JSON Support in MySQL

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Safe Harbor Statement

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Program Agenda

1. Introduction
2. JSON datatype
3. Functions to handle JSON data
4. Indexing of JSON data
5. Examples
6. Performance
Why JSON support in MySQL?

• Convenient object serialization format
• Need to effectively process JSON data
• Provide native support for JavaScript applications
• Seemless integration of relational and schema-less data
• Leverage existing database infrastructure for new applications
Storage Options

• Text
  – Fast to insert
  – Human-readable
  – Requires validation
  – Requires parsing
  – Hard to update

• Binary
  – Validate only once
  – Fast access
  – In-place updates
  – Slower to insert
  – Unreadable as-is
New JSON datatype

• Optimized for read intensive workload
• Parse and validation on insert only
• Dictionary
  – Sorted objects’ keys
  – Fast access to array cells by index
• In-place updates (future enhancement in SE), space reservation
• Smart size: 64K & 4G
• UTF8
New JSON datatype: Supported Types

- **ALL native JSON types**
  - Numbers, strings, bool
  - Objects, arrays

- **Extended**
  - Date, time, datetime, timestamp
  - Other
Examples: CREATE and INSERT

CREATE TABLE t1 (data JSON);
INSERT INTO t1(data) VALUES

('{} "series": 1"'), ('{} "series": 7"'), ('{} "series": 3"'),
('{} "series": 4"'), ('{} "series": 10"'), ('{} "series": 2"'),
('{} "series": 6"'), ('{} "series": 5"'), ('{} "series": 8"'),
('{} "series": 11"');
Examples: more on INSERT

INSERT INTO t1(data) VALUES

  ("{ "a": "valid", "json": ["text"] }"),

  (JSN_QUOTE('some, might be formatted, { text } with "quotes"'));
Examples: SELECT

```sql
> SELECT * FROM t1 LIMIT 3;
+-----------------+
| data |           |
+-----------------+
| {"series": 1} |           |
| {"series": 7} |           |
| {"series": 3} |           |
+-----------------+
```
JSON Comparator: Design Principles

- Polymorphic behavior
- Seamless and consistent comparison
  - JSON vs JSON, JSON vs SQL
  - Different data types always non-equal
  - No automatical type conversion
- Robustness
- Extensive use of caching
**JSON Comparator: example**

```sql
SELECT * FROM t1 WHERE
  jsn_extract(data, "$.series") >= 7 AND
  jsn_extract(data, "$.series") <= 10;
```

<table>
<thead>
<tr>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>{&quot;series&quot;: 7}</td>
</tr>
<tr>
<td>{&quot;series&quot;: 10}</td>
</tr>
<tr>
<td>{&quot;series&quot;: 8}</td>
</tr>
</tbody>
</table>

+-------------------+
New Functions to Handle JSON Data: Path

[[[database.]table.]column]$<path spec>

- **Path expr**
  - [ [ [database.] table.] field] $ .identifier [array] .* and [*] **

- **Example**
  - db.phonebook.data (future extension)
  - document’s root
  - $.user.address.street
  - $.user.addresses[2].street
  - $.user.addresses[*].street
  - $.user**.phone
New functions to handle JSON data: Funcs

• Info
  – JSN_VALID()
  – JSN_TYPE()
  – JSN_KEYS()
  – JSN_LENGTH()
  – JSN_DEPTH()
  – JSN_CONTAINS_PATH()

• Modify
  – JSN_REMOVE()
  – JSN_APPEND()
  – JSN_SET()
  – JSN_INSERT()
  – JSN_REPLACE()
New functions to handle JSON data: Funcs

• Create
  – JSN_MERGE()
  – JSN_ARRAY()
  – JSN_OBJECT()

• Get data
  – JSN_EXTRACT()
  – JSN_SEARCH()

• Helper
  – JSN_QUOTE()
  – JSN_UNQUOTE()
Examples: CREATE + SELECT

CREATE TABLE t2 AS

SELECT

  JSN_OBJECT("b_series",
    JSN_ARRAY(
      JSN_EXTRACT(data, ":.series")))

AS data

FROM t1;

> SELECT * FROM t2 LIMIT 3;

+---------------------------------------+  
<table>
<thead>
<tr>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>---------------------------------------</td>
</tr>
<tr>
<td>{{&quot;b_series&quot;: [1]}}</td>
</tr>
<tr>
<td>{{&quot;b_series&quot;: [7]}}</td>
</tr>
<tr>
<td>{{&quot;b_series&quot;: [3]}}</td>
</tr>
<tr>
<td>---------------------------------------</td>
</tr>
</tbody>
</table>
Examples: UPDATE + join

UPDATE t1, t2

SET t1.data=

    JSN_INSERT(t1.data,"$.inverted",

        11 – JSN_EXTRACT(t2.data,"$.b_series[0]"))

WHERE

    JSN_EXTRACT(t1.data, "$.series") =
    JSN_EXTRACT(t2.data,"$.b_series[0]");
Examples: result of UPDATE

> SELECT * FROM t1 LIMIT 3;

+----------------------------------------------------------+
| data | |
+----------------------------------------------------------+
| {"series": 1, "inverted": 10} | |
| {"series": 7, "inverted": 4} | |
| {"series": 3, "inverted": 8} | |
+----------------------------------------------------------+
Examples: a subquery

```
SELECT * FROM t1
WHERE JSN_EXTRACT(data,"$.series") IN
  (  
    SELECT JSN_EXTRACT(data,"$.inverted")
    FROM t1
    WHERE JSN_EXTRACT(data,"$.inverted")<4
  );
```

<table>
<thead>
<tr>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>+---------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>+-------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

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Indexing JSON data

• Use Functional Indexes, Luke 😊
• STORED and VIRTUAL types are supported

CREATE TABLE t1
  (data JSON, id INT AS (JSN_EXTRACT(data,"$.id")) STORED,
   PRIMARY KEY(id));
ALTER TABLE t1
  ADD COLUMN id INT AS (JSN_EXTRACT(data, "$.series")),
  ADD INDEX id_idx (id);
Indexing JSON data: STORED vs VIRTUAL

• STORED
  – Primary & secondary
  – BTREE, FTS, GIS
  – Mixed with fields
  – Req. table rebuild
  – Not online

• VIRTUAL
  – Secondary only
  – BTREE only
  – Mix with virtual column only
  – No table rebuild
  – Instant ALTER (Coming soon!)
  – Faster INSERT
Indexing JSON data: an example

SELECT data FROM t1 WHERE
  - JSN_EXTRACT(data,"$.series") BETWEEN 3 AND 5;
  - id BETWEEN 3 AND 5;

<table>
<thead>
<tr>
<th>data</th>
<th>id</th>
</tr>
</thead>
<tbody>
<tr>
<td>{&quot;series&quot;: 3, &quot;inverted&quot;: 8}</td>
<td>3</td>
</tr>
<tr>
<td>{&quot;series&quot;: 4, &quot;inverted&quot;: 7}</td>
<td>4</td>
</tr>
<tr>
<td>{&quot;series&quot;: 5, &quot;inverted&quot;: 6}</td>
<td>5</td>
</tr>
</tbody>
</table>
Indexing JSON data: an example

> EXPLAIN SELECT data FROM t1 WHERE JSN_EXTRACT(data,"$.series") BETWEEN 3 AND 5;

<table>
<thead>
<tr>
<th>id</th>
<th>select_type</th>
<th>table</th>
<th>partitions</th>
<th>type</th>
<th>Extra</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SIMPLE</td>
<td>t1</td>
<td>NULL</td>
<td>range</td>
<td>Using index condition</td>
</tr>
</tbody>
</table>

select `test`.`t1`.`data` AS `data` from `test`.`t1`
where (`test`.`t1`.`id` between 3 and 5)
Comparison to Facebook’s solution

• Path expr
  – Glob ops
  – Deterministic name resolution
  – JSON manipulation functions

• More generic indexes
  – Primary keys
  – Virtual secondary keys
  – Any MySQL data type

• More versatile comparator
• Different format
  – In-place updates
  – Faster lookups
Roadmap

• Online alter for virtual columns
• Advanced JSON functions
• In-place update of JSON/BLOB
• Full text and GIS index on virtual columns
• Improved performance through condition pushdown
Questions?
Thank You!