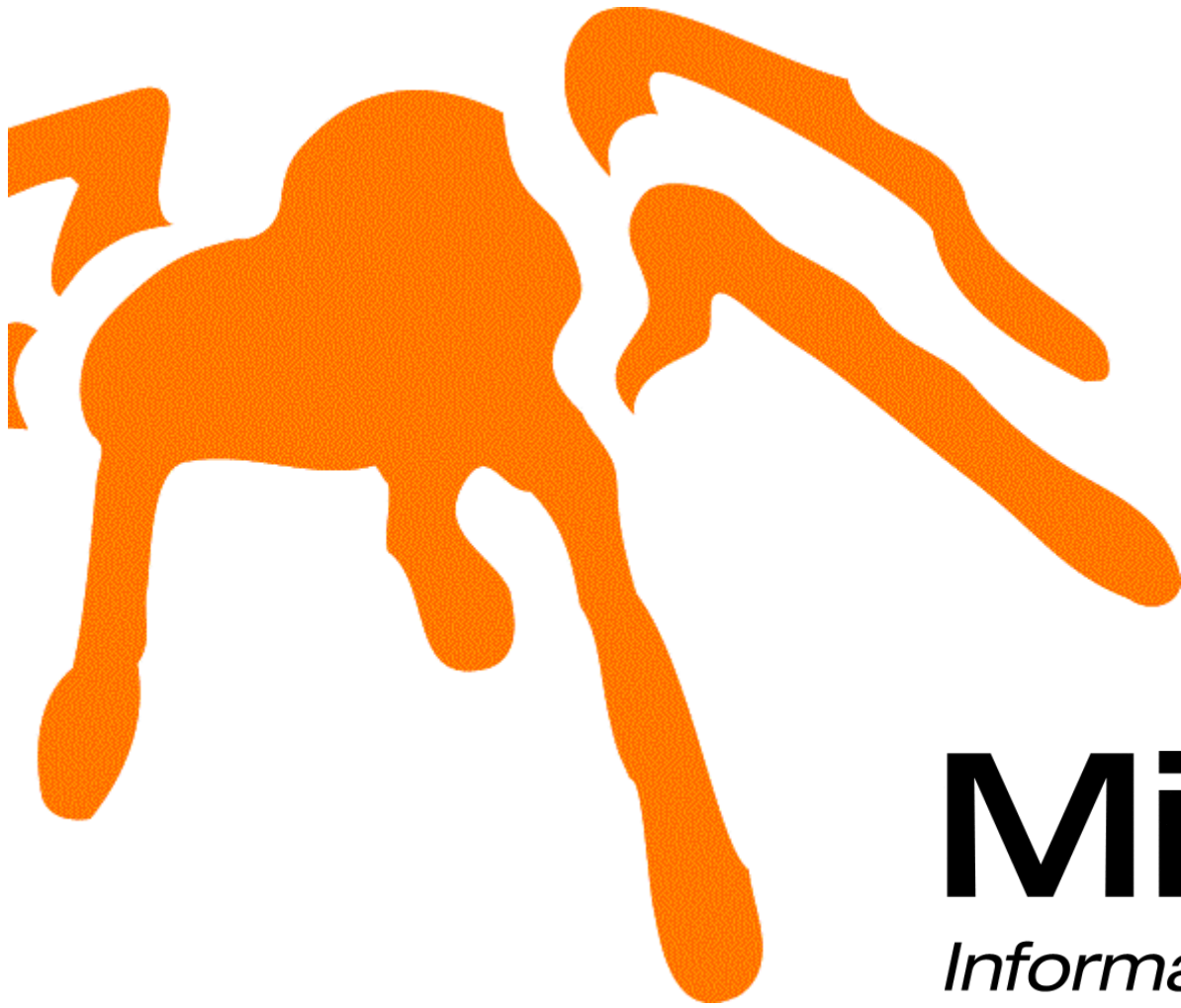




Mimer

Information Technology

**Mimer SQL on OpenVMS
Present and Future**

Bengt Gunne, CTO

Agenda

- **Background**
- Mimer customers
- Platforms
- Technical features
- Mimer SQL on OpenVMS
- Ongoing development
- Q&A

Bengt Gunne



- Started working with Mimer in 1981
 - Have worked with many parts of the system such as:
 - Database kernel
 - Transaction handling
 - Client/server communications
 - Clients such as ODBC and ADO.NET
 - Overall design
 - Multiuser systems for PDP, VMS, HP-UX, Windows etc.
 - Most recently written a new SQL optimizer
 - Head of development since 1991
 - Chief Technical Officer

Who was Mimer?



Mimer was a giant in the Norse Mythology who guarded the well of wisdom.

The gods came to Mimer for advice. When they looked into the well they could see everything that happened in the world.

The god Oden even took out one of his eyes and put it in the well to be able to see everything at all times.

Today, ordinary people come to Mimer for advice...

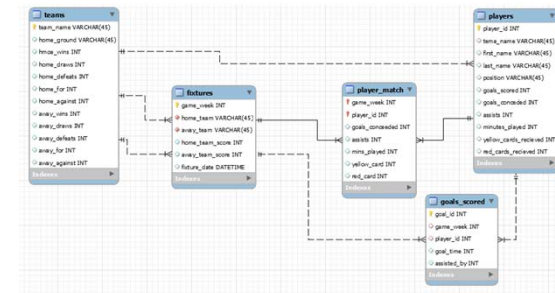
Mimer 

Mimer Information Technology AB

- HQ in Uppsala, Sweden
 - Office in Stockholm and Beijing
 - Partners in China, Japan, Korea, Central Europe, and USA
- World class experts in relational database technology
- Developer of the Mimer SQL product family
 - Enterprise Solutions
 - Industrial/Automotive/Embedded Solutions
 - Mobile Solutions
- Mimer SQL used in mission critical systems world wide since the 1970s

What is Mimer SQL?

- Relational database management system
- Standard SQL
- Runs on many platforms
 - Tight integration with OpenVMS



Company focus

- The company focuses solely on Mimer SQL
 - Tools are through third party integrations
 - How is this possible/facilitated?
 - Standard SQL
 - Standard programming interfaces
- Requires a truly open system



Mimer SQL background

- Roots at Uppsala University, Sweden
- 35+ years on VMS! First port 1980 (VAX780)
- Close co-operation with VSI
- OpenVMS main development platform since 1982
 - VAX
 - Alpha
 - Integrity
 - and now...



Mimer SQL port to OpenVMS on x86

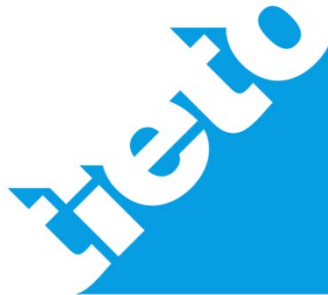
- Will be done using prerelease from VSI
- Close in time with OS release to customers



Agenda

- ✓ Background
- **Mimer customers**
- Platforms
- Technical features
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- Q&A

Some Customers

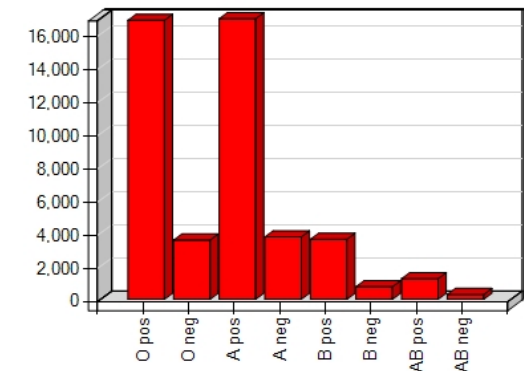


OpenVMS

Mimer 

Mimer SQL in Life-Critical System

- World's largest centralized blood supply management system
- NHS Blood and Transplant service, England & Wales
 - Responsible for **all** donated blood and tissues
 - System controls 2.5 million donations annually
 - 3,500+ active users
 - Database of 1 billion records
+8 million / week
- *“Our experience is that Mimer SQL rarely gives us a problem and has a very low maintenance overhead, so there's no need for any expensive database administrators to run the system.”*



Ian Henderson, MD at Savant Enterprises,
the developer of PULSE

NHS Blood and Transplant

An Integrated System

*“NHS Blood & Transplant provides a life-saving service. **It cannot fail**, especially in the face of major incidents. NHSBT has achieved an **extremely high level of disaster tolerance** through the use of dual data centers and split-site OpenVMS clusters.*

...

*In summary, this system demonstrates considerable in-depth strength to deliver extremely **high availability** blood-product services to NHSBT by using the **PULSE** software, the **Mimer SQL** database, and the **OpenVMS clusters** running on Integrity Server systems and EVA storage subsystems.”*

Availability Digest, Oct 2008

Mimer SQL at NHS

- Database Server
 - HP Integrity servers at 2 locations
 - OpenVMS
 - Mimer SQL database
 - Serving data through ODBC
- COM+ Windows server
 - Providing “middleware” data services to clients
- Clients
 - Windows PC (thin client through Citrix)
 - HTML web pages
 - Web services to third party clients

Mimer SQL at NHS BT

Vital Statistics (July 21 2011)

- Live System
 - 1,251,033,111 records in 715 tables
 - Largest table (donation audit) is 130+ million records
- Archive System
 - For older, time expired records
 - 2,065,863,274 records

UK National Health Service – Blood & Transplant Builds World's Largest Centralised Blood Supply Management System on HP Integrity Servers and HP OpenVMS



'We've built the biggest centralised blood management system in the world, and we now have great visibility into our end-to-end supply chain. It was a challenge moving to a national system, and we credit HP and our other partners involved for mitigating the risks and making this project a success.' – Neil Hogg, general manager of IT, NHS Blood and Transplant

- Maintained 99.9% uptime
- Reduced data centre footprint
- Maintained exceptional reliability
- Built disaster-tolerant solution

NHS
Blood and Transplant

HP customer case study: NHSBT UK National Health Service – Blood & Transplant (NHSBT)

Industry: health services

Objectives

- Provide a better experience to donors
- Increase visibility of blood supply and improve contingency plans
- Consolidate and simplify the central system with minimal business disruption
- Ensure high uptime
- Reduce costs and improve efficiency

Approach

- Implement HP Integrity servers in OpenVMS cluster configuration at two separate data centres with multiple layers of redundancy
- Move from three regional centres with isolated databases to one national system

IT improvements

- Maintained 99.9% uptime
- Reduced data centre footprint
- Maintained exceptional reliability
- Built disaster-tolerant solution

Business benefits

- Enhanced donor relationships
- Improved blood stock management through visibility across entire country
- Improved disaster and emergency planning and capabilities
- Provided better health support services to the public while reducing costs
- Increased visibility into blood supply chain nationwide



Lifesaving services, reliant on technology

Every country's population is vitally dependent on a consistent and safe supply of blood, organs, plasma and tissues – and a solid base of blood and organ donors. As part of the UK's National Health Service, NHS Blood & Transplant (NHSBT) is responsible for optimising the supply of blood, organs, plasma and tissues and raising the quality, effectiveness and efficiency of blood and transplant services. NHSBT manages the supply of blood to hospitals throughout England and North Wales, tracking it from when it is first donated, through its testing and separation into various products and, finally, to its dispatch to hospitals.

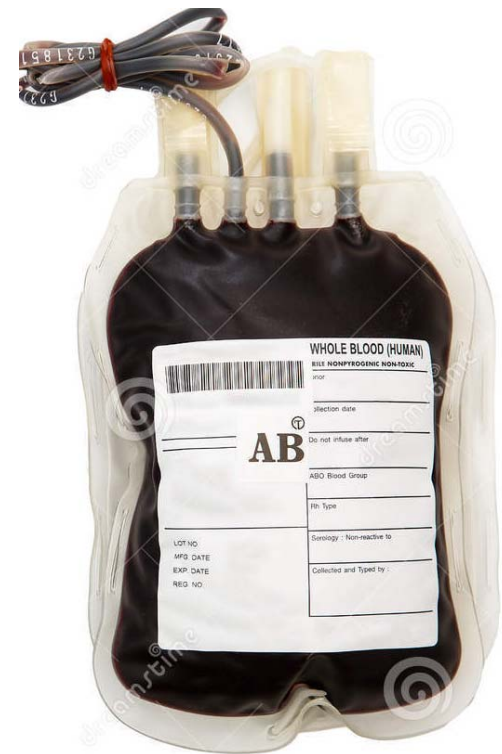
Mimer SQL in Production

- Controls flow of parts to the assembly lines at the Volvo car plant in Gothenburg
- Mission critical (unplanned database downtime very expensive)
- 450 database servers for different purposes
- 250.000 cars annually
- In production since 30+ years



Mimer SQL in Life-Critical System

- National Blood Service, England & Wales
- Nation-wide system responsible for all donated blood and tissues
 - System controls 2.5 million donations annually
 - 3,500+ active users
 - Database of 1 billion records
 - +8 million / week in a single table
- Runs in OpenVMS cluster
- 99.9% uptime





- Mimer Installations of Mission critical systems within Telecom industry

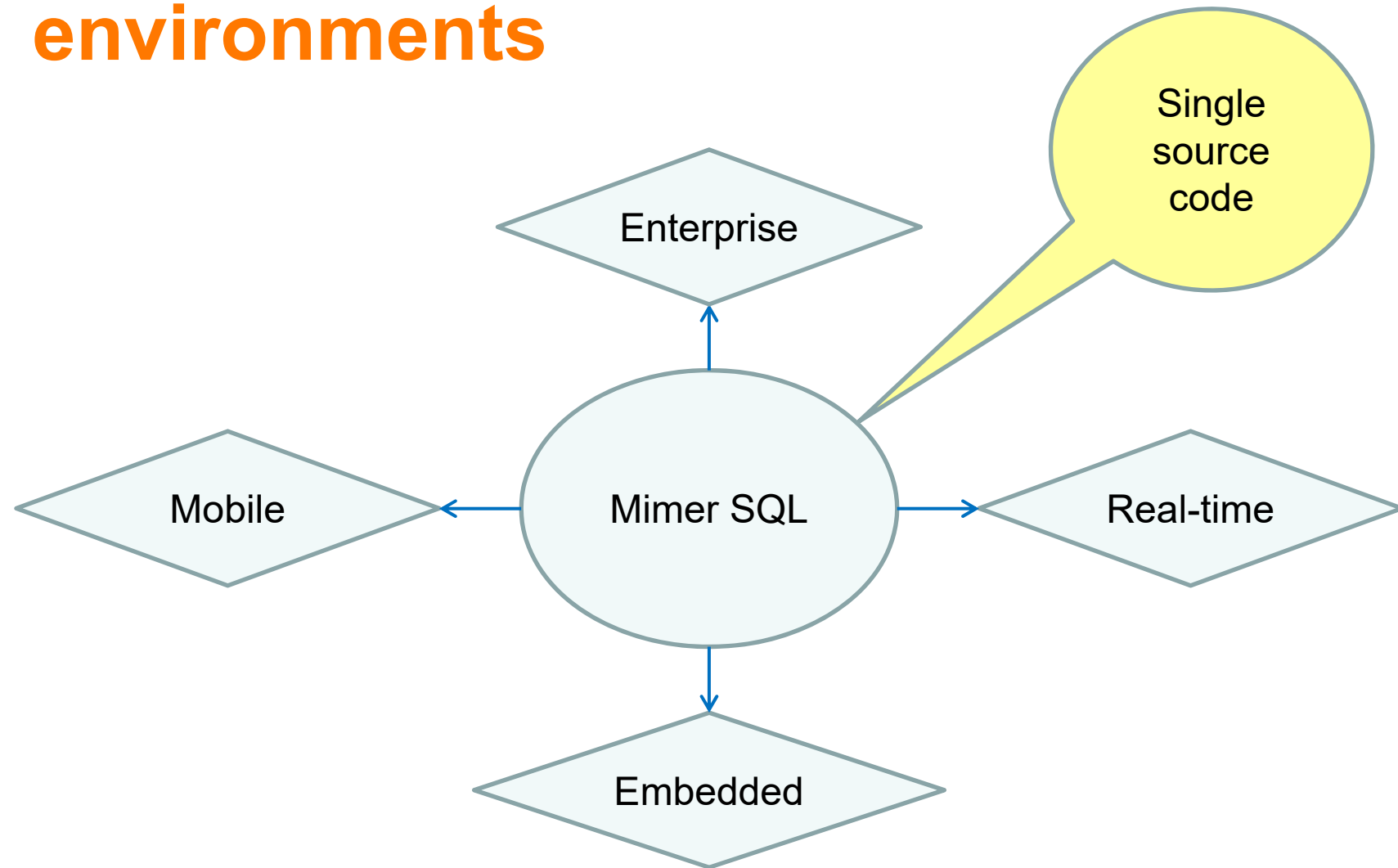
System type:	Managing SMS for operators
Transaction volume total:	Two digit billions of SMS every month
Number of operators:	29
Number of servers:	178
Number of processors:	700 (more than 2100 cores)
Support incidents since 2014:	1

- All systems migrated from Oracle/Rdb to Mimer SQL
- Runs in cluster environment to achieve redundancy

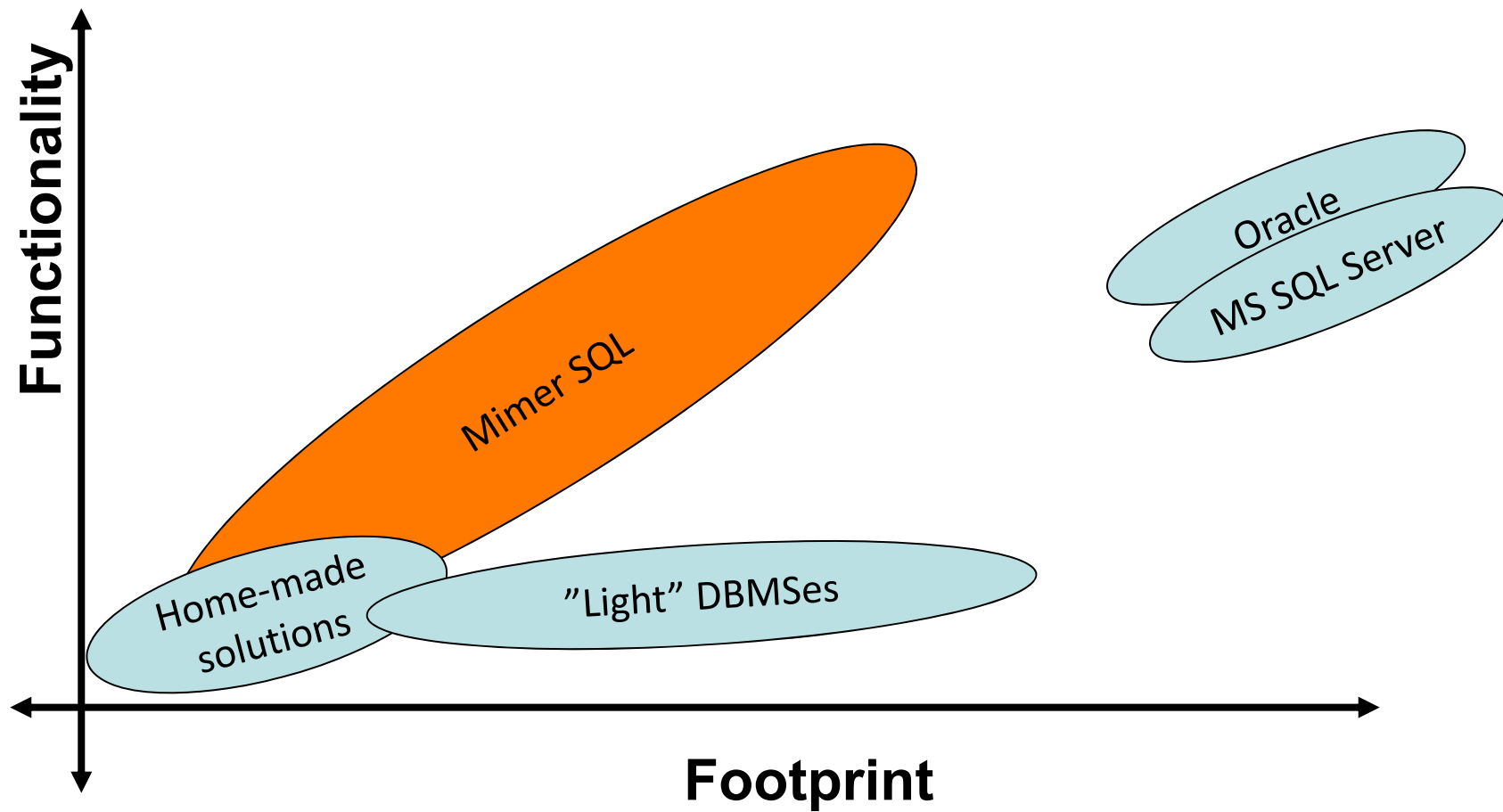
Agenda

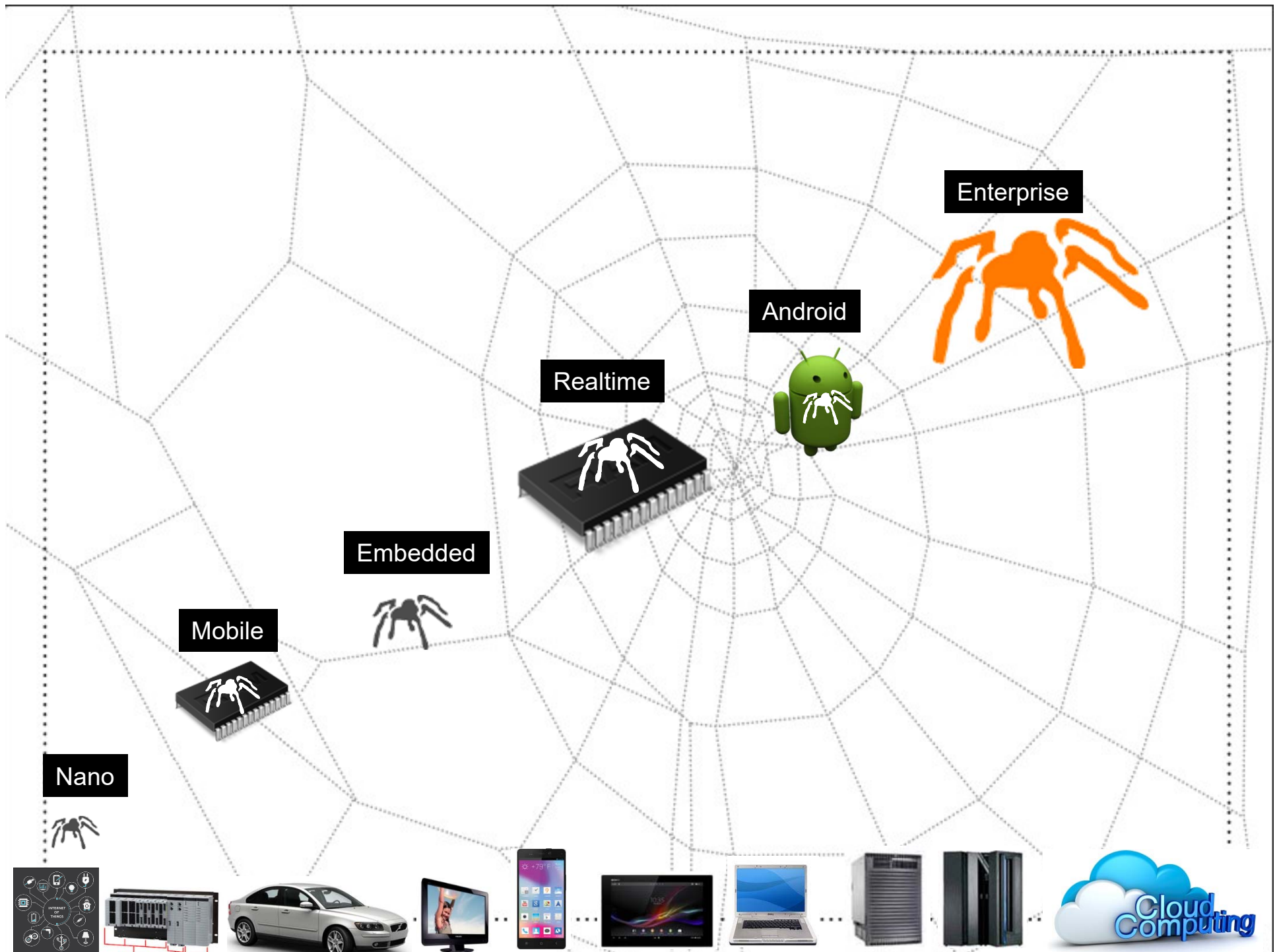
- ✓ Background
- ✓ Mimer customers
- **Products**
- Technical features
- Mimer SQL on OpenVMS
- Ongoing development
- Q&A

Mimer SQL in different environments

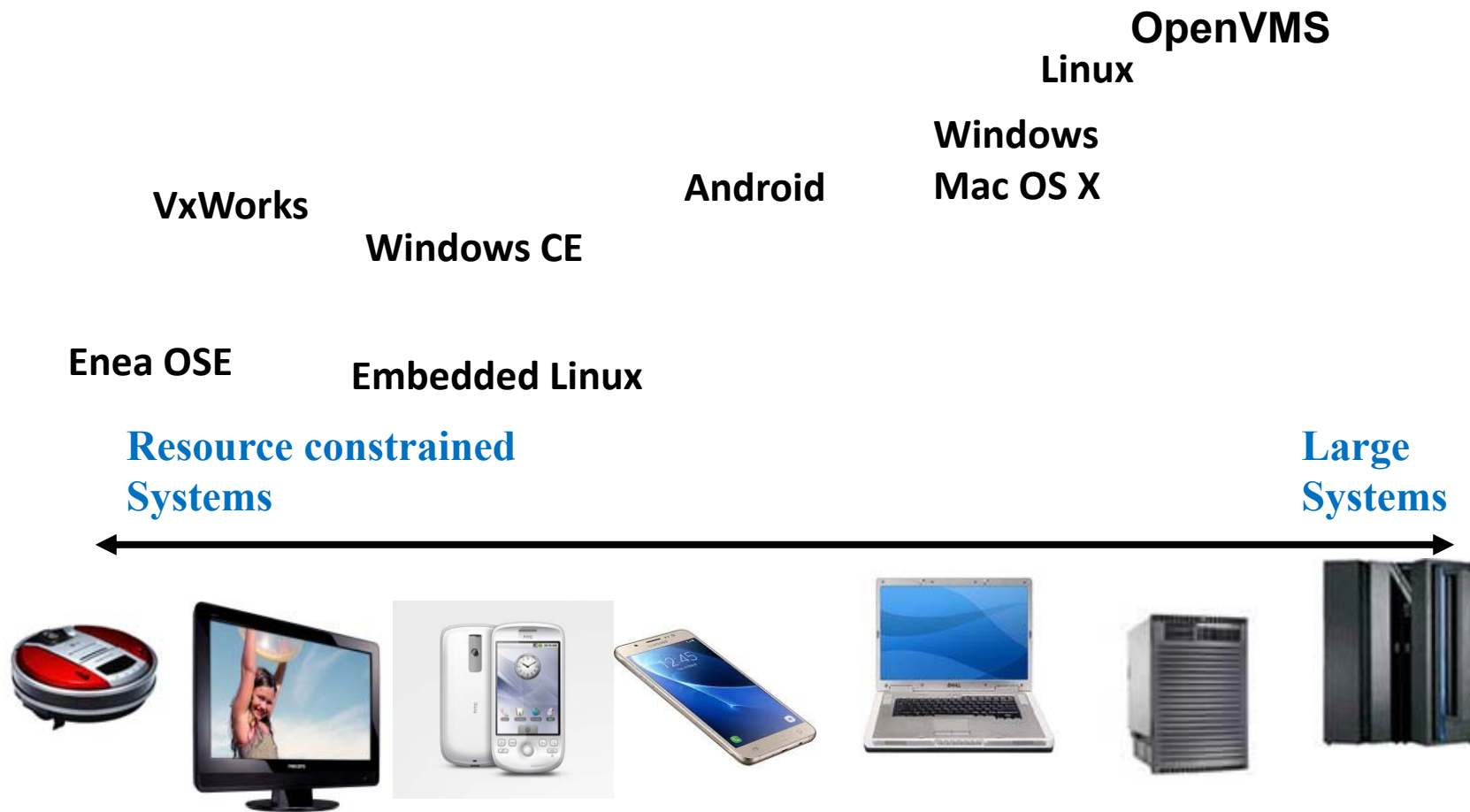


Mimer SQL positioning





Mimer SQL platforms

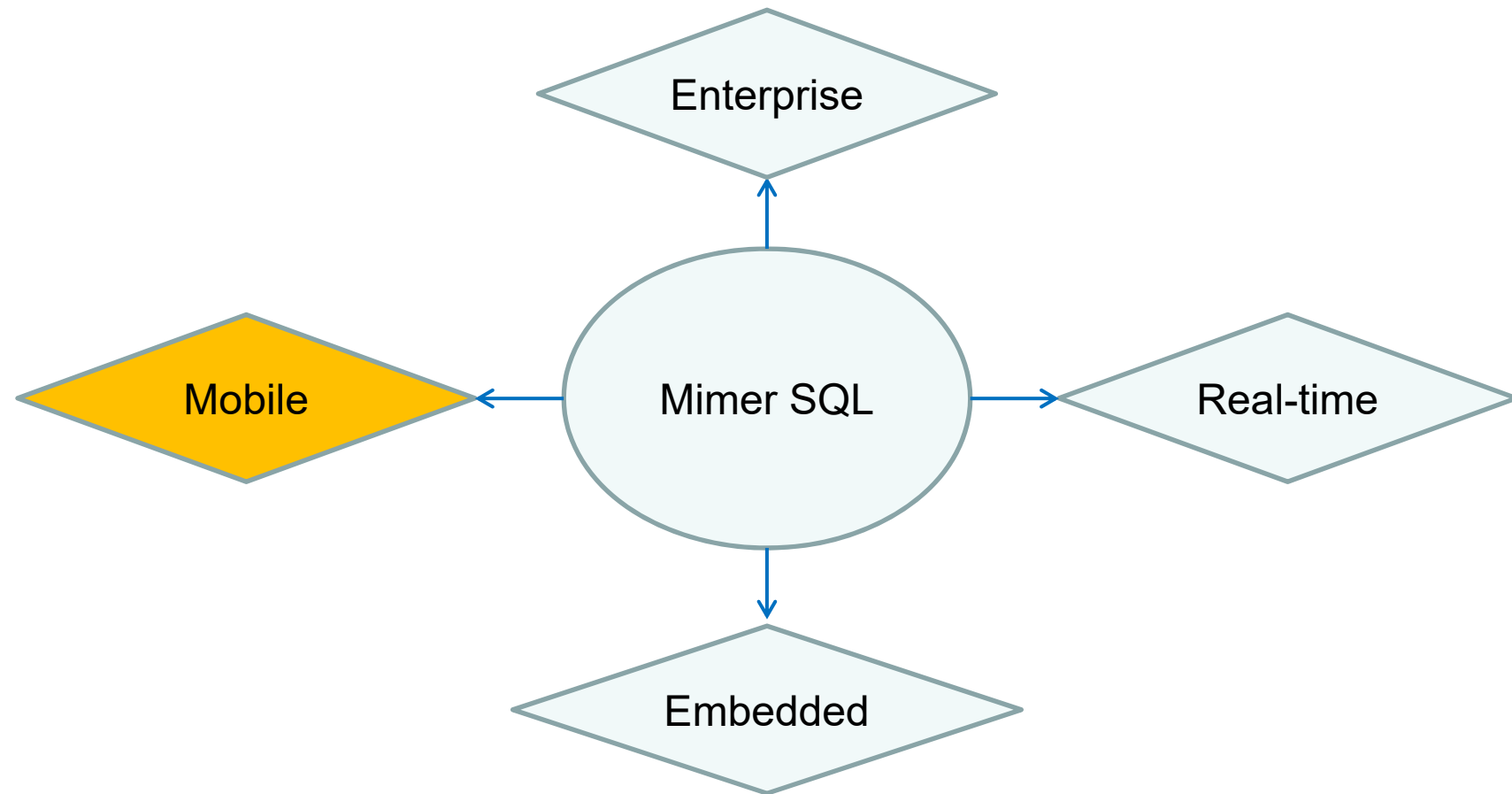


Mimer SQL platforms

- Same database kernel on all platforms
 - Enterprise server on a mobile phone
 - Small footprint and zero maintenance enterprise server

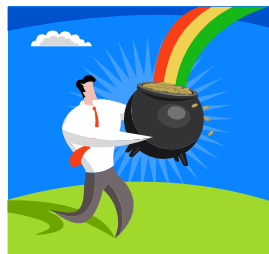


Mimer SQL in different environments



Rich functionality

- Even the smallest editions of Mimer SQL contains functionality only found in enterprise class databases
 - Stored procedures
 - Views
 - Statement triggers
 - Instead of triggers
 - Foreign keys
 - Constraints
 - Union/Intersect/Except/Unique
 - Distinct
 - Sub-queries
 - Left/Right/Full Outer join
 - Precompiled SQL
 - Multi-user
 - Client/Server based
 - ...
- Optional:
 - Collations
 - Sequences
 - Large objects
 - Auto-upgrade



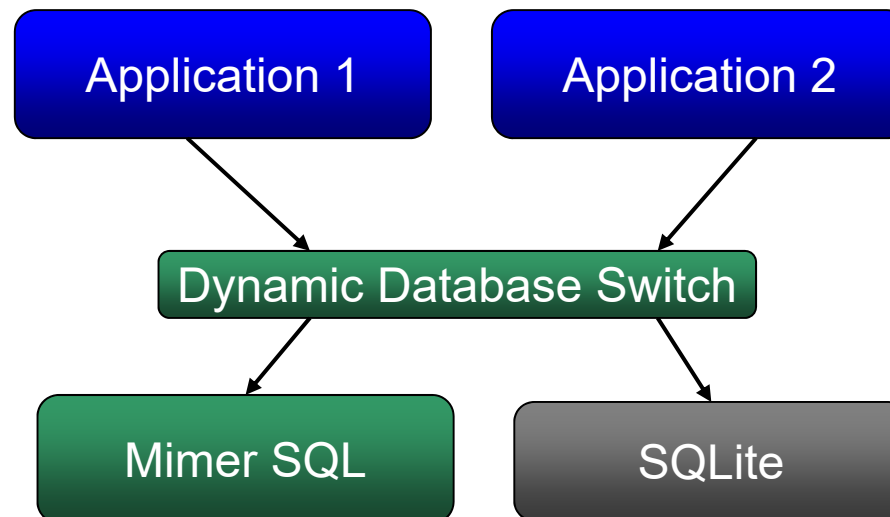
Phones with Operating systems from Enea OSE, Symbian, Windows, and Android with Mimer Inside



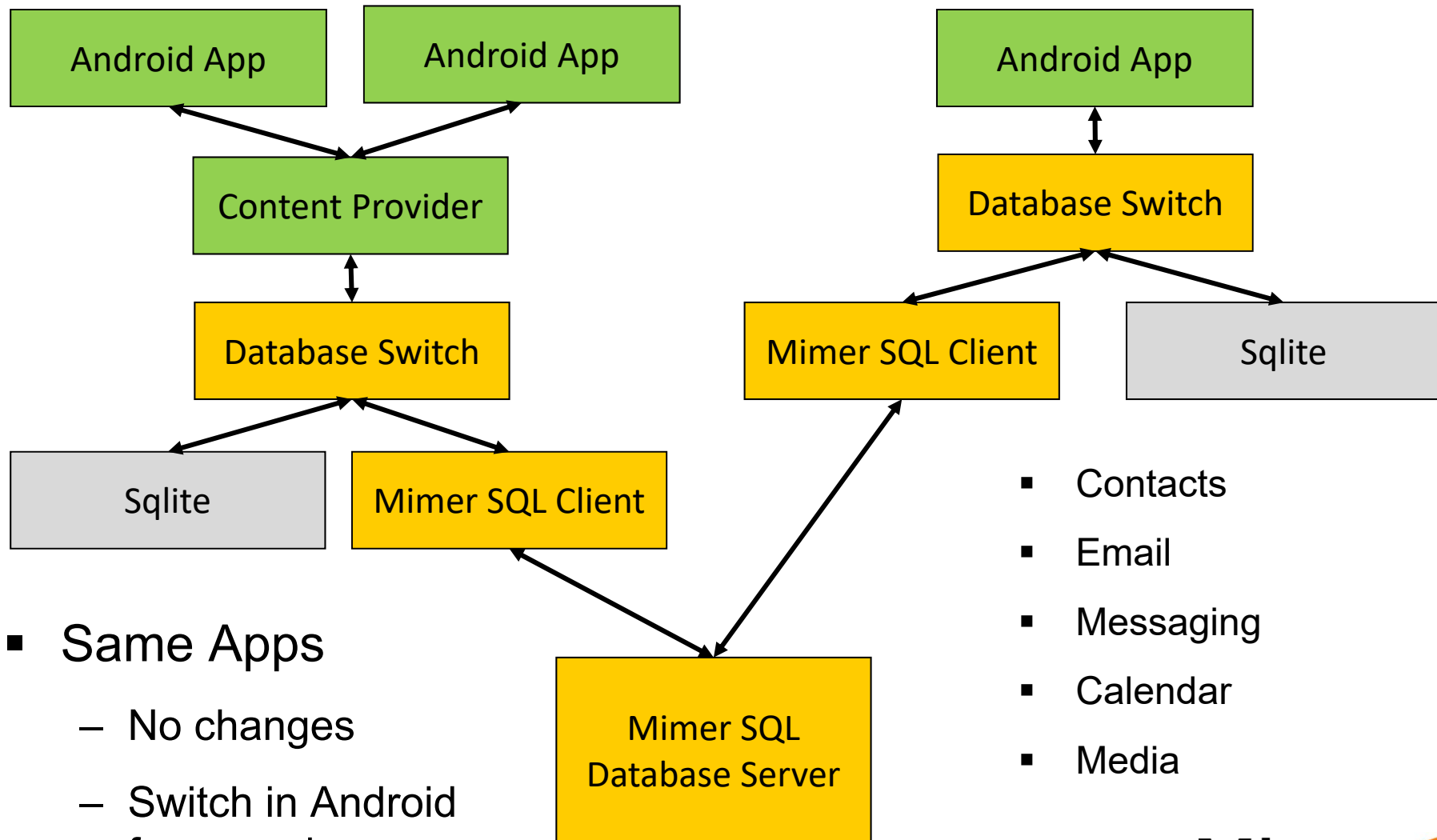
Included in more than 125.000.000 devices.

Mimer SQL on Android: Dynamic Database Switch

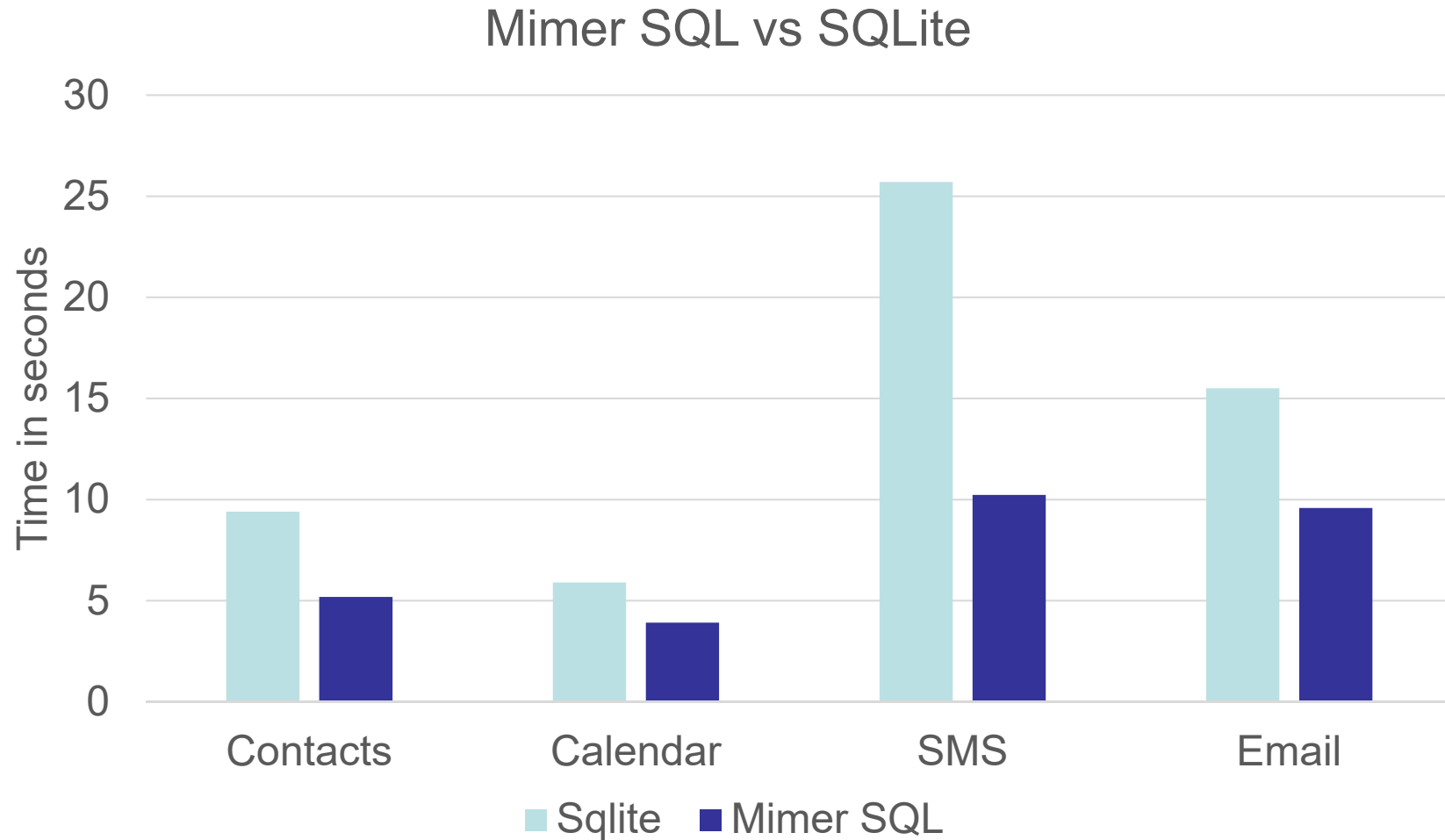
- Different applications/providers may use different database engines
 - Application/Provider does not know which database is used
 - Runtime switch
 - XML configuration



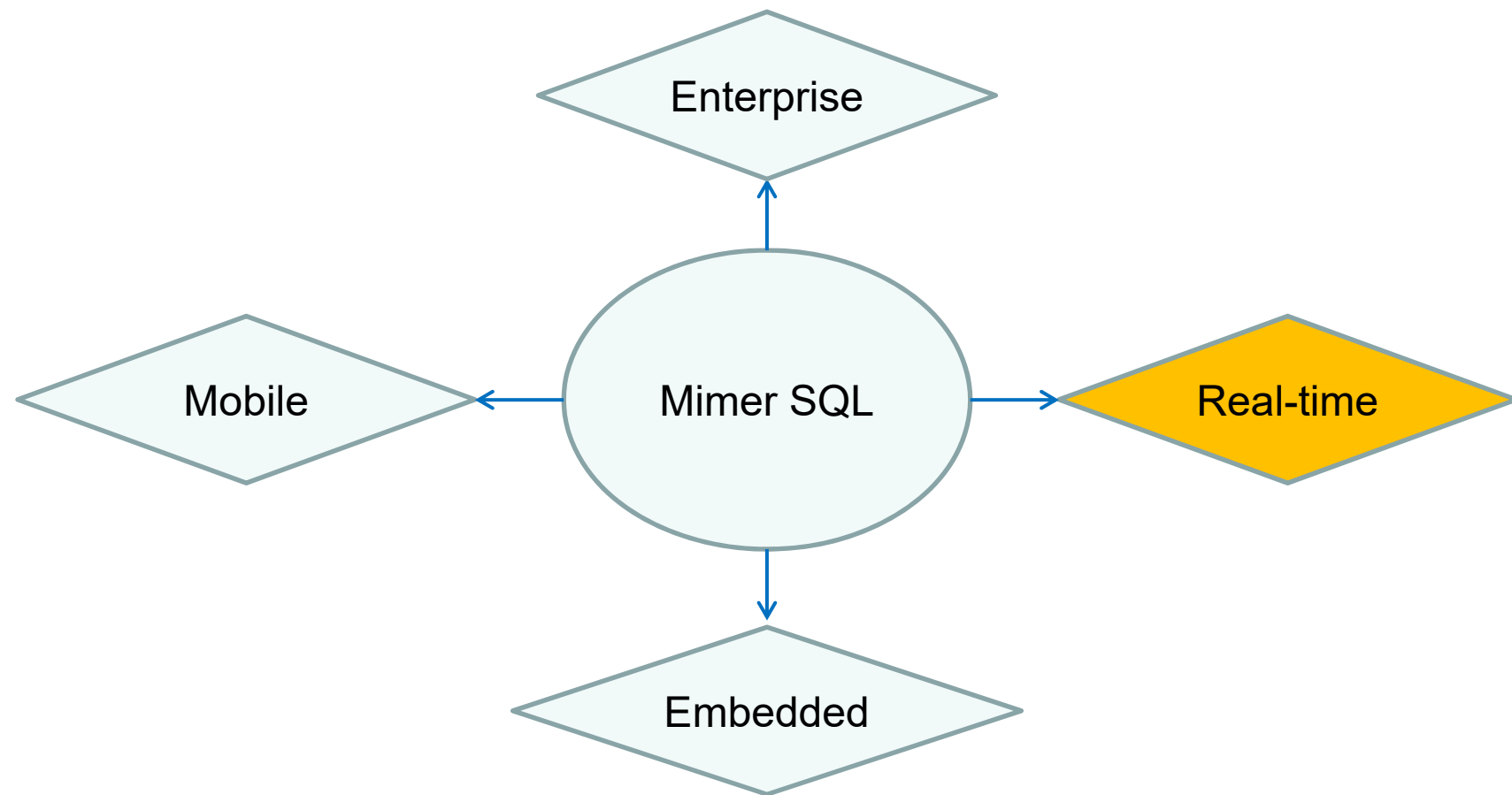
Mimer SQL on Android



Performance on Android

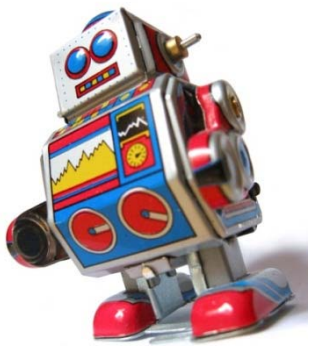


Mimer SQL in different environments



Real-time databases

- Customer problems
 - Amount of data constantly growing
 - Many different mechanisms used
 - Need to make new real-time analysis for each implementation
 - Hard to perform analysis and aggregation of data

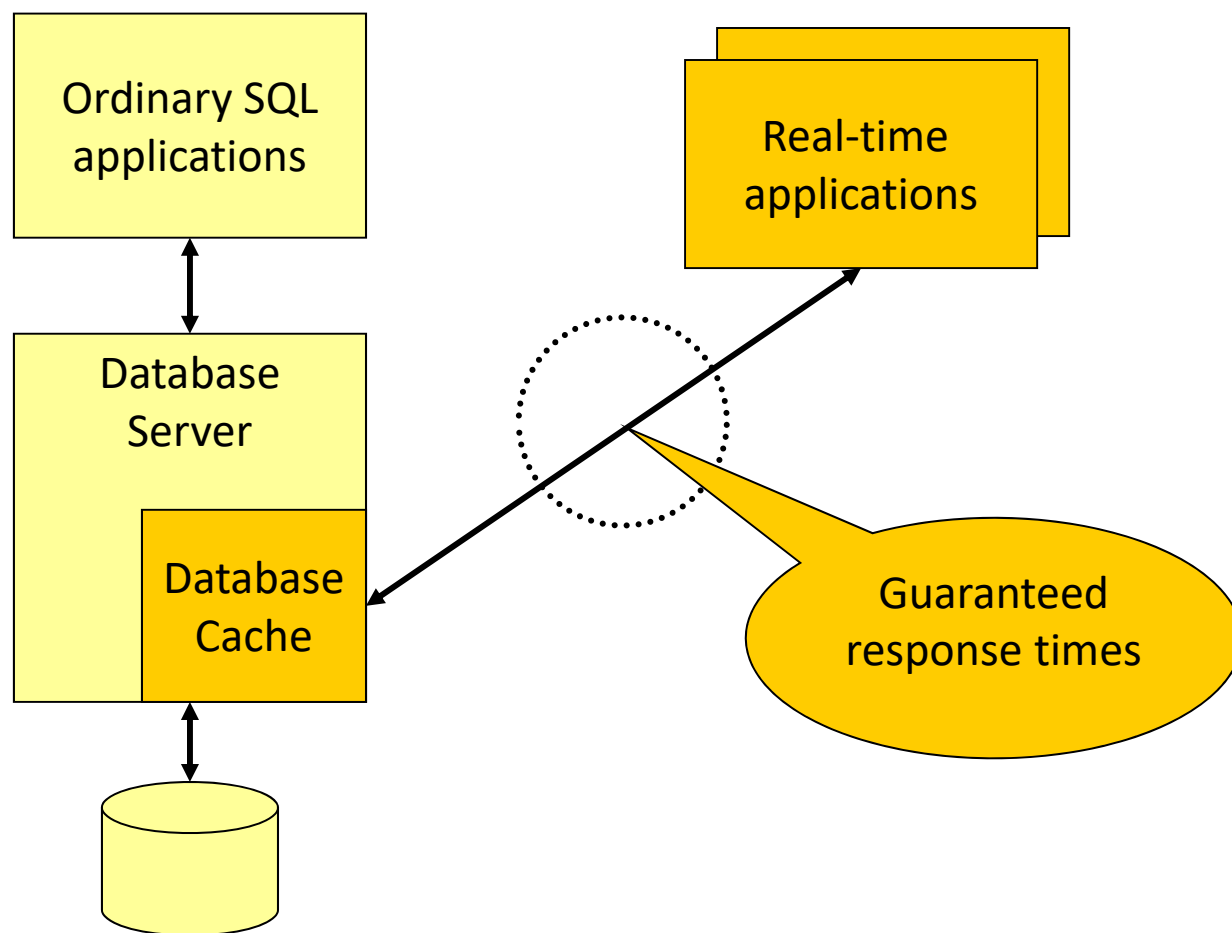


Mimer SQL Real-Time Edition

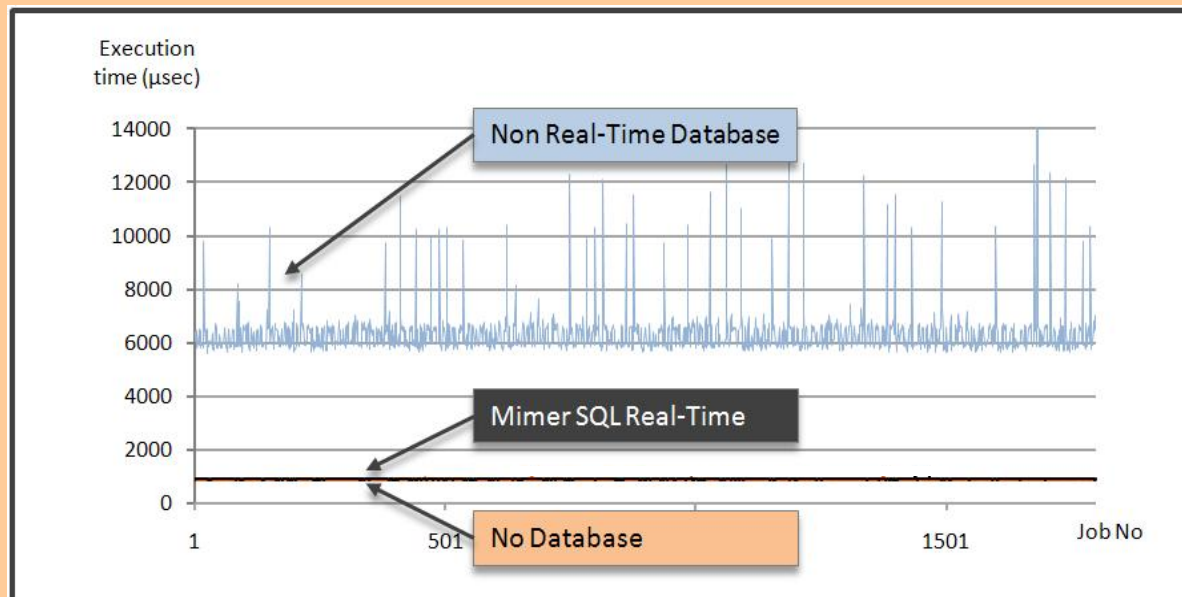
- A "true"-real-time edition of Mimer SQL
 - Real-Time database operations has...
 - ... **predictable** behavior
 - ... **guaranteed worst-case response-time**
 - ... **full control** of I/O and blocking
- Safe sharing of real-time and non-real-time data
 - **All** system data modeled in one database



Mimer SQL Real-time Architecture

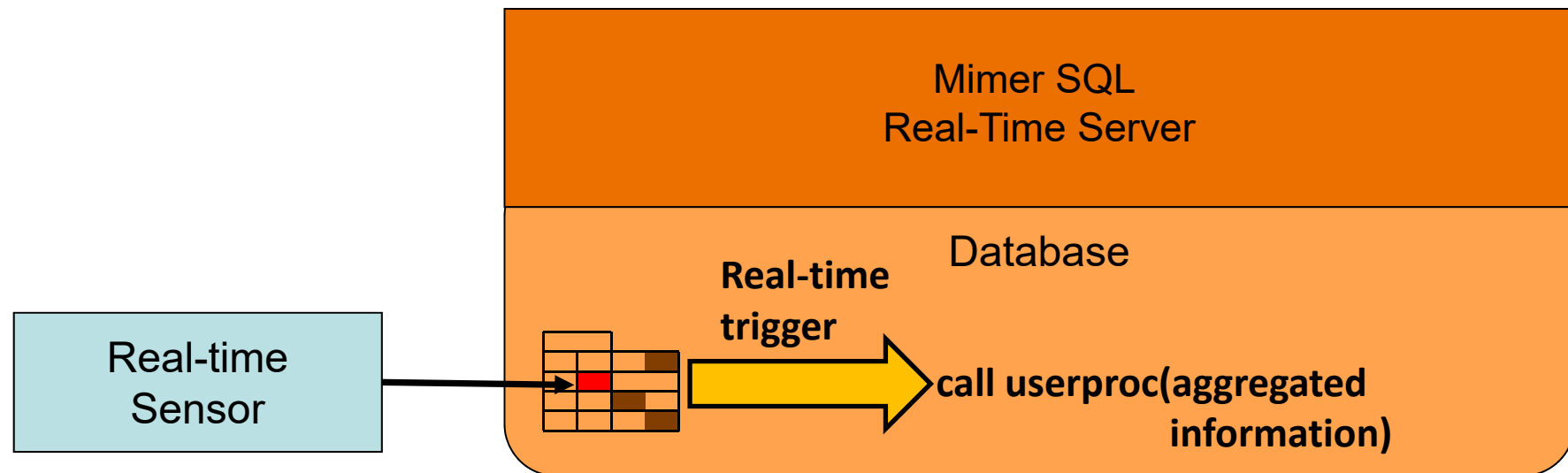


Mimer SQL Real-Time – Performance



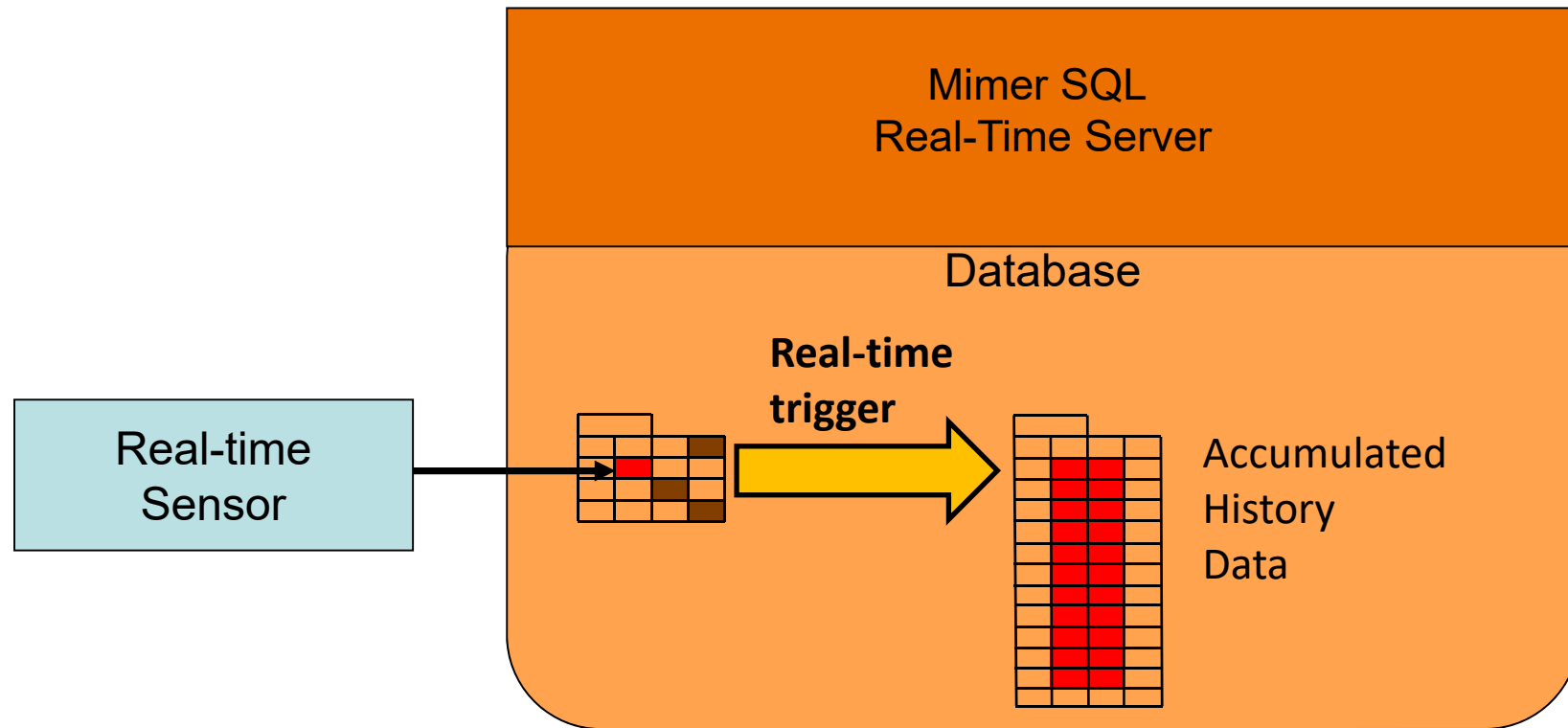
Mimer SQL real-time introduces as little as 3% overhead compared to using shared variables!

Aggregating real-time information



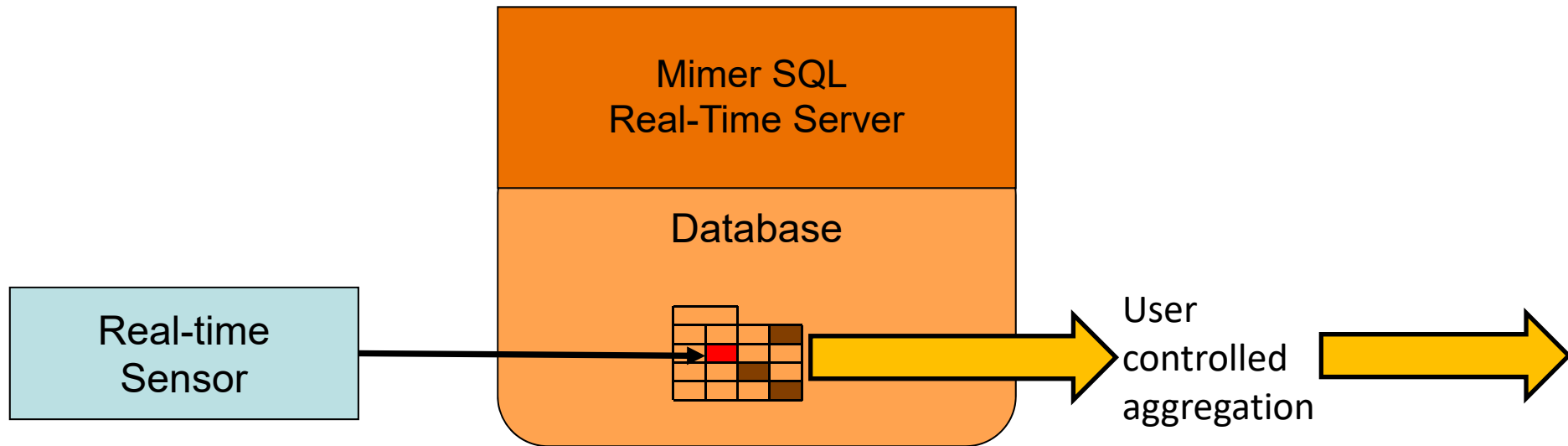
- Real-time sensor code unaware of trigger
- Trigger calls SQL stored procedure to process data
- Procedure customizable by user

Aggregating real-time information



- Procedure writes to log table
 - SQL access to history data

User controlled aggregation



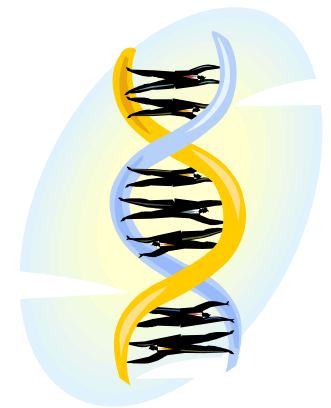
- User written code gets the aggregated information
 - Frequency can be varied
- Can, for example, write aggregated data to network

Agenda

- ✓ Background
- ✓ Mimer customers
- ✓ Platforms
- **Technical features**
- Mimer SQL on OpenVMS
- Ongoing development
- Q&A

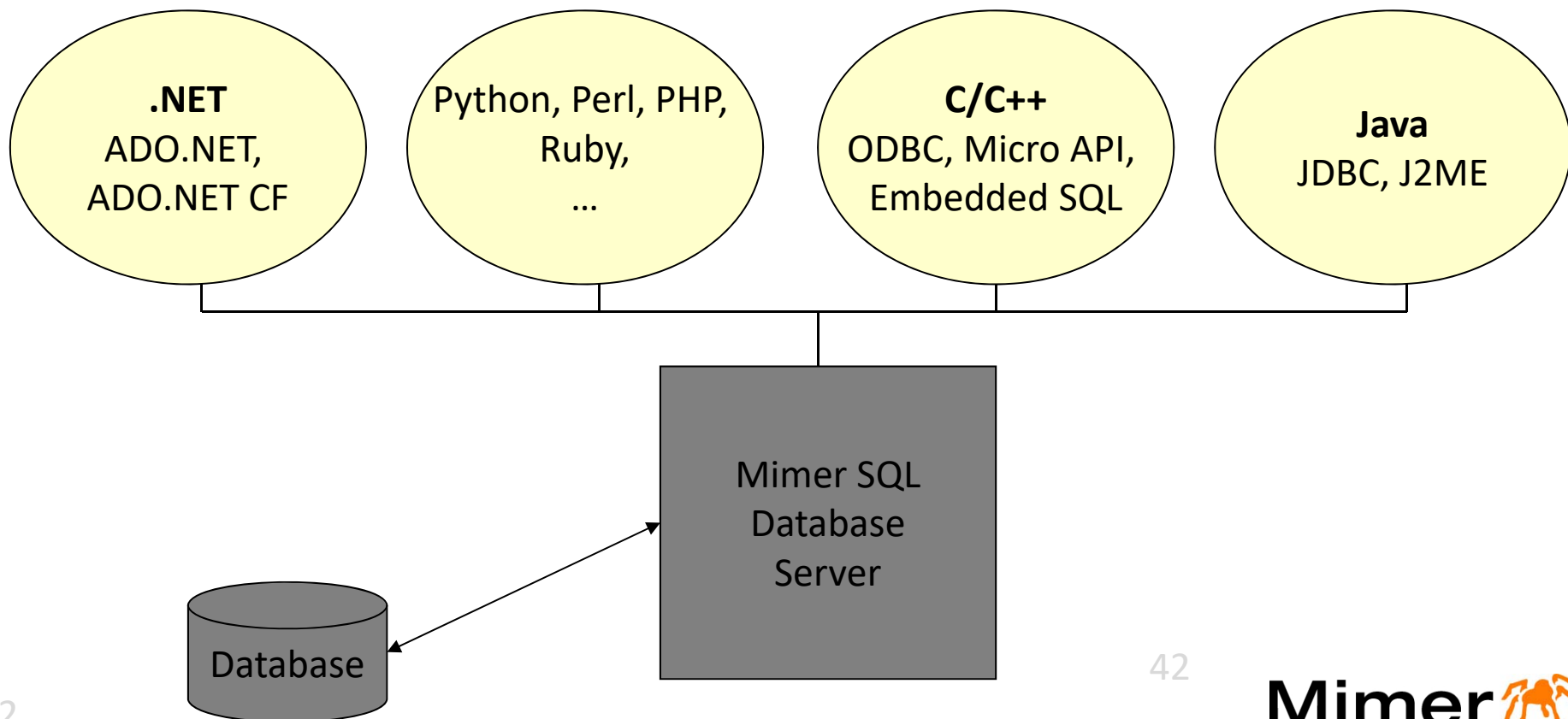
Mimer SQL foundation

- Rich SQL support
- Performance
 - Scalability
- Availability
 - Reorganization free
 - Online backup
- Ease of use
 - Self-maintaining
 - Few system parameters



Mimer SQL Standard APIs

- Open architecture and APIs



Visual Studio integration

The screenshot displays the Microsoft Visual Studio interface. The main window shows a SQL query result table with columns: product, producer, format, price, stock, reorder_level, release_date, and ean_cod. The table contains 20 rows of data. The right-hand pane shows the Server Explorer, which is expanded to show the 'Data Connections' section. Under 'Data Connections', the 'ABC.mimer_store' database is selected, and the 'product_details' table is highlighted. The bottom status bar indicates 'Ready'.

product	producer	format	price	stock	reorder_level	release_date	ean_cod
'Murder in the ...	HarperCollins	Paperback	5,99	17	4	1998-02-16	97800064
'Reave the Just' ...	Voyager	Paperback	6,99	14	3	1999-10-04	97800065
100 Anos	EMI International	Audio CD	9,98	16	5	1990-12-20	77774238
12 Golden Cou...	Elektra/Asylum	Audio CD	17,98	17	4	1996-07-16	75596190
12 Super Exitos	EMI International	Audio CD	9,98	15	5	1996-12-10	72438548
1492: Conquest...	Atlantic	Audio CD	17,98	10	5	1992-10-20	75678243
15 Exitos Y Una ...	Sony Internatio...	Audio CD	9,98	12	5	1998-09-22	37628283
1929-1940	ASV Living Era	Audio CD	11,98	12	3	1994-04-20	74362550
1930	Tzadik	Audio CD	15,98	22	3	1998-05-19	70239772
1944	Melodie Jazz Cl...	Audio CD	18,98	10	4	1996-11-19	78936812
1979-1983: Volu...	Beggars Banquet	Audio CD	15,98	9	3	1994-10-25	60761800
20 Jazz Funk Gr...	Elektra/Asylum	Audio CD	11,98	22	4	1993-12-02	24596109
20 Vodka Jellies	Le Grand Magis...	Audio CD	16,98	10	4	1997-11-18	61665600
22 Great Hits	Ranwood Recor...	Audio CD	13,98	20	3	1991-07-01	14921703
3 Feet High and...	Tommy Boy	Audio CD	17,98	22	3	2001-10-09	16998101
71 Minutes of F...	Recommended...	Audio CD	19,98	16	4	1995-03-29	75272500
A Bear Called P...	Collins	Audio Cassette	8,99	9	3	1998-04-06	97800010
A Centenary Ce...	MCA	Audio CD	50,98	20	6	1994-09-27	88111124
A Complicated ...	HarperCollins	Paperback	6,99	16	6	1998-03-02	97800064
A Dance to the ...	BBC Audio (Sp...	Audio Cassette	18,72	8	6	1997-08-15	97818554
A Darkening St...	HarperCollins	Paperback	5,99	11	4	1999-02-01	97800064
A Daughter's a	HarperCollins	Paperback	5,00	17	3	1997-05-10	97800064

Visual Studio documentation

Microsoft Help Viewer 2.2 - Visual Studio Documentation

Contents

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- Help Viewer Home
 - Mimer SQL Data Provider
 - Introducing the Mimer SQL Data Provider
 - ADO.NET Reference
 - Mimer.Data.Client Assembly
 - Mimer.Data.Client Namespace
 - MimerCommand Class**
 - MimerCommand Constructor
 - MimerCommand Class Members
 - MimerCommand Class Methods
 - Cancel Method
 - CreateParameter Method (MimerCommand)
 - Dispose Method (MimerCommand)
 - ExecuteNonQuery Method
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 - ExecuteScalar Method
 - GetExplainXmlText Method
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 - ResetCommandTimeout Method (MimerCommand)
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 - MimerConnectionStringBuilder Class
 - MimerDataAdapter Class
 - MimerDataReader Class
 - MimerDataSourceEnumerator Class
 - MimerDbType Enumeration
 - MimerError Class
 - MimerErrorCollection Class

MimerCommand Class Manage Content

Mimer SQL Data ProviderMimerCommand Class

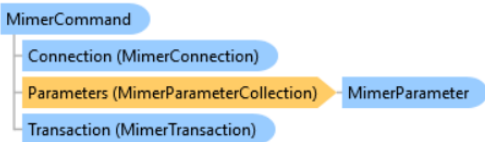
MimerCommand Class

Members Collapse All Language Filter: All

Mimer.Data.Client Namespace : MimerCommand Class

This class is used to execute an SQL statement for a specific connection.

Object Model



```
graph TD; MC[MimerCommand] --> C["Connection (MimerConnection)"]; MC --> P["Parameters (MimerParameterCollection)"]; MC --> T["Transaction (MimerTransaction)"]; P --> MP[MimerParameter];
```

Syntax

Visual Basic C# Delphi JScript Managed Extensions for C++

```
public sealed class MimerCommand : System.Data.Common.DbCommand
```

Remarks

A **MimerCommand** is used by setting the [CommandText](#) (and possibly [CommandType](#)) properties. Depending on the type of statement entered one of the three of the following methods are used:

Method	Description
ExecuteNonQuery	Used for SQL statements that do not return a result, for example INSERT, UPDATE, and DELETE statements.
ExecuteReader	Used for select statements and procedure calls that return a result set.
ExecuteScalar	Used for select statements that return a single value.

Inheritance Hierarchy

DbVisualizer

DbVisualizer Pro 10.0 - abc (MIMER_STORE)/Schemas/mimer_store/Tables/countries

File Edit View Database SQL Commander Tools Window Help

<Drop your favorite objects here>

Databases Scripts Favorites

1: Untitled* x 2: Untitled* x abc (MIMER_STORE) countries x

Table: countries
abc (MIMER_STORE)/Schemas/mimer_store/Tables/countries

Info Data Row Count Indexes References Navigator Comments Primary Key Access F

* code country currency_code

1	AD	Andorra	EUR
2	AE	United Arab Emirates	AED
3	AF	Afghanistan	AFA
4	AG	Antigua and Barbuda	XCD
5	AI	Anguilla	XCD
6	AL	Albania	ALL
7	AM	Armenia	AMD
8	AN	Netherlands Antilles	ANG
9	AO	Angola	AOA
10	AR	Argentina	ARS
11	AS	American Samoa	USD
12	AT	Austria	EUR
13	AU	Australia	AUD
14	AW	Aruba	AWG
15	AZ	Azerbaijan	AZM
16	BA	Bosnia and Herzegovina	BAM
17	BB	Barbados	BBD
18	BD	Bangladesh	BDT
19	BE	Belgium	EUR
20	BF	Burkina Faso	XOF

Max Rows: 1000 Max Chars: -1 Pattern: n/a

0.002/0.003 sec 234/3 1-20

94M of 512M

DbVisualizer – SQL explain

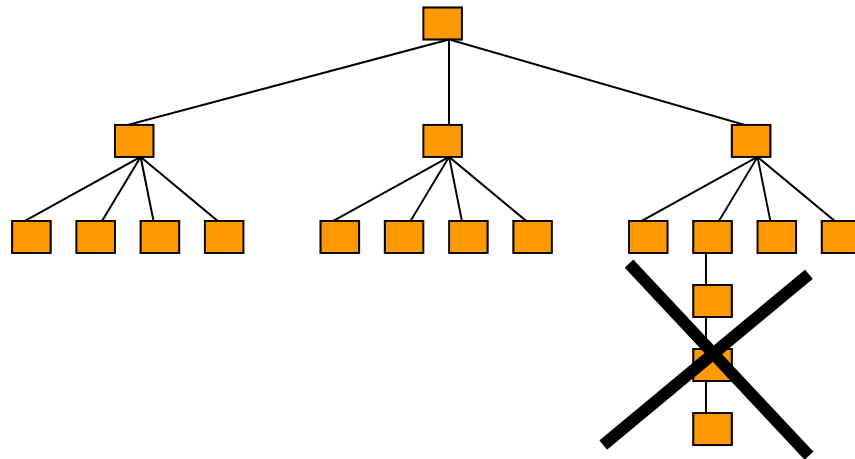
The screenshot shows the DbVisualizer interface with the following components:

- Left Panel (Database Explorer):** Displays a tree view of the database schema. The 'product_details' table is selected, showing its columns: product (CHARACTER V), producer (CHARACTER V), format (CHARACTER V), price (DECIMAL(7,2)), stock (SMALLINT), reorder_level (SMALLINT), release_date (DATE), ean_code (BIGINT), status (CHARACTER(1)), product_search (CHAR), item_id (INTEGER), category_id (SMALLINT), product_id (INTEGER), display_order (SMALLINT), and image_id (INTEGER).
- Top Panel (Query Editor):** Contains the SQL query: `1 select * from product_details where product <= 'A Darkening Stain' order by product`. The 'Database Connection' is set to 'abc (MIMER_STORE)'.
- Bottom Panel (EXPLAIN at 11:43:34):** Displays the execution plan in Graph View. The plan shows an 'outerJoin' node at the top, which branches into an 'innerJoin' node and a 'producers' table node. The 'innerJoin' node further branches into another 'innerJoin' node and a 'formats' table node. The bottom-most 'innerJoin' node branches into the 'products' and 'items' tables. Each node displays statistics: Node Cost, Scan Order, Scan, Type, Index, Visits, Hits, and Rows.

Powered by yf

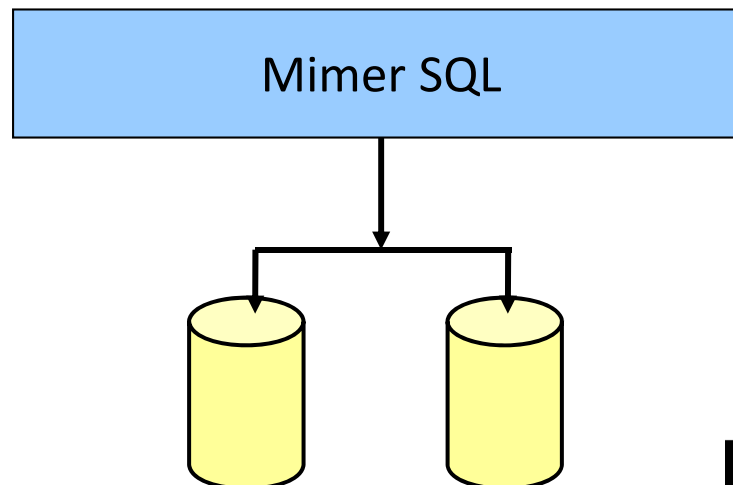
Mimer SQL: Zero maintenance

- Automatic database reorganization
- Non-locking concurrency control
- Very few tuning parameters



Mimer SQL: Availability (i)

- Database shadowing
 - One or more copies of the data
- Transparent fail-over to shadow on error
 - Applications unaffected



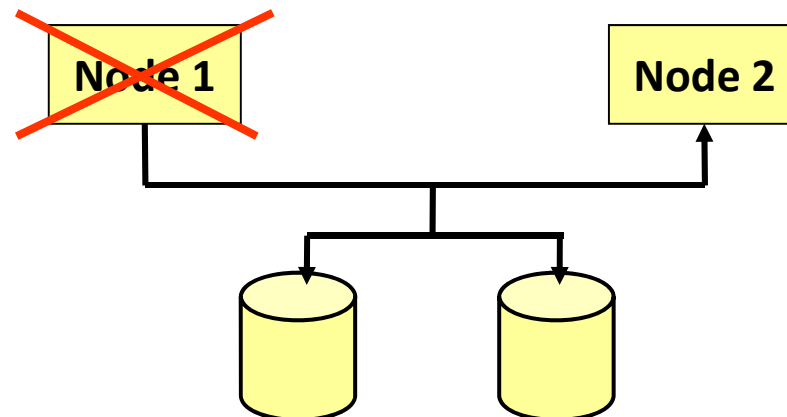
Mimer SQL: Availability (ii)

- Zero down-time for database reorganizations
- Online backup
 - With Mimer SQL commands
 - or OS backup utilities



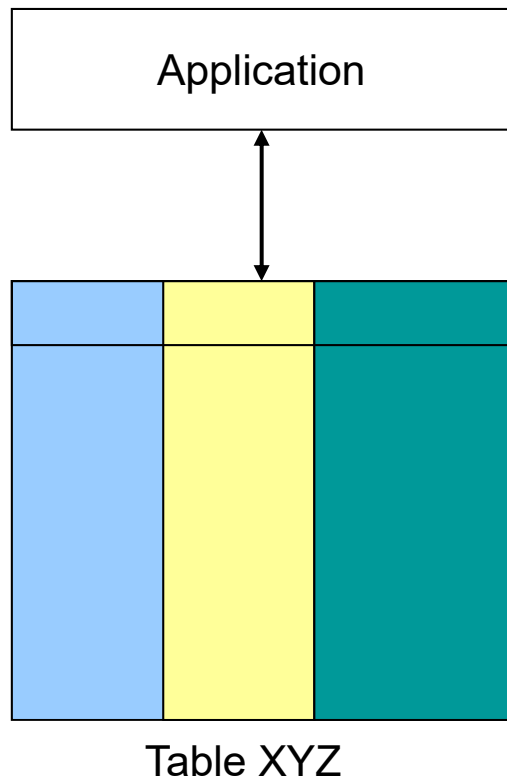
Mimer SQL: Availability (iii)

- Immediate restart
 - Allows the database to be accessible directly after a system crash even when the database size is several 100 GB
 - Can be used with dual ported disks or cluster with shared disks to start the server from another node after a fail-over

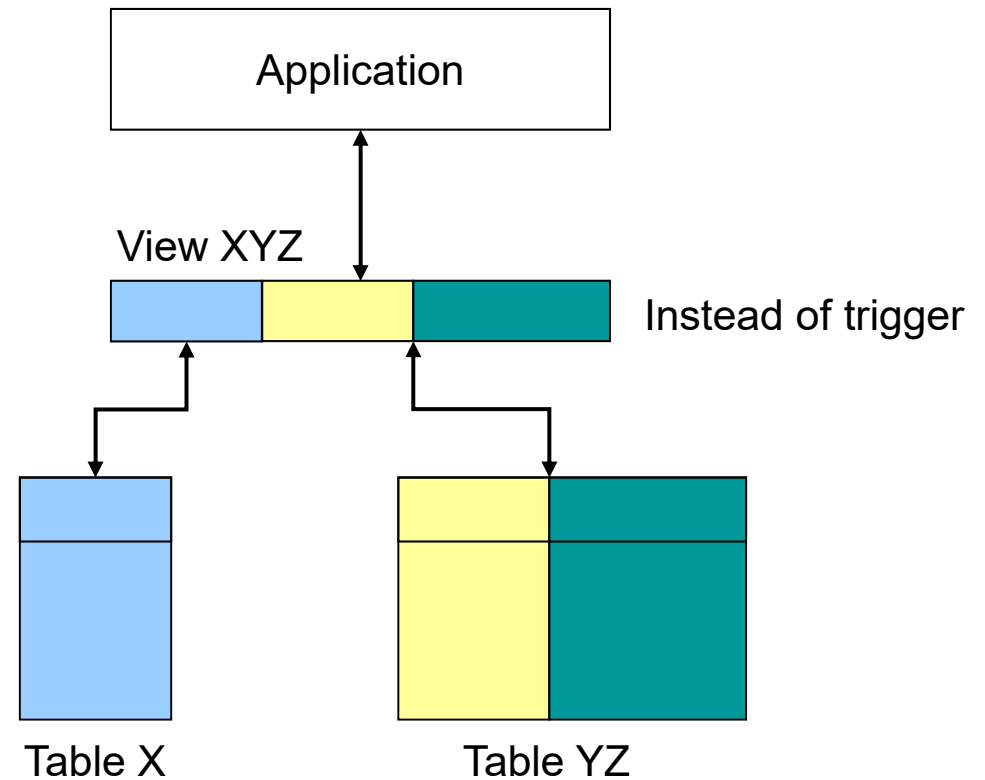


Logical independence

Original configuration: table XYZ



Modified table structure:



Distributed transaction handling

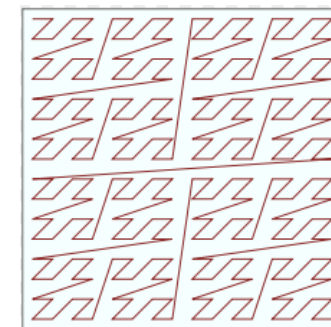
- Allows operations to be performed over several database systems as one single unit (transaction)
 - Can be several Mimer SQL databases
 - Mixed vendor transactions also possible



Standard: X/Open Distributed Transaction Processing Model

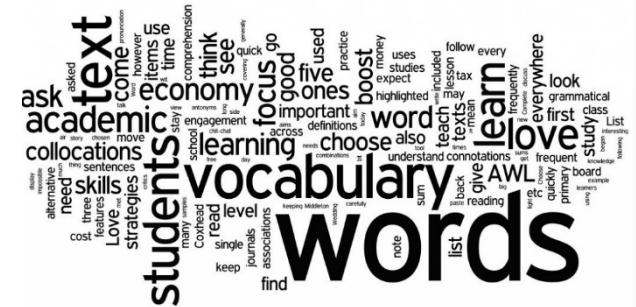
Spatial data

- Developed specifically for small footprint environments
- Data types:
 - Latitude and Longitude
 - Location
 - Coordinate
- Location index
 - completely maintenance free
 - not sensitive to order of operations
 - predictable with regards to response times
 - very space efficient



Linguistic Sorting and Searching

- Built-in and user defined collations
 - 140+ different built-in languages
- Text search and sorting:
 - Independent of case
 - With national characters in correct order
 - With or without regard for accents
- Index according to collation
- Word search and indexing
- Pinyin search and indexing
- User defined collations



拼音

[pīnyīn]

Pinyin

Some built-in collations

- AFRIKAANS
- ALBANIAN
- ARABIC
- ARUMANIAN
- ASTURIAN
- BASQUE
- BELARUSIAN
- BOSNIAN
- BRETON
- BULGARIAN
- CATALAN
- AZERBAIJANI
- CORSICAN
- CROATIAN
- CZECH
- DANISH
- DUTCH
- ENGLISH
- EOR
- ESPERANTO
- ESTONIAN
- FAROESE
- FILLIPINO
- FINNISH
- FRENCH
- FRISIAN
- FRIULIAN
- GALICIAN
- GERMAN
- GREEK
- GREENLANDIC
- HEBREW
- HUNGARIAN
- ICELANDIC
- IRISH_GAELIC
- ITALIAN
- KAZAKH
- KIRGHIZ
- KURDISH
- LATIN
- LATVIAN
- LITHUANIAN
- LUXEMBOURGISH
- MACEDONIAN
- MALTESE
- MOLDAVIAN
- NORWEGIAN
- OCCITAN
- POLISH
- PORTUGUESE
- ROMANIAN
- ROMANSCH
- RUSSIAN
- SAMI
- SCOTS
- SCOTTISH_GAELIC
- SERBIAN
- SLOVAK
- SLOVENIAN
- SORBIAN
- SPANISH
- SWEDISH
- TATAR
- THAI
- TURKISH
- TURKMEN
- UKRAINIAN
- UNICODE
- UZBEK
- VIETNAMESE
- WELSH

Some additional collations

- Indian languages

- Assamese
- Bengali
- Gujarati
- Hindi
- Kannada
- Konkani
- Malayalam
- Manipuri
- Marathi
- Nepali
- Oriya
- Punjabi
- Sanskrit
- Sinhala
- Tamil
- Telugu



- African Languages

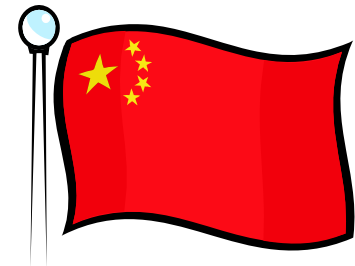
- Hausa
- Igbo
- Yoruba

- Middle East languages

- Dari
- Pashto
- Persian

- Chinese

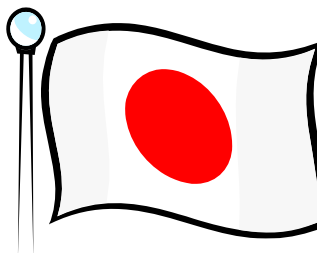
- KangXi (康熙)
- Pinyin (拼音)
- ZhuYin (注音)
- WuBiHua (五笔画)



- Korean

- Hangul and Chinese together

- Japanese



Multilingual Support

```
SQL>select word from t order by word collate japanese_3;
```

WORD

====

ていねい- teinei - polite
テープ - teepu - tape
でぐち - deguchi - exit
テスト - tesuto - test
では - dewa - well, then
デパート- depaato - dep. store

```
SQL>select * from t where name  
      like 'AA%' collate danish_1;
```

NAME

====

Aalborg
Århus



Advanced search using collations

- T9 sorting for numeric keypads
- Can also be used with Pinyin

select * from state where name like '83%' collate t9

NAME

=====

Texas

Vermont

2 rows found

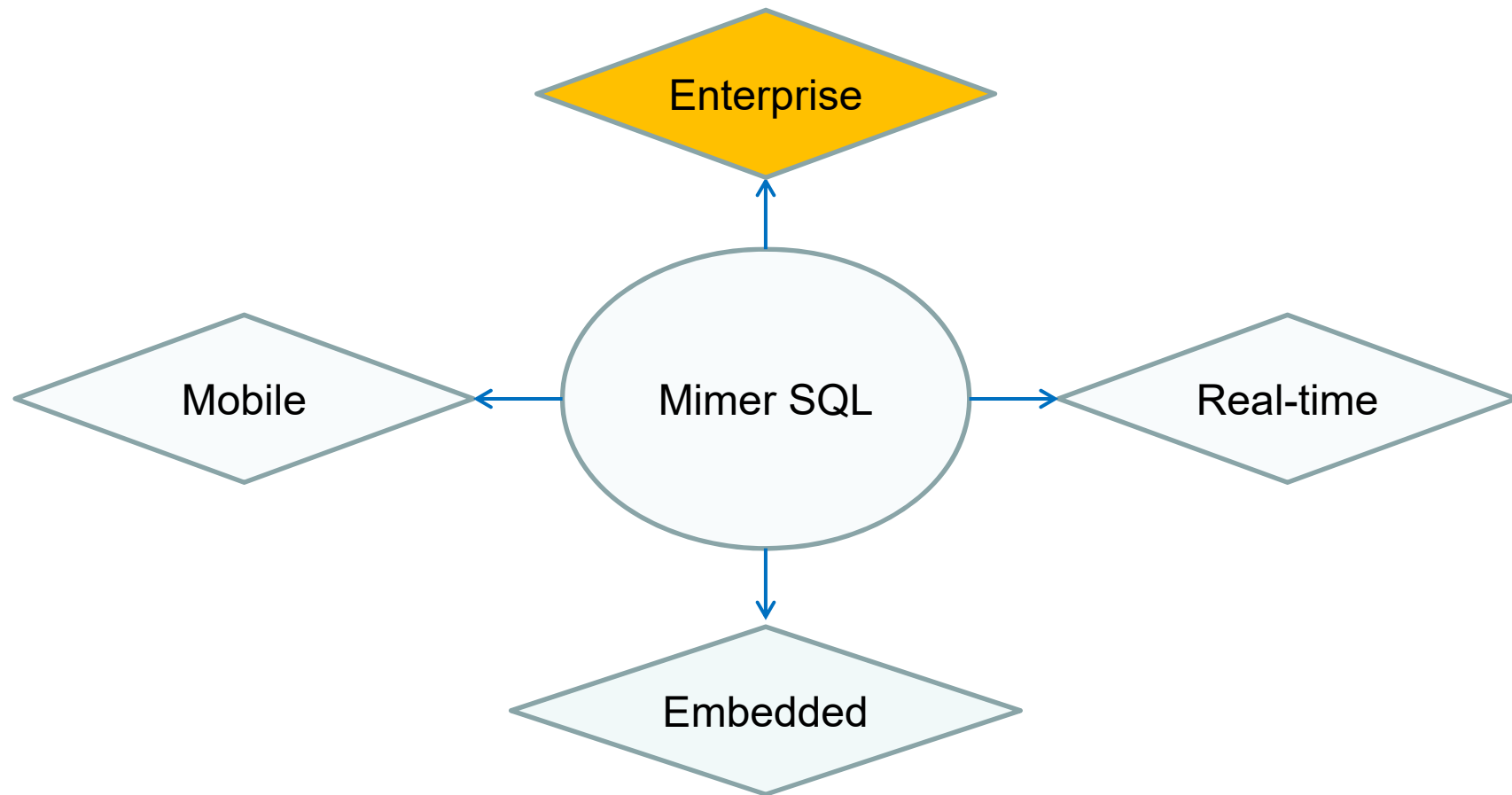
1 ∞	2 ABC	3 DEF
4 GHI	5 JKL	6 MNO
7 PQRS	8 TUV	9 WXYZ

8 matches T,U,
and V
3 matches D,E,
and F

Agenda

- ✓ Background
- ✓ Mimer customers
- ✓ Platforms
- ✓ Technical features
- **Mimer SQL on OpenVMS**
- Ongoing development
- Q&A

Mimer SQL in different environments



Mimer SQL on OpenVMS

- Developed on OpenVMS for OpenVMS
- Not a Unix or Windows product ported to OpenVMS!
- Tightly integrated on OpenVMS to get best possible performance and scalability



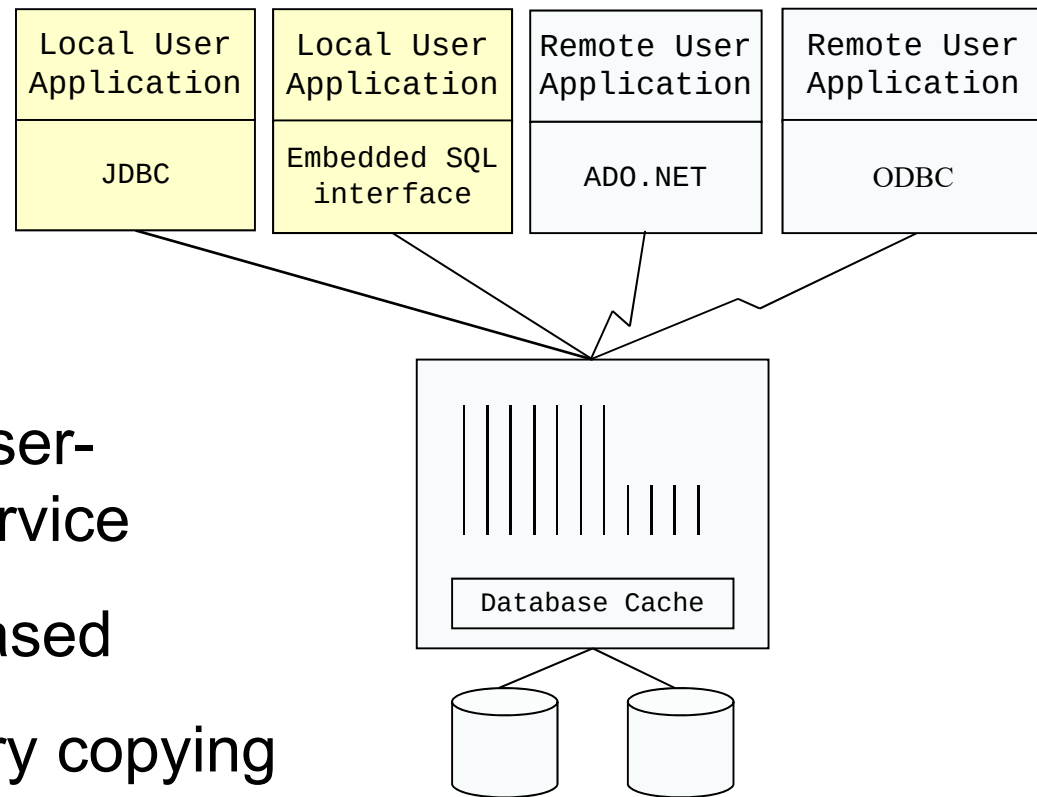
Mimer SQL Server communication

Remote client

- TCP/IP

Local clients

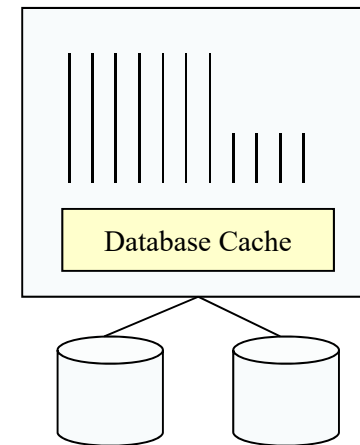
- Executive mode User-Written System Service
- Shared memory based
- Avoids unnecessary copying of data
- \$HIBER/\$WAKE synchronization



Mimer SQL Database Server

Mimer SQL: Database cache

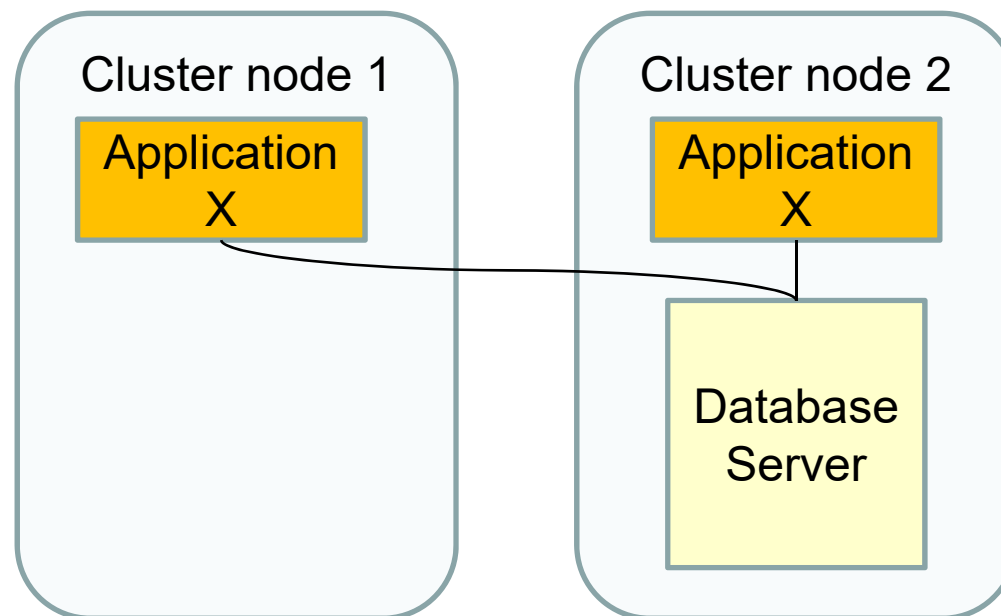
- Stores large parts of database in main memory
- 64-bit size
- Possible to use *Reserved Memory Registry* in OpenVMS
 - No paging
 - No working set quota taxation
 - Reserved at boot time



Mimer Database Server

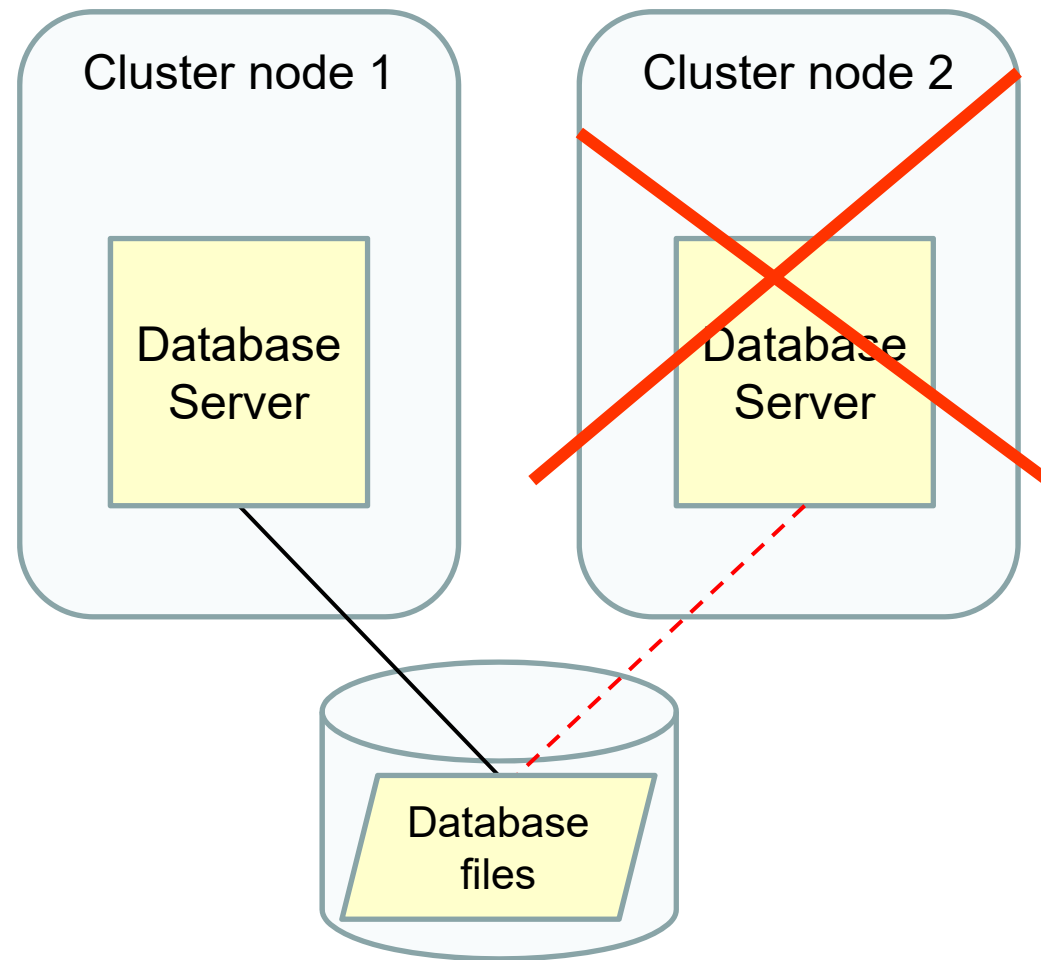
Mimer SQL in a cluster (i)

- Application configured to run local communication on cluster node 2 and TCP/IP from node 1
- Done outside application



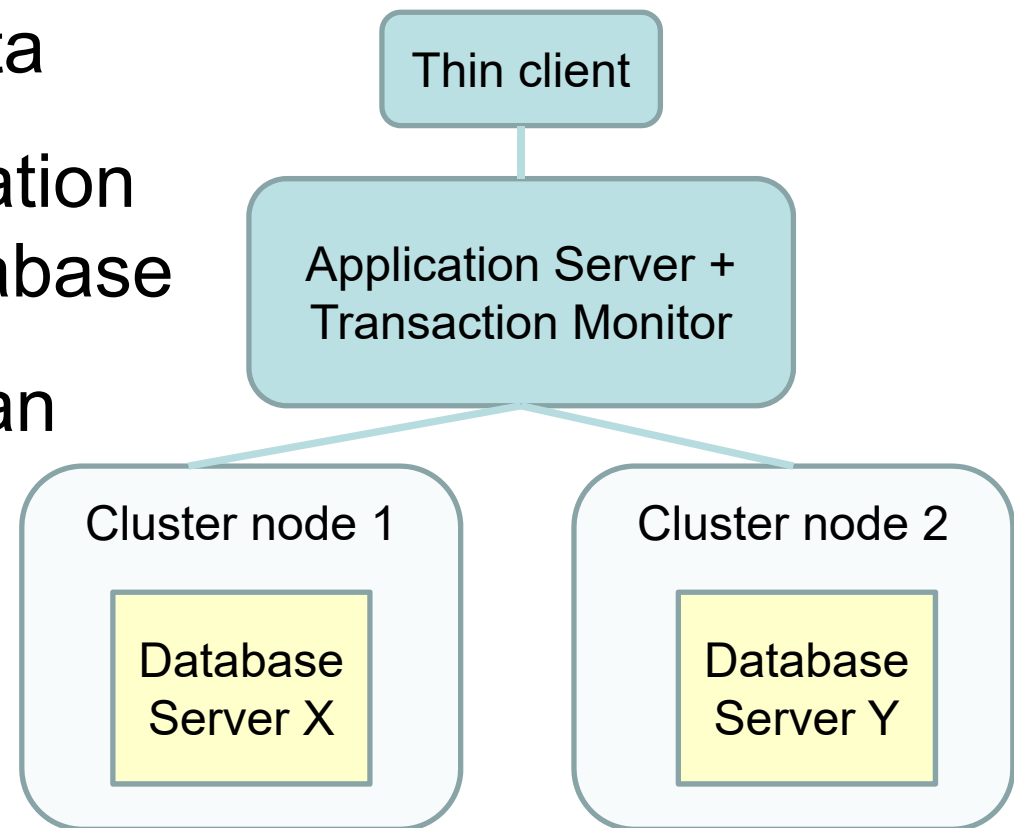
Mimer SQL in a cluster (ii)

- Database server can be automatically restarted on node 1 if node 2 fails
- Server gives instantaneous access to data after database server start (called **immediate restart!**)



Mimer SQL in a cluster (iii)

- Two database servers handles separate data
- Each database operation towards a single database
- Transactions can span both databases



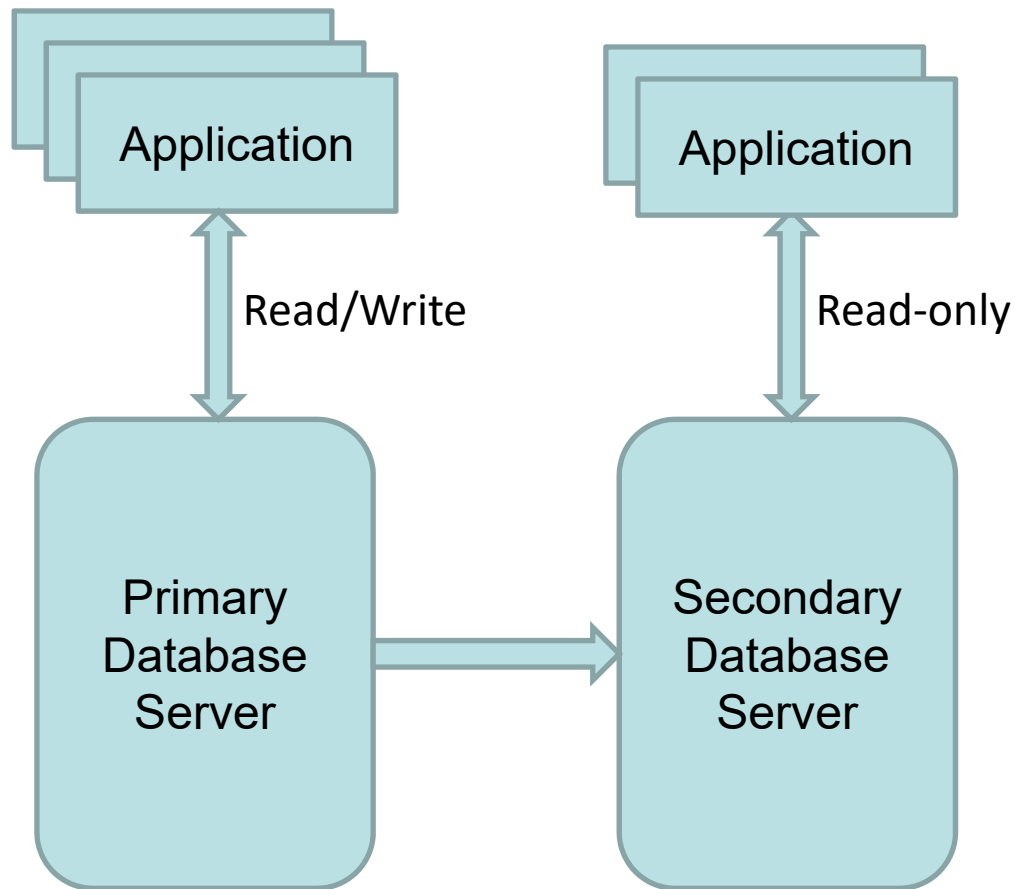
Mimer SQL Version 11.0

- New storage engine
 - Database cache from 16 GB -> any size
 - File size from 8 TB -> no limit
 - New efficient storage formats and block sizes
- New SQL functionality
 - Full outer join
 - Unique predicate
 - Etc.
- Beta version available for OpenVMS on Itanium at:
<http://developer.mimer.com/>

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Ongoing - Hot standby



- Automatic failover
 - Actual triggering logic platform dependent
- Can be combined with in-memory option
- Next
 - Read/write access in all databases server instances

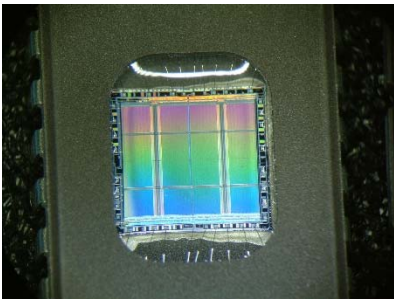
Ongoing - Rdb migration tools

- Support for Module SQL
- Tool that translates from SQL dialect used by Oracle/Rdb to Mimer SQL
 - Translate SQL scripts
 - Translate Embedded SQL source
 - Translate entire Module SQL files
 - Perform ad-hoc translation of a SQL command
- Customer driven



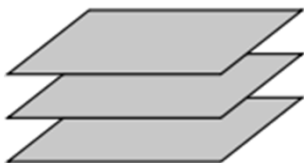
Ongoing – In memory solutions

- Migrating from small footprint versions
 - Database schema “linked” into database server
- Schema and data in database files
 - Possible to memory map database files
 - Optionally save at shutdown
- Combine with hot standby

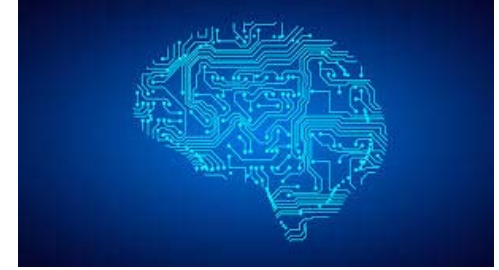


Ongoing - Parallel execution

- Will allow a single query to be executed by several server threads
- Optimizer controlled concurrency and plan
- Parallel joins
 - Inner join
 - Merge join
- Parallel sorts
- Straightforward to extend current architecture



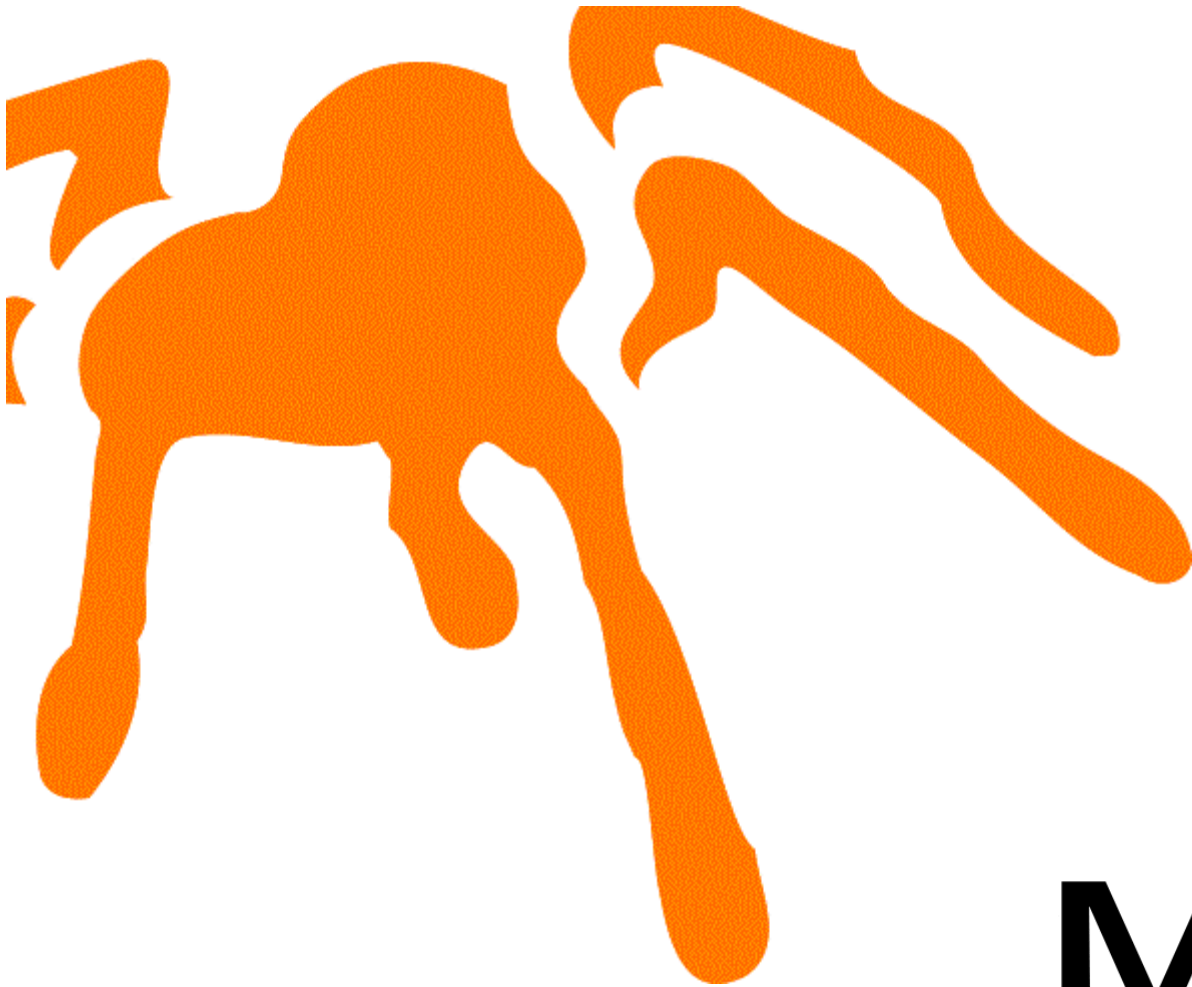
Ongoing - Machine learning



1. Facilitate access to data in Mimer SQL
 - New Python database client
2. Allow deployment of trained neural networks etc. within database server
 - Deployed as functions within the database server
 - Accessible from SQL
 - Advanced indexing techniques
3. Allow training within database server
 - Allows incremental refinement as more data is added

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