

## Introduction

**wal2json** is an output plugin for logical decoding. It means that the plugin have access to tuples produced by INSERT and UPDATE. Also, UPDATE/DELETE old row versions can be accessed depending on the configured replica identity. Changes can be consumed using the streaming protocol (logical replication slots) or by a special SQL API.

**format version 1** produces a JSON object per transaction. All of the new/old tuples are available in the JSON object. Also, there are options to include properties such as transaction timestamp, schema-qualified, data types, and transaction ids.

**format version 2** produces a JSON object per tuple. Optional JSON object for beginning and end of transaction. Also, there are a variety of options to include properties.

## Requirements

- PostgreSQL 9.4+

## Build and Install

This extension is supported on [those platforms](#) that PostgreSQL is. The installation steps depend on your operating system.

You can also keep up with the latest fixes and features cloning the Git repository.

```
$ git clone https://github.com/eulerto/wal2json.git
```

## Unix based Operating Systems

Before use this extension, you should build it and load it at the desirable database.

```
$ git clone https://github.com/eulerto/wal2json.git
$ cd wal2json
# Make sure your path includes the bin directory that contains the correct 'pg_config'
$ PATH=/path/to/pg/bin:$PATH
$ USE_PGXS=1 make
$ USE_PGXS=1 make install
```

## Windows

There are several ways to build **wal2json** on Windows. If you are build PostgreSQL too, you can put **wal2json** directory inside contrib, change the contrib Makefile (variable SUBDIRS) and build it following the [Installation from Source Code on Windows](#) instructions. However, if you already have PostgreSQL installed, it is also possible to compile **wal2json** out of the tree. Edit `wal2json.vcxproj` file and change `c:\postgres\pg103` to the PostgreSQL prefix directory. The next step is to open this project file in MS Visual Studio and compile it. Final step is to copy `wal2json.dll` to the `pg_config --pkglibdir` directory.

## Configuration

### postgresql.conf

You need to set up at least two parameters at `postgresql.conf`:

```
wal_level = logical
max_replication_slots = 10
```

After changing these parameters, a restart is needed.

By default, PostgreSQL 10 or later doesn't need to adjust parameters.

### Parameters

- `include-xids`: add *xid* to each changeset. Default is *false*.
- `include-timestamp`: add *timestamp* to each changeset. Default is *false*.
- `include-schemas`: add *schema* to each change. Default is *true*.
- `include-types`: add *type* to each change. Default is *true*.
- `include-typmod`: add modifier to types that have it (eg. `varchar(20)` instead of `varchar`). Default is *true*.
- `include-type-oids`: add type oids. Default is *false*.
- `include-not-null`: add *not null* information as *columnoptionals*. Default is *false*.
- `pretty-print`: add spaces and indentation to JSON structures. Default is *false*.
- `write-in-chunks`: write after every change instead of every changeset. Default is *false*.
- `include-lsn`: add *nextlsn* to each changeset. Default is *false*.

- **include-unchanged-toast** (deprecated): add TOAST value even if it was not modified. Since TOAST values are usually large, this option could save IO and bandwidth if it is disabled. Default is *true*.
- **filter-tables**: exclude rows from the specified tables. Default is empty which means that no table will be filtered. It is a comma separated value. The tables should be schema-qualified. `*.foo` means table `foo` in all schemas and `bar.*` means all tables in schema `bar`. Special characters (space, single quote, comma, period, asterisk) must be escaped with backslash. Schema and table are case-sensitive. Table `"public"."Foo bar"` should be specified as `public.Foo\ bar`.
- **add-tables**: include only rows from the specified tables. Default is all tables from all schemas. It has the same rules from **filter-tables**.
- **filter-msg-prefixes**: exclude messages if prefix is in the list. Default is empty which means that no message will be filtered. It is a comma separated value.
- **add-msg-prefixes**: include only messages if prefix is in the list. Default is all prefixes. It is a comma separated value. `wal2json` applies **filter-msg-prefixes** before this parameter.
- **format-version**: defines which format to use. Default is *1*.
- **actions**: define which operations will be sent. Default is all actions (insert, update, delete, and truncate). However, if you are using **format-version** *1*, truncate is not enabled (backward compatibility).

## Examples

There are two ways to obtain the changes (JSON objects) from **wal2json** plugin: calling functions via SQL or `pg_recvlogical`.

### `pg_recvlogical`

Besides the configuration above, it is necessary to configure a replication connection to use `pg_recvlogical`. A logical replication connection in version 9.4, 9.5, and 9.6 requires **replication** keyword in the database column. Since version 10, logical replication matches a normal entry with a database name or keywords such as **all**.

First, add a replication connection rule at `pg_hba.conf` (9.4, 9.5, and 9.6):

```
local    replication    myuser                                trust
```

If you are using version 10 or later:

```
local    mydatabase     myuser                                trust
```

Also, set `max_wal_senders` at `postgresql.conf`:

```
max_wal_senders = 1
```

A restart is necessary if you changed `max_wal_senders`.

You are ready to try **wal2json**. In one terminal:

```
$ pg_recvlogical -d postgres --slot test_slot --create-slot -P wal2json
$ pg_recvlogical -d postgres --slot test_slot --start -o pretty-print=1 -f -
```

In another terminal:

```
$ cat /tmp/example1.sql
CREATE TABLE table_with_pk (a SERIAL, b VARCHAR(30), c TIMESTAMP NOT NULL, PRIMARY KEY(a, c));
CREATE TABLE table_without_pk (a SERIAL, b NUMERIC(5,2), c TEXT);

BEGIN;
INSERT INTO table_with_pk (b, c) VALUES('Backup and Restore', now());
INSERT INTO table_with_pk (b, c) VALUES('Tuning', now());
INSERT INTO table_with_pk (b, c) VALUES('Replication', now());
DELETE FROM table_with_pk WHERE a < 3;

INSERT INTO table_without_pk (b, c) VALUES(2.34, 'Tapir');
-- it is not added to stream because there isn't a pk or a replica identity
UPDATE table_without_pk SET c = 'Anta' WHERE c = 'Tapir';
COMMIT;

$ psql -At -f /tmp/example1.sql postgres
CREATE TABLE
CREATE TABLE
BEGIN
INSERT 0 1
INSERT 0 1
INSERT 0 1
DELETE 2
INSERT 0 1
UPDATE 1
COMMIT
```

The output in the first terminal is:

```
{
  "change": [
```

```

]
}
{
  "change": [
  ]
}
WARNING: table "table_without_pk" without primary key or replica identity is nothing
{
  "change": [
    {
      "kind": "insert",
      "schema": "public",
      "table": "table_with_pk",
      "columnnames": ["a", "b", "c"],
      "columnvalues": [1, "Backup and Restore", "2018-03-27 11:58:28.988414"]
    },
    {
      "kind": "insert",
      "schema": "public",
      "table": "table_with_pk",
      "columnnames": ["a", "b", "c"],
      "columnvalues": [2, "Tuning", "2018-03-27 11:58:28.988414"]
    },
    {
      "kind": "insert",
      "schema": "public",
      "table": "table_with_pk",
      "columnnames": ["a", "b", "c"],
      "columnvalues": [3, "Replication", "2018-03-27 11:58:28.988414"]
    },
    {
      "kind": "delete",
      "schema": "public",
      "table": "table_with_pk",
      "oldkeys": {
        "keynames": ["a", "c"],
        "keytypes": ["integer", "timestamp without time zone"],
        "keyvalues": [1, "2018-03-27 11:58:28.988414"]
      }
    },
    {
      "kind": "delete",
      "schema": "public",

```

```

        "table": "table_with_pk",
        "oldkeys": {
            "keynames": ["a", "c"],
            "keytypes": ["integer", "timestamp without time zone"],
            "keyvalues": [2, "2018-03-27 11:58:28.988414"]
        }
    }, {
        "kind": "insert",
        "schema": "public",
        "table": "table_without_pk",
        "columnnames": ["a", "b", "c"],
        "columntypes": ["integer", "numeric(5,2)", "text"],
        "columnvalues": [1, 2.34, "Tapir"]
    }
]
}

```

Dropping the slot in the first terminal:

```

Ctrl+C
$ pg_recvlogical -d postgres --slot test_slot --drop-slot

```

## SQL functions

```

$ cat /tmp/example2.sql
CREATE TABLE table2_with_pk (a SERIAL, b VARCHAR(30), c TIMESTAMP NOT NULL, PRIMARY KEY(a, c));
CREATE TABLE table2_without_pk (a SERIAL, b NUMERIC(5,2), c TEXT);

SELECT 'init' FROM pg_create_logical_replication_slot('test_slot', 'wal2json');

BEGIN;
INSERT INTO table2_with_pk (b, c) VALUES('Backup and Restore', now());
INSERT INTO table2_with_pk (b, c) VALUES('Tuning', now());
INSERT INTO table2_with_pk (b, c) VALUES('Replication', now());
DELETE FROM table2_with_pk WHERE a < 3;

INSERT INTO table2_without_pk (b, c) VALUES(2.34, 'Tapir');
-- it is not added to stream because there isn't a pk or a replica identity
UPDATE table2_without_pk SET c = 'Anta' WHERE c = 'Tapir';
COMMIT;

SELECT data FROM pg_logical_slot_get_changes('test_slot', NULL, NULL, 'pretty-print', '1');
SELECT 'stop' FROM pg_drop_replication_slot('test_slot');

```

The script above produces the output below:

```
$ psql -At -f /tmp/example2.sql postgres
CREATE TABLE
CREATE TABLE
init
BEGIN
INSERT 0 1
INSERT 0 1
INSERT 0 1
DELETE 2
INSERT 0 1
UPDATE 1
COMMIT
psql:/tmp/example2.sql:17: WARNING:  table "table2_without_pk" without primary key or replication
{
  "change": [
    {
      "kind": "insert",
      "schema": "public",
      "table": "table2_with_pk",
      "columnnames": ["a", "b", "c"],
      "columnvalues": [1, "Backup and Restore", "2018-03-27 12:05:29.914496"]
    }
  ],
  {
      "kind": "insert",
      "schema": "public",
      "table": "table2_with_pk",
      "columnnames": ["a", "b", "c"],
      "columnvalues": [2, "Tuning", "2018-03-27 12:05:29.914496"]
    }
  ],
  {
      "kind": "insert",
      "schema": "public",
      "table": "table2_with_pk",
      "columnnames": ["a", "b", "c"],
      "columnvalues": [3, "Replication", "2018-03-27 12:05:29.914496"]
    }
  ],
  {
      "kind": "delete",
      "schema": "public",
      "table": "table2_with_pk",
      "oldkeys": {
```

```

        "keynames": ["a", "c"],
        "keytypes": ["integer", "timestamp without time zone"],
        "keyvalues": [1, "2018-03-27 12:05:29.914496"]
    }
}
,{
    "kind": "delete",
    "schema": "public",
    "table": "table2_with_pk",
    "oldkeys": {
        "keynames": ["a", "c"],
        "keytypes": ["integer", "timestamp without time zone"],
        "keyvalues": [2, "2018-03-27 12:05:29.914496"]
    }
}
,{
    "kind": "insert",
    "schema": "public",
    "table": "table2_without_pk",
    "columnnames": ["a", "b", "c"],
    "columntypes": ["integer", "numeric(5,2)", "text"],
    "columnvalues": [1, 2.34, "Tapir"]
}
]
}
stop

```

Let's repeat the same example with format-version 2:

```

$ cat /tmp/example3.sql
CREATE TABLE table2_with_pk (a SERIAL, b VARCHAR(30), c TIMESTAMP NOT NULL, PRIMARY KEY(a, c));
CREATE TABLE table2_without_pk (a SERIAL, b NUMERIC(5,2), c TEXT);

SELECT 'init' FROM pg_create_logical_replication_slot('test_slot', 'wal2json');

BEGIN;
INSERT INTO table2_with_pk (b, c) VALUES('Backup and Restore', now());
INSERT INTO table2_with_pk (b, c) VALUES('Tuning', now());
INSERT INTO table2_with_pk (b, c) VALUES('Replication', now());
DELETE FROM table2_with_pk WHERE a < 3;

INSERT INTO table2_without_pk (b, c) VALUES(2.34, 'Tapir');
-- it is not added to stream because there isn't a pk or a replica identity
UPDATE table2_without_pk SET c = 'Anta' WHERE c = 'Tapir';
COMMIT;

```



```
SELECT data FROM pg_logical_slot_get_changes('test_slot', NULL, NULL, 'format-version', '2')
SELECT 'stop' FROM pg_drop_replication_slot('test_slot');
```

The script above produces the output below:

```
$ psql -At -f /tmp/example3.sql postgres
CREATE TABLE
CREATE TABLE
init
BEGIN
INSERT 0 1
INSERT 0 1
INSERT 0 1
DELETE 2
INSERT 0 1
UPDATE 1
COMMIT
psql:/tmp/example3.sql:17: WARNING: no tuple identifier for UPDATE in table "public"."table2_with_pk"
{"action": "B"}
{"action": "I", "schema": "public", "table": "table2_with_pk", "columns": [{"name": "a", "type": "integer"}]}
{"action": "I", "schema": "public", "table": "table2_with_pk", "columns": [{"name": "a", "type": "integer"}]}
{"action": "I", "schema": "public", "table": "table2_with_pk", "columns": [{"name": "a", "type": "integer"}]}
{"action": "D", "schema": "public", "table": "table2_with_pk", "identity": [{"name": "a", "type": "integer"}]}
{"action": "D", "schema": "public", "table": "table2_with_pk", "identity": [{"name": "a", "type": "integer"}]}
{"action": "I", "schema": "public", "table": "table2_without_pk", "columns": [{"name": "a", "type": "integer"}]}
{"action": "C"}
stop
```

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