Stockage et analyse temps réel d'événements avec Riak chez Booking.com

Damien Krotkine

Damien Krotkine

- Ingénieur chez Booking.com

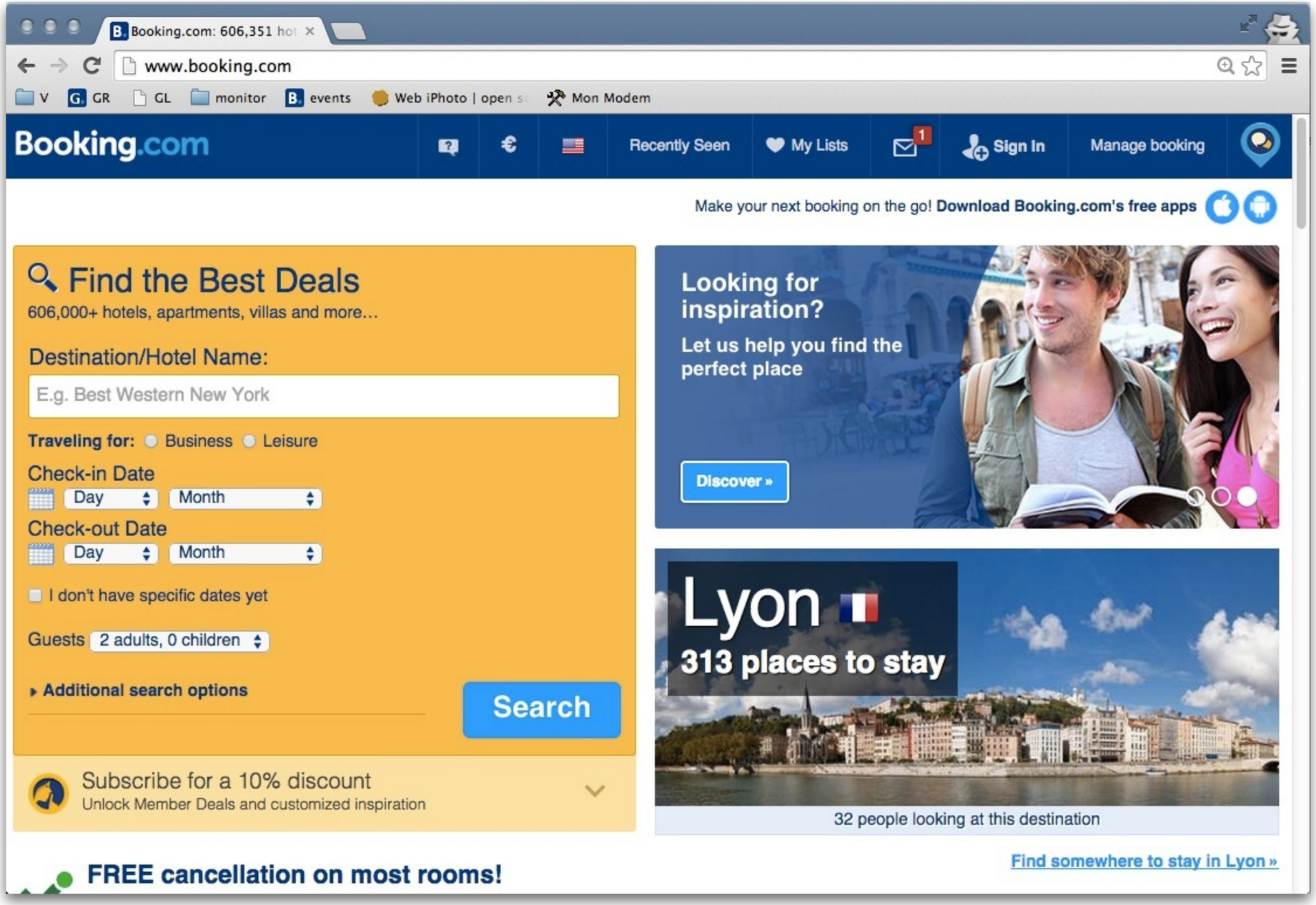
- github.com/dams

- @damsieboy

- dkrotkine

- 800,000 chambres reservées par jour

INTRODUCTION


Booking.com: 606,351 hot
www.booking.com
V
GR
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monitor
events
Web iPhoto | open s
Mon Modem
Booking.com
Recently Seen
My Lists
1
Sign In
Manage booking
Make your next booking on the go! Download Booking.com's free apps
Find the Best Deals
606,000+ hotels, apartments, villas and more…
Destination/Hotel Name:
E.g. Best Western New York
Traveling for: Business Leisure
Check-in Date
Day
Month
Check-out Date
Day
Month
I don't have specific dates yet
Guests 2 adults, 0 children
Additional search options
Search
Looking for inspiration?
Let us help you find the perfect place
Discover »
Lyon
313 places to stay
32 people looking at this destination
Subscribe for a 10% discount
Unlock Member Deals and customized inspiration
FREE cancellation on most rooms!
Find somewhere to stay in Lyon »


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monitor
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Day
Month
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Guests 2 adults, 0 children
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313 places to stay
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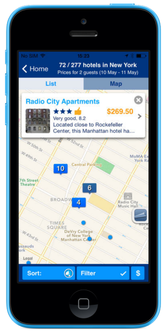
FREE cancellation on most rooms!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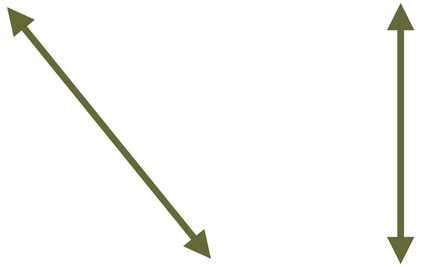
72 / 277 hotels in New York
List
Map
Radio City Apartments
$269.50
Sort:
Filter

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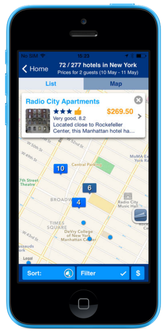
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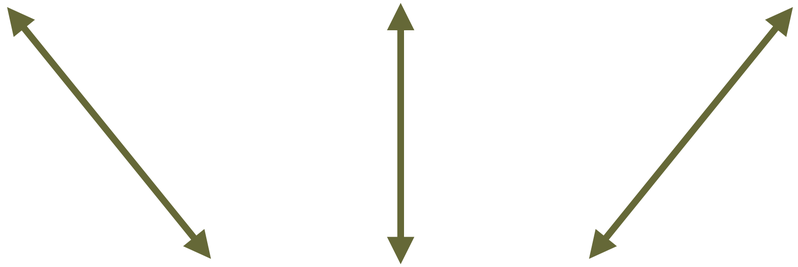
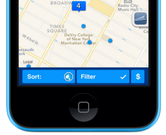


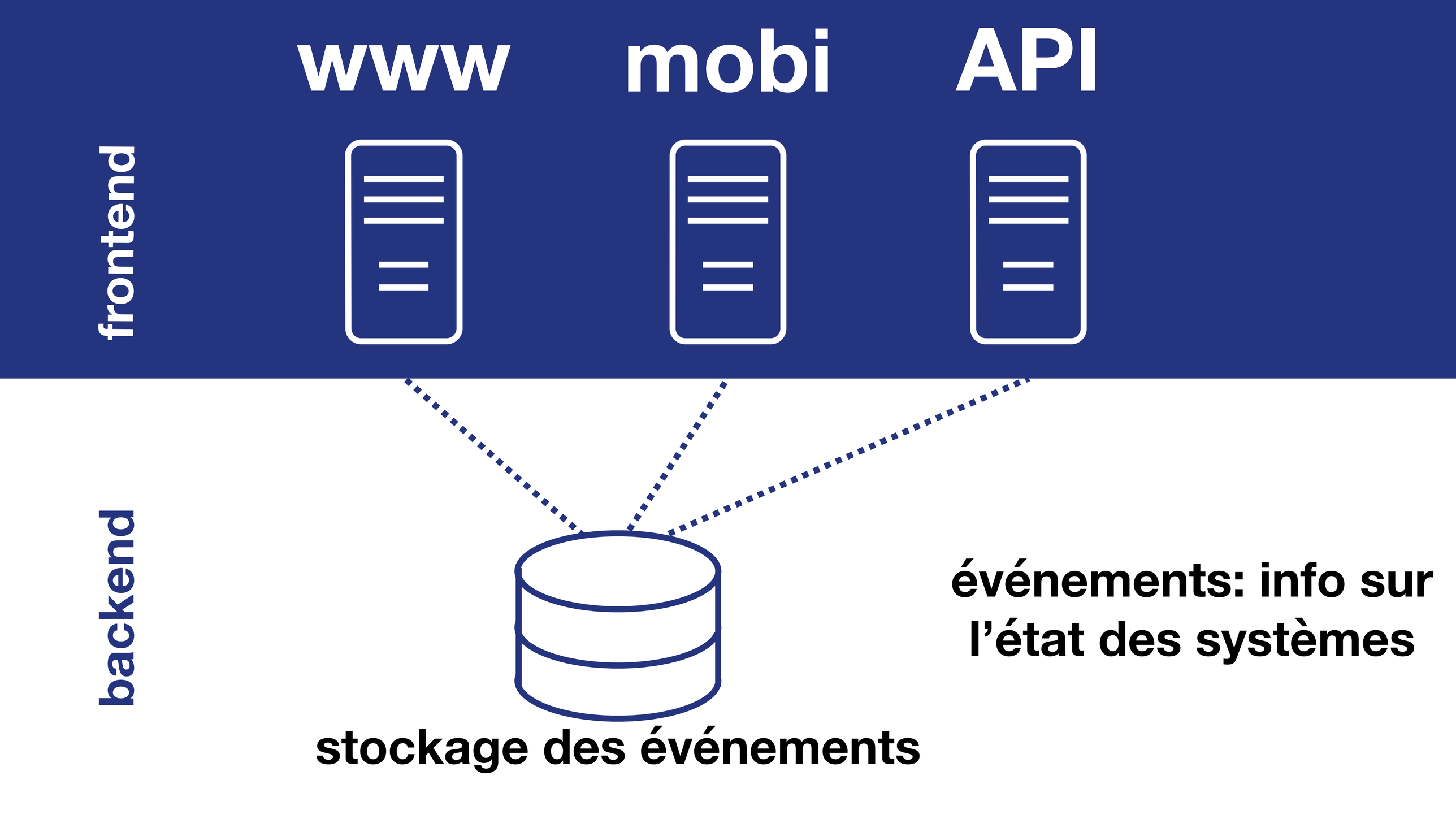


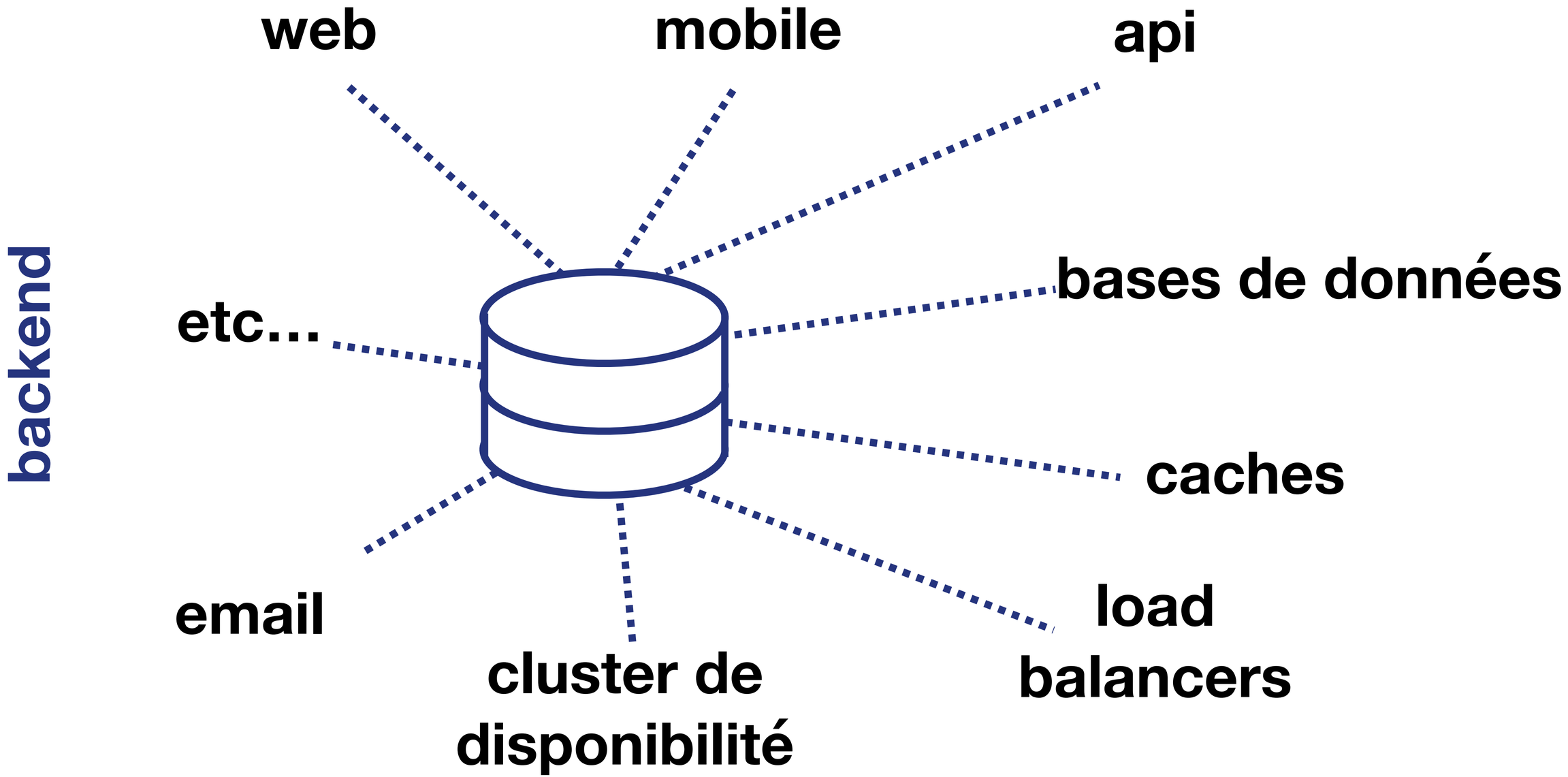
frontend

www

mobi

API


www
mobi
API
frontend
backend
stockage des événements
événements: info sur
l’état des systèmes


backend
web
mobile
api
bases de données
etc…
caches
email
cluster de
disponibilité
load
balancers

QU’EST-CE QU’UN EVENEMENT ?

STRUCTURE D’UN EVENEMENT

- **Information** sur un **système**
- Données
- HashMap profond
- Timestamp
- Data Center + Type + Sous-type
- Le reste: données spécifiques
- **Sans Schema**

```
{ timestamp => 12345,
  type => 'WEB',
  subtype => ‘app',
  dc => 1,
  action => { is_normal_user => 1,
              pageview_id => '188a362744c301c2',
              # ...
            },
  tuning => { the_request => 'GET /display/...'
              bytes_body => 35,
              wallclock => 111,
              nr_warnings => 0,
              # ...
            },
  # ...
}
```

```
{ type => 'FAV',
  subtype => 'fav',
  timestamp => 1401262979,
  dc => 1,
  tuning => {
      flatav => {
          cluster => '205',
          sum_latencies => 21,
          role => 'fav',
          num_queries => 7
      }
  }
}
```

PROPRIETES DU FLUX D’EVENEMENTS

- Lecture seule
- Sans schema
- Flux continu, ordonné, temporel
- 15 K événements par sec
- **1.25 Milliards** événements par jour
- pics à 70 MB/s, min 25MB/s
- 100 GB par heure

UTILISATION

DEFINIR LES BESOINS

- Avant d’aborder le stockage
- Penser à l’utilisation

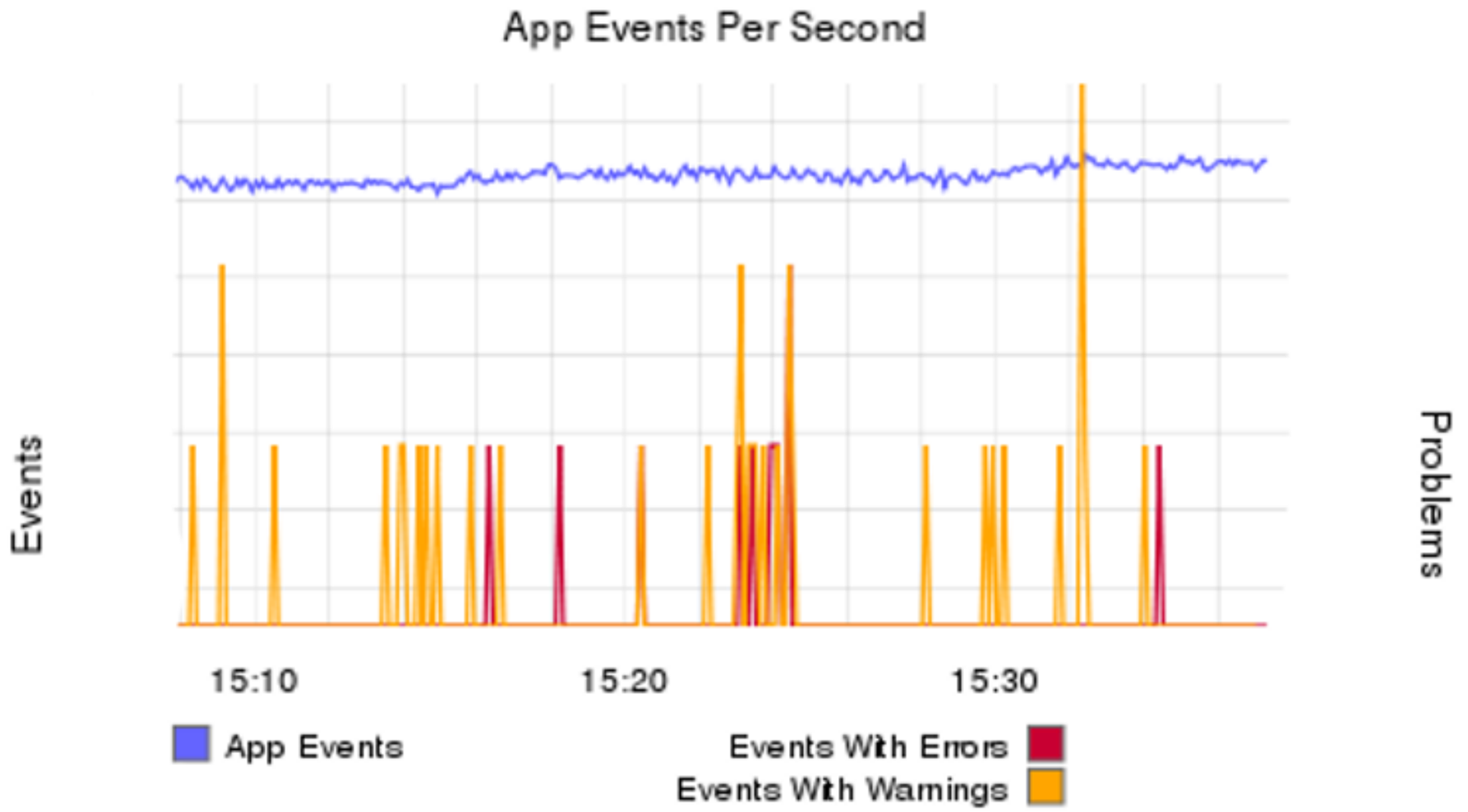
UTILISATION

1. GRAPHS
2. PRISE DE DECISION
3. ANALYSE COURT TERME
4. A/B TESTING

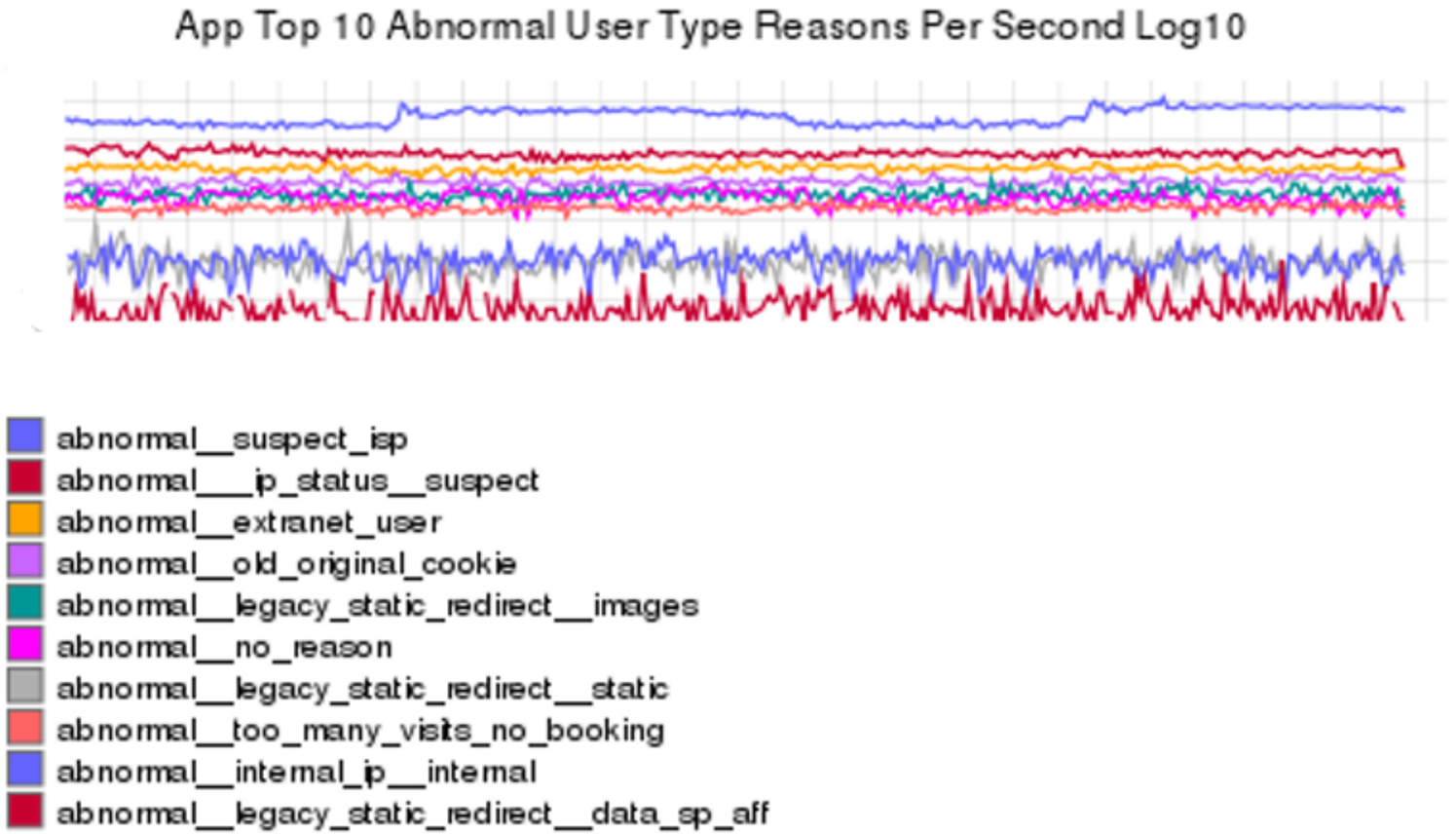
GRAPHS

- Graph en temps réel (lag = quelques secondes)
- Graph pour le plus de systèmes possibles
- Etat de santé général de la plateforme

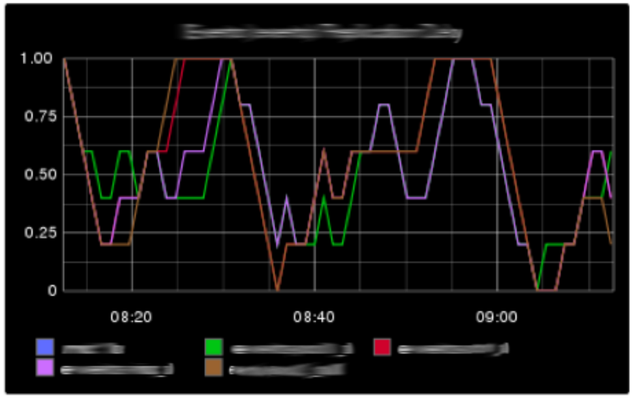
GRAPHS

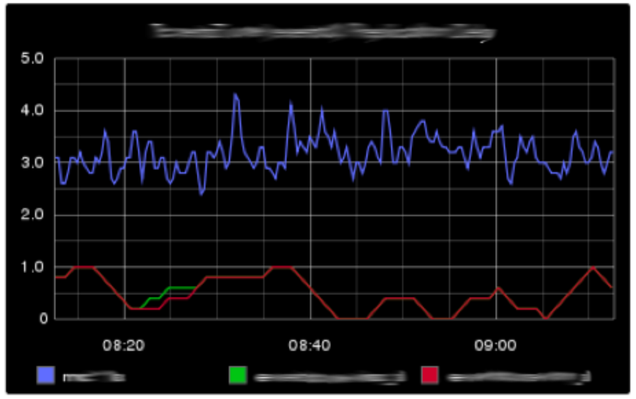

App Events Per Second
Events
Problems
15:10
15:20
15:30
App Events
Events With Errors
Events With Warnings

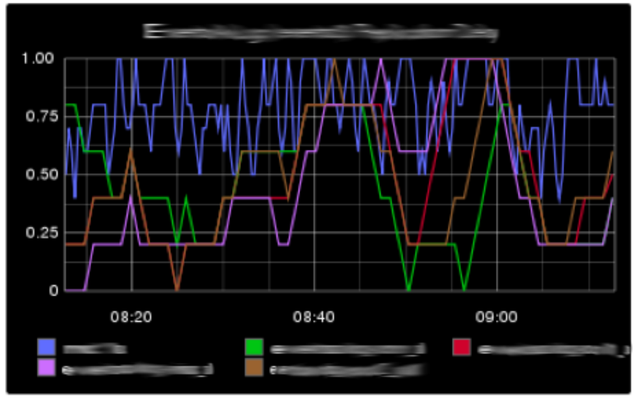
GRAPHS

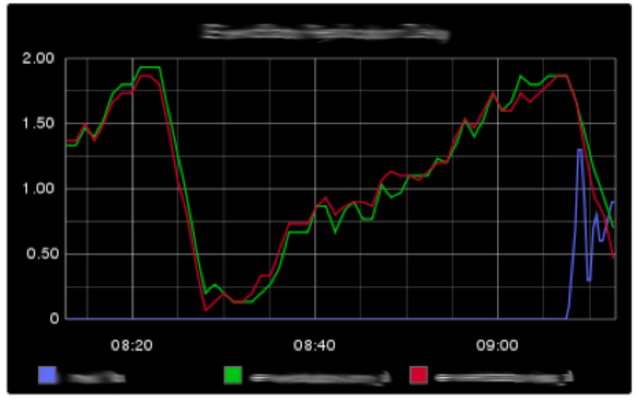

App Top 10 Abnormal User Type Reasons Per Second Log10
abnormal__suspect_isp
abnormal___ip_status__suspect
abnormal__extranet_user
abnormal__old_original_cookie
abnormal__legacy_static_redirect__images
abnormal__no_reason
abnormal__legacy_static_redirect__static
abnormal__too_many_visits_no_booking
abnormal__internal_ip__internal
abnormal__legacy_static_redirect__data_sp_aff

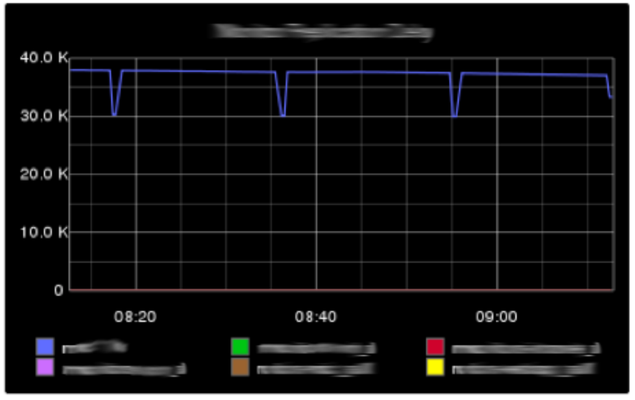
DASHBOARDS

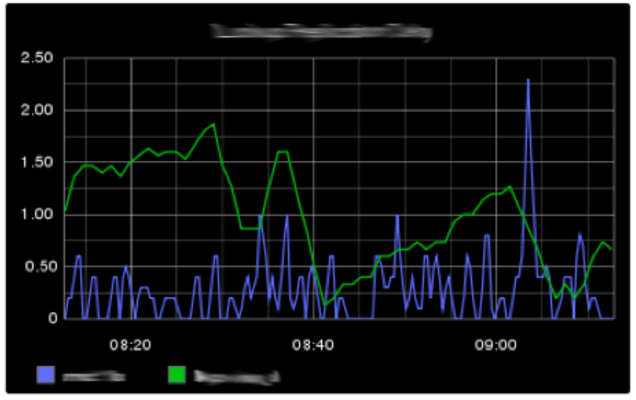

1.00
0.75
0.50
0.25
0
08:20
08:40
09:00

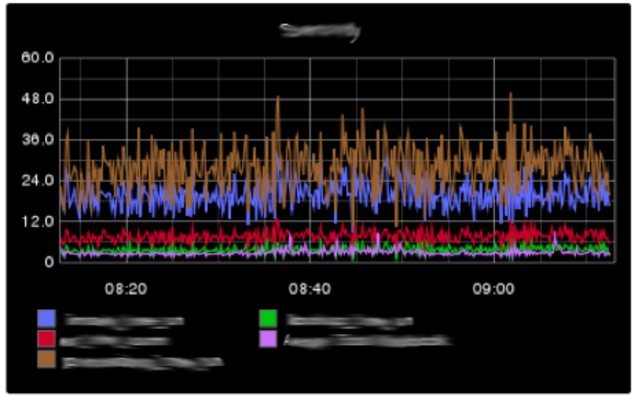

5.0
4.0
3.0
2.0
1.0
0
08:20
08:40
09:00

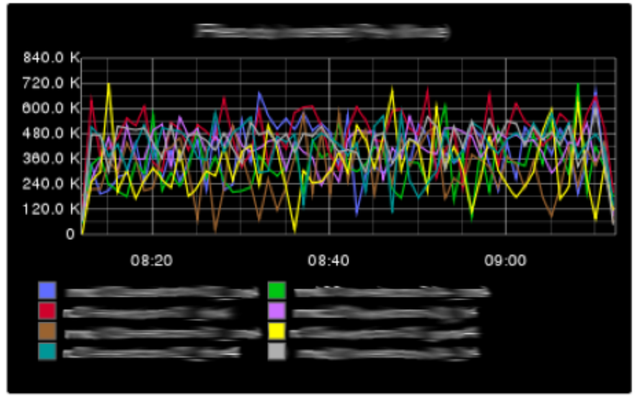

1.00
0.75
0.50
0.25
0
08:20
08:40
09:00

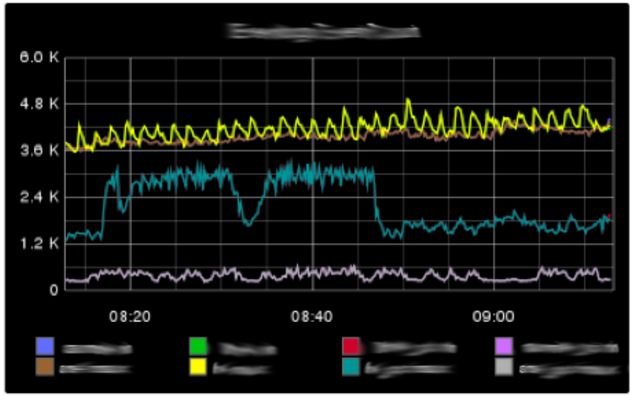

2.00
1.50
1.00
0.50
0
08:20
08:40
09:00


40.0 K
30.0 K
20.0 K
10.0 K
0
08:20
08:40
09:00


2.50
2.00
1.50
1.00
0.50
0
08:20
08:40
09:00


60.0
48.0
36.0
24.0
12.0
0
08:20
08:40
09:00


840.0 K
720.0 K
600.0 K
480.0 K
360.0 K
240.0 K
120.0 K
0
08:20
08:40
09:00


6.0 K
4.8 K
3.6 K
2.4 K
1.2 K
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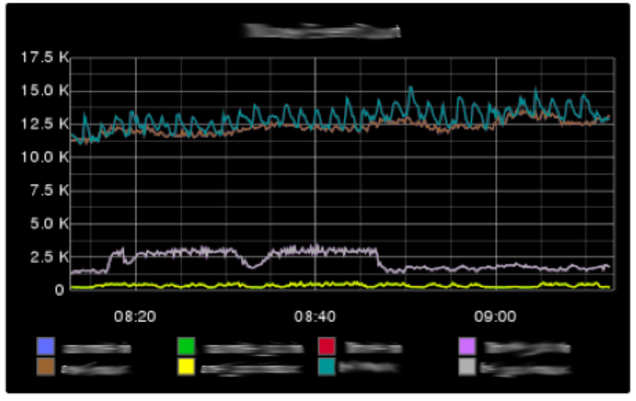
17.5 K
15.0 K
12.5 K
10.0 K
7.5 K
5.0 K
2.5 K
0
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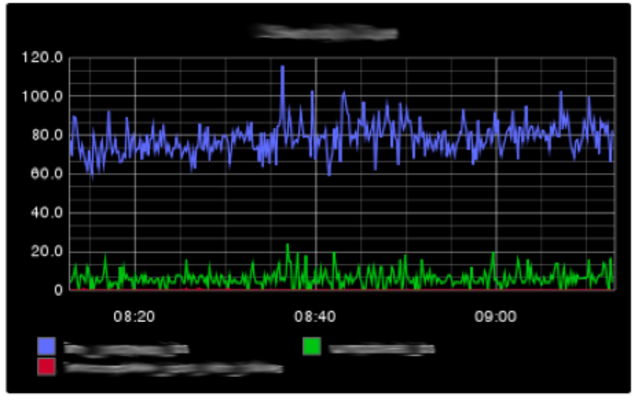
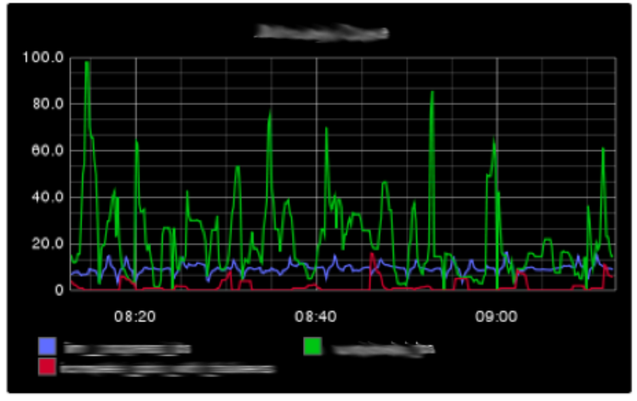
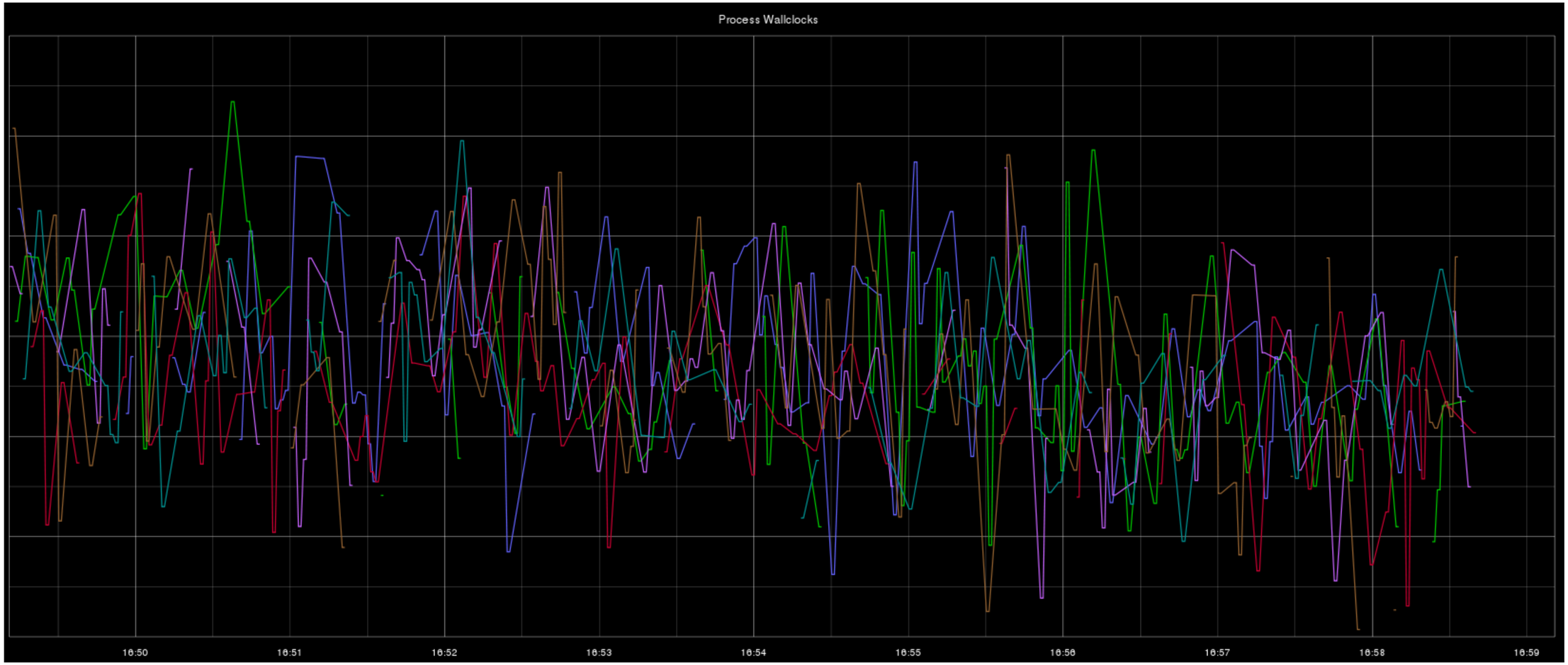
08:40
09:00


120.0
100.0
80.0
60.0
40.0
20.0
0
08:20
08:40
09:00


100.0
80.0
60.0
40.0
20.0
0
08:20
08:40
09:00

META GRAPHS


Process Wallclocks
16:50
16:51
16:52
16:53
16:54
16:55
16:56
16:57
16:58
16:59

USAGE

1. GRAPHS
2. PRISE DE DECISION
3. ANALYSE COURT TERME
4. A/B TESTING

DECISION MAKING

- Decisions Stratégiques (philosophie “use facts”)
- Court terme / long terme
- Décisions techniques / non techniques

USAGE

1. GRAPHS
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SHORT TERM ANALYSIS

- 10 dernières secondes -> il y a 8 jours
- Déploiement de code et rollback
- Détecteur d’Anomalies

USAGE

1. GRAPHS
2. PRISE DE DECISION
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4. A/B TESTING

A/B TESTING

- Philosophie “use facts”
- Implique A/B testing
- Concept d’”experimentations”: Experiments
- Evénements procurent la matière première

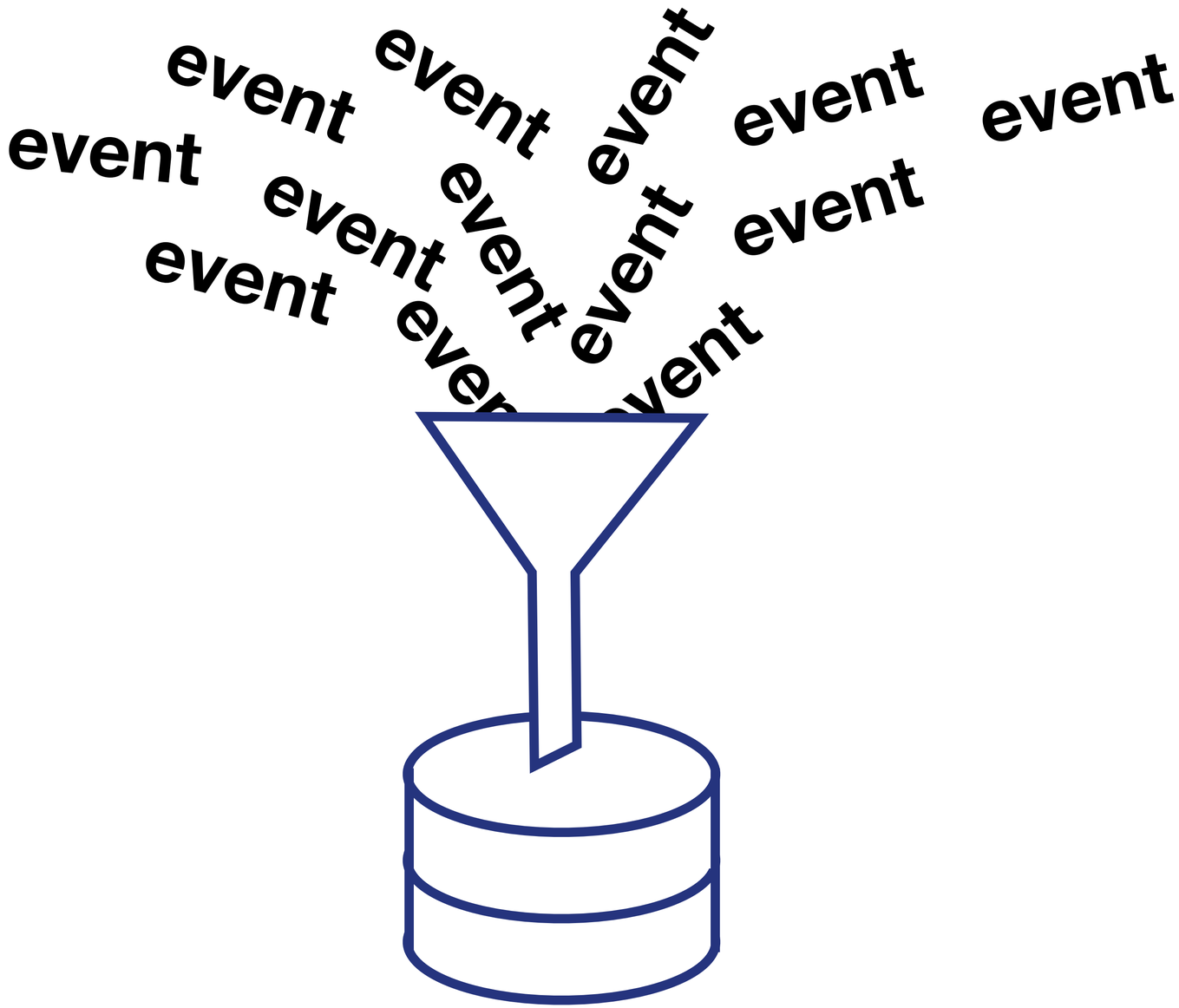
AGGREGATION D’EVENEMENTS

AGGREGATION D’EVENEMENTS

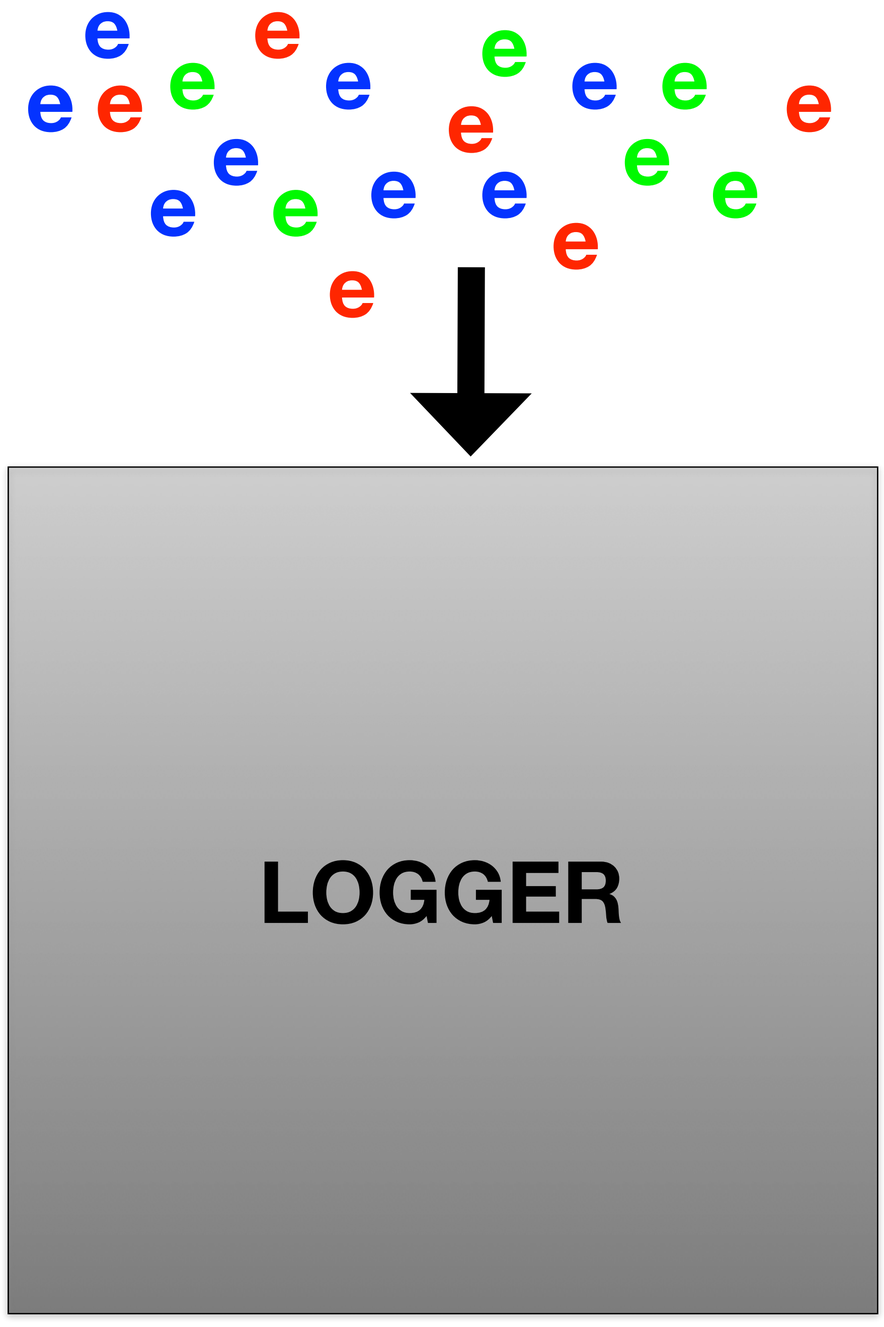
- Regrouper les événements
- Granularité nécessaire: seconde

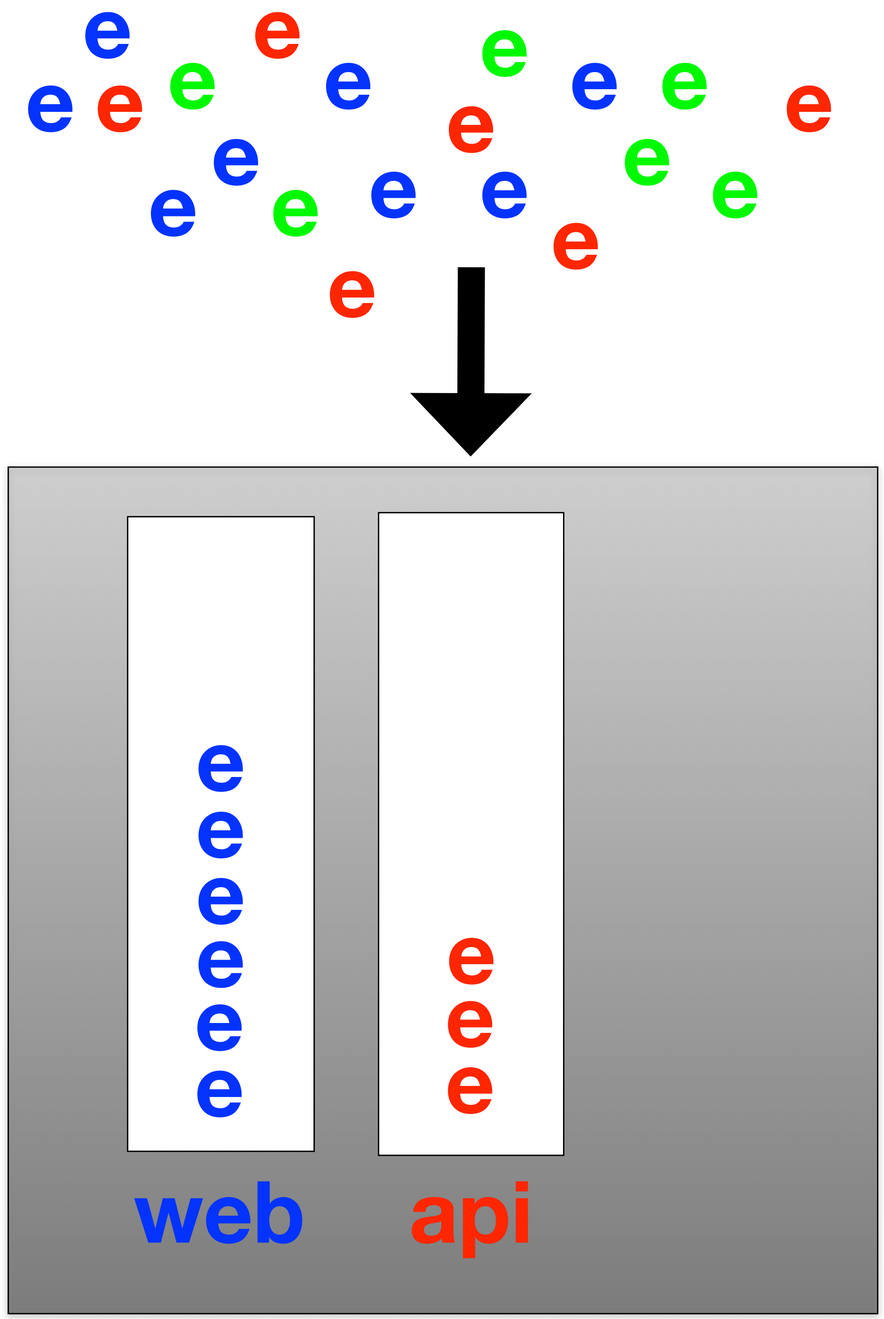
SERIALISATION

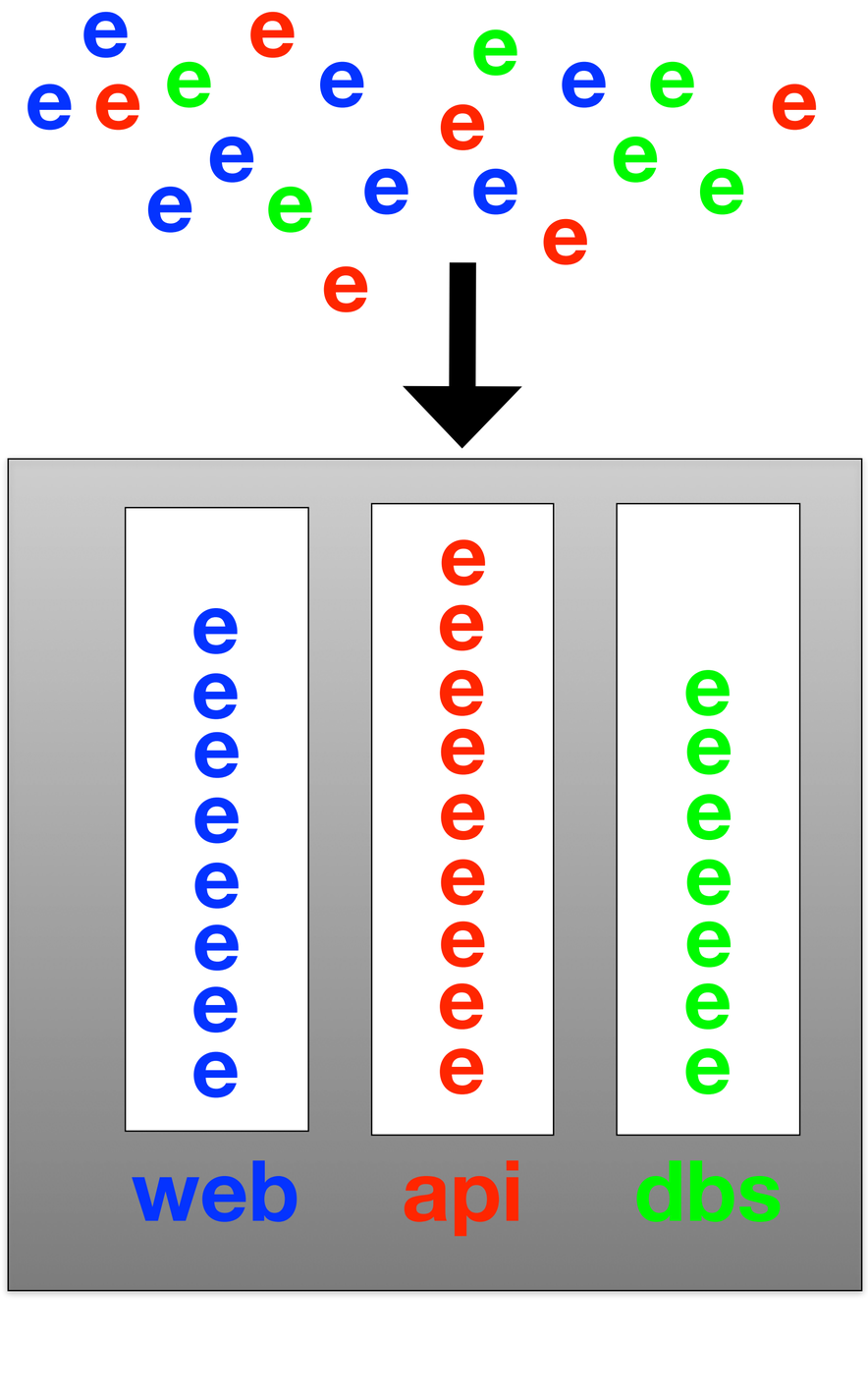
- JSON ne nous allait pas (lent, gros, manque de fonct.)
- Création de Sereal en 2012
- « *Sereal, a new, **binary** data serialization format that provides high-**performance**, **schema-less** serialization* »
- https://github.com/Sereal/Sereal

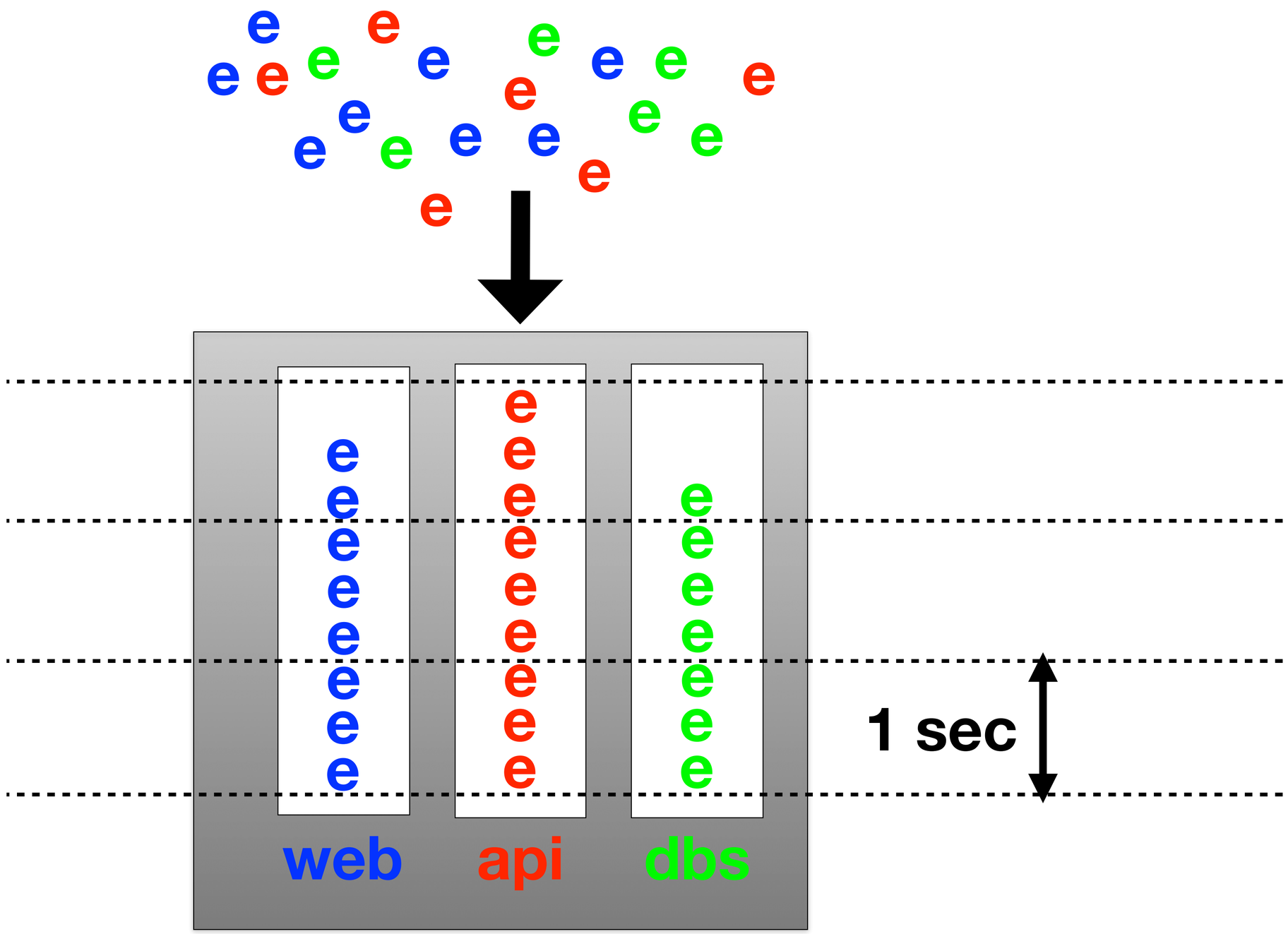


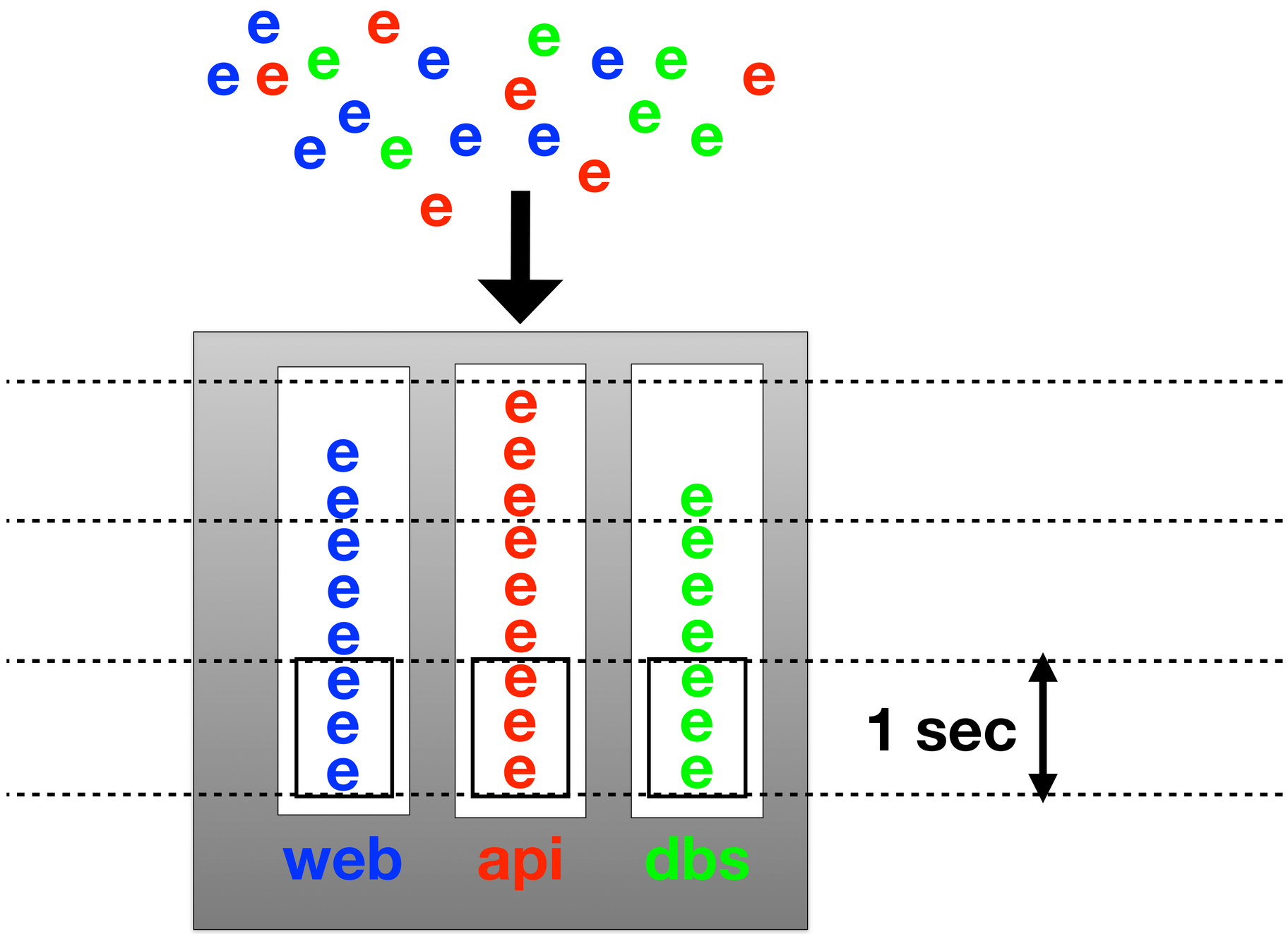
stockage des événements

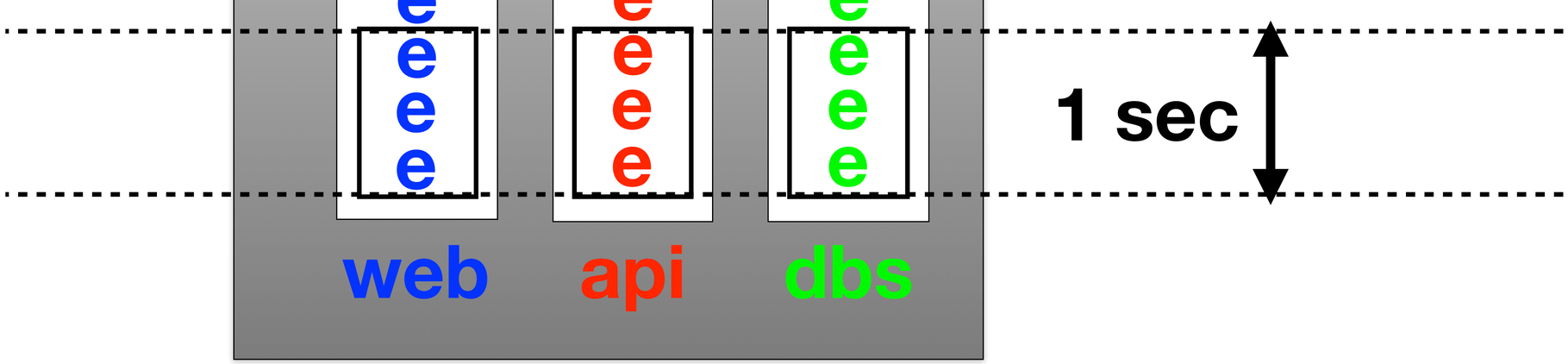

LOGGER

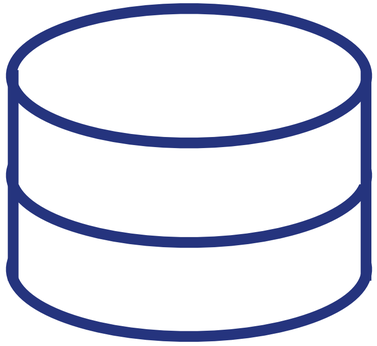

web
api


web
api
dbs

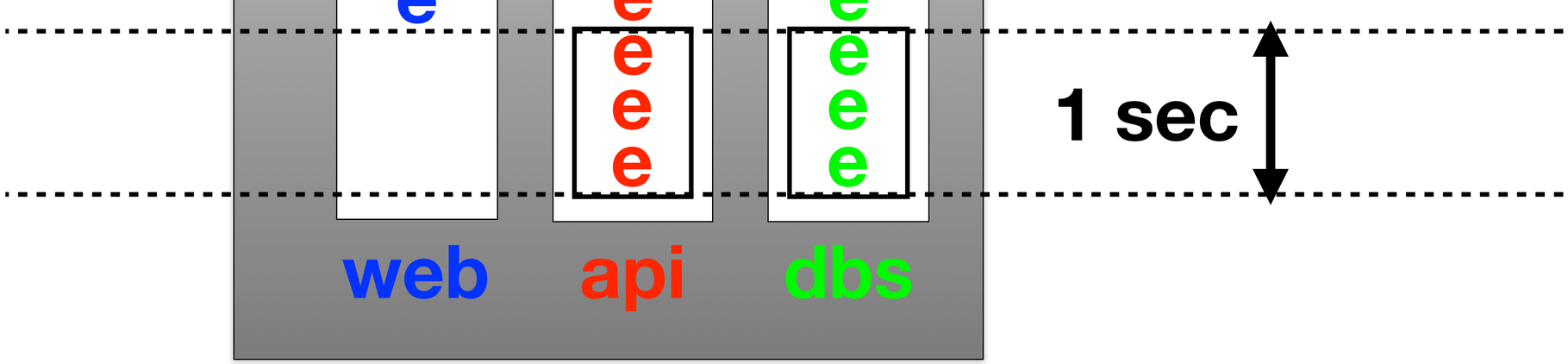

web
api
dbs
1 sec

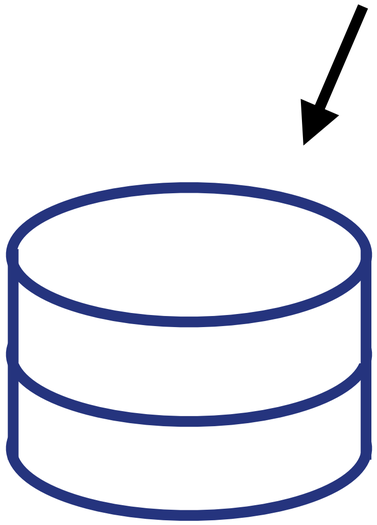

web
api
dbs
1 sec



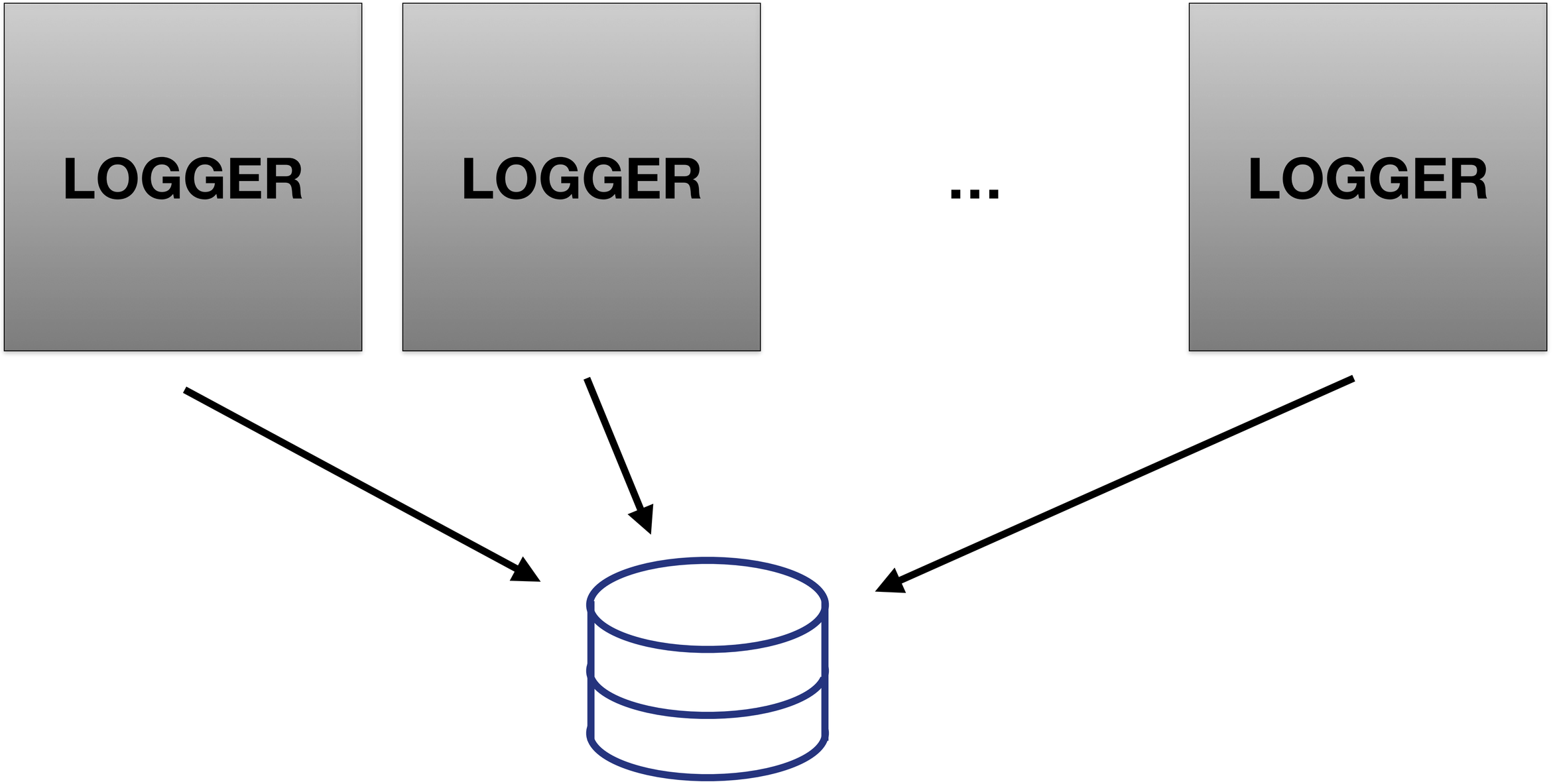


stockage des événements





stockage des événements



stockage des événements

STOCKAGE

BESOINS

- Sécurité de stockage
- Performance écriture massive
- Performance lecture massive
- Administration Facile
- Très scalable

NOUS AVONS CHOISI RIAK

- Sécurité: cluster, distribué, replication, Ring très robuste
- Performances bonnes et prévisibles
- Très facile à administrer

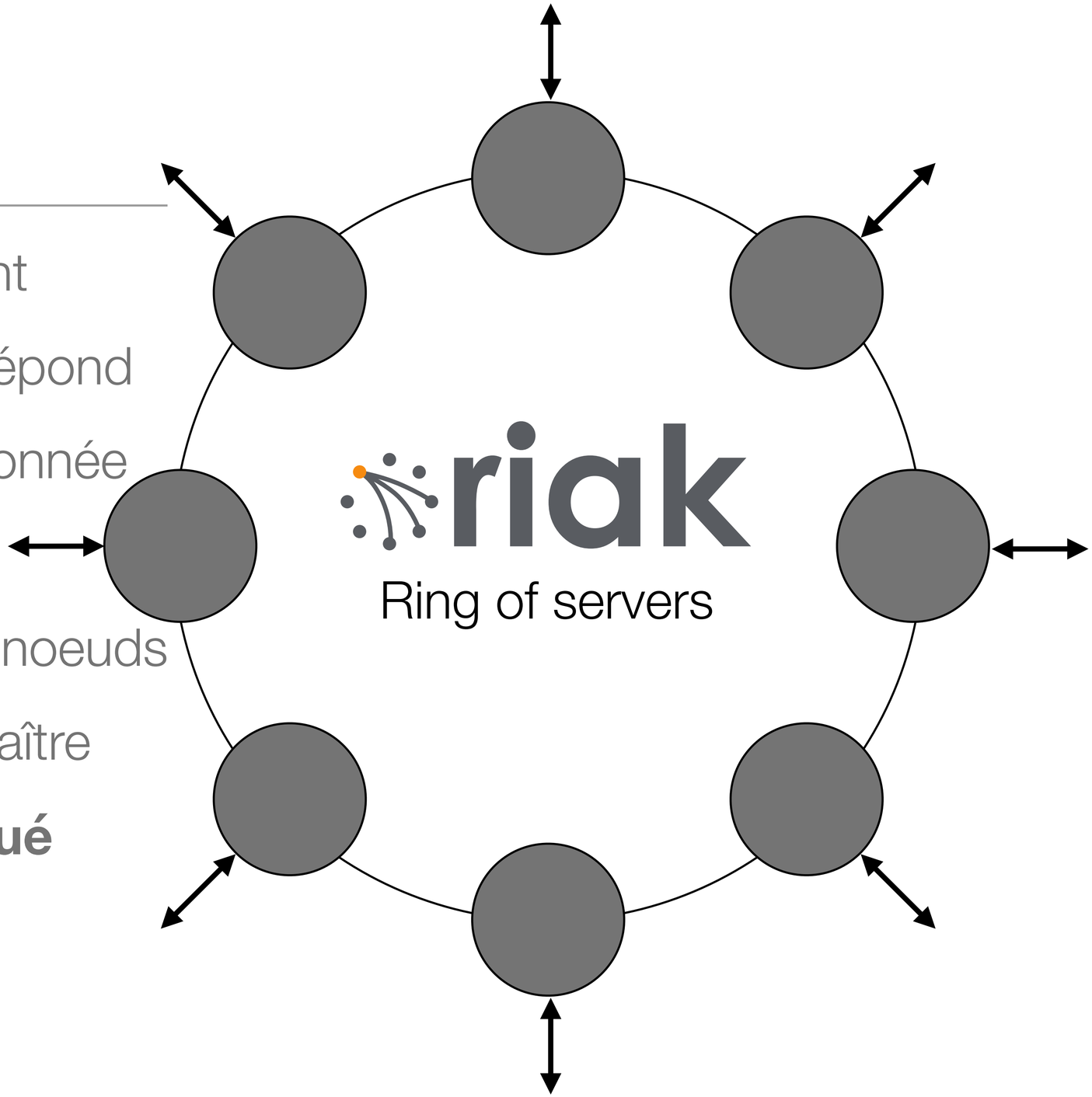
- Fonctions avancées (MapReduce, triggers, 2i, CRDTs …)
- Riak Search
- Réplication Multi-Datacenter


riak

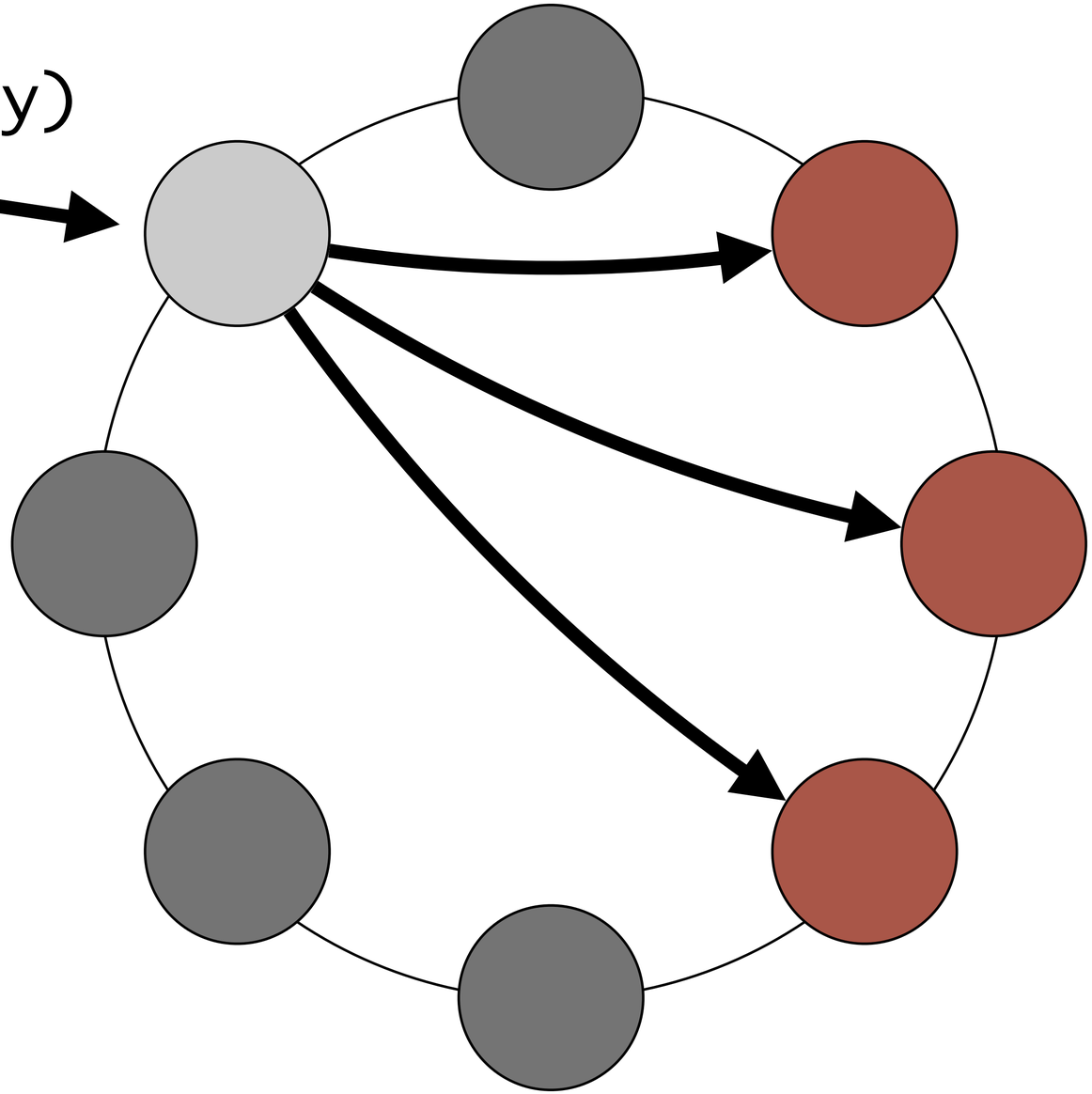
CLUSTER

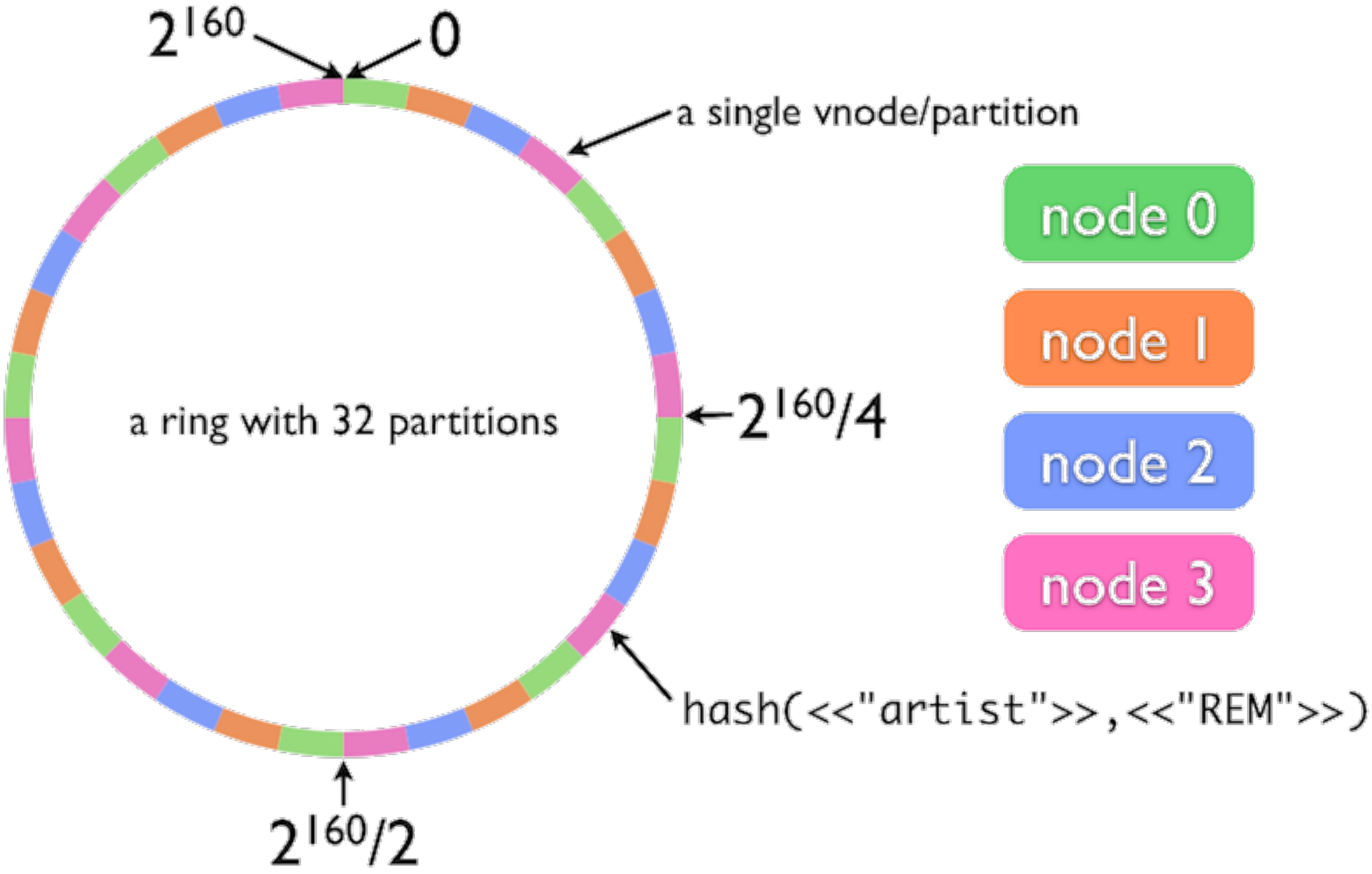
- Hardware courant
- Chaque noeud répond
- Réplication de donnée

- Gossip entre les noeuds
- Pas de noeud maître
- Système **distribué**



hash(key)




2^{160}
0
a single vnode/partition
node 0
node 1
node 2
node 3
a ring with 32 partitions
$2^{160}/4$
hash(<<"artist">>,<<"REM">>)
$2^{160}/2$

STOCKAGE CLEF VALEUR

- Espaces de noms: **bucket**
- Valeurs: **opaque** ou CRDTs

RIAK: FONCTIONALITES AVANCEES

- MapReduce
- Index secondaires (2i)
- Riak Search
- Réplication Multi-DataCenter

MULTI-BACKEND DE STOCKAGE

- Bitcask
- Eleveldb
- Memory

BACKEND: BITCASK

- Backend basé sur un système de logs
- AOF (Append-only files)
- Expiration de données fine
- Performance prévisibles (1 seek max)
- Parfait pour des données séquentielles

CONFIGURATION DU CLUSTER

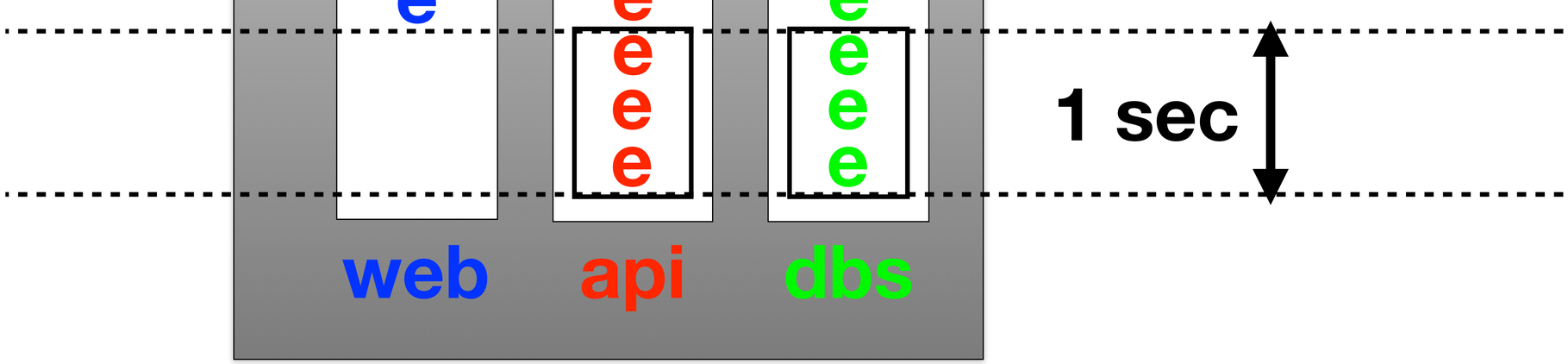
ESPACE DISQUE NECESSAIRE

- 8 jours
- 100 GB par heure
- Réplication = 3
- 100 * 24 * 8 * 3
- Besoin de **60 T**

HARDWARE UTILISE

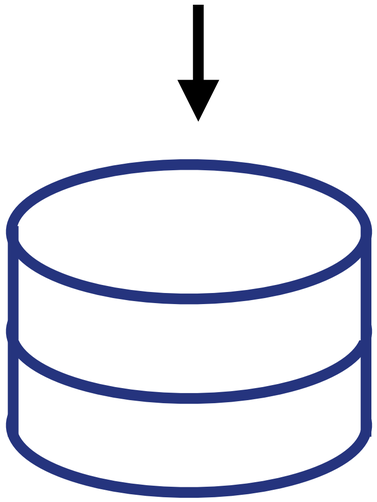
- 12 puis 16 nodes (bientôt 24)
- 12 CPU cores (Xeon 2.5Ghz) par noeud
- 192 GB RAM
- réseau 1 Gbit/s
- 8 TB (raid 6)
- Espace total: 128 TB

DATA DESIGN



regroupé par EPOCH / DC / CELL / TYPE / SUBTYPE

500 KB max par morceaux



stockage des événements

DONNEES

- Bucket : “`data`“
- Clef: “`12345:1:cell0:WEB:app:chunk0`“
- Valeur: Liste sérialisée compressée des events HashMap
- 200 clefs par secondes

META-DONNEES

- Bucket : “metadata“
- Clef: <epoch>-<dc> “1428415043-2“
- Valeur: liste de clef données:

```
[ “1428415043:1:cell0:WEB:app:chunk0“,
  “1428415043:1:cell0:WEB:app:chunk1“
…
  “1428415043:4:cell0:EMK::chunk3“ ]
```

- PSV (pipe separated value)

ECRIRE LES DONNEES

ECRIRE LES DONNEES

- Dans chaque DC, cellule, Loggers poussent vers Riak
- 2 protocoles: REST ou ProtoBuf
- Chaque seconde:
  - Ecrire les valeurs “data” vers Riak, en asynchrone
  - Attendre retour succès
  - Ecrire les meta-données “metadata”

JAVA

```
Bucket DataBucket = riakClient.fetchBucket("data").execute();
DataBucket.store("12345:1:cell0:WEB:app:chunk0", Data1).execute();
DataBucket.store("12345:1:cell0:WEB:app:chunk1", Data2).execute();
DataBucket.store("12345:1:cell0:WEB:app:chunk2", Data3).execute();

Bucket MetaDataBucket = riakClient.fetchBucket("metadata").execute();
MetaDataBucket.store("12345-1", metaData).execute();
riakClient.shutdown();
```

Perl

```
my $client = Riak::Client->new(…);

$client->put(data => '12345:1:cell0:WEB:app:chunk0', $data1);
$client->put(data => '12345:1:cell0:WEB:app:chunk1', $data2);
$client->put(data => '12345:1:cell0:WEB:app:chunk2', $data3);

$client->put(metadata => '12345-1', $metadata, 'text/plain' );
```

LIRE LES DONNEES

LIRE UNE SECONDE

- Pour **une seconde** (une epoch donnée)
- Lire les meta-données pour l’<epoch>-DC
- Parser la valeur
- **Filtrer les types / sous-types**
- Récupérer les données de “data”

Perl

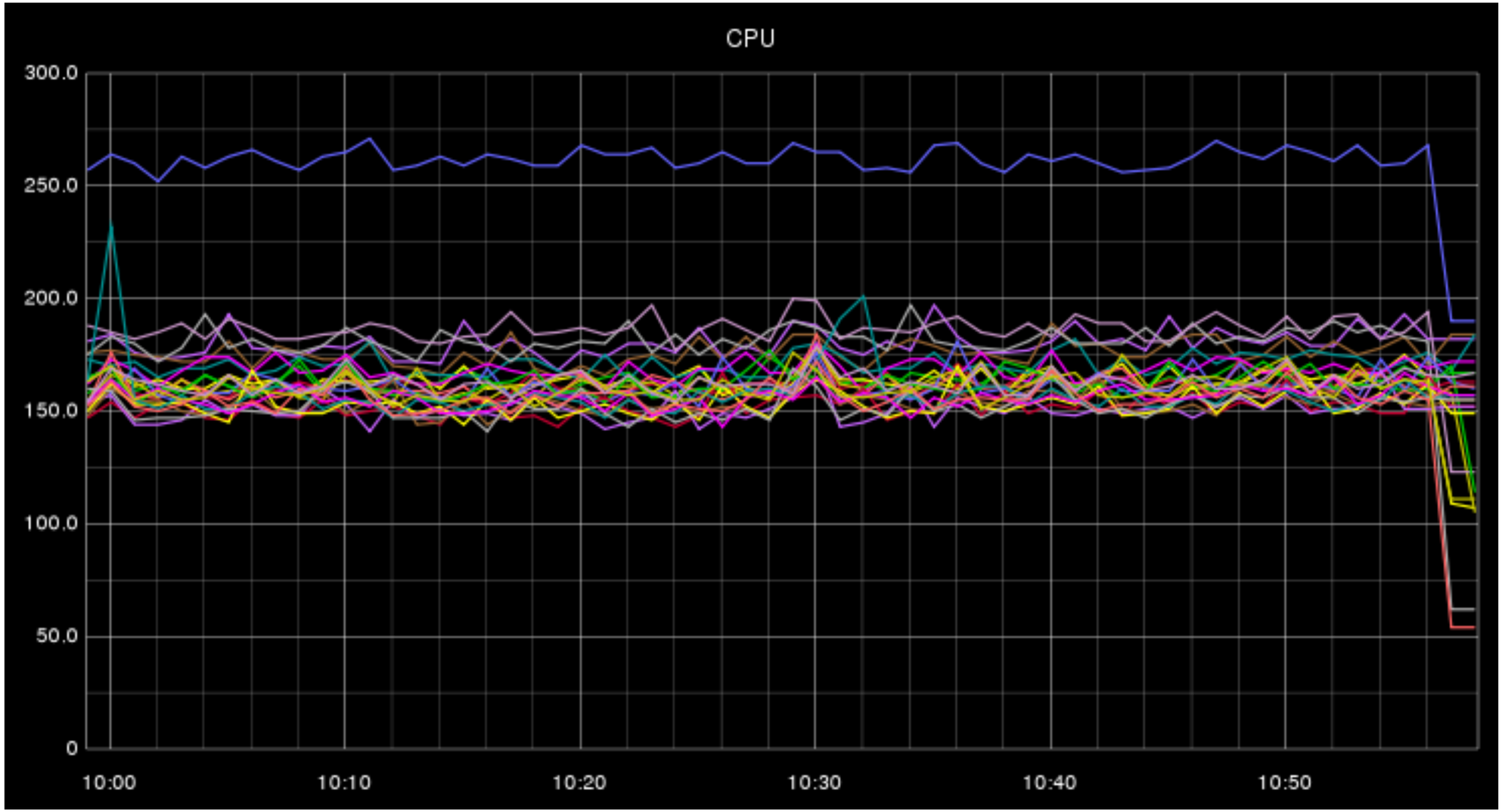
```
my $client = Riak::Client->new(…);
my @array = split '\|', $client->get(metadata => '1428415043-1');
@filtered_array = grep { /WEB/ } @array;
$client->get(data => $_) foreach @filtered_array;
```

LIRE UNE PERIODE

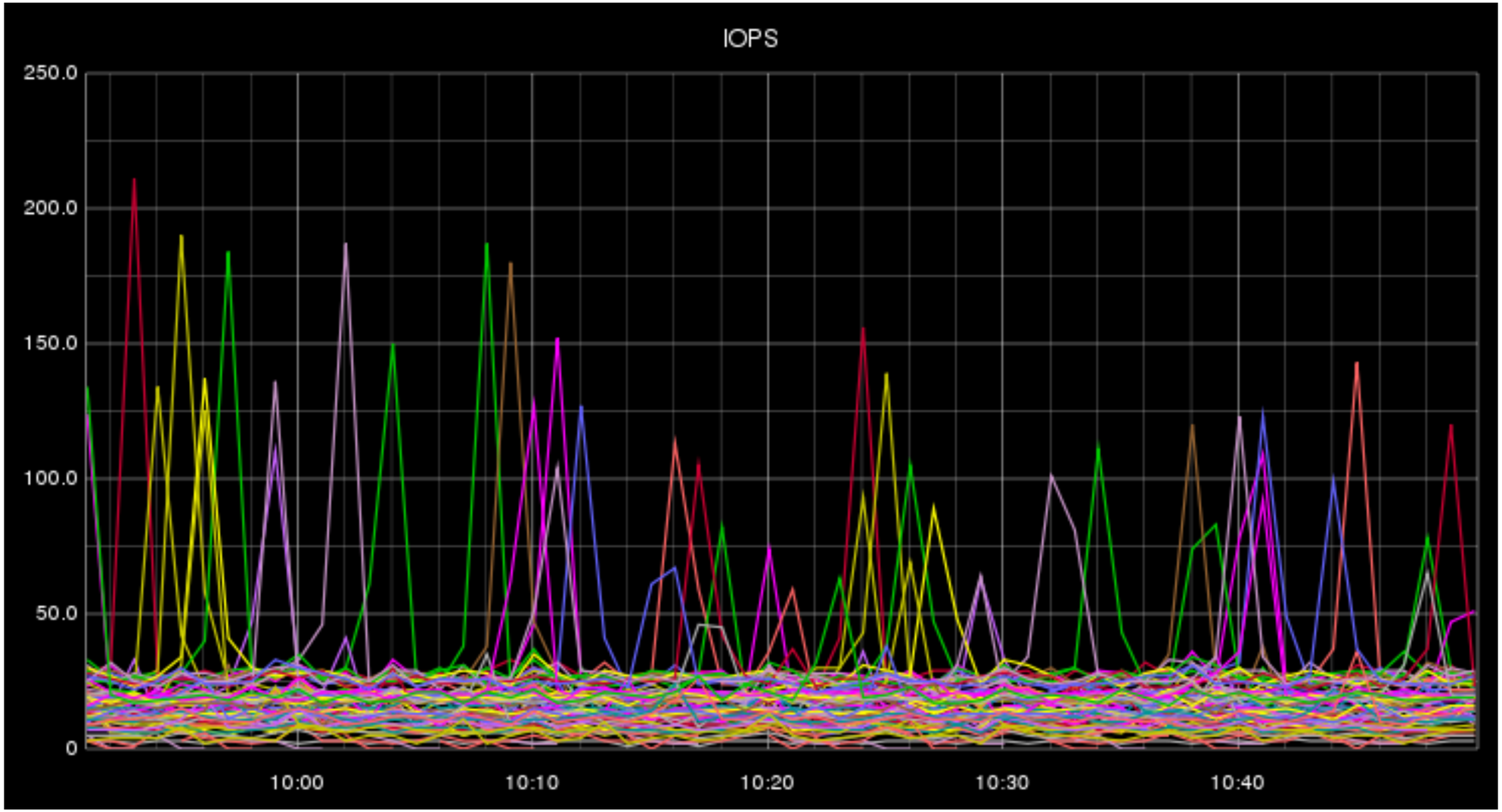
- Pour **un intervalle** epoch1 -> epoch2
- Générer la liste des epochs
- Récupérer en parallèle

RIAK CLUSTER HEALTH

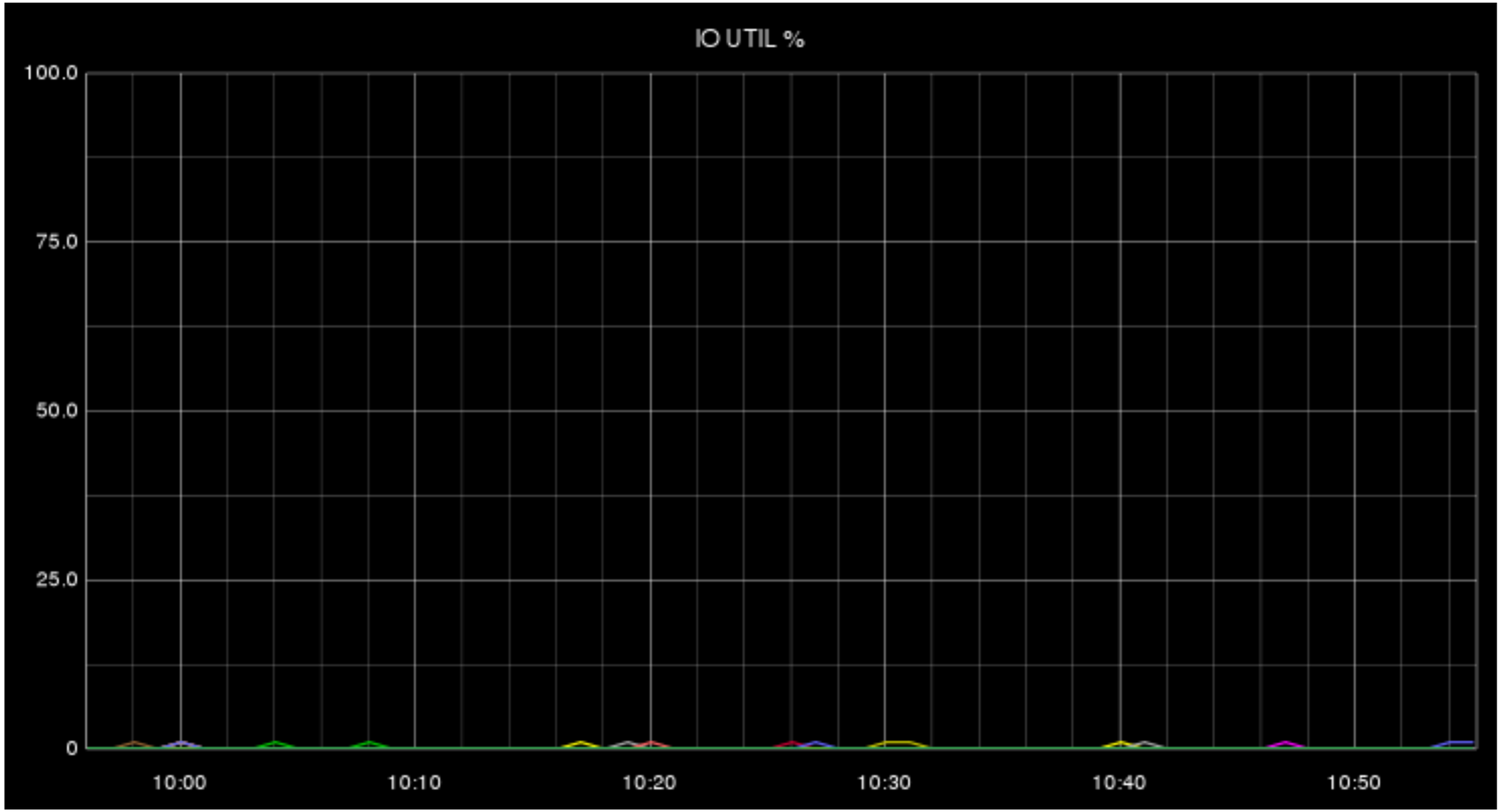
CPU


CPU
300.0
250.0
200.0
150.0
100.0
50.0
0
10:00
10:10
10:20
10:30
10:40
10:50

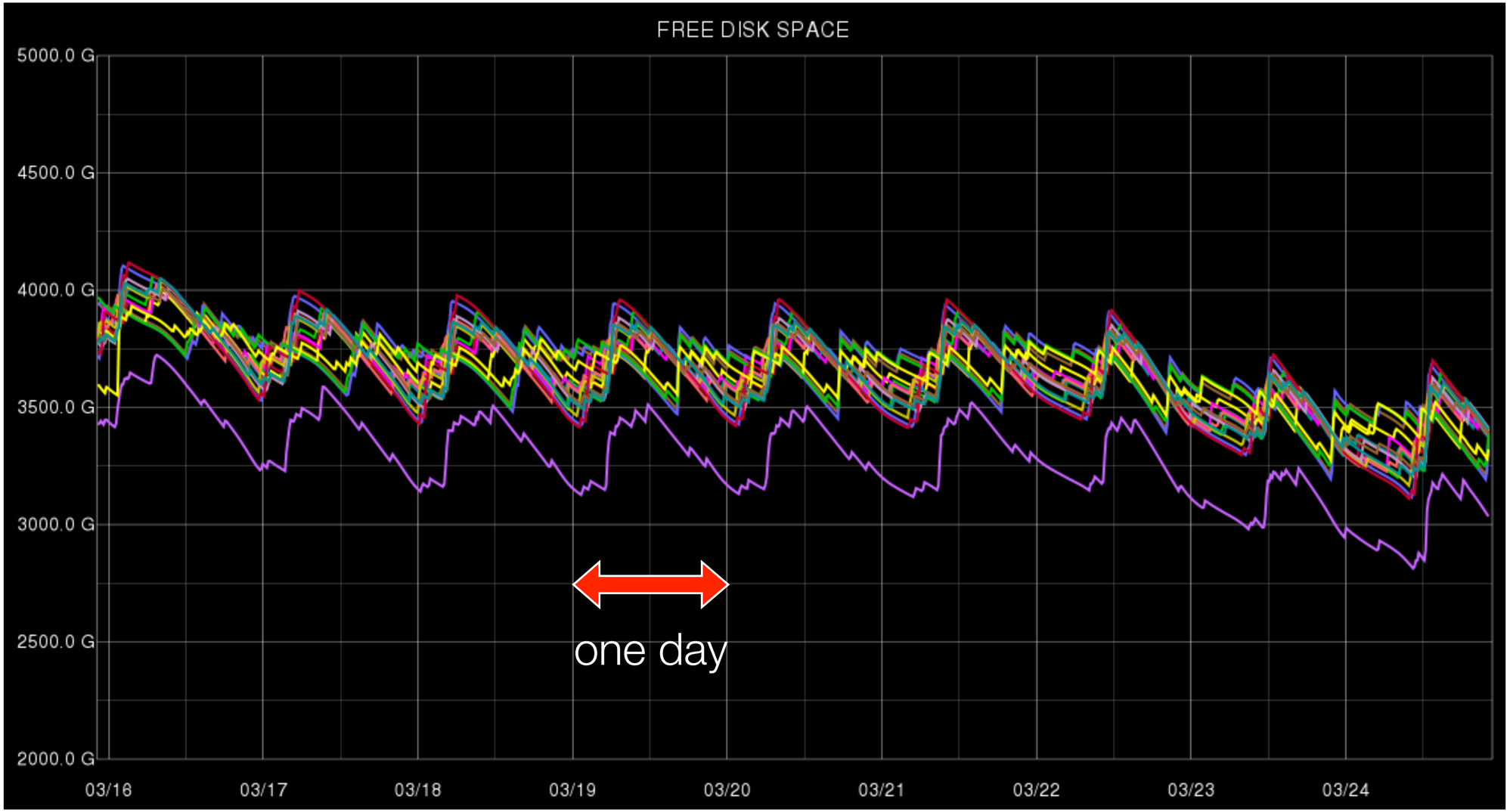
DISK IOPS



DISK IO %



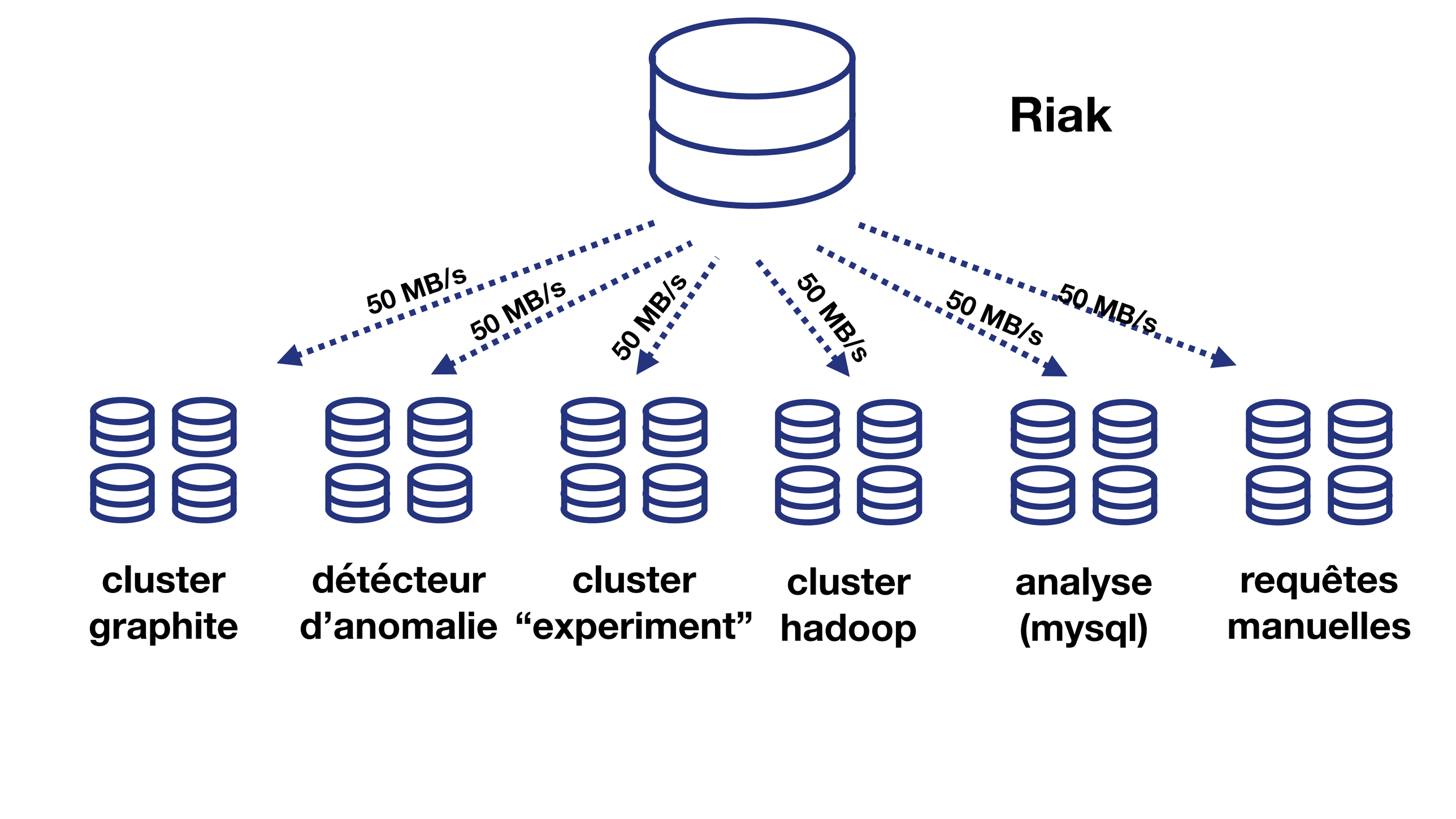
EXPIRATON & ESPACE DISQUE



TRAITEMENT TEMPS REEL HORS RIAK

EXEMPLES

- Streaming => Cluster Graphite (chaque seconde)
- Streaming => Détecteur d'Anomalie (agrégation 2 min.)
- Streaming => Cluster "Experiment" (agrégation 1 jour)
- Chaque minute => Cluster Hadoop
- Requête manuelle => tests, debug, investigation
- Requête Batch => analyse ad hoc
- => quantité **énorme** de requête en **lecture**


Riak
50 MB/s
50 MB/s
50 MB/s
50 MB/s
50 MB/s
50 MB/s
cluster graphite
détécteur d’anomalie
cluster “experiment”
cluster hadoop
analyse (mysql)
requêtes manuelles

VRAI TEMPS REEL

- 1 seconde de données
- Stockée en moins d’une seconde
- Disponible en moins d’une seconde
- Problème long terme : saturation réseau

TRAITEMENT TEMPS REEL DANS RIAK

L’IDEE

- Au lieu de
  - Lire la donnée
  - Traiter la donnée (ex: moyenne)
  - Produire un petit résultat
- Faire
  - Envoyer le code près des données
  - Traiter les données sur Riak
  - Récupérer le résultat

CE QUI PREND DU TEMPS

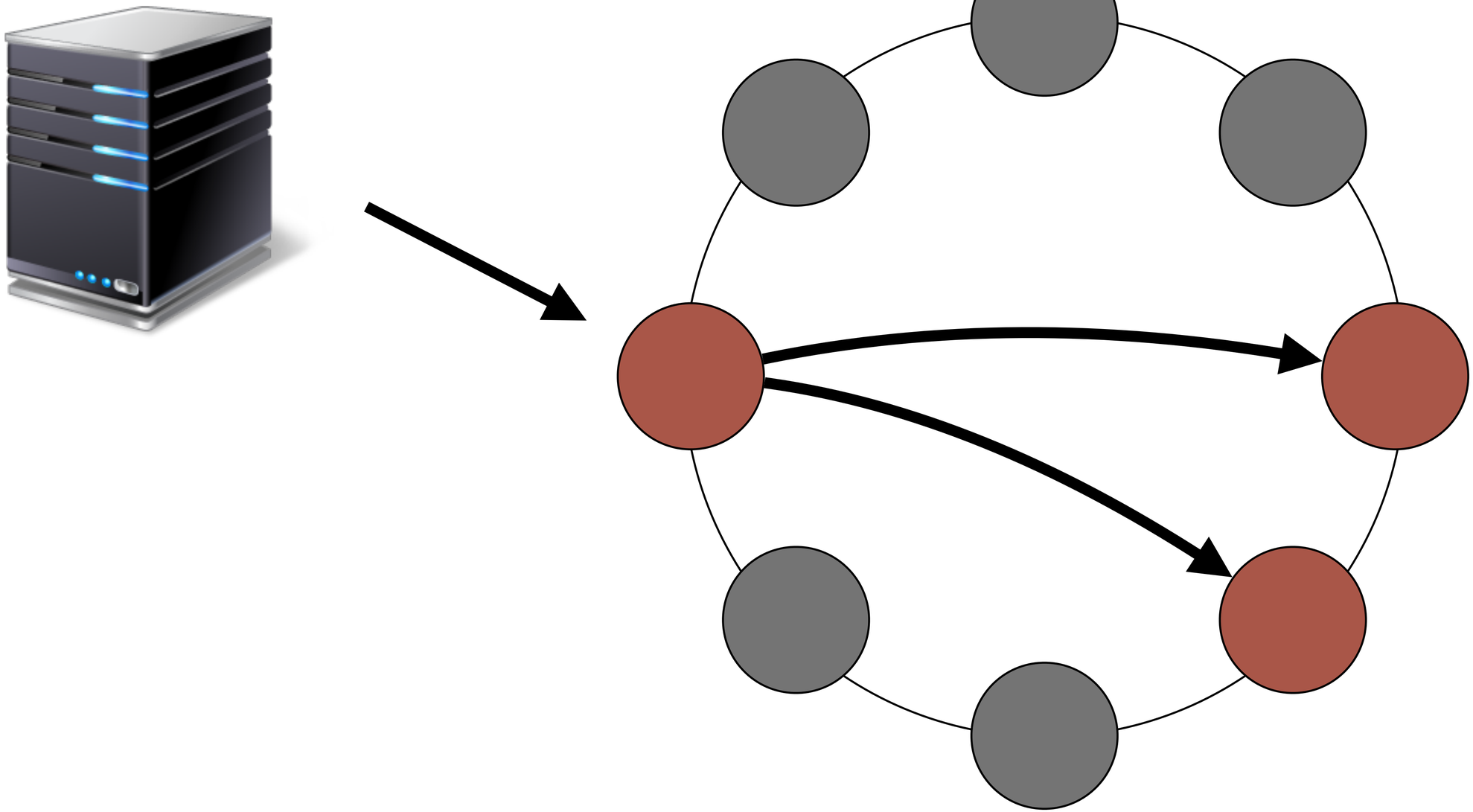
- Prend du temps et de la bande passante
  - Récupérer les données: **BP Réseau**
  - Décompresser/désérialiser: **Temps CPU**
- Ne prend pas de temps
  - Traiter les données

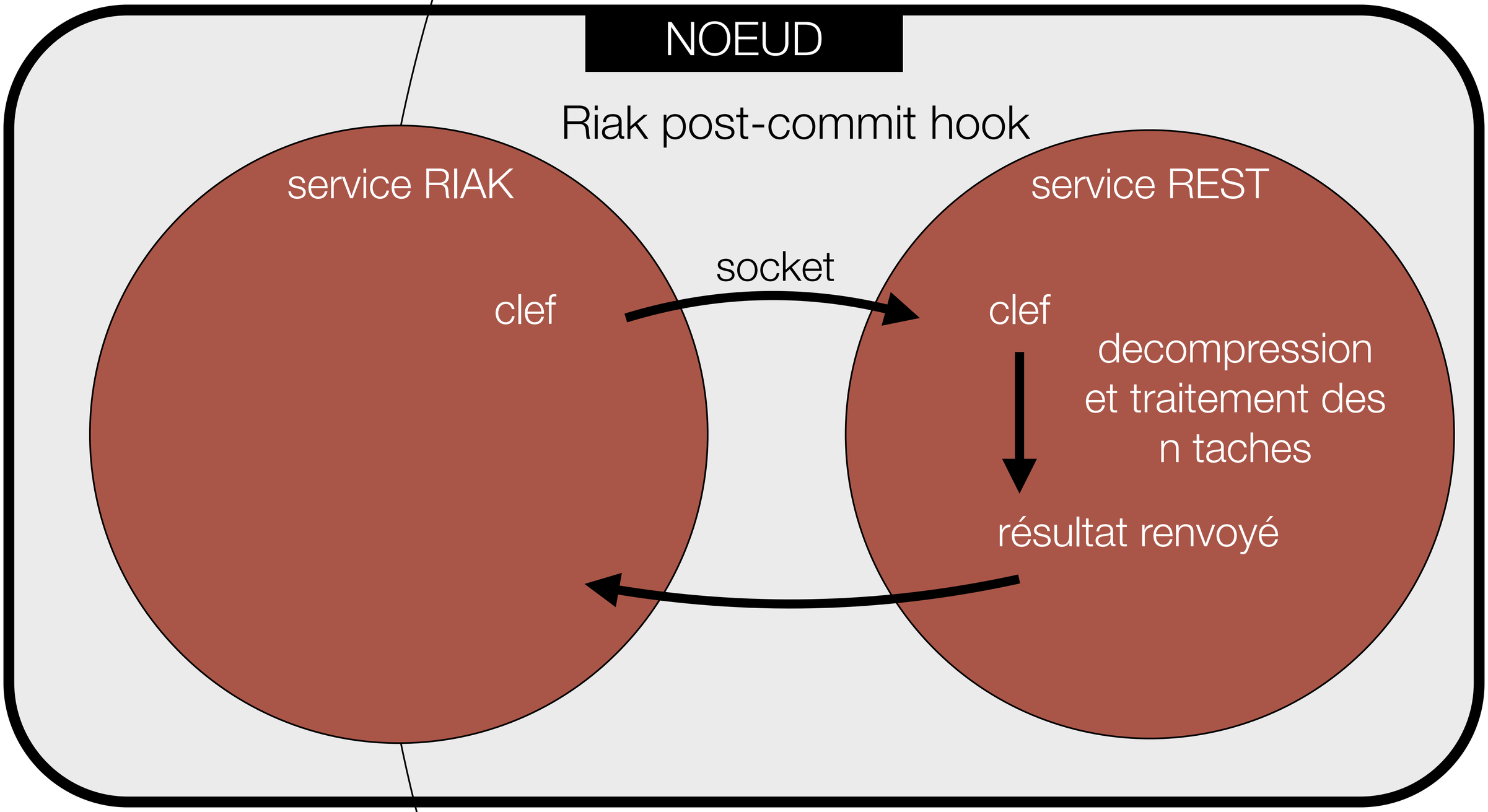
MAPREDUCE

- Entrée: epoch-dc
- Map1: clef meta-donnée -> clefs données
- Map2: calcul sur la donnée
- Reduce: regrouper
- Temps réel: OK
- OK pour la **BP réseau**, pas pour le **Temps CPU**

HOOKS

- A chaque écriture des méta-données
- Post-Commit hook déclenché
- Traite les données sur les noeuds




NOEUD
Riak post-commit hook
service RIAK
clef
socket
service REST
clef
decompression
et traitement des
n taches
résultat renvoyé

HOOK CODE

```
metadata_stored_hook(RiakObject) ->
    Key = riak_object:key(RiakObject),
    Bucket = riak_object:bucket(RiakObject),
    [ Epoch, DC ] = binary:split(Key, <<"-">>),
    MetaData = riak_object:get_value(RiakObject),
    DataKeys = binary:split(MetaData, <<"|">>, [ global ]),
    send_to_REST(Epoch, Hostname, DataKeys),
    ok.
```

```
send_to_REST(Epoch, Hostname, DataKeys) ->
    Method = post,
    URL = "http://" ++ binary_to_list(Hostname)
       ++ ":5000?epoch=" ++ binary_to_list(Epoch),
    HTTPOptions = [ { timeout, 4000 } ],
    Options = [ { body_format, string },
                { sync, false },
                { receiver, fun(ReplyInfo) -> ok end }
              ],
    Body = iolist_to_binary(mochijson2:encode( DataKeys )),
    httpc:request(Method, {URL, [], "application/json", Body},
                  HTTPOptions, Options),
    ok.
```

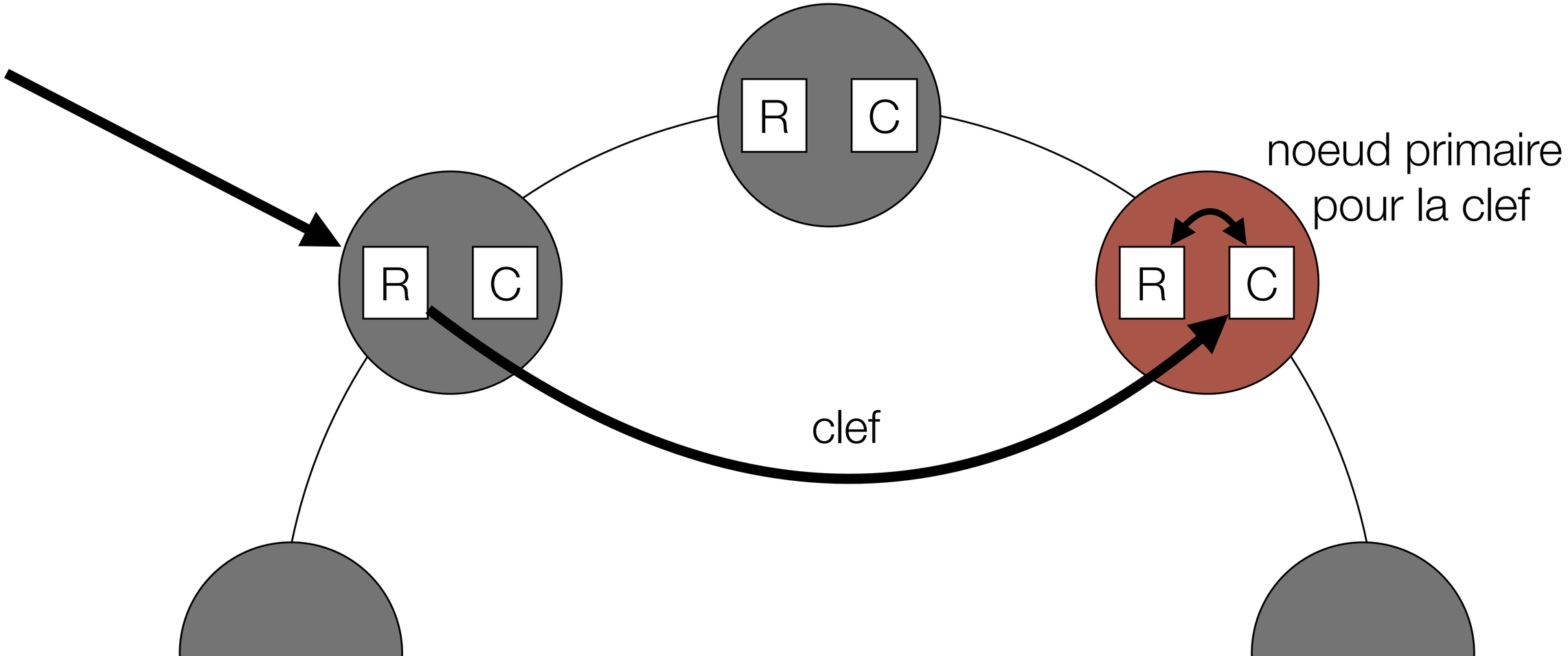
SERVICE REST

- En Perl, norme PSGI (WSGI), Starman, preforks
- Permet d’écrire les traitements en Perl
- Supporte chargement de code à la demande

SERVICE REST: SCALABLE

- **Scalable**
- 1 seconde = 200 clefs
- 16 noeuds, 10 CPUs (2 pour Riak)
- 1 clef doit être traitée en 16*10/200 sec = 0.8 sec
- Inclus réseau + CPU + overhead
- => Amplement le temps

OPTIMISATION



AVANTAGES

- Utilisation CPU et tps d’execution peut être limité
- Donnée est **locale** au traitement
- Donnée décompressée **une seule fois**
- Tous les traitements sont fait sur une donnée
- Les deux systèmes sont découplés (Erlang surveille)
- Peut être écrit en n’importe quel langage

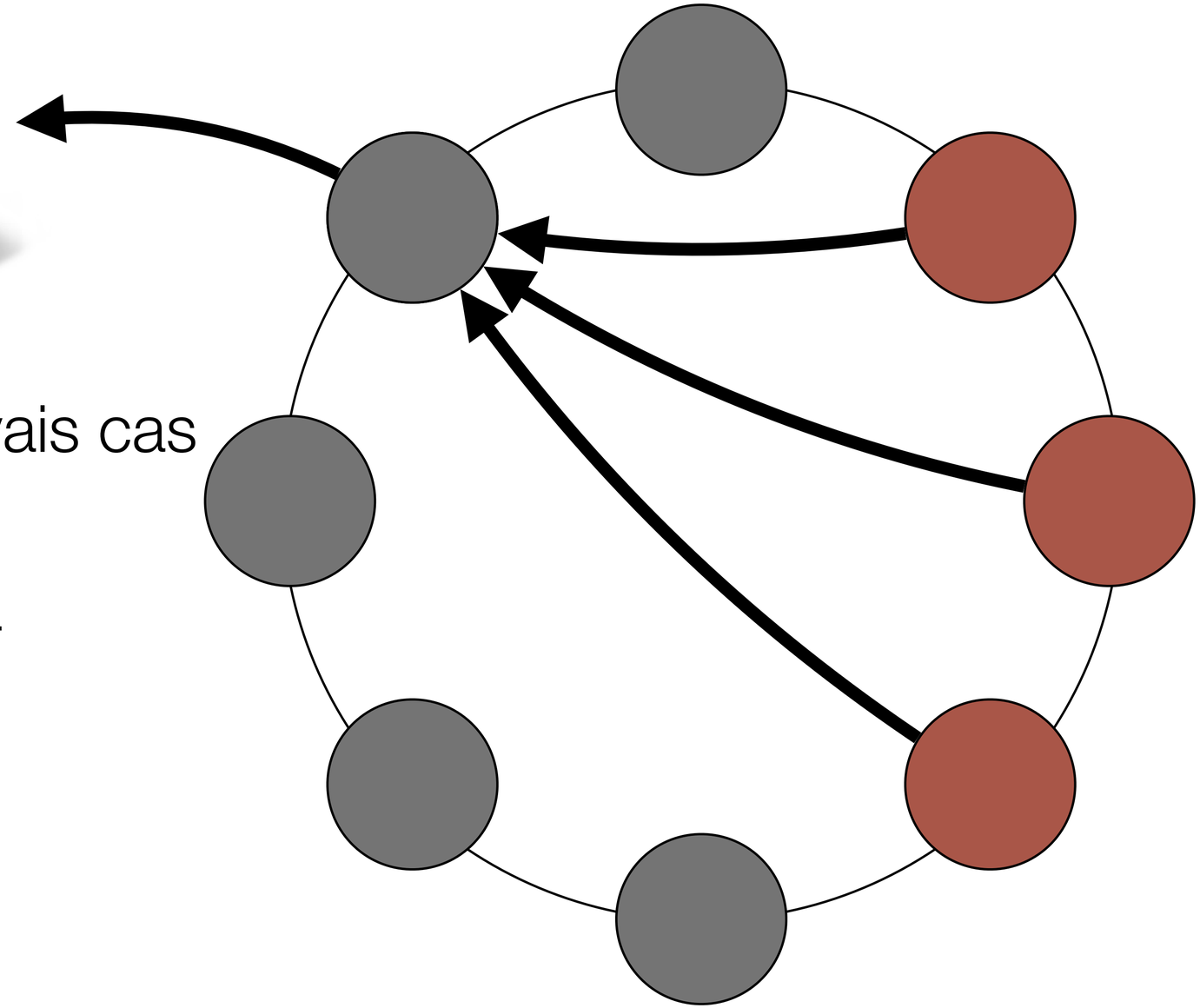
DESAVANTAGES

- Seulement pour données temps réel
- Traitement inter-epoch moins facile

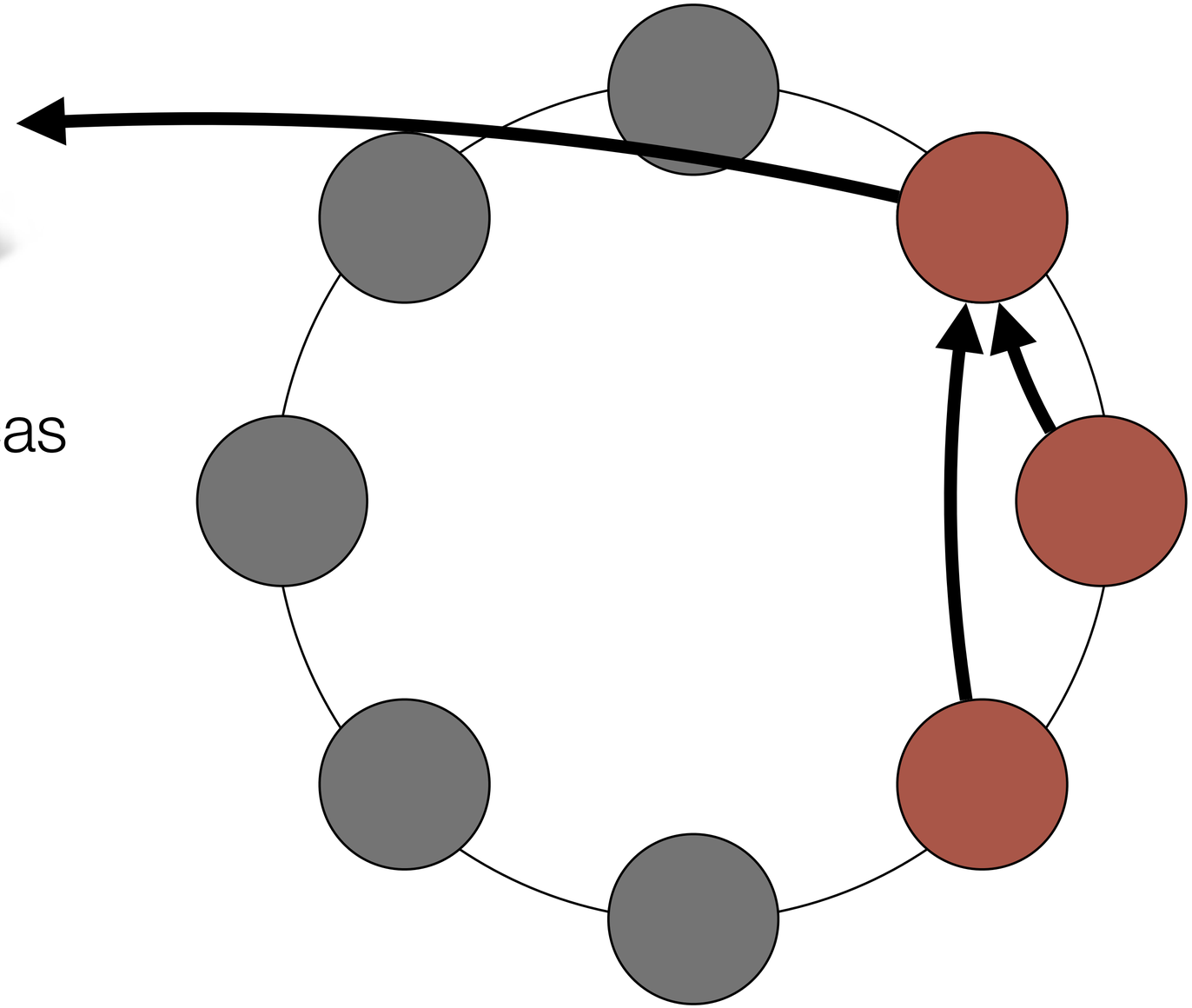
FUTUR

- Utiliser ce système pour réduire l’utilisation réseau
- Explorer la piste de Riak Search

BANDE PASSANTE RESEAU: PROBLEME



- **GET** - mauvais cas
- intérieur =
  3 x extérieur



- **GET** - bon cas
- intérieur =
  2 x extérieur

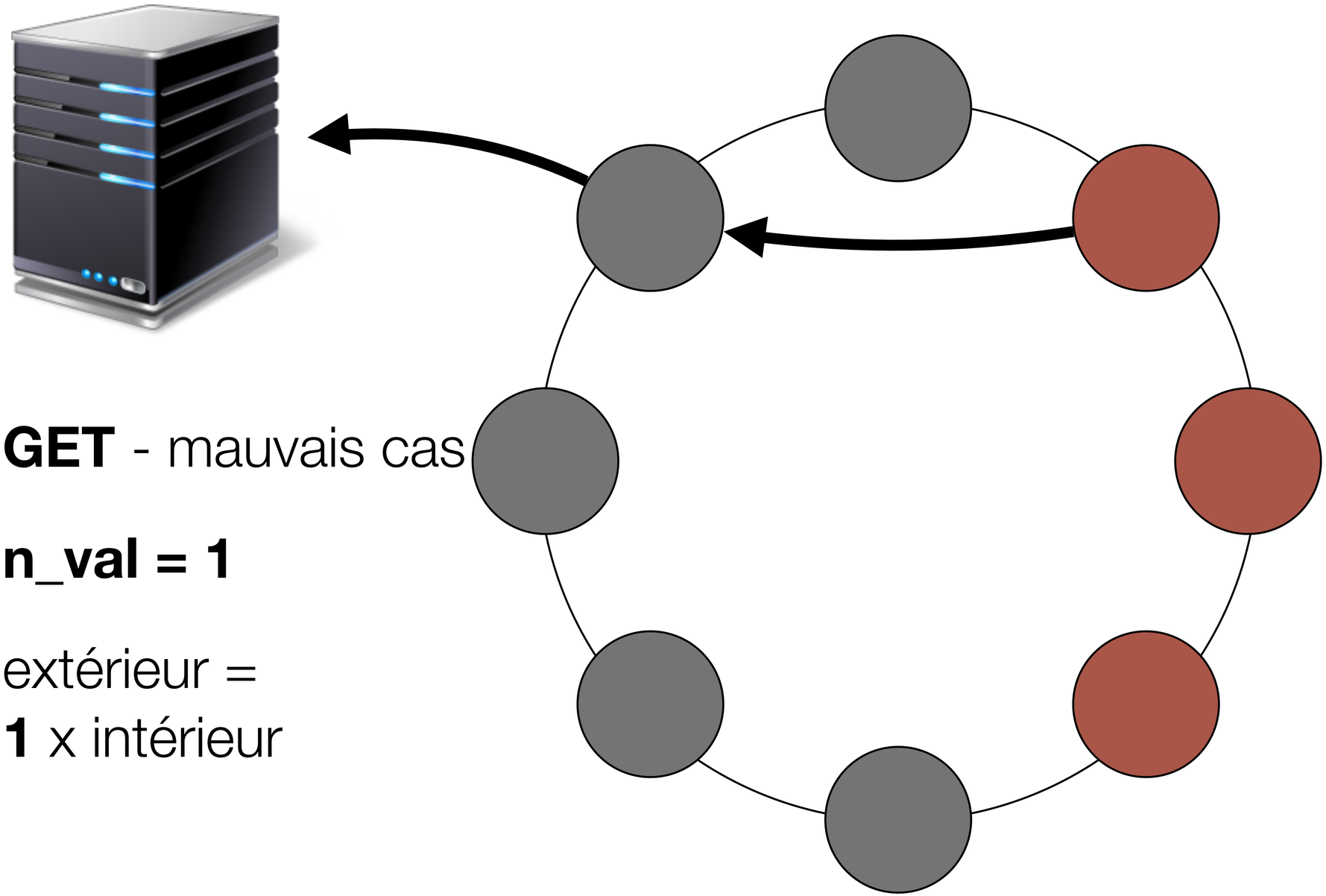
BANDE PASSANTE

- Ratio tend vers 3
- Cas général : OK
- Dans notre cas: problème
- Grosses valeurs, PUT constants, beaucoup de GET
- Limité à 1 Gbits/s

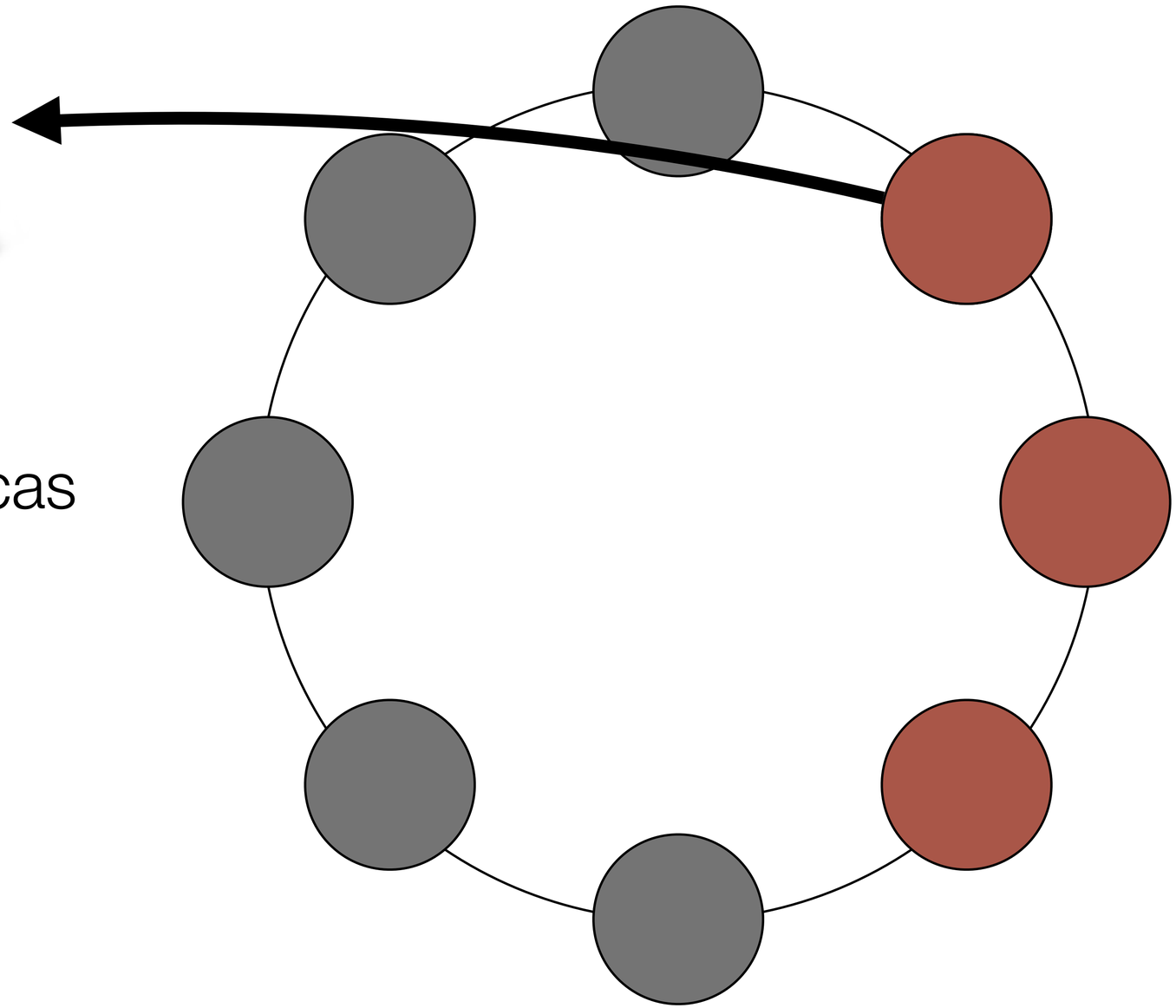
BANDE PASSANTE RESEAU: SOLUTIONS

BANDE PASSANTE RESEAU: SOLUTIONS

1. GET à faible consommation réseau
2. Ne pas choisir un noeud au hasard



- **GET** - mauvais cas
- **n_val = 1**
- extérieur =
  1 x intérieur



- **GET** - bon cas
- **n_val = 1**
- exterieur =
  0 x intérieur

RESULTAT

- Utilisation réseau réduite par 2 !

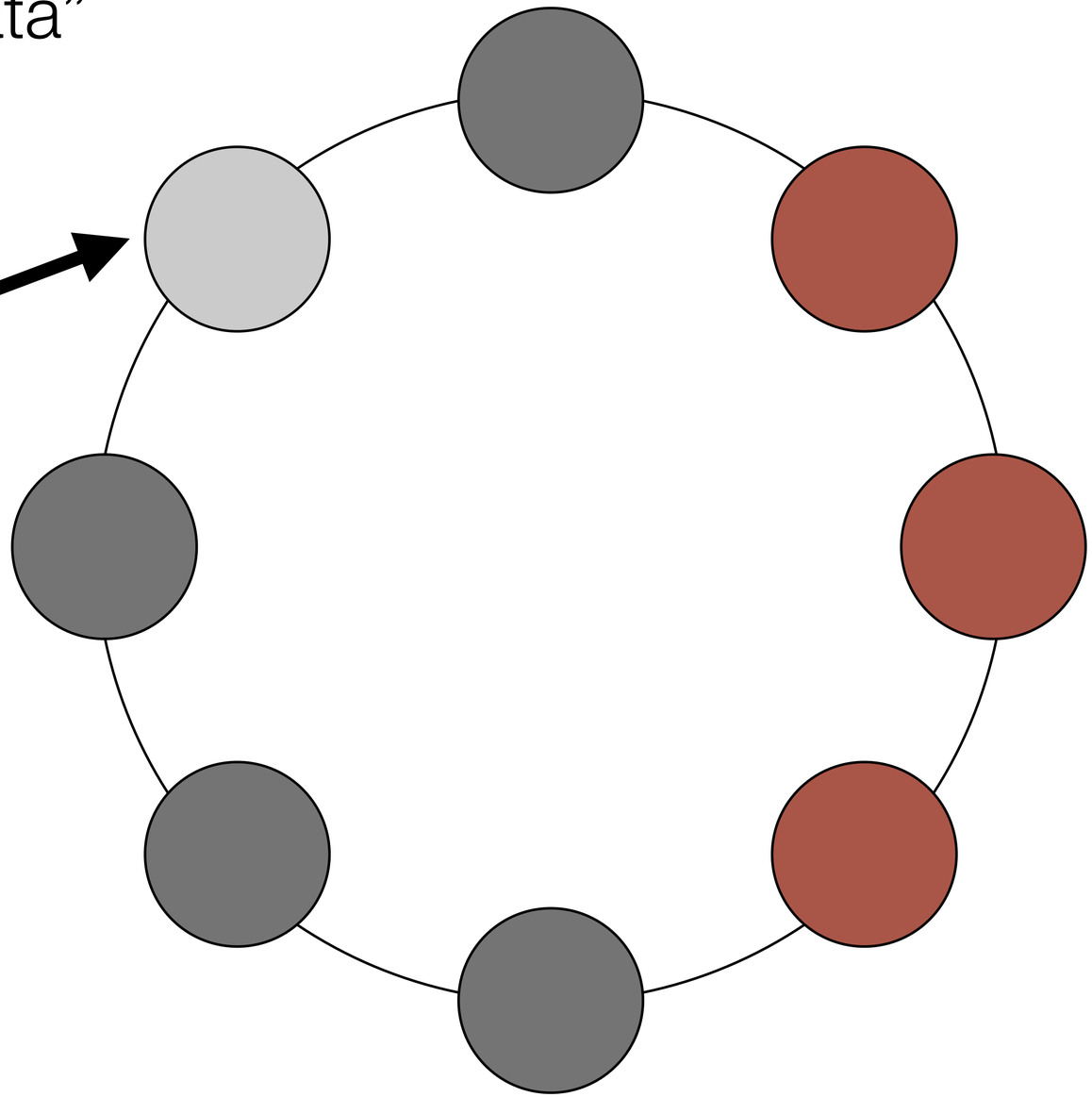
ATTENTION

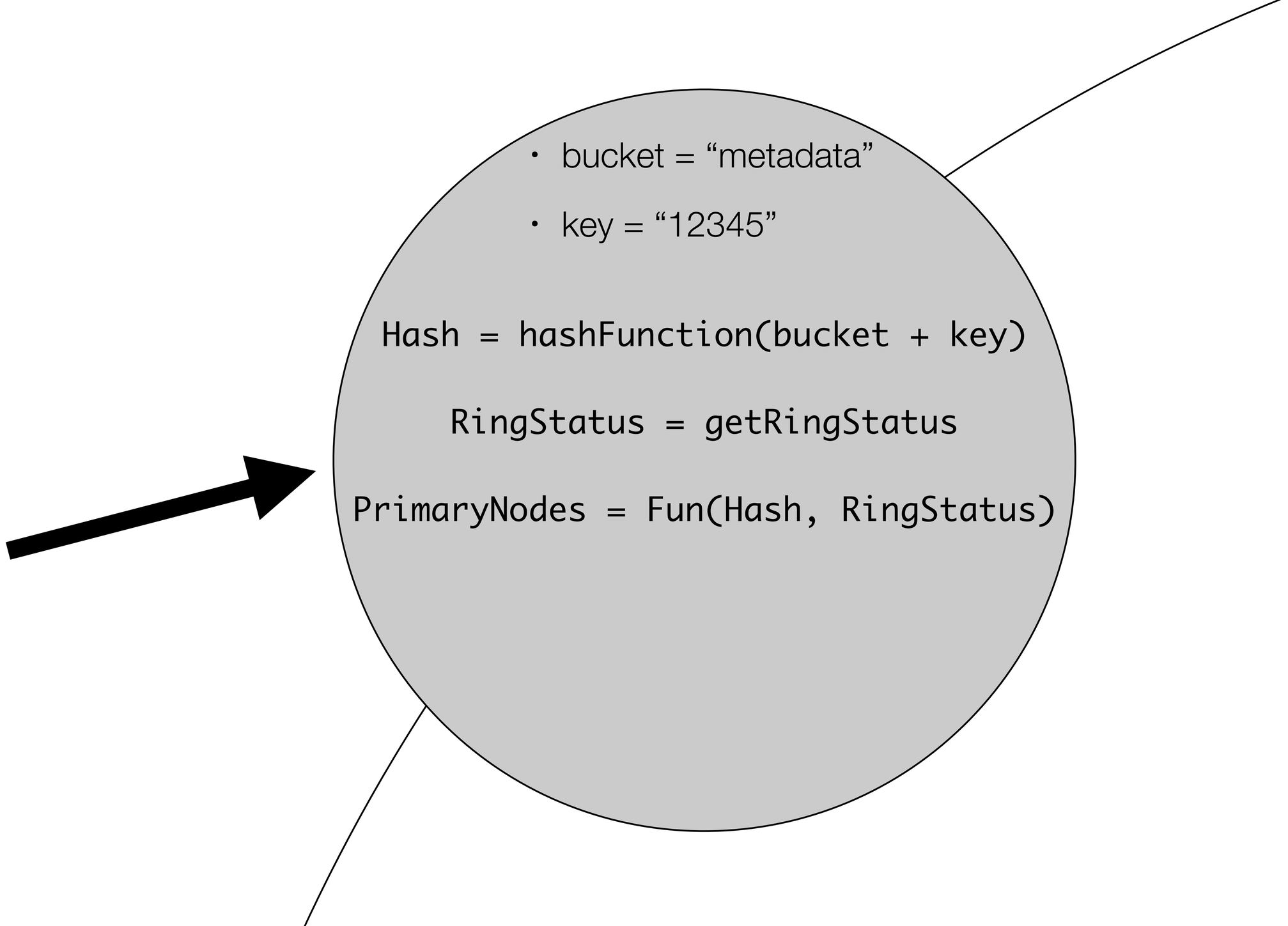
- Possible car les données sont en lecture seule
- Données ont un checksum interne
- Aucun conflit n’est possible
- Corruption de donnée auto-détectée
- Prévoir un fallback avec n_val=3

BANDE PASSANTE RESEAU: SOLUTIONS

1. GET à faible consommation réseau
2. Ne pas choisir un noeud au hasard

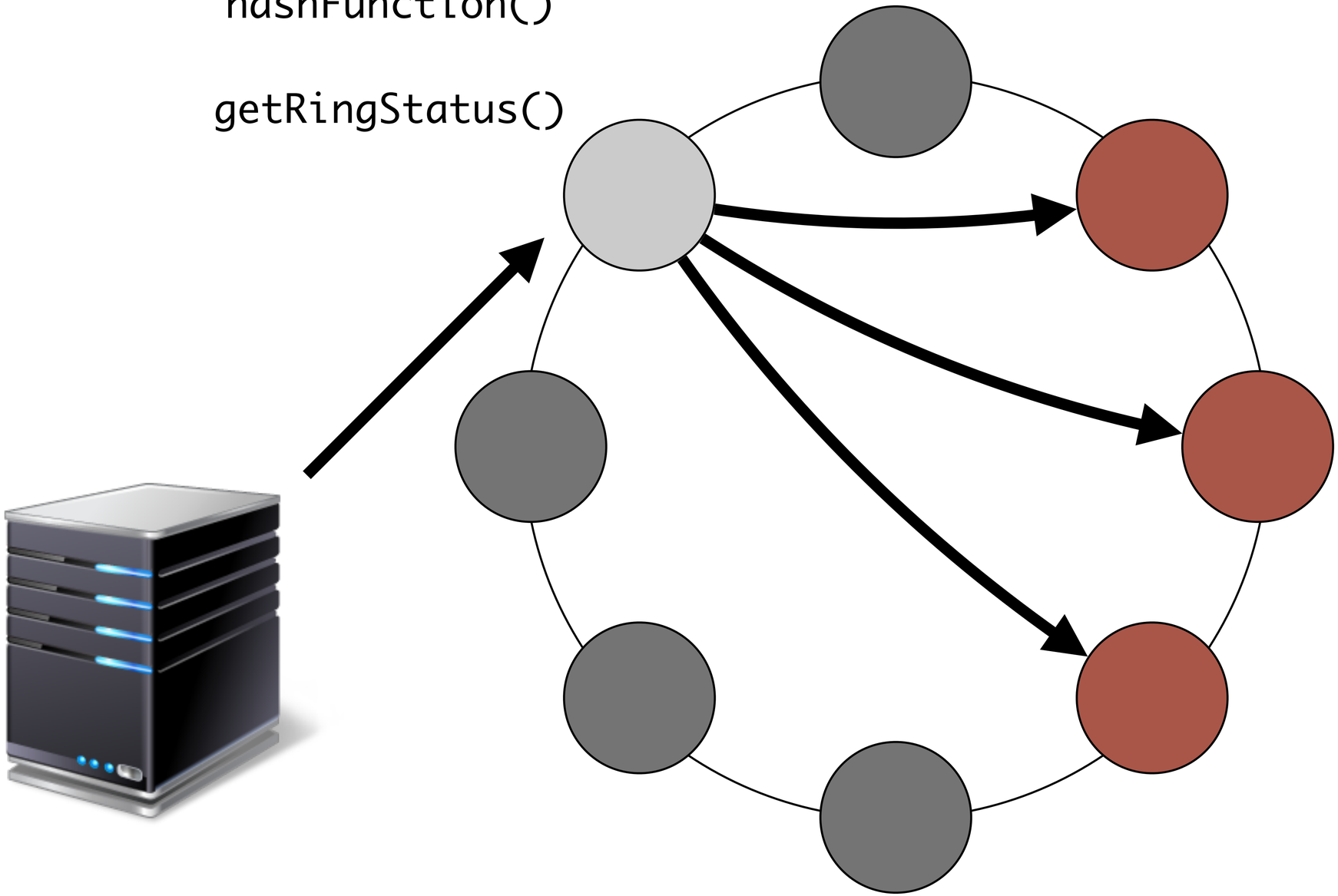
- bucket = “metadata”
- key = “12345”




• bucket = “metadata”
• key = “12345”
Hash = hashFunction(bucket + key)
RingStatus = getRingStatus
PrimaryNodes = Fun(Hash, RingStatus)

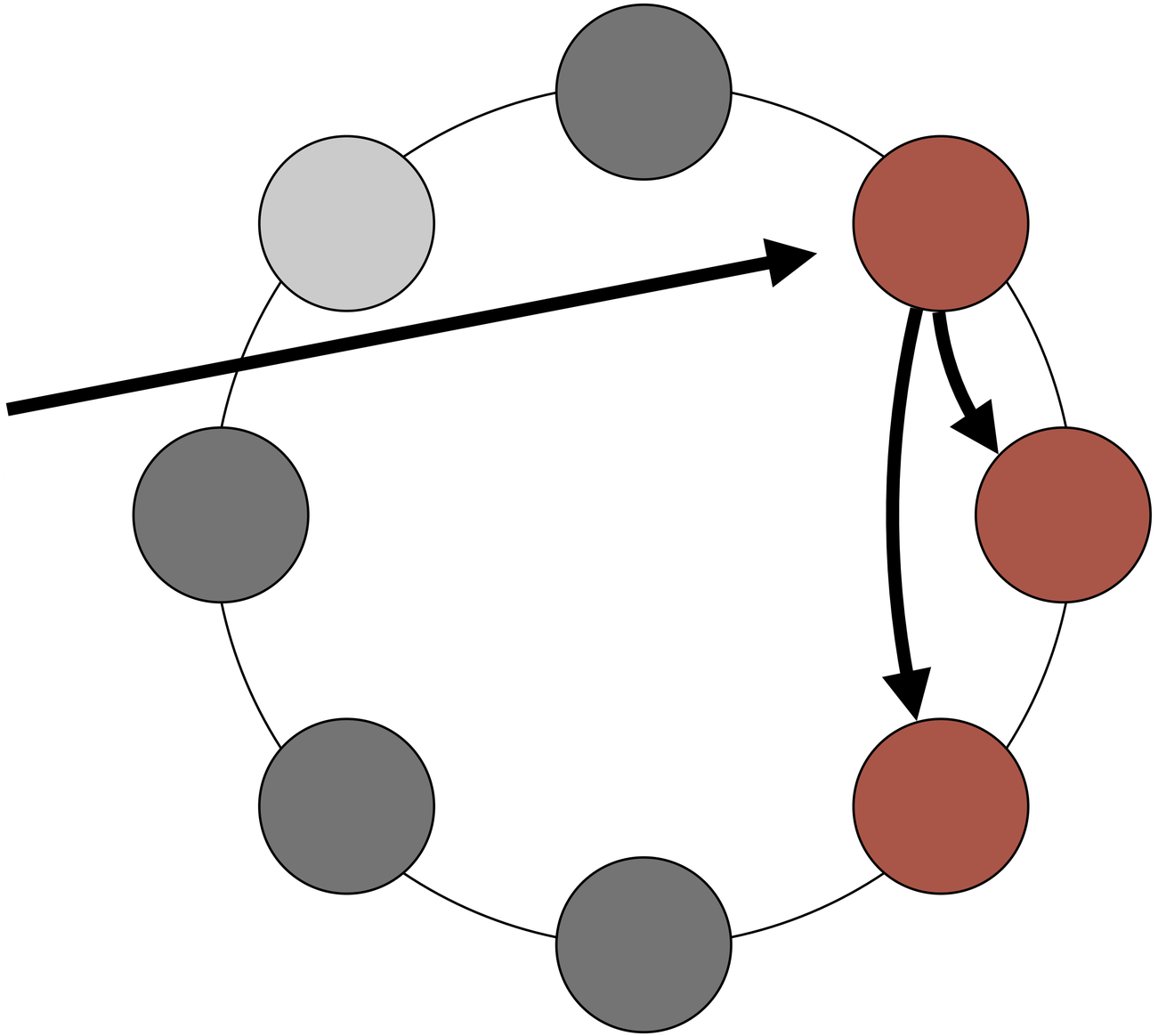
hashFunction()

getRingStatus()



hashFunction()

getRingStatus()



LE PRINCIPE

- Faire le hashing **côté client**
- Fonction de hash par défaut:
  - `“chash_keyfun”:{"mod":"riak_core_util", "fun":"chash_std_keyfun"},`
- Allons voir le code sur github

LA FONCTION DE HASH

```
%% @spec chash_std_keyfun(BKey :: riak_object:bkey()) -> chash:index()
%% @doc Default object/ring hashing fun, direct passthrough of bkey.
chash_std_keyfun({Bucket, Key}) -> chash:key_of({Bucket, Key}).
```

```
%% @doc Given any term used to name an object, produce that object's key
%%      into the ring.  Two names with the same SHA-1 hash value are
%%      considered the same name.
-spec key_of(ObjectName :: term()) -> index().
key_of(ObjectName) ->
    sha(term_to_binary(ObjectName)).
```

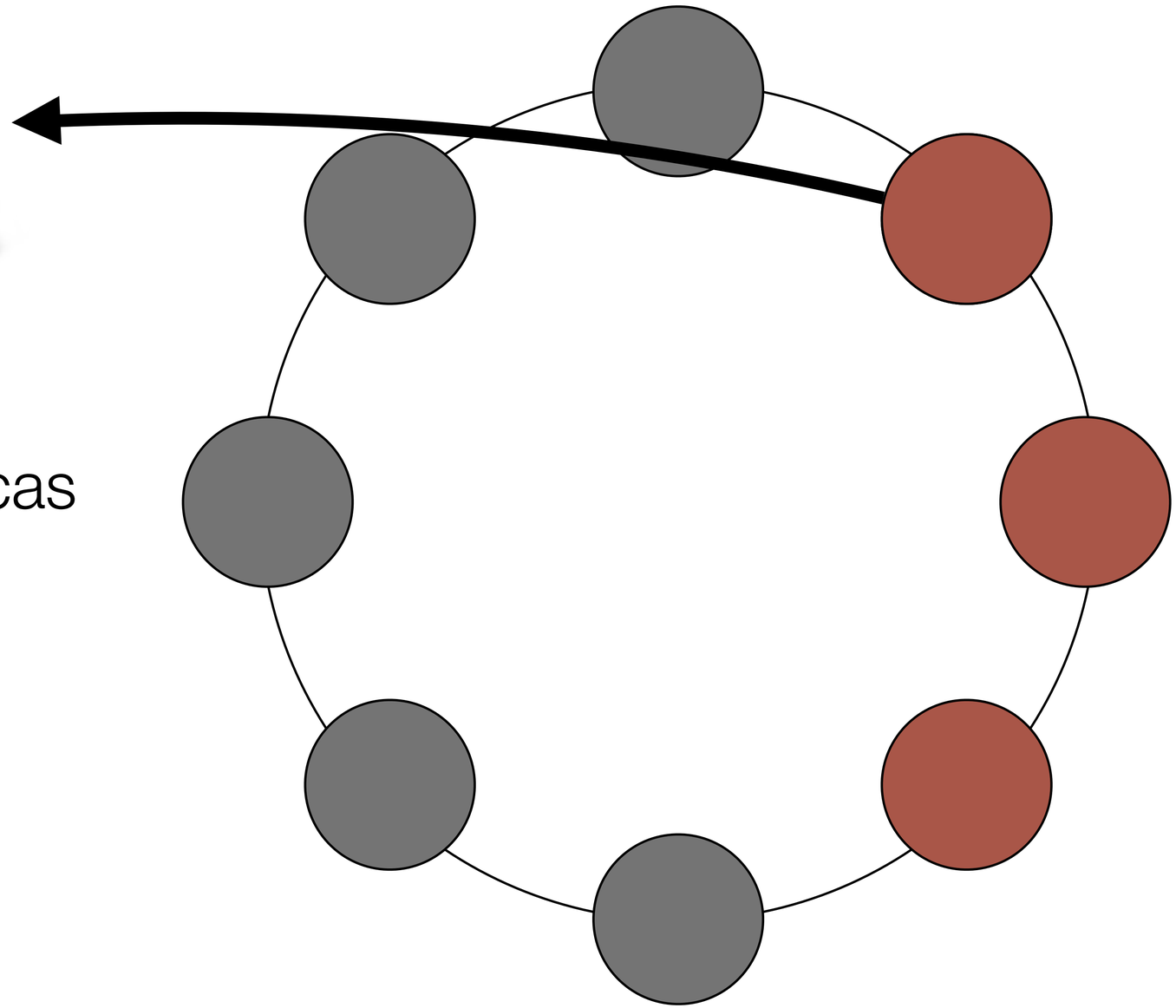
- riak_core/src/chash.erl

LA FONCTION DE HASH

- Facile à réimplémenter côté client:
- sha1 représenté en BigInt
- 400899077082383952423314387779798054553098649 6
- entre 0 et 2^160

ETAT DU RING

```
$ curl -s  -XGET http://$host:8098/riak_preflists/myring
{
  "0"                                                  :"riak@host-16"
  "570899077082383952423314387779798054553098649 6"    :"riak@host-17"
  "1141798154164767904846628775559596109106197299 2":"riak@host-18"
  "1712697231247151857269943163339394163659295948 8":"riak@host-19"
  …etc…
}
```



- **GET** - bon cas
- **n_val = 1**
- exterieur =
  0 x intérieur

RESULTAT

- Utilisation réseau encore diminuée
- Particulièrement pour les GETs

ATTENTION

- Possible seulement si
  - Noeuds sont monitorés (ici Zookeeper)
  - En cas d’échec, retour à noeud au hasard
  - Données lues de manière uniforme

CONCLUSION

CONCLUSION

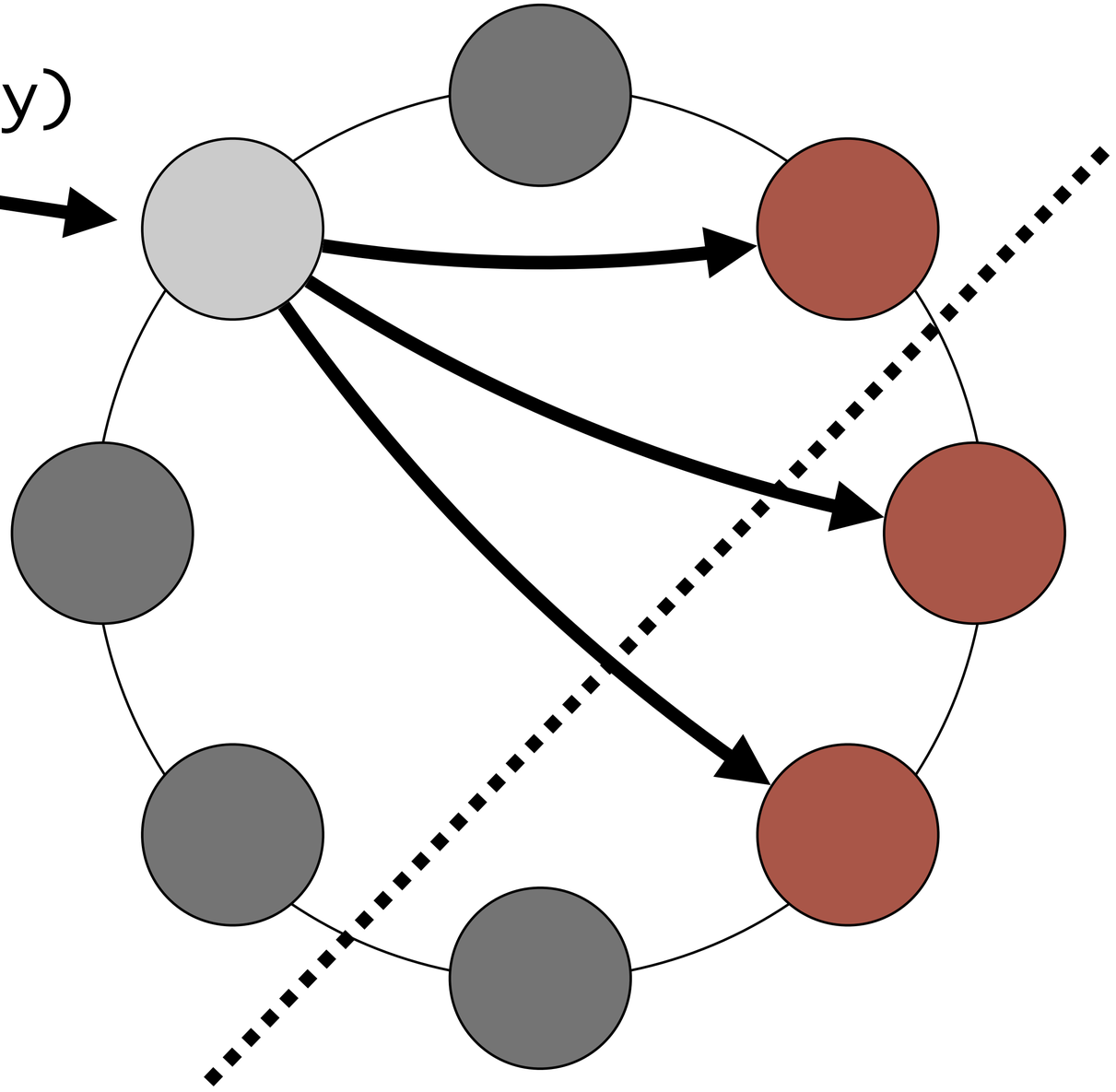
- Version Open Source de Riak
- Pas de training, autodidacte, équipe très petite
- Riak est une bonne solution
  - Robuste, rapide, scalable, facile
  - Très flexible and hackable
- Nous permet de continuer à scaler chez Booking.com

Q&A

 @damsieboy

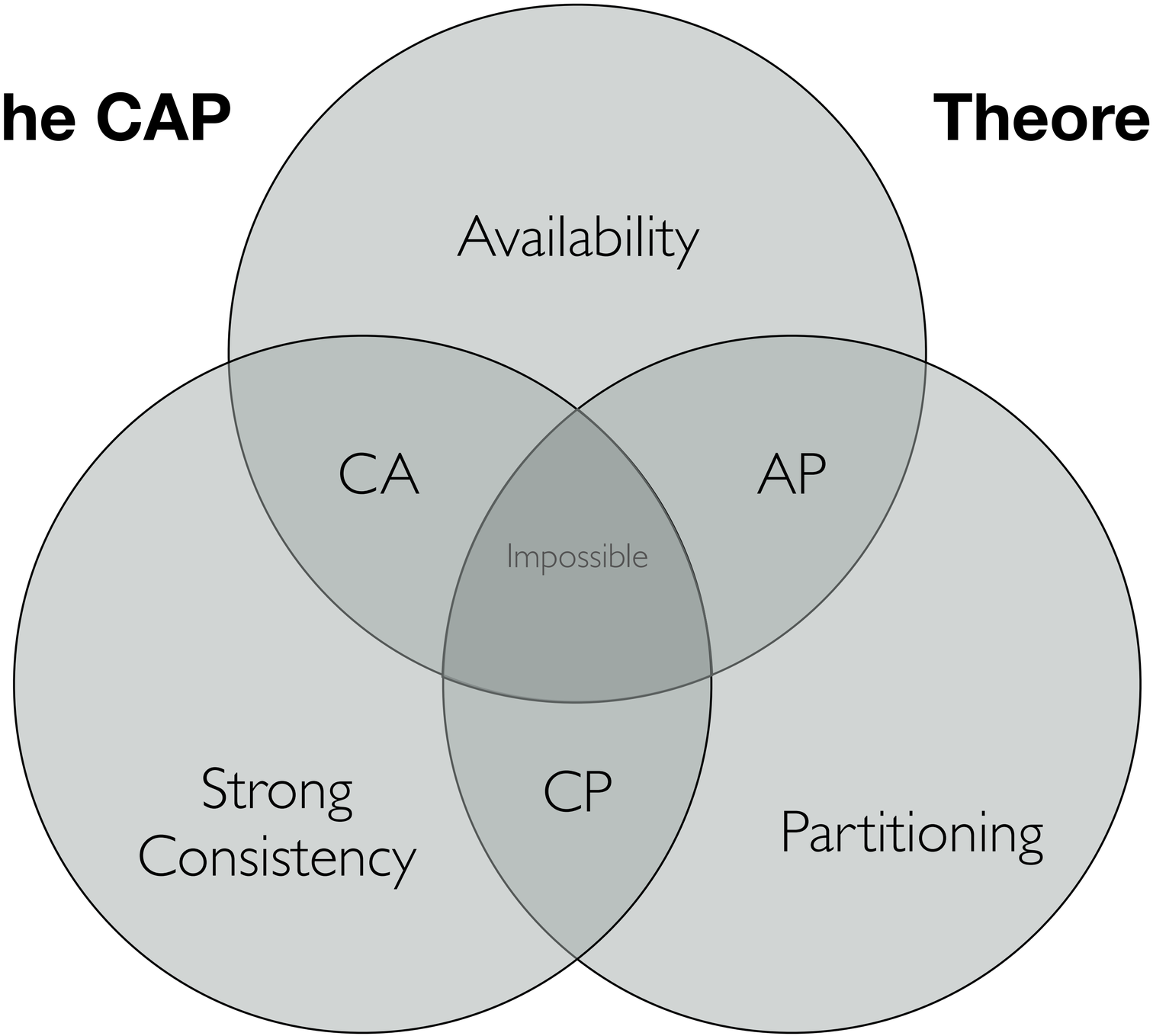
EXTRA: RIAK ET LE “CAP THEOREM”

hash(key)

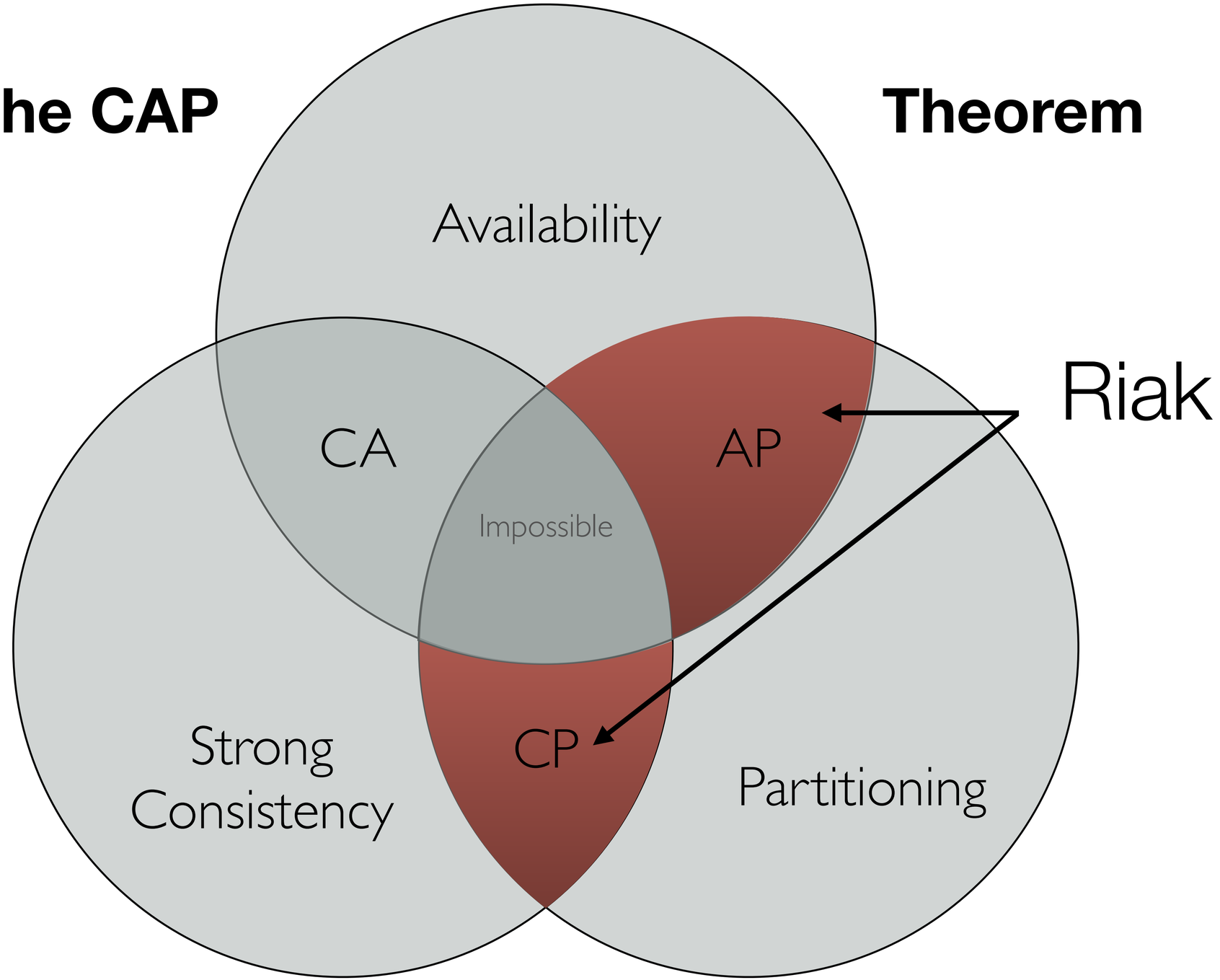


partition

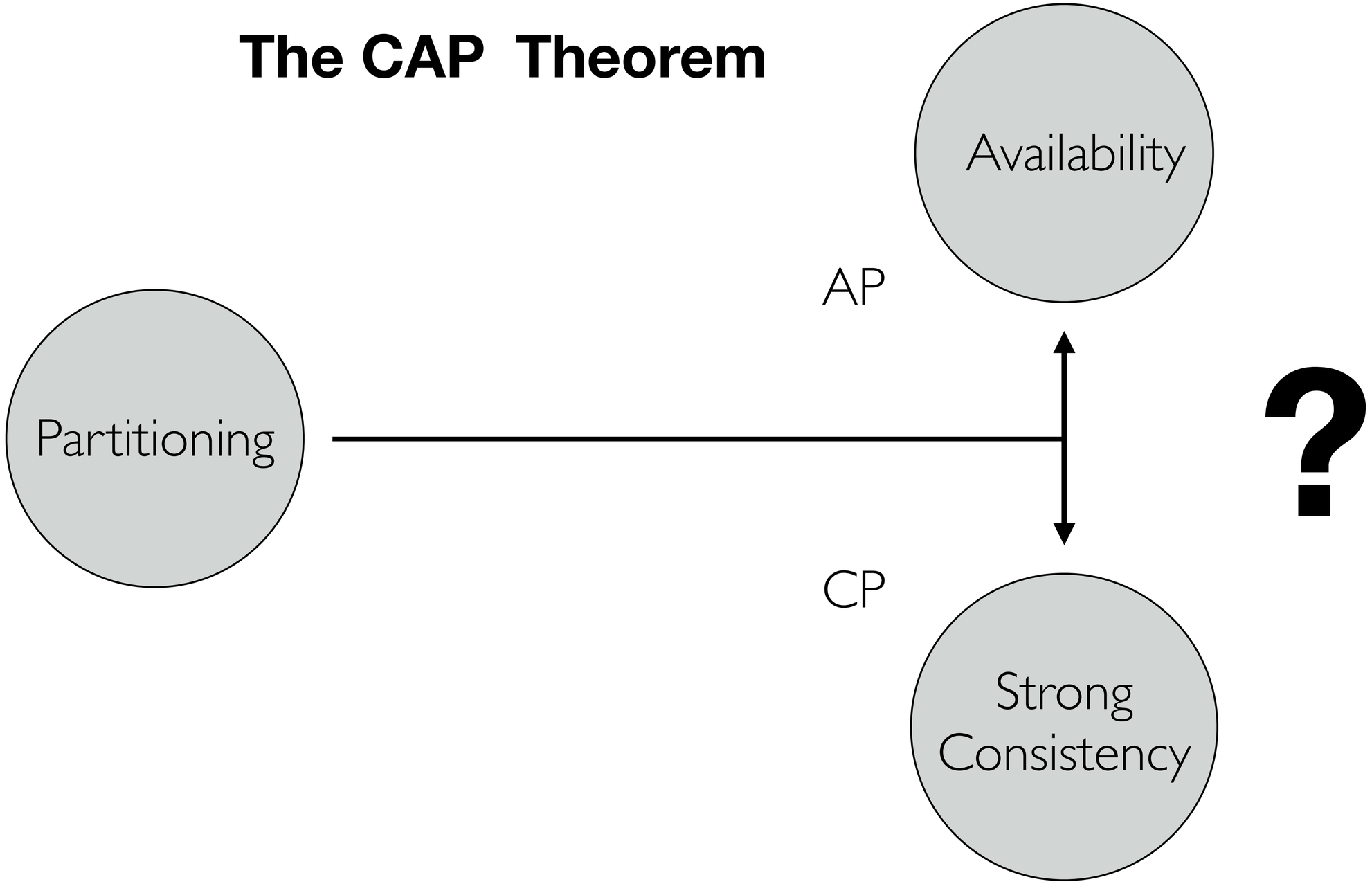
The CAP Theorem

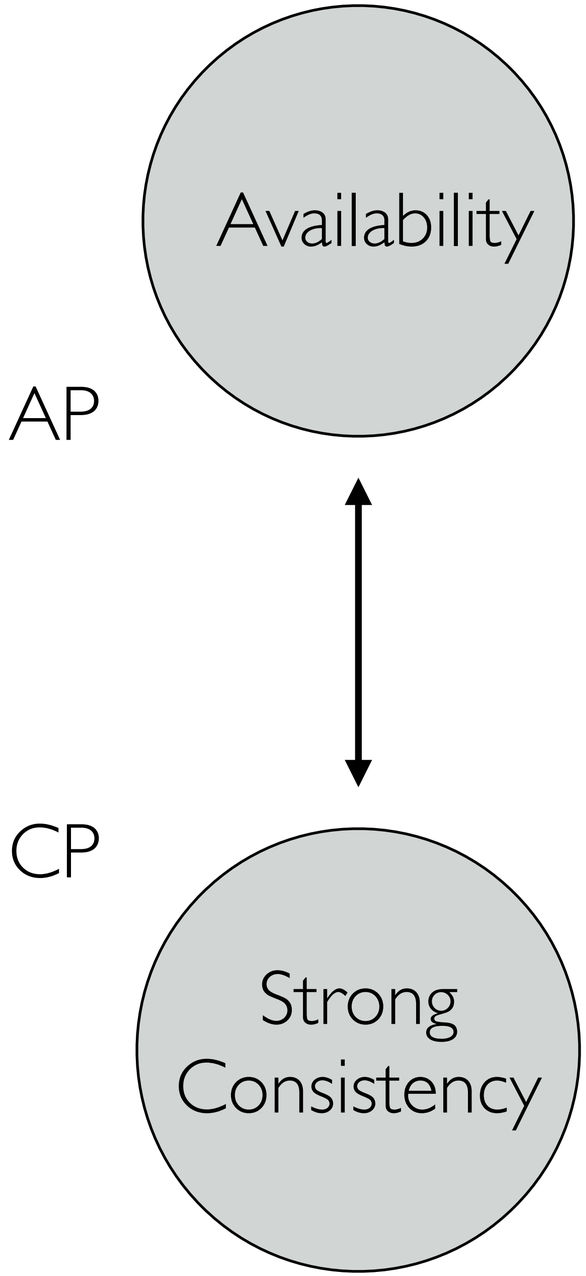


The CAP Theorem



The CAP Theorem





Eventual consistency
+ full availability

Riak does both

Strong consistency
+ partial availability