IEEE Postgres Keynote: Battling the NoSQL Hype Cycle and Obtaining Academic Assistance

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This talk explores how new NoSQL technologies are unique, and how existing relational database systems like Postgres are adapting to handle NoSQL workloads.

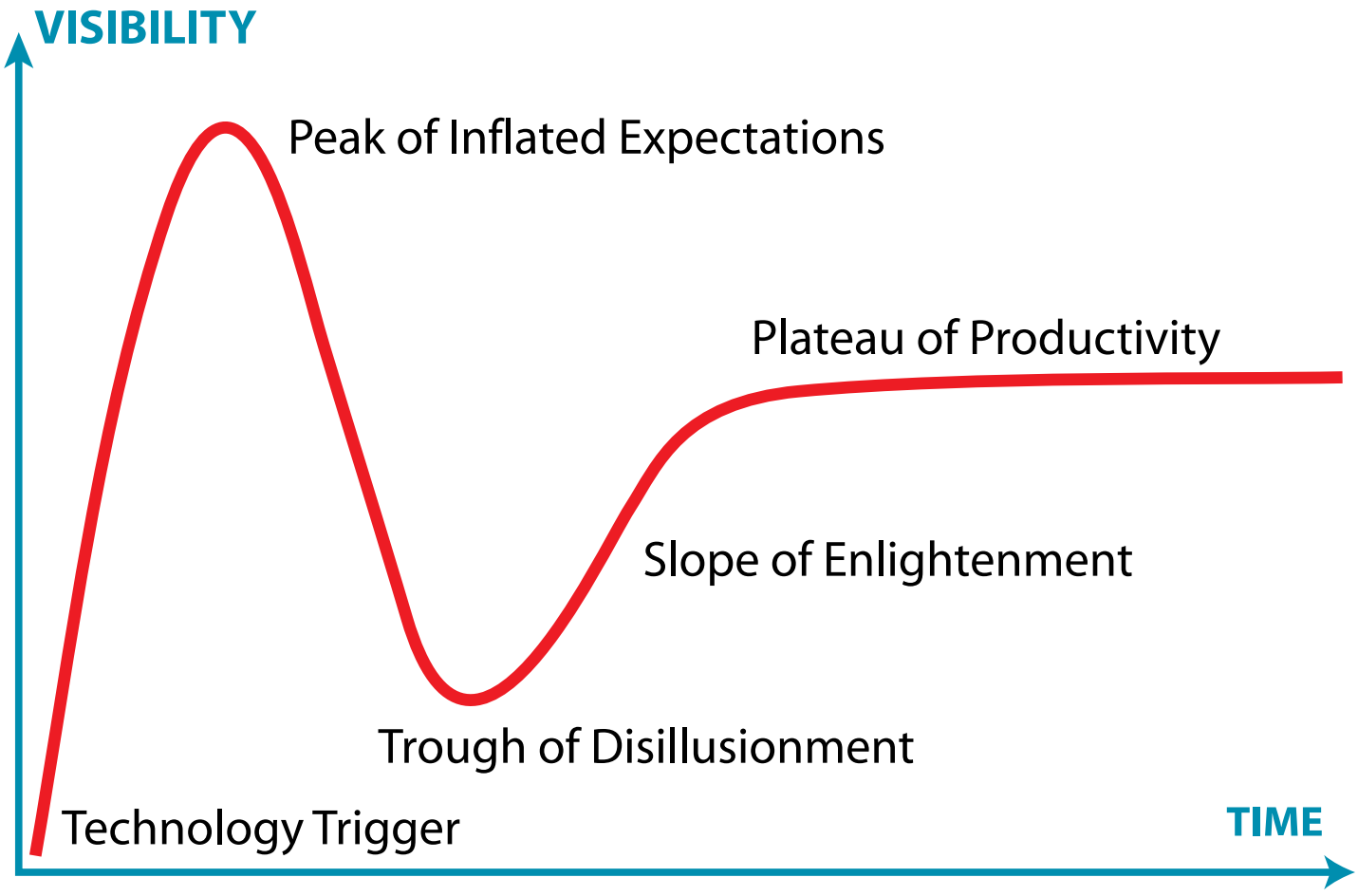
 http://momjian.us/presentations

Last updated: May, 2016

Outline

1. Hype Cycle
2. History of relational challenges
3. NoSQL goals
4. Postgres adaptations
5. Postgres history
6. How you can help

1. Hype Cycle



http://en.wikipedia.org/wiki/Hype_cycle

2. History of Relational Challenges

- Object databases
- XML databases

3. NoSQL Goals

There is no single NoSQL technology. They all take different approaches and have different features and drawbacks:

- Key-value stores, e.g. Redis
- Document databases, e.g. MongoDB (JSON)
- Columnar stores: Cassandra
- Graph databases: Neo4j

These are mostly aggregate-oriented — see Martin Fowler's video at https://www.youtube.com/watch?v=qI_g07C_Q5I.

Why NoSQL Exists

Generally, NoSQL is optimized for:

- Fast simple queries
- Auto-sharding
- Flexible schemas

NoSQL Sacrifices

- A powerful query language
- A sophisticated query optimizer
- Data normalization
- Joins
- Referential integrity
- Durability

Are These Drawbacks Worth the Cost?

- **Difficult Reporting** Data must be brought to the client for analysis, e.g. no aggregates or data analysis functions. Schema-less data requires complex client-side knowledge for processing
- **Complex Application Design** Without powerful query language and query optimizer, the client software is responsible for efficiently accessing data and for data consistency
- **Durability** Administrators are responsible for data retention

When Should NoSQL Be Used?

- Massive write scaling is required, more than a single server can provide
- Only simple data access pattern is required
- Additional resource allocation for development is acceptable
- Strong data retention or transactional guarantees are not required
- Unstructured duplicate data that greatly benefits from column compression

When Should Relational Storage Be Used?

- Easy administration
- Variable workloads and reporting
- Simplified application development
- Strong data retention

Postgres Adaptations

Postgres has many NoSQL features without the drawbacks:

- Schema-less data types, with sophisticated indexing support
- Transactional schema changes with rapid addition and removal of columns
- Durability by default, but controllable per-table or per-transaction

Schema-Less Data: JSON and JSONB

```
CREATE TABLE customer (id SERIAL, data JSONB);

INSERT INTO customer VALUES (DEFAULT, '{"name" : "Bill", "age" : 21}');

SELECT data->>'name' FROM customer
WHERE data->>'age' = '21';
 ?column?
----------
 Bill

-- this lookup is indexable
SELECT data->>'name' FROM customer
WHERE data @> '{"age" : 21}'::jsonb;
 ?column?
----------
 Bill
```

Incremental JSON Improvements

- 9.2 (2012): JSON data type (syntax checking)
- 9.3 (2013): JSON extraction and conversion functions
- 9.4 (2014): JSONB (binary JSON) and GIN index improvements
- 9.5 (2016): JSONB generation and manipulation functions

JSONB matches or beats MongoDB in performance and storage size, except for update operations, which are slower.

Easy Relational Schema Changes

```
ALTER TABLE customer ADD COLUMN status CHAR(1);
BEGIN WORK;
ALTER TABLE customer ADD COLUMN debt_limit NUMERIC(10,2);
ALTER TABLE customer ADD COLUMN creation_date TIMESTAMP WITH TIME ZONE;
ALTER TABLE customer RENAME TO cust;
COMMIT;
```

NoSQL Access via Foreign Data Wrappers

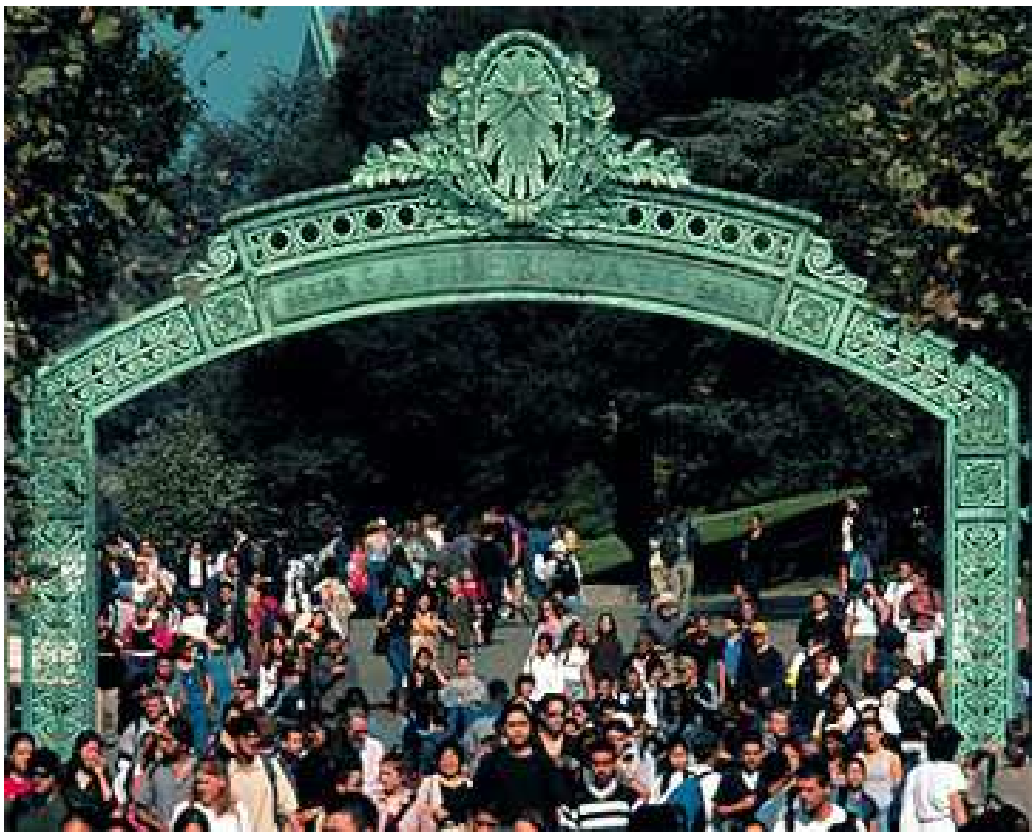
Foreign data wrappers (SQL MED) allow queries to read and write data to foreign data sources. Foreign database support includes:

- Cassandra (columnar)
- CouchDB (document)
- MongoDB (document)
- Neo4j (graph)
- Redis (key-value)

The transfer of aggregates and sorts to foreign servers is not yet implemented. Join transfer is implemented in Postgres 9.6.

http://www.postgresql.org/docs/current/static/ddl-foreign-data.html
http://wiki.postgresql.org/wiki/Foreign_data_wrappers

5. Postgres History
The University of California at Berkeley



Postgres

Michael Stonebraker

Postgres95

Jolly Chen and Andrew Yu

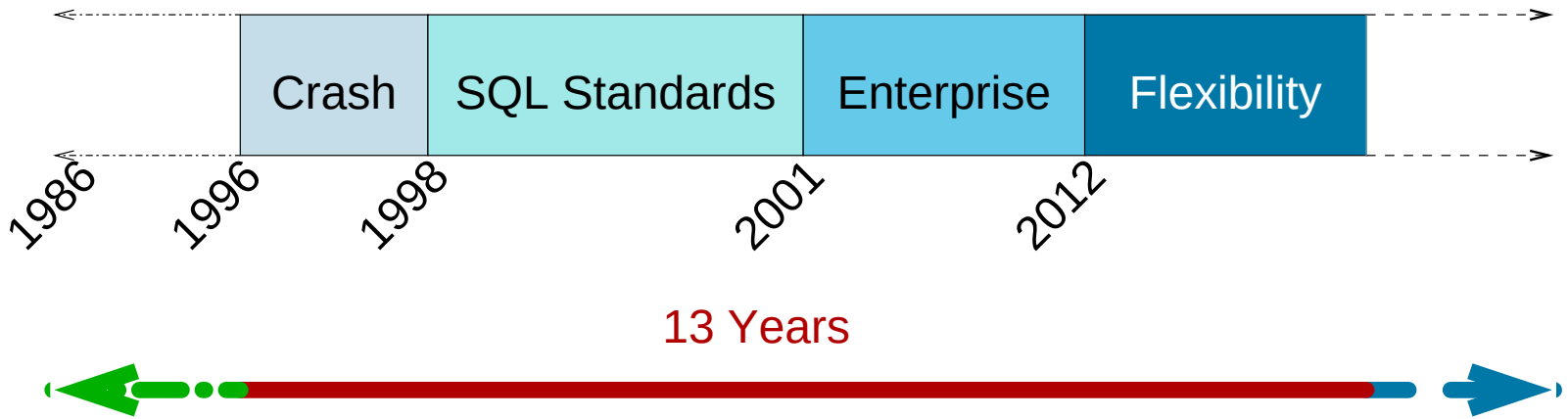
PostgreSQL Code Base History

- Ingres — research prototype, spawned Relational Technologies, purchased by Computer Associates
- Postgres — research prototype, spawned Illustra, purchased by Informix
- Postgres95 — added SQL, spawned PostgreSQL

PostgreSQL Through the Years

1977-1985	Ingres
1986-1994	Postgres
1994-1995	Postgres95
1996-	PostgreSQL

PostgreSQL Evolution



6. How You Can Help

- Query optimization
- Optimizer statistics
- Indexing structures
- Sorting
- Parallelism
- Sharding
- Distributed transactions and snapshots
- Machine learning
- Incremental maintenance of materialized views
- Automated substitution of materialized views in queries
- Performance under very heavy loads
- Non-relational/Json/NoSQL performance

Hardware Issues

- CPU locality
- Reducing function call overhead
- High CPU core performance
- NUMA
- Large RAM performance
- Persistent memory (NVRAM,PCM)
- SSD performance

Tips to Being Effective

- Use the most recent version of PostgreSQL
- Publish source code in a permanent location
- Supply a commit log showing all your changes
- Publish the data used for testing, or data generator code
- Copyright your changes under a Postgres-compatible license

Conclusion

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