CouchDB and GeoCouch

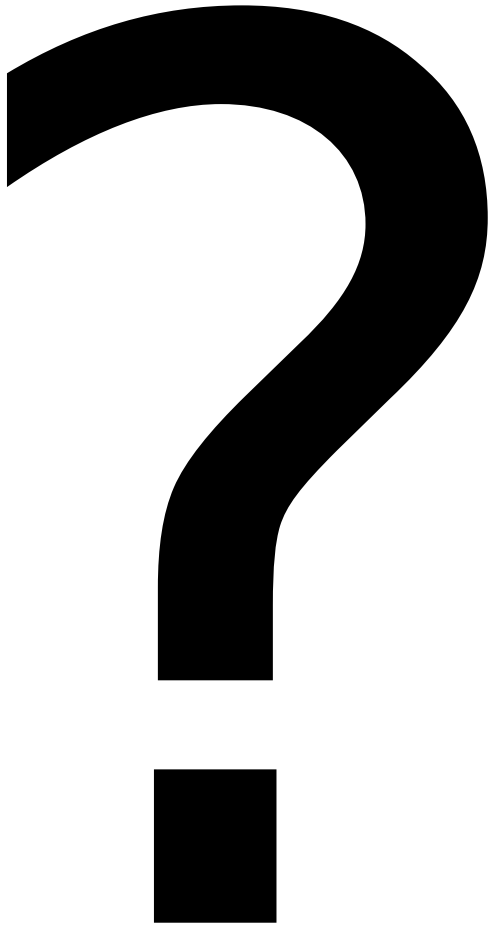
Volker Mische

Erlang Factory Lite Munich
January 31st 2011
Munich

About me

- Volker "vmx" Mische, volker@couchone.com, @vmische
- Creator of GeoCouch
- Open source developer, Erlang and JavaScript fan
- Proponent of all things open and geo
- Raver


CouchDB
relax



Document

```
 1 {
 2     "_id": "Station-2942_001",
 3     "_rev": "3-77f17a55f6ab11f7f6668e63a75f2281",
 4
 5     "name": "Station-2942",
 6     "date": "2011-01-31",
 7     "loc": [48.136944, 11.575278],
 8     "temperature": -3,
 9     "rainfall": 5.0
10 }
```

RESTful HTTP API

The four basic functions of a database (CRUD):

Create	HTTP **PUT** /db/Station-2942_001
Read	HTTP **GET** /db/Station-2942_001
Update	HTTP **PUT** /db/Station-2942_001
Delete	HTTP **DELETE** /db/Station-2942_001

Views

MapReduce

Map function

```
1 function(doc) {
2   // emit(keys, value)
3   emit(...);
4 }
```

Map function

```
1 function(doc) {
2   // emit(keys, value)
3   emit([doc.name, doc.date], doc.rainfall);
4 }
```

Keys	Value
...	...
Station-1873, 2009-10-19	2
Station-1873, 2009-10-20	0
Station-2942, 2009-07-08	13
Station-2942, 2009-07-09	14
Station-2942, 2009-07-10	17
...	...

Accessing the View

```
http://localhost:5984/db/_design/stations/_view/rainfall
```

Keys	Value
...	...
Station-1873, 2009-10-19	2
Station-1873, 2009-10-20	0
Station-2942, 2009-07-08	13
Station-2942, 2009-07-09	14
Station-2942, 2009-07-10	17
...	...

Accessing the View

“Get the rainfall from 8–9 July 2009 of Station-2942”

Keys	Value
...	...
Station-1873, 2009-10-19	2
Station-1873, 2009-10-20	0
Station-2942, 2009-07-08	13
Station-2942, 2009-07-09	14
Station-2942, 2009-07-10	17
...	...

Accessing the View

“Get the rainfall from 8–9 July 2009 of Station-2942”

```
http://localhost:5984/db/_design/stations/_view/rainfall?
startkey=["Station-2942","2009-07-08"]&
endkey=["Station-2942","2009-07-09"]
```

Keys	Value
...	...
Station-1873, 2009-10-19	2
Station-1873, 2009-10-20	0
Station-2942, 2009-07-08	**13**
Station-2942, 2009-07-09	**14**
Station-2942, 2009-07-10	17
...	...

Reduce

Reduce

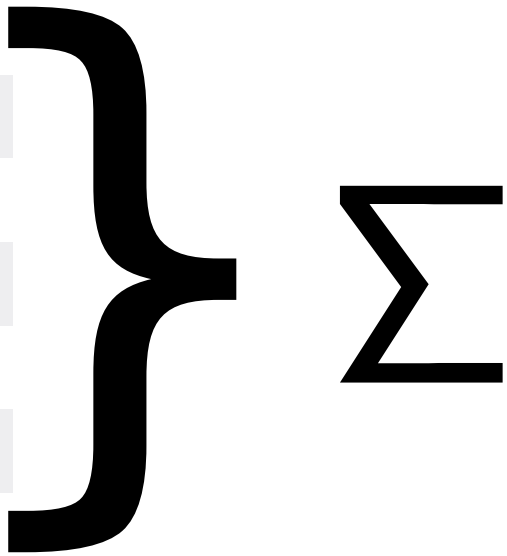
```
1 function(keys, values) {
2   var sum = 0;
3   for each(var val in values) {
4     sum = sum + val;
5   }
6   return sum;
7 }
```

Reduce result

Keys	Value
...	...
Station-1873, 2009-10-19	2
Station-1873, 2009-10-20	0
Station-2942, 2009-07-08	13
Station-2942, 2009-07-09	14
Station-2942, 2009-07-10	17
...	...

Reduce result

Keys	Value
...	...
Station-1873, 2009-10-19	2
Station-1873, 2009-10-20	0
Station-2942, 2009-07-08	13
Station-2942, 2009-07-09	14
Station-2942, 2009-07-10	17
...	...



Reduce result

Keys	Value
...	...
Station-1873, 2009-10-19	2
Station-1873, 2009-10-20	0
Station-2942, 2009-07-08	**13**
Station-2942, 2009-07-09	**14**
Station-2942, 2009-07-10	17
...	...

} 27

Fancy Features

Schema Free

Schema Free

```
{
    "id": "Station-2942_001",
    "_rev": "3-77f17a55f6ab11f7f6668e63a75f2281",

    "name": "Station-2942",
    "date": "2011-01-31",
    "loc": [48.136944, 11.575278],
    "temperature": -3,
    "rainfall": 5.0

}
```

Schema Free

```
{
    "id": "Station-2942_001",
    "_rev": "3-77f17a55f6ab11f7f6668e63a75f2281",

    "name": "Station-2942",
    "date": "2011-01-31",
    "loc": [48.136944, 11.575278],
    "temperature": -3,
    "rainfall": 5.0
    "atmospheric_pressure": 1012
}
```

Arbitrary input/output

JSON + JavaScript

=

anything

Append-only data structure (Example)

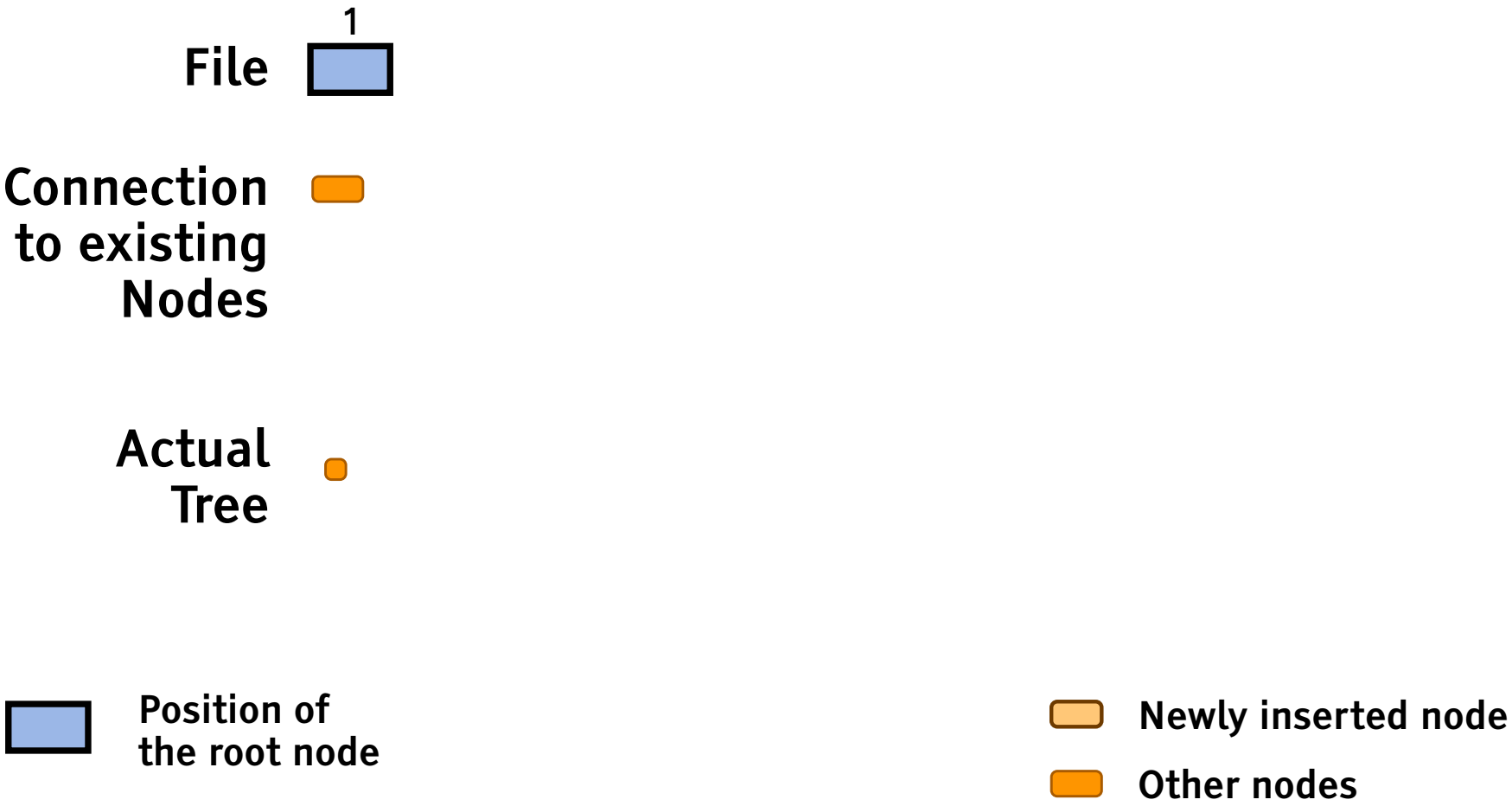
File

Connection to existing Nodes

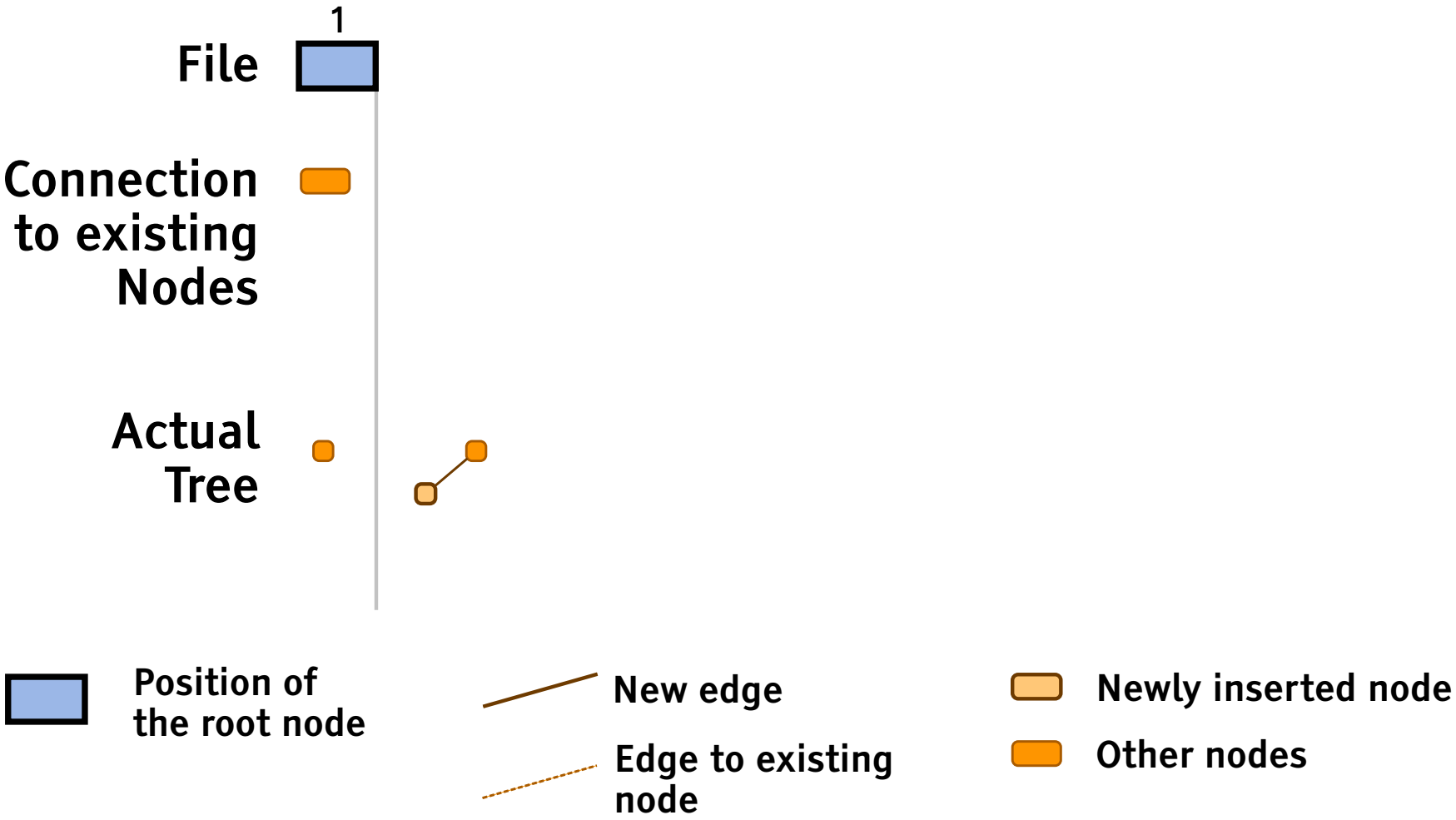
Actual Tree

Append-only data structure (Example)

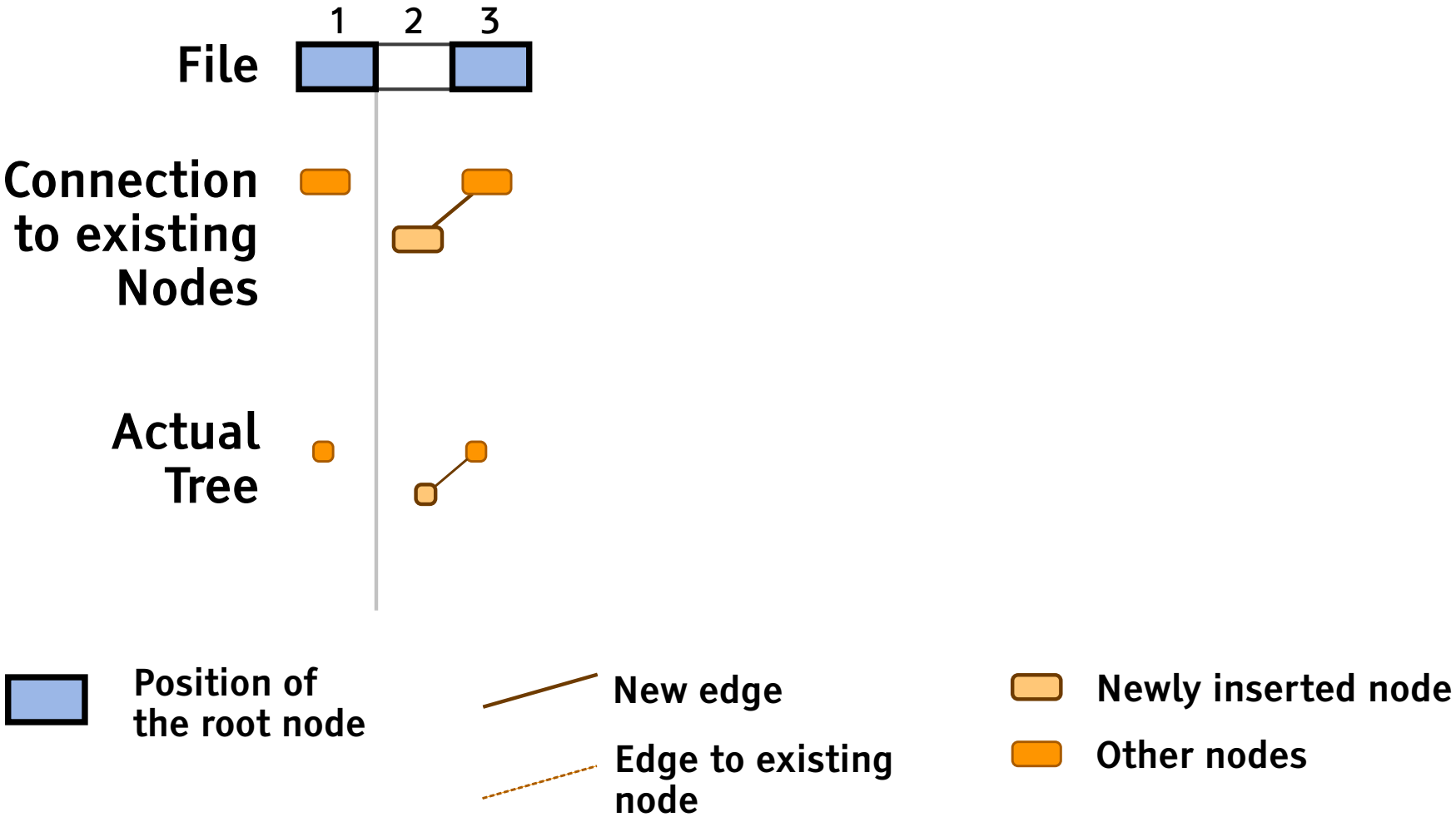
Append-only data structure (Example)



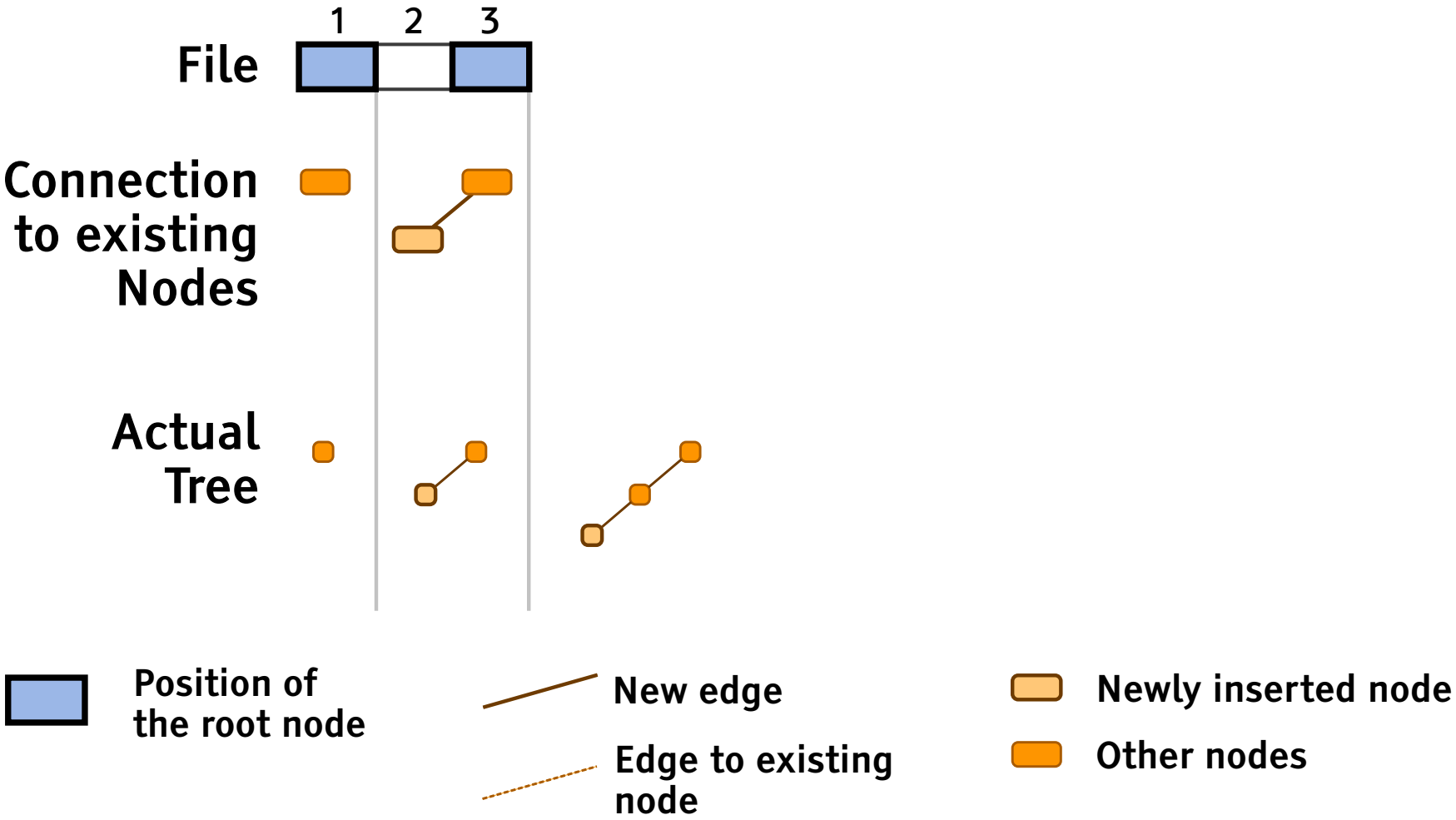
Append-only data structure (Example)



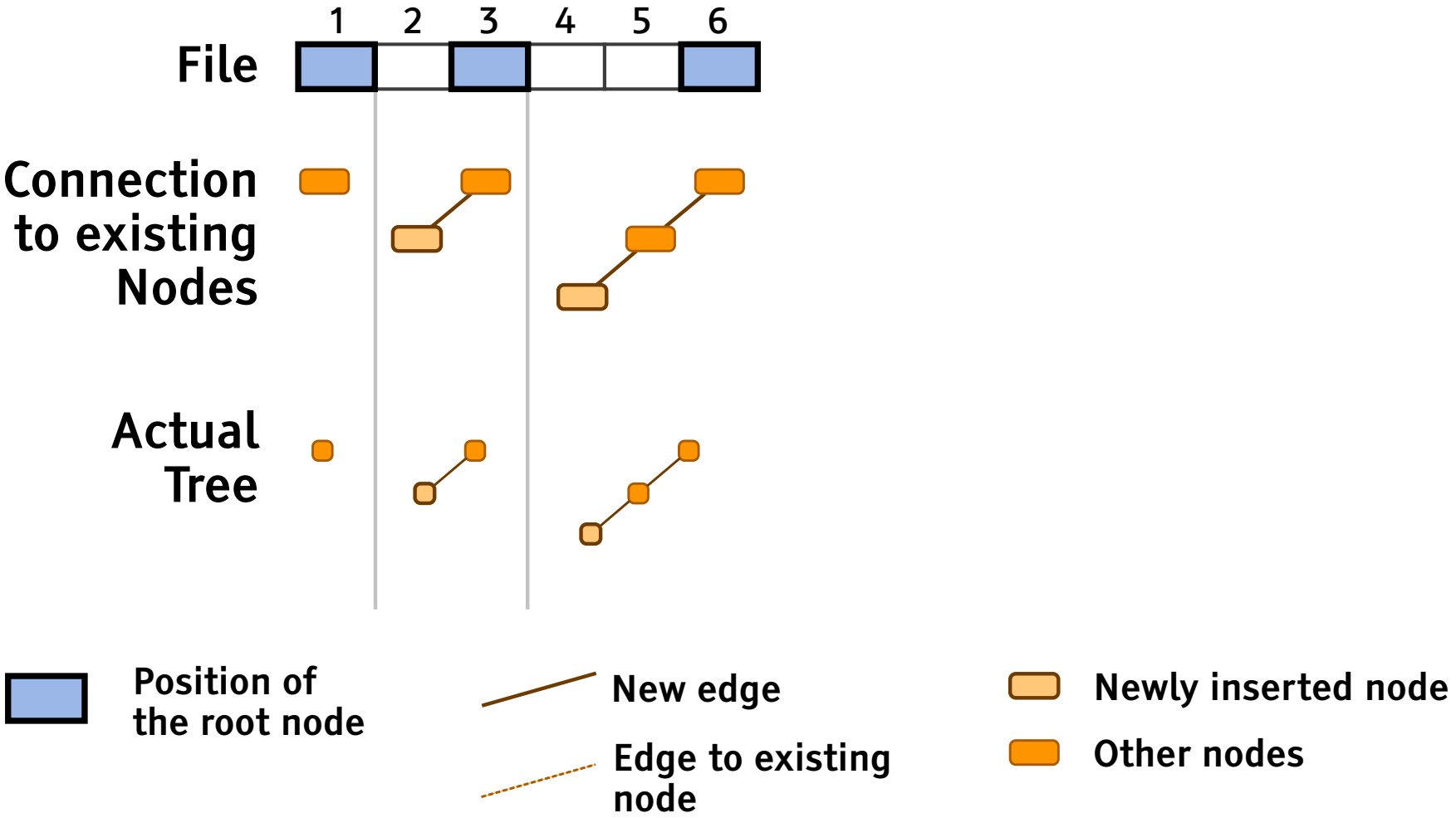
Append-only data structure (Example)



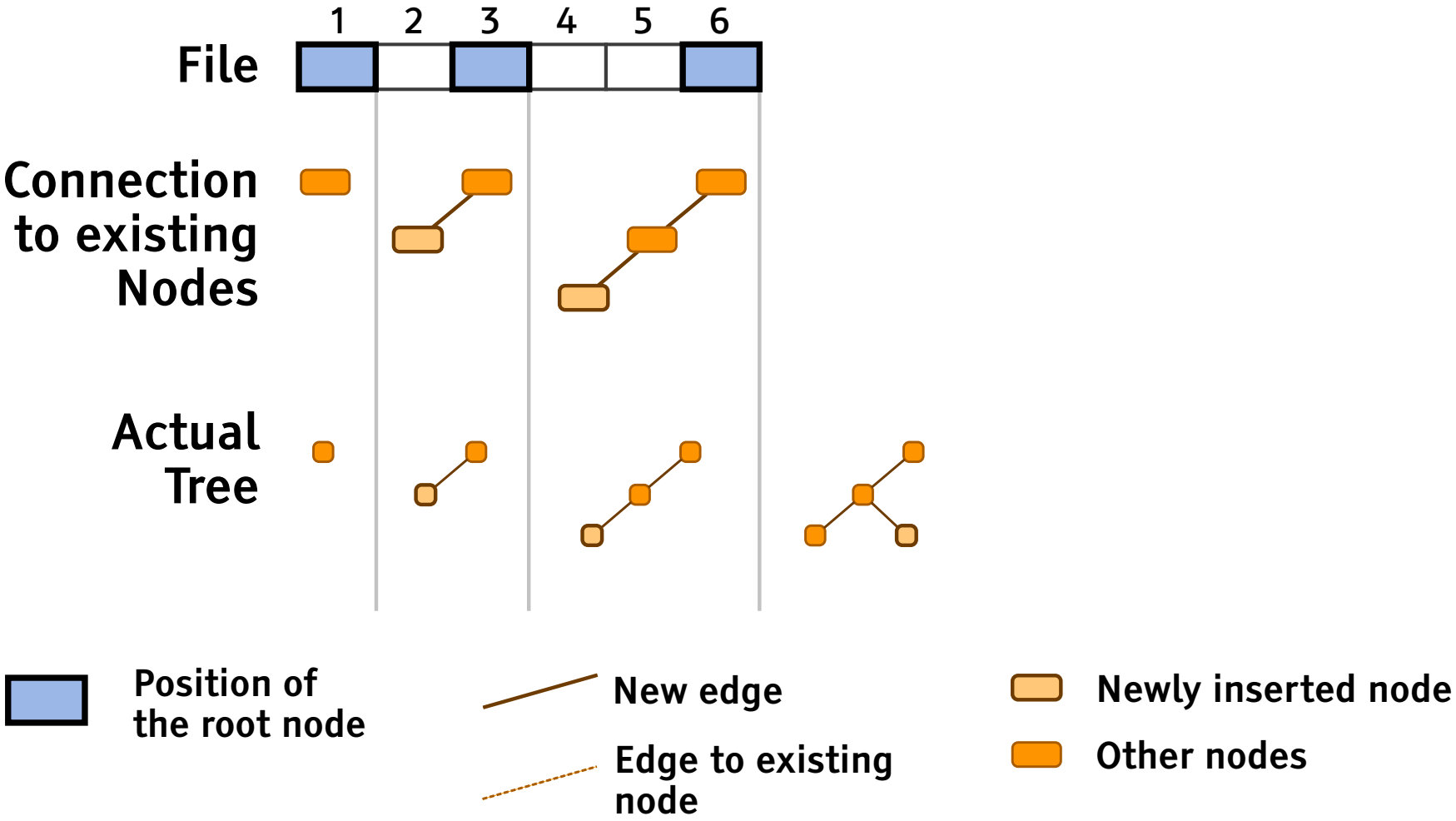
Append-only data structure (Example)



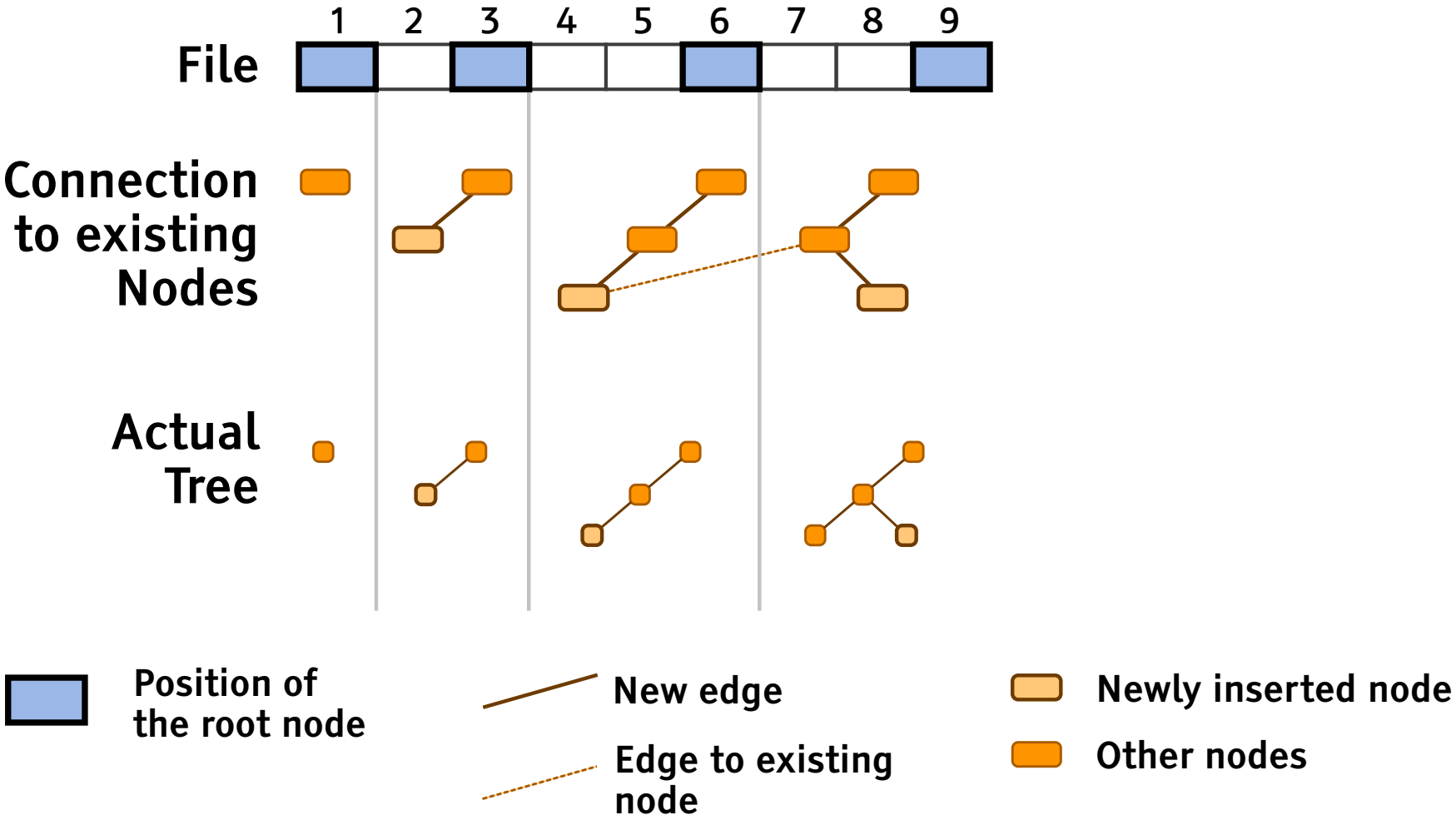
Append-only data structure (Example)



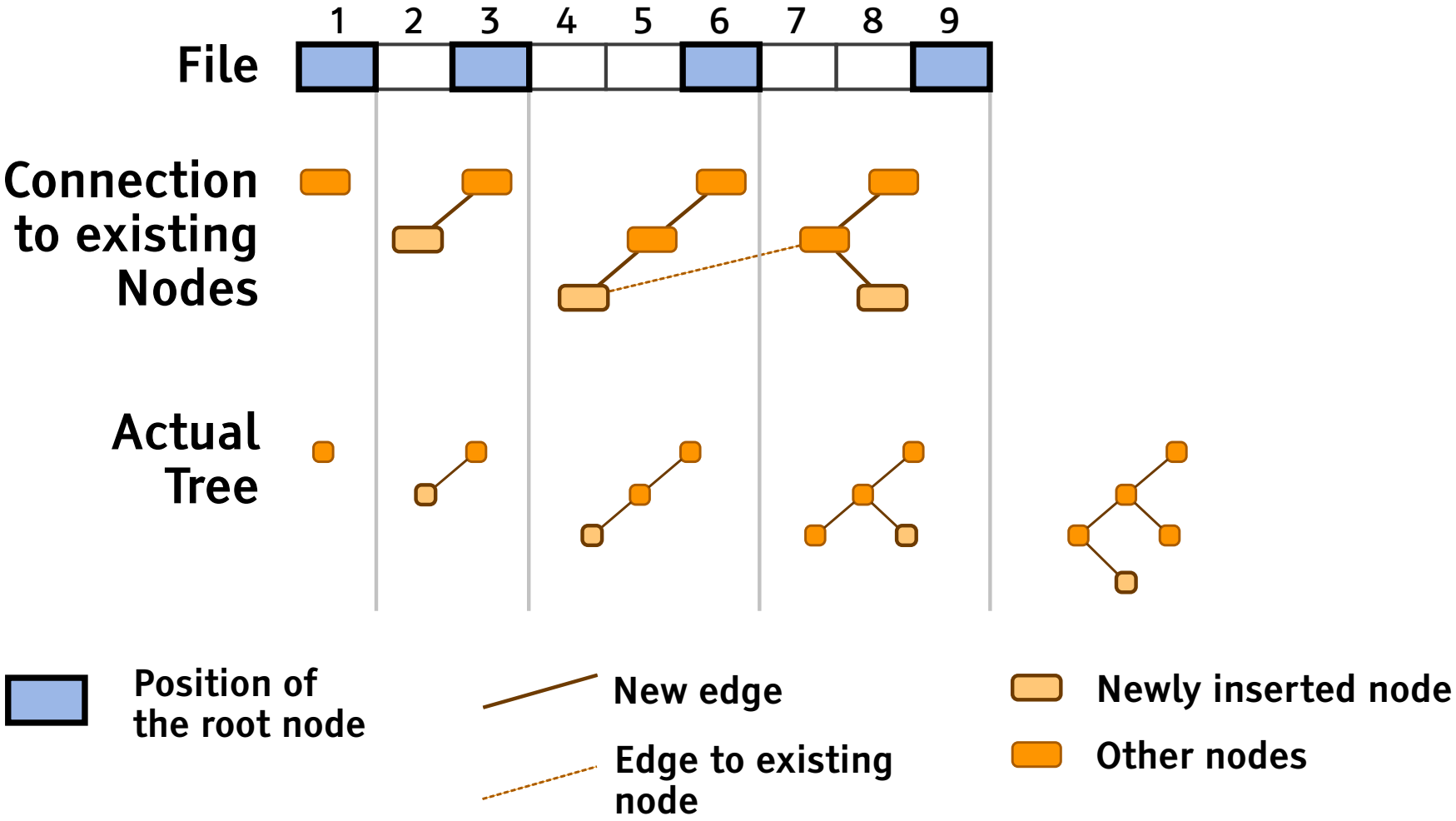
Append-only data structure (Example)



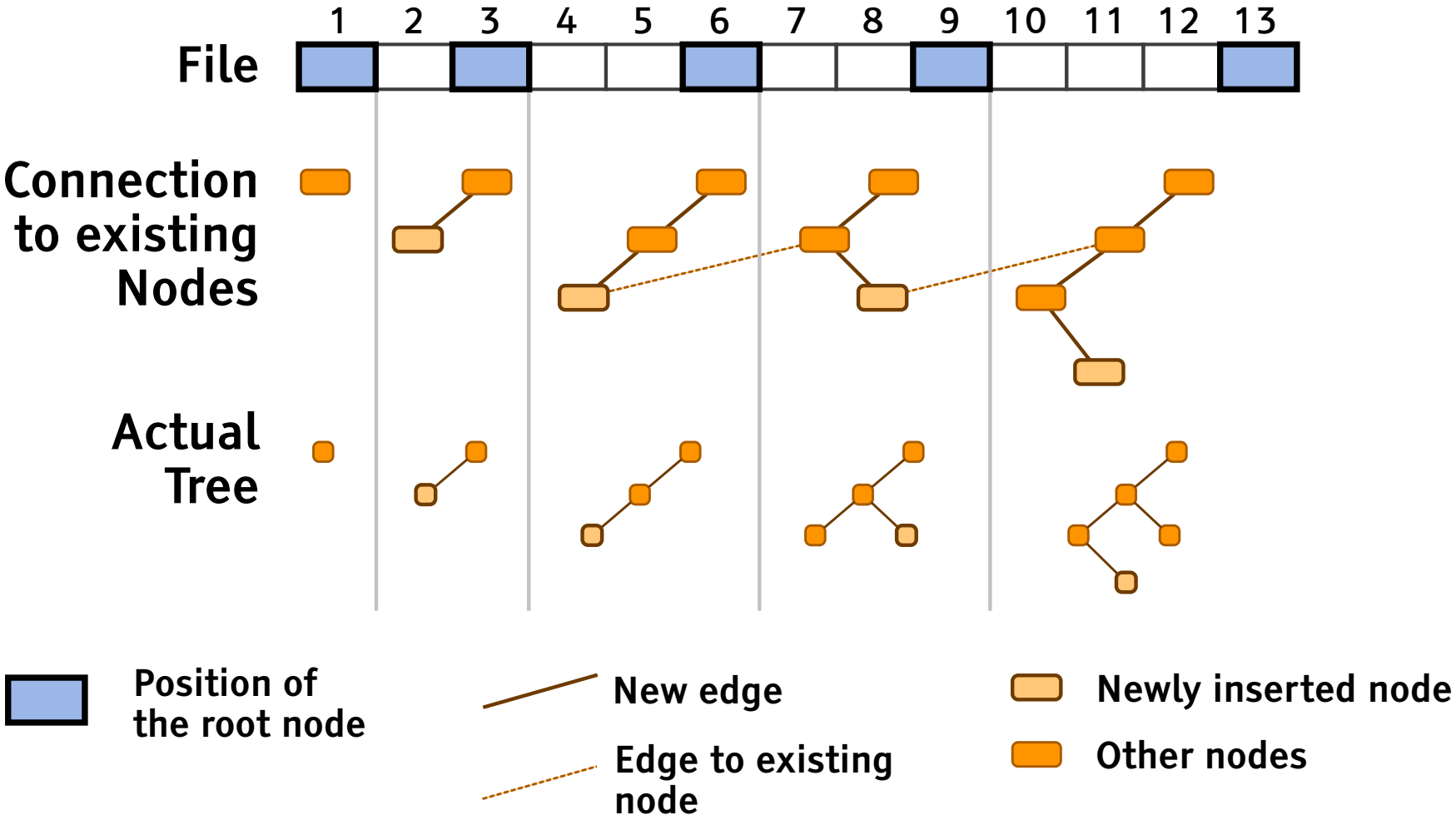
Append-only data structure (Example)



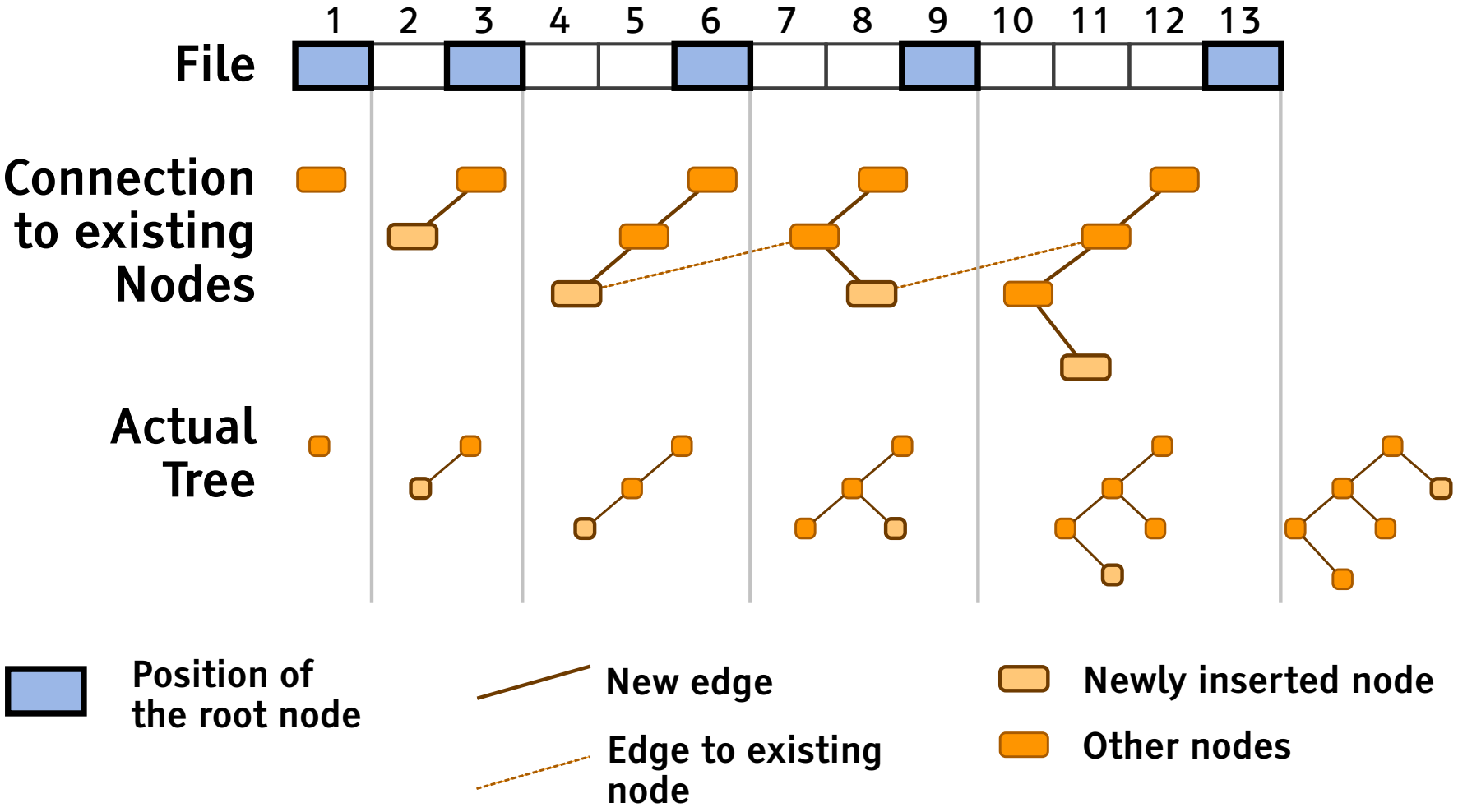
Append-only data structure (Example)



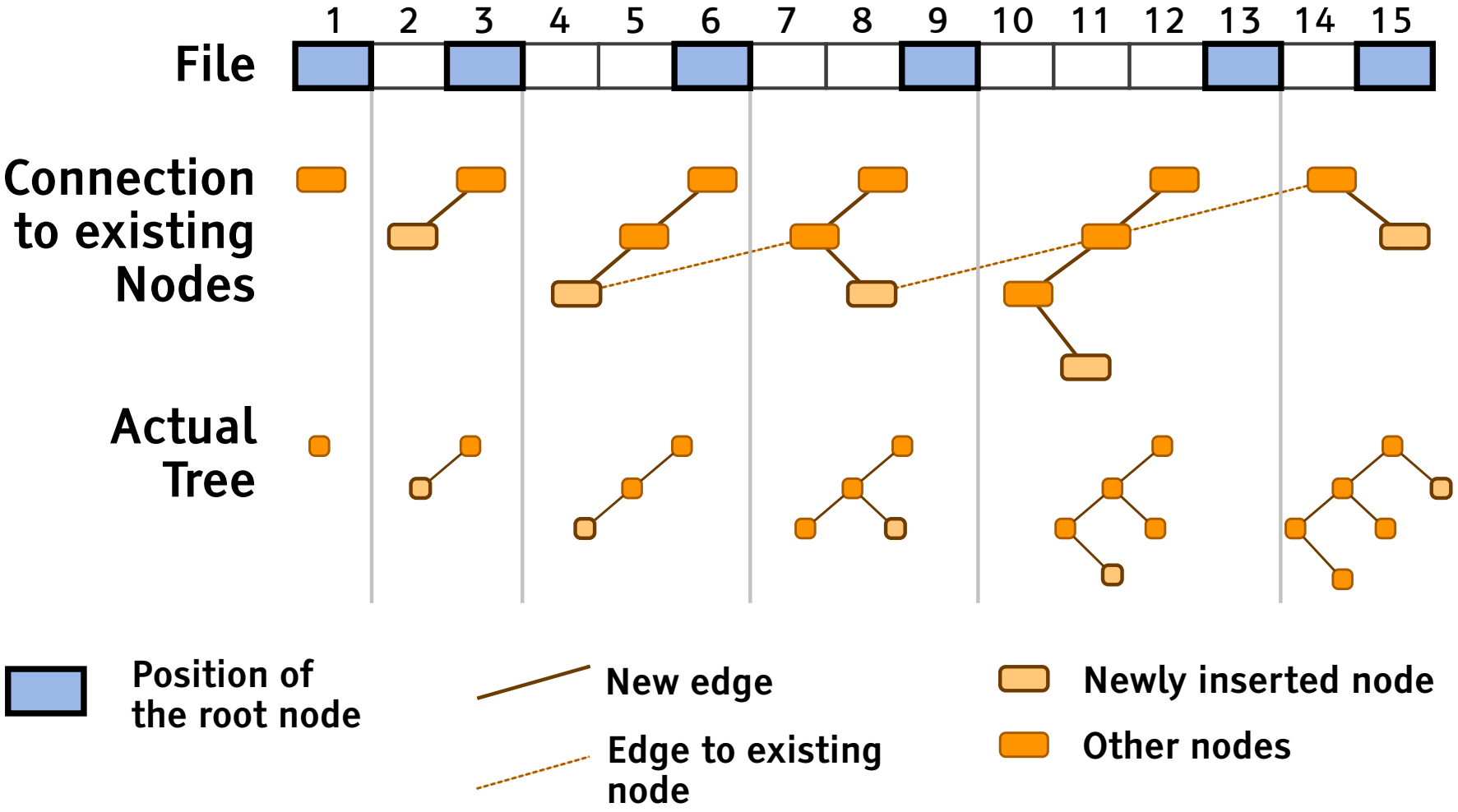
Append-only data structure (Example)



Append-only data structure (Example)



Append-only data structure (Example)

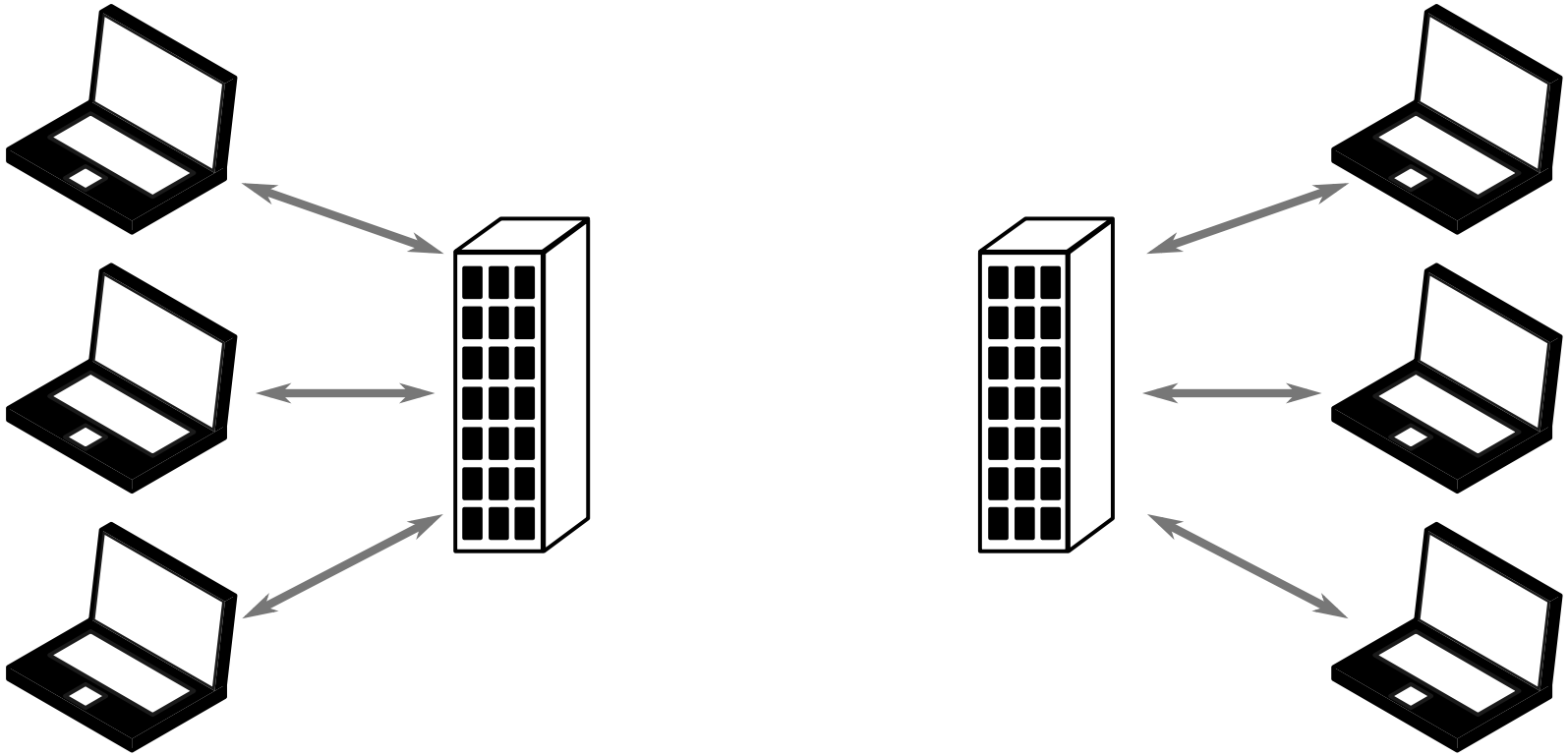


Concurrency/Robustness

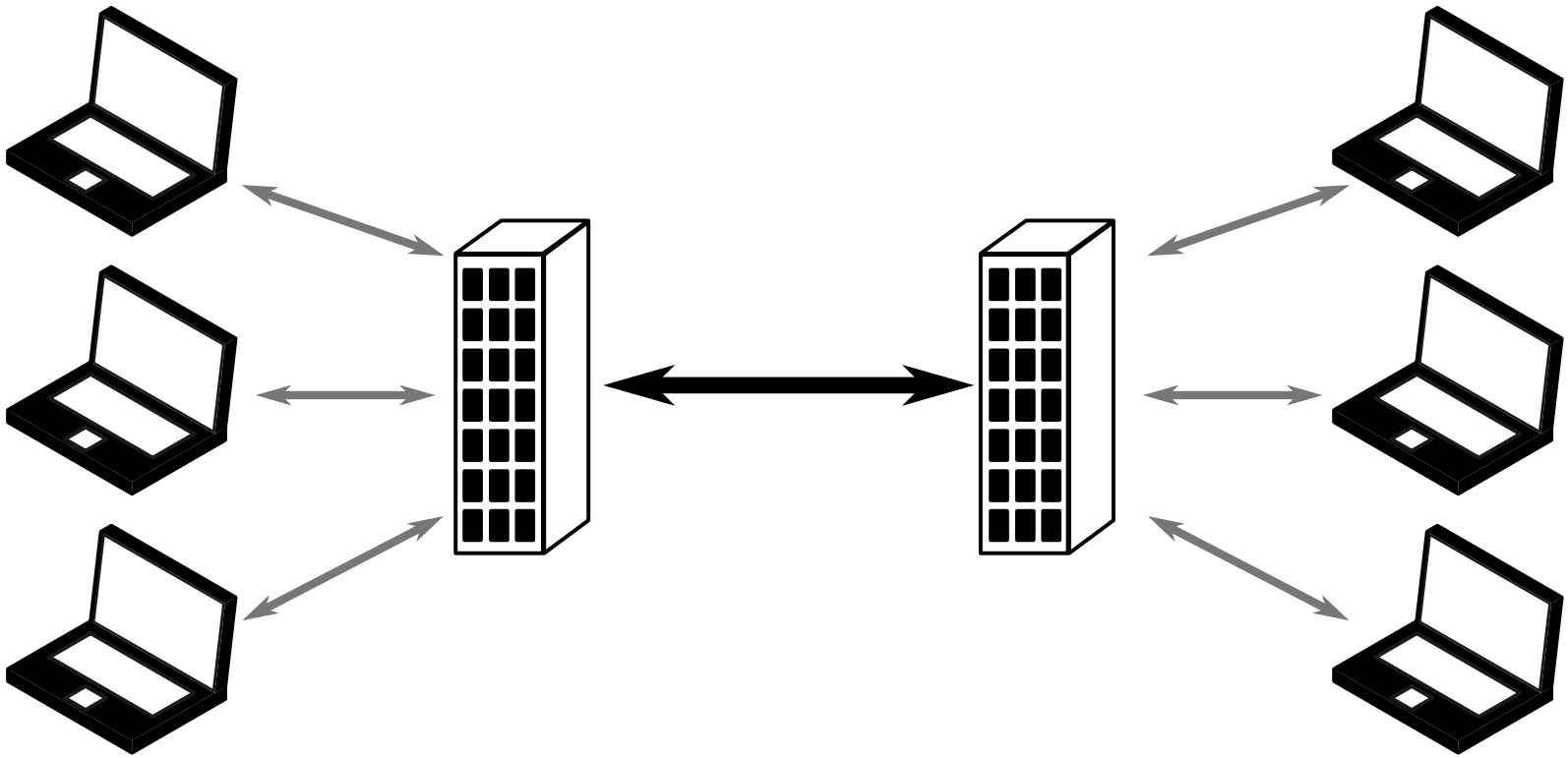
- Erlang
- Append-only
- Durability (crash-only design)
- No lock on reads (MVCC)

Replication

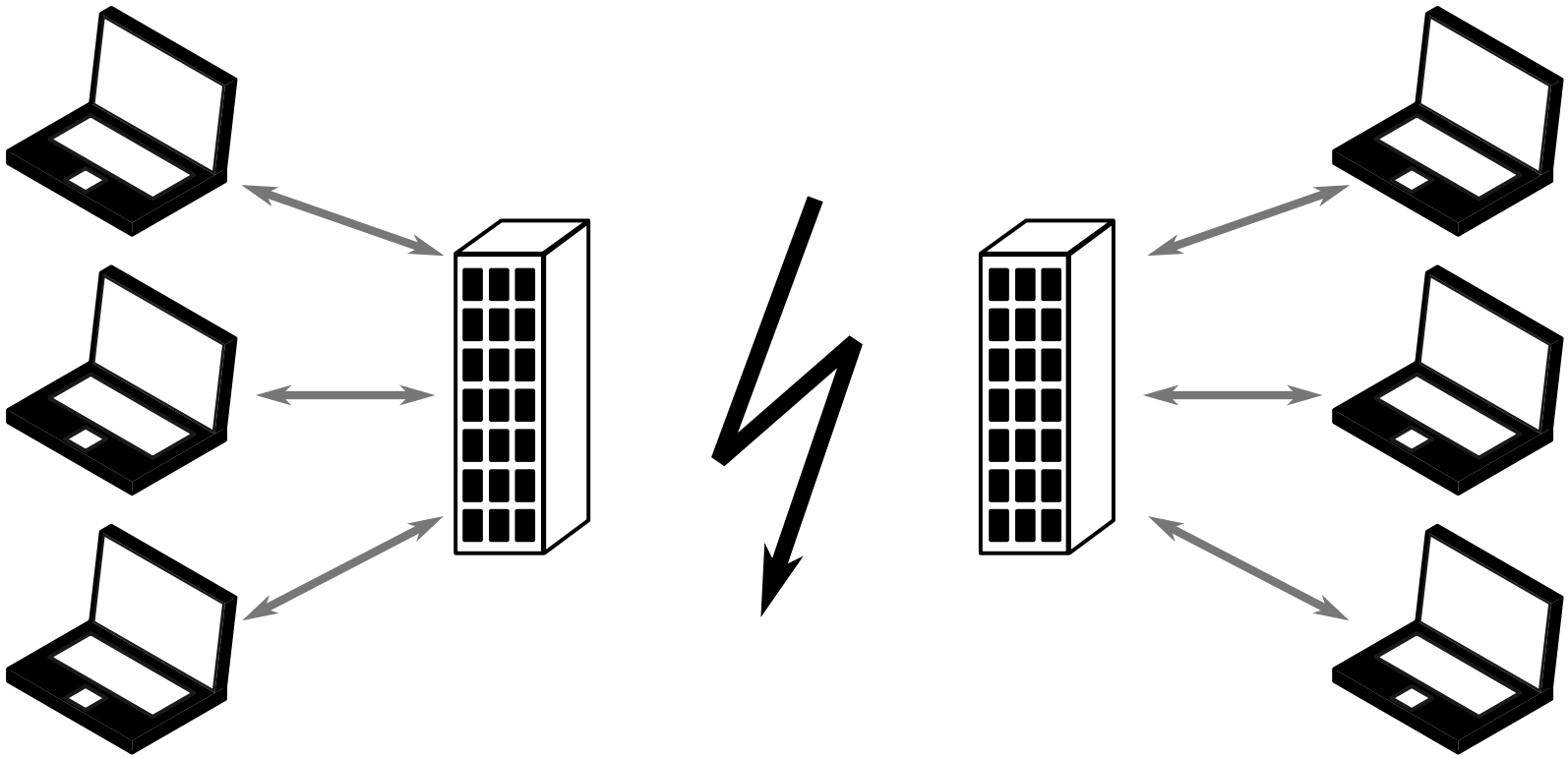
Replication



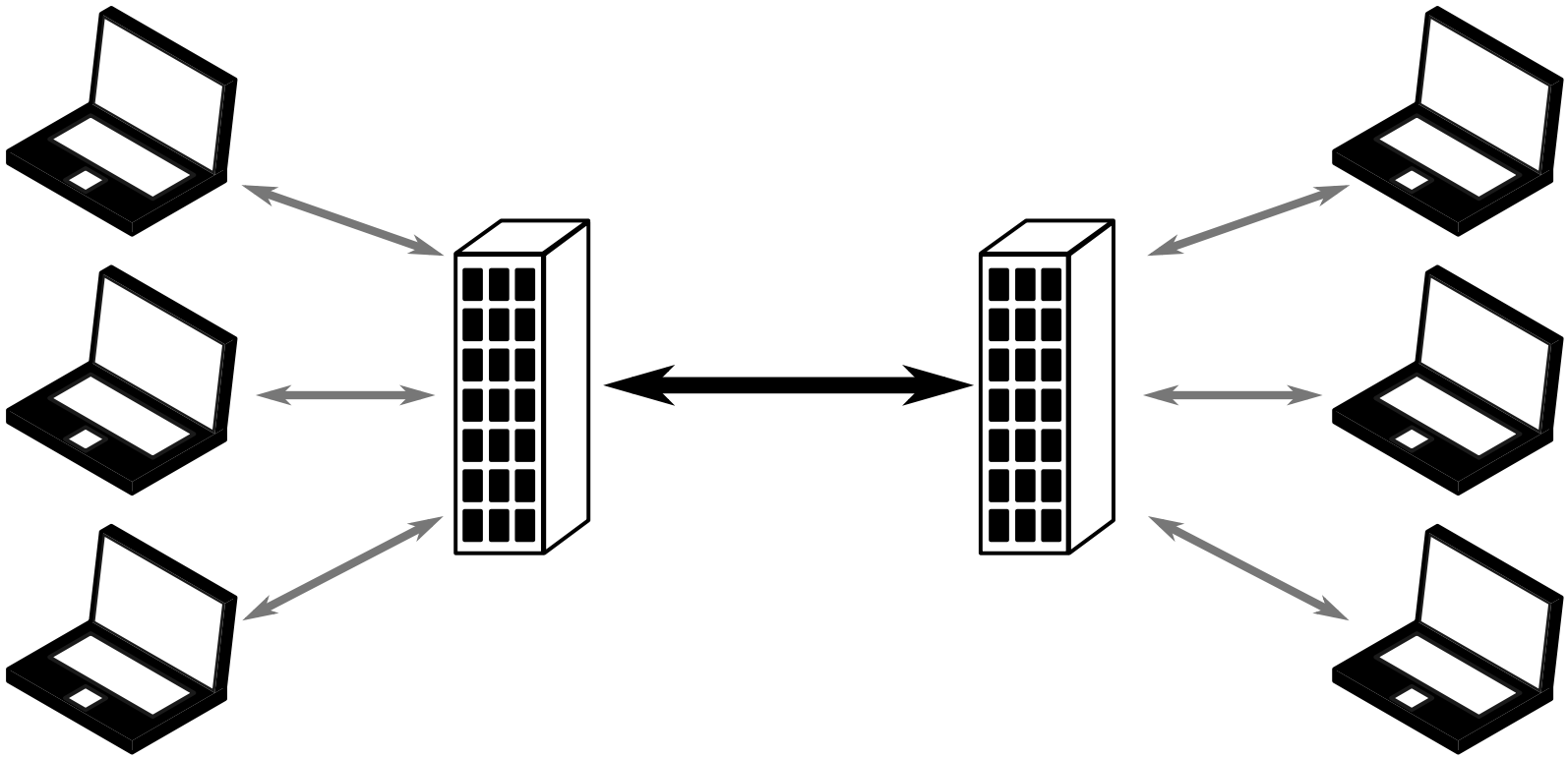
Replication



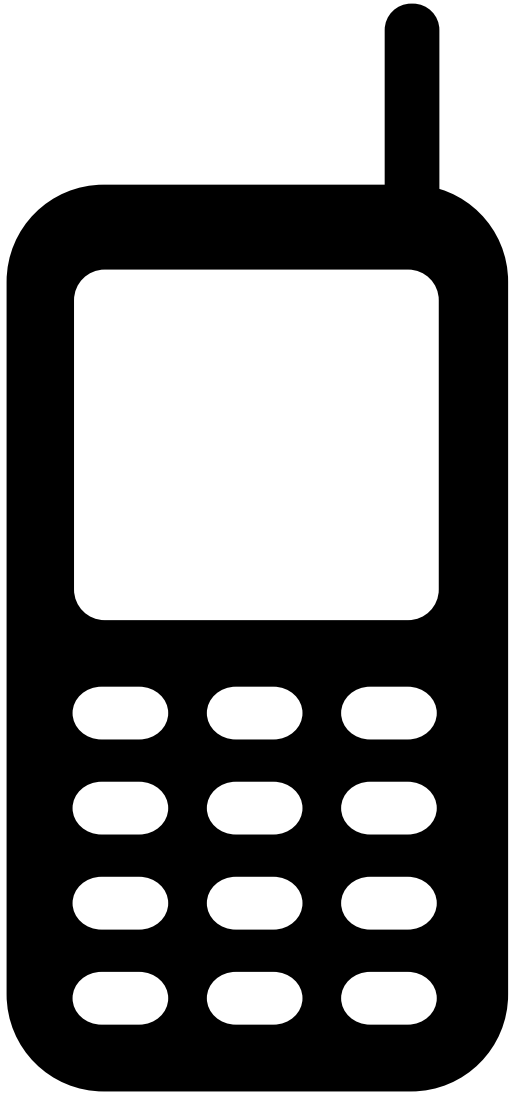
Replication



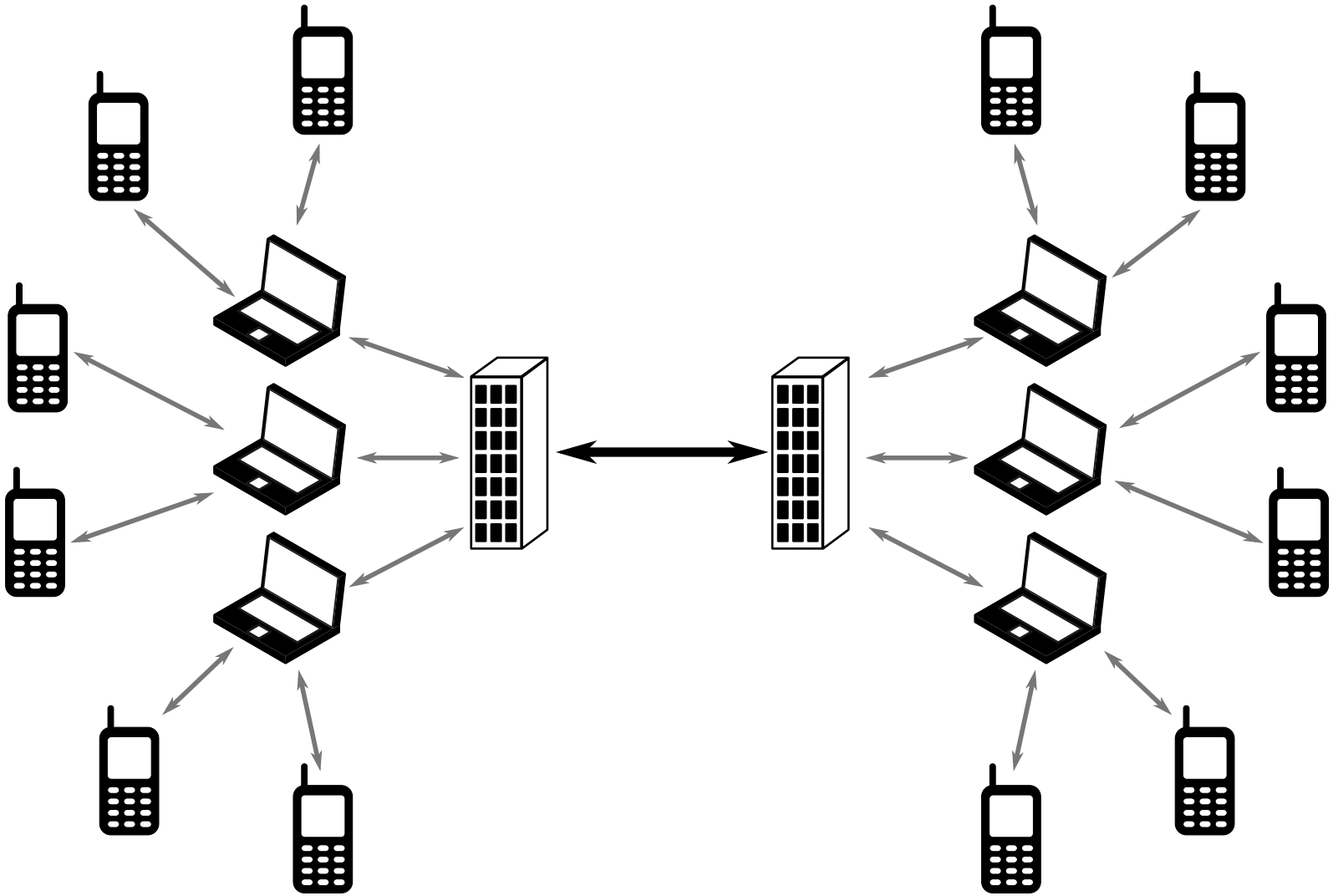
Replication



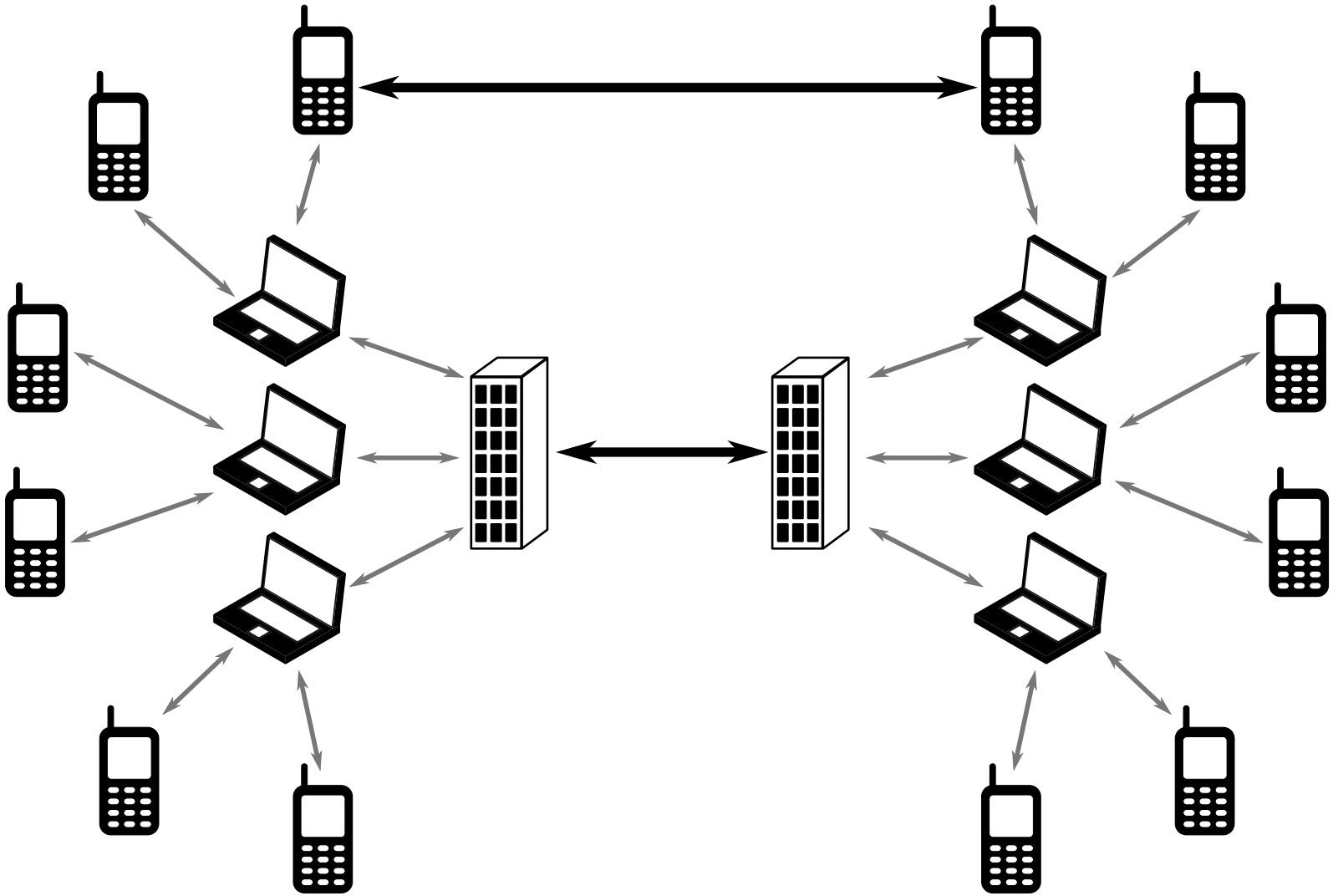
Replication



Replication



Replication



Seth Sawyers (CC-BY/2.0) (verändert)

GeoCouch

What is GeoCouch?

A spatial index for CouchDB

Implementation

- Completely written in Erlang
- No additional dependencies
- R-Tree
- Spatial index is independent of view index

GeoJSON

- Emerged as simple geo standard for the web
- Widely used
- Points, Lines, Polygons (all are supported by GeoCouch)
- Example:

```
{
  "type": "Point",
  "coordinates": [10.898333,48.371667]
}
```

Spatial Index Function

```
1 function(doc) {
2
3
4
5
6
7
8 }
```

Spatial Index Function

```
1 function(doc) {
2     if (doc.loc) {
3
4
5
6
7     }
8 }
```

Spatial Index Function

```
1 function(doc) {
2     if (doc.loc) {
3         emit(/* key */
4
5
6         ,/* value */);
7     }
8 }
```

Spatial Index Function

```
1 function(doc) {
2     if (doc.loc) {
3         emit({
4             type: "Point",
5             coordinates: doc.loc
6         },/* value */);
7     }
8 }
```

Spatial Index Function

```
1 function(doc) {
2     if (doc.loc) {
3         emit({
4             type: "Point",
5             coordinates: doc.loc
6         }, doc._id);
7     }
8 }
```

OpenSearch Geo

OpenSearch Geo

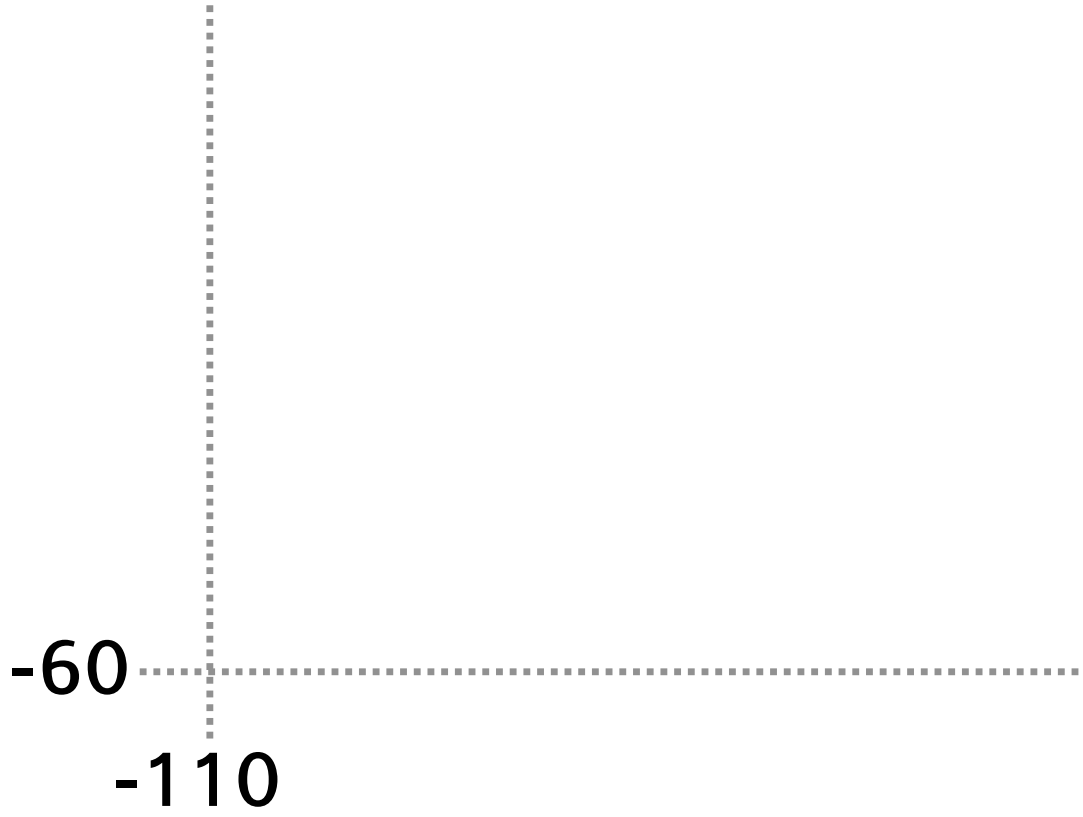
```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```

OpenSearch Geo

```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```

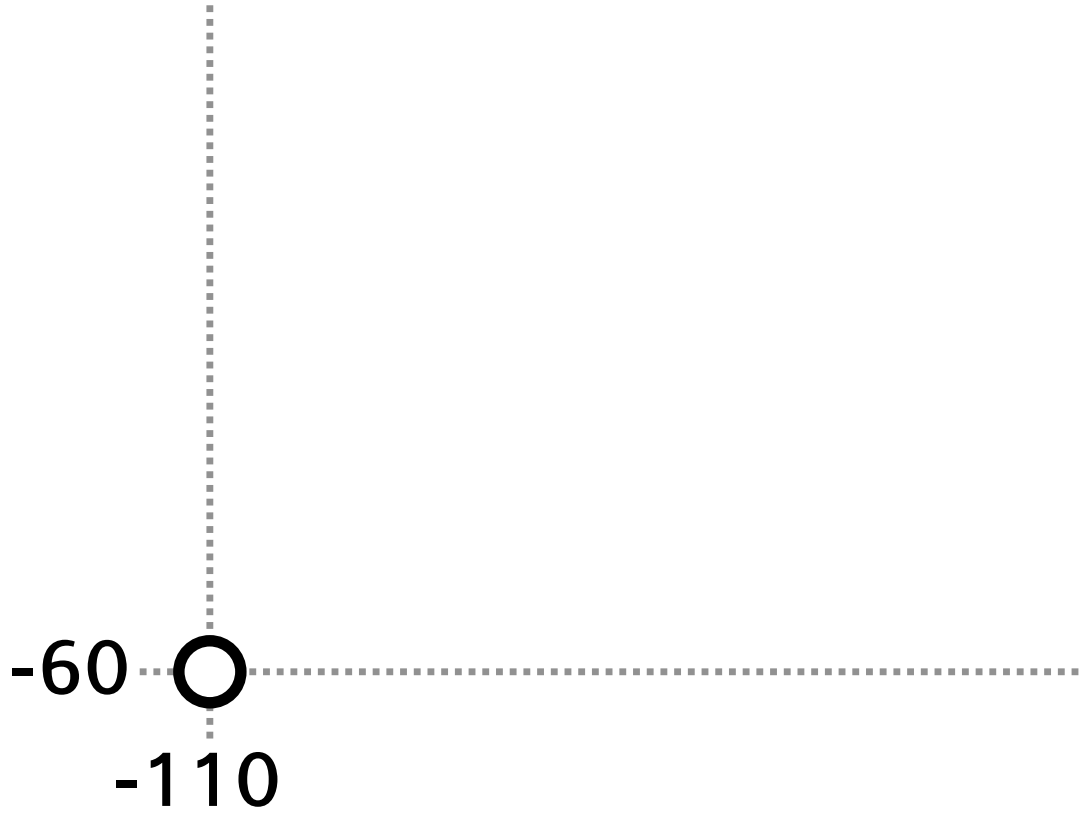
OpenSearch Geo

```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```



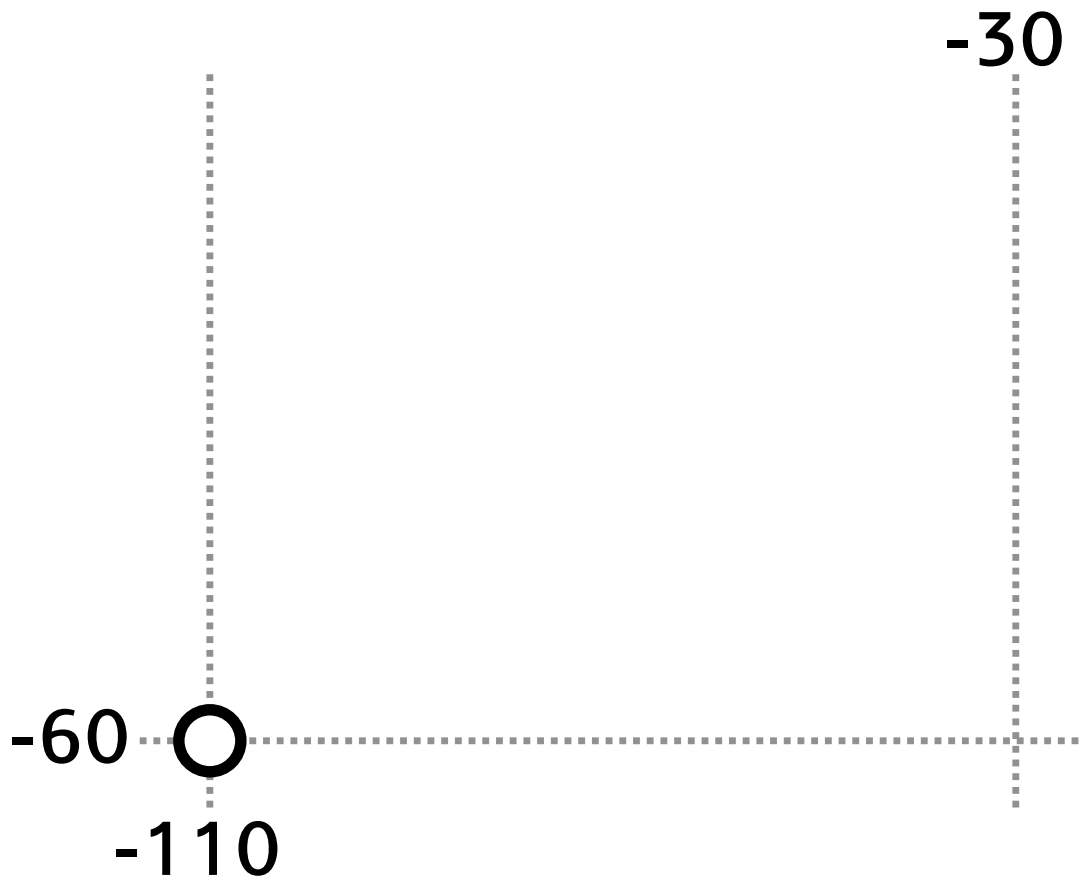
OpenSearch Geo

```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```



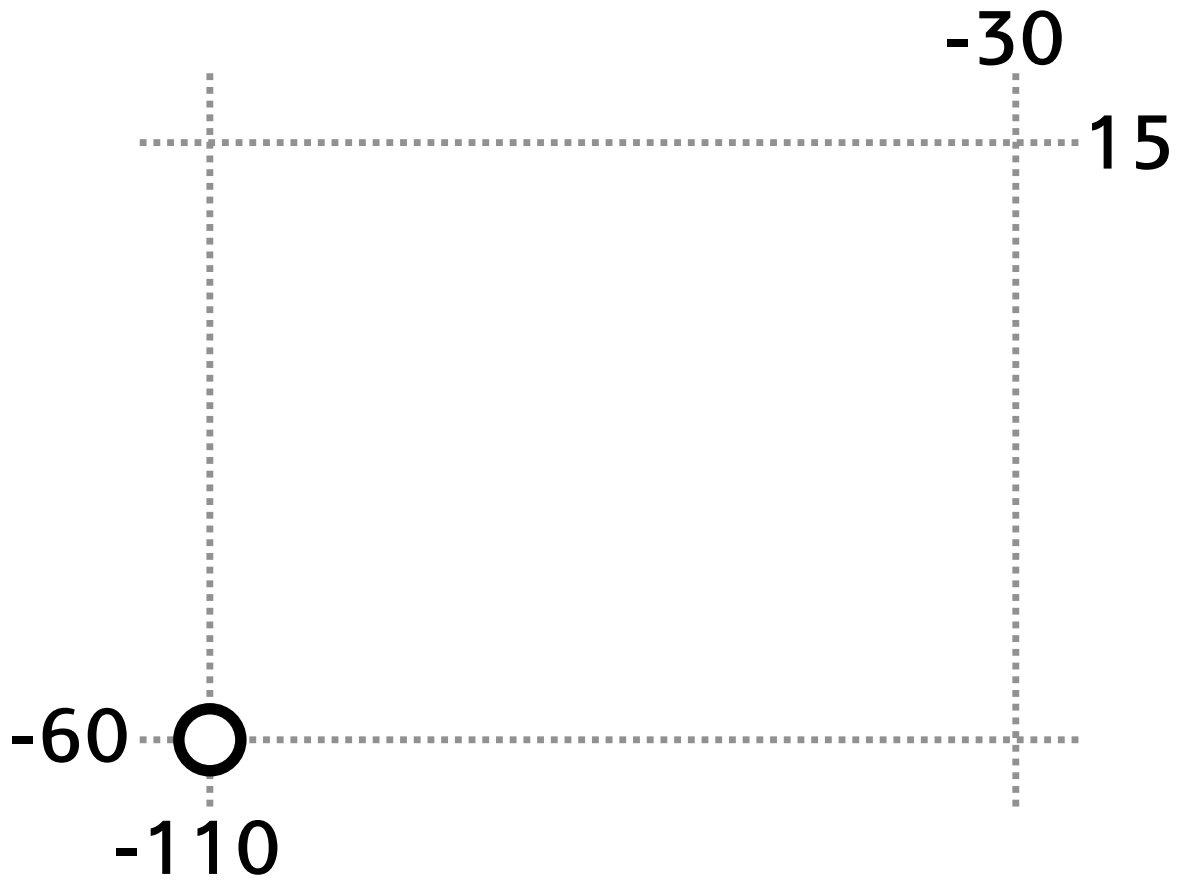
OpenSearch Geo

```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```



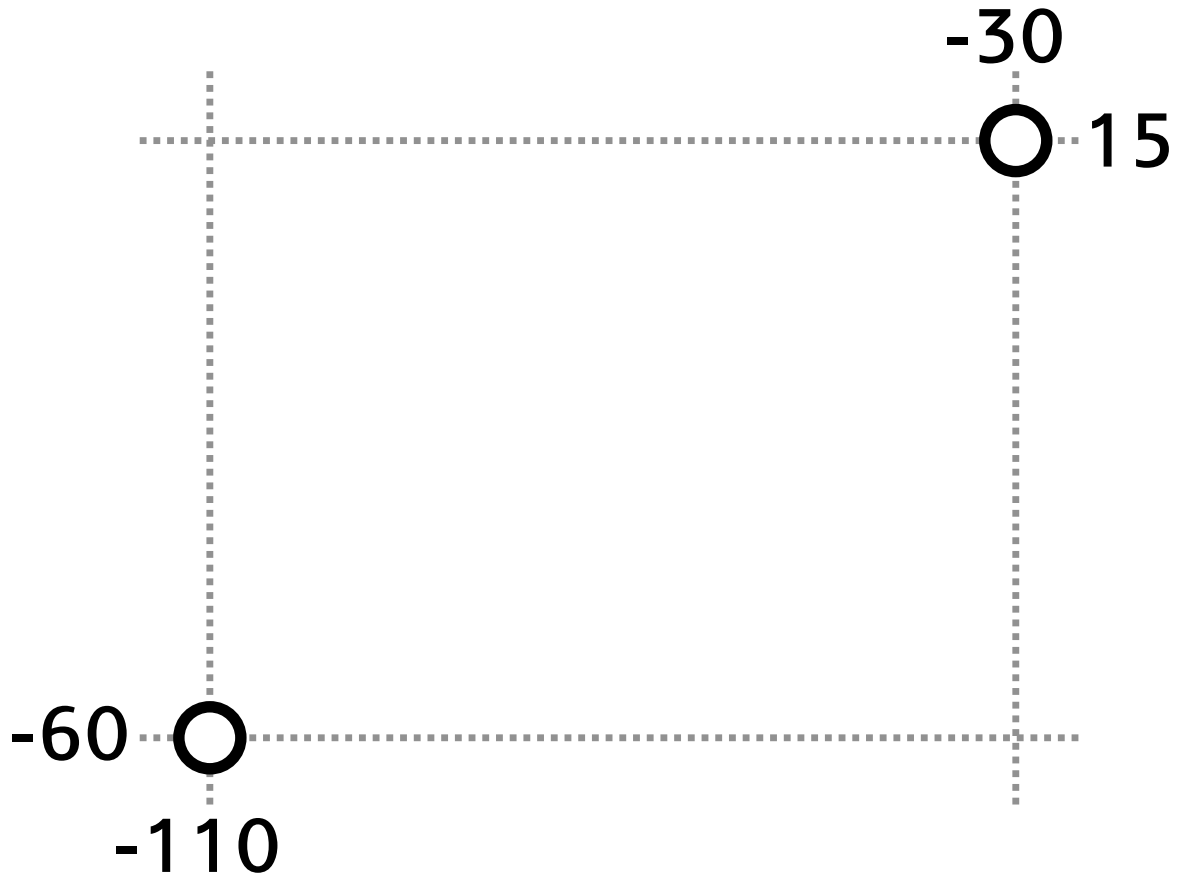
OpenSearch Geo

```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```



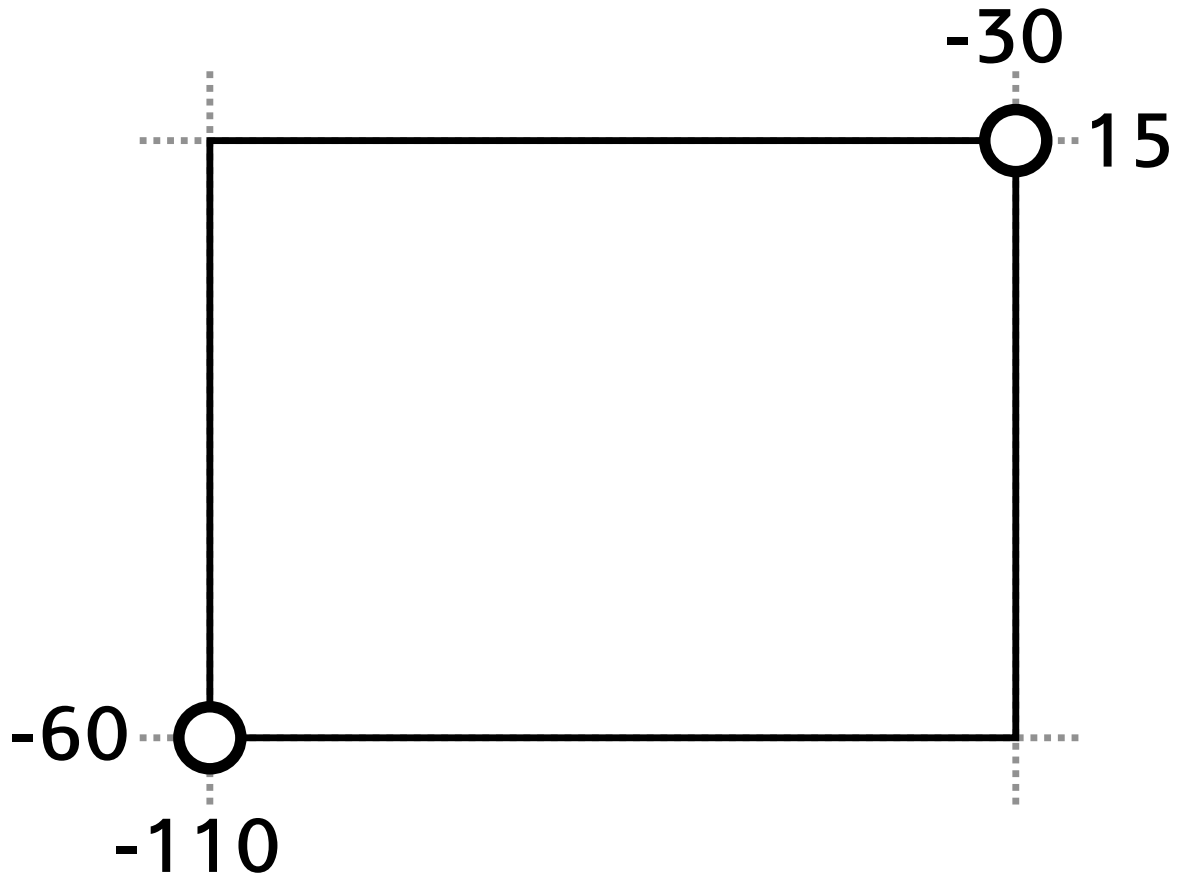
OpenSearch Geo

```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```



OpenSearch Geo

```
http://localhost:5984/db/_design/stations/
_spatial/points?bbox=-110,-60,-30,15
```



Web Mapping Applications

Serving up data

- Base map (e.g. Google, OpenStreetMap)

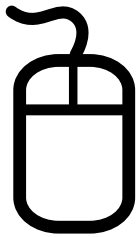
Source: http://www.openstreetbrowser.org/

Serving up data

- Base map (e.g. Google, OpenStreetMap)
- Some overlay (your data)

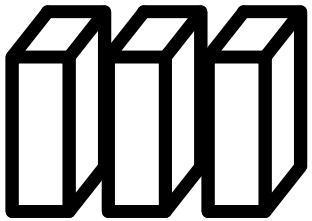
Source: http://www.openstreetbrowser.org/

Typical 3-Tier architecture



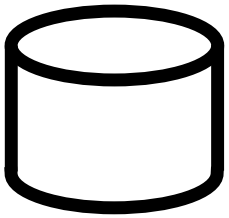
Client

JavaScript
(e.g. OpenLayers)



Server

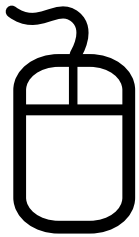
Web Map/Feature Server
(e.g. GeoServer, MapServer)



Database

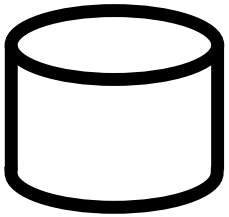
Geospatial database
(e.g. PostGIS, SpatiaLite)

2-Tier architecture with CouchDB



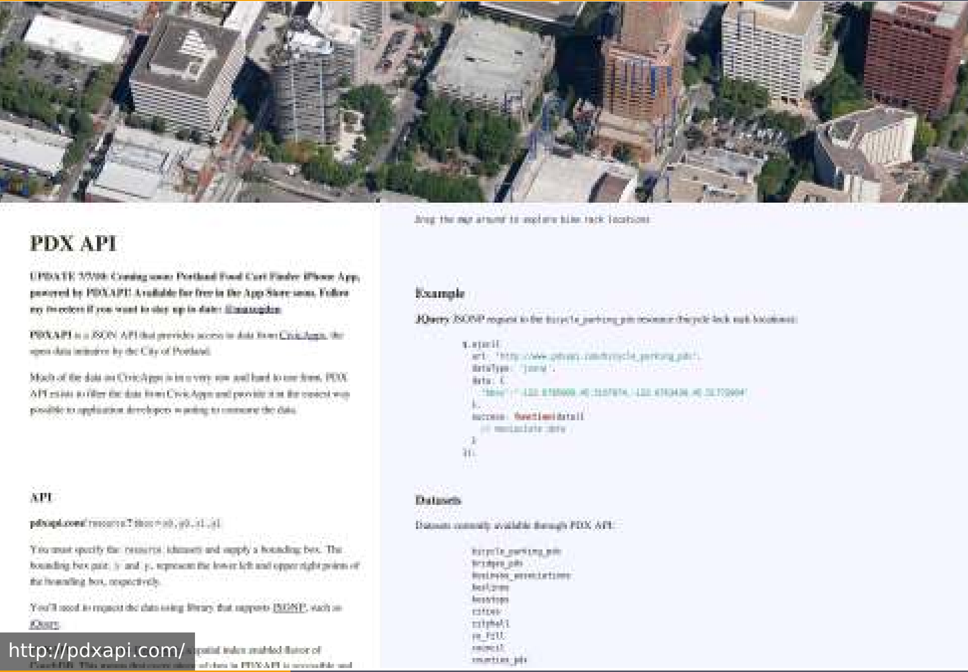
Client

JavaScript
(e.g. OpenLayers,
code to access CouchDB)

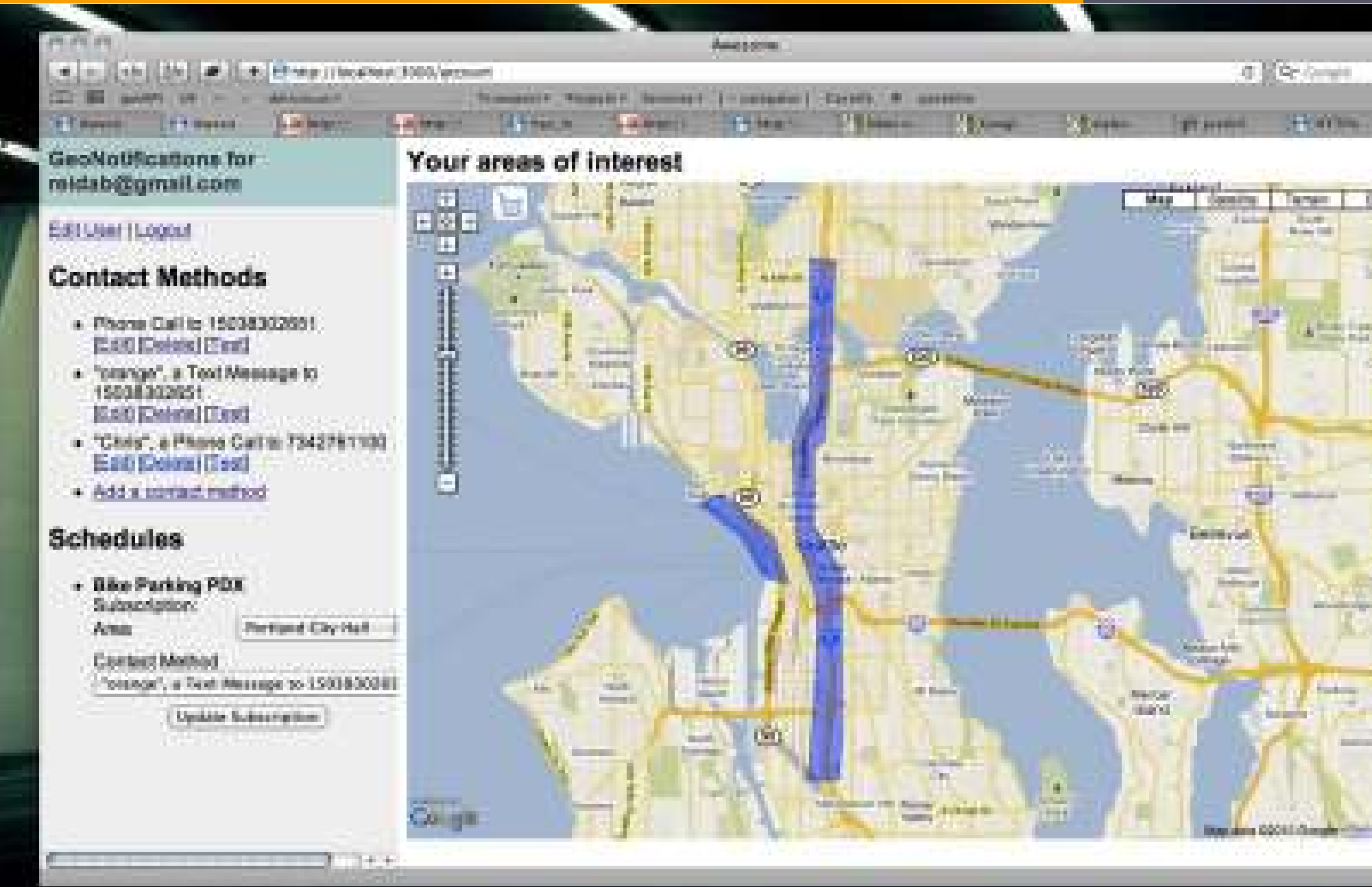


CouchDB
+ GeoCouch

Applications



http://pdxapi.com/


GeoNotifications for
mlslab@gmail.com
Edit User | Logout
Contact Methods
Phone Call to 15038302851
[Edit] [Delete] [Test]
"orange", a Text Message to
15038302851
[Edit] [Delete] [Test]
"Chris", a Phone Call to 7342761100
[Edit] [Delete] [Test]
Add a contact method
Schedules
Bike Parking PDX
Subscription:
Area
Portland City Hall
Contact Method
"orange", a Text Message to 15038302851
Update Subscription
Your areas of interest

Long term goals

- Polygon and radius search ($\rightarrow$ Erlang geometry library)
- Layer on top (e.g. for clustering, reprojection)
- Sharding

Thanks!

Get in touch with me

- Website: http://vmx.cx/
- IRC: vmx @ freenode
- Email: volker@couchone.com
- Jabber: volker@vmx.cx
- Twitter: @vmische