasters → **Data Guard** — *Guaranteed Zero Data Loss*
- Human Errors → **Flashback Everything** — *Enable Users to Correct their Mistakes*

Planned Downtime

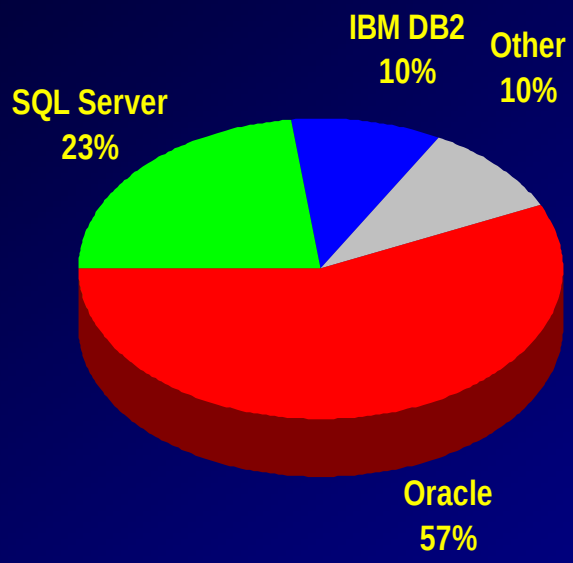
- System Maintenance → **Dynamic Reconfiguration** — *Capacity on Demand without Interruption*
- Database Maintenance → **Online Redefinition** — *Adapt to Change Online*
- Storage Failures → **ASM Mirroring** — *Storage Failure Protection*

Oracle Firsts – *Innovation!*

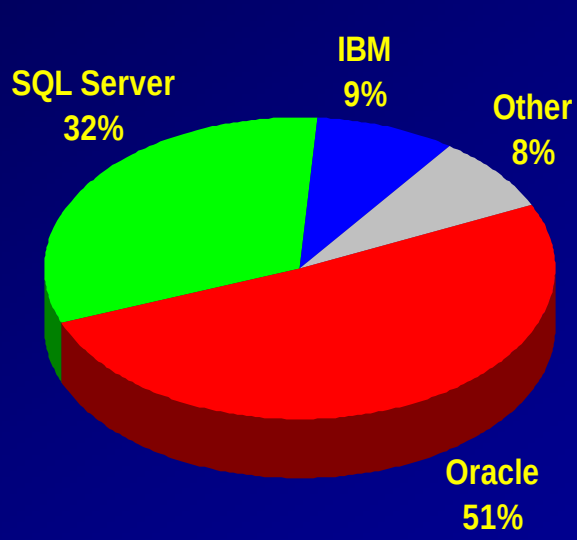
1979 First commercial SQL relational database management system
1983 First 32-bit mode RDBMS
1984 First database with read consistency
1987 First client-server database
1988 First RDBMS with SMP support
1994 First commercial and multilevel secure database evaluations
1995 **First 64-bit** mode RDBMS
1996 First to break the 30,000 TPC-C barrier
1997 **First Web** database
1998 First Database - Native **Java** Support; Breaks 100,000 TPC-C
1998 First Commercial RDBMS ported to **Linux**
2000 First database with **XML**
2001 First middle-tier database cache
2001 First RDBMS with **Real Application Clusters**
2004 First **True Grid Database**
2005 First **FREE Oracle Database** (10g Express Edition)
2006 First **Oracle Support for LINUX Offering**

Oracle #1 in Packaged Applications

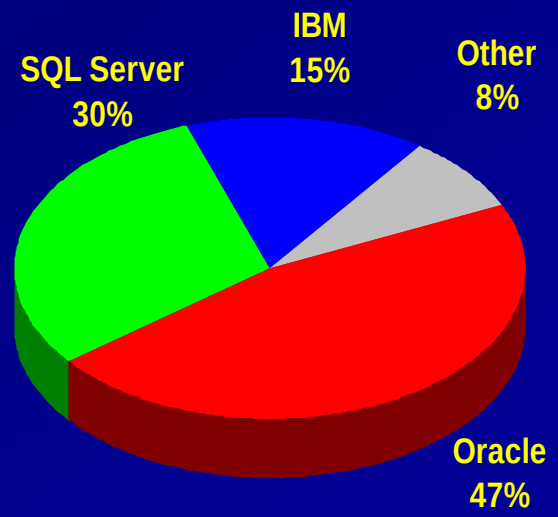
ERP
Oracle 57%



SCM
Oracle 51%

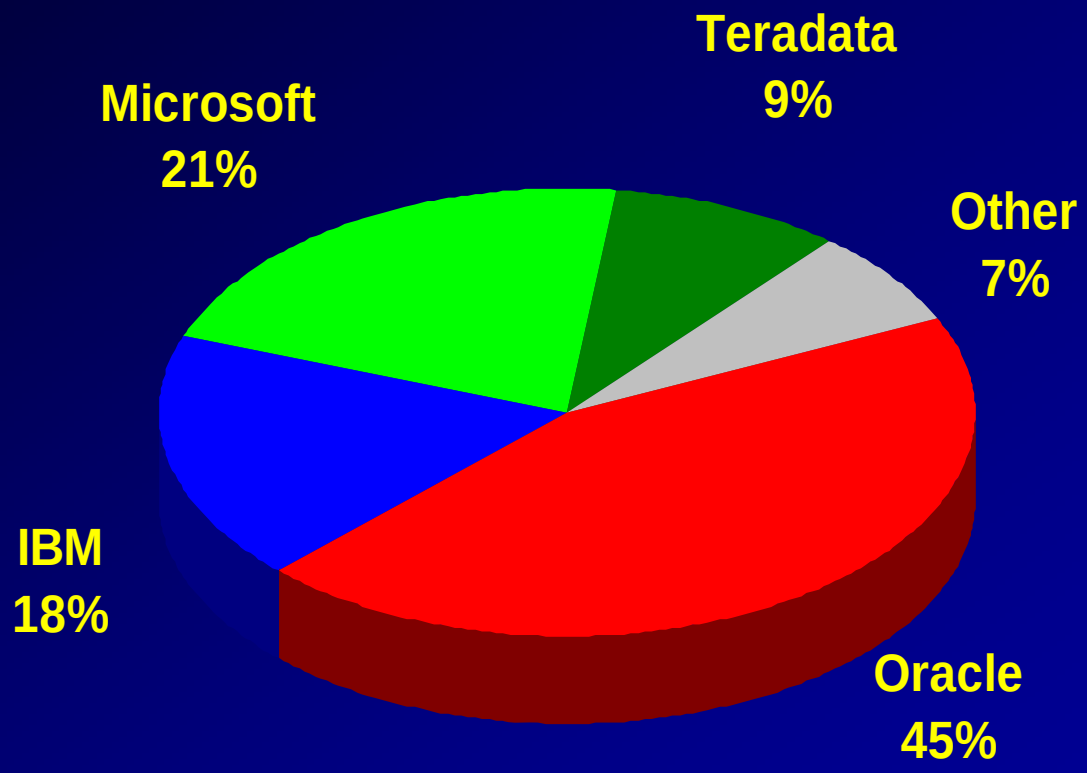


CRM
Oracle 46%



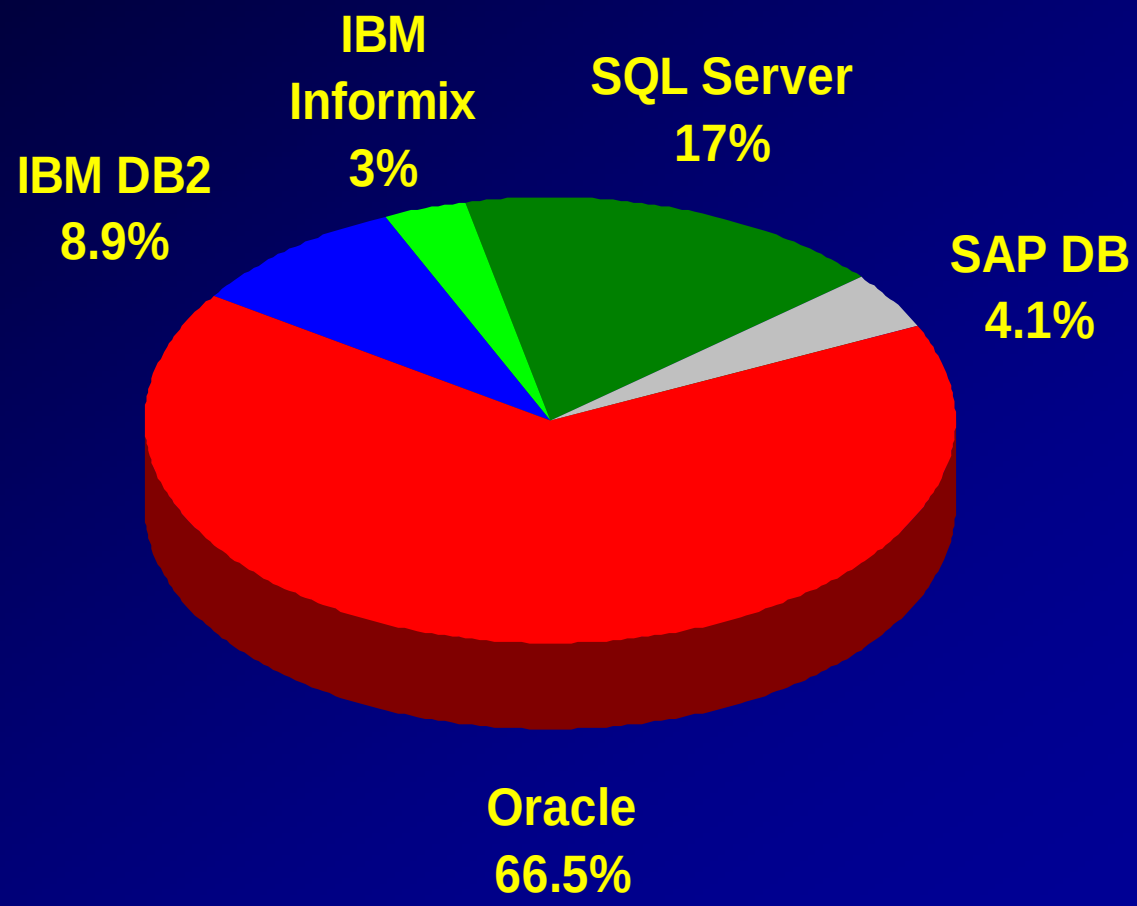
Sources: The Enterprise Resource Planning Report, The Supply Chain Management Applications Report, The Customer Management Applications Report, 2003–2008 AMR June 2004

Oracle #1 for Data Warehousing



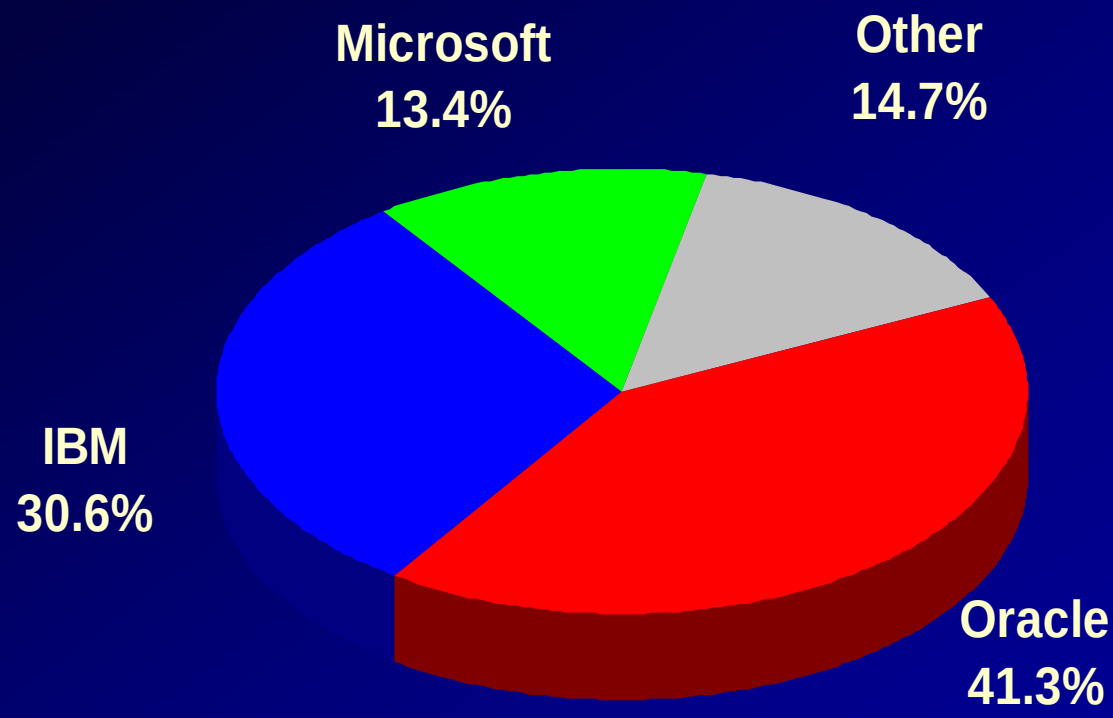
Source:Legacy Databases Take A Dive: Oracle Earns Data Warehousing Bragging Rights, Forrester Nov 2004
http://www.forrester.com/Research/Document/Excerpt/0,7211,35752,00.html

Oracle #1 for SAP



Source: AMR March 24th, 2005, http://www.amrresearch.com/Content/View.asp?pmillid=18120&docid=12412

Oracle: #1 Database in the World 2005 - IDC



Source: IDC March 2005. Worldwide RDBMS 2004 Vendor Shares

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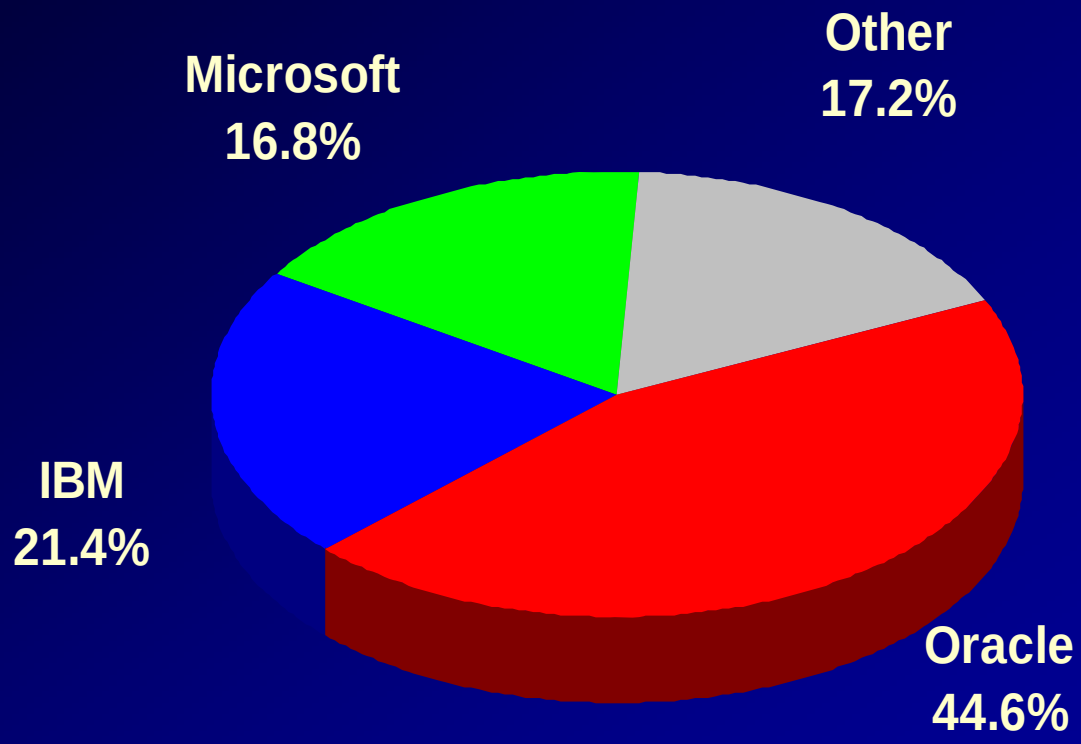
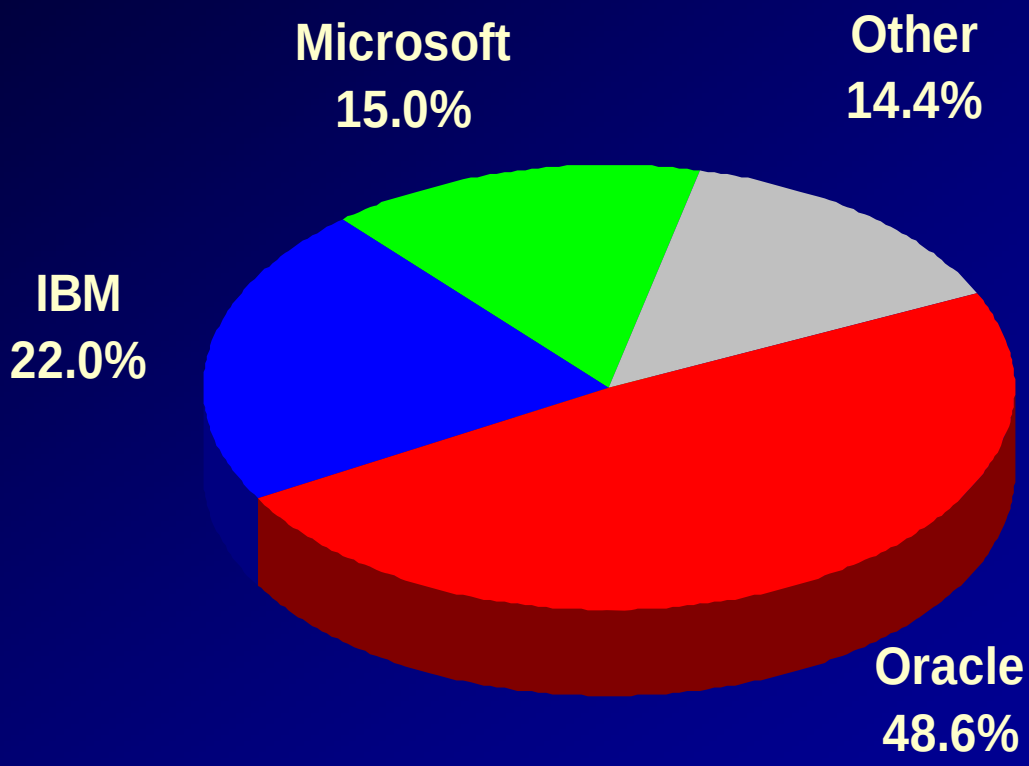


Source: IDC 2006. Worldwide RDBMS 2005 Vendor Shares

Oracle: #1 Database in the World 2006 - Gartner



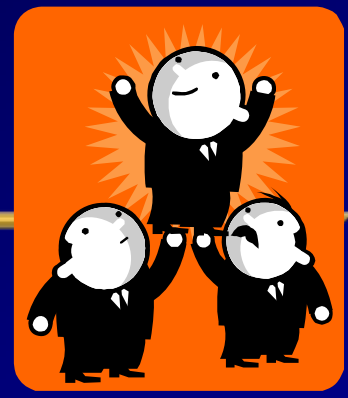
Source: Gartner 2006. Worldwide RDBMS 2005 Vendor Shares

A Diverse Team is Oracle's Secret!

"Larry Ellison is the genius behind Oracle, the company, Bob Miner was the genius behind Oracle, the product. The combination of the diverse team Oracle has had over the years is the secret of their success!"

- Rich Niemiec, Select Magazine, 2001

Summary



- The Paper that started it all – E. F. Codd
- System-R & Ingres
- Oracle is Founded as SDL
- V1-V10g
- Why did Oracle win?
- Future market direction
- Summary

Thanks for Coming!

Oracle is never caught from behind
Oracle's 30th Anniversary in 2007

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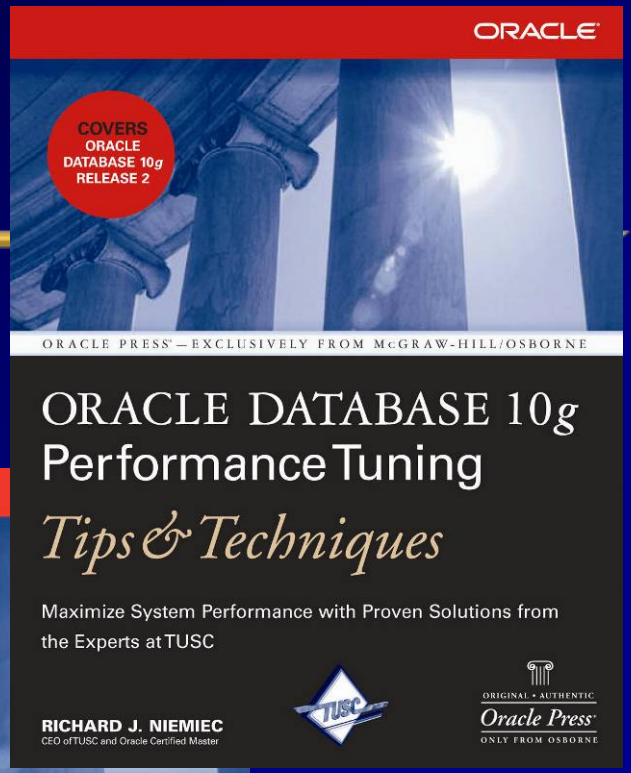
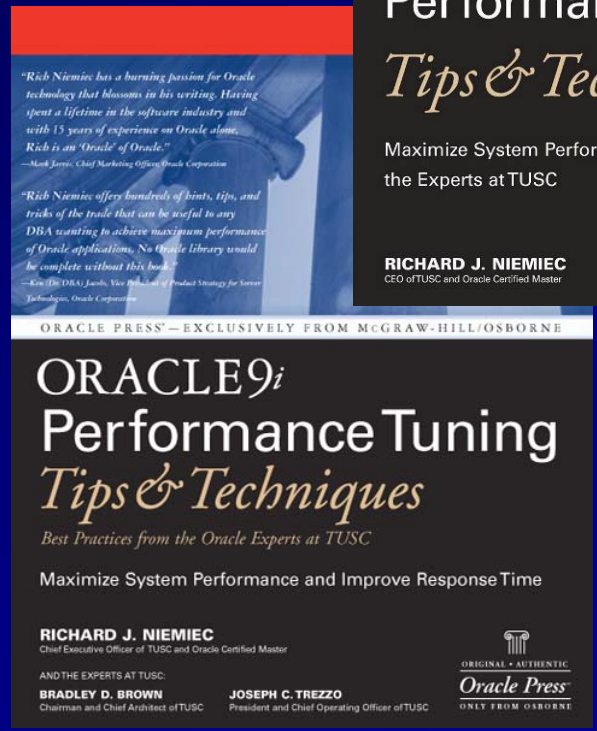
- Great Database
- Applications Leader
- BI Leader
- Already in the lead
- Game Over!

For More Information

- www.tusc.com
- *Oracle9i Performance Tuning Tips & Techniques; Richard J. Niemiec; Oracle Press (May 2003)*
- *Oracle 10g Tuning (Early 2007)*





History of Oracle is in the Introduction of this book...

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"Success usually comes to those that are too busy to be looking for it."

- Henry David Thoreau

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- *3 Trends shape the Oracle World*, Rich Niemiec; Database Trends and Applications
- *The Present, The Future but not Science Fiction; Real Application Clusters Development*, Angelo Pruscino, Oracle
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- *The New Enterprise Manager: End to End Performance Management of Oracle*; Julie Wong & Arsalan Farooq, Oracle Corporation
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- *Oracle9i Web Development,* Bradley D. Brown; Oracle Press
- *Special thanks to Steve Adams, Mike Ault, Brad Brown, Don Burleson, Kevin Gilpin, Herve Lejeune, Kirk McGowan, Erik Peterson, Randy Swanson, GP, Anil and Joe Trezzo.*

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