

# IMS Data Integration with Hadoop

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## z/OS Structured Data Integration for Big Data

- The Big Data Landscape
  - **Introduction to Hadoop**
    - What, Why, How
  - **The IMS community cares about Hadoop because ...**
    - Exponential value at the intersection of Hadoop and Structured Data
  
- z/OS Data Integration with Hadoop
  - **The Requirements and The Journey**
    - Hadoop on z?
    - z/OS data integration
  - **InfoSphere System z Connector for Hadoop**
    - Fast, Easy, Low Investment z/OS data delivery to HDFS and Hive
  - **InfoSphere Data Replication**
    - Keeping your Big Data Up-to-Date

# Hadoop ... Created to Go Beyond Traditional Database Technologies

## Foundation for Exploratory Analytics

- Hadoop was pioneered by Google and Yahoo! to address issues they were having with then-available database technology:
  - Data volumes could not be cost effectively managed using database technologies
  - Analyzing larger volumes of data can provide better results than sampling smaller amounts
  - Insights needed to be mined from unstructured data types
  - Data was being explored to understand its potential value to the business

### Typical Use Cases



**Analyze a Variety of Information**  
Novel analytics on a broad set of mixed information that could not be analyzed before



**Analyze Extreme Volumes of Information**  
Cost-efficiently process and analyze petabytes of information



**Discovery and Experimentation**  
Quick and easy sandbox to explore data and determine its value

# What is Hadoop?

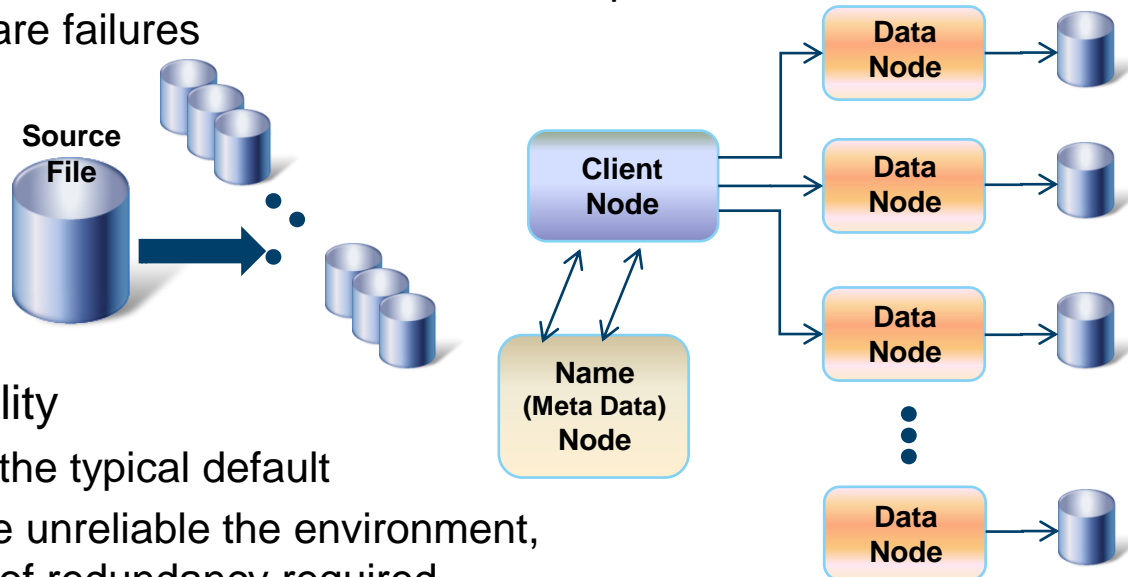
## Divide and Conquer!

- Rapidly evolving open source software framework for creating and using hardware clusters to process vast amounts of data!
  
- 2.# version framework consists of:
  - **Common Core**: the basic modules (libraries and utilities) on which all components are built
  - **Hadoop Distributed File System (HDFS)**: manage data stored on multiple machines for very high aggregate bandwidth across the "cluster" of machines
  - **MapReduce**: programming model to support the high data volume processing of data in the cluster
  - **"Yet Another Resource Negotiator" (YARN)**: platform to manage the cluster's compute resources, de-coupling Hadoop workload and resource management

# Typical Hadoop Data Flow

## 1. Load Data into an HDFS cluster

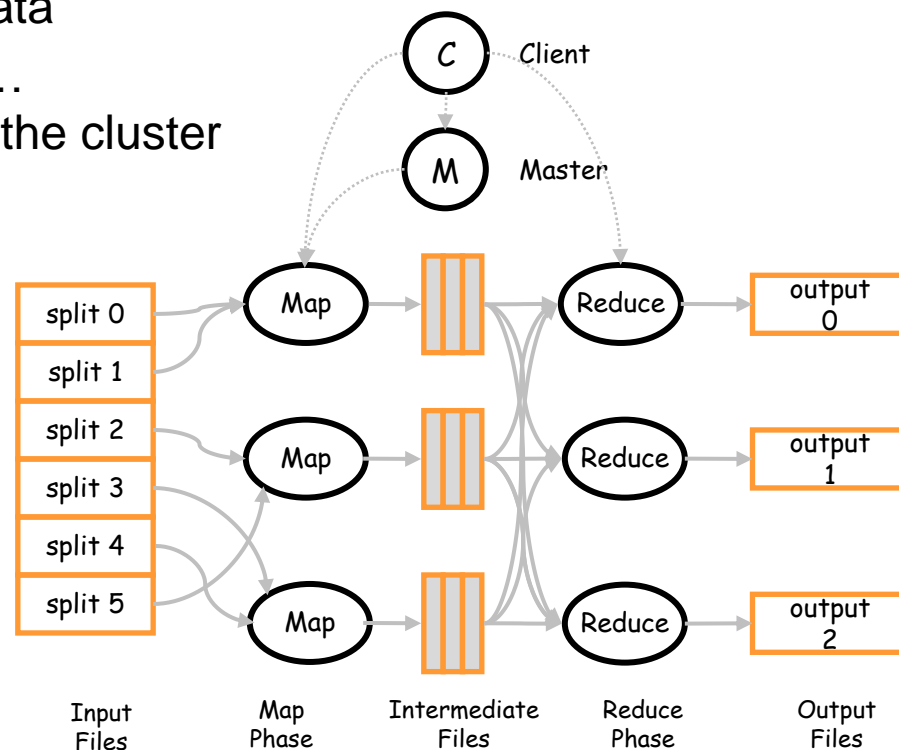
- Optimize for parallelism and reliability
  - Break the source into large blocks (typically 64MB) so that each block can be written (and read) independently
  - Each block is written to a node ... the more nodes the more dispersion of the data for future parallel processing
  - Redundant copies of each block are maintained on separate nodes to protect against hardware failures



- Redundancy for reliability
  - Configurable, three is the typical default
  - Simplistically, the more unreliable the environment, the higher the degree of redundancy required

# Typical Hadoop Data Flow

1. Load Data into an HDFS cluster
2. **Analyze the data in the cluster using a MapReduce "program"**
  - Map: Drive analysis of the data
  - Reduce: Construct a result ...  
Writing it back into the cluster
3. Use the result!



# Hadoop Cluster Configuration Implications

- Redundancy drives Network Traffic
  - With three-way redundancy, each terabyte of data results in three terabytes of network traffic
  
- Parallelism drives Performance
  - **Scale OUT** (more nodes) and/or files OUT (more blocks)
    - Spread blocks of data across more nodes so more blocks can be read in parallel
    - Can spread a file to more nodes if you have enough nodes
    - Network activity spread across many nodes/files
  
  - **Scale UP** (more CPUs and/or memory per node rather than more nodes)
    - Increases the density of each node
    - More network activity concentrated on each node

# The Landscape is Rapidly Evolving

## More Apache Frameworks and Products You'll Hear About

- **Hive™** Apache data warehouse framework accessible using HiveQL
- **Spark** In-memory framework providing an alternative to MapReduce
- **HBase™** Apache Hadoop database
- **Pig** High level platform for creating long and deep Hadoop source programs
- **Zookeeper** Infrastructure & services enabling synchronization across large clusters
- **Flume** Collect and integrate data into Hadoop coordinating Web/app services, ...
- **Oozie** Workflow processing connecting multiple types of Hadoop source jobs

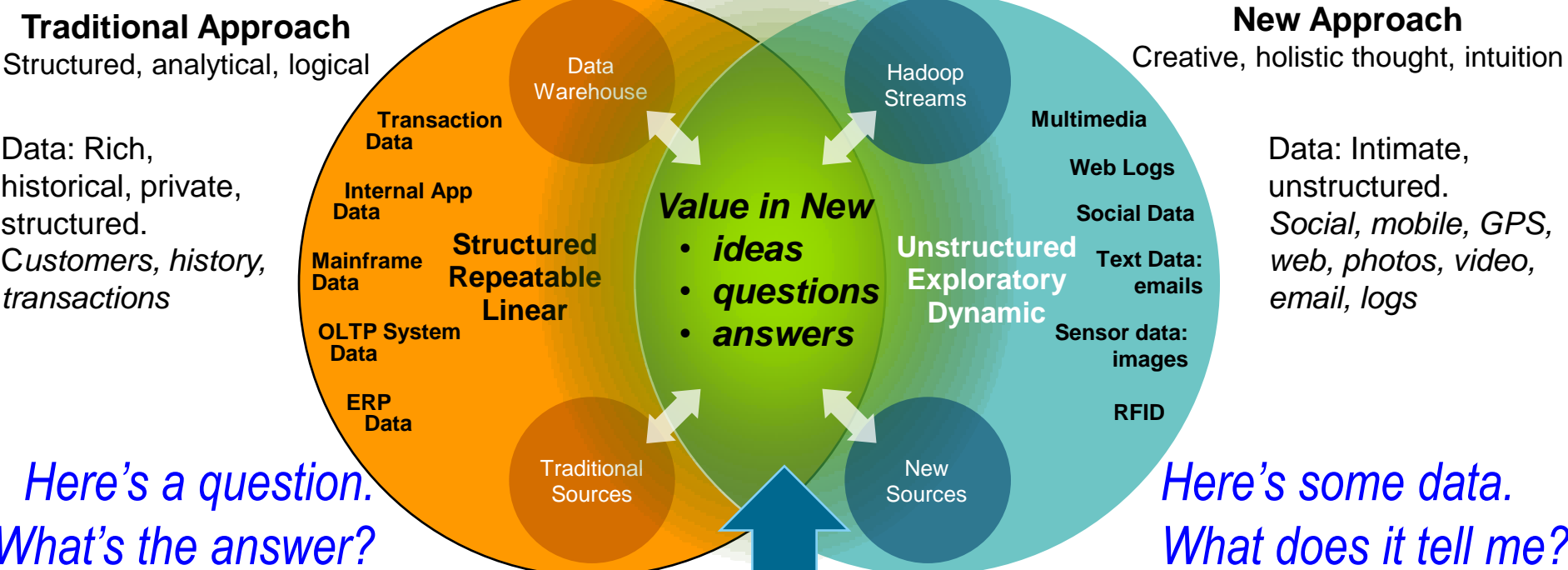




## z/OS Structured Data Integration for Big Data

- The Big Data Landscape
  - **Introduction to Hadoop**
    - What, Why, How
  - **The IMS community cares about Hadoop because ...**
    - Exponential value at the intersection of Hadoop and Structured Data
  
- Starting on the z/OS data integration with Hadoop journey
  - **InfoSphere System z Connector for Hadoop**
    - Fast, Easy, Low Investment z/OS data delivery to HDFS and Hive
  
- Keeping Big Data Current
  - **InfoSphere Data Replication**
    - Continuous incremental updates

# Imagine the possibility of leveraging all of your information assets



**Transformational benefit comes from integrating "new" data and methods with traditional ones!**

# This is Driving the Shifting Sands of Enterprise IT

## New ways of thinking for transformative economics

### Traditional Approach

- Vertical Infrastructure
- Design schemas in advance
- What data should I keep?
- What reports do I need?
- ETL, down-sample, aggregate
- On-premise

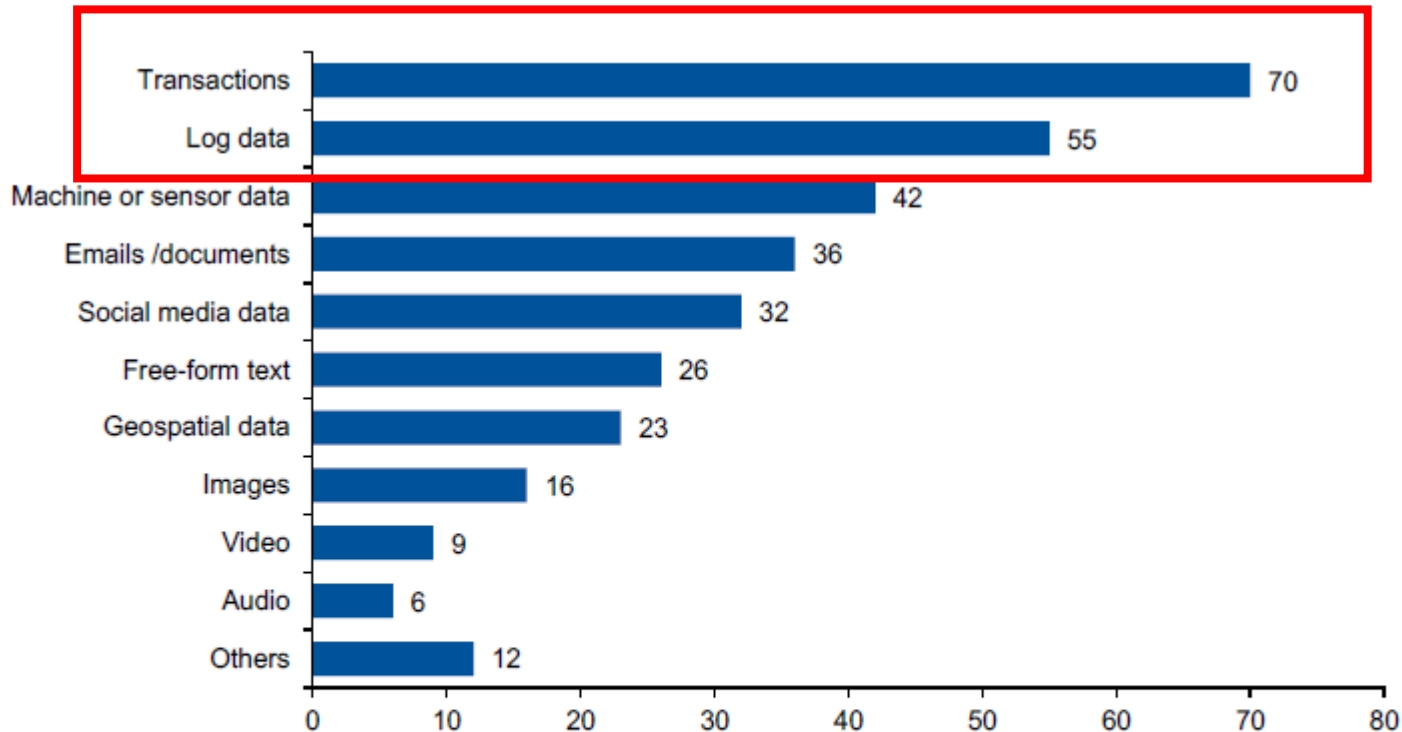


### New Approach

- Distributed data grids
- Evolve schemas on-the-fly
- Keep everything, just in case
- Test theories, model on-the-fly
- Knowledge from raw-data
- On-premise, cloud, hybrid

# Transaction & Log Data Dominate Big Data Deployments

Very High Proportion of this Data Resides on System z



N=465 (multiple responses allowed)

Source: Gartner (September, 2013)

Gartner research note “Survey Analysis - Big Data Adoption in 2013 Shows Substance Behind the Hype“ Sept 12 2013

Analyst(s): Lisa Kart, Nick Heudecker, Frank Buytendijk

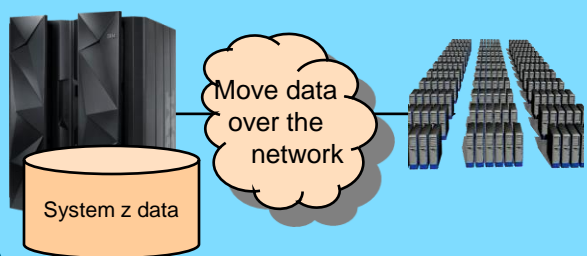
# Hadoop and System z

## The Requirements and The Journey



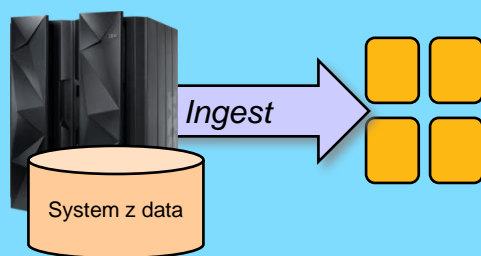
# Hadoop Topology Choices for System z Data

Processing done outside z  
(Extract and move data)



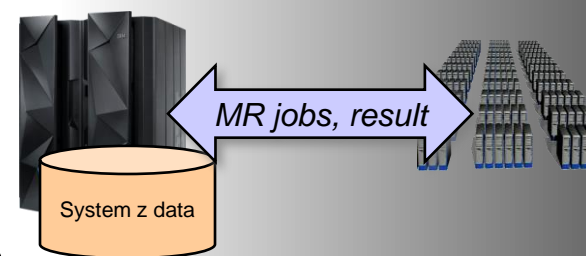
Petabytes possible  
Additional infrastructure.  
Challenges with:  
- scale  
- governance  
- ingestion.  
Data is outside System z control.

Processing done on z  
(Hadoop cluster on zLinux)



Gigabytes to Terabytes reasonable  
Rapidly provision new node(s)  
Near linear scale.  
System z is the control point.

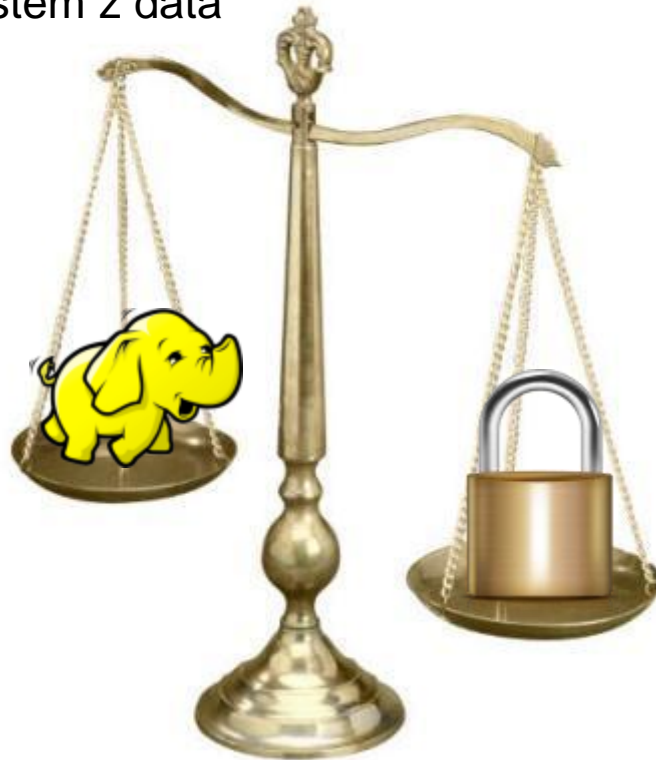
Extract and consume  
(z controls the process)



External data NOT routed through System z.  
System z governance for the result set.  
System z is the control point.

# The most likely driver for Hadoop on System z

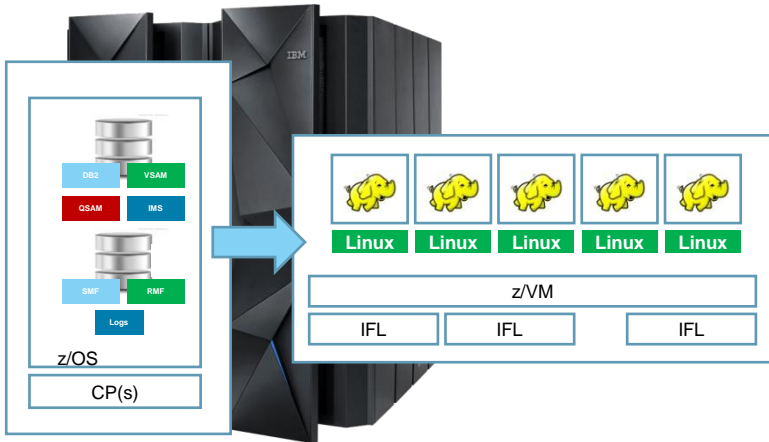
Value of exploratory  
analytic models applied  
to System z data



Risk associated with numerous  
copies of sensitive data  
dispersed across commodity  
servers with broad access

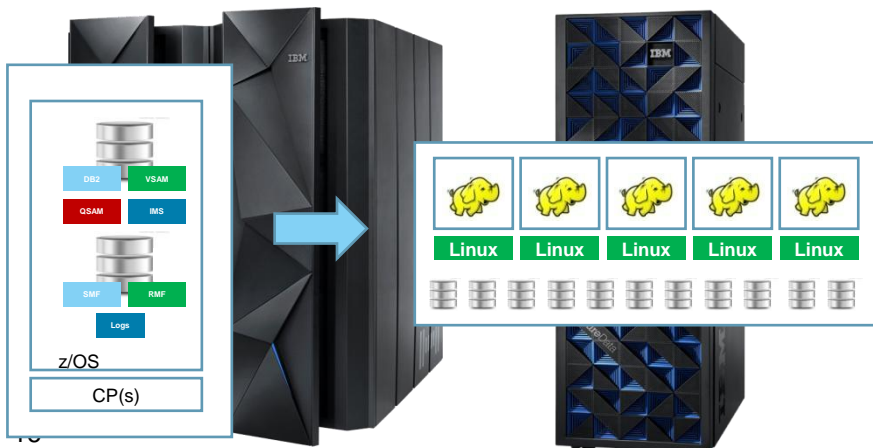
# Hadoop on System z ... What makes sense when?

## Case 1: Hadoop on the Mainframe



- *Data originates mostly on the mainframe (Log files, database extracts) and data security is important*
- *Z governance & security models needed*
- *Network volume or security concerns*
- *Moderate volumes – 100 GB to 10s of TBs*
- *Hadoop value from rich exploratory analytics*  
*(Hybrid Transaction-Analytic appliances for traditional analytics)*

## Case 2: Hadoop off the Mainframe



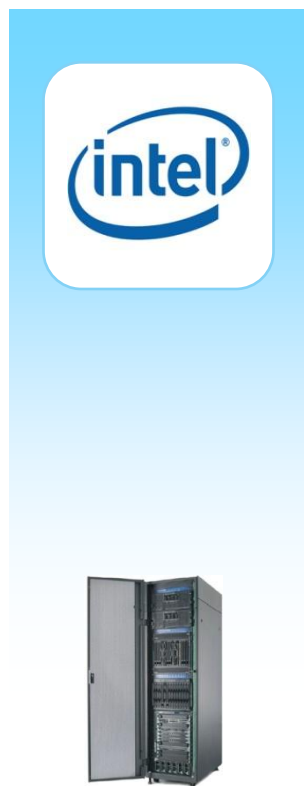
- *Most data originates off of the mainframe*
- *Security less of a concern since data is not "trusted" anyway*
- *Very large data sets – 100s of TB to PBs*
- *Hadoop is valued for ability to economically manage large datasets*
- *Desire to leverage lowest cost processing and potentially cloud elasticity*



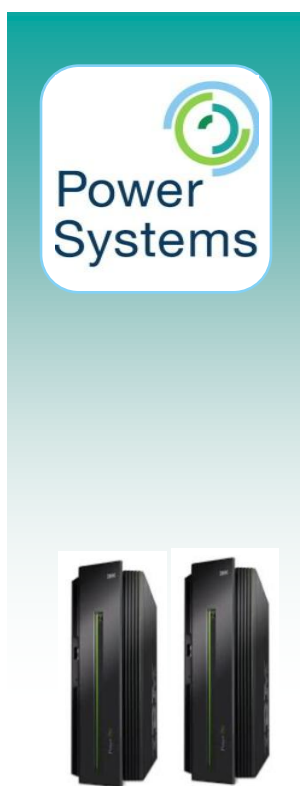
# IBM InfoSphere BigInsights Uniquely Offers ...

## Multiple technology options & deployment models

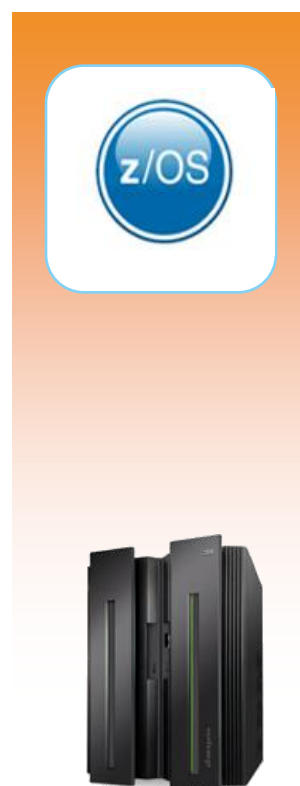
**Intel Servers**



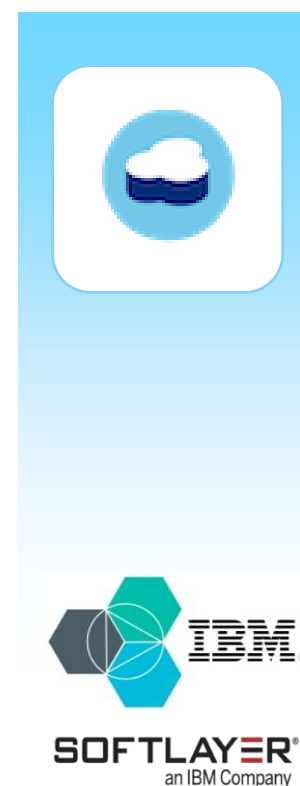
**IBM Power**



**IBM System z**

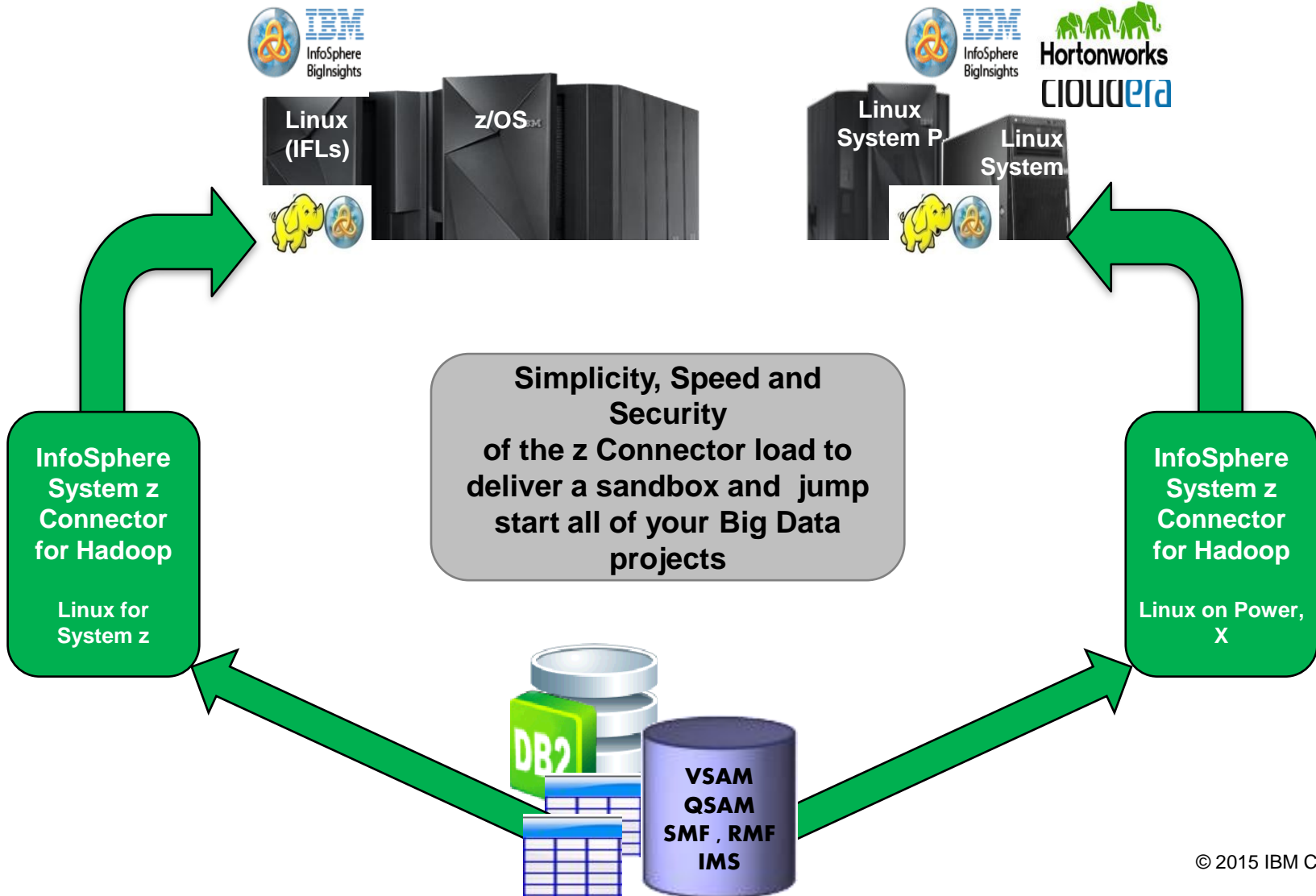


**On Cloud**



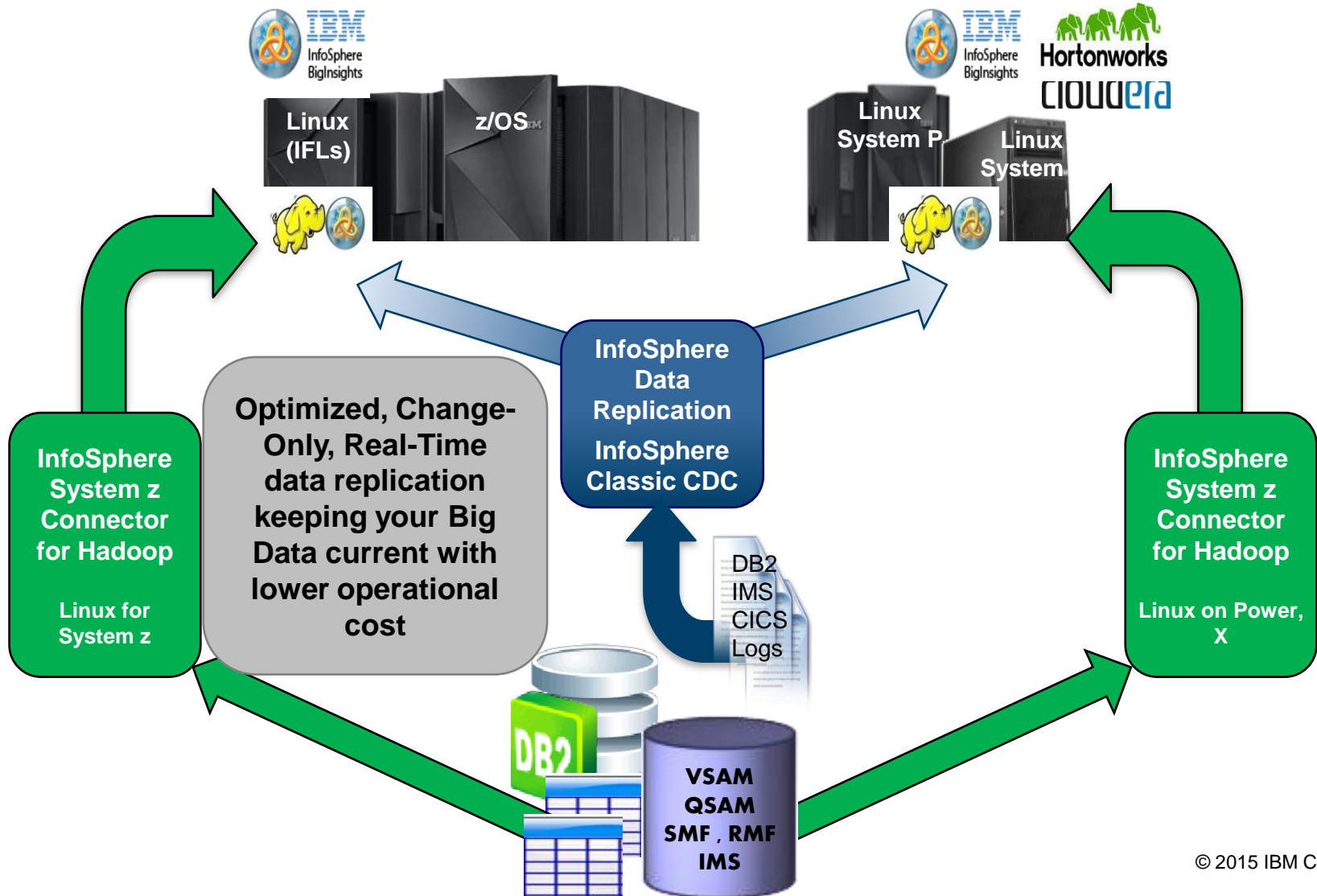
# IBM's InfoSphere z/OS Data Integration with Hadoop

## From the Sandbox to the Enterprise



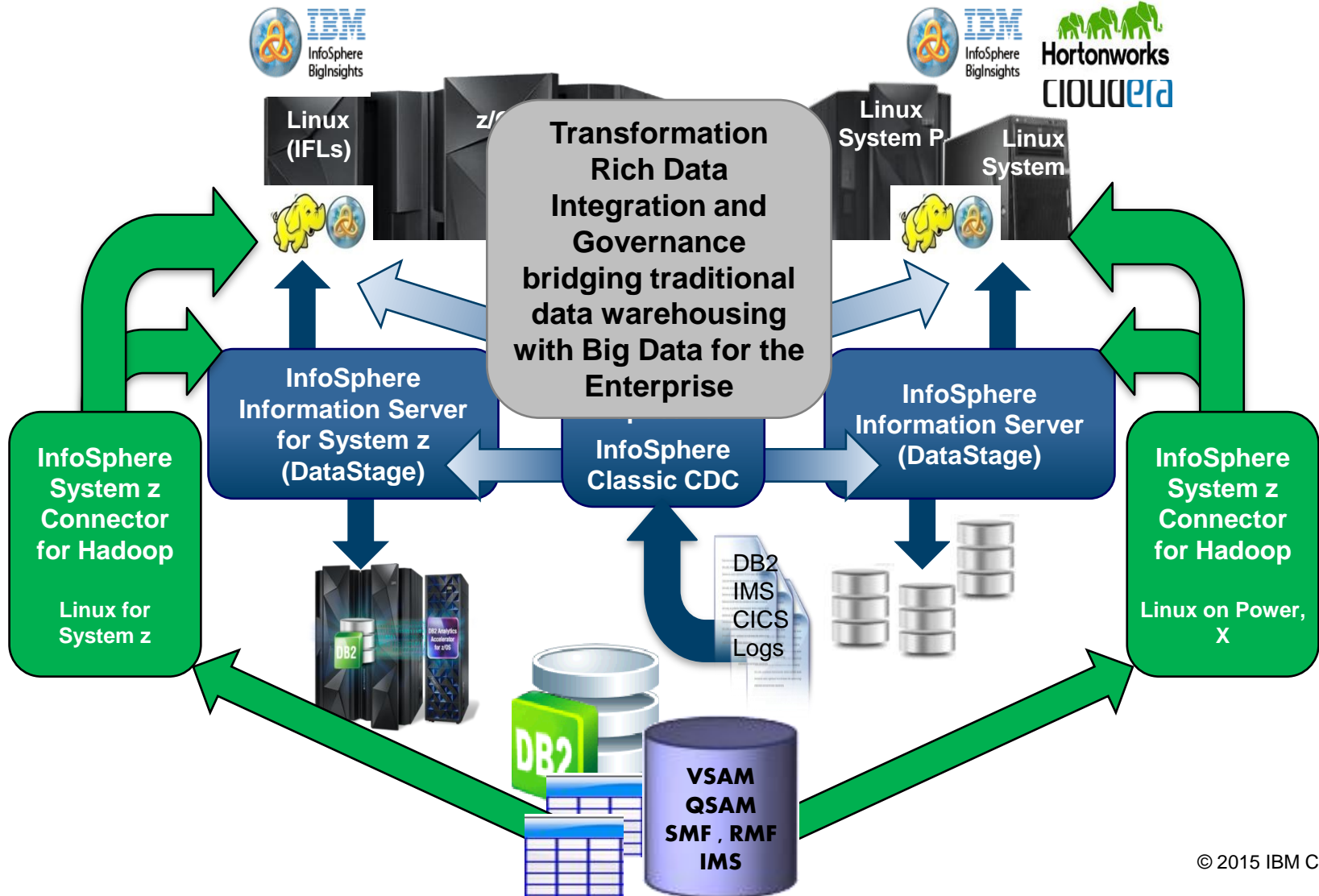
# IBM's InfoSphere z/OS Data Integration with Hadoop

## From the Sandbox to the Enterprise



# IBM's InfoSphere z/OS Data Integration with Hadoop

## From the Sandbox to the Enterprise



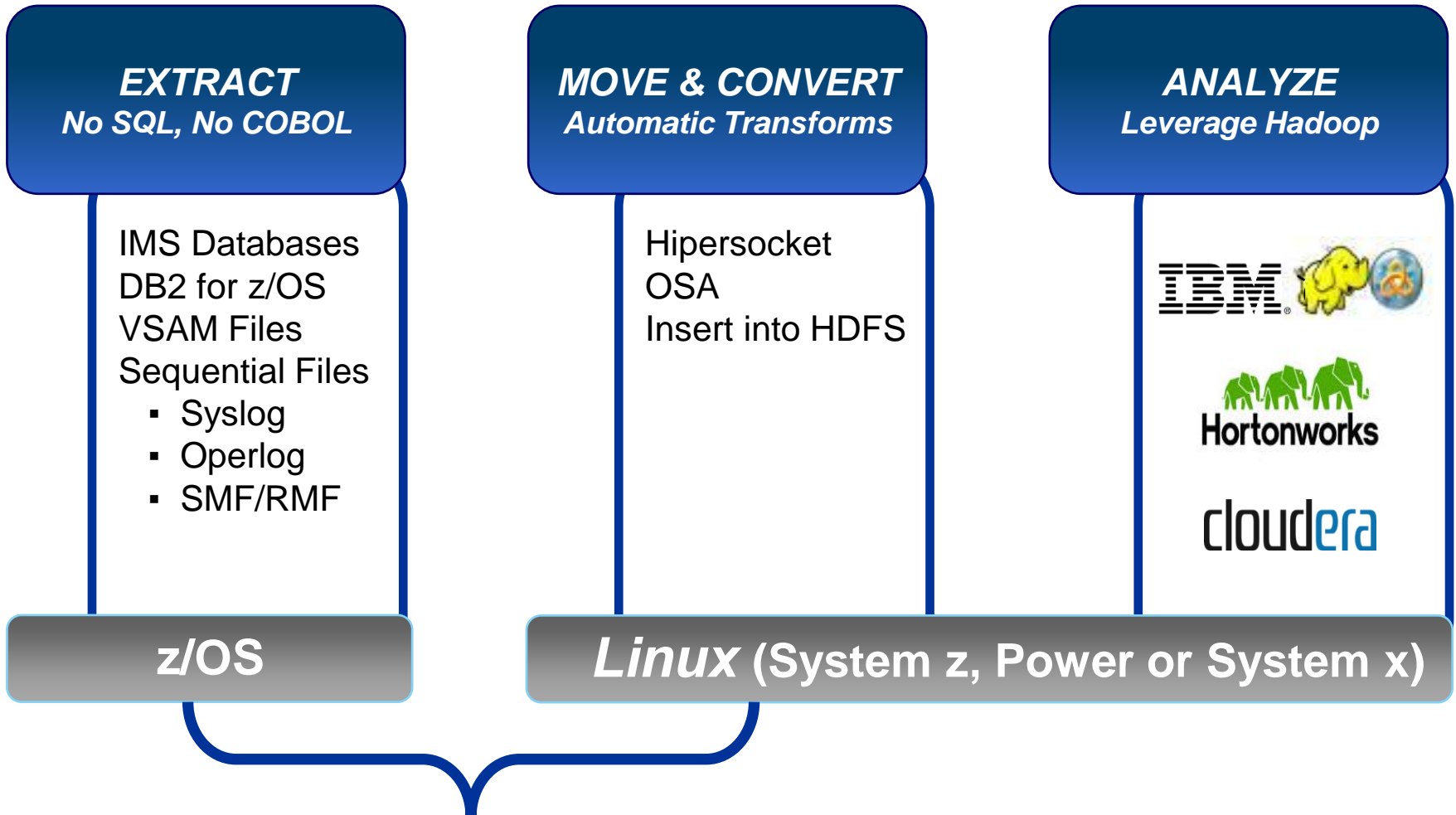
# z/OS Data Integration with Hadoop

**The InfoSphere System z Connector for Hadoop**



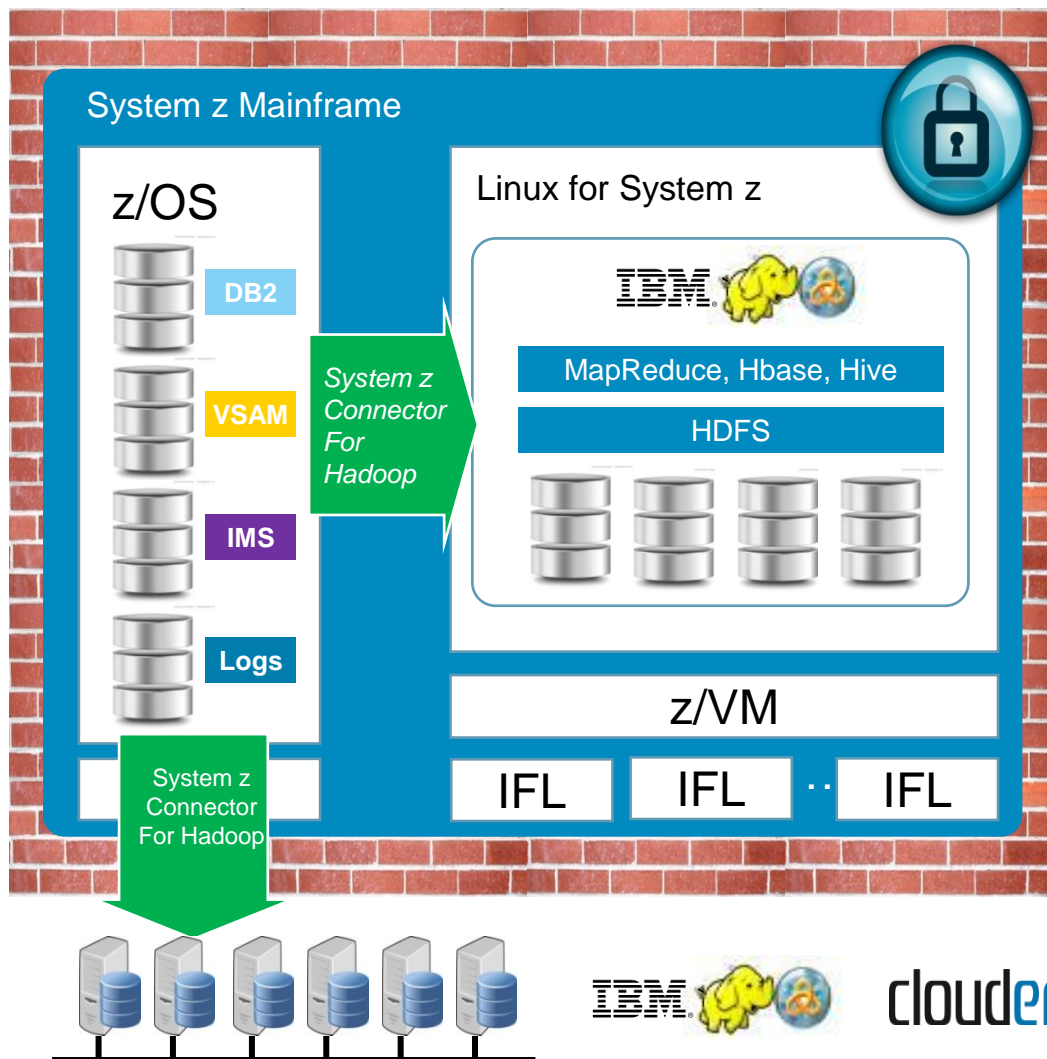
# IBM InfoSphere System z Connector for Hadoop

Setup in Hours, Generated Basic Transforms, Interactive or Scheduled



**Click and Copy**

# IBM InfoSphere System z Connector for Hadoop



- Leverage z data with Hadoop on your platform of choice
  - ✓ IBM System z for security
  - ✓ Power Systems
  - ✓ Intel Servers
- Point and click or batch self-service data access
- Lower cost processing & storage

# IBM InfoSphere System z Connector for Hadoop

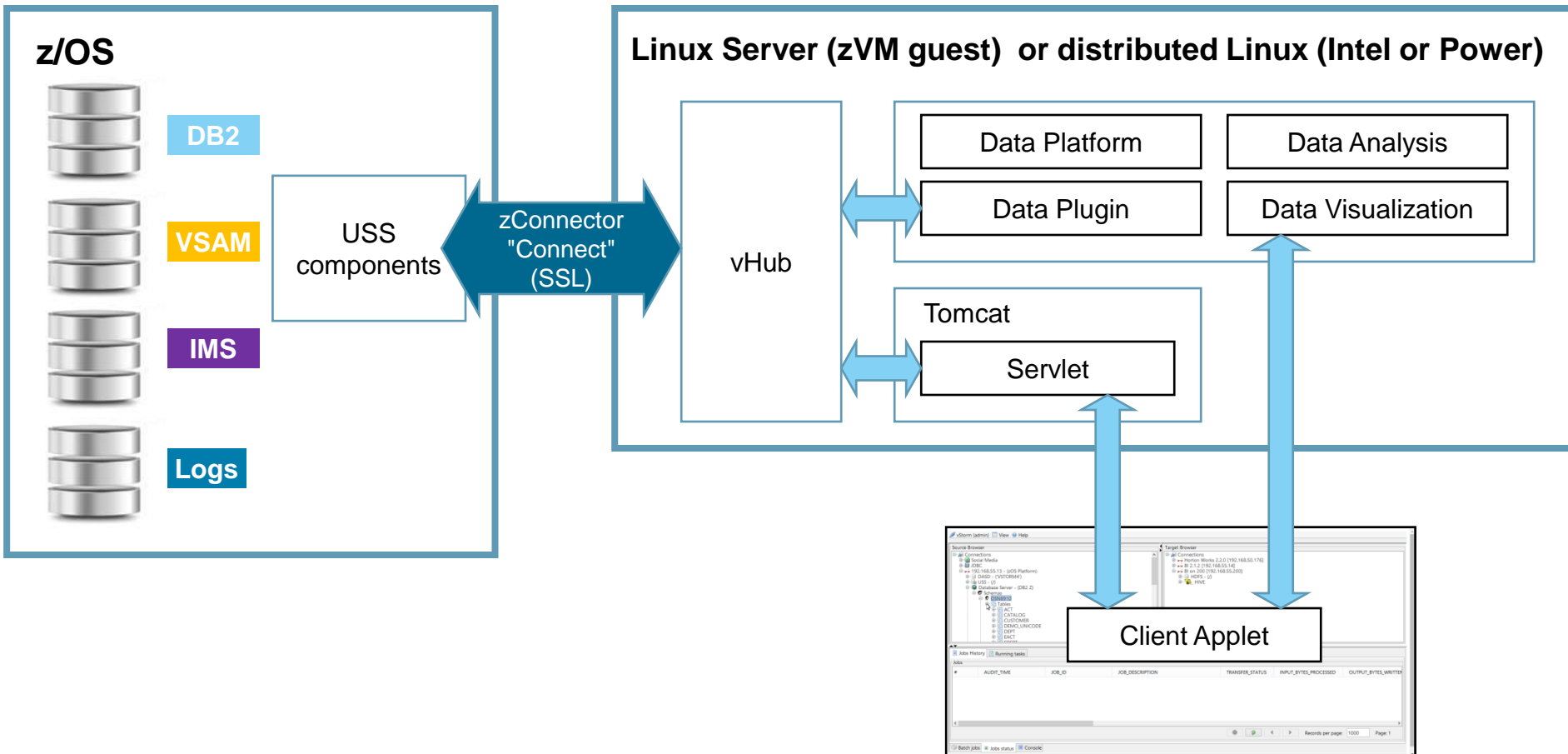
## Key Product Features

- Supports multiple Hadoop distributions – on and off the mainframe
- Multiple source formats: IMS, DB2, VSAM/QSAM, Log files
- HiperSockets and 10 GbE Data Transfer
- Drag-and-drop interface – no programming required
- Multiple destinations: Hadoop, Linux File Systems, Streaming endpoints
- Define multiple data transfer profiles
- Streaming interface – filter and translate data & columns on the fly, on the target
- Secure pipe – RACF integration
- Preserves metadata, landing mainframe data in Hive tables



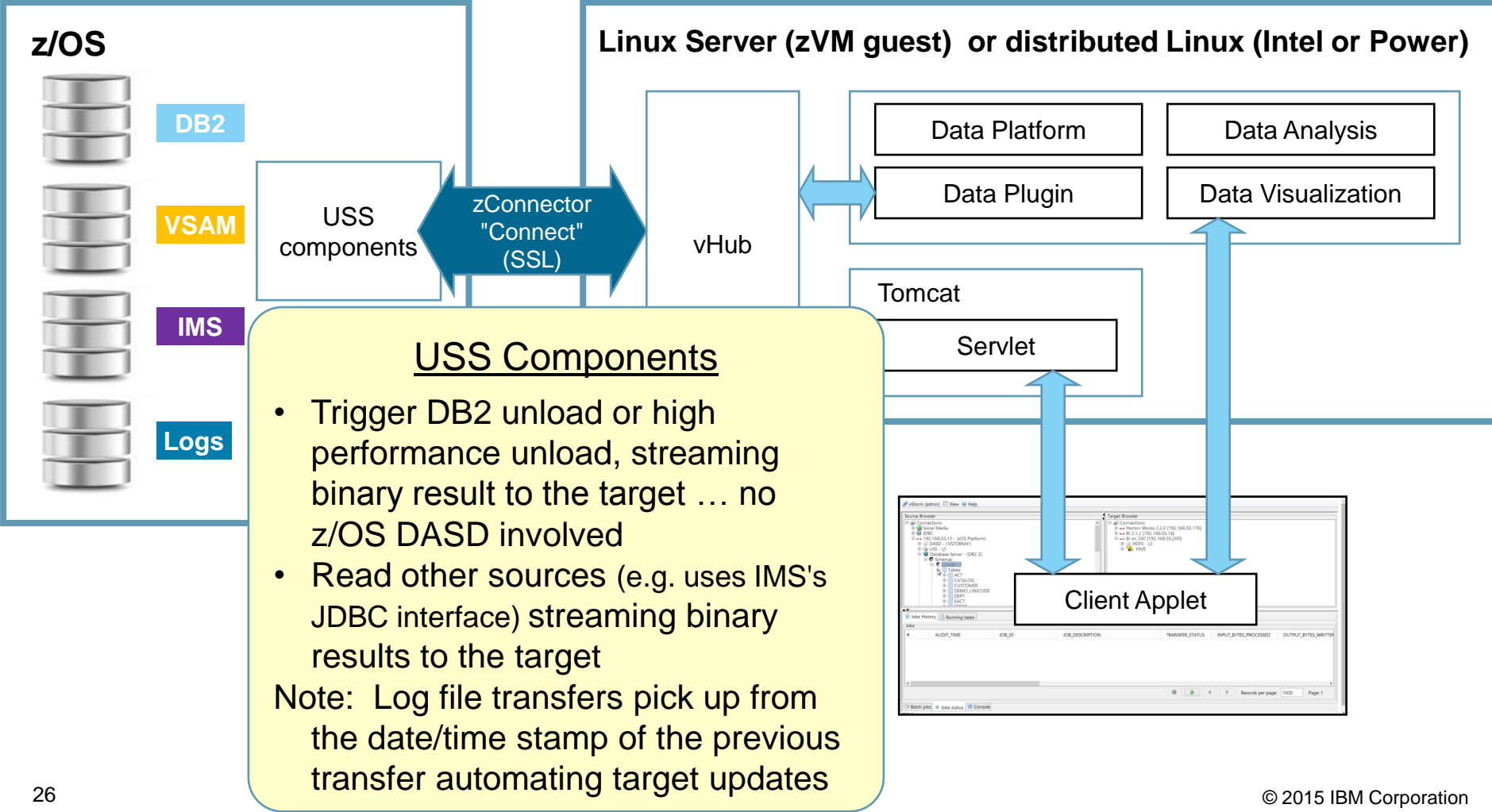
# IBM InfoSphere System z Connector for Hadoop

## Architectural view



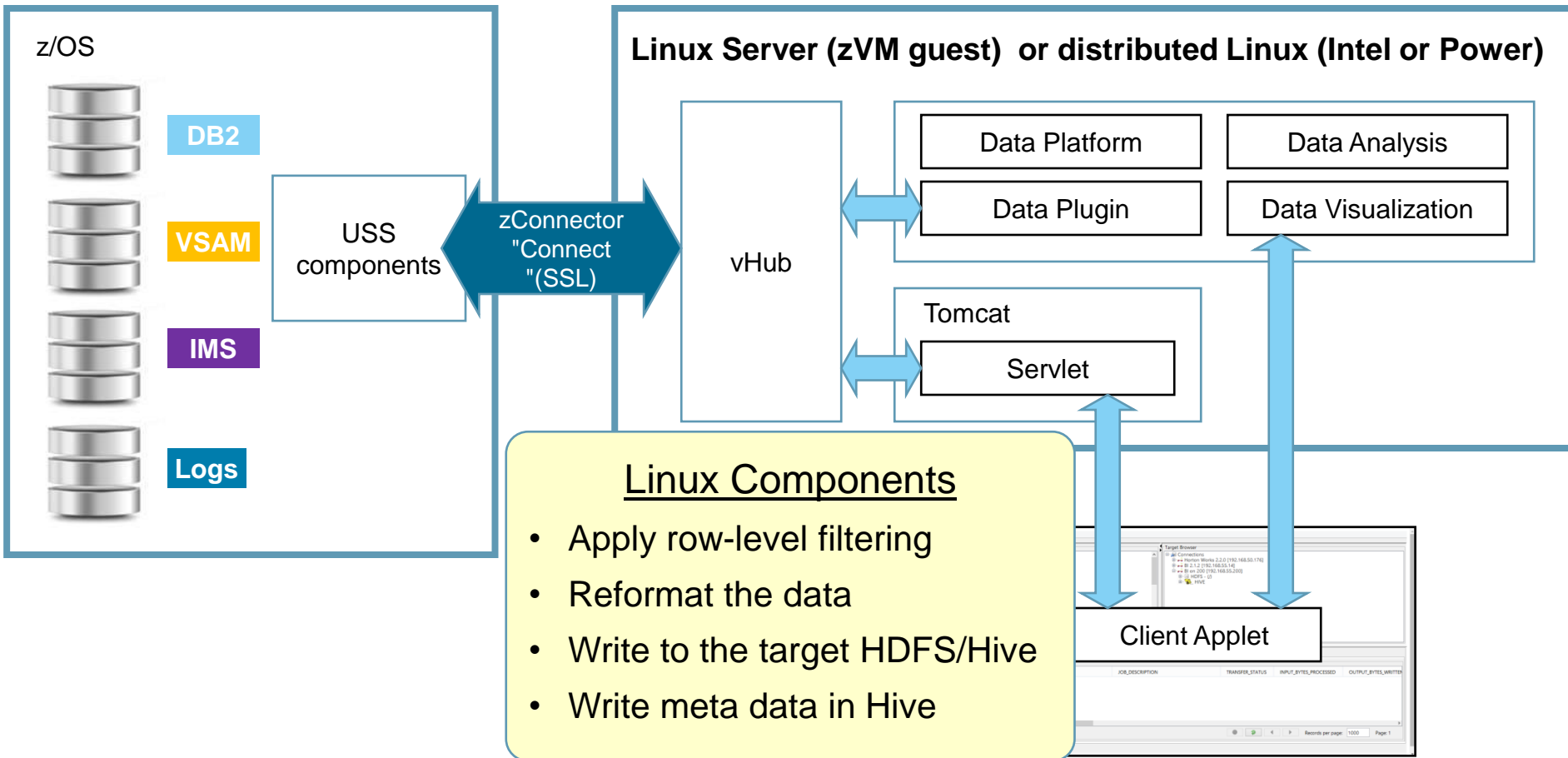
# IBM InfoSphere System z Connector for Hadoop

## Architectural view



# IBM InfoSphere System z Connector for Hadoop

## Architectural view



## InfoSphere System z Connector for Hadoop Summary

- **A secure pipe for data**
  - RACF integration – standard credentials
  - Data streamed over secure channel using hardware crypto
- **A Rapid Deployment**
  - Integrating z/OS data in a few hours
- **Easy to use ingestion engine**
  - Light-weight; no programming required
  - Native data collectors accessed via a graphical user interface
  - Wide variety of data sources supported
  - Conversions handled automatically
  - Streaming technology does not load z/OS engines nor require DASD for staging

### **Best Use Cases**

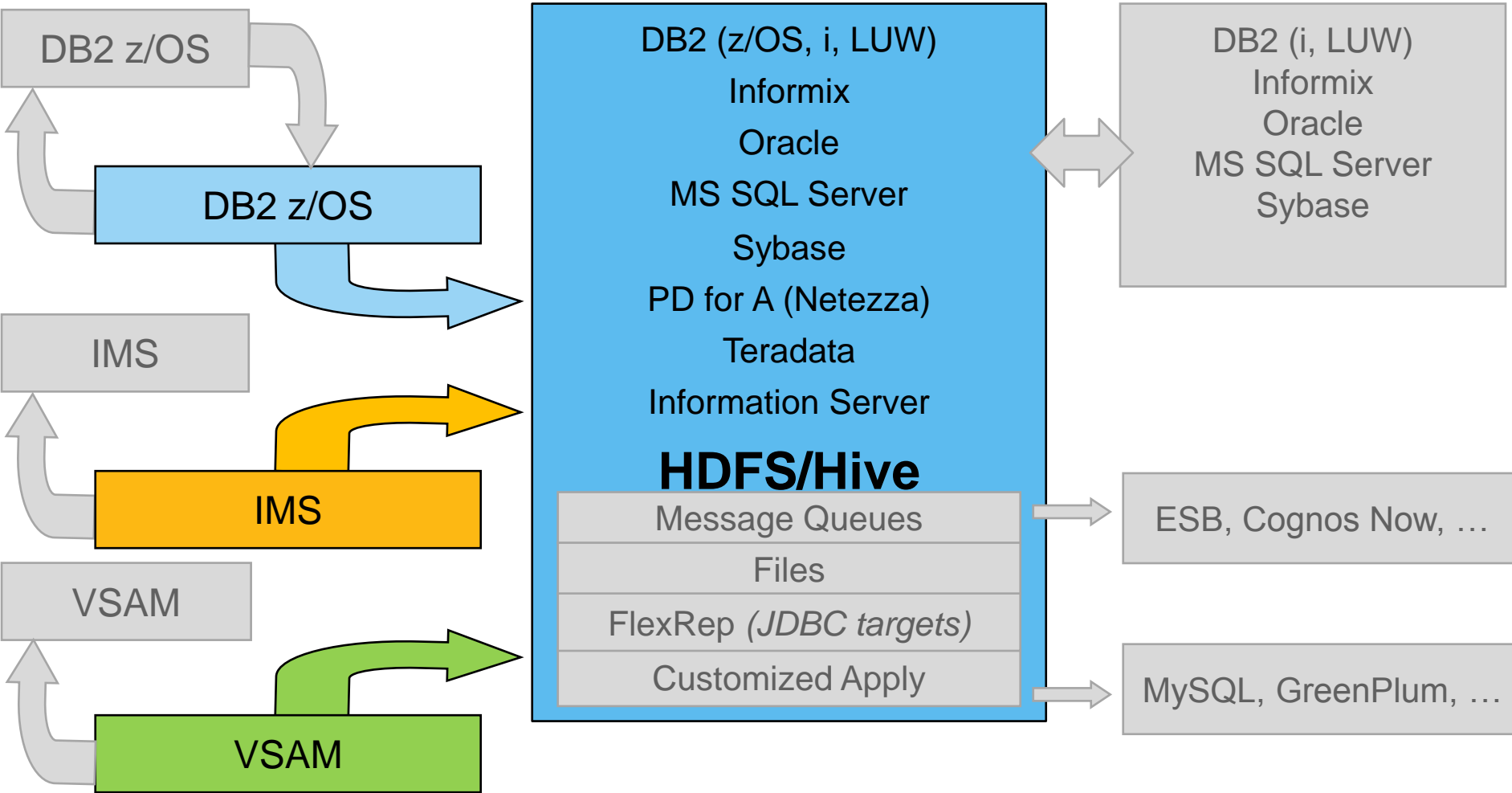
- HDFS/Hive sandbox for initial deployments ... explore your data
  - ✓ ***Easy to setup ... Hours, not Days!***
- Operational Analytics using z/OS log data (SMF, RMF, ...)
  - ✓ ***Exploring operational data using Hadoop on day one!***
- Moderate volumes (100s of GBs to 10s of TBs) of transactional data
  - ✓ ***Source of the data is z/OS***
  - ✓ ***Security may be a primary concern***

# z/OS Data Integration with Hadoop

Keeping your Hadoop Data Current



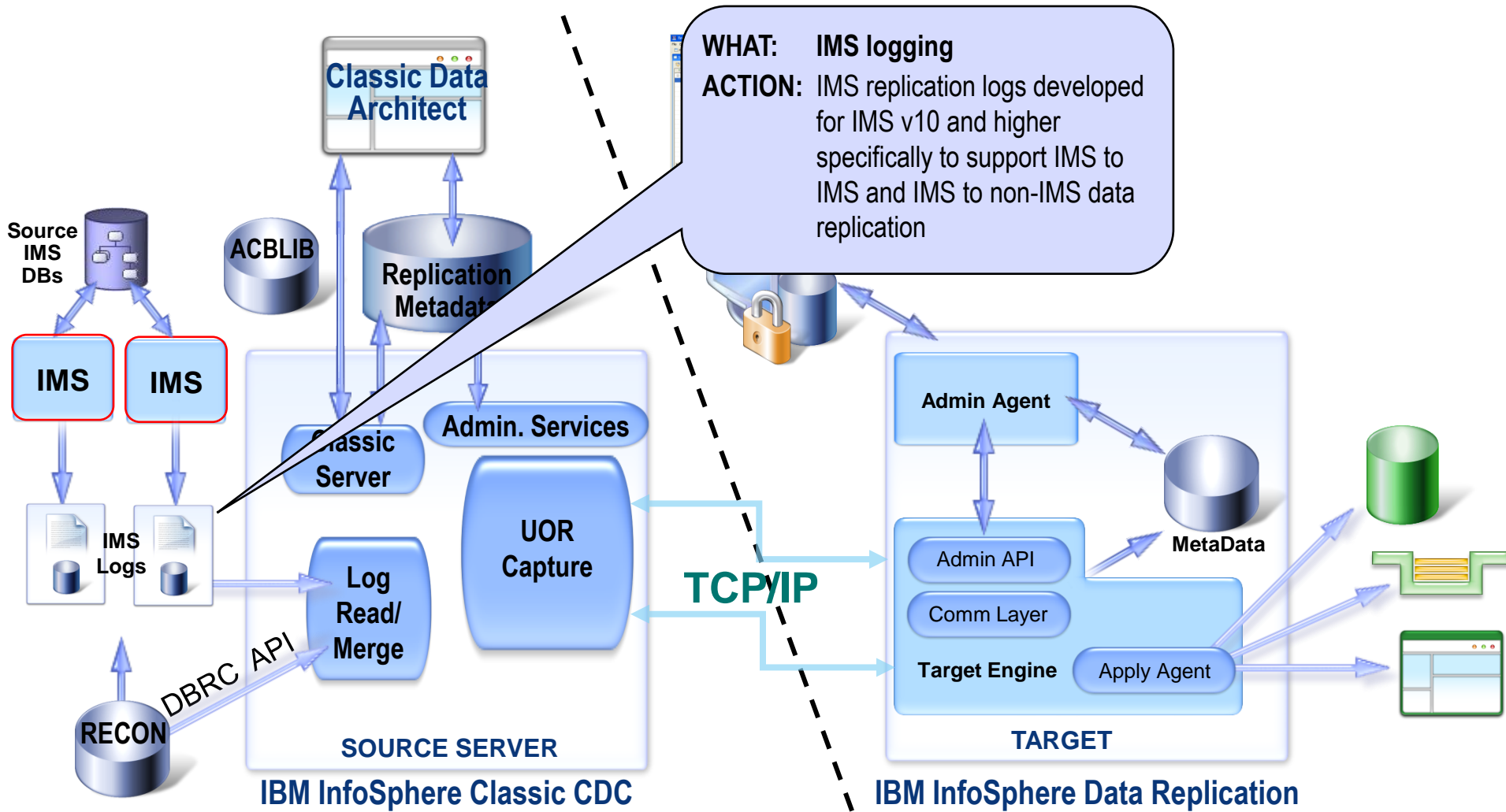
# IBM's InfoSphere Data Replication (IIDR) Coverage



# IMS to Hadoop

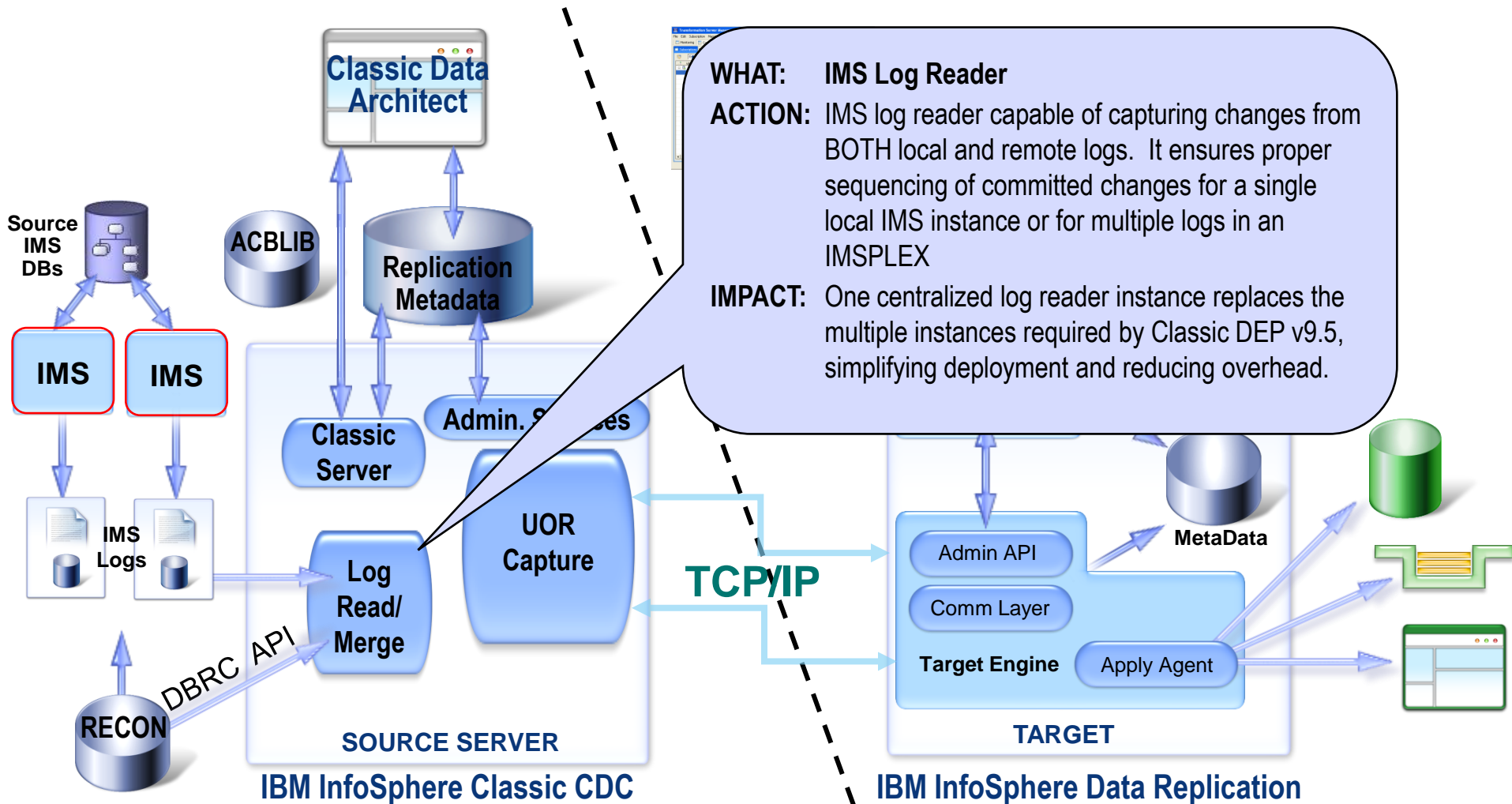
Read logs - Send committed changes - Apply changes

**WHAT:** IMS logging  
**ACTION:** IMS replication logs developed for IMS v10 and higher specifically to support IMS to IMS and IMS to non-IMS data replication



# IMS to Non-IMS Data Replication

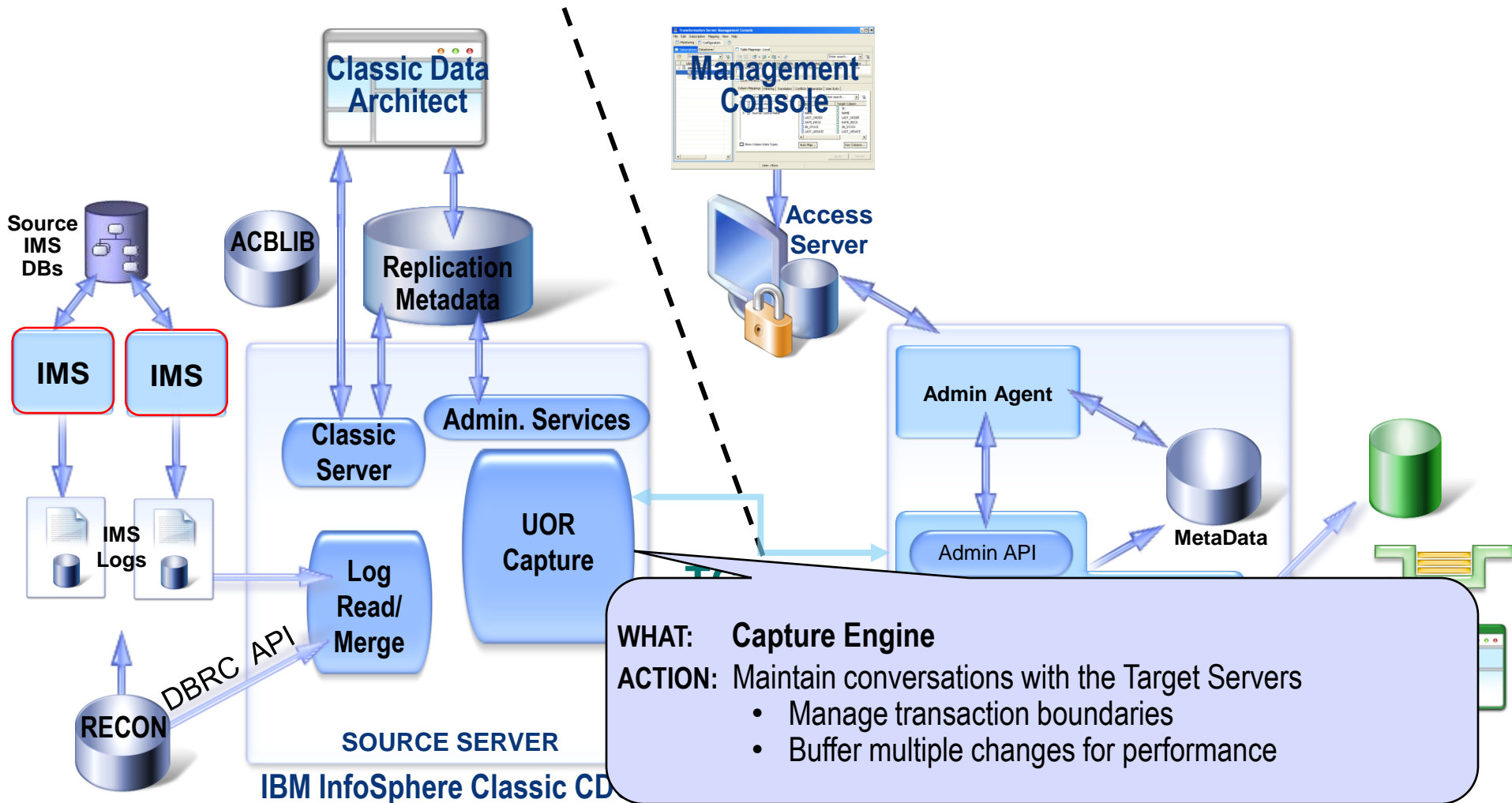
## Read logs - Send committed changes - Apply changes





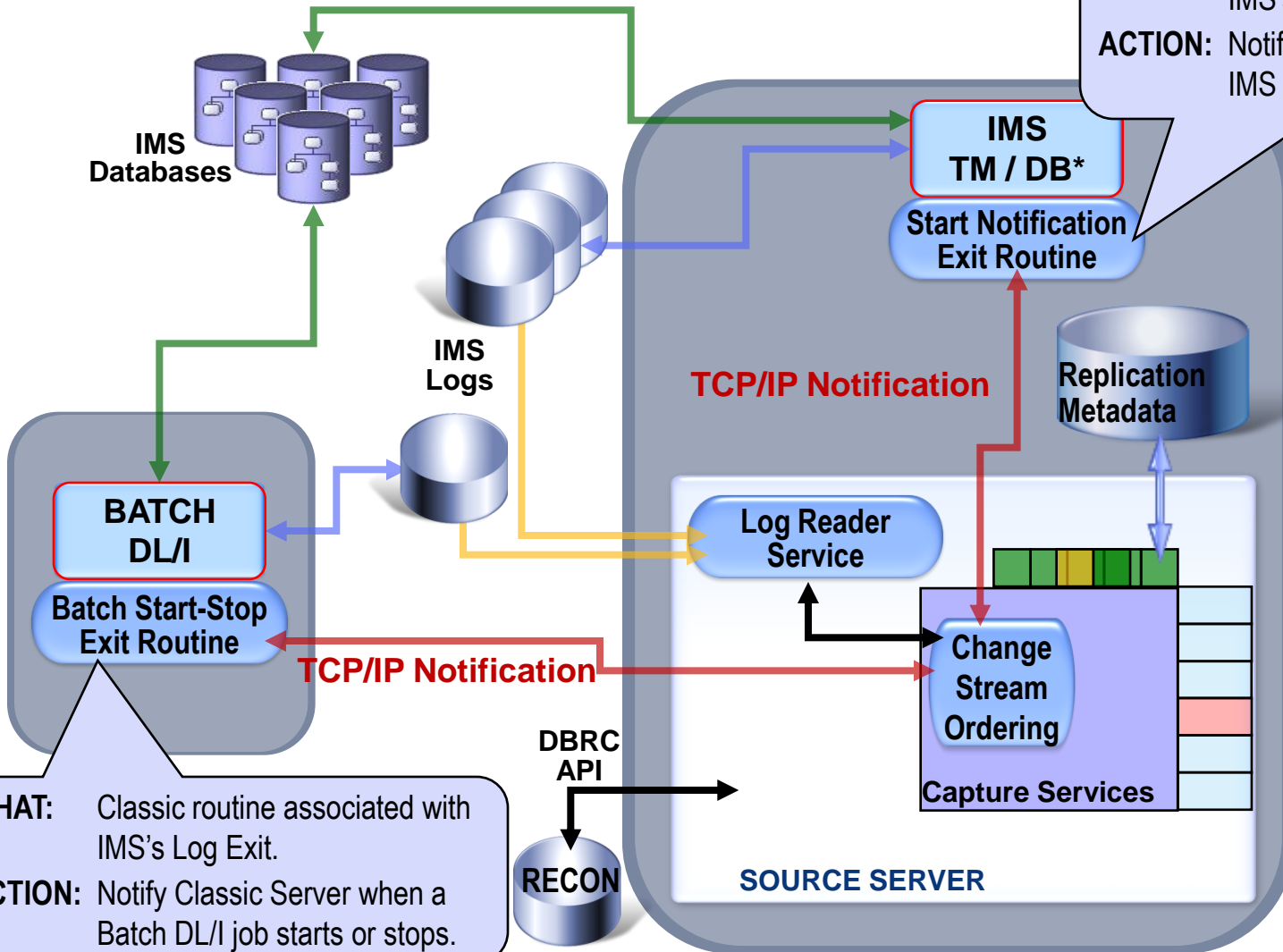
# IMS to Non-IMS Data Replication

Read logs - Send committed changes - Apply changes



# InfoSphere Data Replication for IMS for z/OS

## Details of IMS Source Capture



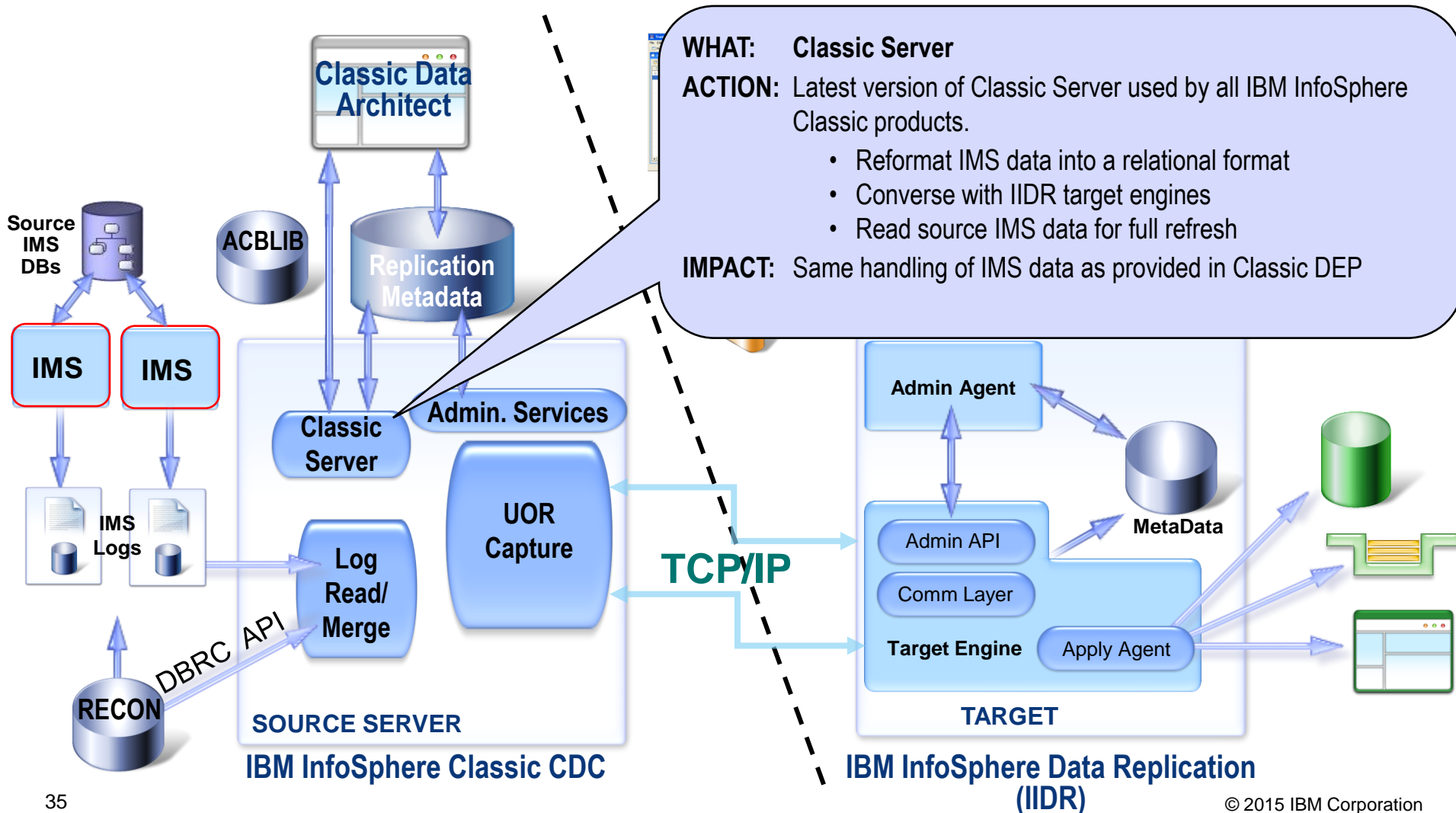
**WHAT:** Classic routine associated with IMS's Partner Program Exit.  
**ACTION:** Notify Classic Server when an IMS system starts.

**WHAT:** Classic routine associated with IMS's Log Exit.  
**ACTION:** Notify Classic Server when a Batch DL/I job starts or stops.

\* includes BMP and DBCTL

# IMS to Non-IMS Data Replication

Read logs - Send committed changes - Apply changes



# IMS to Non-IMS Data Replication

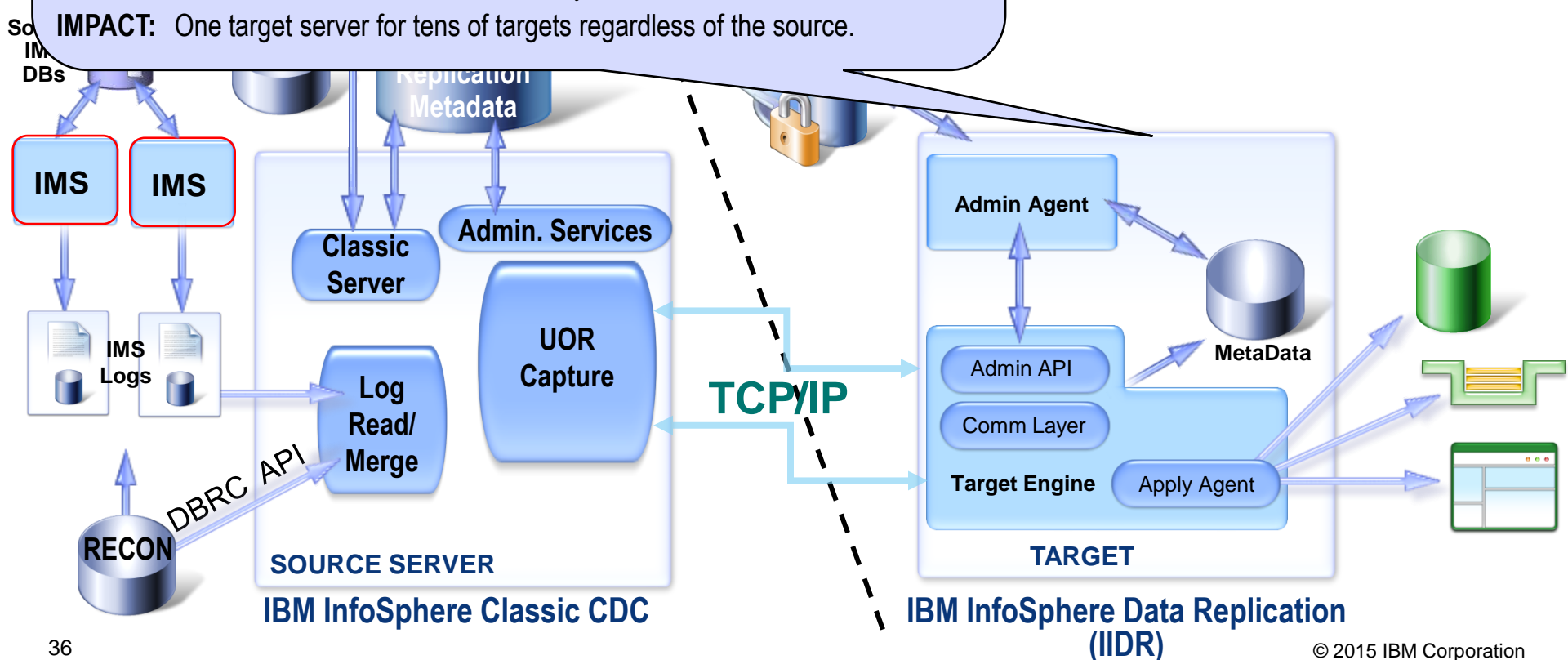
Apply changes

**WHAT:** IIDR Target Server

**ACTION:** Apply changes to the target(s) while maintaining restart information in a local bookmark for recovery purposes

- Additional target-based transformations can be applied
- Integration with many other InfoSphere solutions
- Available for z/OS, Linux on System z, Linux, Unix, and Windows

**IMPACT:** One target server for tens of targets regardless of the source.





# IBM InfoSphere System z Connector for Hadoop

The screenshot displays the IBM InfoSphere System z Connector for Hadoop interface. At the top, there is a menu bar with 'vSphere (admin)', 'View', and 'Help'. Below this are two browser panes: 'Source Browser' and 'Target Browser'. The 'Source Browser' shows a tree view under 'Connections' with 'Social Media', 'JDBC', and '192.168.55.13 - (zOS Platform)'. The 'Target Browser' shows a tree view under 'Connections' with 'Horton Works 2.2.0 [192.168.50.176]', 'BI 2.1.2 [192.168.55.14]', 'HDFS - (/)', 'Linux File System - (/)', 'HIVE', 'Network Streaming - ( 192.168.55.14:9999 )', and 'BI on 200 [192.168.55.200]'. Below the browsers is a table with columns: Job Id, Ingest IP/U..., Target IP, Target Pla..., Format, Starts ..., Start ti..., Repeats, Transfer ..., Ena..., Status, and Job Description. A yellow callout box points to the 'BI 2.1.2 [192.168.55.14]' connection in the Target Browser, containing the text: 'Point and click access to z/OS resident data sources with automated transfer to IBM BigInsights and third party Hadoop clusters.' To the right, another yellow callout box shows an 'IBM Sign in' dialog with fields for 'User name' (containing 'admin') and 'Password' (containing '.....'), and a 'Sign in' button.



# IBM InfoSphere System z Connector for Hadoop

The screenshot displays the vStorm (admin) web interface. At the top, there are 'Source Browser' and 'Target Browser' panes. The 'Source Browser' shows connections like 'Social Media', 'JDBC', and '192.168.5...'. The 'Target Browser' shows connections like 'Horton Works 2.2.0 [192.168.50.176]', 'BI 2.1.2 [192.168.55.14]', and 'BI on 200 [192.168.55.200]'. A yellow callout box highlights the text: "Extensive browser-based help is built-in". Below the browsers is a sidebar with a 'Contents' menu for the 'vStorm Enterprise Users Guide', including sections like 'Introduction', 'Product Components', and 'Working with vStorm Enterprise Management Console'. The main content area shows the '1.0 Introduction' and '2.0 Product Components' sections. At the bottom, a diagram illustrates the system architecture, showing data flow from 'z/OS' (DB2/VSAM/QSAM/IMS, SMF/RMF, Logs) through 'vStorm Connect (SSL)' to a 'Linux Server' containing 'vHub', 'Big Data Platforms', 'Big Data Analytics', 'Data Visualization', 'Tomcat', and 'VSE Servlet'. A copyright notice at the bottom reads: "Copyright © 2013 - 2014 :: vStorm Enterprise Management Console :: www.veristorm.com :: All Rights Reserved".

# IBM InfoSphere System z Connector for Hadoop

The screenshot displays the vStorm (admin) interface. On the left, the 'Source Browser' shows connections for Social Media, JDBC, and 192.168.55.13 - (zOS Platform). On the right, the 'Target Browser' shows connections for Horton Works, BI 2.1.2 [192...], and BI on 200 [1...]. A yellow callout box contains the text: 'Multiple users can be provided with access to the web-based System z Connector data transfer tool'. In the foreground, a 'VSE User Management' dialog box is open, showing a table of users and a form for adding a new user.

User Id	First Name	Last Name	Email address	Active	Login Date
admin	admin	admin	admin@vstorm.com	<input checked="" type="checkbox"/>	2014-12-15

The 'VSE User Management' dialog box includes the following fields and controls:

- User Id
- First Name
- Last Name
- Password
- Confirm Password
- Email address
- Active
- New User ---->
- Buttons: Add, Update, Delete, Close



# IBM InfoSphere System z Connector for Hadoop

The screenshot displays the IBM InfoSphere System z Connector for Hadoop interface. It features a 'Source Browser' window on the left and a 'Target Browser' window on the right. A yellow callout box with a blue border is positioned over the Target Browser, containing the text: 'Directly access data on Mainframe DASD'. The Source Browser window shows a tree view of data sources under the connection '192.168.55.13 - (zOS Platform)'. The tree includes a folder 'DASD - ('VSTORM4')' which contains several sub-folders and files: 'ABC', 'COPYBOOK', 'CUST', 'ESDS.EARNINGS', 'ESDS.FOOTBALL.STATS', 'ESDS.PLAYERS', 'ISPF.ISPPROF', 'KSDS.EARNINGS', 'KSDS.FOOTBALL.STATS', 'KSDS.PLAYERS', 'SPFLOG1.LIST', and 'VARS.TEST'. Below this folder are other data sources: 'USS - (/)' and 'Database Server - (DB2 Z)'. The interface also shows a 'Job Id' field and a 'Batch' button.

# IBM InfoSphere System z Connector for Hadoop

The screenshot displays the IBM InfoSphere System z Connector for Hadoop interface. At the top, there is a menu bar with 'vStorm (admin)', 'View', and 'Help'. Below this, there are two browser windows: 'Source Browser' and 'Target Browser'. The 'Source Browser' shows a tree view of connections including 'Social Media', 'JDBC', and '192.168.55.13 - (zOS Platform)'. The 'Target Browser' shows a tree view of connections including 'Horton', 'BI 2.1.2', and 'BI on 20'. A yellow callout box with a blue border points to the 'Target Browser' and contains the text: 'Directly access System z log files including SMF, RMF, Syslog and the Operator logs'. Below the 'Source Browser' window, there is a larger 'Source Browser' window showing a detailed view of the '192.168.55.13 - (zOS Platform)' connection. This view includes a 'Job Id' field and a 'Batch' button. The tree view shows 'Connections' expanded to reveal 'Social Media', 'JDBC', '192.168.55.13 - (zOS Platform)', 'DASD - ('VSTORM4')', 'USS - (/)', 'Database Server - (DB2 Z)', and 'System Logs'. Under 'System Logs', there are four sub-items: 'System Management Facility (SMF)', 'Resource Measurement Facility (RMF)', 'Syslog', and 'Operlog'. A mouse cursor is pointing at the 'Operlog' item.

# IBM InfoSphere System z Connector for Hadoop

Source Connection

Steps

1. IP
2. DASD
3. Unix System Services
4. DB
5. Job Configuration (JCL)

DB2 Connection Configuration

DB Type: DB2 Z

DB Port: 5021

DB User Name: vstorm4

DB Password: ●●●●●●

Location: DB9G

Binary Transfer:

Test DB Connection

- 192.168.55.13
  - SYSIBM
    - SYSTABLES

Test Connection

< Back   Next >   Finish   Cancel

A step-by-step wizard guides users through the process of setting up connections to z/OS data sources (DB2 shown here)

# IBM InfoSphere System z Connector for Hadoop

Source Browser

- Connections
  - Social Media
  - JDBC
  - 192.168.55.13 - (zOS Platform)

Target Browser

- Connection
  - Horton Works 2.2.0 [192.168.50.176]
  - BI 2.1.2 [192.168.55.14]
  - BI on 200 [192.168.55.200]

**Target Connection**

Steps

1. Target IP
2. Linux File System
3. Network Streaming
4. HDFS
5. HIVE

Target IP

Cluster Name: BI 2.1.2

IP Address( Private ): 192.168.55.14

IP Address( Public ):

Linux File System

Network Streaming

HDFS

HIVE

< Back   Next >   Finish   Cancel

A similar wizard is used to configure Hadoop-based targets

# IBM InfoSphere System z Connector for Hadoop

The screenshot displays the web-based GUI for configuring a source connection. The 'Source Connection' dialog box is open, showing a list of steps on the left and configuration fields on the right. The 'Job Configuration (JCL)' step is selected and highlighted in blue. The configuration fields are as follows:

Field	Value
Job Name	VSTORM1
Job Card (Optional)	
Job LPAR (Optional)	PRD1
Job Execution Class	A
Account ID	1
Message Class	H
Unload Dataset	VSTORM1
DB2 Data Source	DB9G
DB2 DSN Load Library	DSN910
Transfer Buffer Size	8192
Executable Path	/bin
HFS Path	/u/VSTORM1
Source Code Page	Cp500

At the bottom of the dialog, there are navigation buttons: '< Back', 'Next >', 'Finish', and 'Cancel'. The 'Finish' button is highlighted with a dashed border.

A yellow callout box in the bottom left corner contains the text: "JCL parameters are entered through the web-based GUI".

# IBM InfoSphere System z Connector for Hadoop

**Source Browser**

- Database Server - (DB2 Z)
  - Schemas
    - DSN8910
    - DSNRGCOL
    - SYSIBM
    - SYSIBMTS
    - VSTORM1
    - VSTORM4
  - Tables
    - NYSE\_2000\_DB10
    - NYSE\_PARTITION
    - TBL\_SPEC
    - TEST\_CLOB
    - TEST\_CLOB\_TINY
    - TEST\_LOB
    - TEST\_LOB\_TINY
    - TEST\_NULL

**Target Browser**

- Connections
  - Horton Works 2.2.0 [192.168.50.176]
  - BI 2.1.2 [192.168.55.14]
  - BI on 200 [192.168.55.200]
  - HDFS - (/)
    - HIVE
      - Schemas
        - default
          - Tables
            - vstorm4\_nyse\_2000\_db10

#	EXCHANGE	STOCK_SYM	TRANDATE	STOCK_PRICE_O	STOCK_PRICE_H	STOCK_PRICE_L	STOCK_PRICE_C	STOCK_VOLUME	STOCK_PRICE_ADJ_CL
1	NYSE	ASP	2001-12-31	12.55	12.80	12.42	12.80	11300	6.91
2	NYSE	ASP	2001-12-28	12.50	12.55	12.42	12.55	4800	6.78
3	NYSE	ASP	2001-12-27	12.59	12.59	12.50	12.57	5400	6.79
4	NYSE	ASP	2001-12-26	12.45	12.60	12.45	12.55	5400	6.78
5	NYSE	ASP	2001-12-24	12.61	12.61	12.61	12.61	1400	6.76
6	NYSE	ASP	2001-12-21	12.40	12.78	12.40	12.60	18200	6.75
7	NYSE	ASP	2001-12-20	12.35	12.58	12.35	12.40	4200	6.65
8	NYSE	ASP	2001-12-19	12.42	12.60	12.35	12.60	10100	6.75
9	NYSE	ASP	2001-12-18	12.37	12.50	12.37	12.41	10100	6.65
10	NYSE	ASP	2001-12-17	12.40	12.52	12.40	12.52	8000	6.71
11	NYSE	ASP	2001-12-14	12.54	12.54	12.32	12.40	283000	6.65
12	NYSE	ASP	2001-12-13	12.40	12.55	12.40	12.54	13700	6.72

Records per page: 1000 Page: 1

Browse the contents of mainframe data sources from within the System z Connector for Hadoop interface

# IBM InfoSphere System z Connector for Hadoop

Source Browser

Database Server - (DB2 Z)

- Schemas
  - DSN8910
  - DSNRGCOL
  - SYSIBM
  - SYSIBMTS
  - VSTORM1
  - VSTORM4
- Tables
  - NYSE\_2000\_DB10
  - NYSE\_PARTITION
  - TBL\_SPEC
  - TEST\_CLOB
  - TEST\_CLOB\_TINY
  - TEST\_LOB
  - TEST\_LOB\_TINY
  - TEST\_NULL

#	EXCHANGE	STOCK_SYM	TRAN
1	NYSE	ASP	2001:
2	NYSE	ASP	2001:
3	NYSE	ASP	2001:
4	NYSE	ASP	2001:
5	NYSE	ASP	2001:
6	NYSE	ASP	2001:
7	NYSE	ASP	2001:
8	NYSE	ASP	2001:
9	NYSE	ASP	2001:
10	NYSE	ASP	2001:
11	NYSE	ASP	2001:
12	NYSE	ASP	2001:

Target Browser

### Copy to HDFS/HIVE/LFS/Network Streaming Wizard

Steps

1. Target
2. Select copybook
3. Parse copybook
4. Schedule

Source: 'VSTORM4.ESDS.EARNINGS'

Source Type:  VSAM/QSAM  File  Directory

Target Format: CSV

Target

- Connections
  - Horton Works 2.2.0 [192.168.50.176]
  - BI 2.1.2 [192.168.55.14]
    - HDFS - (/)
      - biqinsights
      - hadoop
      - hbase
      - misha
      - tmp
      - user
    - Linux File System - (/)
    - HIVE
    - Network Streaming - ( 192.168.55.14:9999 )
    - BI on 200 [192.168.55.200]

< Back Next > Finish Cancel

Copy source data to HDFS, the Linux File System, HIVE or stream data directly to a receiving port on a Linux system or virtual machine in your chosen format

When it comes to realizing time to value:

Commercial Framework Differences Matter



## Capabilities

Software tooling to build higher quality, more maintainable applications quickly and cost efficiently

## Infrastructure

Deploy on reliable, cost-efficient infrastructure that matches quality-of-service requirements

