Partition and Conquer Large Data in PostgreSQL 10

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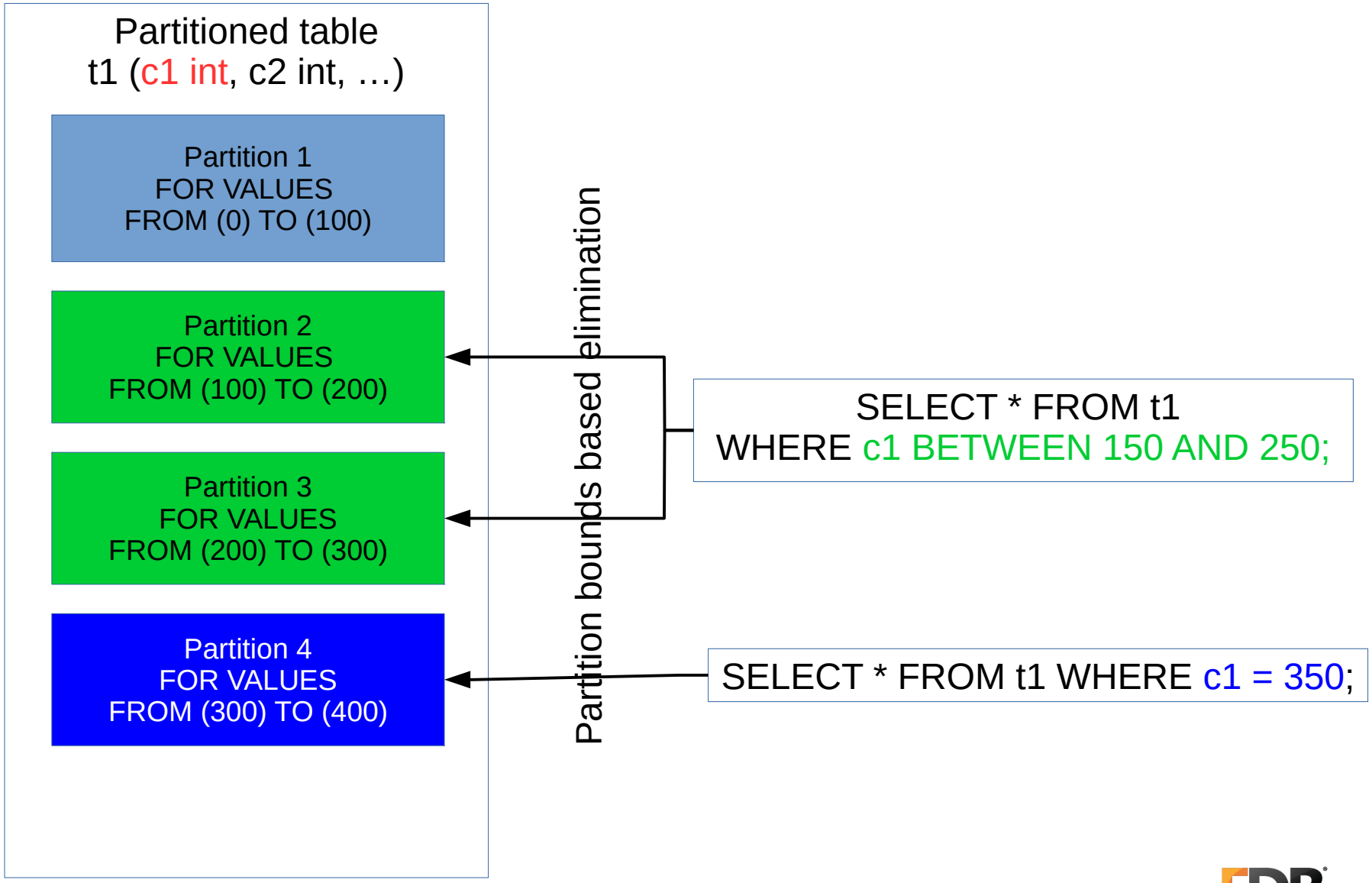
Partition-wise operations

- Partition-wise join
- Partition-wise aggregation/grouping
- Partition-wise sorting/ordering
- Partition-wise set operations?

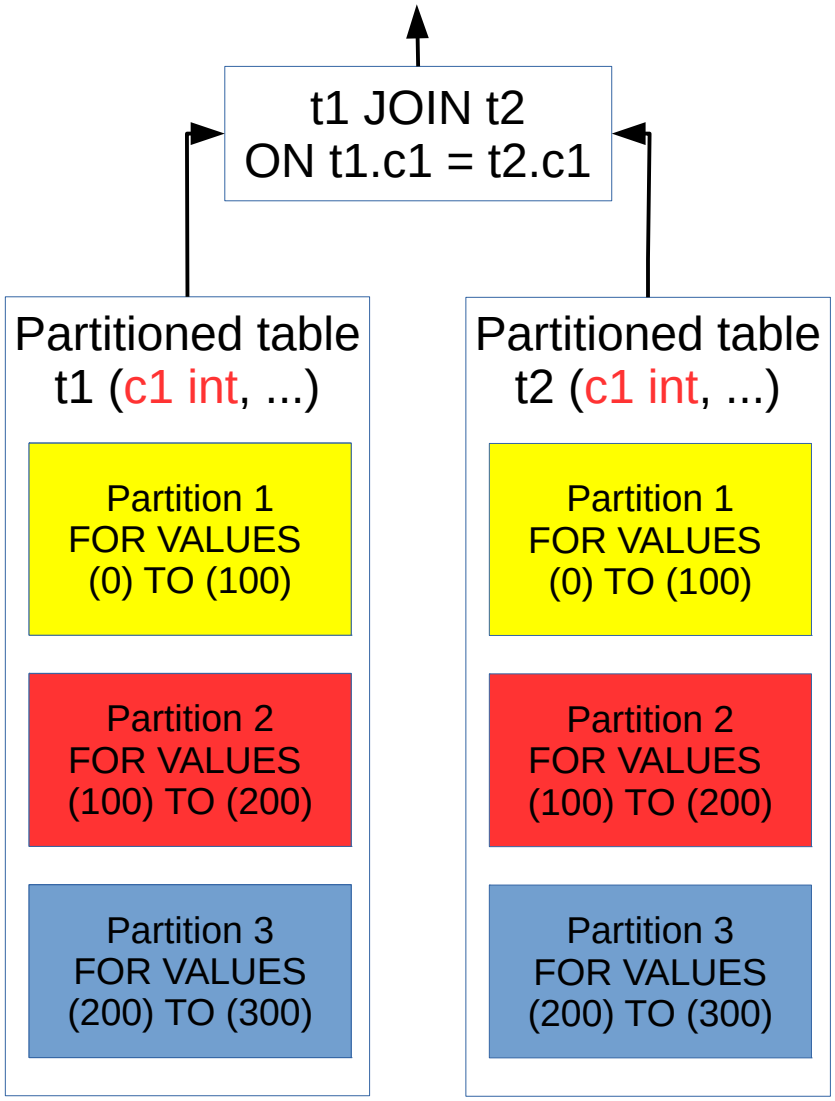
Partition-wise operations

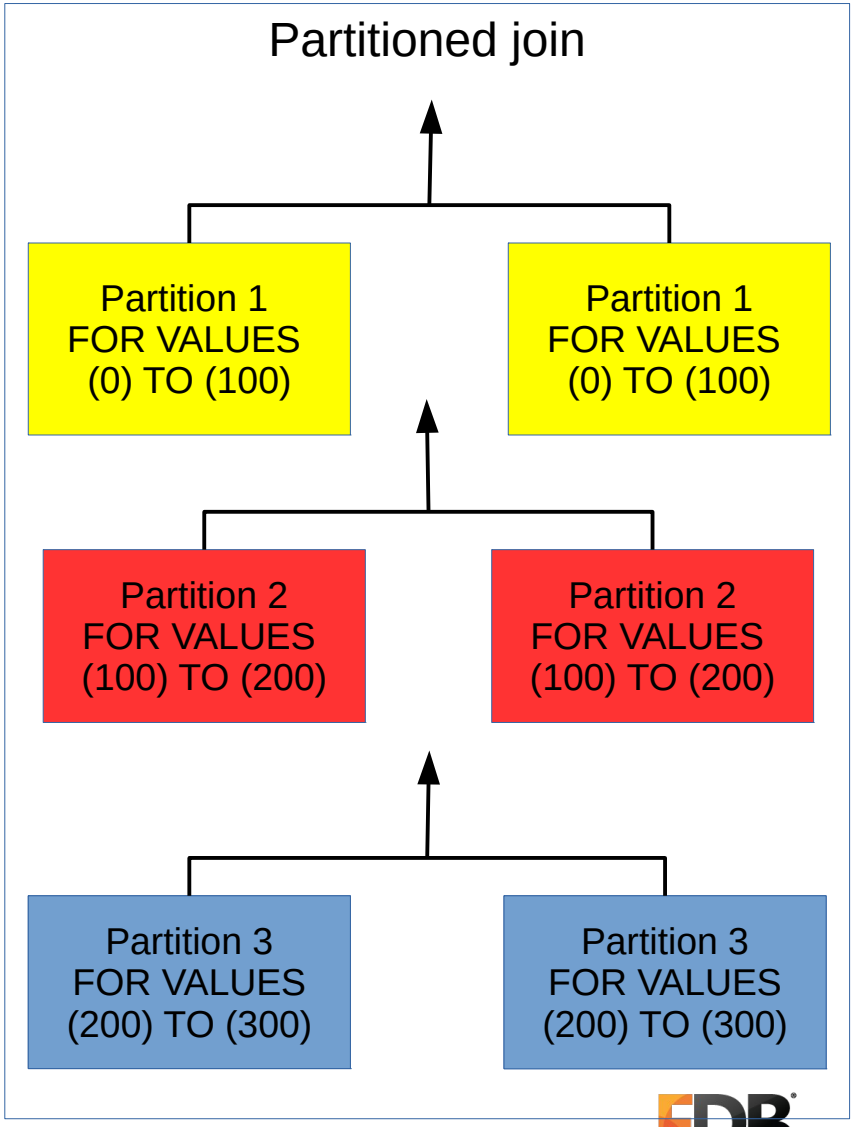
- Push operations down to partitions
- Improve performance by exploiting properties of partitions
  - Indexes, constraints on partitions
- Faster algorithms working on smaller data
- Parallel query: one worker per partition
- FDW push-down for foreign partitions
- Eliminate data from pruned partitions

Partition pruning



Partition-wise join





Partition-wise join performance

- Different join strategy for each partition-join
  - Based on properties of partitions like indexes, constraints, statistics, sizes etc.
- Cheaper strategy for smaller data instead of expensive strategy for large data
  - hash join instead of merge join
  - parameterized nested loop join instead of hash/merge join
- Each partition-join may be executed in parallel
- Partition-join pushed to the foreign server
  - Partitions being joined reside on the same foreign server

Example

```
\d+ prt1000_1
                Table "part_mem_usage.prt1000"
   Column    |       Type        | Collation | Nullable |
-------------+-------------------+-----------+----------+
 a           | integer           |           | not null |
 c           | character varying |           |          |
 a_mod_100k  | integer           |           |          |
Partition key: RANGE (a)
Partitions: prt1000_p1 FOR VALUES FROM (0) TO (1000000),
… other 1000 partitions, each partition has 1M rows

\d+ prt1000_1_p1
                Table "part_mem_usage.prt1000_p1"
   Column    |       Type        | Collation | Nullable |
-------------+-------------------+-----------+----------+
 a           | integer           |           | not null |
 c           | character varying |           |          |
 a_mod_100k  | integer           |           |          |
Partition of: prt1000 FOR VALUES FROM (0) TO (1000000)
Indexes:
    "iprt1000_p1_a" btree (a)
```

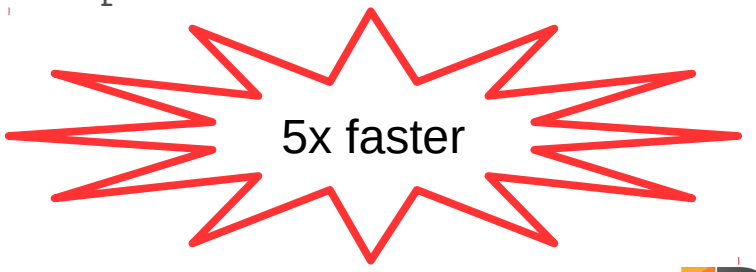
- prt1000_2 similarly partitioned

Example

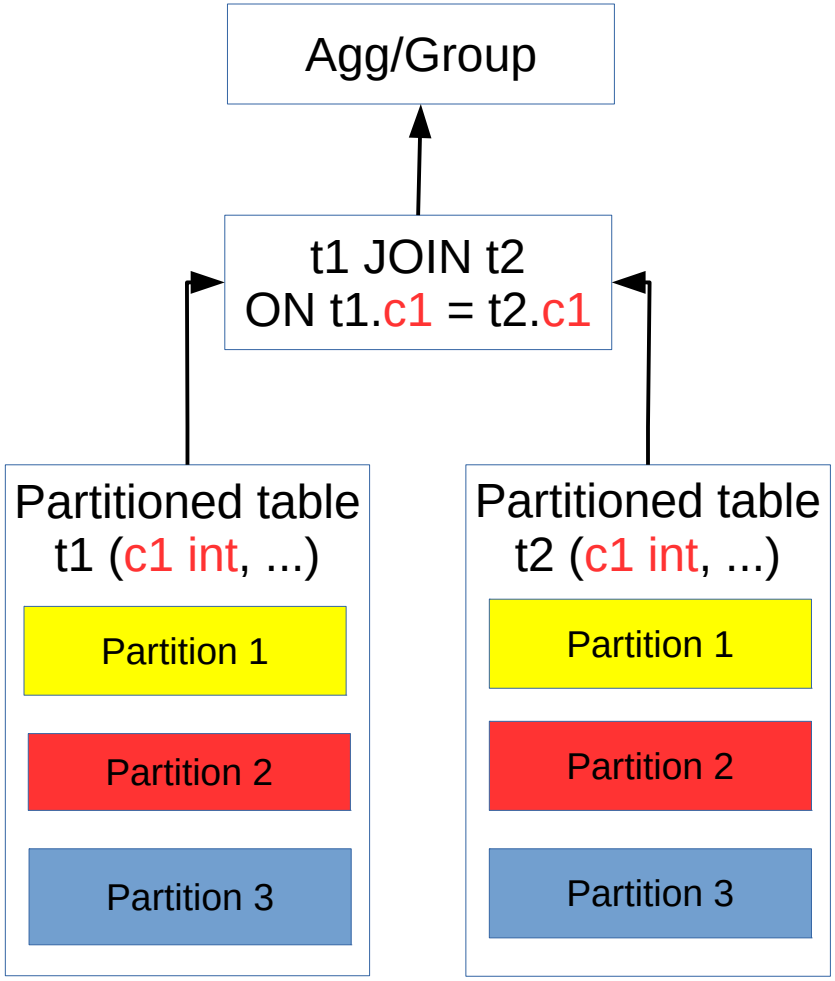
```
Query: select t1.a from prt1000_1 t1, prt1000_2 t2 where t1.a = t2.a and
t2.a_mod_100k < 200;

With enable_partition_wise_join = false

QUERY PLAN
------------------------------------------------------------------------
------------------------------------------------------------------
 Hash Join
   Hash Cond: (t1.a = t2.a)
   ->  Append
         ->  Seq Scan on prt1000_1_p1 t1_1
         … repeat 1000 times for 1000 partitions
   ->  Hash
         Buckets: 524288  Batches: 8  Memory Usage: 12861kB
         ->  Append
               ->  Seq Scan on prt1000_2_p1 t2_1
                     Filter: (a_mod_100k < 200)
                     Rows Removed by Filter: 998000
               … repeat 1000 times for 1000 partitions
 Planning time: 1652.877 ms ~ 1.6s
 Execution time: 1038588.935 ms ~ 1038s
```

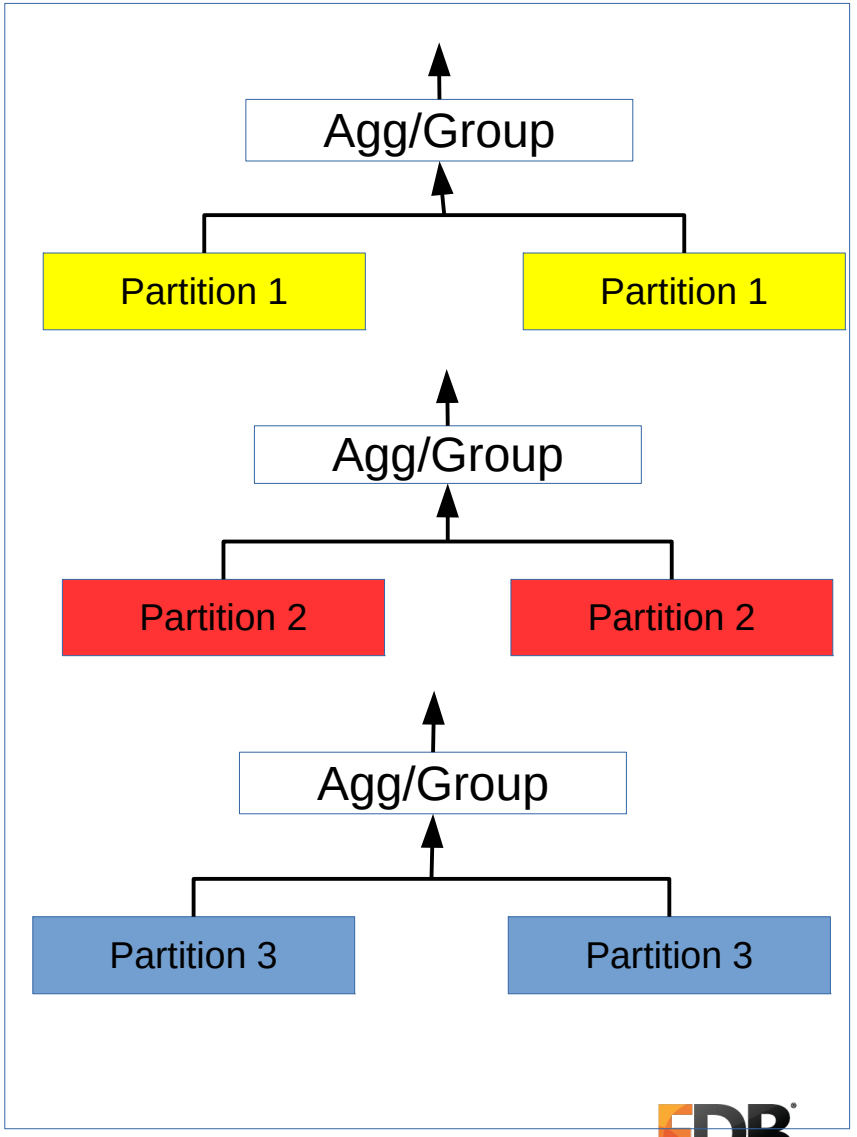
Example

```
Query: select t1.a from prt1000_1 t1, prt1000_2 t2 where t1.a = t2.a and
t2.a_mod_100k < 200;

With enable_partition_wise_join = true

QUERY PLAN

------------------------------------------------------------------------
 Append
   ->  Nested Loop
         ->  Seq Scan on prt1000_2_p1 t2
               Filter: (a_mod_100k < 200)
               Rows Removed by Filter: 998000
         ->  Index Only Scan using iprt1000_p1_a on prt1000_1_p1 t1
               Index Cond: (a = t2.a)
               Heap Fetches: 0
… repeat 1000 times for 1000 joins between partitions

 Planning time: 3047.403ms ~ 3s
 Execution time: 239987.389ms ~ 239s
```



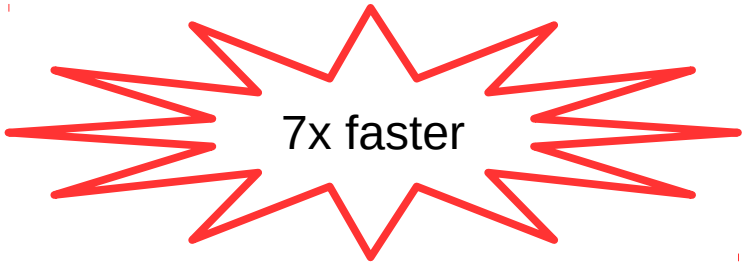
Partition-wise aggregation



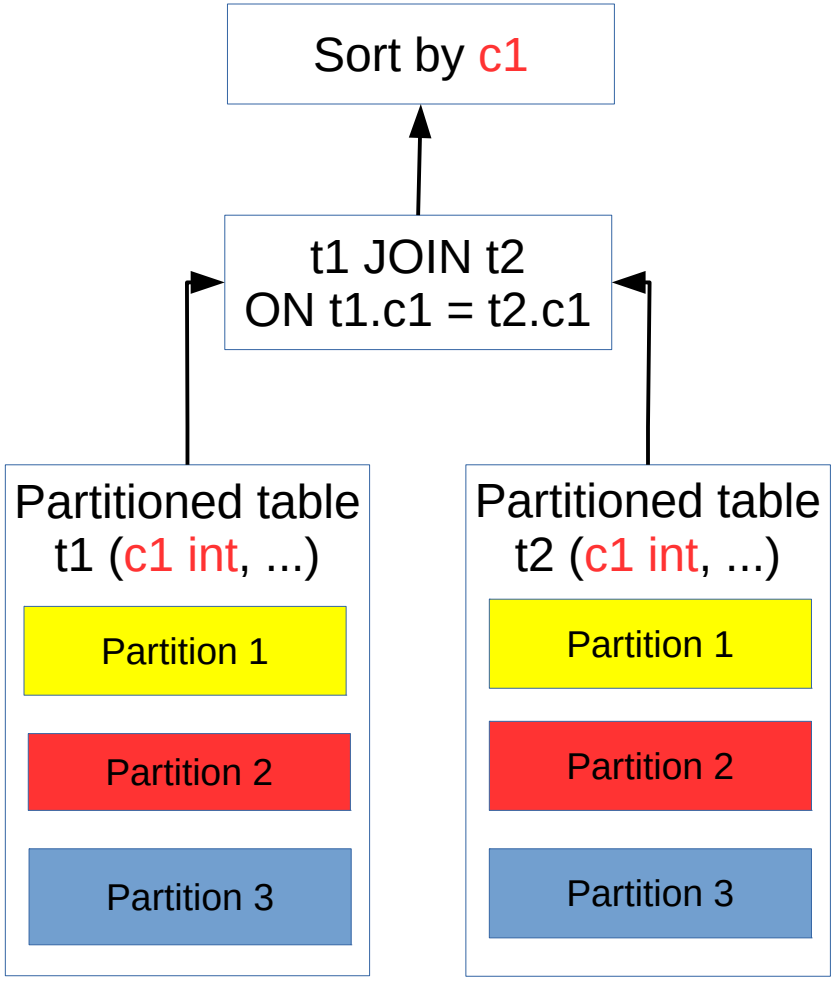


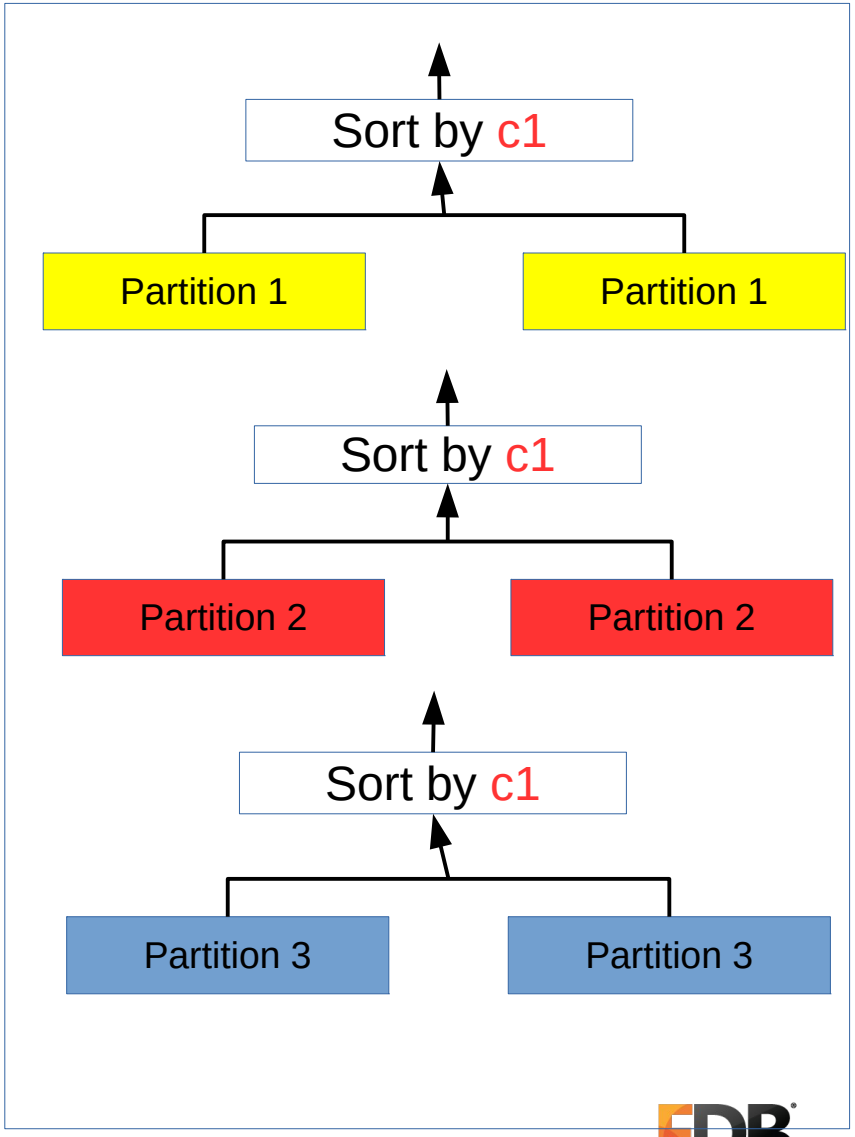
Example

```
Source: Jeevan Chalke's partition-wise aggregate proposal
Query: SELECT a, count(*) FROM plt1 GROUP BY a;
plt1: partitioned table with 3 foreign partitions, each with 1M rows

Query returns 30 rows, 10 rows per partition
enable_partition_wise_agg to false
QUERY PLAN
------------------------------------
 HashAggregate
   Group Key: plt1.a
   ->  Append
         ->  Foreign Scan on fplt1_p1
         ->  Foreign Scan on fplt1_p2
         ->  Foreign Scan on fplt1_p3
 Planning time: 0.251 ms
 Execution time: 6499.018ms ~ 6.5s

enable_partition_wise_agg to true
QUERY PLAN
-----------------------------------------------------
 Append
   ->  Foreign Scan: Aggregate on (public.fplt1_p1 plt1)
   ->  Foreign Scan: Aggregate on (public.fplt1_p2 plt1)
   ->  Foreign Scan: Aggregate on (public.fplt1_p3 plt1)
 Planning time: 0.370ms
 Execution time: 945.384ms ~ .9s
```



Partition-wise sorting






THANK YOU
grazie
merci
spasiba
kam ouen
tak
gratzias
manana
mahalo
kitos
cheers
hvala
welalin
toda
gracias
grassie
thank you
danki
mahalo
danki
gracias
merci
thanks
na gode
mesi
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modupe
talofa
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