Introduction à la Big Data

Concept et historique

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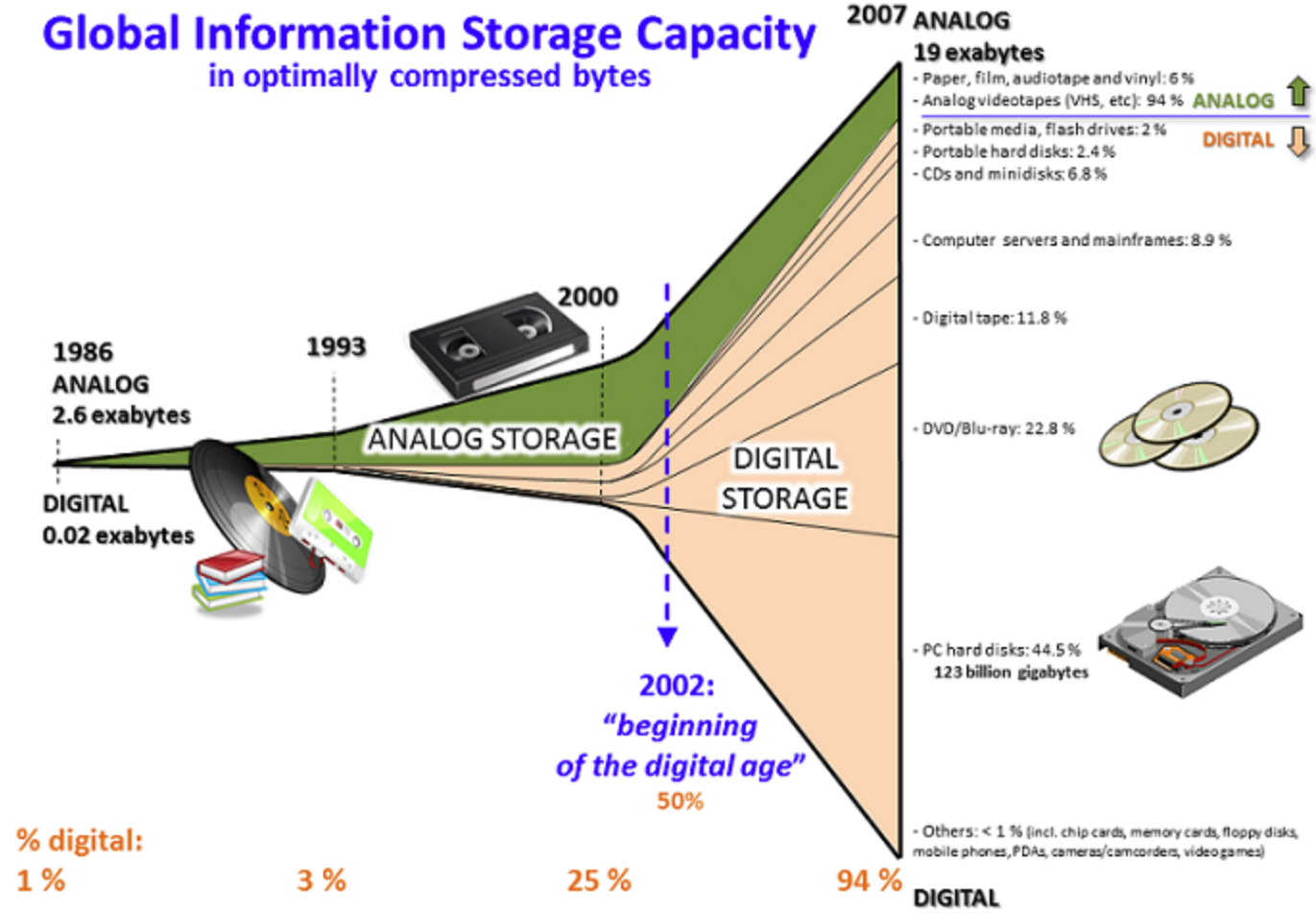
Augmentation des capacités de stockage



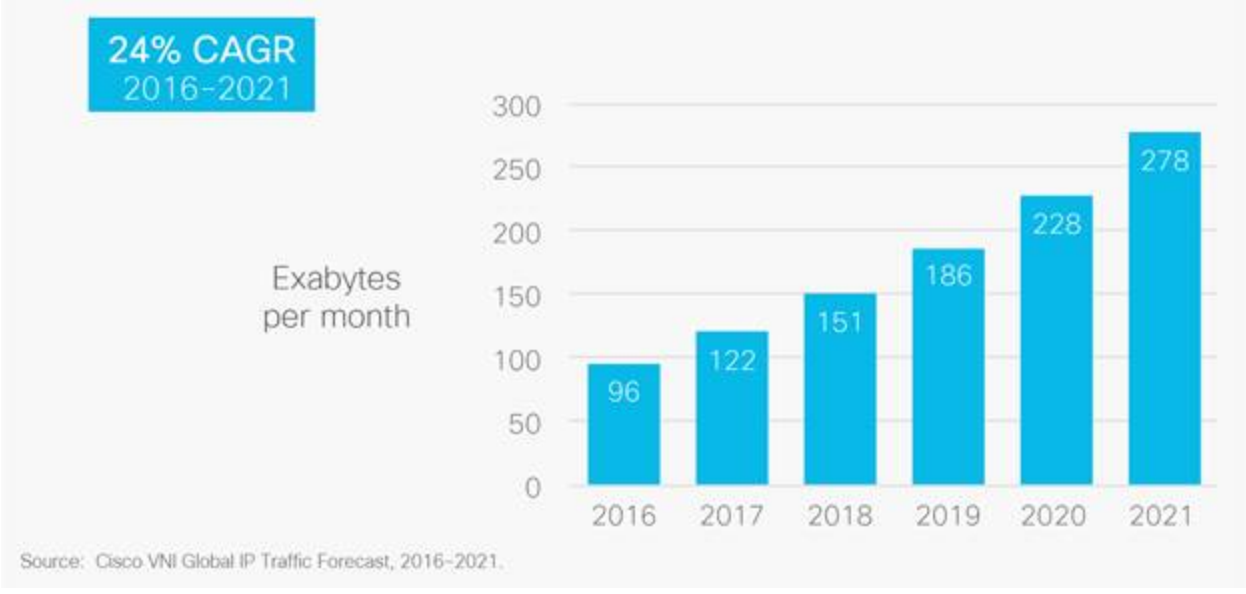
Source: Hilbert, M., & López, P. (2011). The World's Technological Capacity to Store, Communicate, and Compute Information. *Science*, 332(6025), 60 –65. http://www.martinhilbert.net/WorldInfoCapacity.html

Concept : les 3V

- **Volume :**
  téra (10^{12}), péta (10^{15}), exa (10^{18}), zetta (10^{21}), yotta (10^{24})
- **Variété :**
  Profil, activité, interaction, statistique, image, voix, ...
- **Vélocité :**
  Temps réel, milliseconde, haute fréquence, ...

Concept : les 3V

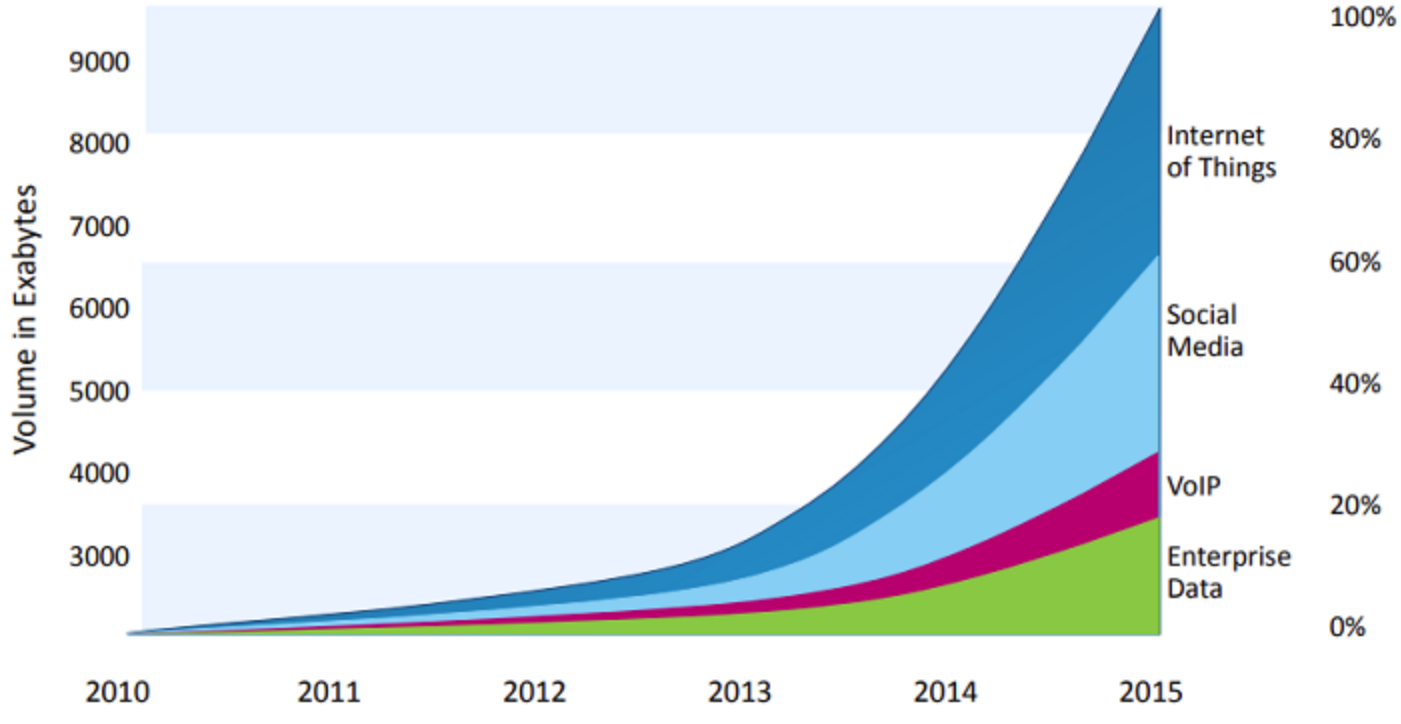
Volume



The Zettabyte Era: Trends and Analysis

Concept : les 3V

Volume



Source: IBM Global Technology Outlook

Be a Smarter Business by Unlocking your Internet of Things

Concept : les 3V

Variété

Produit


```
{
  "_id": {
    "$oid": "5968dd23fc13ae04d9000001"
  },
  "product_name": "sildenafil citrate",
  "supplier": "Wisozk Inc",
  "quantity": 261,
  "unit_cost": "$10.47"
}
```


10 Example JSON Files

Concept : les 3V

Variété

GeoIP


```
{
  "as": "AS16509 Amazon.com, Inc.",
  "city": "Boardman",
  "country": "United States",
  "countryCode": "US",
  "isp": "Amazon",
  "lat": 45.8696,
  "lon": -119.688,
  ...
  "regionName": "Oregon",
  "status": "success",
  "timezone": "America\/Los_Angeles",
  "zip": "97818"
}
```

Concept : les 3V

Variété

Twitter

```
{
  "created_at": "Thu Jun 22 21:00:00 +0000 2017",
  "id": 877994604561387500,
  "id_str": "877994604561387520",
  "text": "....",
  "entities": {
    "hashtags": [{
      ...
    }],
    "user_mentions": [],
    "urls": [{
      "url": "https://t.co/xFox78juL1",
      ...
    }]
  }
```

Concept : les 3V

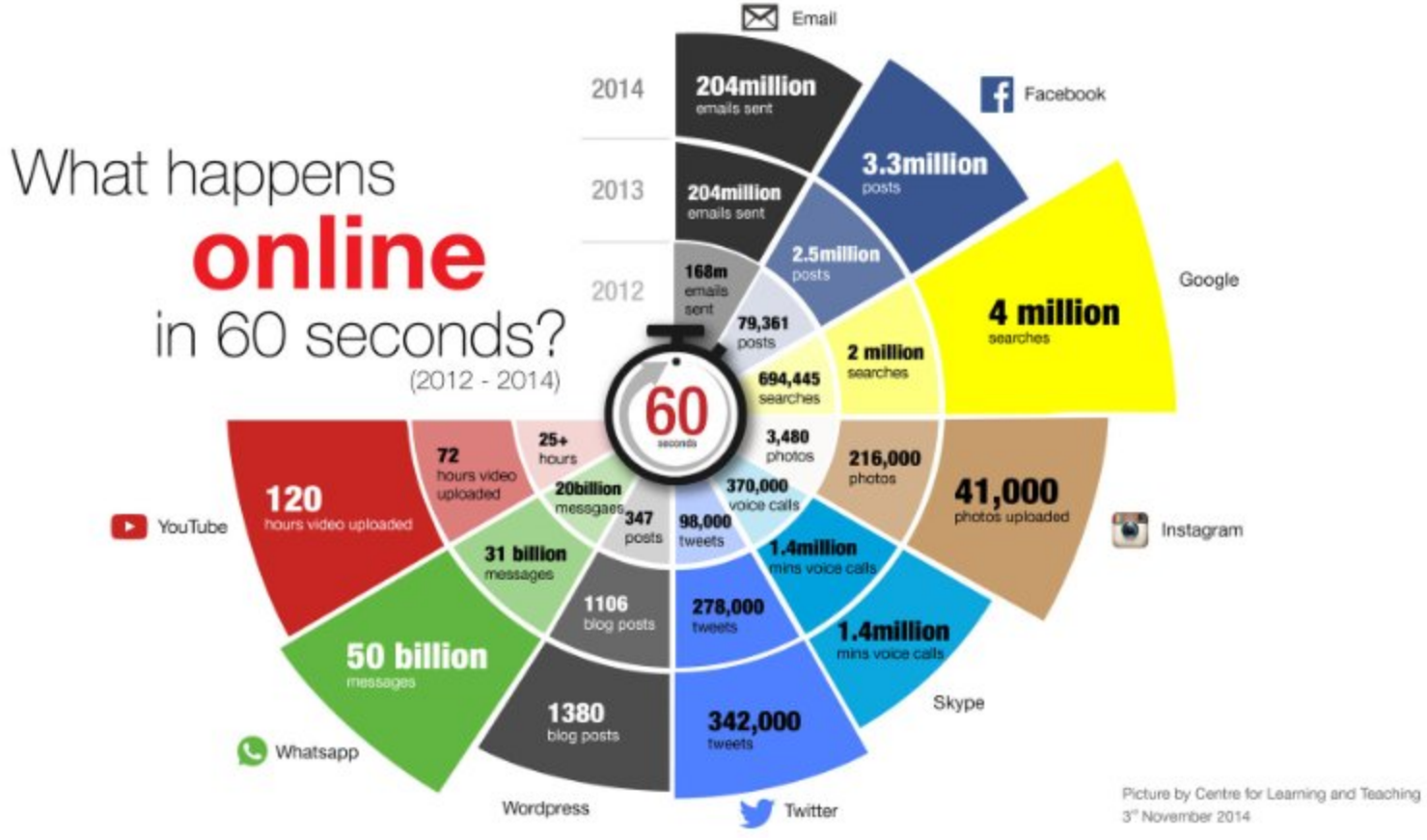
Variété

WordPress


```
{
  "id": 157538,
  "date": "2017-07-21T10:30:34",
  "date_gmt": "2017-07-21T17:30:34",
  "guid": {
     "rendered": "https://www.sitepoint.com/?p=157538"
  },
  "modified": "2017-07-23T21:56:35",
  "modified_gmt": "2017-07-24T04:56:35",
  "slug": "why-the-iot-threatens-your-wordp..",
  "status": "publish",
  "type": "post",
  "link": "https://www.sitepoint.com/why-the-io...",
```

Concept : les 3V

Vélocité



Et les autres

- **Variabilité**
- **Véracité**
- **Visualisation**
- **Valeur**

Hadoop

La démocratisation de la "Big Data"

- 2004
- Doug Cutting
- Framework
- Java
- Doudou

Hadoop

En résumé

Hadoop est un *framework* libre et *open source* écrit en Java destiné à faciliter la création d'applications distribuées (au niveau du stockage des données et de leur traitement) et échelonnables (scalables) permettant aux applications de travailler avec des milliers de nœuds et des pétaoctets de données.
[...] *Hadoop* a été inspiré par la publication de *MapReduce*, *GoogleFS* et *BigTable* de Google
Wikipedia

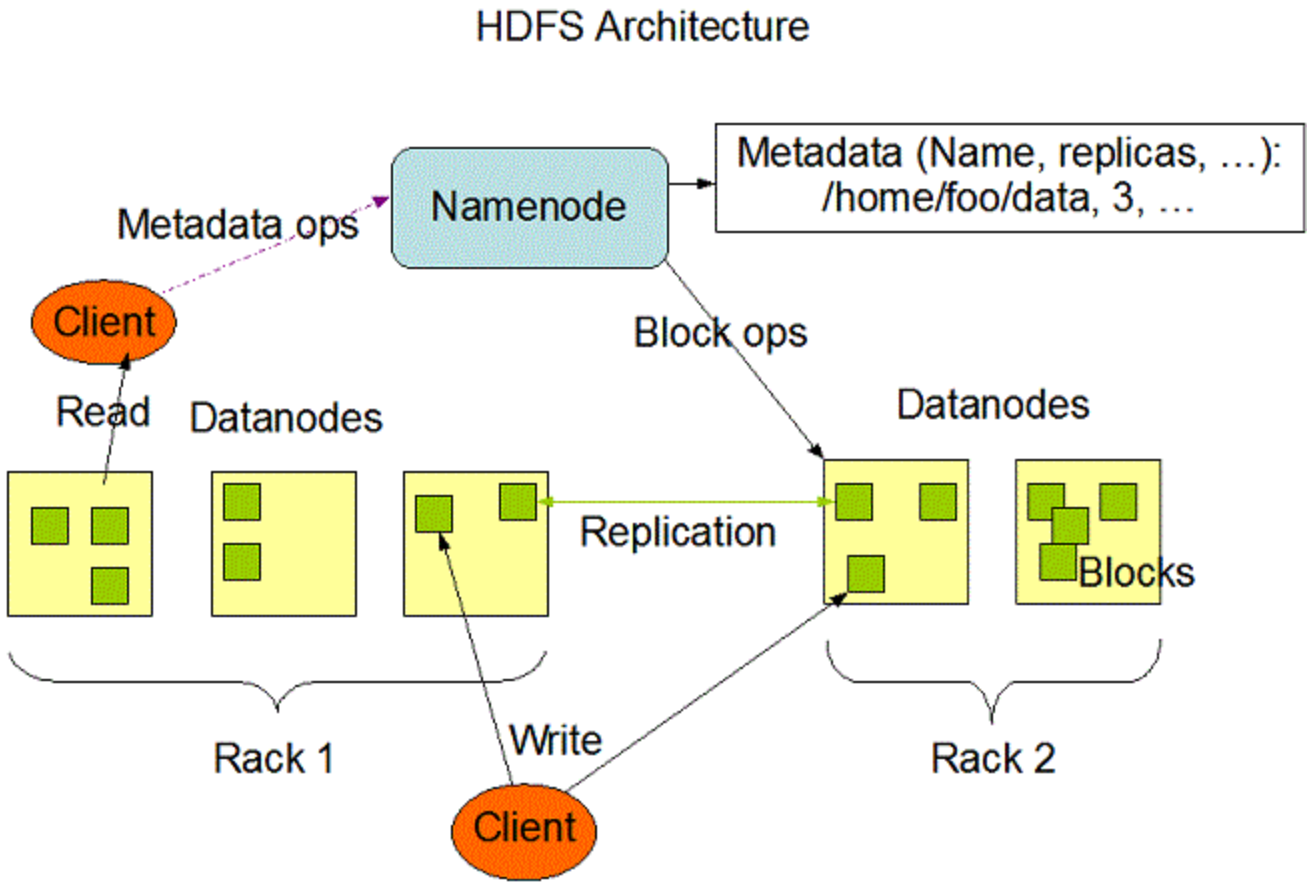
Hadoop

L'architecture

- *Hadoop Distributed File System* (HDFS)
- *YARN*
- *MapReduce*

Hadoop

HDFS



HDFS Architecture Guide

Hadoop

HDFS

- ***NameNode :*** gestion de l'espace de noms, de l'arborescence et des métadonnées
- ***DataNode :*** stockage des blocs de données

Hadoop

HDFS - Quelques commandes

```
hadoop fs -mkdir
hadoop fs -ls
hadoop fs -put
hadoop fs -get
hadoop fs -cp
hadoop fs -mv
...
```

Hadoop

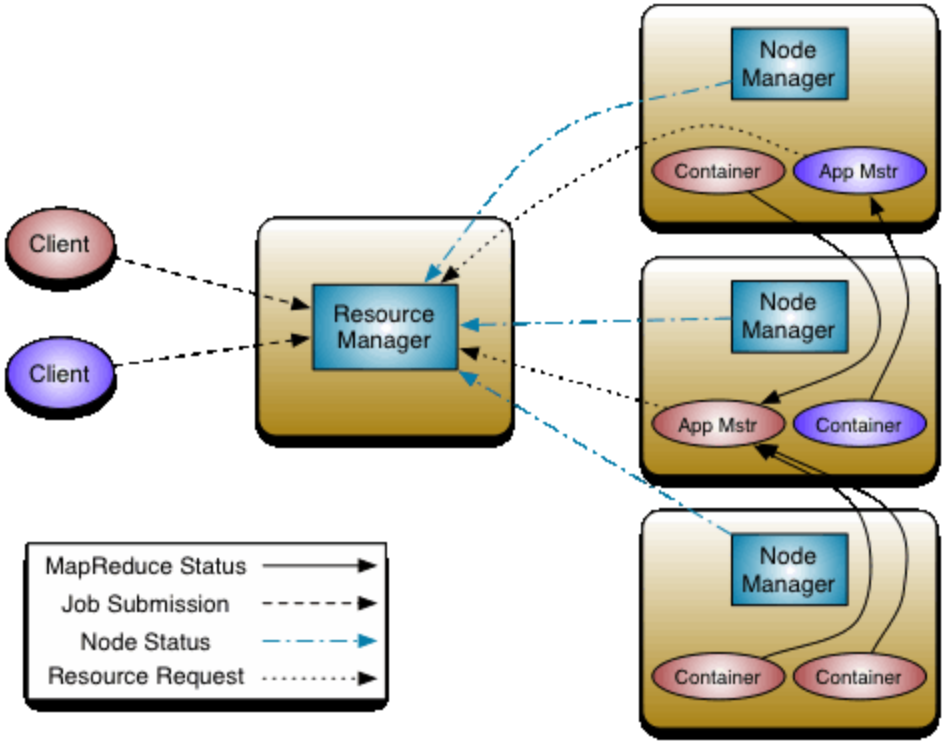
HDFS - Exercice pratique

```
$ docker pull sequenceiq/hadoop-docker:2.7.1
$ docker run -it sequenceiq/hadoop-docker:2.7.1 \
  /etc/bootstrap.sh -bash
bash-4.1# cd $HADOOP_PREFIX
bash-4.1# bin/hadoop version
bash-4.1# bin/hadoop fs -mkdir test
bash-4.1# bin/hadoop fs -ls
bash-4.1# bin/hadoop fs
```

https://github.com/sequenceiq/hadoop-docker

Hadoop

YARN



Apache Hadoop YARN

Hadoop

YARN

- ***Resource Manager :*** arbitre la gestion des ressources au sein du cluster
- ***Node Manager :*** fournit les ressources du nœud sous forme de *Container*
- ***Application Master :*** coordonne l'exécution des tâches
- ***Container :*** exécute les tâches

Hadoop

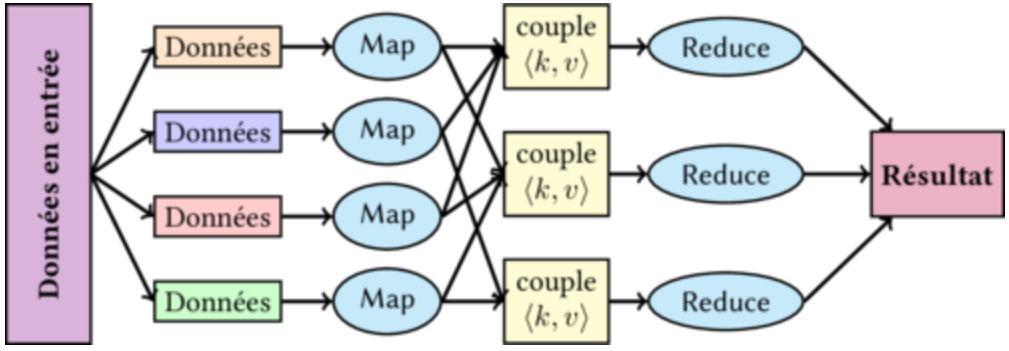
YARN - Web UI

```
$ docker run -p 8088:8088 -it sequenceiq/hadoop-docker:2.7.1 \
  /etc/bootstrap.sh -bash
```

http://host:8088

Hadoop

MapReduce



Wikipedia

input (k1, v1)
-> **map** -> (k2, v2)
-> **combine** -> (k2, v2)
-> **reduce** -> (k3, v3)
output

Hadoop

Par l'exemple : WordCount

Input (flux d'entrée) :

```
Conseil tenu par les rats

Un chat, nommé Rodilardus,
Faisait des rats telle déconfiture
Que l'on n'en voyait presque plus,
Tant il en avait mis dedans la sépulture.
Le peu qu'il en restait n'osant quitter son trou
...
```

Hadoop

Par l'exemple : WordCount

Mapper :

```
import sys

for line in sys.stdin:
    line = line.strip()
    keys = line.split()
    for key in keys:
        value = 1
        print('%s\t%d' % (key, value))
```

Hadoop

Par l'exemple : WordCount

Reducer :

```
import sys

last_key = None
running_total = 0

for input_line in sys.stdin:
    input_line = input_line.strip()
    this_key, value = input_line.split("\t", 1)
    value = int(value)

    if last_key == this_key:
        running_total += value
    else:
        if last_key:
            print("%s\t%d" % (last_key, running_total))
        running_total = value
        last_key = this_key

if last_key == this_key:
    print("%s\t%d" % (last_key, running_total))
```

Hadoop

Par l'exemple : WordCount

```
bash-4.1# cat conseil-tenu-par-les-rats.txt | ./mapper.py \
| sort | ./reducer.py
```

```
bash-4.1# bin/hadoop fs -mkdir wordcount
bash-4.1# bin/hadoop fs -put conseil-tenu-par-les-rats.txt \
wordcount/fable.txt
bash-4.1# bin/hadoop jar share/hadoop/tools/lib/hadoop-streamir
 -mapper "python mapper.py" \
 -reducer "python reducer.py" \
 -input "wordcount/fable.txt" \
 -output "wordcount/output"
```

```
bash-4.1# bin/hadoop fs -cat wordcount/output/*
```

Hadoop

Exercice

- Récupérez une source de données sur data.gouv.fr
- Importez ces données en HDFS
- Développez un code *MapReduce* en Python pour en extraire une nouvelle information
- Représentez-là sous forme de graphique

Base de données et Big Data

Les principes fondamentaux

- ***Partitioning*** : basé sur les colonnes
- ***Sharding*** : basé sur les clés d'une ligne

Base de données et Big Data

Partitioning

Col1	Col2	Col3	Col4	Col5	Col6
–					

—

Col1	Col2	Col3	Col4
–			

Col5	Col6
–	

Base de données et Big Data

Sharding - Horizontal partitioning

Key	Col1	Col2	Col3
x			
y			
z			

Key	Col1	Col2	Col3
x			

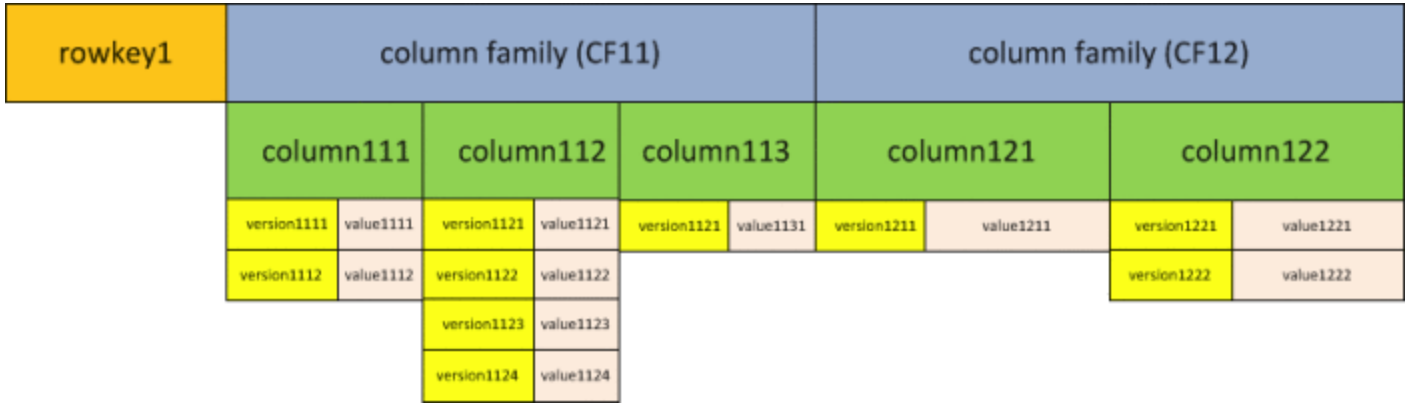
Key	Col1	Col2	Col3
y			
z			

HBase

- Base de données orientée colonnes
- Installé sur le système de fichier HDFS

HBase

Système de stockage



HBase Schema

HBase

Système de stockage

- Une *table* est une collection de *rows*
- Une *row* est une collection de *columns family*
- Une *column family* est une collection de *columns*
- Une *column* est une collection de clé/valeur

HBase

Système de stockage

```
{
"row1": {"1": {"color": "green",
               "size": 25},
         "2": {"weight": 52,
               "size": 18}
        },
"row2": {"1": {"color": "blue"},
         "2": {"height": 192,
               "size": 43}
        }
}
```

HBase

HBase Shell

```
$ docker pull dajobe/hbase
$ mkdir data
$ docker run --name=hbase-docker -h hbase-docker -d \
-v $PWD/data:/data dajobe/hbase
$ docker exec -it hbase-docker bash
root@hbase-docker:/# hbase shell
```

HBase

HBase Shell

HBase Tutorial

```
> status
1 active master, 0 backup masters, 1 servers, 1 dead, 2.0000 av
```

```
> list
TABLE
0 row(s) in 0.0820 seconds

=> []
```

HBase

HBase Shell - Création d'une table

```
> create 'emp', 'personal data', 'professional data'
0 row(s) in 1.3160 seconds

=> Hbase::Table - emp
```

```
> list
TABLE
emp
1 row(s) in 0.0440 seconds

=> ["emp"]
```

HBase

HBase Shell - Désactivation

```
> disable 'emp'
0 row(s) in 2.3980 seconds
```

```
> is_disabled 'emp'
true
0 row(s) in 0.0110 seconds
```

HBase

HBase Shell - Activation

```
> enable 'emp'
0 row(s) in 1.3110 seconds
```

```
> is_enabled 'emp'
true
0 row(s) in 0.0280 seconds
```

HBase

HBase Shell - Ecriture

```
> put 'emp','1','personal data:name','raju'
> put 'emp','1','personal data:city','hyderabad'
> put 'emp','1','professional data:designation','manager'
> put 'emp','1','professional data:salary','50000'
```

```
> scan 'emp'
```

HBase

HBase Shell - Mise à jour

```
> put 'emp','1','personal data:city','Delhi'
ROW  COLUMN+CELL
 1   column=personal data:city, timestamp=1503511522300, value=
 1   column=personal data:name, timestamp=1503511282272, value=
 1   column=professional data:designation, timestamp=1503511332
 1   column=professional data:salary, timestamp=1503511341265,
1 row(s) in 0.0250 seconds
```

HBase

HBase Shell - Accès

```
> get 'emp', '1'
COLUMN                                CELL
 personal data:city                   timestamp=1503511522300, value
 personal data:name                   timestamp=1503511282272, value
 professional data:designation        timestamp=1503511332216, value
 professional data:salary             timestamp=1503511341265, value
4 row(s) in 0.0610 seconds
```

HBase

HBase Shell - Accès à une colonne

```
> get 'emp', '1', {COLUMN => 'personal data:name'}
COLUMN                  CELL
 personal data:name     timestamp=1503511282272, value=raju
1 row(s) in 0.0250 seconds
```

HBase

HBase Shell - Suppression

```
> delete 'emp', '1', 'personal data:city'
> deleteall 'emp','1'
> scan 'emp'
```

HBase

HBase Shell - Sécurité

- **R** lecture
- **W** écriture
- **X** exécution
- **C** création
- **A** admin

```
> grant 'bobsmith', 'RWXCA'
> revoke 'bobsmith'
```

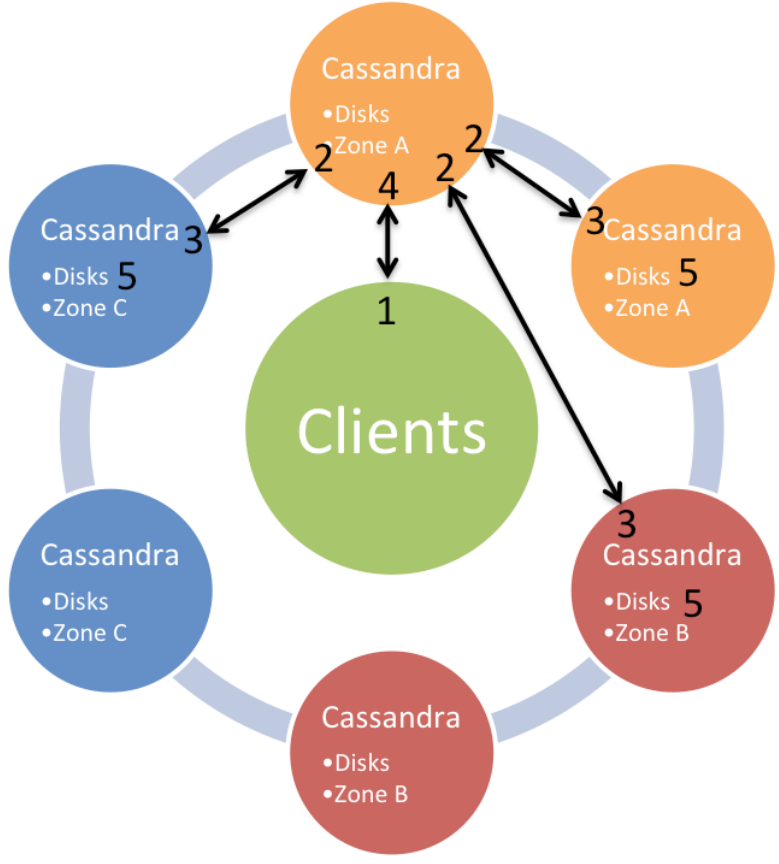
Cassandra

- Tolérance à la panne
- Décentralisé
- Scalable

Cassandra Write Data Flows

Single Region, Multiple Availability Zone

1. Client Writes to any Cassandra Node
2. Coordinator Node replicates to nodes and Zones
3. Nodes return ack to coordinator
4. Coordinator returns ack to client
5. Data written to internal commit log disk



If a node goes offline, hinted handoff completes the write when the node comes back up.

Requests can choose to wait for one node, a quorum, or all nodes to ack the write

SSTable disk writes and compactions occur asynchronously

NETFLIX

Netflix Architecture Tutorial

Cassandra

Tutorial

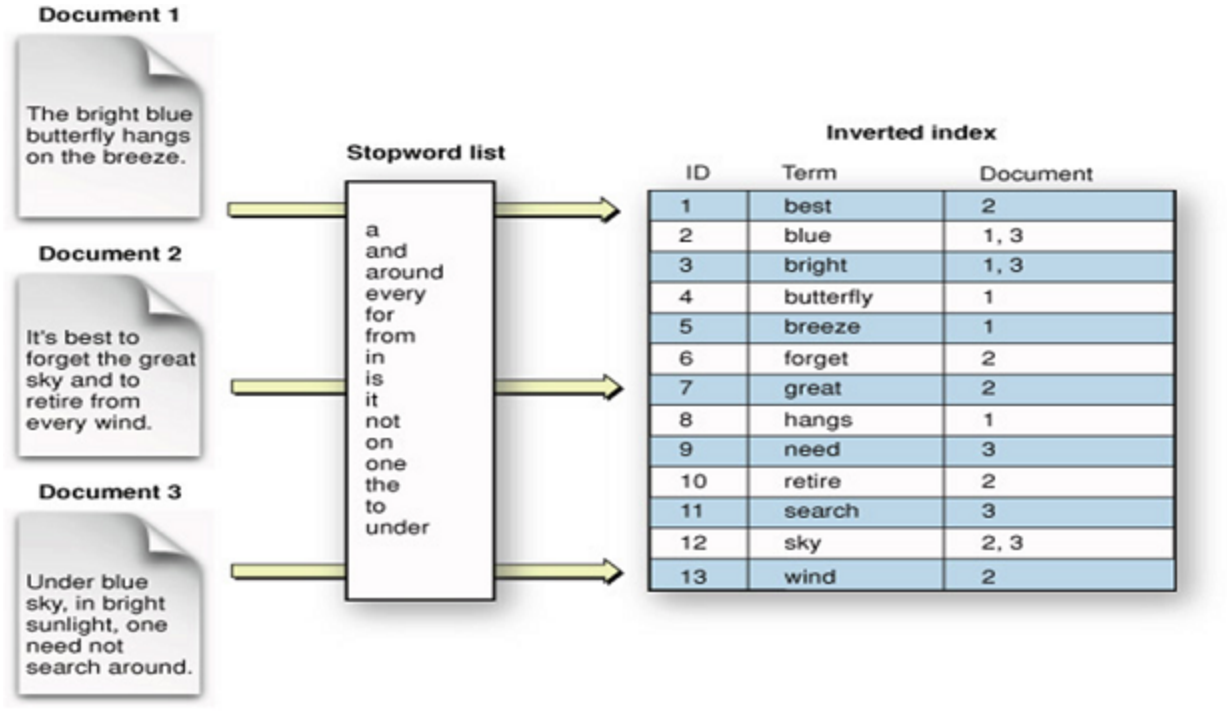
```
$ docker pull cassandra
$ docker run --name=cassandra -d library/cassandra
$ docker exec -it cassandra bash
root@a6b74edad198:/#
```

Cassandra Tutorial

Elasticsearch

- Indexation et recherche de données
- Moteur Lucene
- *API HTTP RESTful* en *JSON*

Elasticsearch



Elasticsearch Tutorial - Elasticsearch Storage Architecture : Analysis and Inverted Indexes

Elasticsearch

Tutorial

```
$ docker pull docker.elastic.co/elasticsearch/elasticsearch:5.5
$ docker run --name=elasticsearch -d -p 9200:9200 \
-e "http.host=0.0.0.0" -e "transport.host=127.0.0.1" \
docker.elastic.co/elasticsearch/elasticsearch:5.5.2
$ curl -u elastic http://127.0.0.1:9200/
```

Utilisateur : elastic

Mot de passe : changeme

Elasticsearch Tutorial