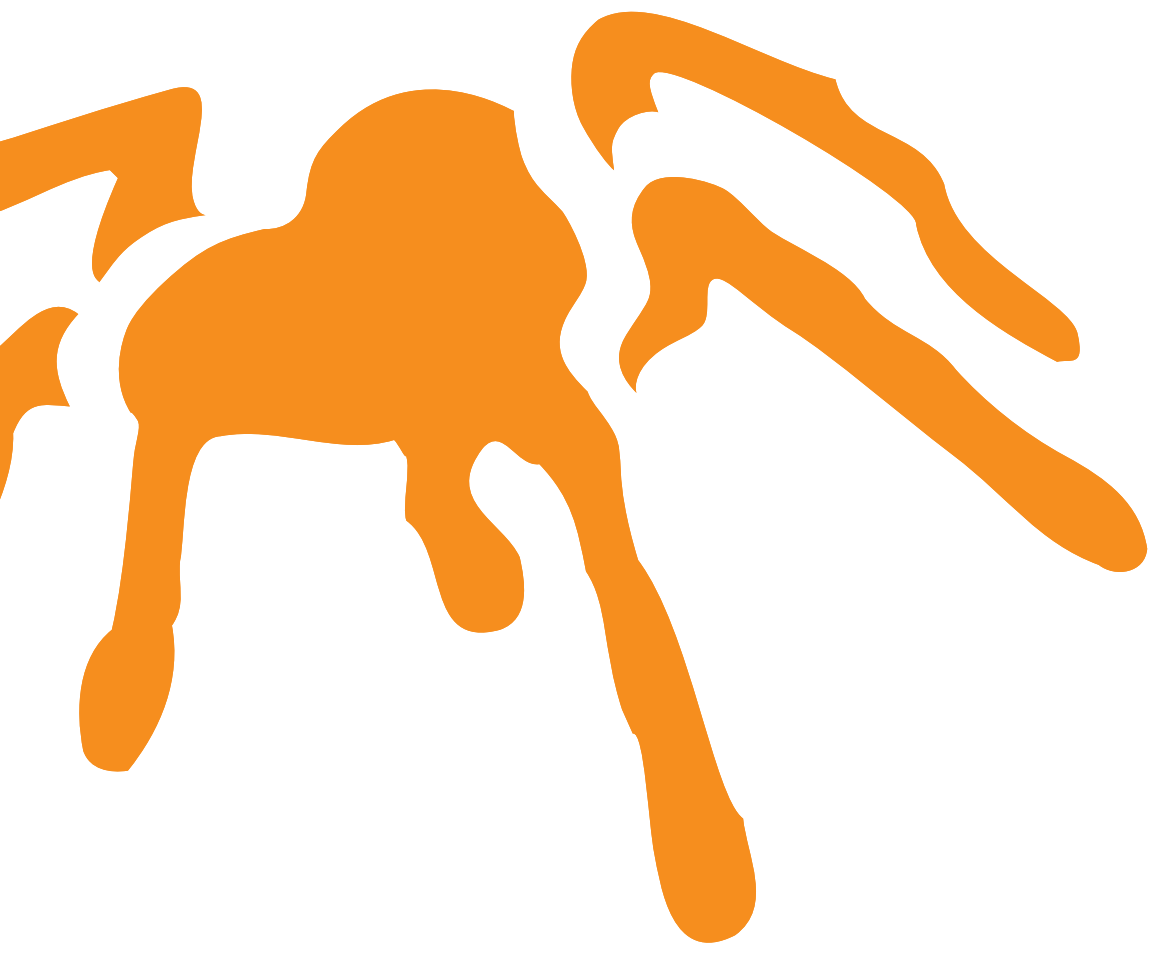
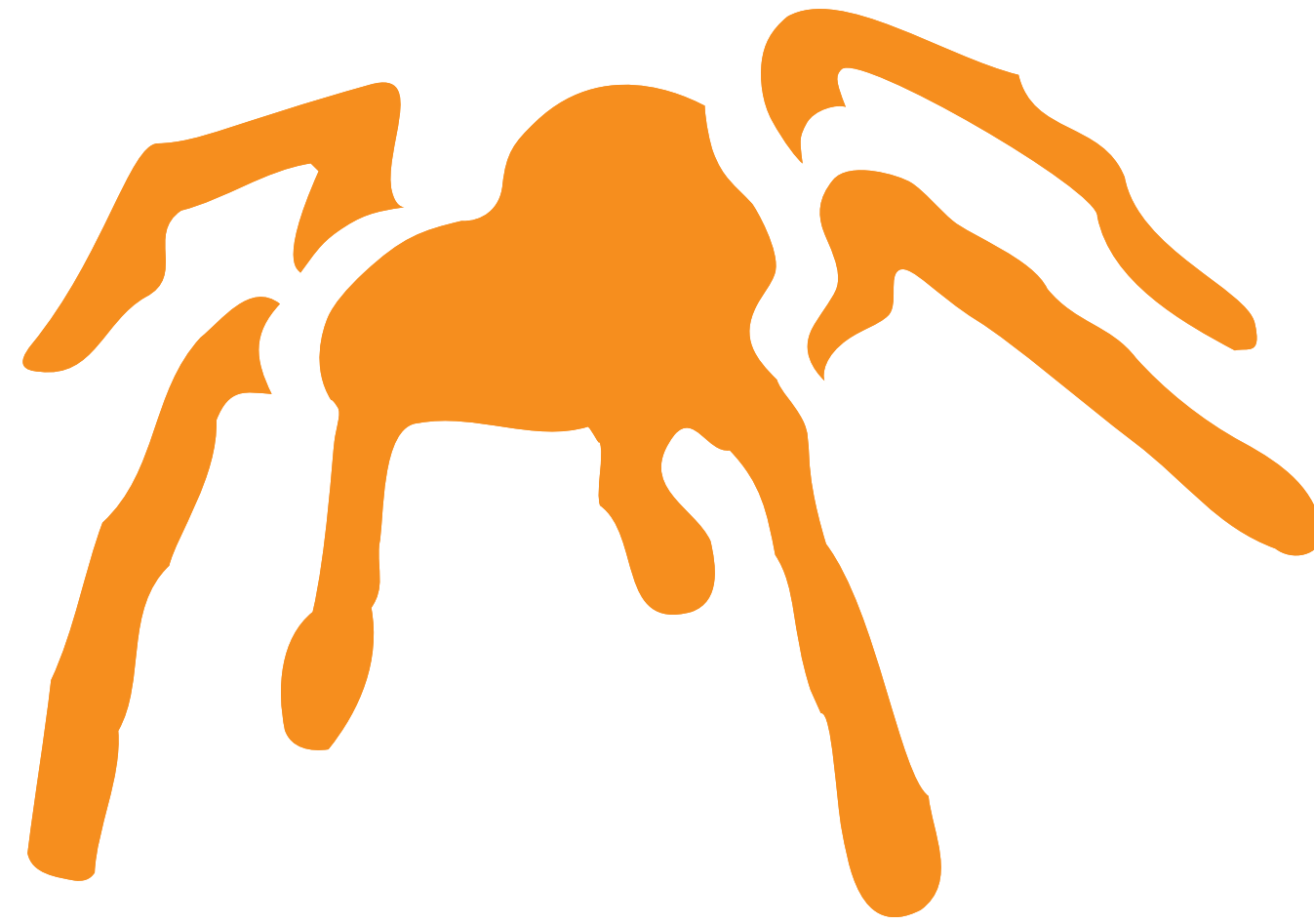


Mimer SQL for OpenVMS on x86

Karl-König Königsson
Mimer Information Technology AB



Background



Mimer SQL 2024

Product features

Mimer SQL 11.0 on OpenVMS

Mimer SQL 11.0

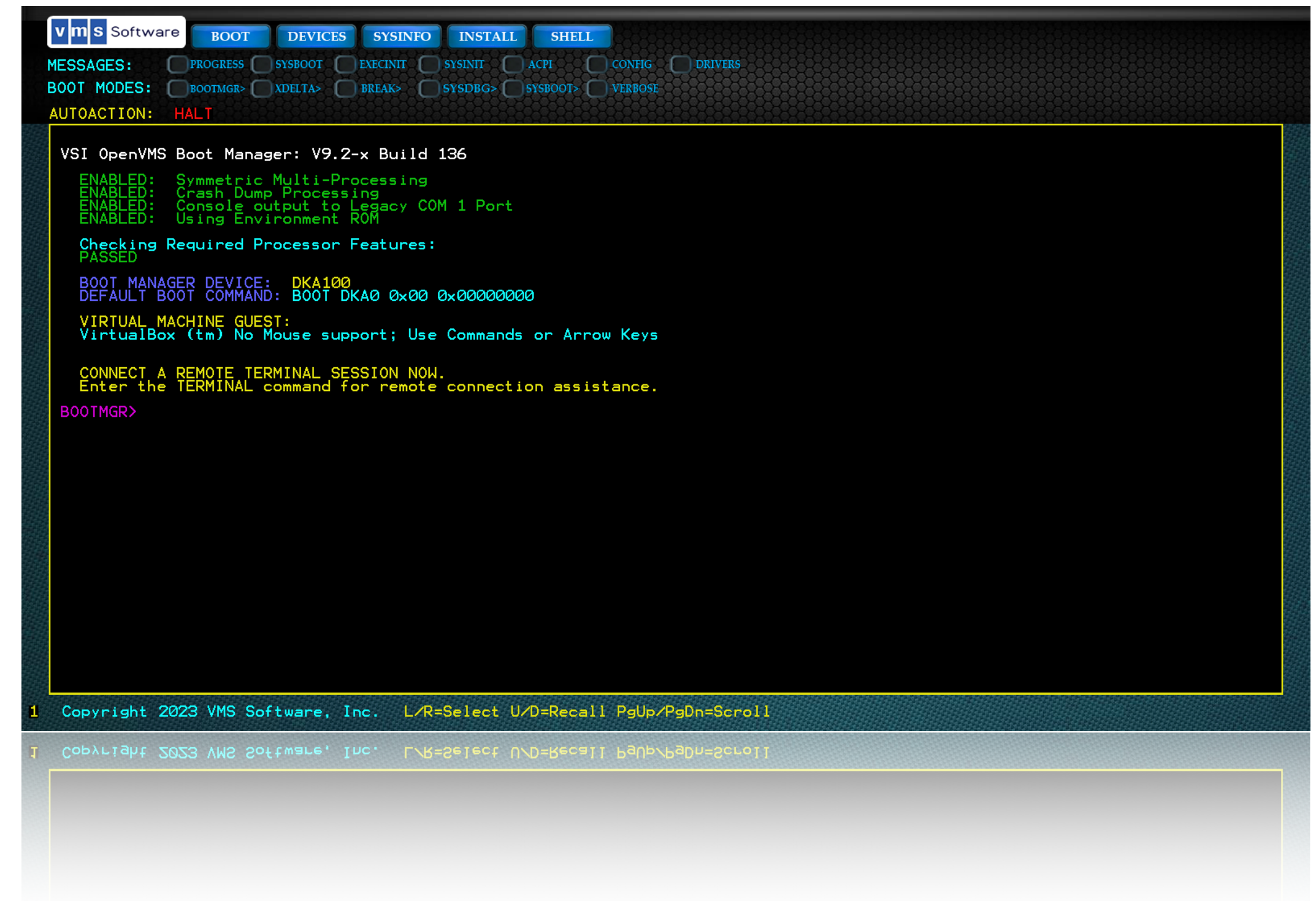
Background

Mimer Information Technology AB

- Developer of the Mimer SQL product family
- Used in mission critical systems world-wide
- Global presence through customers and partners
- Strong R&D team, many with 15-40 years experience of SQL DB
- World class experts in relational database technology
- HQ in Uppsala, Sweden

Mimer Information Technology AB

- Roots in Uppsala University, Sweden
- 40 years on VMS
- Close co-operation with OpenVMS Engineering



```
vms Software  BOOT  DEVICES  SYSINFO  INSTALL  SHELL
MESSAGES:   PROGRESS   SYSBOOT   EXECINT   SYSINT   ACPI   CONFIG   DRIVERS
BOOT MODES:  BOOTMGR>   XDELTA>   BREAK>   SYSDBG>   SYSBOOT>   VERBOSE
AUTOACTION:  HALT

VSI OpenVMS Boot Manager: V9.2-x Build 136
ENABLED: Symmetric Multi-Processing
ENABLED: Crash Dump Processing
ENABLED: Console output to Legacy COM 1 Port
ENABLED: Using Environment ROM

Checking Required Processor Features:
PASSED

BOOT MANAGER DEVICE:  DKA100
DEFAULT BOOT COMMAND:  BOOT DKA0 0x00 0x00000000

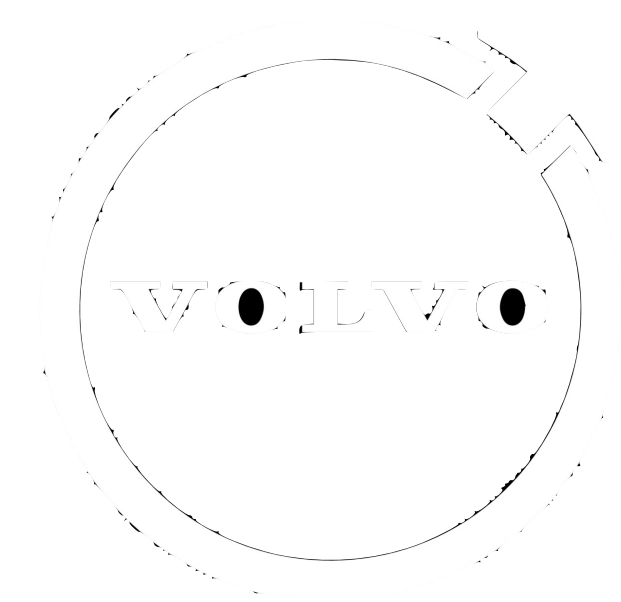
VIRTUAL MACHINE GUEST:
VirtualBox (tm) No Mouse support; Use Commands or Arrow Keys

CONNECT A REMOTE TERMINAL SESSION NOW.
Enter the TERMINAL command for remote connection assistance.

BOOTMGR>
```

Mimer Information Technology AB

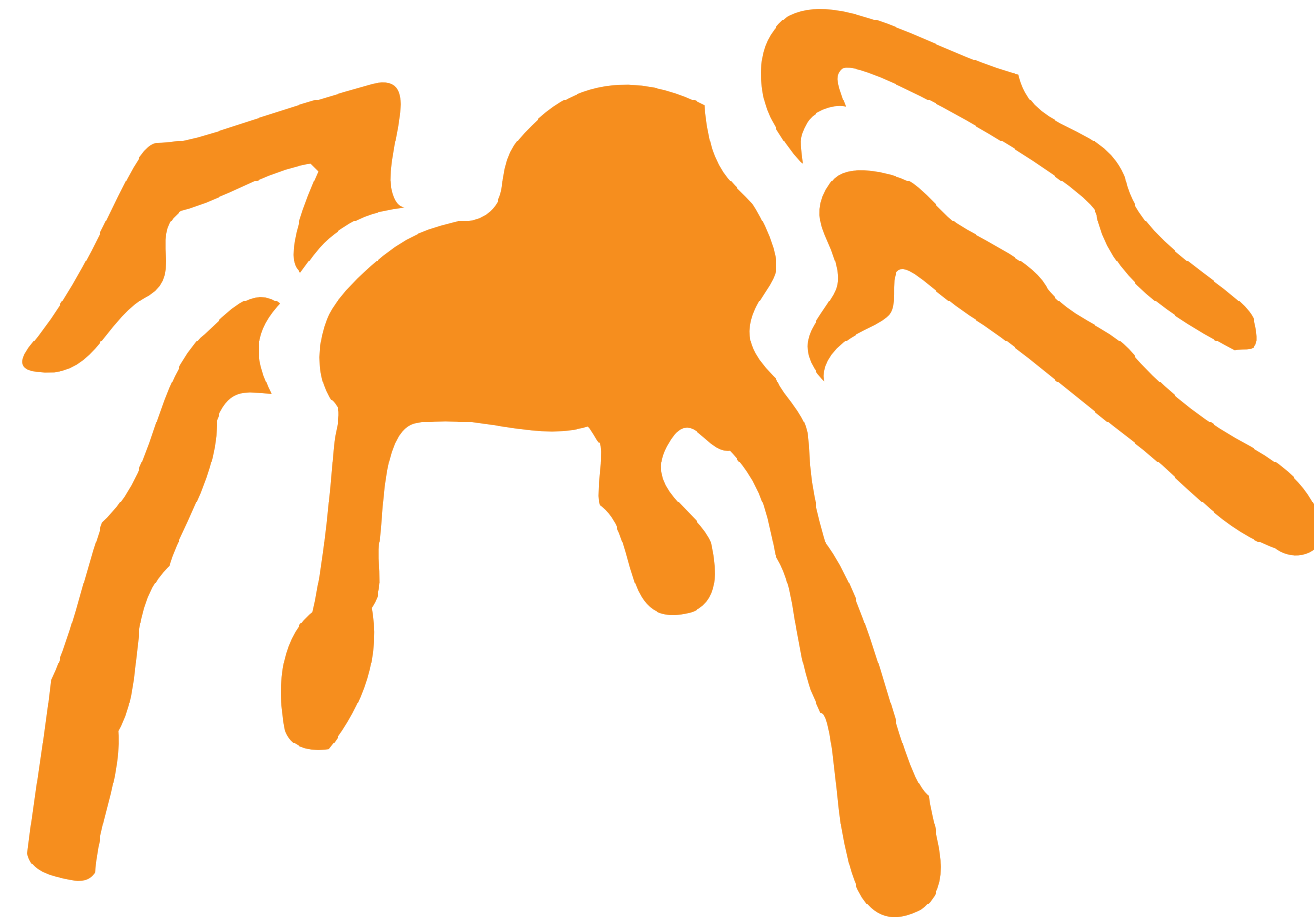
- Many different applications all over the world
- Automotive industry is the next segment



TRUSTONIC

ETAS

Background



Mimer SQL 2024

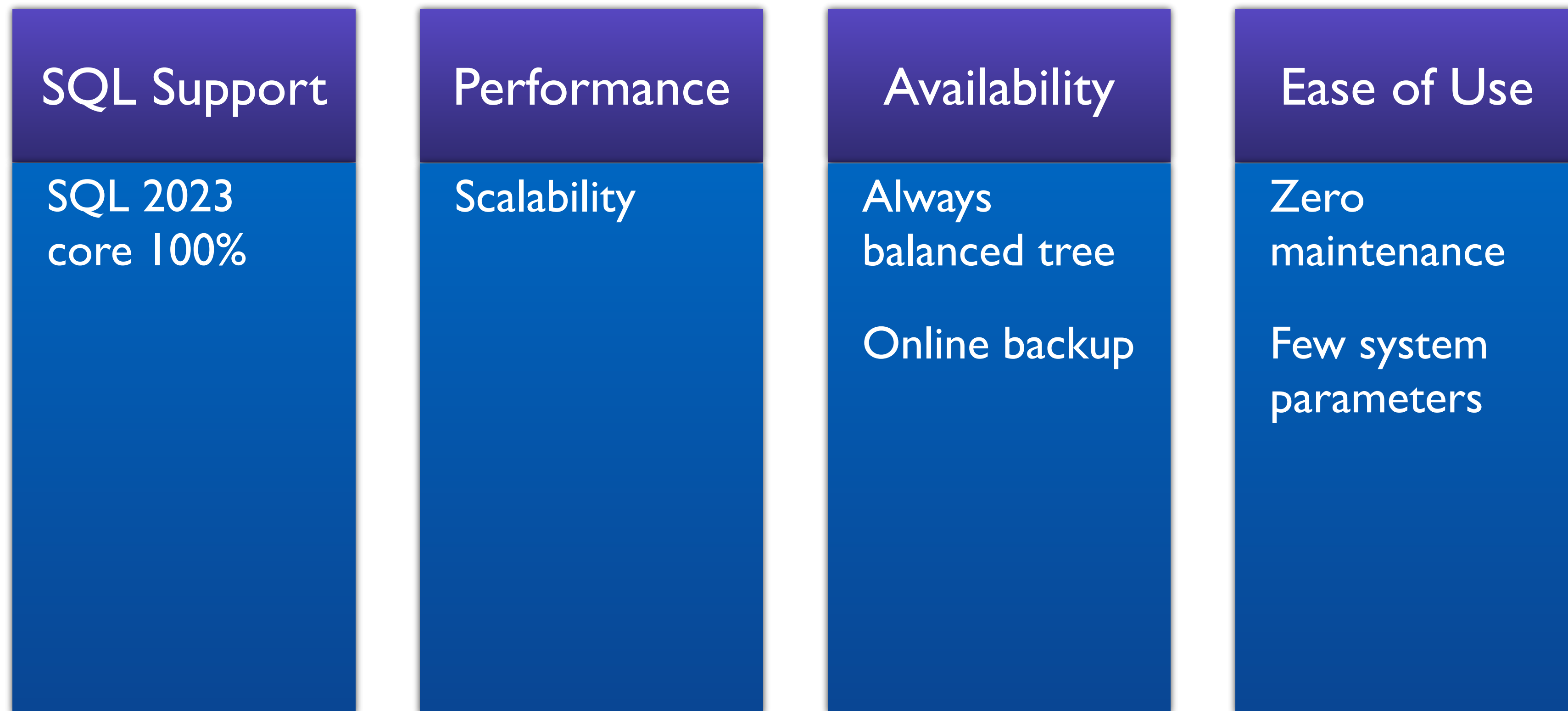
Product features

Mimer SQL 11.0 on OpenVMS

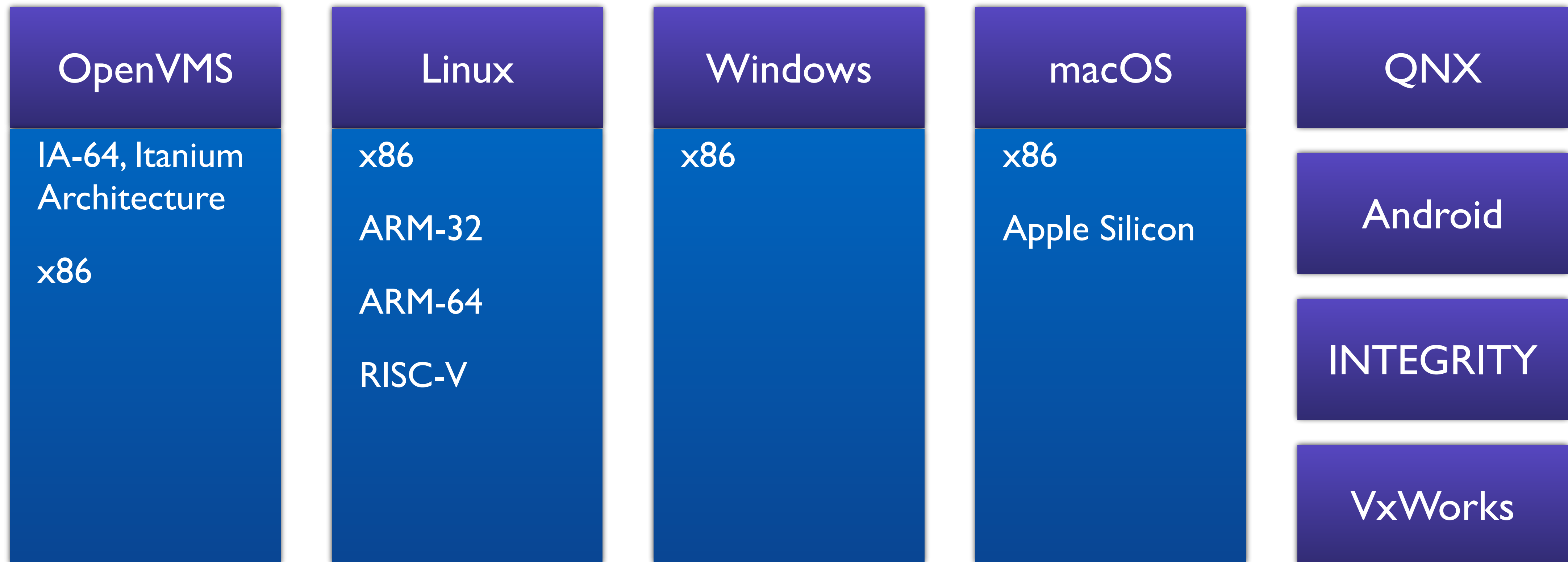
Mimer SQL 11.0

Product features

Mimer SQL foundation



Portability



Zero Maintenance

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

Linguistic sorting

- Built-in and user defined collations with over 140 different built-in languages
- Character data can be sorted according to different rules, such as:
 - Independent of case
 - With national characters in correct order
 - With or without regard for accents
 - Several letters as one (contractions) or one letter as several (expansions)
- Output from the same column can be sorted differently

Mimer SQL

Sorting is not built into column type

Secondary indexes with different sort orders possible

Background



Mimer SQL 2024

Product features

Mimer SQL 11.0 on OpenVMS

Mimer SQL 11.0

Mimer SQL 11.0

Most efficient database in the world

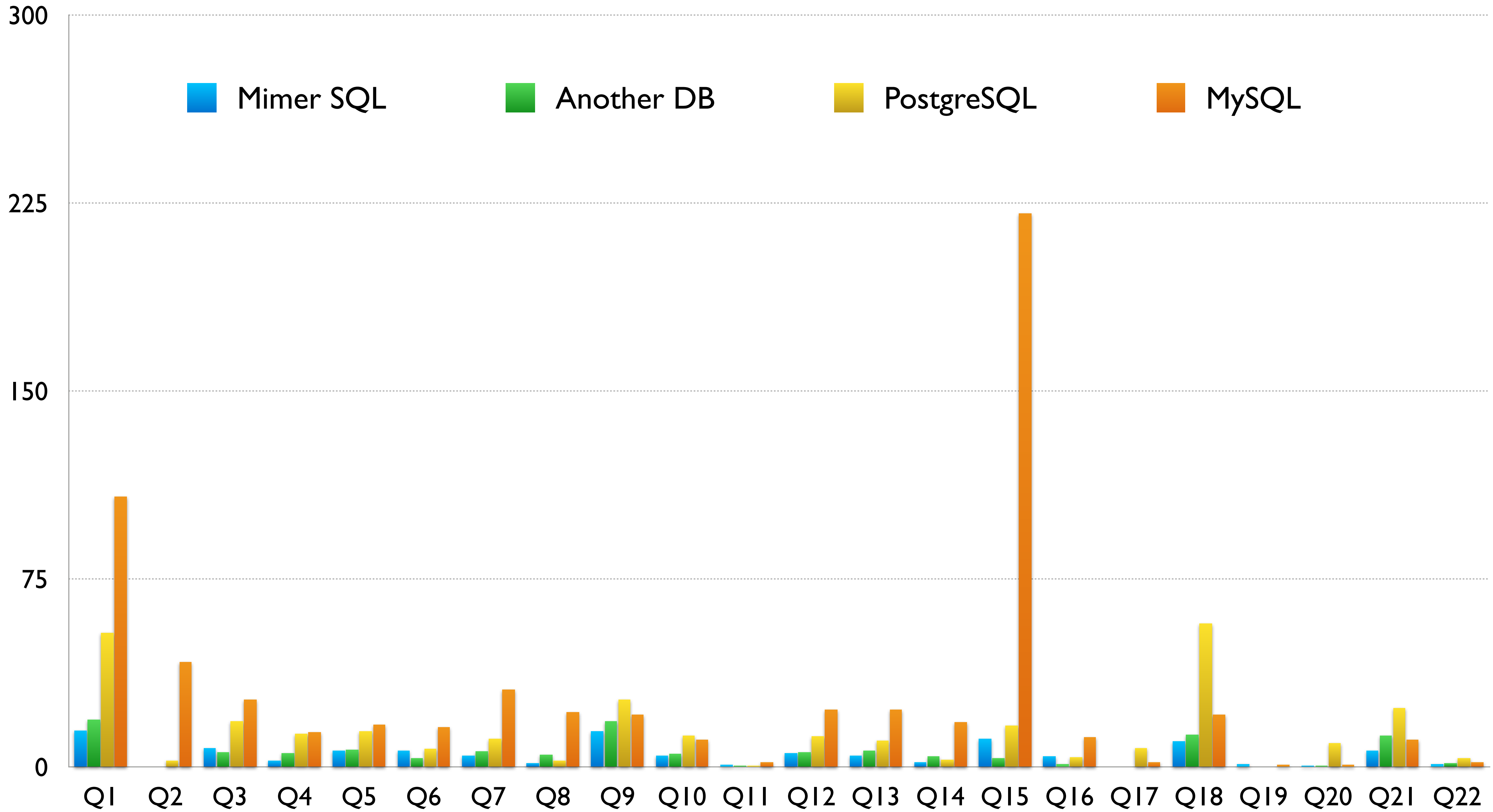
- Fast response times
- Cheaper cost in the cloud
- Handles increased load efficiently

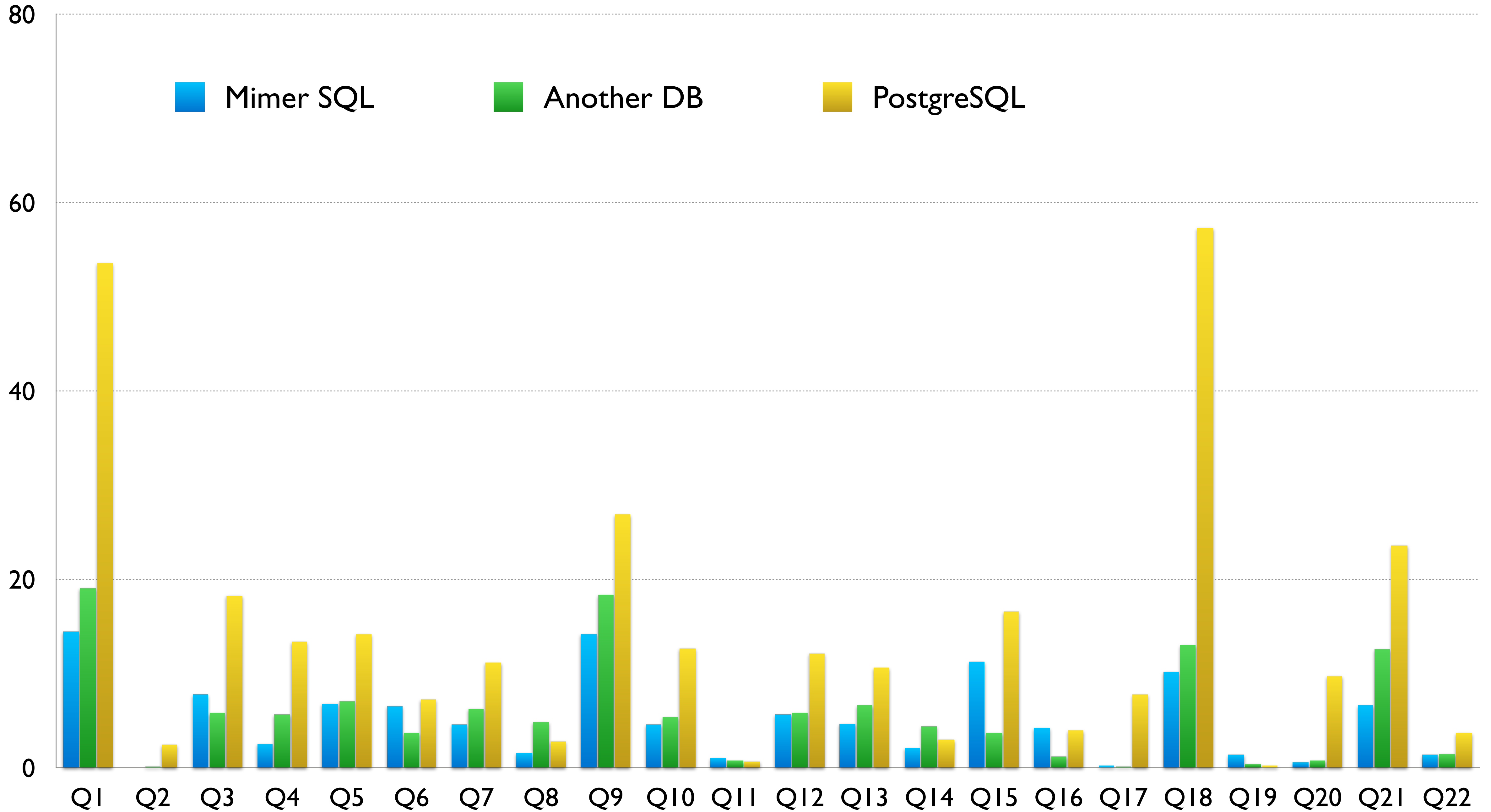
Mimer SQL

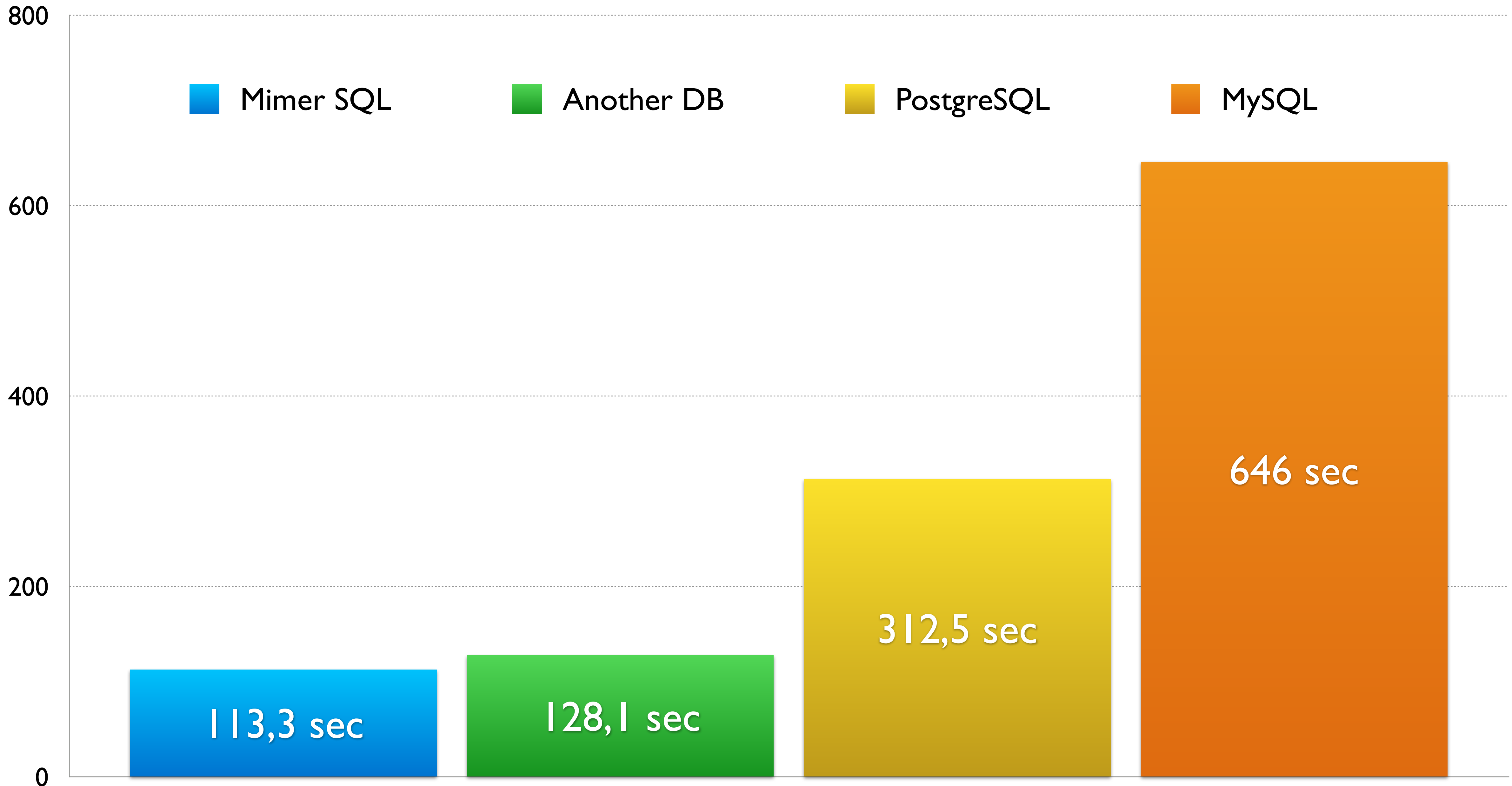
Fastest SQL execution engine
combined with advanced
optimization

Fastest transaction handling

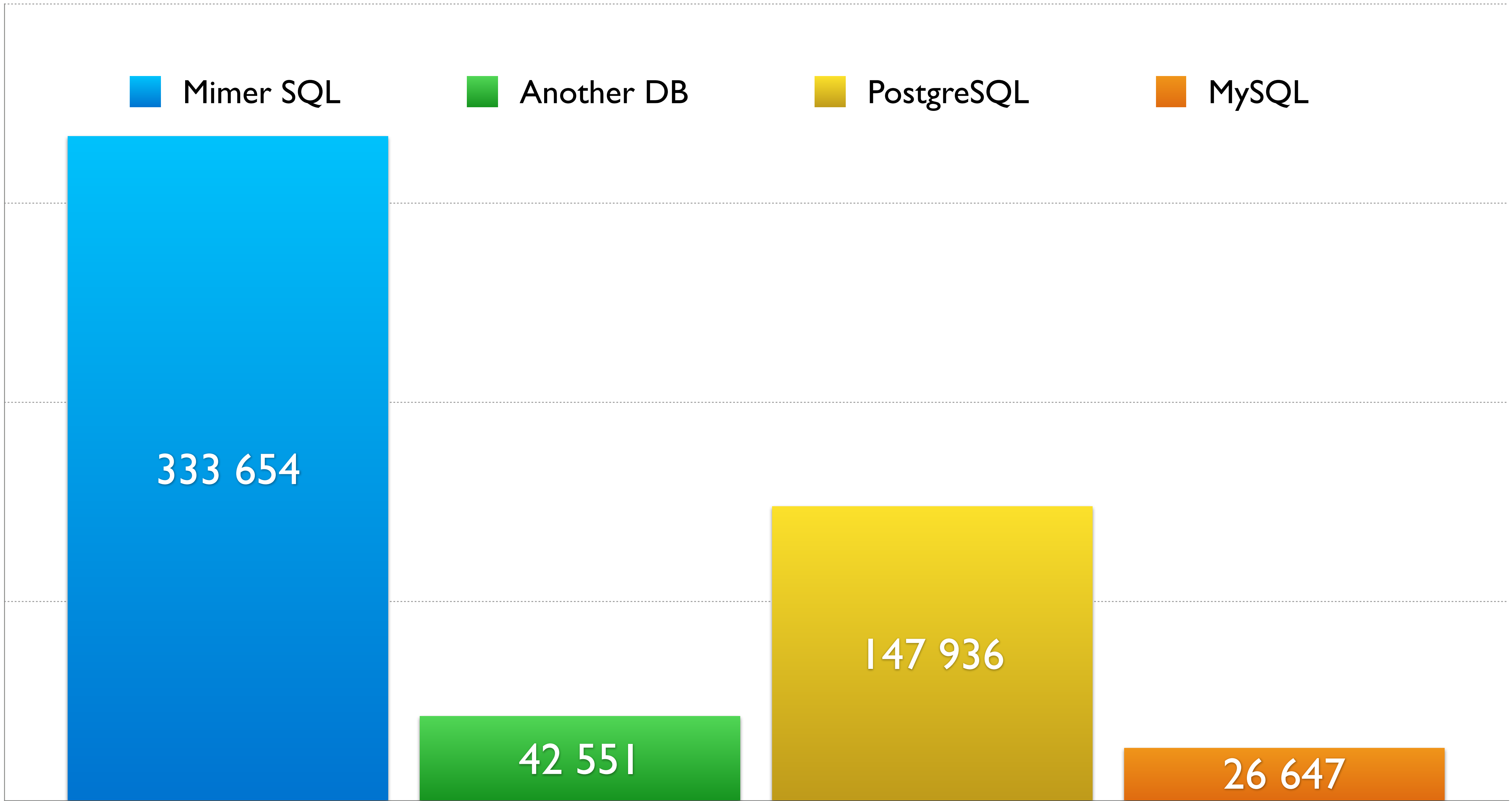
OLAP







OLTP



Version 11.0

New Storage Engine

Database cache size from
16 GB to no limit

File size from
8 TB to no limit

New efficient storage
formats and block sizes

SQL Extensions

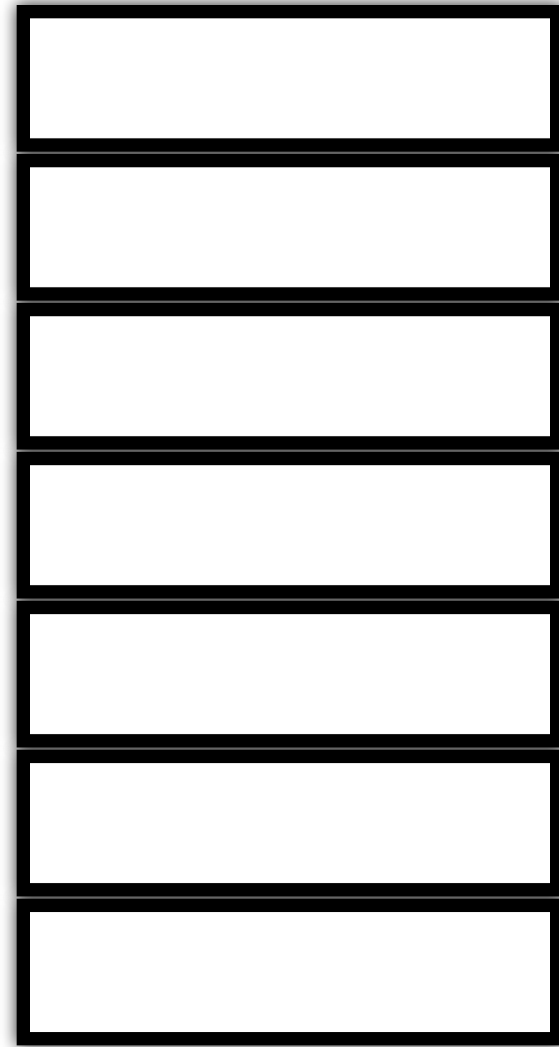
Distinct data types

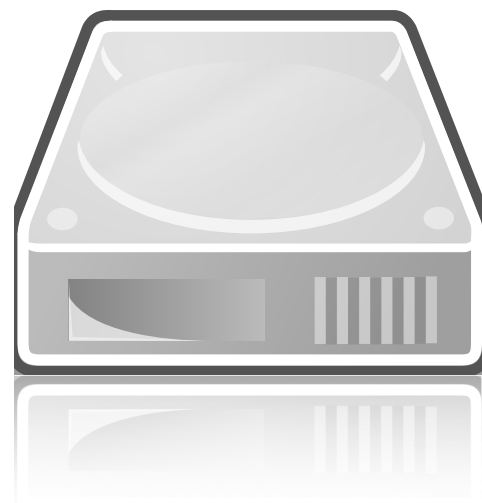
WITH-clause

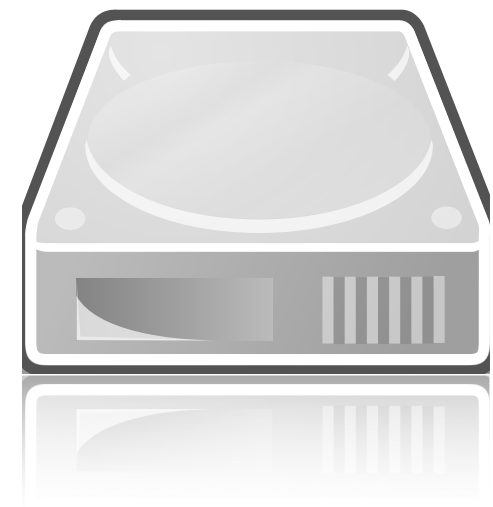
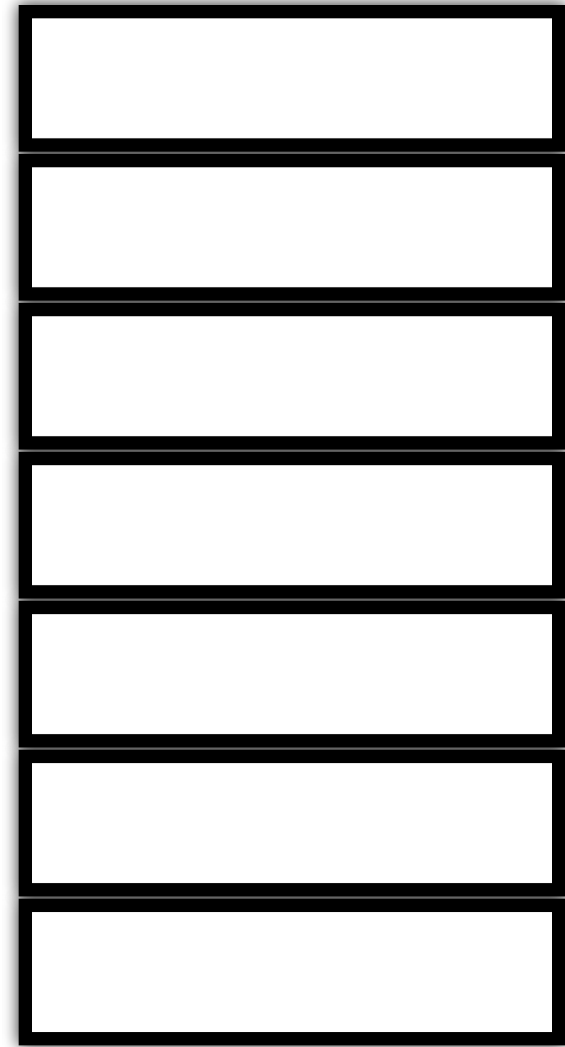
100% SQL 2023 core SQL
compliant

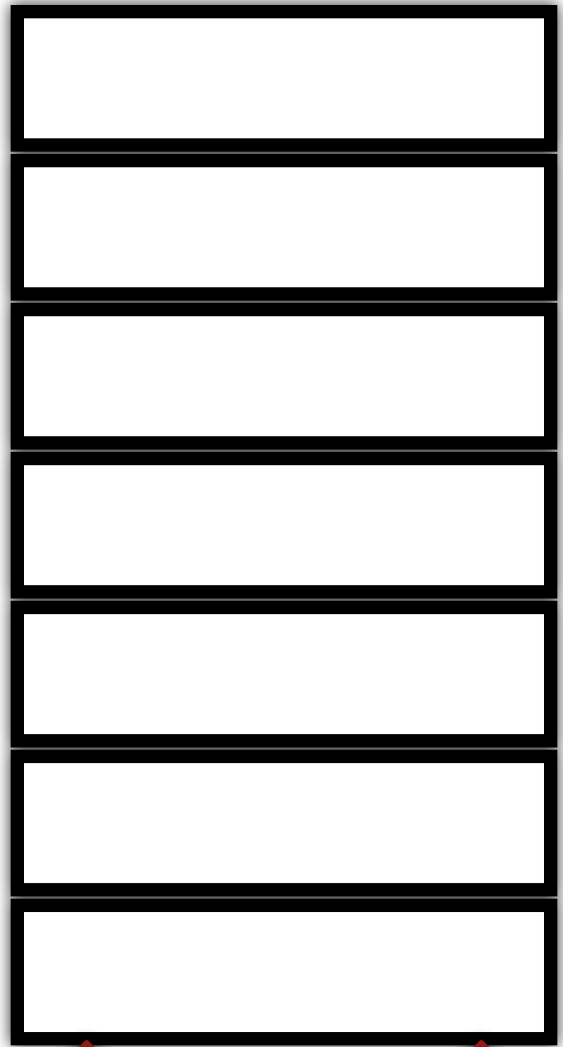
145 features beyond core

Multifile databanks



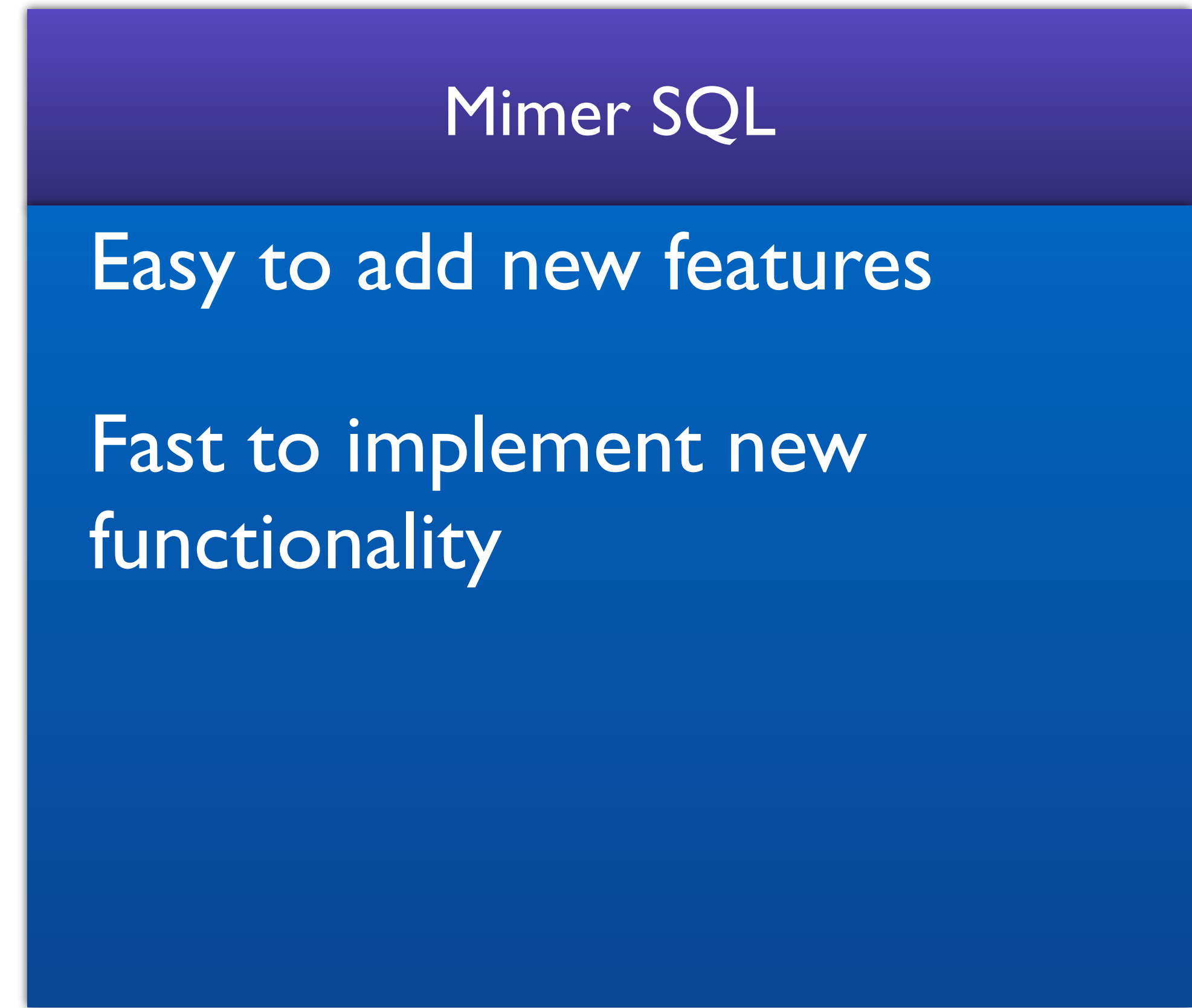






Modern code base

- Huge investment in new SQL compiler
- Rewritten storage handling
- Fastest transaction handling and low level operations
- World class sorting
- Built for extensibility and server to server communication



Client/Server encryption

- Each session unique – new encryption keys automatically generated
- Authenticated encryption algorithm designed to provide both data authenticity (integrity) and confidentiality
- Data is protected from eavesdropping
- Tampering with the data is detected
- Uses hardware acceleration

Mimer SQL

Completely transparent for application

Simple to use – setting in server

In-memory server

- Starts from a database image
- Has support for online backups to take snapshots
- Restarts with same database image
- Supports basically all functionality, such as:
 - Create databank (in memory)

Mimer Trust

Concepts

Trusted Execution Environment – TEE

Kinibi — an implementation of a TEE in ARM Trust Zone

TEE is not accessible from operating system and is completely tamper proof

Trusted Applications (TA) run within the TEE

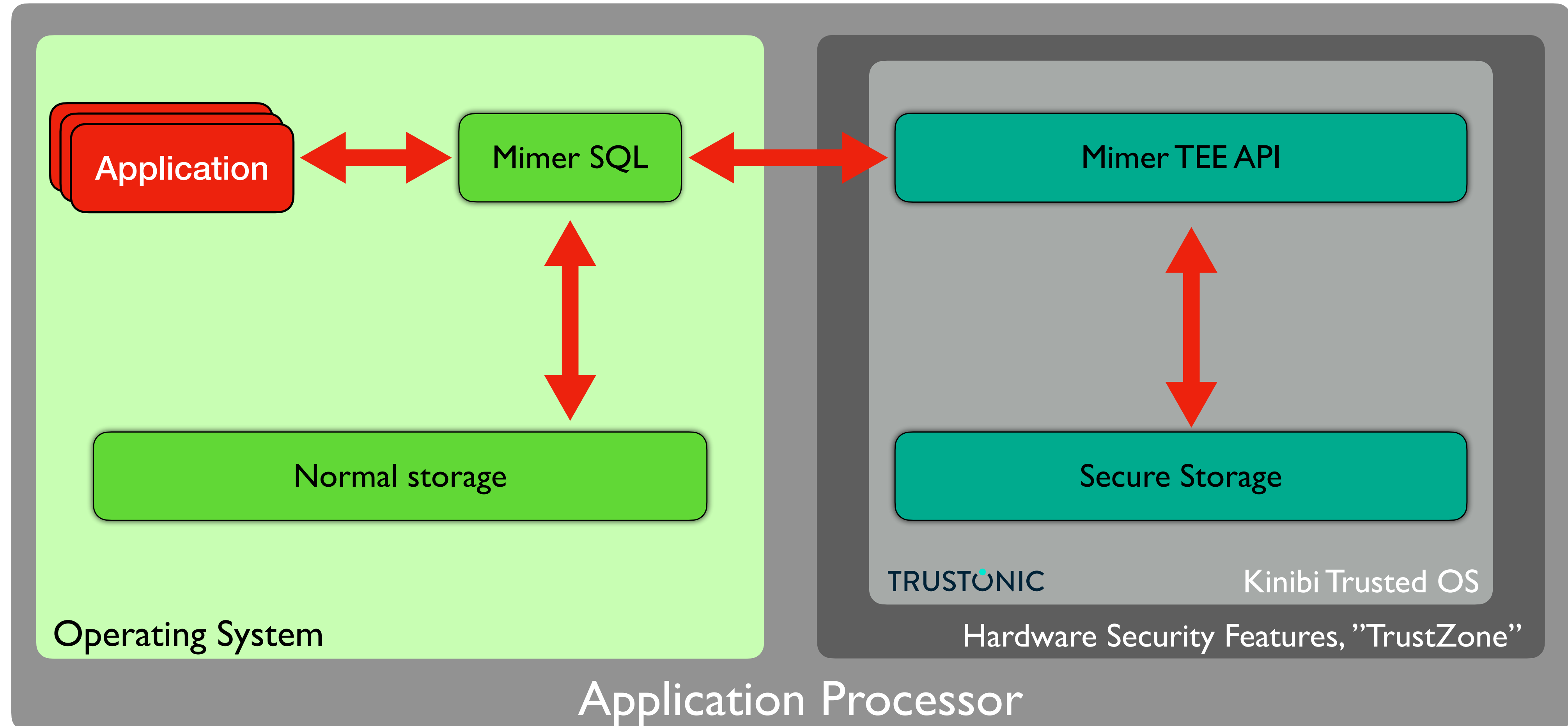
Mimer SQL, Kinibi, and Secure Tablestore

Rich database functionality

Data is securely stored in transactional TEE-protected storage

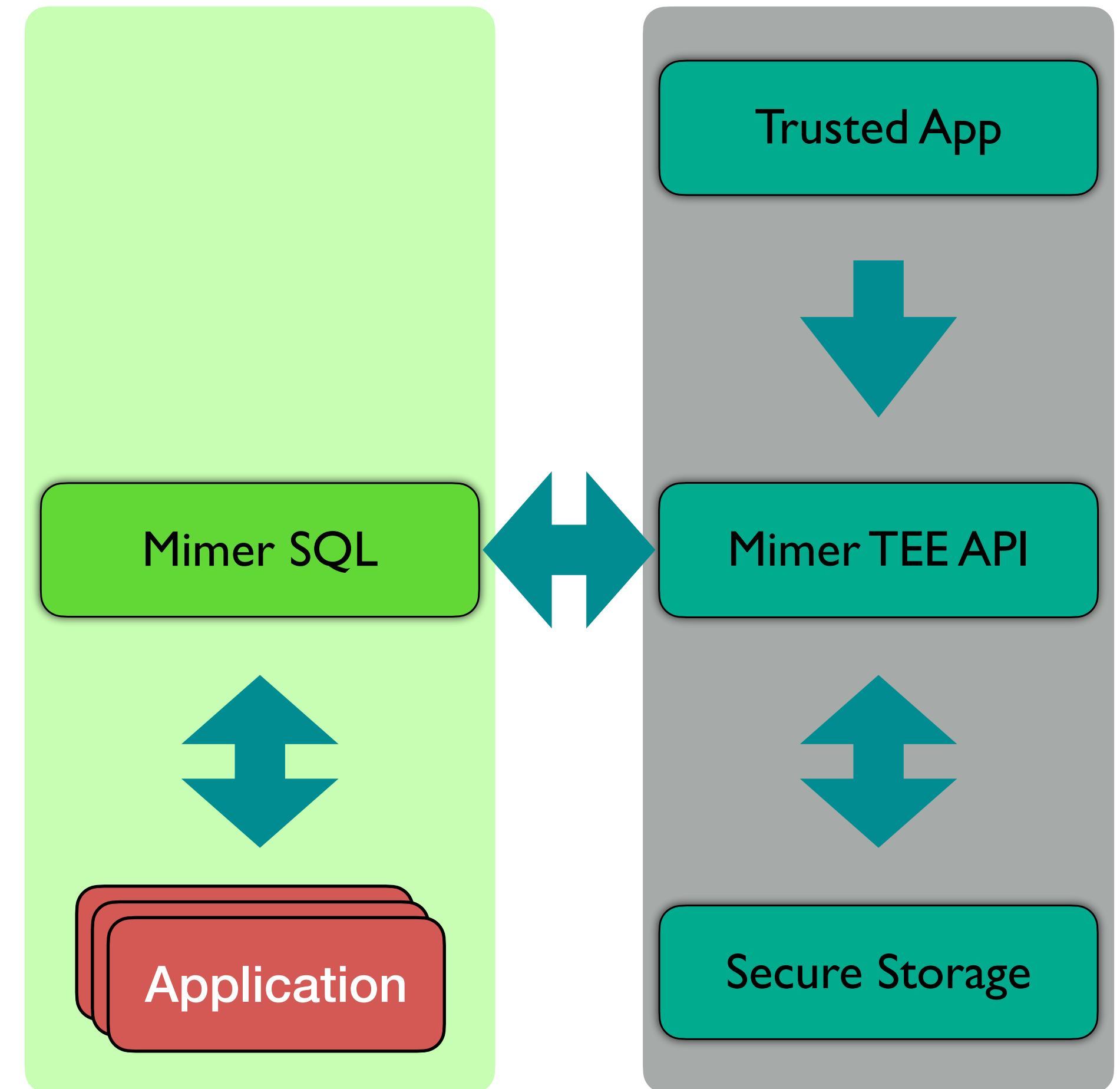
Secure Tablestore TA controls all access, enabling data to be “born secure” with certifiable provenance

Mimer Trust



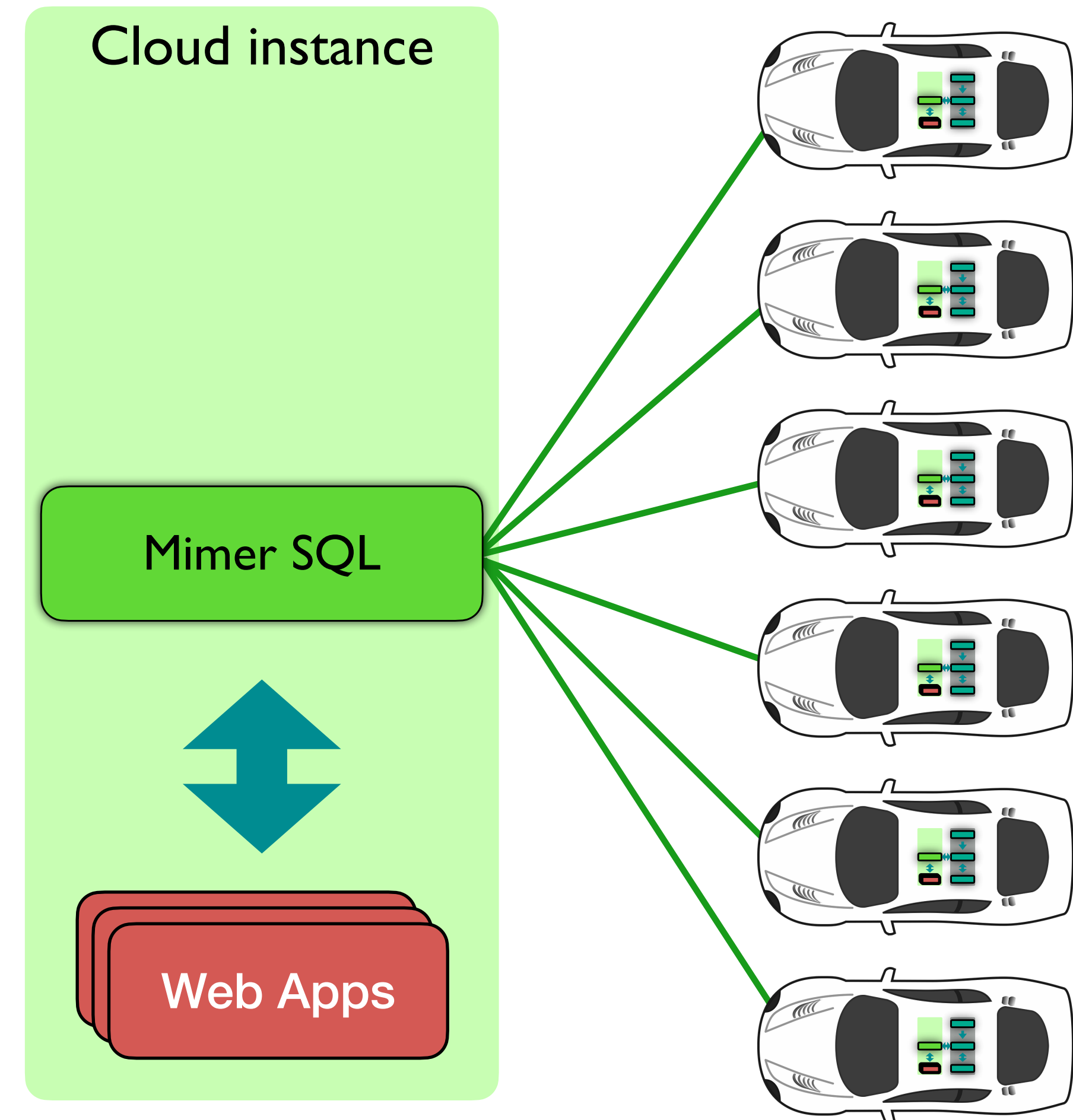
Use case #1

- Data is collected by a trusted application and signed
- Data is stored and processed by the database applications within the car
- The signature will not match if data is manipulated

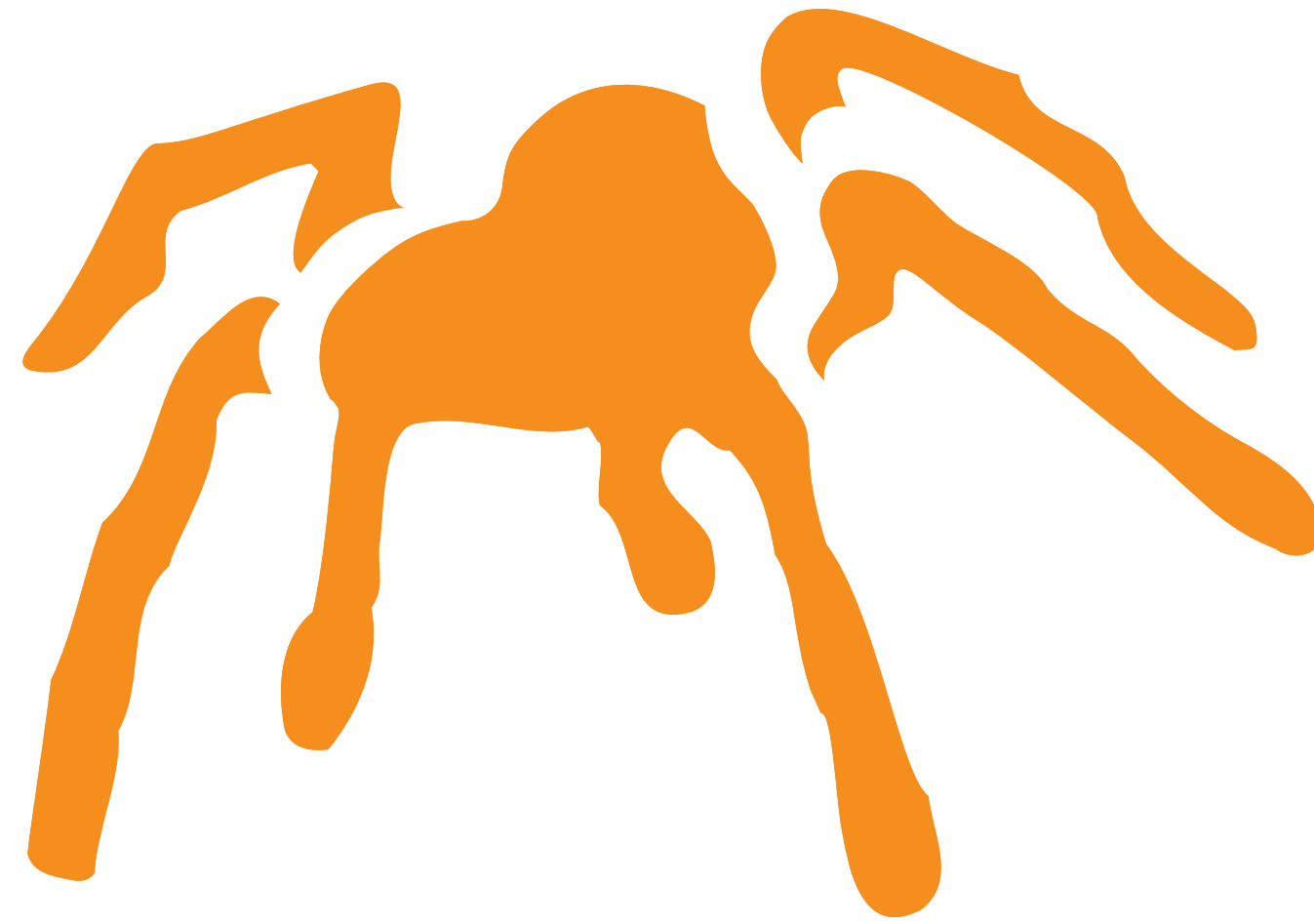


Use case #2

- Data from different cars may be collected in the cloud
- In the cloud we collect data about all cars
- Data can be validated through signature from trusted execution environment
- All communication is encrypted



Background



Mimer SQL 2024

Technical features

Mimer SQL 11.0 on OpenVMS

Mimer SQL 11.0

Mimer SQL I I.0 on OpenVMS

Mimer SQL on OpenVMS 9.2

- Developed on OpenVMS for OpenVMS
- Tightly integrated with OpenVMS to get best possible performance and scalability
- Fully functional evaluation version available for download

<https://developer.mimer.com/>

First database on OpenVMS x86

- Mimer SQL first database to complete a port to VSI OpenVMS on x86
- Itanium production release also made at the same time with same source code as beta release on x86
- Cross compilation kit from Itanium



Client support on VMS

- JDBC client for JAVA
- ODBC client
- Embedded SQL for C, FORTRAN, and COBOL
- Module SQL
- MimerPy client for Python

Performance monitoring

- SQLMonitor
 - See who is using resources in server
 - Identify SQL statements that are expensive
- T4 support
 - Allows long term overview of lots of database parameters

Remote performance monitoring

- Windows performance monitor can monitor Mimer SQL database server running on OpenVMS
- Graphical version of SQLMonitor also on Windows
- Remote command line based utilities on any platform

Next steps

- We are trying out native x86 C compiler
- Libraries created with native compiler and cross compiler should produce same code
- Waiting for optimizing compilers!

Mimer SQL

Applications will be built both on x86 and Itanium in the same way

Experiences from port

OpenVMS

OpenVMS is stable

Extremely compatible

Itanium versus x86

Test suites on Itanium and x86 behaved exactly the same

Could debug problems and on Itanium since debugger works better there

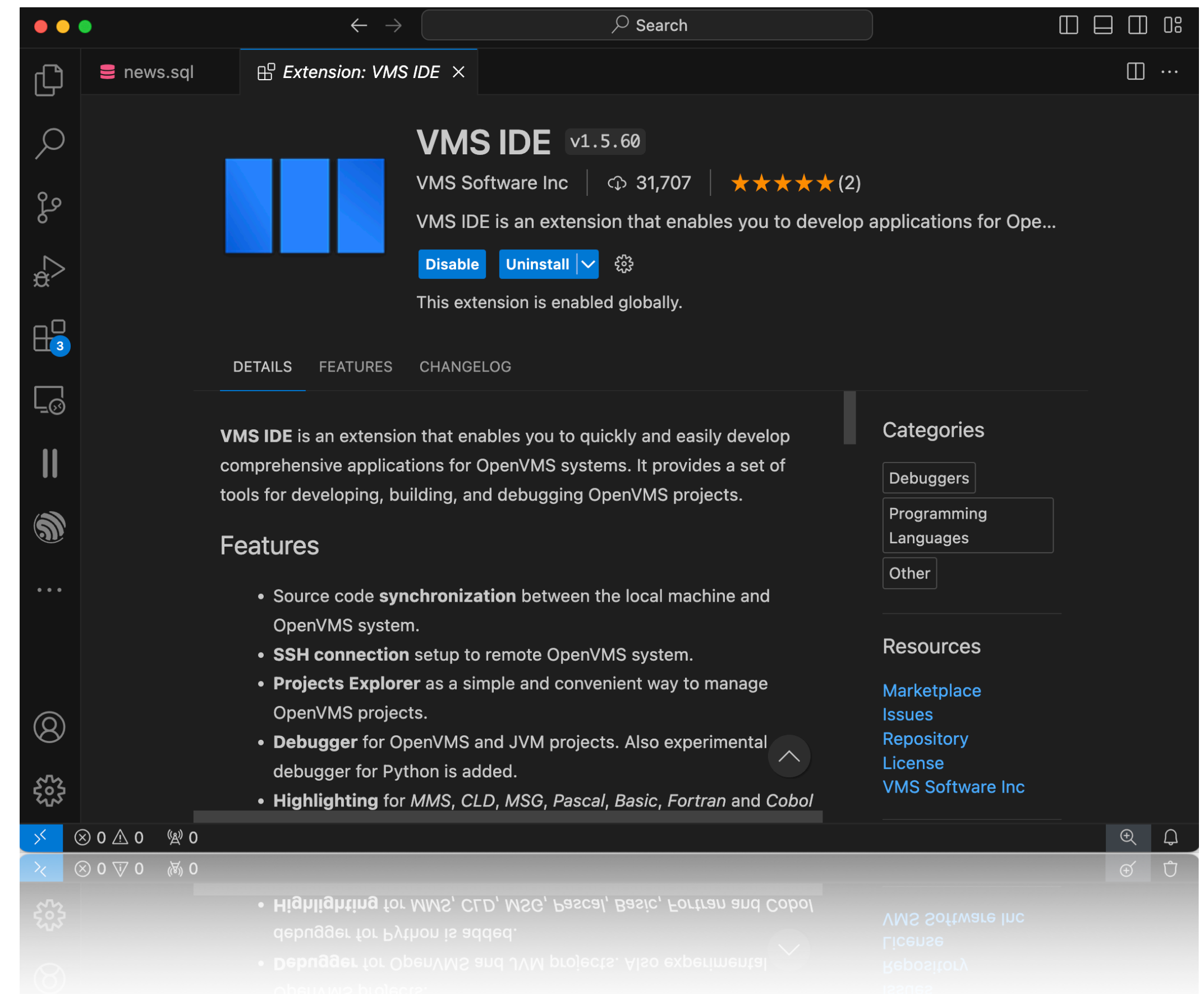
And correction then worked on both platforms

Experiences from port 🙄

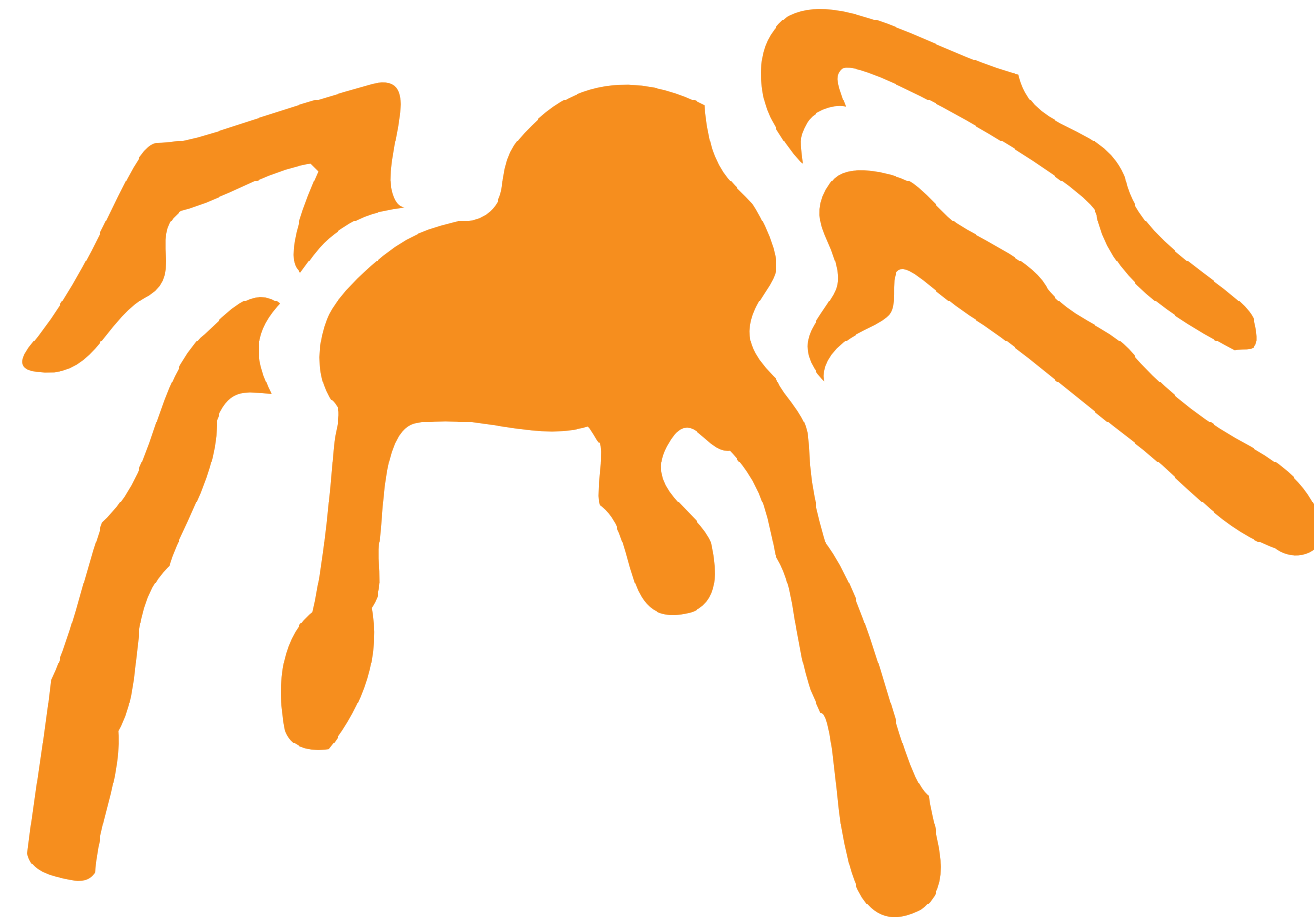
- There is no Emacs on x86...
- Source code handling does not work well on x86 with neither Subversion nor Git
- Much more work to do cross-compilation than to work natively on a system

Experiences from port 🤔

- There is no Emacs on x86...
- Source code handling does not work well on x86 for either Subversion or Git
- Much more work to do cross-compilation than to work natively on a system



Background



Mimer SQL 2024

Technical features

Mimer SQL 11.0 on OpenVMS

Mimer SQL 11.0

Mimer SQL 2024

Ongoing/completed development

- Encrypted database files
- Grouping sets: ROLLUP, CUBE, GROUPING SETS
- Temporary tables in SQL
- SQL Window functions
- Merge join
- Any name for SYSADM user
- Improved failover support
- Index support further enhanced
- External .NET procedures

Encrypted database files

- An encryption recovery key file is created with a utility
- The encryption file is applied with an SQL command
- The system will automatically encrypt everything
- Recovery file moved to safe location (on other hardware) and backed up
- Recovery file needed only if database moved to new hardware

Improved failover

- Database connection is lost.
Machine where database server stops or the database server stops
- A new server for the database is (automatically) started on the same machine, or on another machine in a cluster

Mimer SQL

We want to make it easy for applications to manage failover

Improved failover

Application is not in a transaction

Mimer client will automatically failover transparently on the next call

Application is in the middle of building up a transaction

Mimer client will give a specific error code that a transaction should be rolled back.

On rollback, the Mimer client will automatically reconnect

The application has called commit

Mimer client will failover and automatically ask the new database server if the original commit went through or not

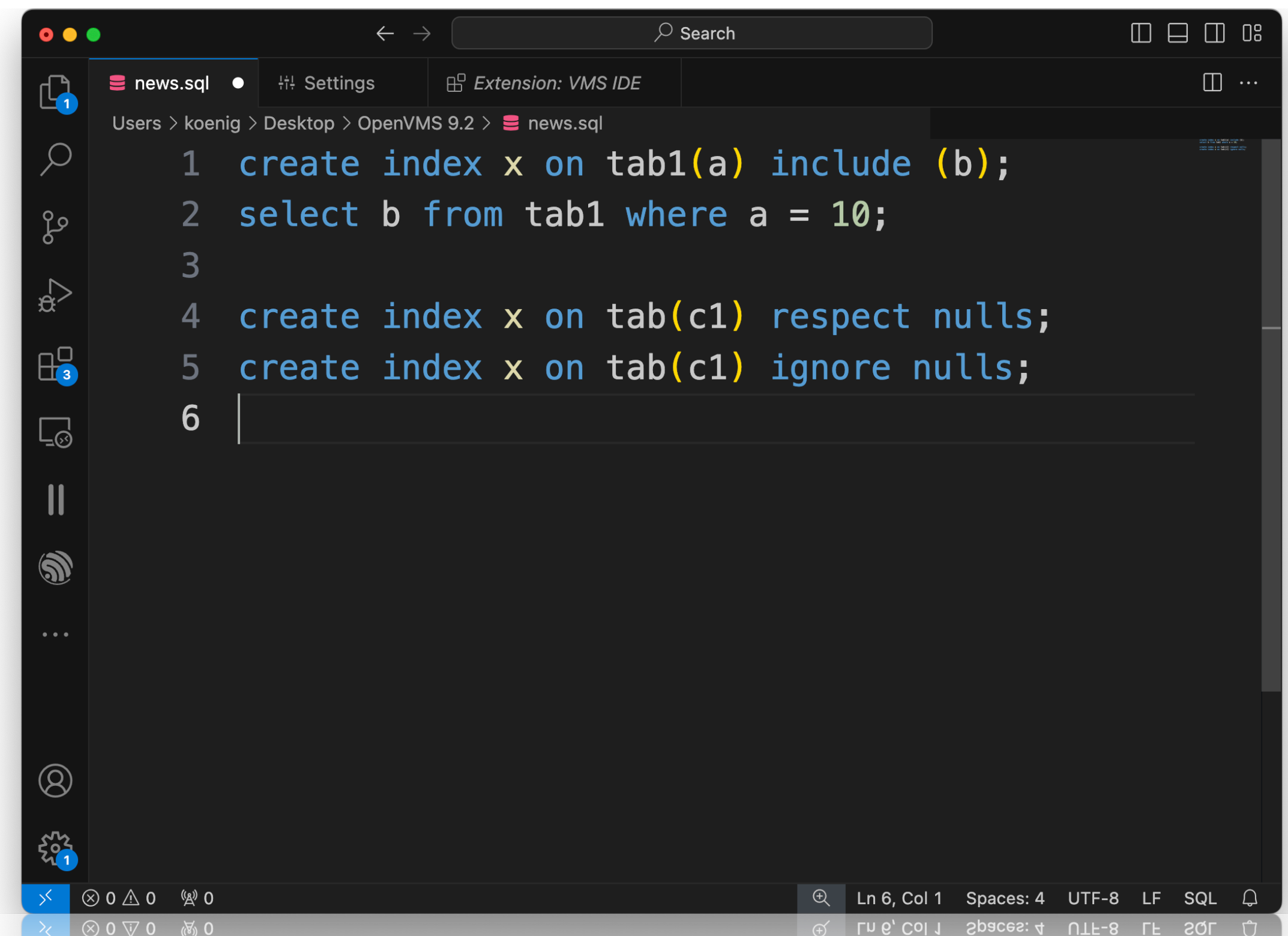
Application will only get a commit or rollback indication and is unaware of the failover

Current indexing

- Possible to index one or several columns in an index
- Index according to a collation
- Index according to current collation
 - Index automatically updated when current collation changes
- Word indexes
- Pinyin indexes
- Coordinate indexes

New indexing

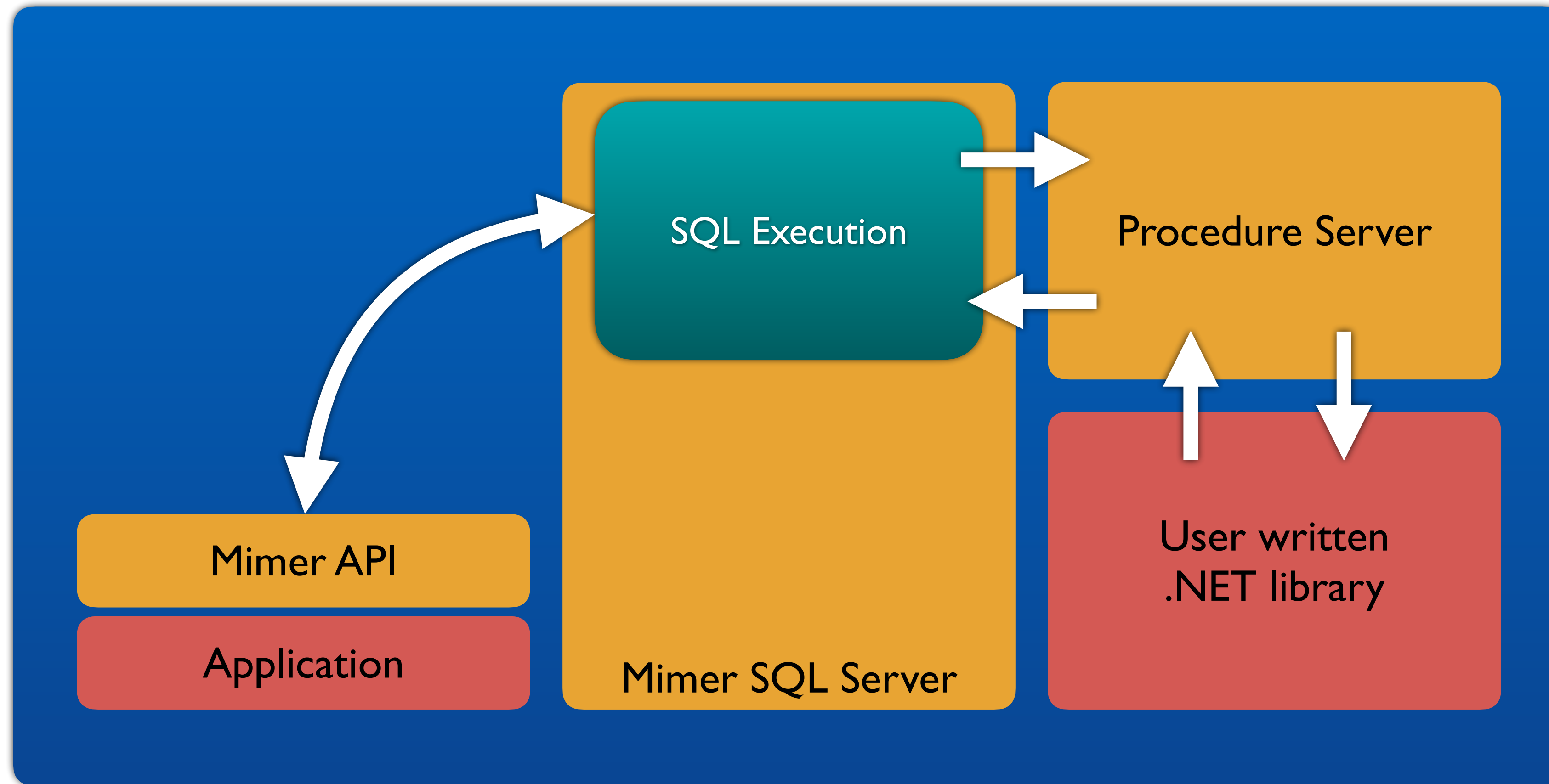
- An index can include extra columns that are not part of index key
- Null values may be excluded from index
 - More compact
 - Does not allow indexed IS NULL queries
- Index created and dropped on the fly



```
news.sql • Settings Extension: VMS IDE  
Users > koenig > Desktop > OpenVMS 9.2 > news.sql  
1 create index x on tab1(a) include (b);  
2 select b from tab1 where a = 10;  
3  
4 create index x on tab(c1) respect nulls;  
5 create index x on tab(c1) ignore nulls;  
6
```

External procedures

- Allows procedure code written in .NET languages to be seamlessly called from SQL
 - Functionality can be extended
 - Can, for example, interface with machine learning packages, XML and JSON parsers and much more
- The actual code runs in separate process from database server for security reasons
 - .NET code cannot access database server data
 - .NET code does not inherit database server privileges



Procedure Server Architecture


```
1 namespace UserLib
2 {
3     public static class UserClass1
4     {
5         public static MimerInteger C_from_F(in MimerInteger fahrenheit)
6         {
7             MimerInteger celsius = (int)((fahrenheit.Value - 32) * 5.0 / 9);
8             return celsius;
9         }
10    }
11 }
```

```
1 CREATE LIBRARY NETLIB FILE 'C:\test\dotnetlibs\UserLib\UserLib.dll' LANGUAGE CLR;
2 CREATE FUNCTION C_from_F(Fdegrees INTEGER) RETURNS INTEGER
3     LANGUAGE CLR EXTERNAL NAME 'UserLib.UserClass1.C_from_F' IN NETLIB;
4
5 SET ? = C_from_F(100);
6
7 ?
8 ==
9 37
```

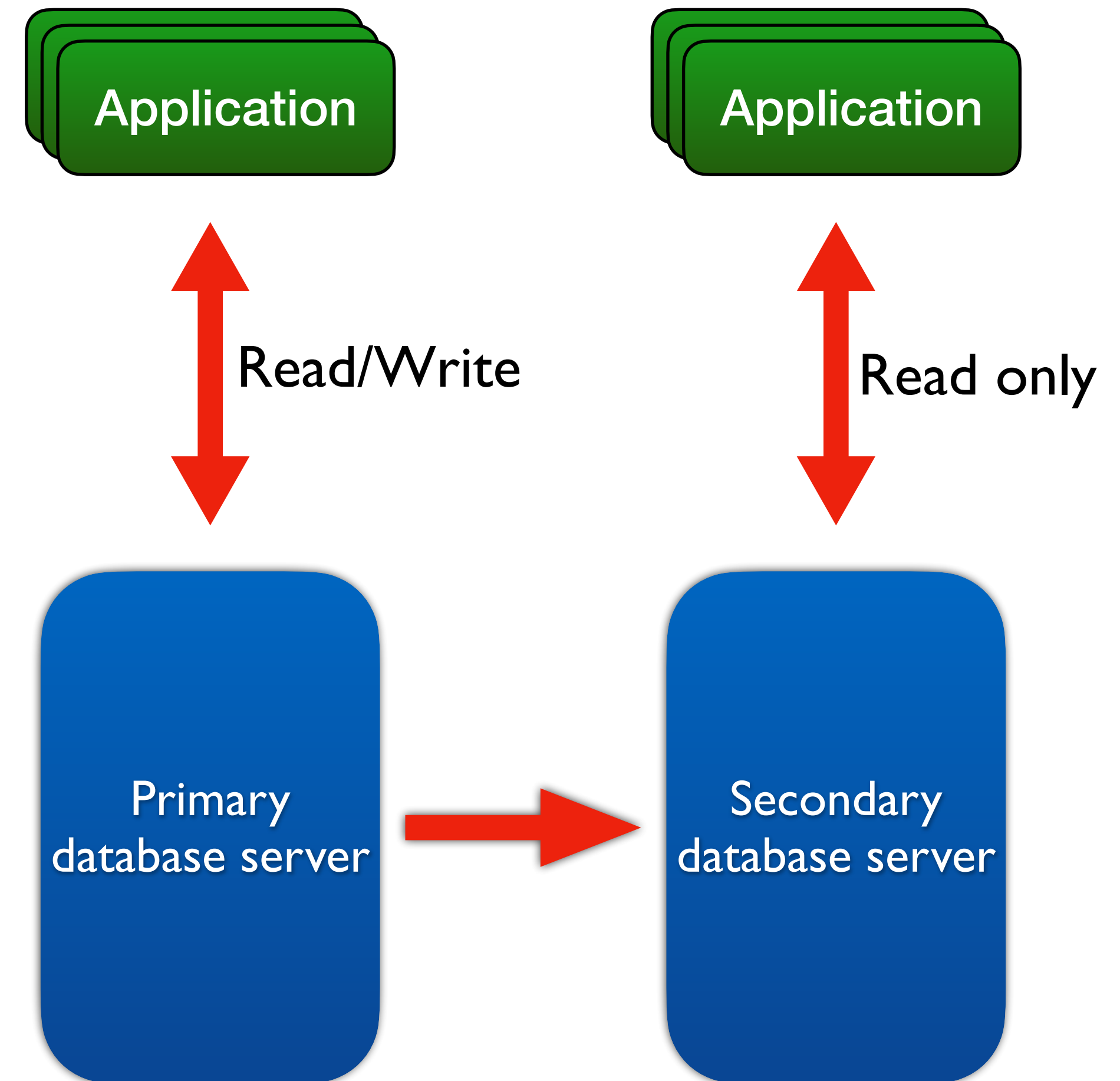
Sample external procedure

Further ahead

- Hot standby
 - Read-only in first phase
 - Read/write in next phase
- Multithreaded query processing
 - Single query may execute in parallel on several processors

Hot standby

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



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

Mimer SQL on the web

- <https://www.mimer.com>
- <https://developer.mimer.com>
- <https://docs.mimer.com>