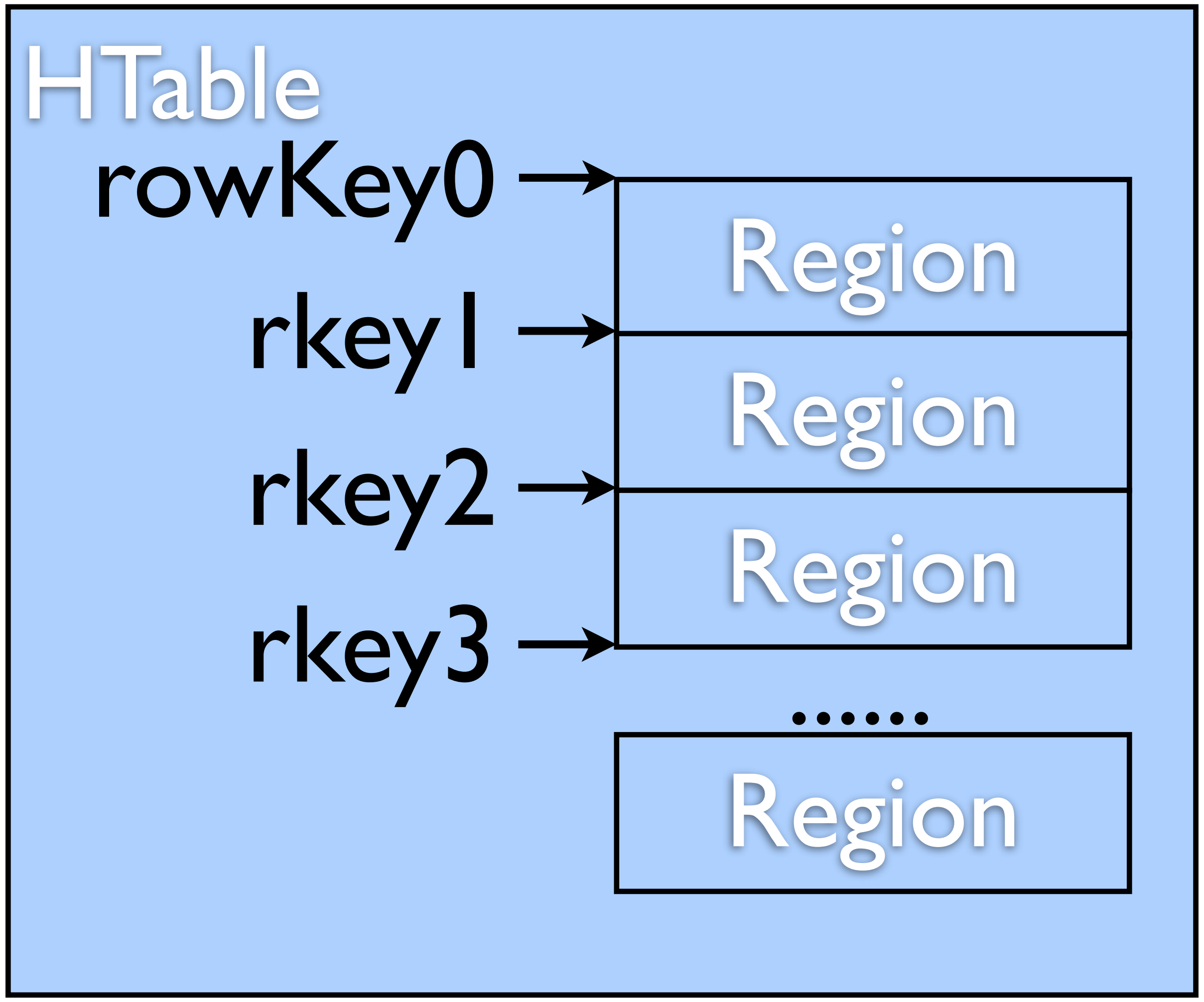
Project Mitosis

Second dimension for HBase Table: PartitionKey

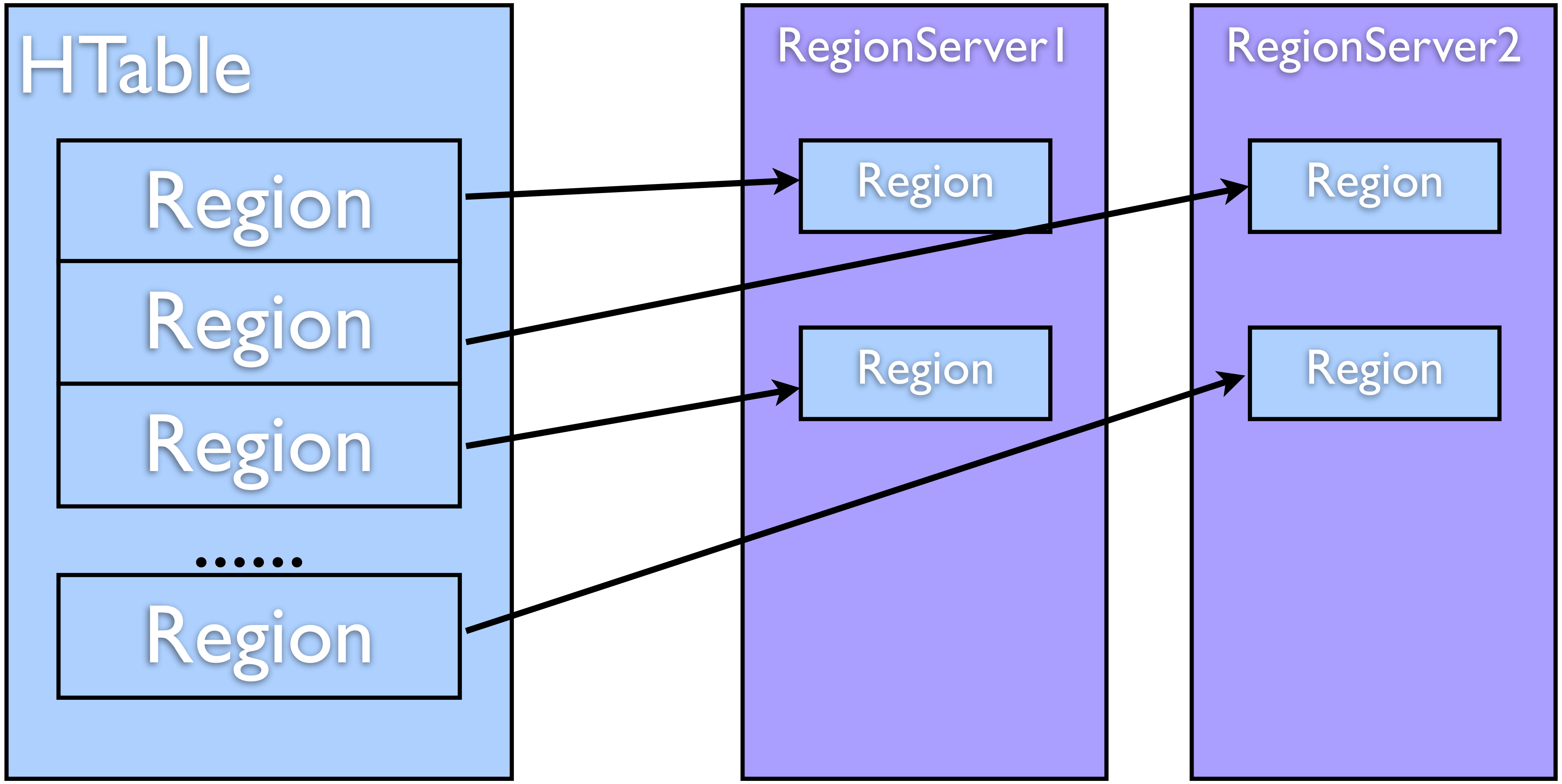
Current Region Layout

- HTable
  - ={Regions}
- Region
  - =[rkey0, rkey1)



Current Region Layout

- RegionServer
    - = *



Current Region Layout

- Benefits
  - do not worry about data distribution
    - ease of system admin
- Drawbacks
  - have no control over data distribution
    - hard to reduce query cost (join)

Current Region Layout

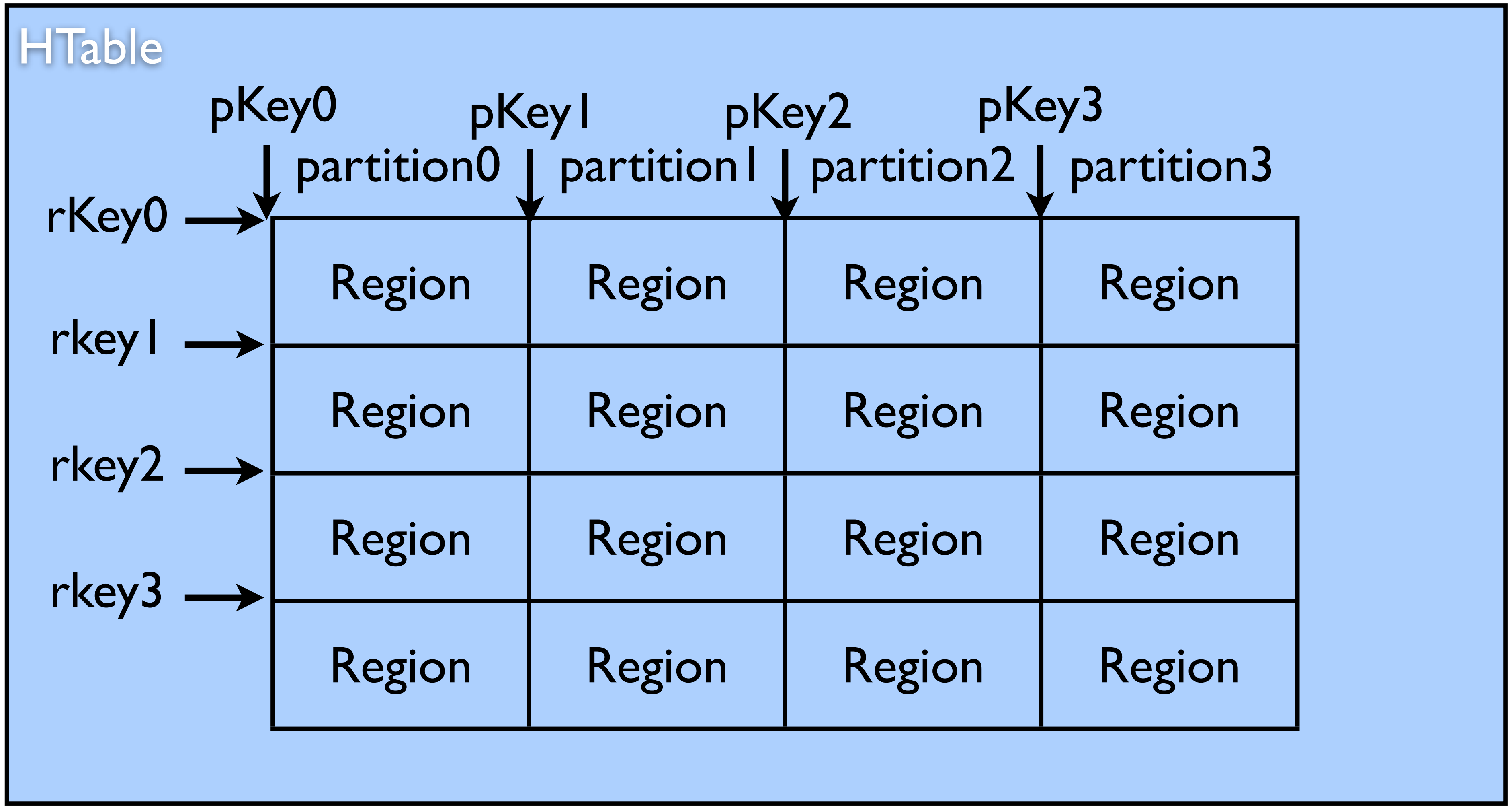
- Drawbacks because
  - rowKey is used for
    - BOTH the key of the most performant query
    - AND the key of definition of Region, thus the definition of data partitioning

Redifinition of Region

- Introduce: **PartitionKey**
  - HTable = {Regions}
  - Region = ([rKey0, rKey1), [pKey0, pKey1))
  - Partition: [pKey0, pKey1)
  - RegionServer = {Partitions}

The New Region

- 2 dimensional data space of HTable



HTable

pKey0 pKey1 pKey2 pKey3

partition0 partition1 partition2 partition3

rKey0

rkey1

rkey2

rkey3

Region Region Region Region

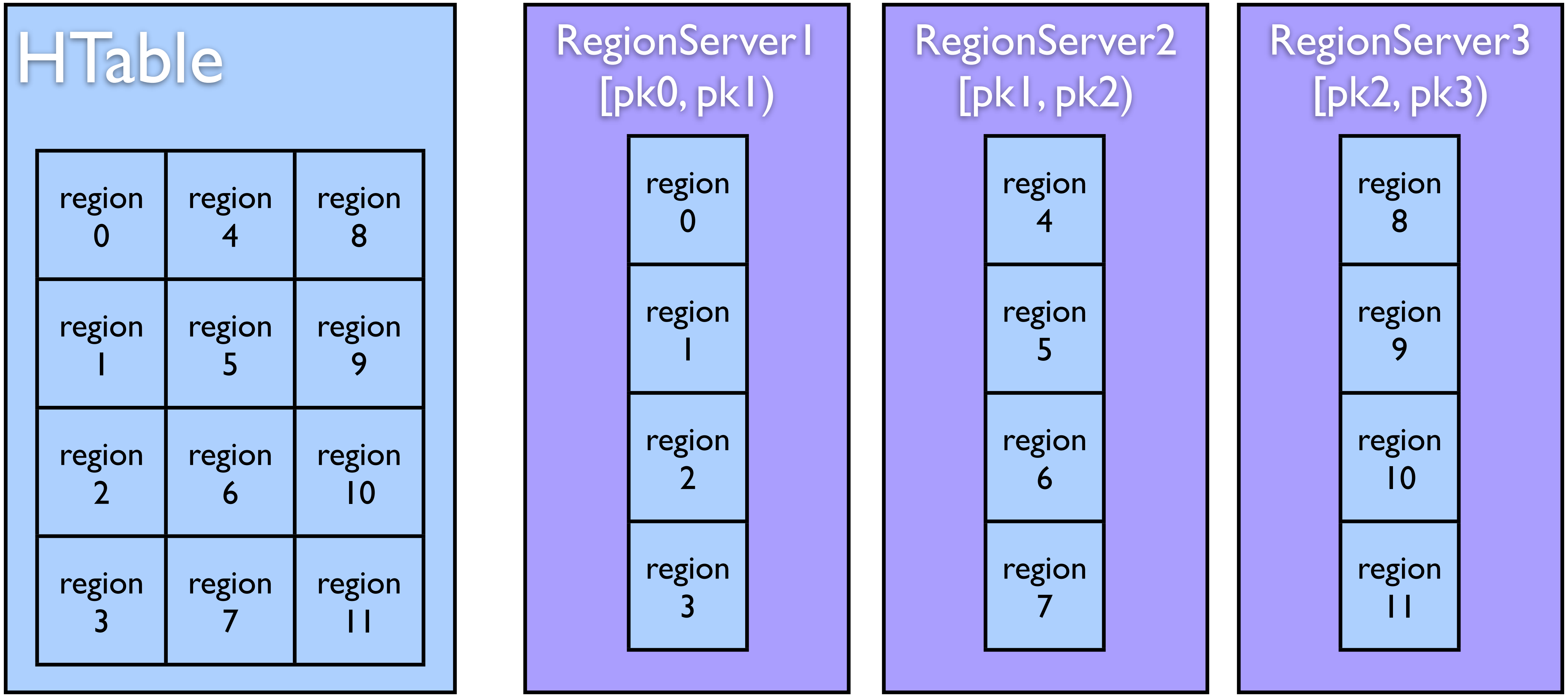
Region Region Region Region

Region Region Region Region

Region Region Region Region

The New Region

- RegionServer example
  - 3 RegionServers with 1 partition each



HTable

region 0	region 4	region 8
region 1	region 5	region 9
region 2	region 6	region 10
region 3	region 7	region 11

RegionServer1
[pk0, pk1)

region 0
region 1
region 2
region 3

RegionServer2
[pk1, pk2)

region 4
region 5
region 6
region 7

RegionServer3
[pk2, pk3)

region 8
region 9
region 10
region 11

The New Region

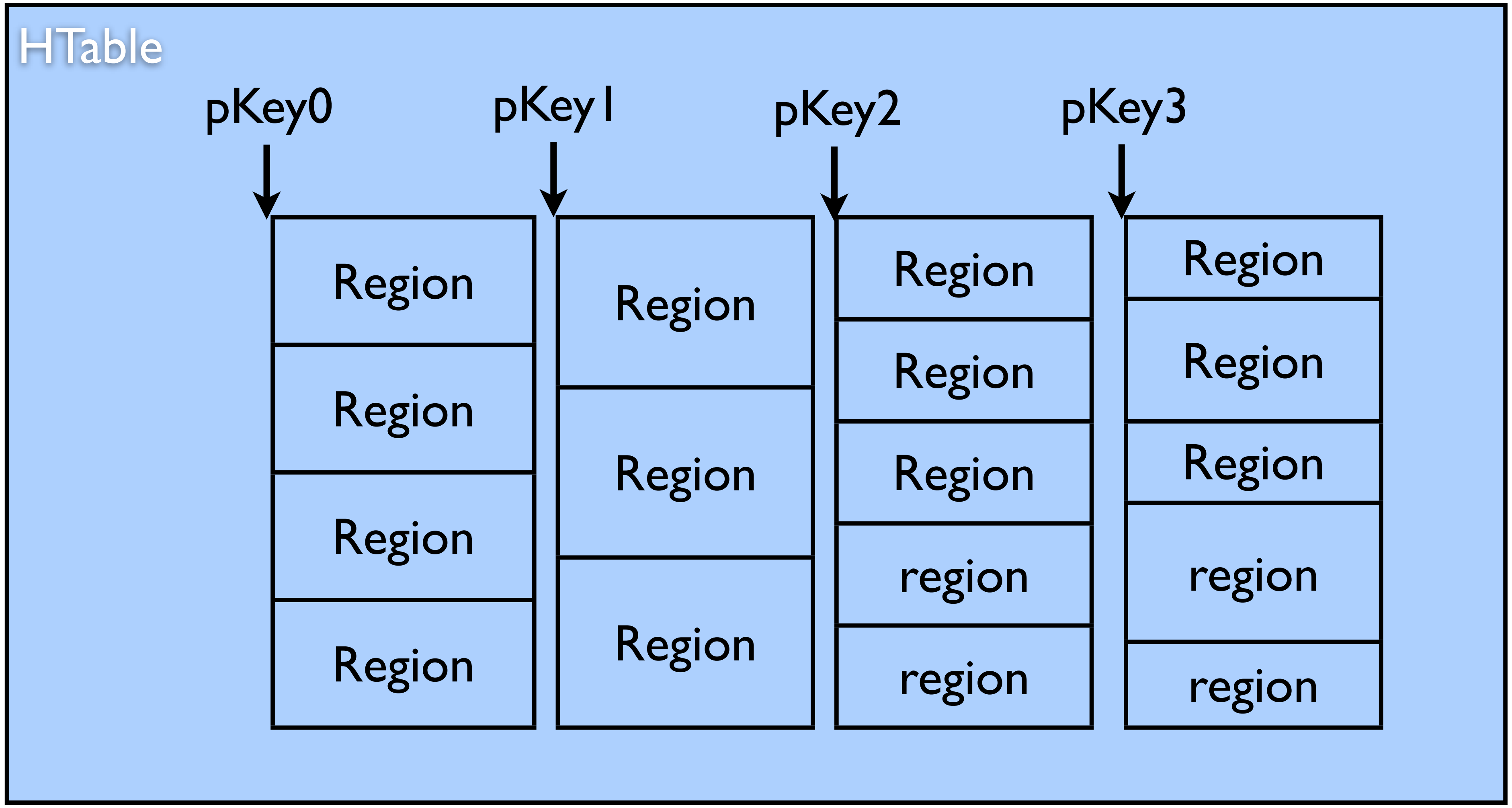
- All regions within a partition belong to the same RegionServer.
- partitions of a RegionServer do not overlay with partitions of another RS.

The New Region: P.S.

- In fact, we care more about data distribution across RegionServers.
- we don’t really care about data distribution within a RegionServer.
- So...

The New Region: P.S.

- rowKey boundaries of different partitions do not align.



HTable

pKey0

Region
Region
Region
Region

pKey1

Region
Region
Region

pKey2

Region
Region
Region
region
region

pKey3

Region
Region
Region
region
region

TODO list: changes

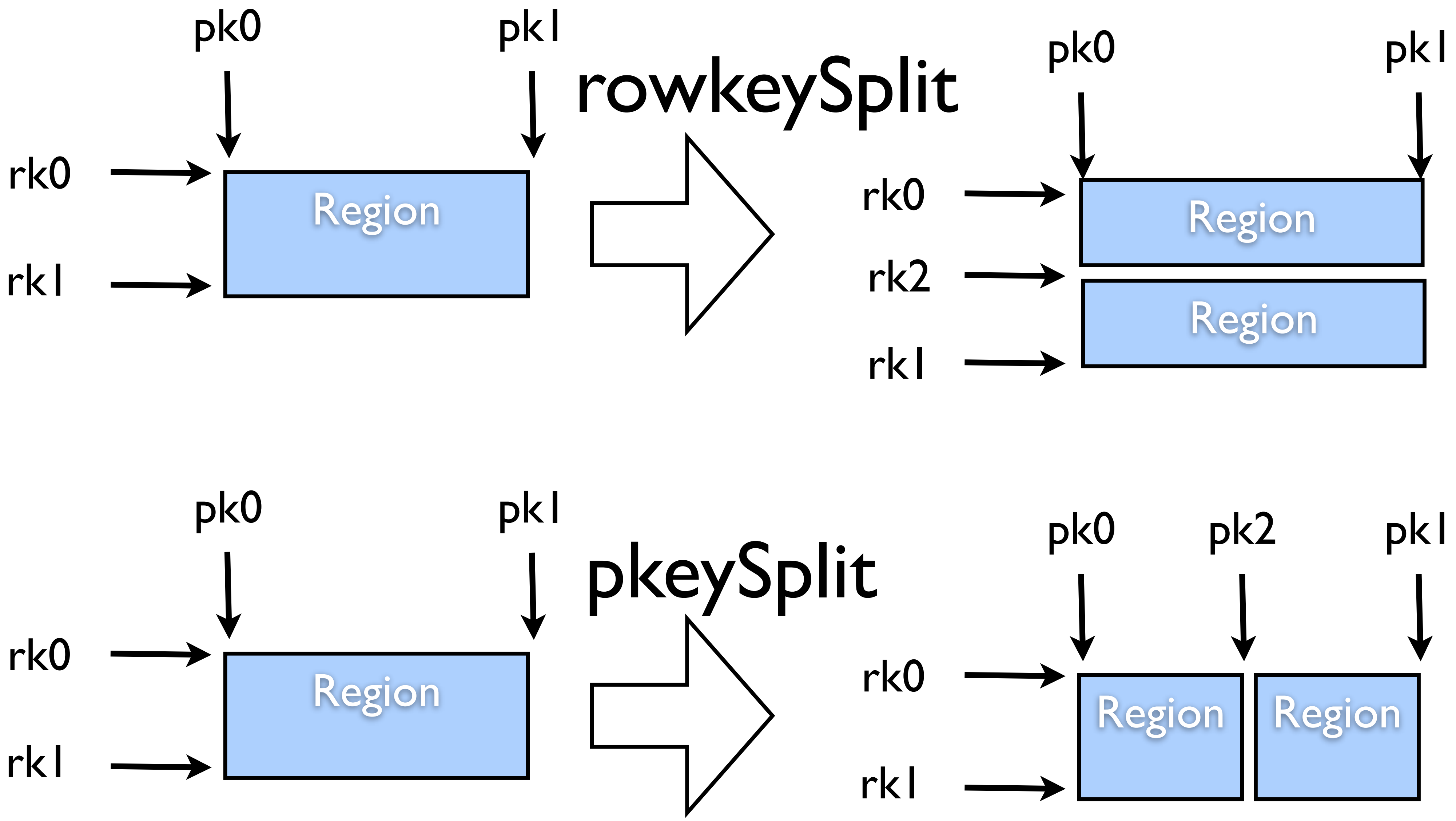
- Region
  - additional meta about pKey
- RegionServer
  - additional meta about pKey
- HMaster
  - pKey-aware of Region-RS assignment
- new procedure: **PartitionSplit**
- changes in read/write op of HBase

Partition Split

- Why a region splits? mainly 2 reasons:
  - (a) we need smaller region for faster op.
  - (b) we need to distribute data to more node .
- with PartitionKey, there are 2 types of split:
  - a region split along rowKey (for (a))
  - a region split along pKey (for (b))

Partition Split

- rowKey Split vs pKey Split

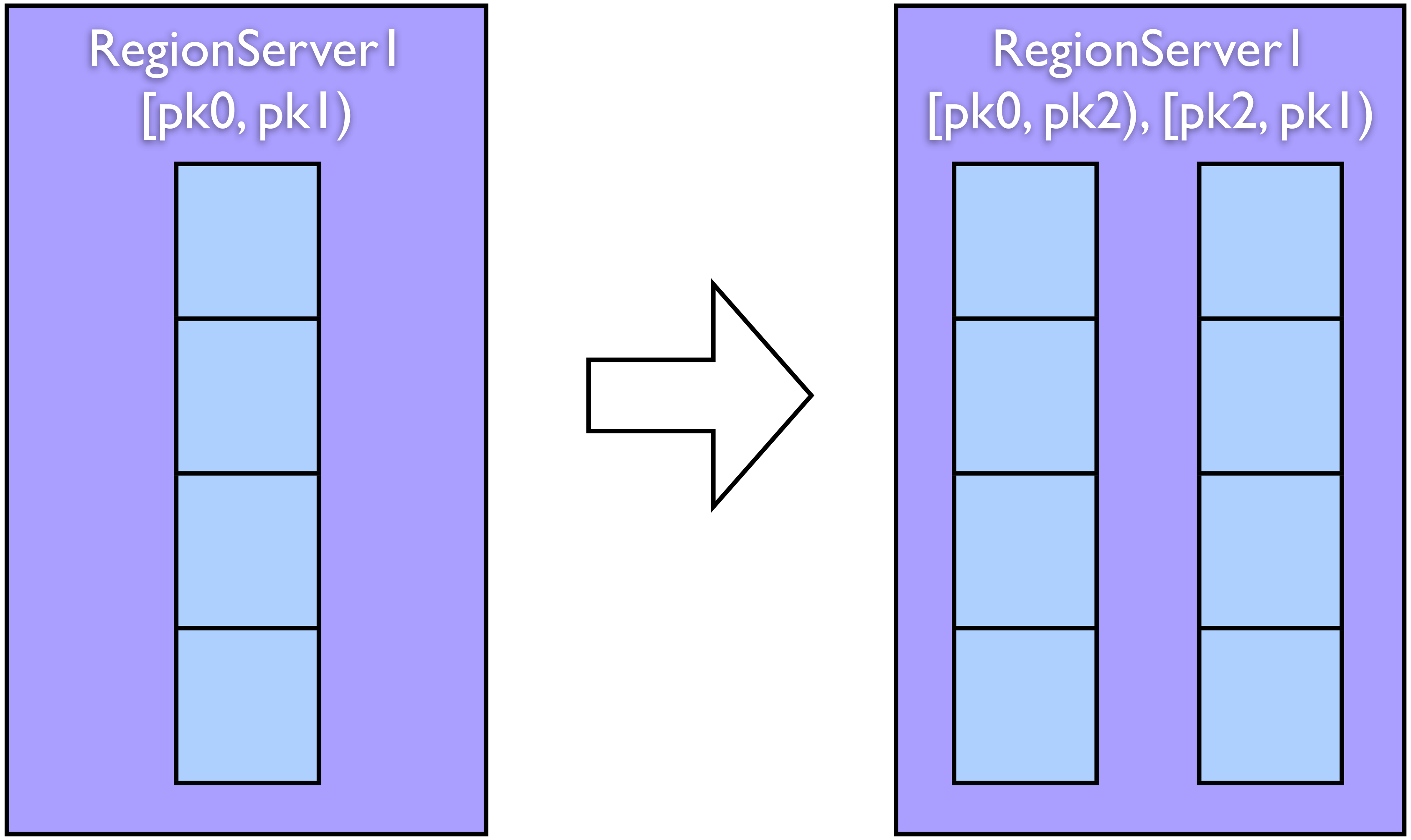


Partition Split

- Definition: a partition splits into 2
  - [pK0, pK1) -> [pk0, pk2), [pk2, pk1)
- every Region in the partition split into 2 along pKey

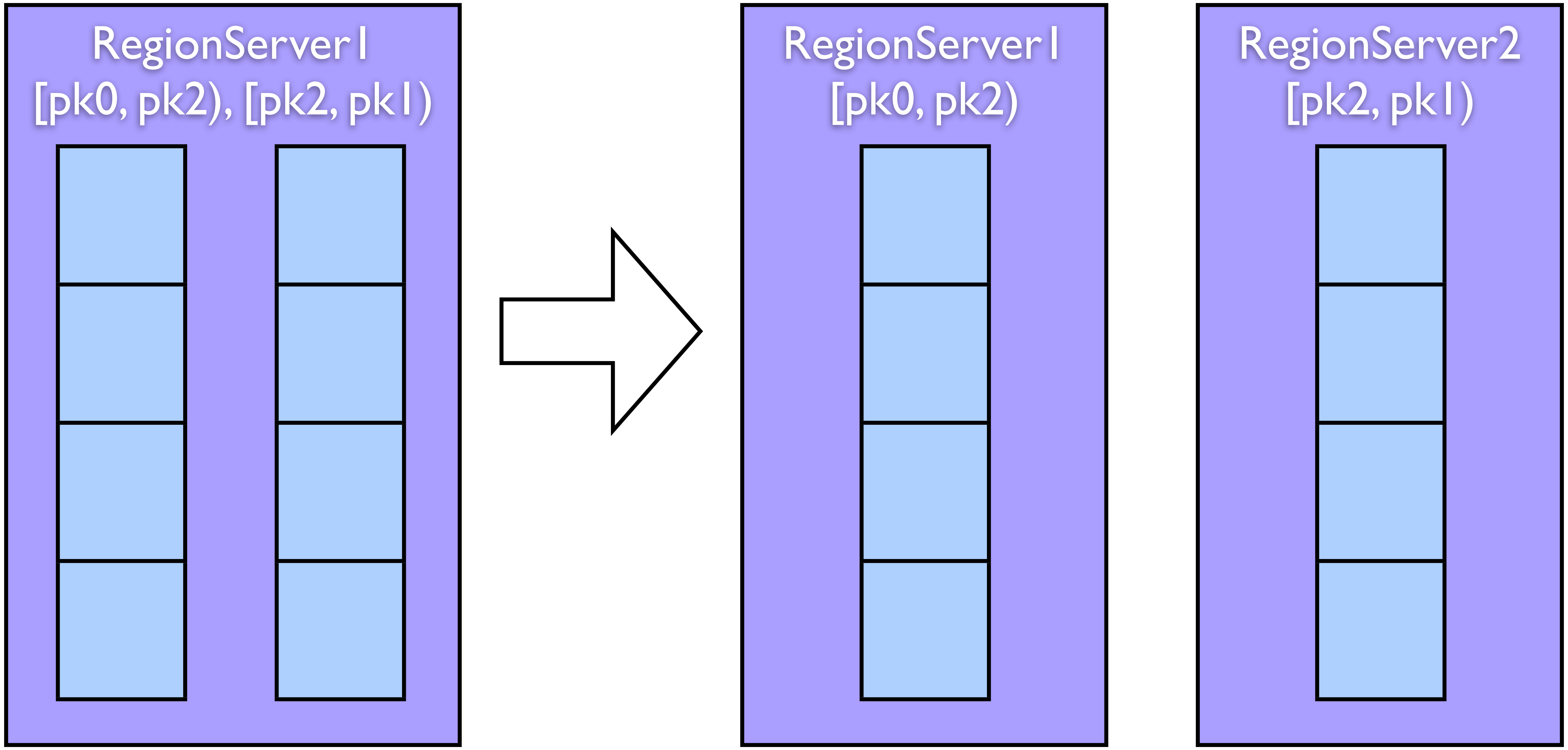
Partition Split

- every Region in the partition split into 2



Partition Split

- Why partition split? because we need more node



Partition Split

- More questions
  - when ordinary split? when partition split?
  - what happend when adding node?

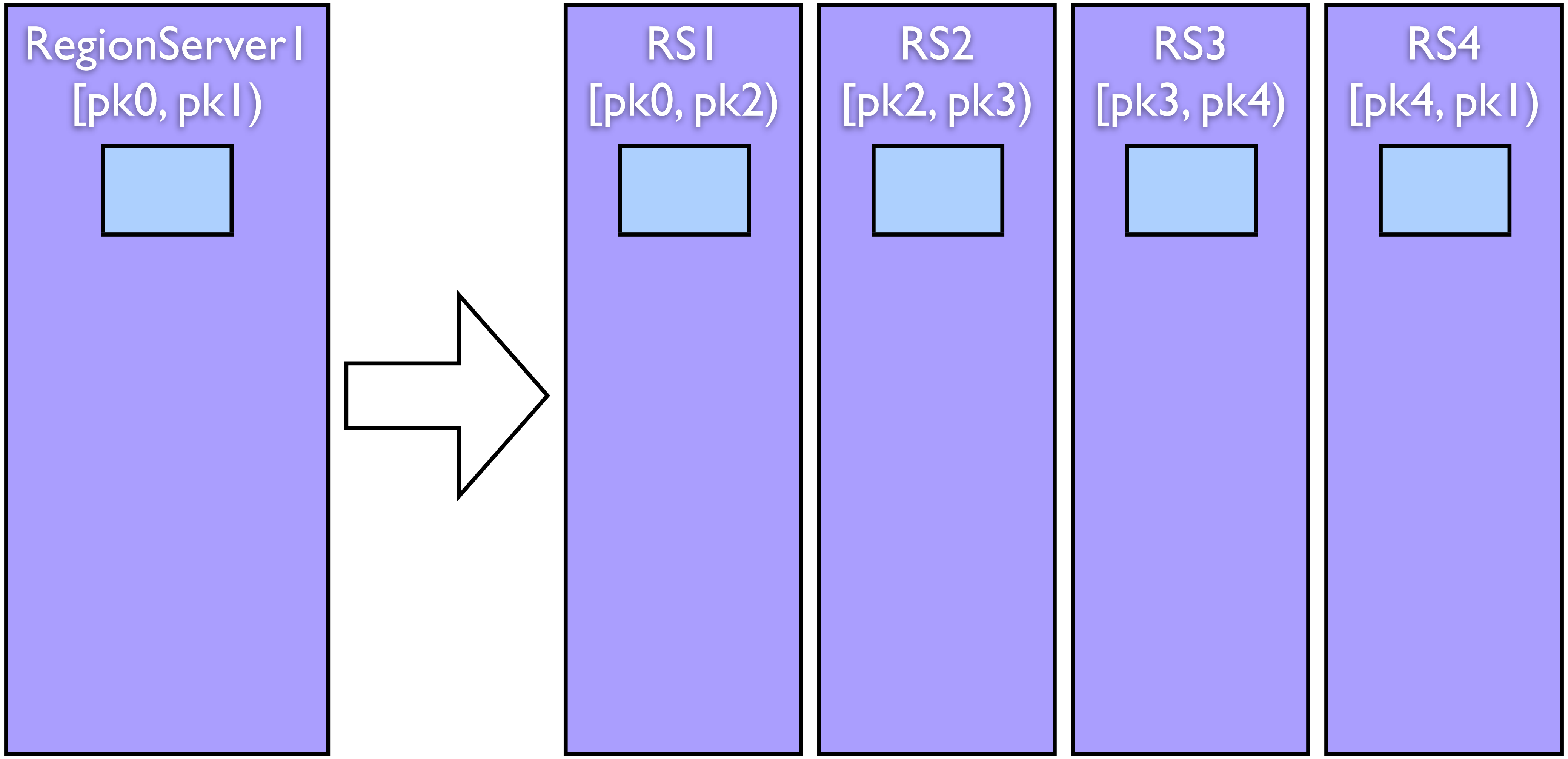
Split Policy

- rowKey split: same as now
- partition split: means we need more node for this HTable
    - regions size
    - query load

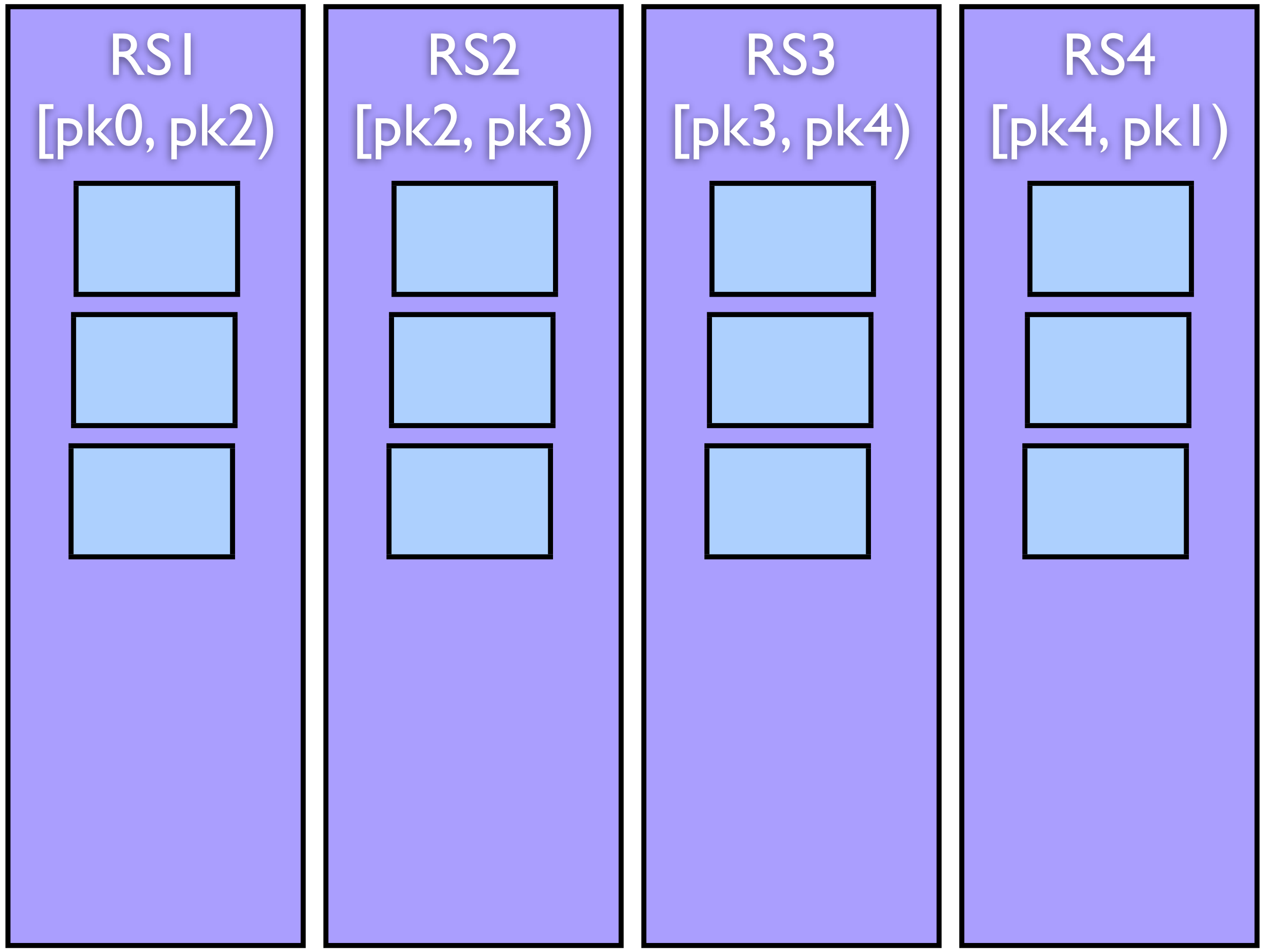
Split Policy Proposal

- partition split first
- with per table maxinum partition limit
  - region would first pKey split to Pmax partitions, then rowKey split within each partition

Split Policy Proposal



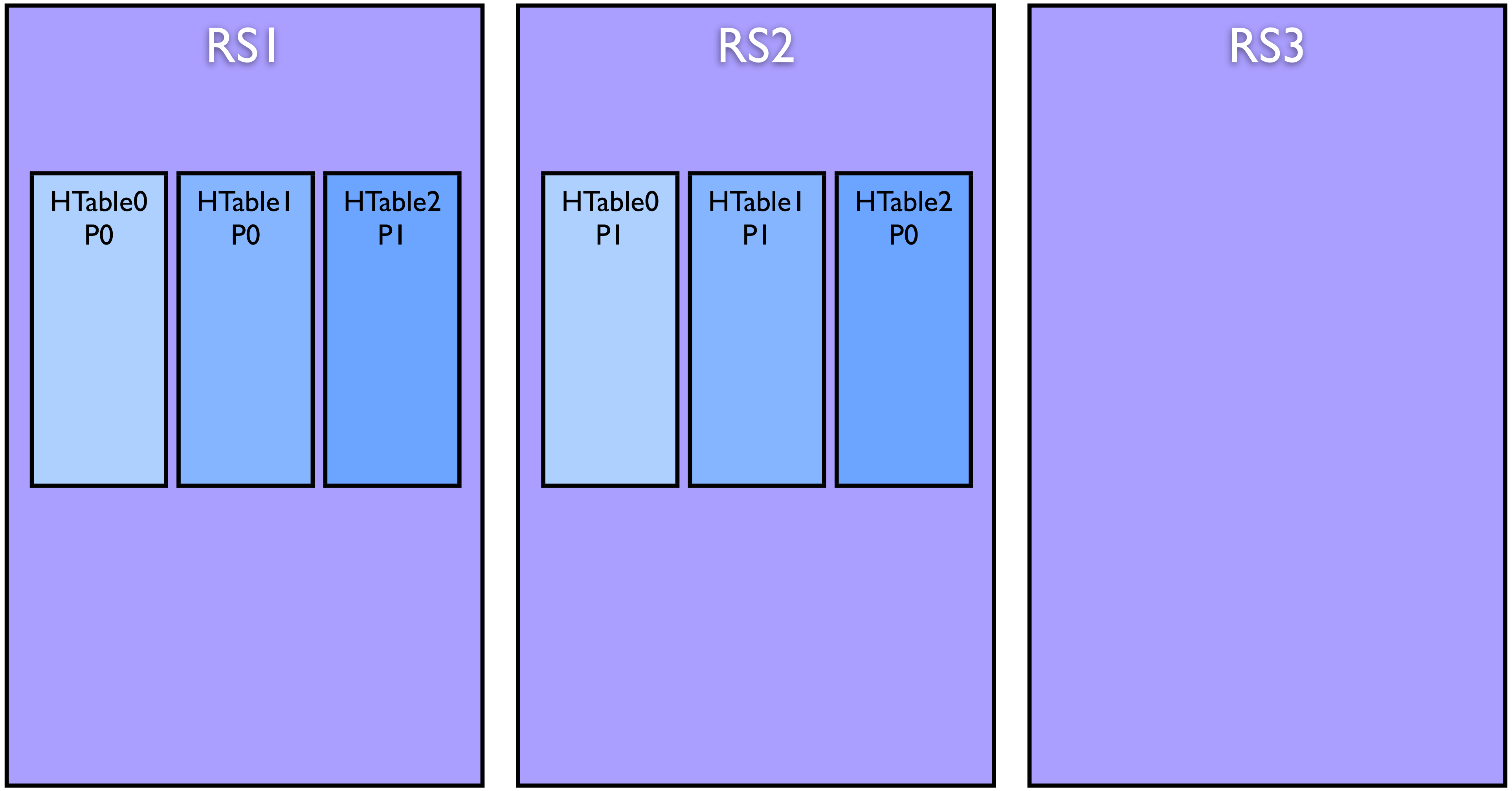
Split Policy Proposal



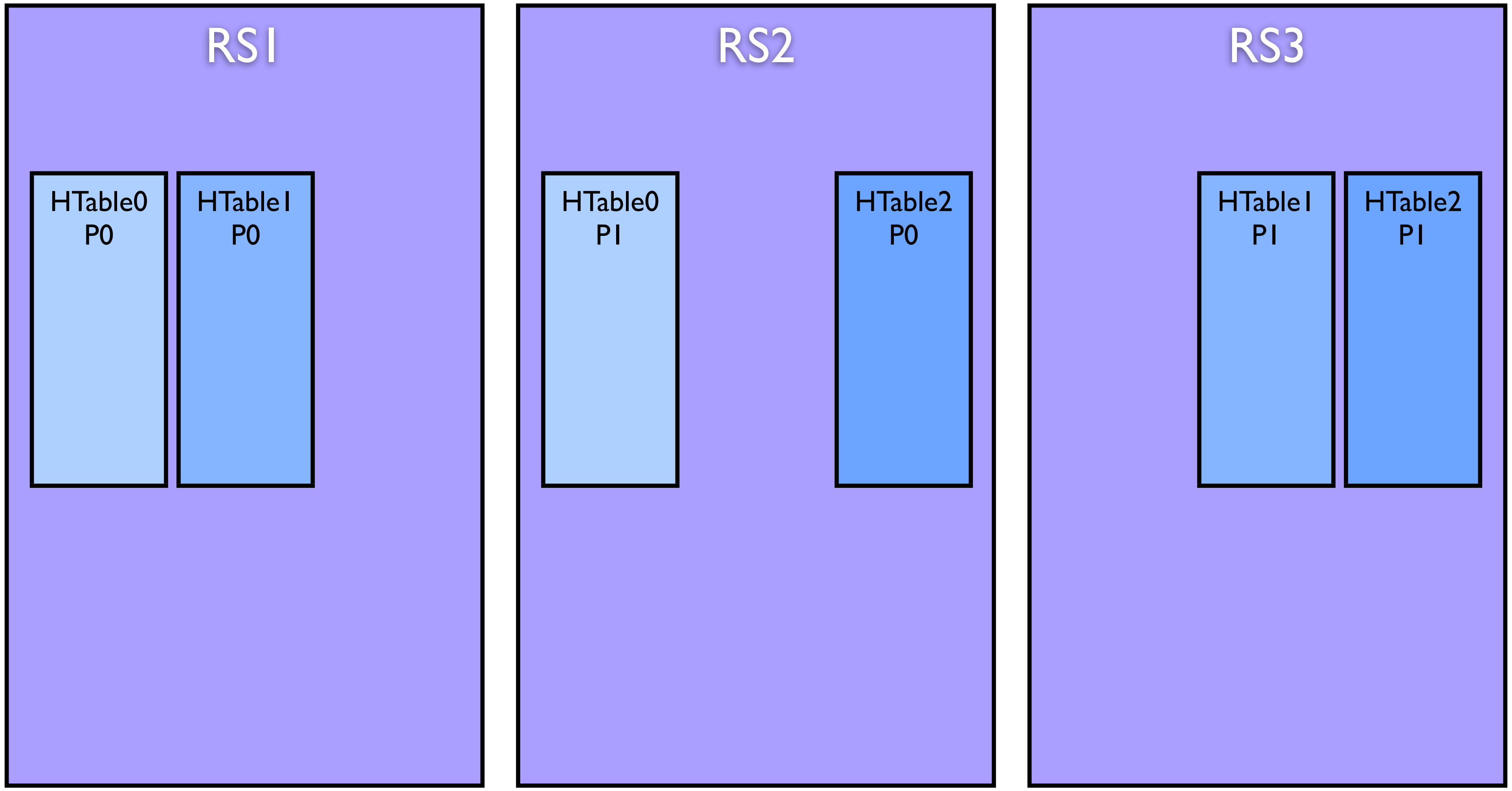
Adding Node Proposal

- Same as HBase
  - do not trigger split;
  - reassign partitions, like HBase reassign regions

Adding Node Proposal



Adding Node Proposal



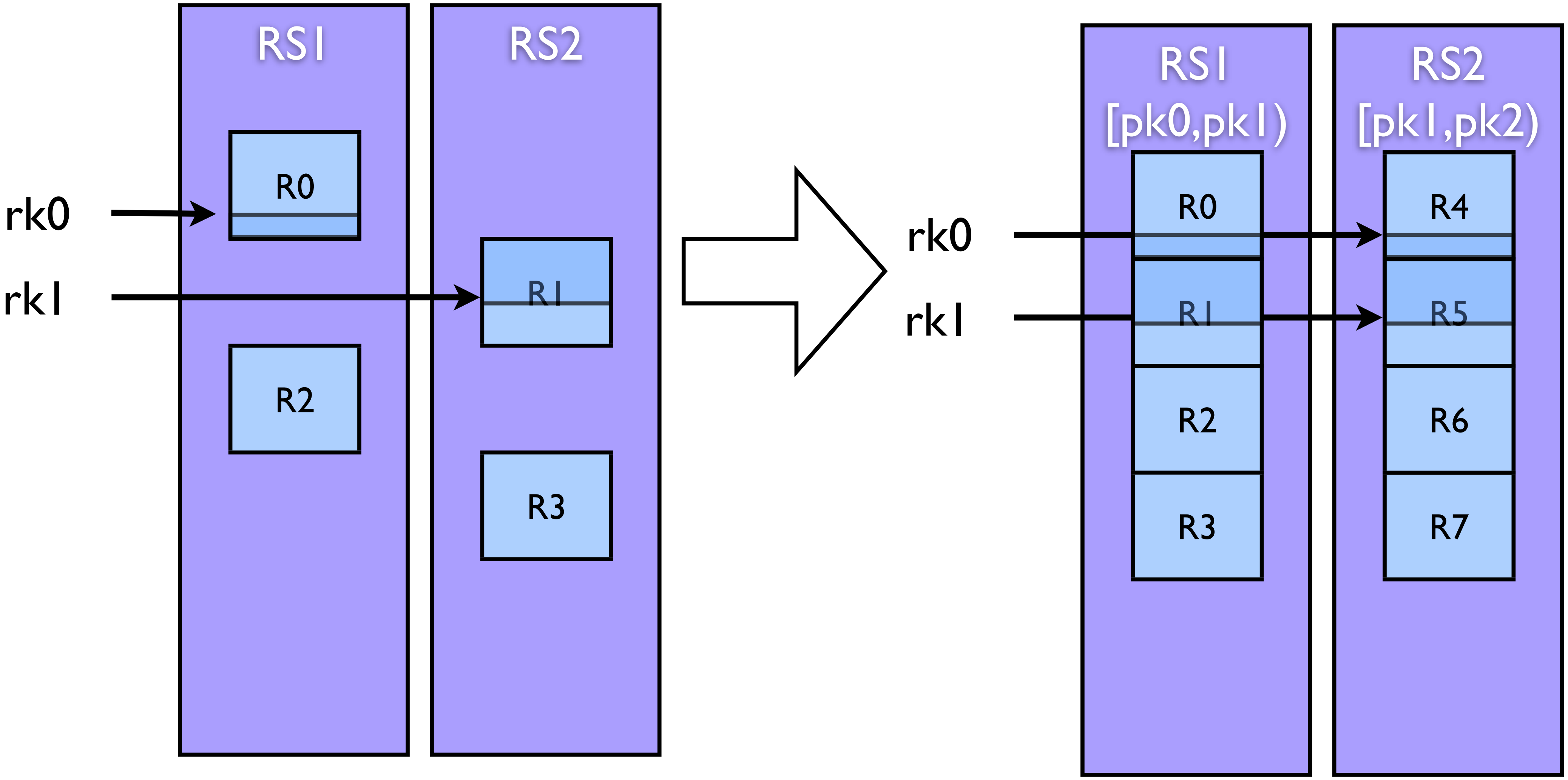
Adding Node Proposal

- If a partition need to plit, but not enough node, adding node would trigger partition split.

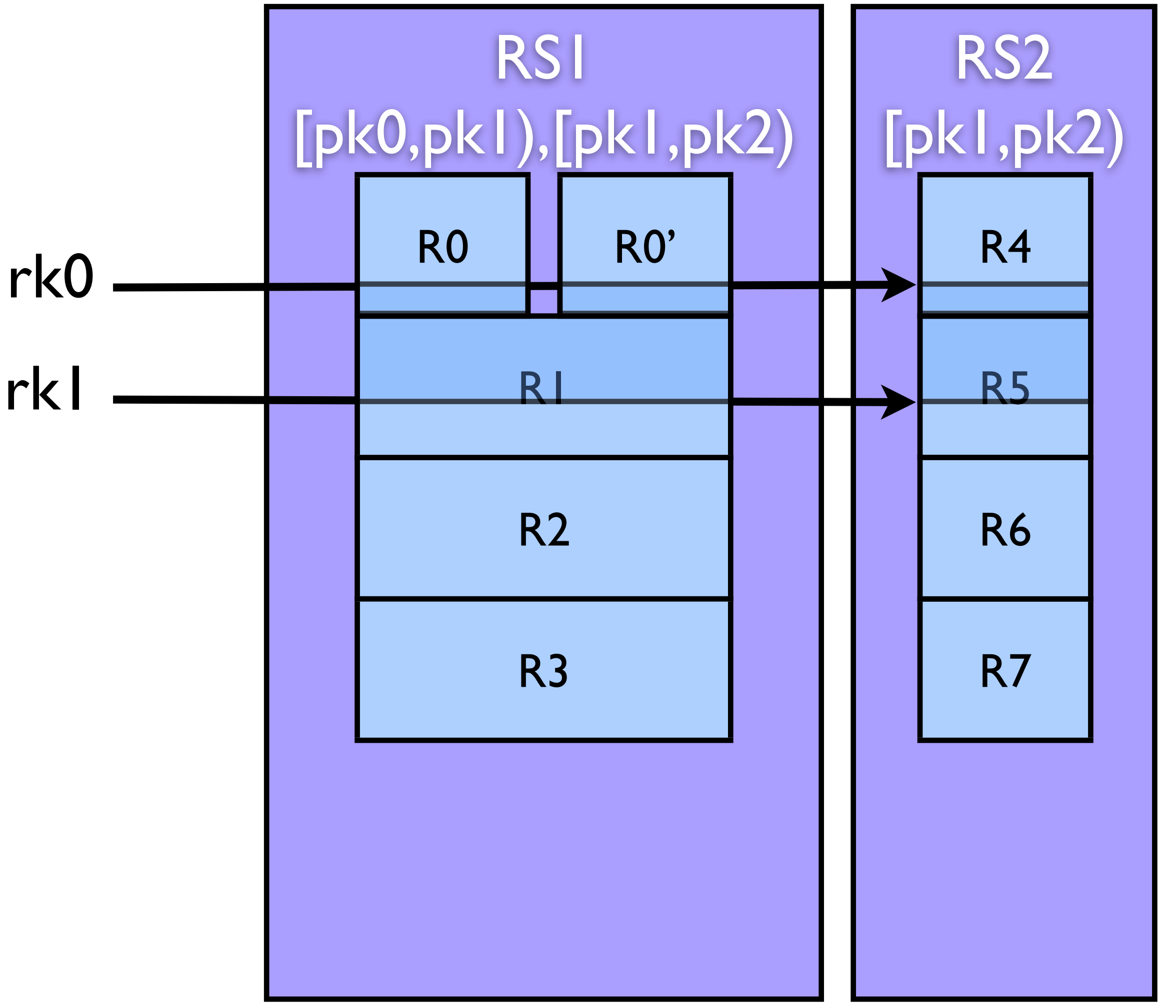
TODO list: changes

- Region
  - additional meta about pKey
- RegionServer
  - additional meta about pKey
- HMaster
  - pKey-aware of Region-RS assignment
- new procedure: PartitionSplit
- changes in **read/write op** of HBase

Change in Scan

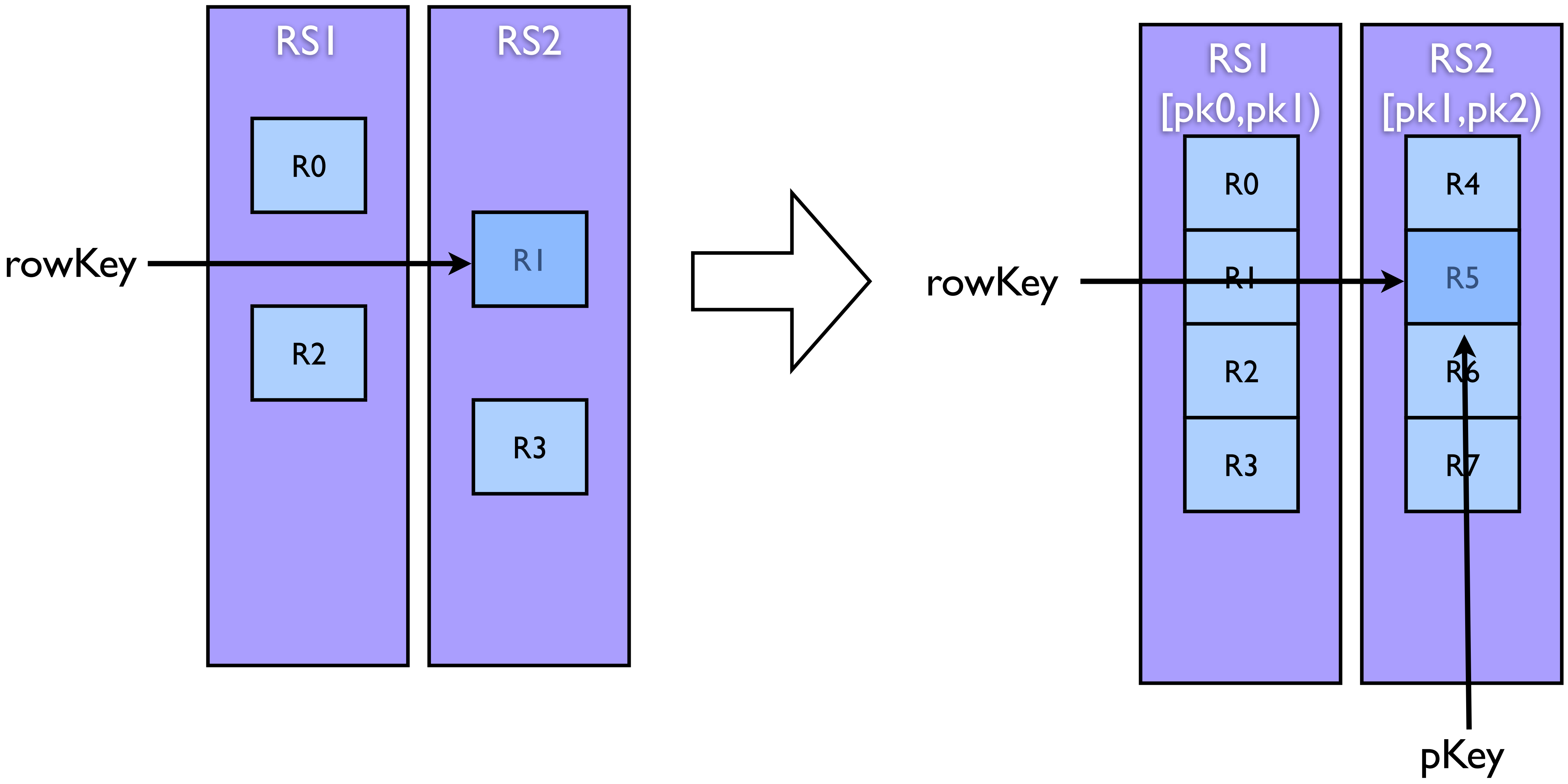


During partition Split



Change in Put

- Put(rowKey, CF): derive pKey first



Questions

- proper way of describing partitionkey?
    - part of rowkey? a column? a CF?
- write into HBase?
- scan from HBase?
- split along partition key?
- split while writing?
- split while reading?
- split failover?
- Phase 2?

Phase 2: TableGroup

- Define 2 HTable with same Partition Def
    - 2 HTable with same partition info
    - 2 HTable partition-split simultaneously