Overcoming the Top Four Challenges to Real-Time Performance in Large-Scale, Data-Centric Applications

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Founder and CEO

SL Corporation

17 November 2011

- Disclaimers

- I am not Mike Lee

- No Mariachi hat
- No Facial hair
- A LOT more boring

- My other computer is a Mac

- However, we have "shipped" …

Select SL RTView Customers

SL

Financial Services

- WACHOVIA
- TWO SIGMA INVESTMENTS
- Deutsche Bank
- WELLS FARGO
- BNP PARIBAS
- ING BANK
- TD AMERITRADE
- SOCIETE GENERALE
- DOWJONES
- BARCLAYS CAPITAL
- A.G. EDWARDS FULLY INVESTED IN OUR CLIENTS
- UBS
- OTA LLC
- Litle &Co
- H&R BLOCK
- Allstate You're in good hands.

E-Commerce/Retail

- macy's
- P&G
- PEPSI
- OfficeMax
- ORBITZ
- McAfee Proven Security
- MOTOROLA
- RIOT GAMES
- Smart&Final

Energy

- ISO NEW YORK INDEPENDENT SYSTEM OPERATOR
- New York Power Authority
- Gaz de France
- HYDRO
- TVA

Telecommunications

- FUJITSU
- Telstra
- PCCW
- TELECOM ITALIA
- verizon
- T-Mobile
- NTT Group
- bp

Other

- HARRIS
- HEALTHWAYS
- SOUTHWEST AIRLINES
- DOW
- OOCL
- ON24 ENGAGING COMMUNICATION
- BOEING
- FUJIFILM
- Harrah's
- NORTHROP GRUMMAN

About SL Corporation

- Software Product company since 1983
- Headquarters in Marin County, CA
- Worldwide presence in Americas, APAC, EMEA
- Over 100,000 licenses sold
- Core expertise in application performance monitoring – special focus on middleware

- Here to talk about Scalability and Performance

- Problem Space:

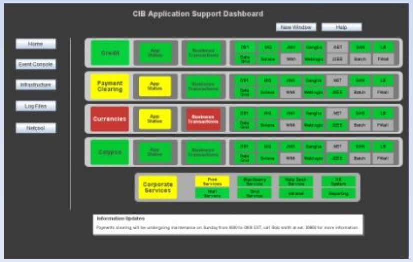
  Collection, Analysis, and Visualization in Real-Time of large volumes of monitoring data from large-scale, complex, distributed applications

  Keywords: Real-Time, Large Volumes of Data

RTView: The Solution Offering

Application Performance Monitoring

- Collect all necessary application-centric and middleware-centric performance data
- Configure data aggregation and persistence, filters, analytics, alerts and displays to deliver information tailored for app support teams

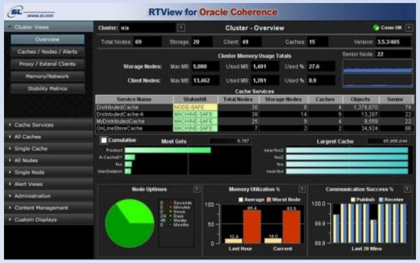


Information Updates

Payments clearing will be undergoing maintenance on Sunday from [illegible] to [illegible] GMT, call Bob smith at ext. [illegible] for more information.

Oracle Coherence Monitoring

- •Understand the behavior of Coherence
- •Debug and validate functionality after configuration changes
- •Integrate OCM with existing monitoring tools
- •Enable quick notification of problems



Cluster: n/a

Total Nodes: 69 Storage: 20 Client: 49 Caches: 15 Version: 3.5.3/465

Senior Node: 22

Cluster Memory Usage Totals

Storage Nodes: Max MB: 5,080 Used MB: 1,401 Used %: 27.6

Client Nodes: Max MB: 13,462 Used MB: 1,201 Used %: 8.9

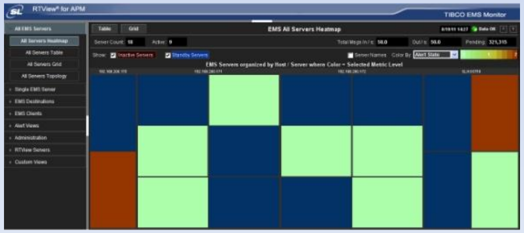
Cache Services

Service Name	StatusHA	Total Nodes	Storage Nodes	Caches	Objects	Senior
DistributedCache	NODE-SAFE	38	8	4	1,378,870	79
DistributedCache-A	MACHINE-SAFE	38	14	5	13,207	22
MyDistributedCache	MACHINE-SAFE	25	9	4	9,559	22
OnLineStoreCache	MACHINE-SAFE	7	2	2	34,924	86

☐ Cumulative

Middleware Monitoring

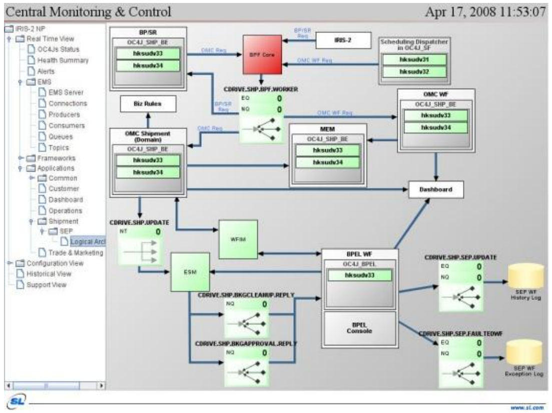
- Determine how applications are interacting with middleware systems
- Assess whether applications are running efficiently and reliably
- Ensure the maximum benefit from an ESB investment



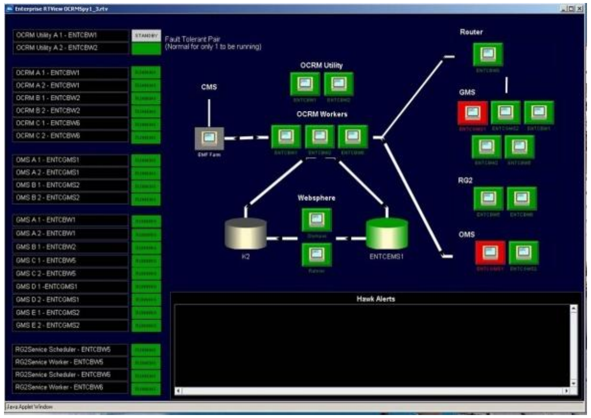
Server Count: 18 Active: 9 Total Msgs In/s: 58.0 Out/s: 58.0 Pending: 321,315

Show: ☑ Inactive Servers ☑ Standby Servers ☐ Server Names Color By: Alert State

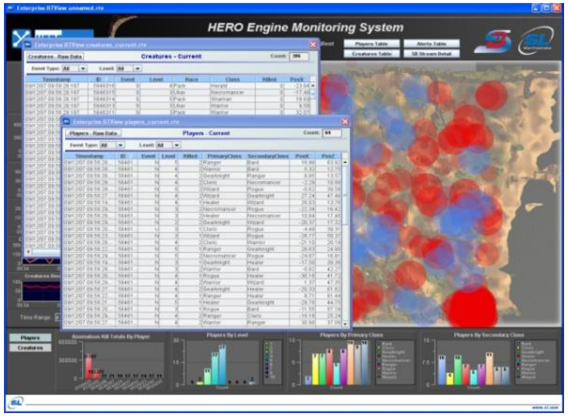
RTView – Sample Applications



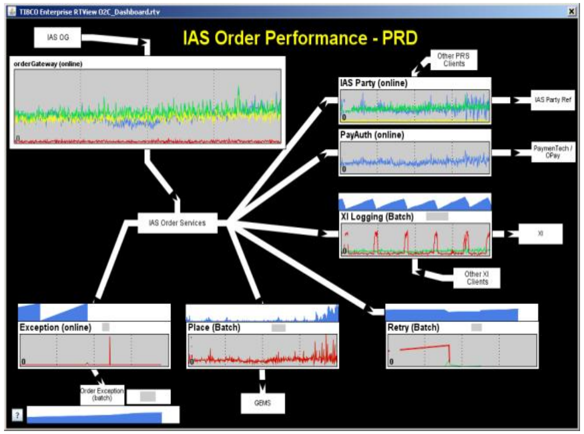
OOCL World WideShipment Tracking


Enterprise RTView OCRMSpy1_3.rtv
Fault Tolerant Pair (Normal for only 1 to be running)
Router
CMS
OCRM Utility
OCRM Workers
GMS
Websphere
RG2
OMS
K2
ENTCEMS1
Hawk Alerts

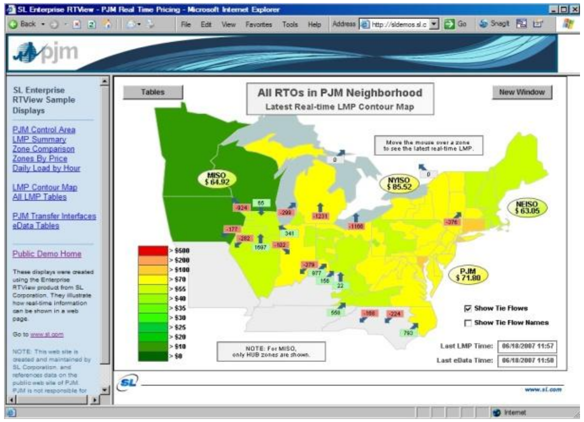
Hospitality Card application at Harrah's casino gaming tables



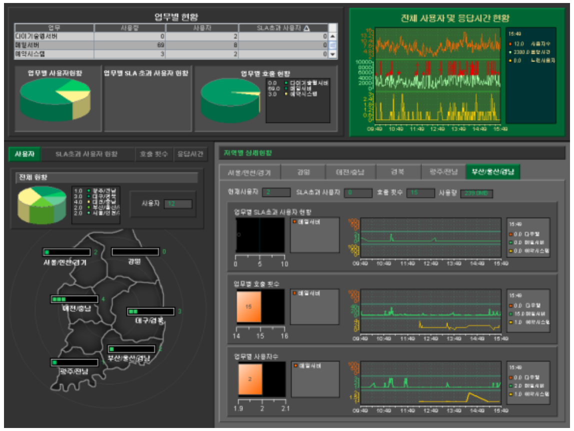
Online Gaming Systems



Tax Season at Intuit

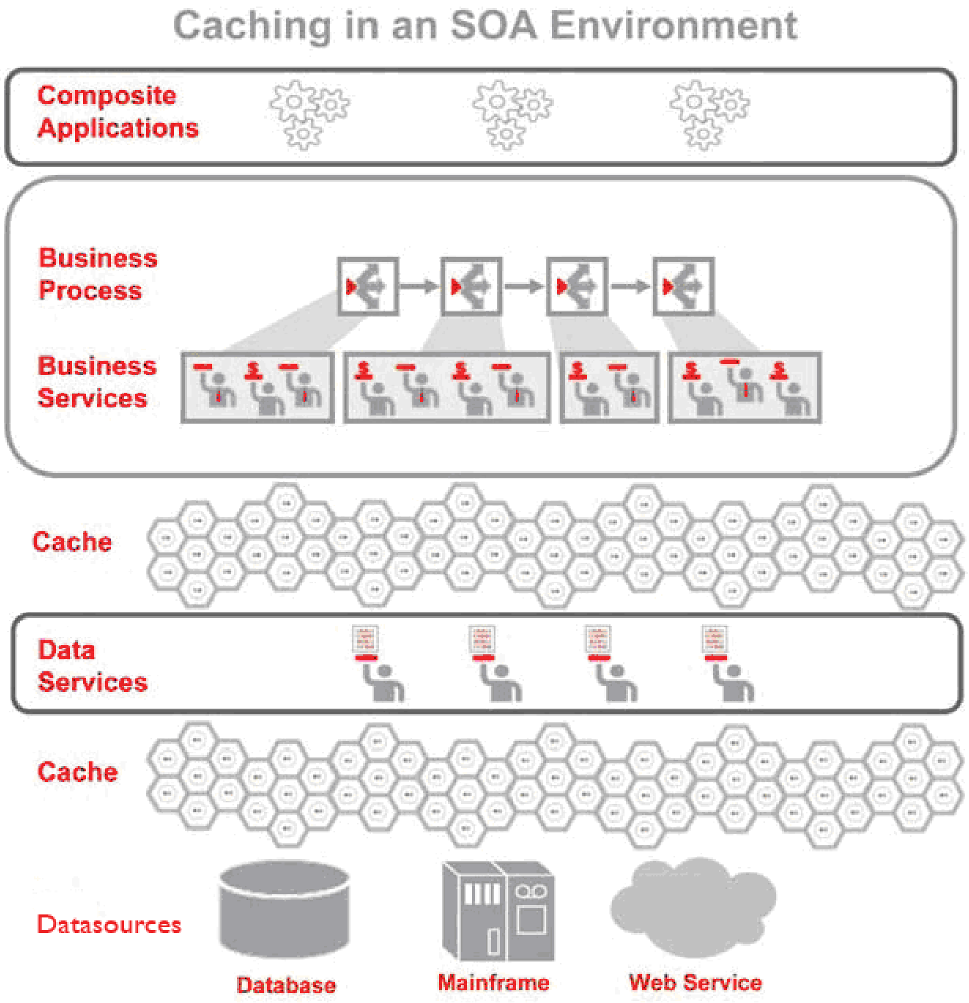


PJM Real-time Energy Pricing

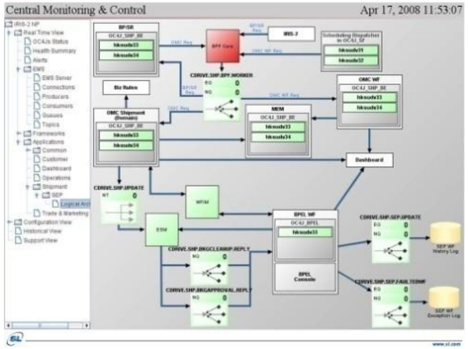


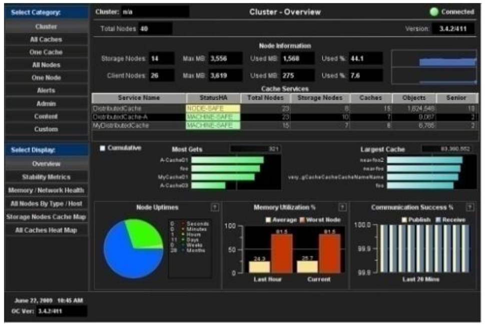
Banking application in Korea

RTView – Multi-Tier Visibility



Unified Real-time display of data from all Application tiers





Cluster: n/a

Cluster - Overview

Total Nodes 40

Version: 3.4.2/411

Node Information

Storage Nodes: 14 Max MB: 3,556 Used MB: 1,568 Used %: 44.1

Client Nodes: 26 Max MB: 3,619 Used MB: 275 Used %: 7.6

Cache Services

Service Name	StatusHA	Total Nodes	Storage Nodes	Caches	Objects	Senior
DistributedCache	NODE-SAFE	23	8	15	1,624,548	10
DistributedCache-A	MACHINE-SAFE	23	10	7	9,067	2
MyDistributedCache	MACHINE-SAFE	15	7	8	6,765	2

□ Cumulative

Most Gets 321

A-Cache01
foo
MyCache01
A-Cache03

Largest Cache 83,360,552

nearfoo2
nearfoo
very..gCacheCacheCacheNameName
foo

0 Seconds
0 Minutes
1 Hour
11 Days
0 Weeks
28 Months

Average Worst Node

24.3 81.5 25.7 81.5

Publish Receive

June 22, 2009 10:45 AM

OC Ver: 3.4.2/411

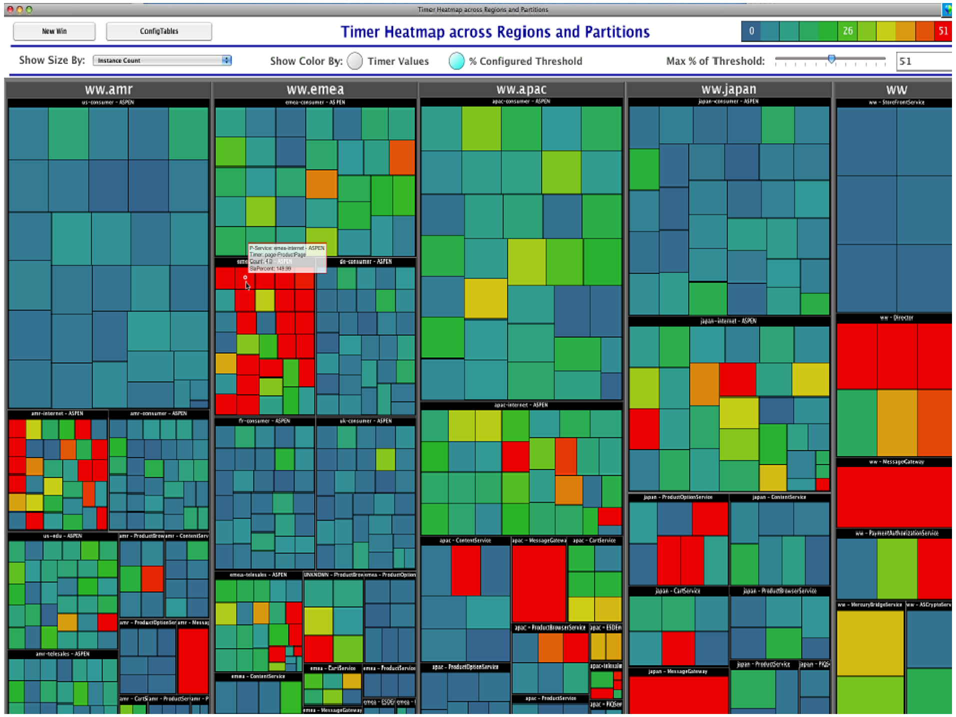
In-depth Monitoring of Middleware Components

RTView – Large Data Volumes

- Typical large implementation, distributed over several regions with many custom applications

- Heatmap View showing current state of entire system – size represents number of servers for application

- Color represents how close metric is to SLA – large red boxes are worst – drilldown to detail



Timer Heatmap across Regions and Partitions

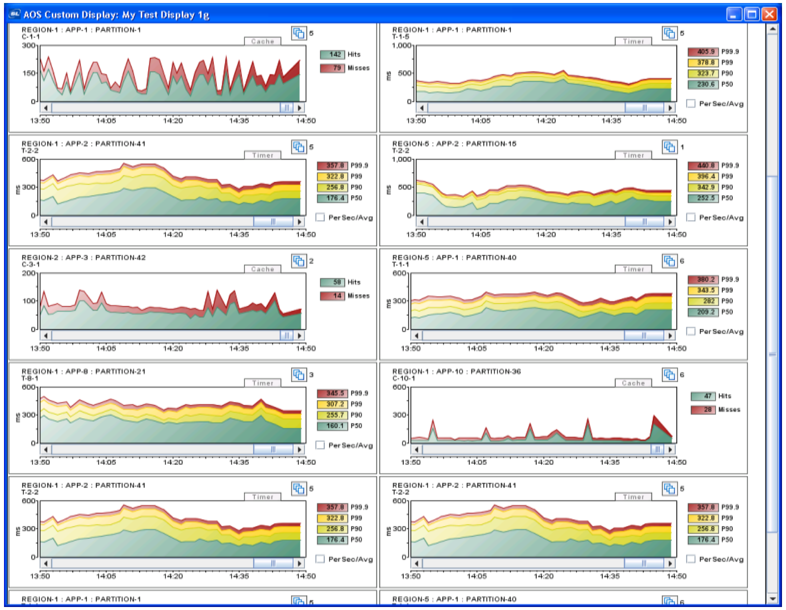
Show Size By: Instance Count

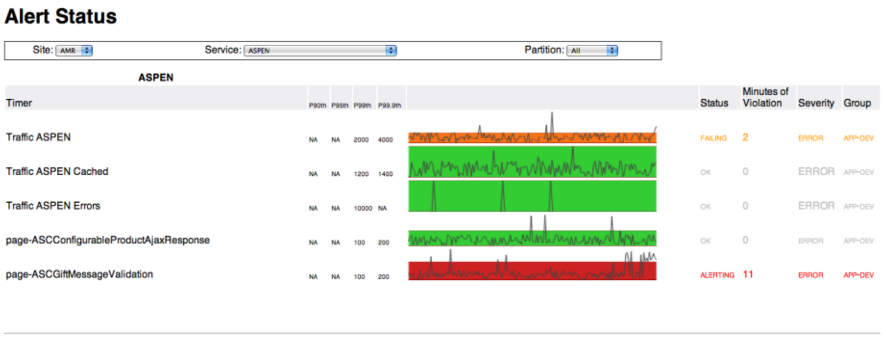
Show Color By: ○ Timer Values ● % Configured Threshold

Max % of Threshold: 51

RTView - Drill-Down to Detail Metrics

- Drilldown to detail level metrics showing internal metrics from each application
- Sophisticated history and alert view allows fine-tuning of thresholds for each metric





Alert Status

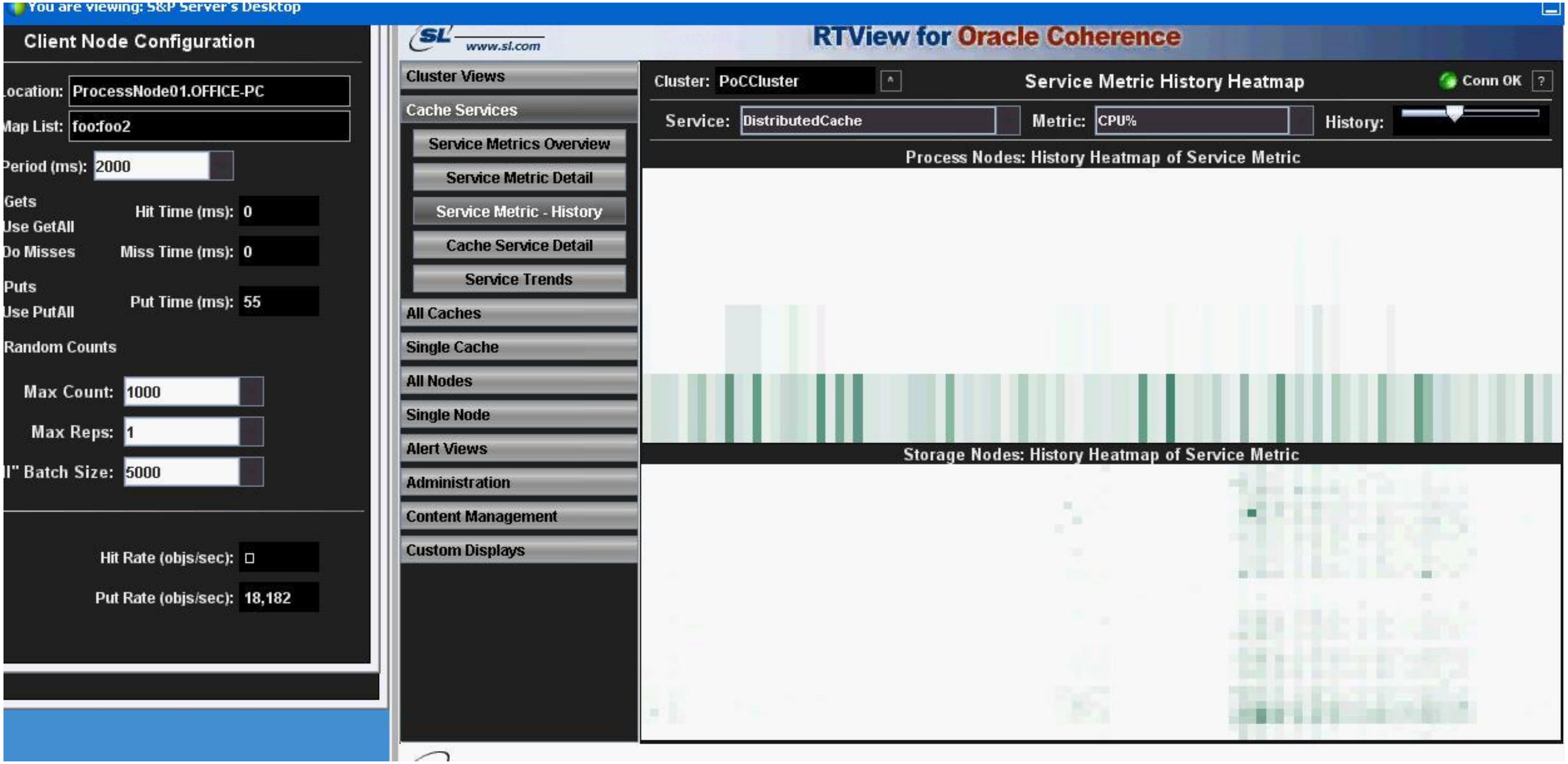
Site: AMR Service: ASPEN Partition: All

ASPEN

Timer	P90th	P95th	P99th	P99.9th		Status	Minutes of Violation	Severity	Group
Traffic ASPEN	NA	NA	2000	4000		FAILING	2	ERROR	APP-DEV
Traffic ASPEN Cached	NA	NA	1200	1400		OK	0	ERROR	APP-DEV
Traffic ASPEN Errors	NA	NA	10000	NA		OK	0	ERROR	APP-DEV
page-ASCConfigurableProductAjaxResponse	NA	NA	100	200		OK	0	ERROR	APP-DEV
page-ASCGiftMessageValidation	NA	NA	100	200		ALERTING	11	ERROR	APP-DEV

RTView – Complex Visualizations

Observe “internal load balancing” of Data Grid



You are viewing: S&P Server's Desktop

Client Node Configuration

ocation: ProcessNode01.OFFICE-PC

Map List: foo:foo2

Period (ms): 2000

Gets

Use GetAll

Do Misses

Hit Time (ms): 0

Miss Time (ms): 0

Puts

Use PutAll

Put Time (ms): 55

Random Counts

Max Count: 1000

Max Reps: 1

l" Batch Size: 5000

Hit Rate (objs/sec): 0

Put Rate (objs/sec): 18,182

Cluster: PoCCluster

Service Metric History Heatmap

Conn OK

Service: DistributedCache

Metric: CPU%

History:

Process Nodes: History Heatmap of Service Metric

Storage Nodes: History Heatmap of Service Metric

Challenges

- Challenge #1:

  Database Performance

  Common to see queries taking minutes

  How can you get real-time that way ?

Challenges

- Challenge #2:

  Network Data-Transfer Bandwidth

  Bigger pipes, but there’s more data to send

  How do you get the greatest throughput ?

Challenges

- Challenge #3:

  Processor Performance

  More cores just means more processes !

  How do you optimize your utilization ?

Challenges

- Challenge #4:

  Lack of Real-Time Predictability

  Virtualization is the new time-share !

  How can you trust your data ?

  "time-sharing", "network computer", "cloud", do things ever really change ?

- Solution – Clues ?

- Facts of Life:

Database – can’t live with it, can’t live without it

Network – it’s a funnel, no way around it

Processor – must limit what you ask it to do

Virtualization - it’s erratic, have to compensate

Solutions

- Solution #1:

  Proper Data Model

  - Data structures designed for real-time
  - In-memory structures to buffer database

Can your application be …

… like a high-performance racecar ?

What is most important part of racecar ?

(besides the engine)

… the Transmission …

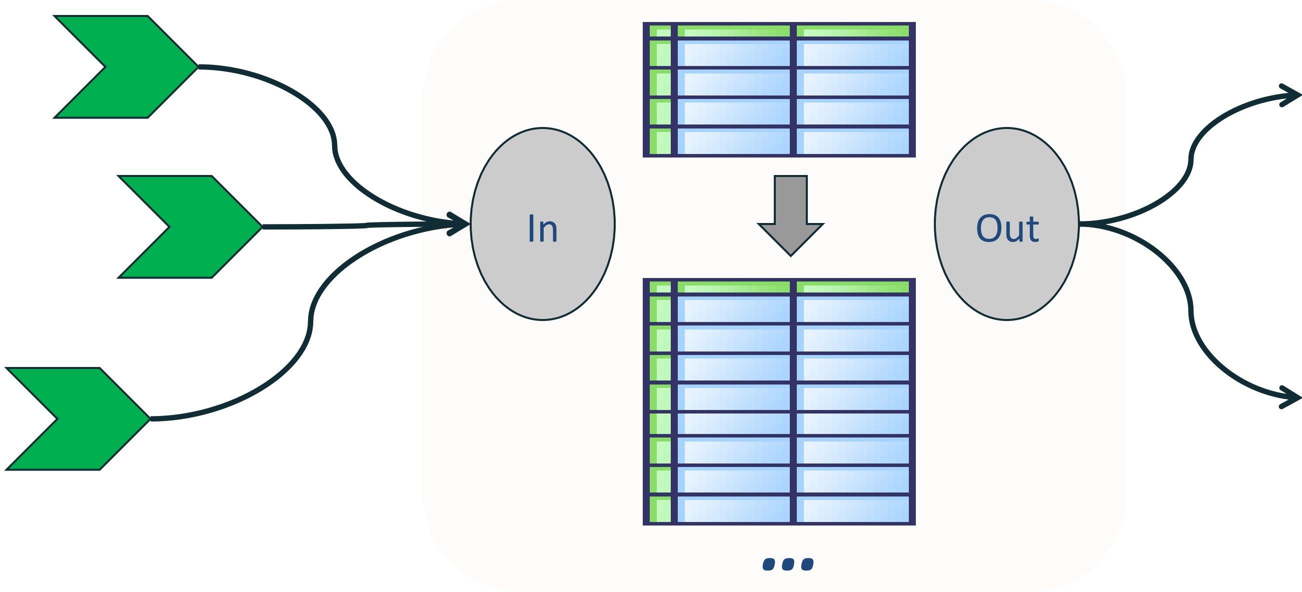
For Real-Time performance, it’s the ***Cache*** *…*

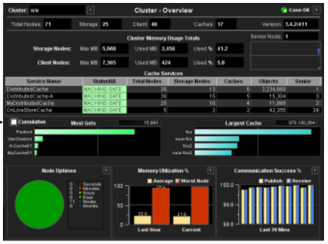
Not a simple “current value” cache

High-performance Real-time Multi-dimensional Data Cache

***Real-Time Cache** – optimized for performance !*

Current / History Tables:




Cluster: n/a

Cluster - Overview

Conn OK

Total Nodes: 71 Storage: 25 Client: 46 Caches: 17 Version: 3.4.2/411

Cluster Memory Usage Totals

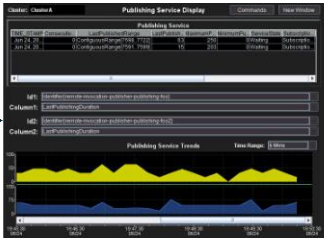
Senior Node: 1

Storage Nodes: Max MB: 5,968 Used MB: 2,456 Used %: 41.2

Client Nodes: Max MB: 7,365 Used MB: 424 Used %: 5.8

Cache Services

Service Name	Status/HA	Total Nodes	Storage Nodes	Caches	Objects	Senior
DistributedCache	MACHINE-SAFE	38	13	6	3,234,668	1
DistributedCache-A	MACHINE-SAFE	36	15	5	15,304	3
MyDistributedCache	MACHINE-SAFE	25	10	4	11,868	3
OnLineStoreCache	MACHINE-SAFE	5	2	2	42,355	38


Cluster: ClusterA

Publishing Service Display

Commands | New Window

Publishing Service

TIME_STAMP	Consecutiv...	LastPublishedRange	LastPublish...	MaximumP...	MinimumPu...	ServiceState	Subscriptio...
Jun 24, 20...	0	ContiguousRange[7698..7722]	63	250	0	Waiting	Subscriptio...
Jun 24, 20...	0	ContiguousRange[7591..7598]	15	293	0	Waiting	Subscriptio...

Id1: Identifier{remote-invocation-publisher-publishing-foo}

Column1: LastPublishingDuration

Id2: Identifier{remote-invocation-publisher-publishing-foo2}

Column2: LastPublishingDuration

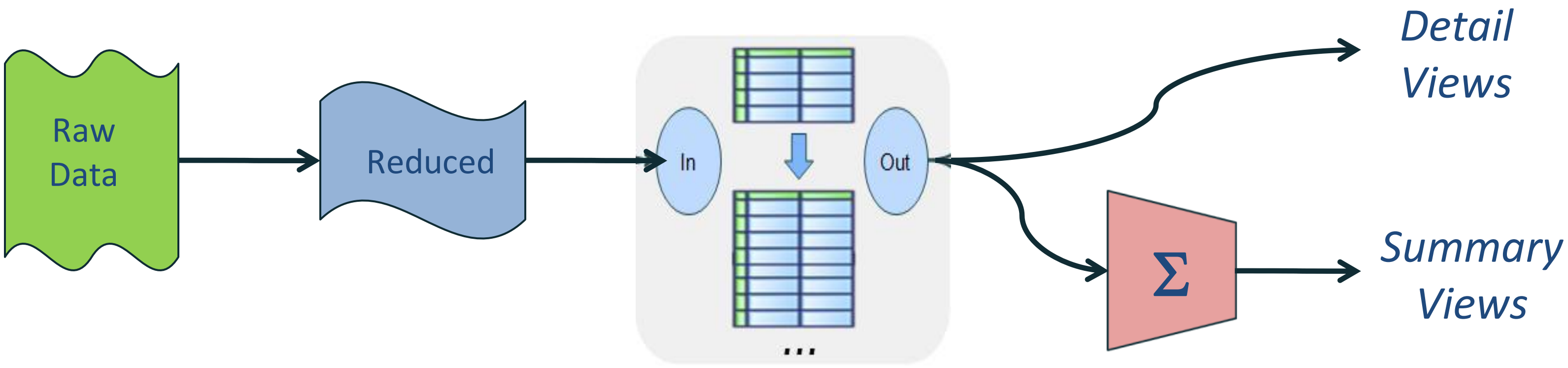
Publishing Service Trends

Time Range: 5 Mins

Indexed Insertion -
asynchronous real-time data

Indexed extraction -
optimized transfer to clients

Real-Time Cache *– Data Processing / Aggregation*



Raw Data

Reduced

Detail Views

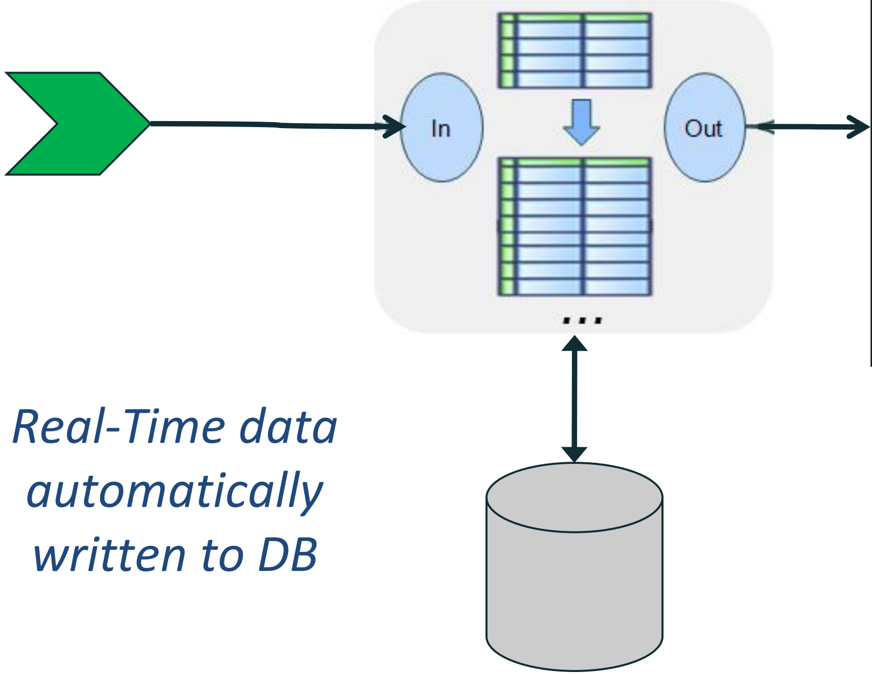
Summary Views

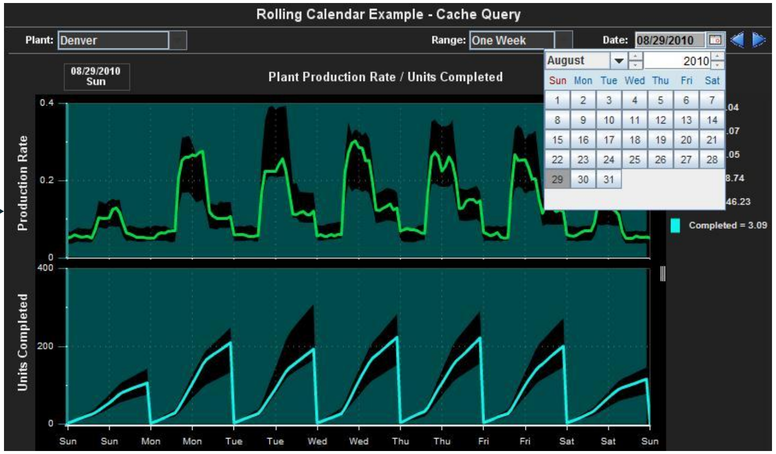
Reduction, Resolution, Aging

Aggregation

Real-Time Cache *– Database read/write through*

(optimized for timestamped multi-dimensional data)





Rolling Calendar Example - Cache Query

Plant: Denver

Range: One Week

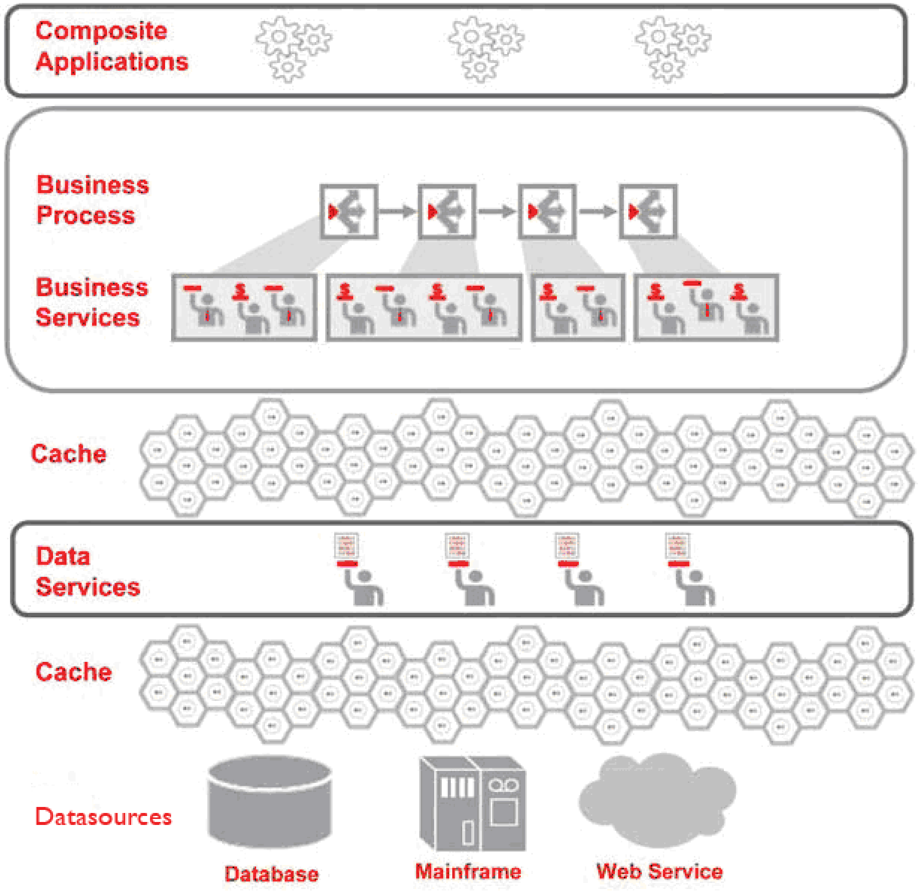
Date: 08/29/2010

Real-Time data automatically written to DB

Seamless timeline navigation with automatic database query

This sounds a bit like Oracle Coherence …

Caching in an SOA Environment



Buffer database

Read/write through

Listeners

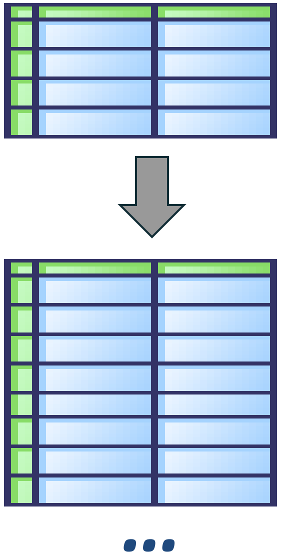
Indexed queries

What's different ?

Different tools for different problems !

Real-Time Multi-dimensional data:

Current / History Tables:



Multiple rows (time range) of selected columns returned in one query

Coherence cache distributes objects (rows) = optimized horizontally

Real-Time multi-dimensional cache manages columns and optimizes vertically

Benefits: Indexed Real-Time Caching

Slow SQL queries minimized

Users shielded from database details

Minimize CPU load using effective indexing

Solutions

- Solution #2

  Server-Side Aggregation

  (am I being too obvious with this one ?)

  Know the use cases

  Joins and GroupBy done on server

  SQL does this, but do you need it ?

Problems with SQL Database Queries

Slow

Slowwer with concurrent queries

If you need it fast, it goes even slowwwwwwer !

SQL = Not portable

(Timestamps, especially)

Know your problem space !

Real-Time Monitoring:

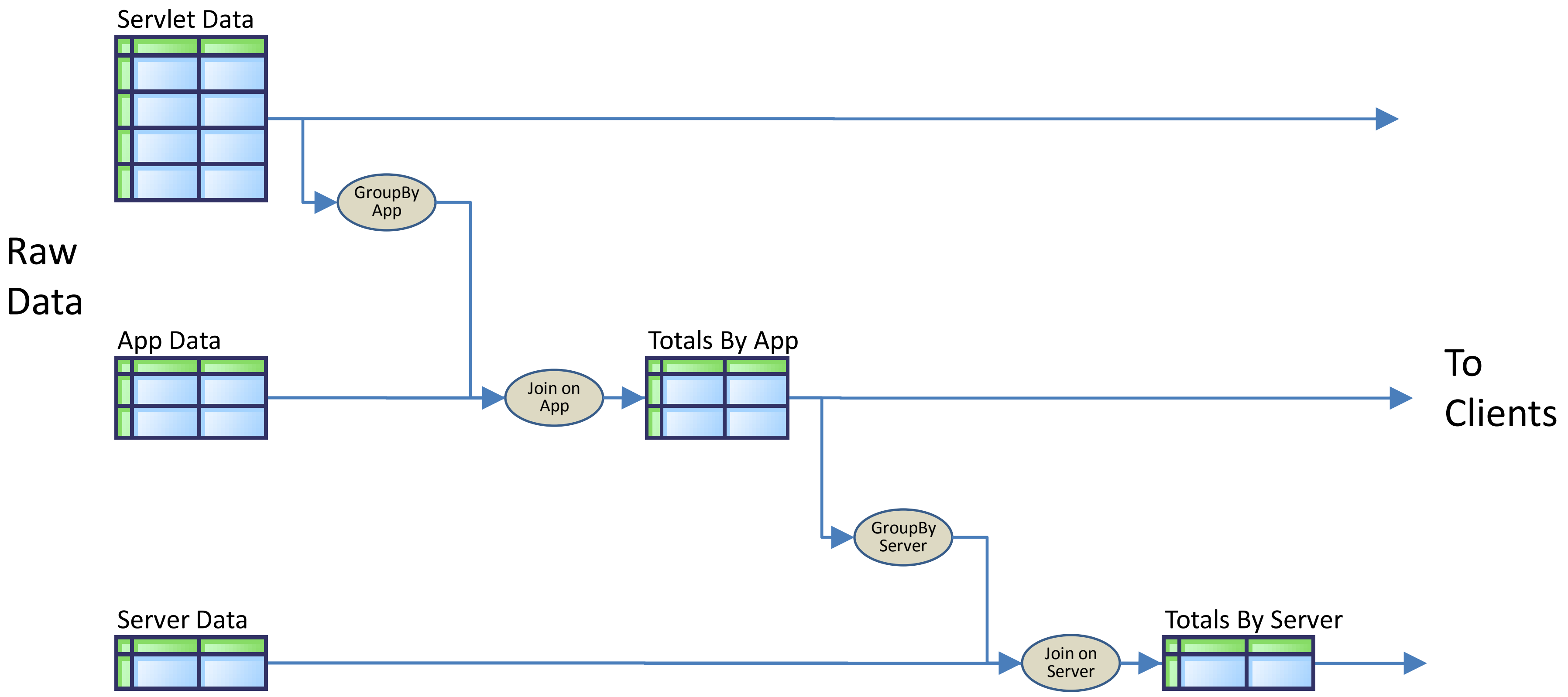
Join and GroupBy heavily used

We wrote our own!

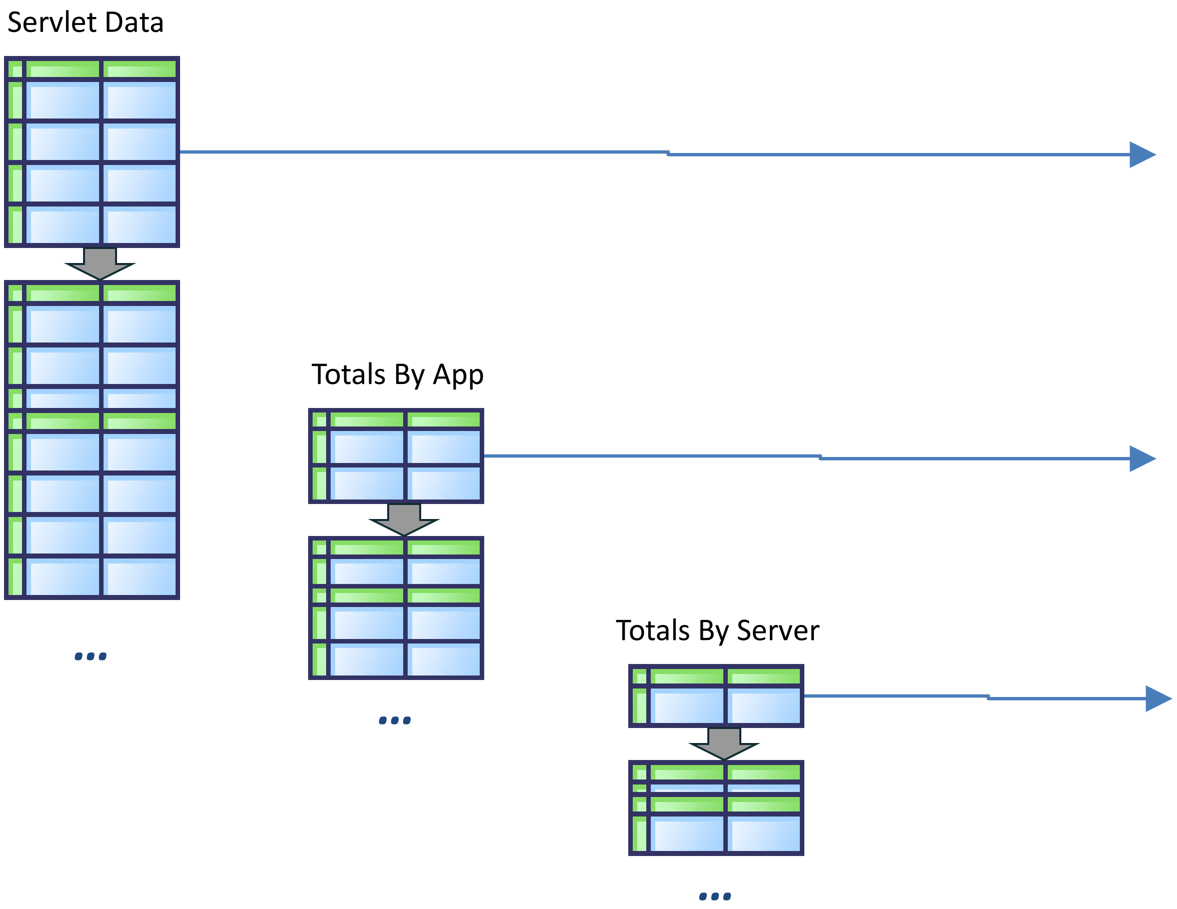
Performed in real-time on server-side data

Optimized for real-time requirements

- Example: Server-Side Aggregation/Caching



- Each cache can maintain its own history


Servlet Data

Totals By App

Totals By Server

Cached
Data
And
Aggregates

To
Clients

- Result: trend chart of Totals by History has all data available immediately

- Using SQL would require:

Query 3 tables

2 GroupBys, 2 Joins, + Join on Timestamp (not portable)

Benefits: Server-Side Aggregation

Client requests and gets exactly what is needed

Client processing = zero

Server processing = done ahead of time

Current/History for aggregates readily available (No SQL)

Response time = fast

Solutions

- Solution #3

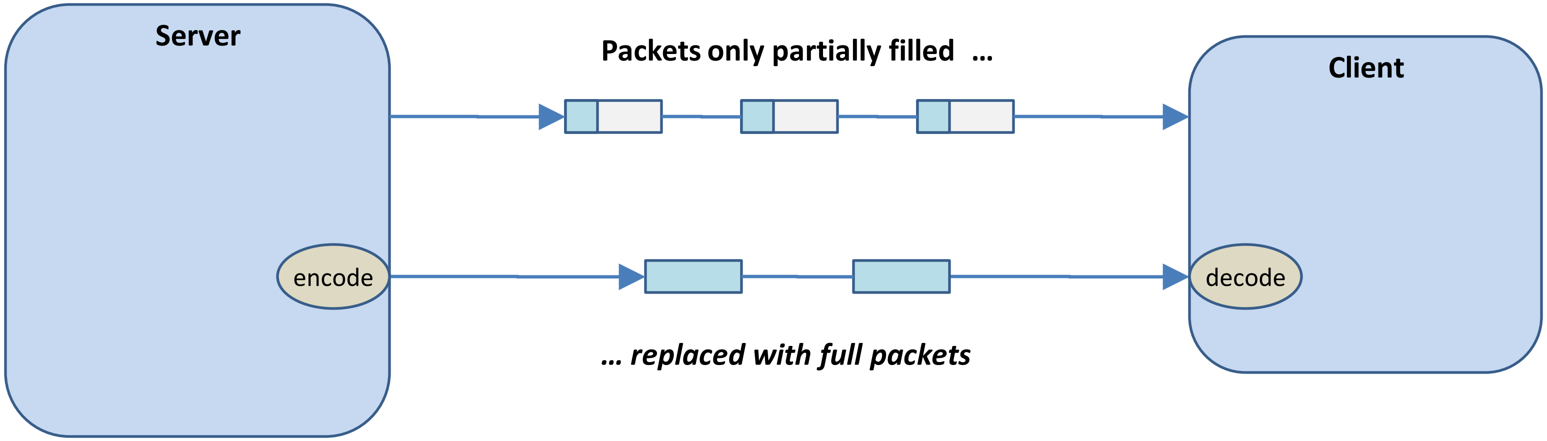
  Use Appropriate Design Patterns

  Server-Side vs. Client-Side Processing
  Efficient Data Transfer Patterns

- Pattern #1:

Data Compaction

(obvious, initial approach for any data transfers)

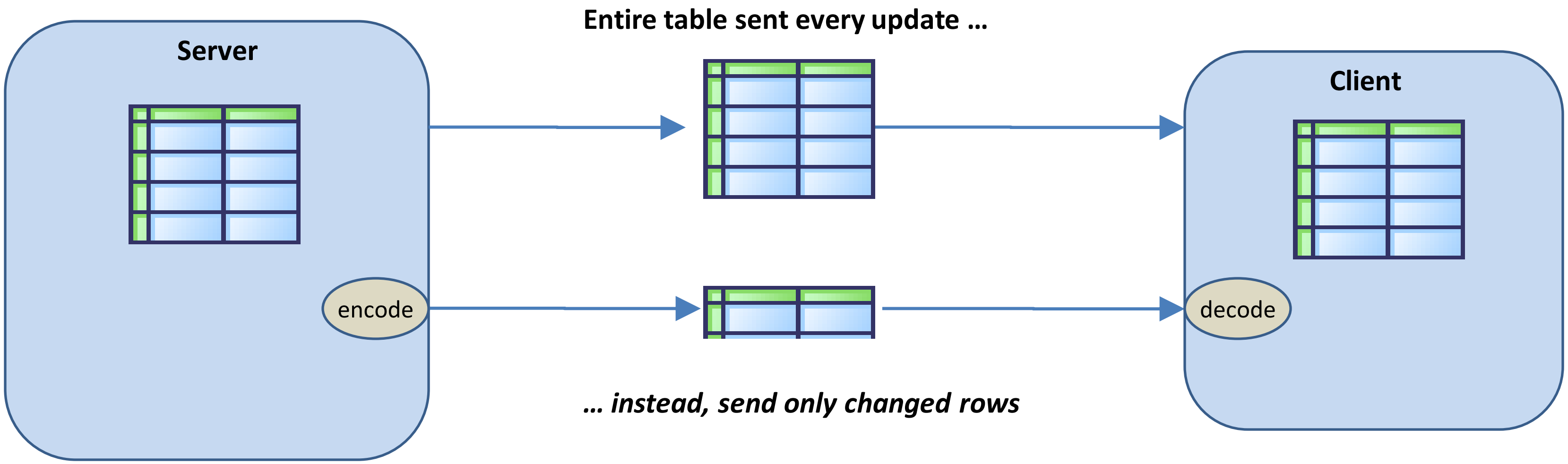


… even simple, non-proprietary algorithms can make big difference

- Pattern #2:

Data Current / Changed

(large data tables with sparse real-time updates)

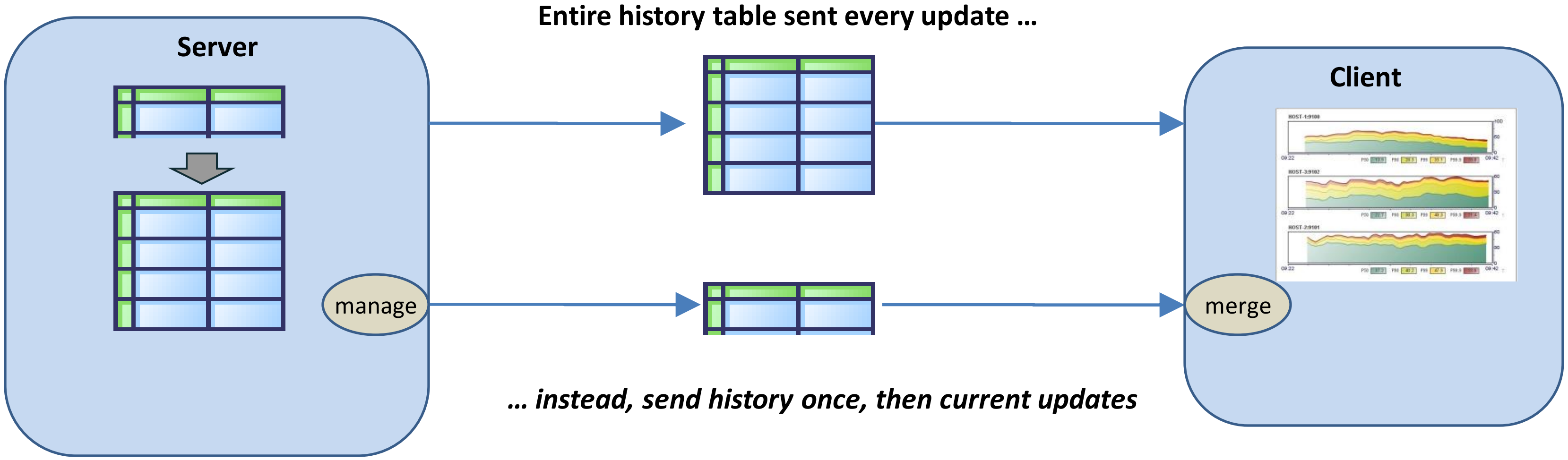

Entire table sent every update …
Server
Client
encode
decode
… instead, send only changed rows

… little more complex, requires indexing

- Pattern #3:

Data History / Current

(trend chart invoke with real-time updates)



Entire history table sent every update …

Server

manage

Client

merge

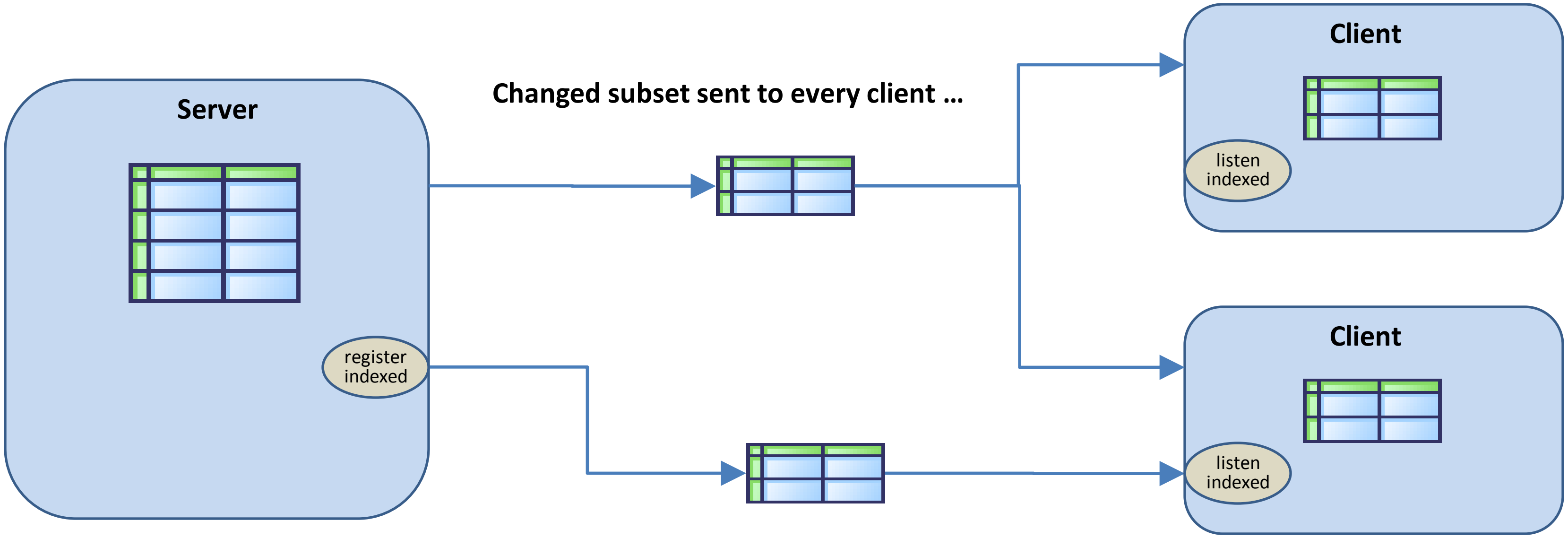
… instead, send history once, then current updates

… similar to current / changed pattern, but specific to history

- Pattern #4:

Data Current / Subset

(optimizing transfer of data subsets to multiple clients)



… instead, send subset only to registered client

… requires registration logic coupled with cache

Benefits: Design Patterns for Data Transfer

Same problem over and over again solved similar way

Reduce load on network

Optimize response time – no unnecessary data

Conclusions

- Conclusion #1:

  Know your data !

  Data Model designed for real-time
  In-memory structures to buffer database
  Server-side aggregations

Conclusions

- Conclusion #2

  Respect Design Patterns !

  - Server-Side vs. Client-Side Processing
  - Efficient Data Transfer Patterns
  - Don’t over-generalize – solve the problem

Questions?

See www.sl.com
for more into about SL and RTView