2ndQuadrant
Professional PostgreSQL

# Getting ready for PostgreSQL 9.1

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PostgreSQL

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# About myself

- Founder of 2ndQuadrant Italia
- Database architect at 2ndQuadrant
  - Business Critical OLTP databases
  - Data warehousing
- PostgreSQL user for over 10 years
- Founder of PostgreSQL Europe
  - Former Vice President
- Founder of the Italian PostgreSQL Users Group
  - Current President

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# About 2ndQuadrant

- Professional Open-Source Software House
- Platinum sponsor of PostgreSQL
- 100+ customers worldwide
- Directly represented in 5 countries
  - Special coverage in Latin America and Nordic Countries
- 24x7 support for PostgreSQL production environments
- What we do
  - Design, Develop and Support PostgreSQL
  - We deliver high quality professional services
  - Leaders in HA, Recovery, Scalability and Performance
  - Training

# Who's using PostgreSQL?

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# Table of contents

- The PostgreSQL Project
- PostgreSQL 9.0
- PostgreSQL 9.1

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# Part I

# The PostgreSQL Project

# Postgres or PostgreSQL?

- Officially it is **PostgreSQL**
- Postgres was the initial name of the project
- With SQL support (1996) the project changed name into PostgreSQL
- **Postgres** is commonly accepted as a synonym

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# PostgreSQL and its key features

- Open-Source Database Management System
- Close support of the SQL Standard (SQL:2008)
- Multi-Version Concurrency Control
  - Multi-user, **designed** for concurrency
- Extensibility:
  - Data types
  - Functions

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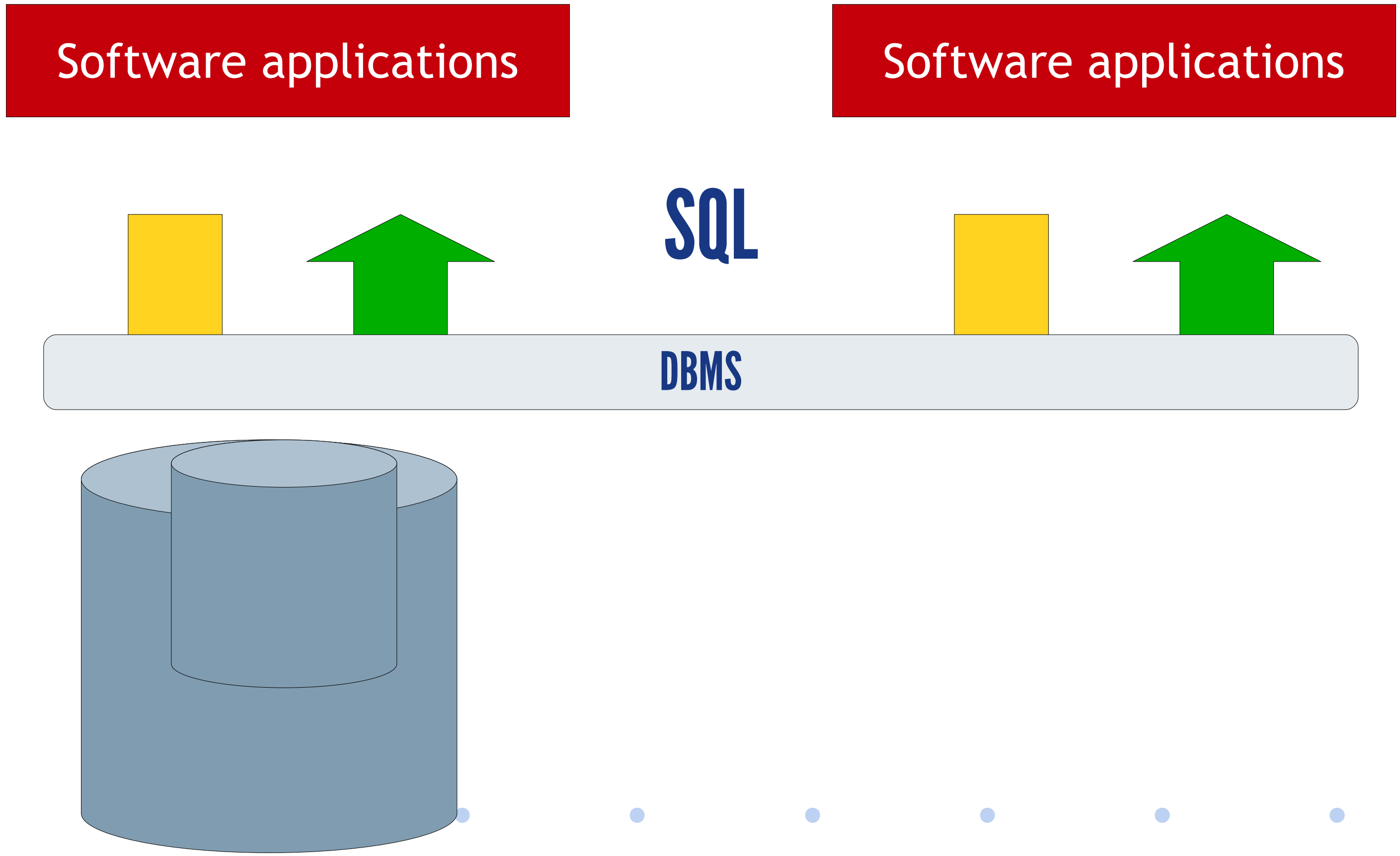
# Applications, databases and DBMS



Software applications

Software applications

SQL

DBMS

# 100% Open-Source and Community

- Distributed under a BSD-like license
  - The “PostgreSQL License” (TPL)
    - http://www.opensource.org/licenses/postgresql
  - Highly **permissive**
  - Not subject to change of licensing
    - It will always be open-source
  - Not subject to acquisitions
- A community project

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# The "PostgreSQL" ecosystem

- Community
  - Developers
  - Users
- End users
  - Companies and organisations
  - Consulting companies
  - Individuals
- Sponsors
  - Development
- External Stakeholders
  - Companies that sponsor the development of key features

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# A mature project

- PostgreSQL has been developed for over 25 years
  - It is an adult
  - It is even allowed to drink (in some countries)
- It has grown rapidly in popularity
  - Particularly in the last 3 years
    - OpenStreetMap moved to Postgres (2009)
    - Provider of support for Solaris changed (2010)

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# PostgreSQL releases

- Current stable release: 9.0.4 (18 April 2011)
- Current Major release: 9.0 (September 2010)
  - 5 major releases in the last 5 years
- Oldest supported release: 8.1 (2005)
  - On Windows: 8.2
- Major releases supported by the community:
  - 8.1, 8.2, 8.3, 8.4 and 9.0
- PostgreSQL 9.1 is expected later this year
  - Currently 9.1.0beta2 is out

# Part II

## PostgreSQL 9.0

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# Architecture

- Client / Server
- Multi-processing
- ANSI C
- Uses stable system functions
- Multi-platform

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# Typical use cases

- Transactional databases (OLTP)
- Telecommunications
- E-Commerce
- Monitoring of electronic devices
- ERP, CRM, data warehousing, BI
- Social networking platforms
- High traffic websites
- Geographical Information Systems (PostGIS)
- Web CMS, Blog systems
- etc.

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# A versatile product

- Multiple interfaces for connectivity:
  - Native, JDBC, **Python**, Perl, PHP, ODBC, .Net, ...
- Multiple server languages:

PL/pgSQL, **PL/Python**, PL/Perl, PL/Java, ecc.

- User, path, options, environment

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# Cool robust features

- Views
- Stored procedures
- Triggers
  - Column and/or conditional
- ACID transactions
- Schemas
- Tablespaces
- Partitioning
- Custom types
- Rules

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# Security and data protection

- Concept of “**security by default**”
- Multi-level security model
  - server, database, table, column
- SSL
- Integration with the company's security infrastructure
- Full disclosure of vulnerabilities
- Rapid fix of security bugs

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# Features for web technologies

- Support for SQL:2008
- Support for the UNICODE standard (UTF-8 charset)
- Support for regular expressions
- Support for XML
- Database level collation
- Localisation

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# Advanced web features

- Full text search
- Arrays
- Transparent compression of text data
- Data types (enums, uuid, cidr, macaddr, hstore, ...)
- Session parameters with SET
- Asynchronous commit

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# Business critical environments

- Two of the major challenges and requirements:
  - Maximise the uptime (“5 Nines” = ~ 5 minutes/year)
    - Reduce downtimes
  - Remove data loss
    - While keep data consistent (always)

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# PostgreSQL's answer

- Robustness and reliability
  - WAL Files
- Hot backup
- Online Backup and Point in time recovery
- High Availability
  - Warm/Hot Standby
- Asynchronous Streaming Replication
- Synchronous Streaming Replication (9.1!)

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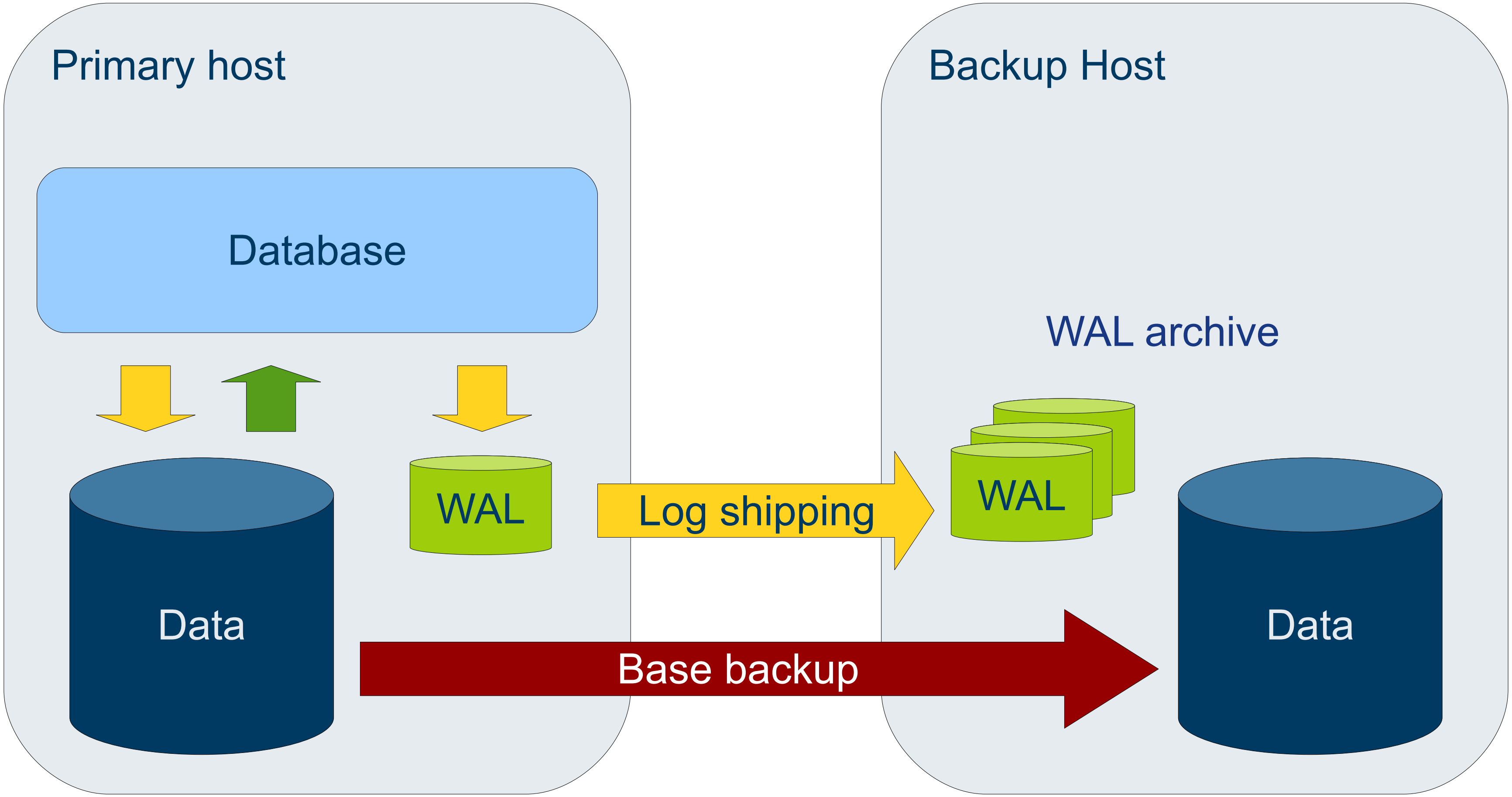
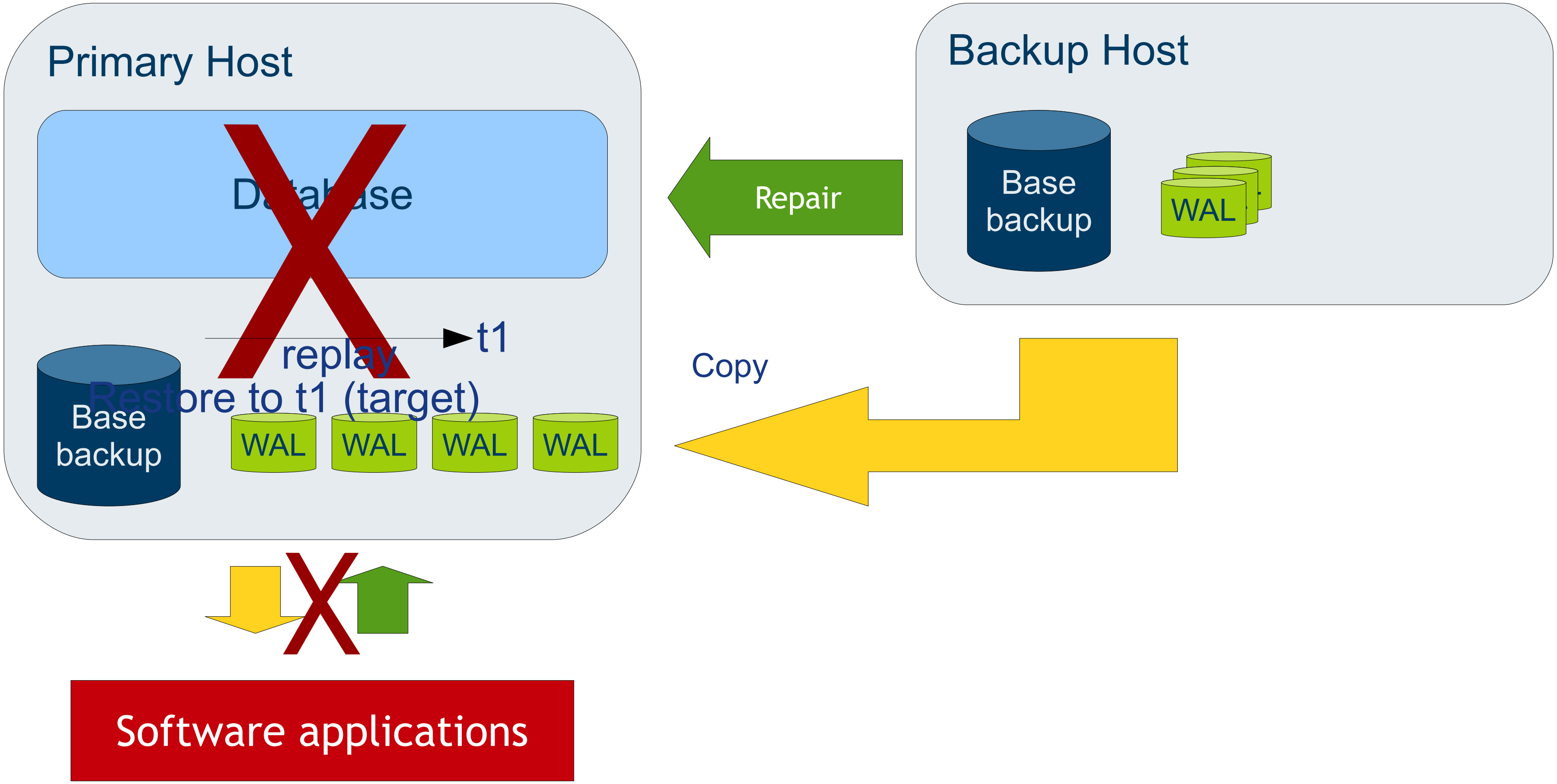
# Online backup



# Point In Time Recovery



# Warm standby

- Technology for **asynchronous replication** based on:
  - Write Ahead Log (WAL) files shipping
  - Through operating system commands (e.g. rsync)
- 1 primary node, N secondary nodes
- Secondary nodes:
  - Are called **standby** nodes
  - Do not accept connections
  - Are an almost identical copy of the master
    - Small delay due to WAL shipping
- High Availability technology
- The standby is promoted in case of **failover** (unexpected) or **switchover** (deliberate)

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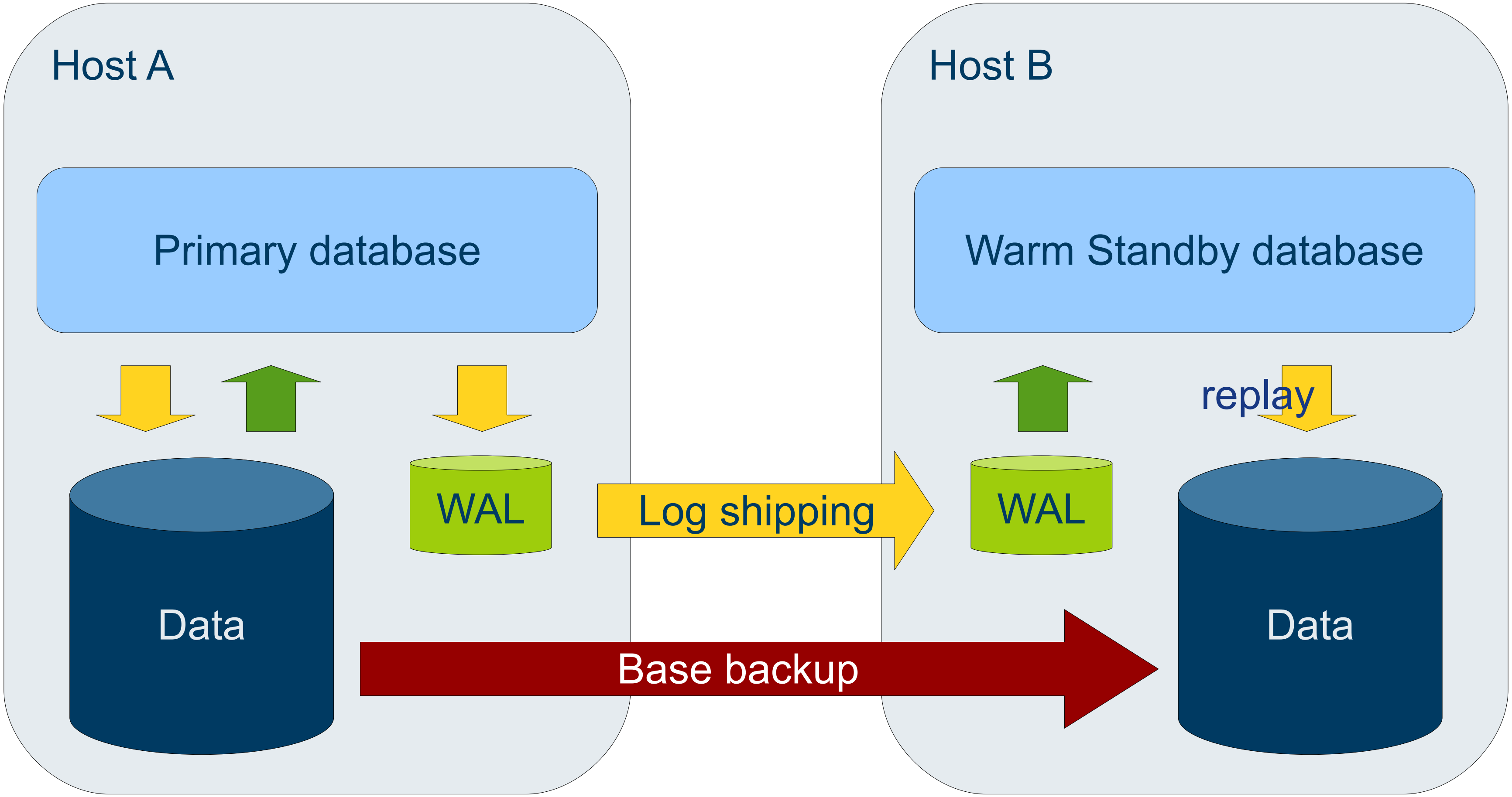
# Warm Standby, overview



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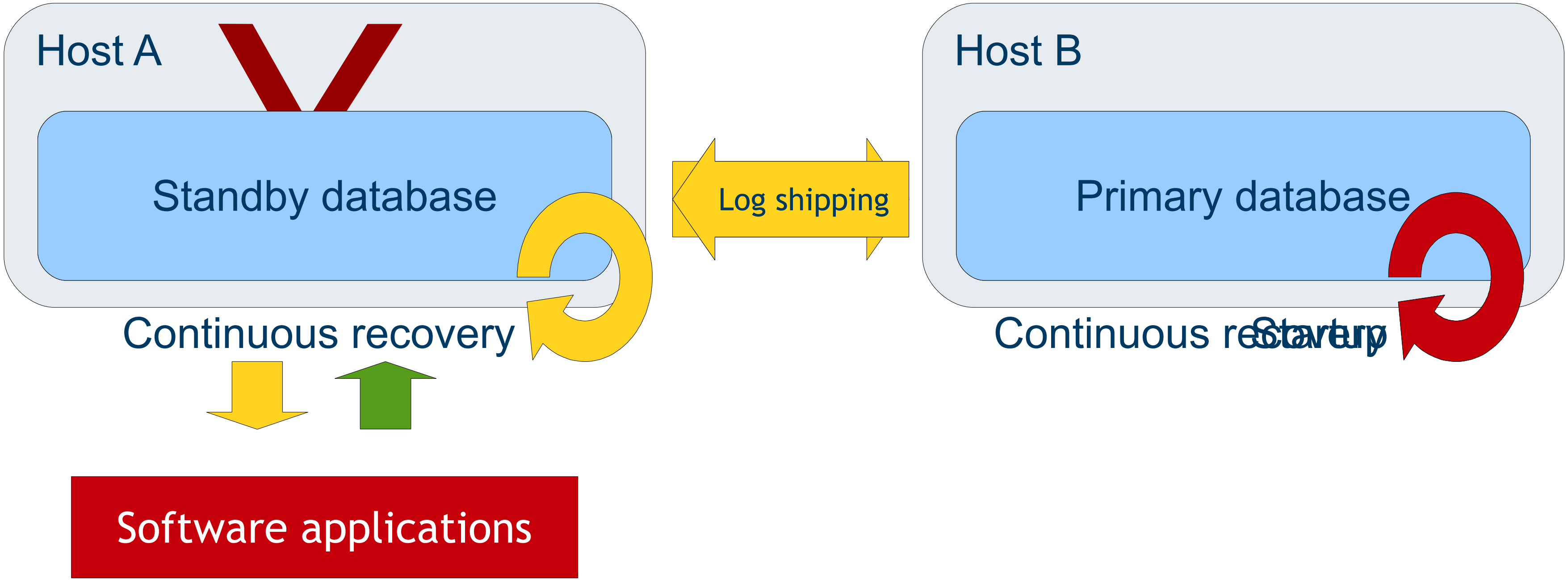
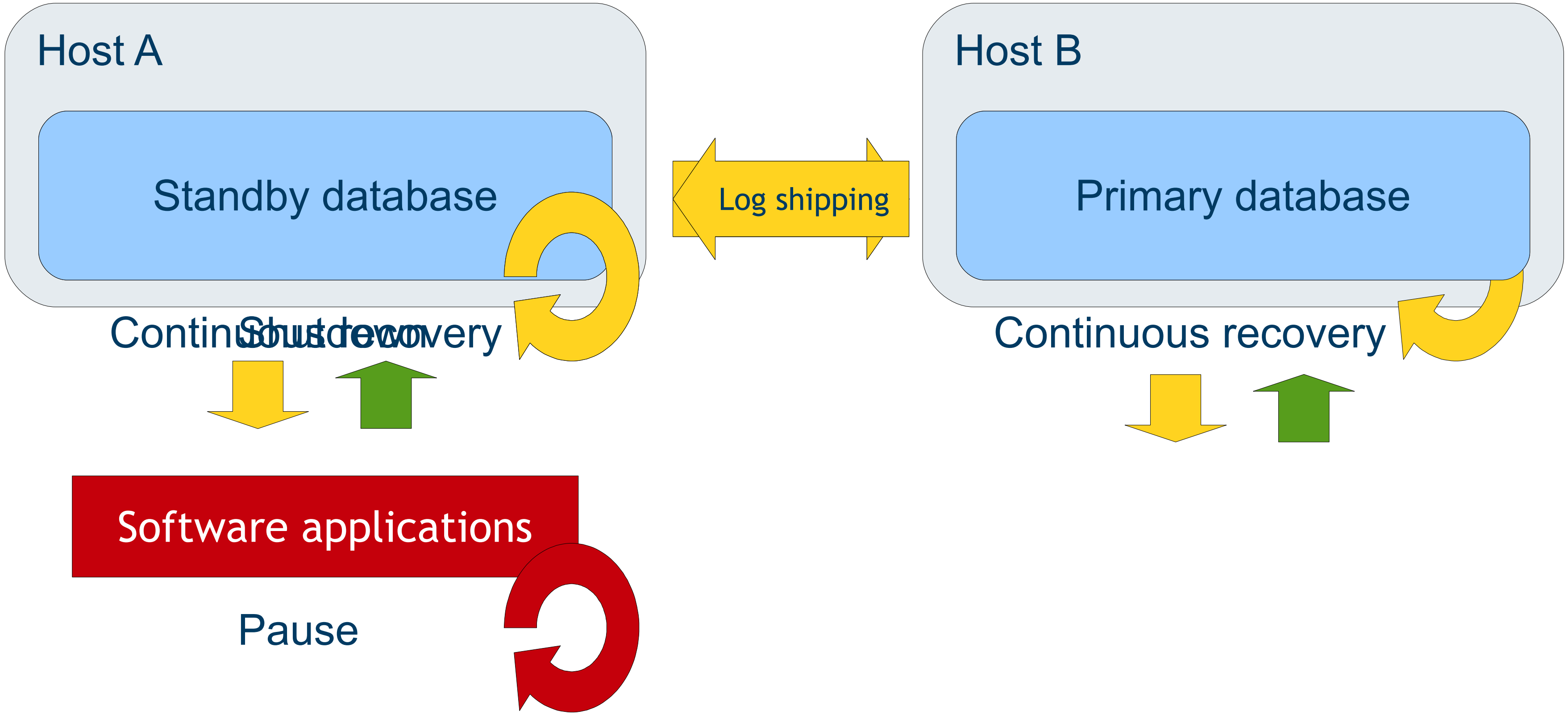
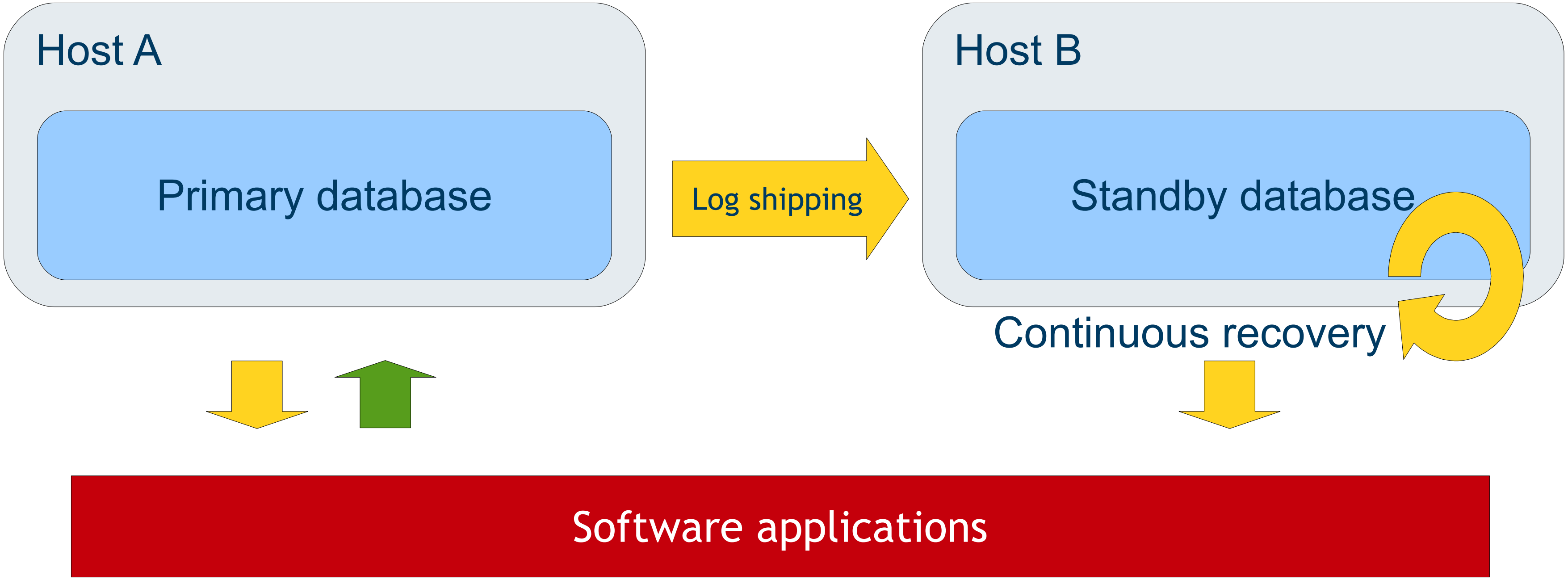
# Failover


Host A
Standby database
Continuous recovery
Log shipping
Host B
Primary database
Continuous restore
Startup
Software applications

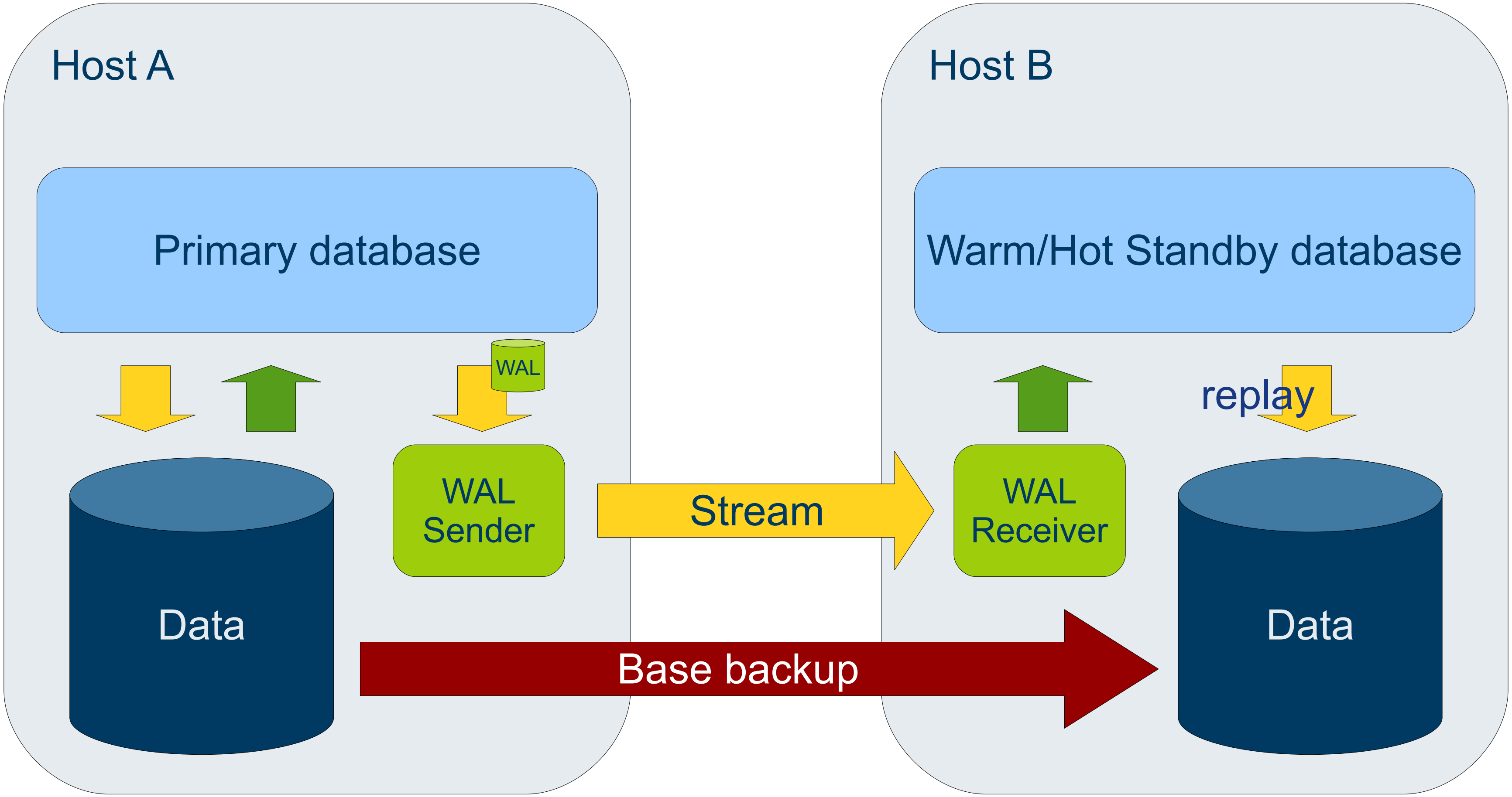
# Switchover


Host A
Standby database
Continuous recovery
Shutdown
Log shipping
Host B
Primary database
Continuous recovery
Software applications
Pause

# Hot Standby


Host A
Primary database
Log shipping
Host B
Standby database
Continuous recovery
Software applications

# Streaming Replication



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# More replication solutions

- Not part of PostgreSQL's core
  - Only available solutions for PostgreSQL < 9
- A few alternatives
  - Slony
  - PGPool
  - Bucardo
  - Londiste (Skype)

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# VLDB

- Many 1TB+ databases with PostgreSQL
- Typical usage is 100GB+ databases
- Key features:
  - SMP architectures
  - Tablespaces
  - Horizontal partitioning

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# Scalability

- Caching:
  - pgmemcache – integration with memcache
- Distribution on multiple nodes:
  - PgBouncer (connection pooling)
  - PL/Proxy
    - Map/Reduce (RUN ON ALL, ANY, single node)

# Administration and monitoring tools

- Command line:
  - psql, pg_dump, pg_restore, ecc.
- GUI:
  - PgAdmin3
- Web:
  - PHPpgAdmin

- Alerting:
  - Nagios integration
- Monitoring:
  - Cacti and Munin integration
- Replication:
  - repmgr (*devel*)

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# Spatial extension: PostGIS

- PostgreSQL's most important extension
- Geographical Information System (GIS)
- OpenStreetMap
- Add geographical data types
  - Open Geospatial Consortium
- Geodatabase

# Part III

# PostgreSQL 9.1

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# Overview

- Improvements in operations
- Extensions packaging
- New features and performance improvements in key areas

- **Synchronous Replication**
- Triggers on views ("updatable views")
- Column collations
- Writable CTE
- Serializable Snapshot Isolation
- Better partitioning
- …

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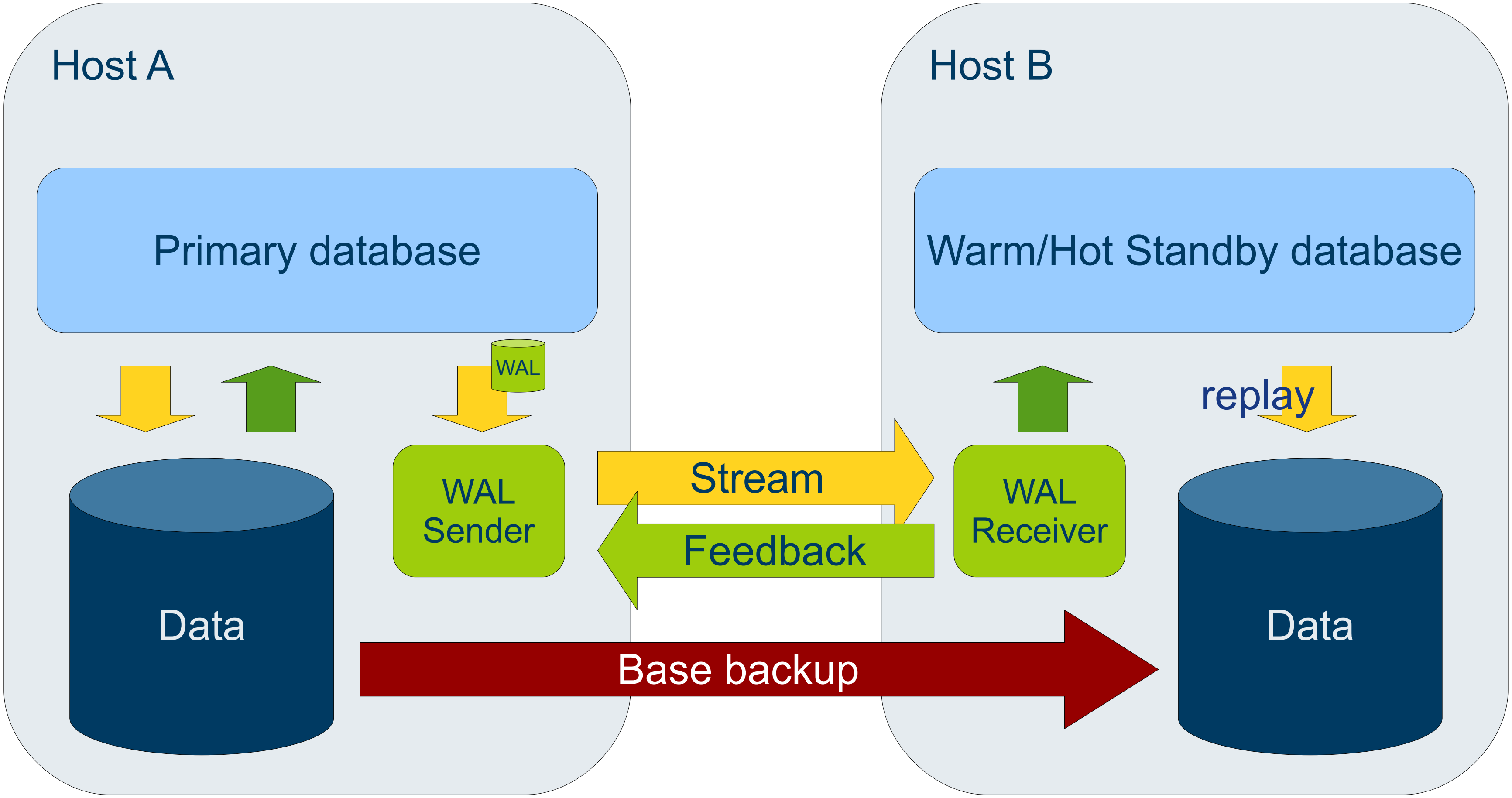
# Synchronous Replication

- Data loss prevention technology
- Uses streaming replication
- Performance downgrade
- Main concept:
  - A transaction is written on >=1 standby servers before COMMIT
- Priority ordered list of servers
  - Identified by their `application_name`
  - `synchronous_standby_names = '*'`
  - `synchronous_standby_names = 'slave1, slave2, slave3'`
- Can be controlled at several levels:
  - Transaction, session, user, database, server
  - `SET synchronous_commit TO off;`

# Example of transaction control

- **SET synchronous_commit TO off;**
- BEGIN;   -- *I could not care less*
- INSERT INTO bands ('*Take that*');
- INSERT INTO bands ('*Black Eyed Peas*');
- COMMIT;
- **SET synchronous_commit TO on;**
- BEGIN; -- *Extremely important!*
- INSERT INTO bands ('**AC/DC**');
- INSERT INTO bands ('**Cream**');
- COMMIT;

# Synchronous Replication



# A few improvements from 9.0

- pg_basebackup
- Improved monitoring
  - Views, including `pg_stat_replication`
- Feedback from Hot Standby servers to the master about running read-only queries
  - Prevents query cancellation (VACUUM on master)
- Allows to pause/resume replication on slaves

# Extensions before 9.1

- Extensibility has been a key feature in PostgreSQL
- With one limitation:
  - No dump/restore support
    - No special attention for their objects
  - Issues with upgrades
- pg_dump cannot distinguish extensions' object from the rest of the objects
  - Extensions, including functions, are included in the dump
  - Sometimes this can be a mess

# Extensions from now on

- pg_dump is now able to produce only this:
  - `CREATE EXTENSION IF NOT EXISTS extname`
- Programmers can define their own extensions through a control file, which specifies metadata and **contained** objects
  - Version, SQL files directory, modules path, dependencies, …
- More commands:
  - `DROP EXTENSION extname`
  - `ALTER EXTENSION extname UPDATE`
- PGXN: PostgreSQL Extension Network (pgxn.org)

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# Example of extensions: PGMP

Homepage: http://pgmp.projects.postgresql.org/

**pgmp.control file**

```
default_version = '1.0'
comment = 'Multiple Precision Arithmetic extension'
directory = 'pgmp'
relocatable = cd true
```

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# Column level collations

- Collations control how to perform character comparisions within strings
- Crucial in non English speaking countries
  - Think about Europe!
- You can now specify different collations inside the same table, at **column level**

```
CREATE TABLE collate_example (
        c_text TEXT COLLATE ucs_basic,
        en_text TEXT COLLATE "en_EN.utf8",
        it_text TEXT COLLATE "it_IT.utf8"
);
```

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# Example of collations

- SELECT it_text FROM collate_example **ORDER BY c_text;**

a<br>
e<br>
i<br>
à<br>
é<br>
…

- SELECT it_text FROM collate_example **ORDER BY it_text;**

a<br>
à<br>
e<br>
é<br>
i<br>
…

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# Triggers on views

- `CREATE TRIGGER trigger_name INSTEAD OF event ON view_name FOR EACH ROW;`
- Events:
  - INSERT
  - UPDATE
  - DELETE
- Allows views to be **UPDATEABLE**

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# Unlogged tables

- `CREATE UNLOGGED TABLE`
- Do not produce any WAL content
  - Not crash safe (`TRUNCATE` on recovery)
  - Their content is not replicated
    - Just the schema
- Typical use case:
  - **Caching**
  - Storage of Web temporary sessions
- Differences with temporary tables
  - They go beyond a session's lifetime
  - Global namespace and visibility

# Foreign tables

- Part of SQL/MED
  - Prior to 9.1: dblink, DBI-link, PL/Proxy
- Foreign data wrapper API (FDW)
- `CREATE FOREIGN TABLE`
- Currently only one example as contrib
  - file_dw (foreign data wrapper for reading CSV files)
  - Exposes a CSV as a FOREIGN TABLE in the database
  - Supports only SELECT
  - Mainly a test case to show the potential of the API
- It will be improved from 9.2

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# Writeable Common Table Expressions

- Improvement to WITH queries introduced in 8.4
- Support for write queries within the WITH clause

```
WITH d AS (
   DELETE * FROM log WHERE logday = '2011-06-01'
       RETURNING *
)
INSERT INTO old_log SELECT * FROM d;
```

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# Other important changes

- Serialisable Isolation Level
  - Great feature (too complex to talk about it now!)
- Optimization of queries that use ORDER BY, LIMIT, or MIN/MAX with inherited tables
- K-Nearest Neighbour GIST
- Standard conforming strings
  - By default: \' (escaping) throws an error (use '')
- `format()` (for sprintf lovers!)
- SE-Linux Integration for PostgreSQL
- … and more
  - For a full list of changes, see the Release Notes

# Conclusions

- PostgreSQL allows a database to be:
  - Fast
  - Consistent
  - Reliable
  - Secure
  - Integrable
  - Available
  - Recoverable
- …

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# … and reduces the costs

- No license fee
- Simple license model
  - No dual licensing headaches
- Reduces the total cost of ownership (TCO) for a database solution
- Invest in knowledge
- Removes any vendor lock-in / monopolisation
- Largest community for an open-source database management system project

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# Let's make the Elephant happy!

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# Questions?

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# Thank you

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- See you next year!

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