



# GOTC 2023

## 全球开源技术峰会

THE GLOBAL OPENSOURCE TECHNOLOGY CONFERENCE

---

# OPEN SOURCE, INTO THE FUTURE #

---

### AI is Everywhere 专场

本期议题: ByteDance Primus

徐合邦 2023年05月28日

In this sharing Background

Design

Primus at Work

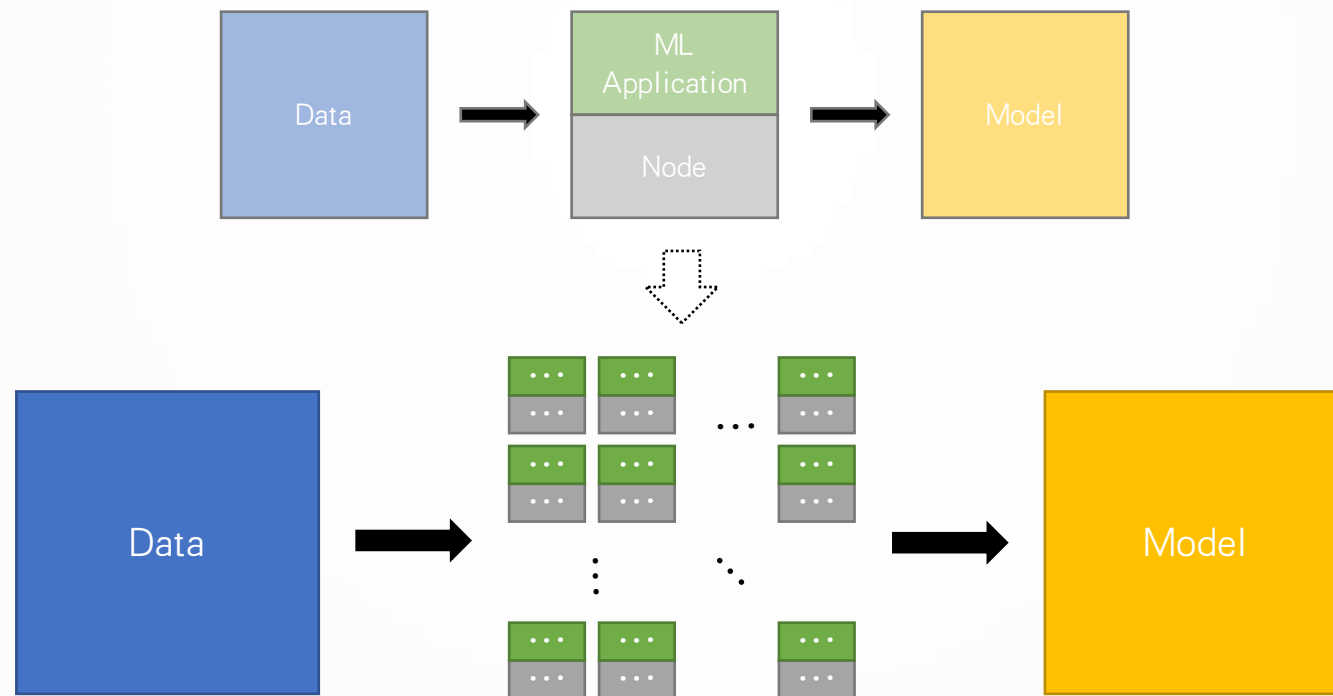
Upcoming Features



Inspire Creativity, Enrich Life

# Background

## Distributed Training



When the workload is too intense, it's time to use a cluster!

New challenges arise, while old ones stay.

## Different ML Frameworks

- TensorFlow
- PyTorch
- Monolith
- ...

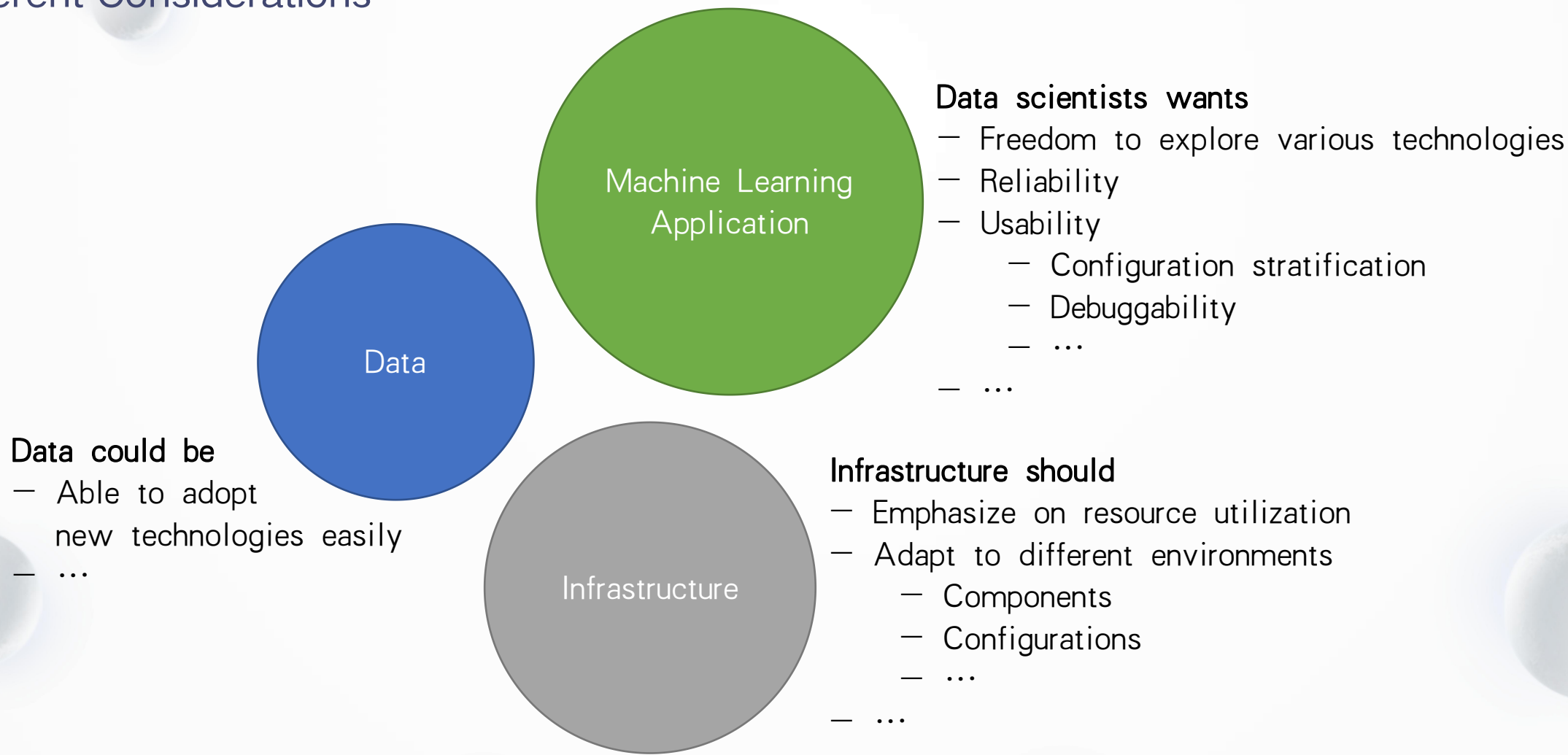
## Various Paradigms

- Parallelism
  - Data parallelism
  - Model parallelism
  - Hybrid
  - ...
- Synchronous / Asynchronous
- ...

## Repetitive Works

- Container Orchestrating
- Data acquisition
- Fault Tolerances
- ...

## Different Considerations



# Background

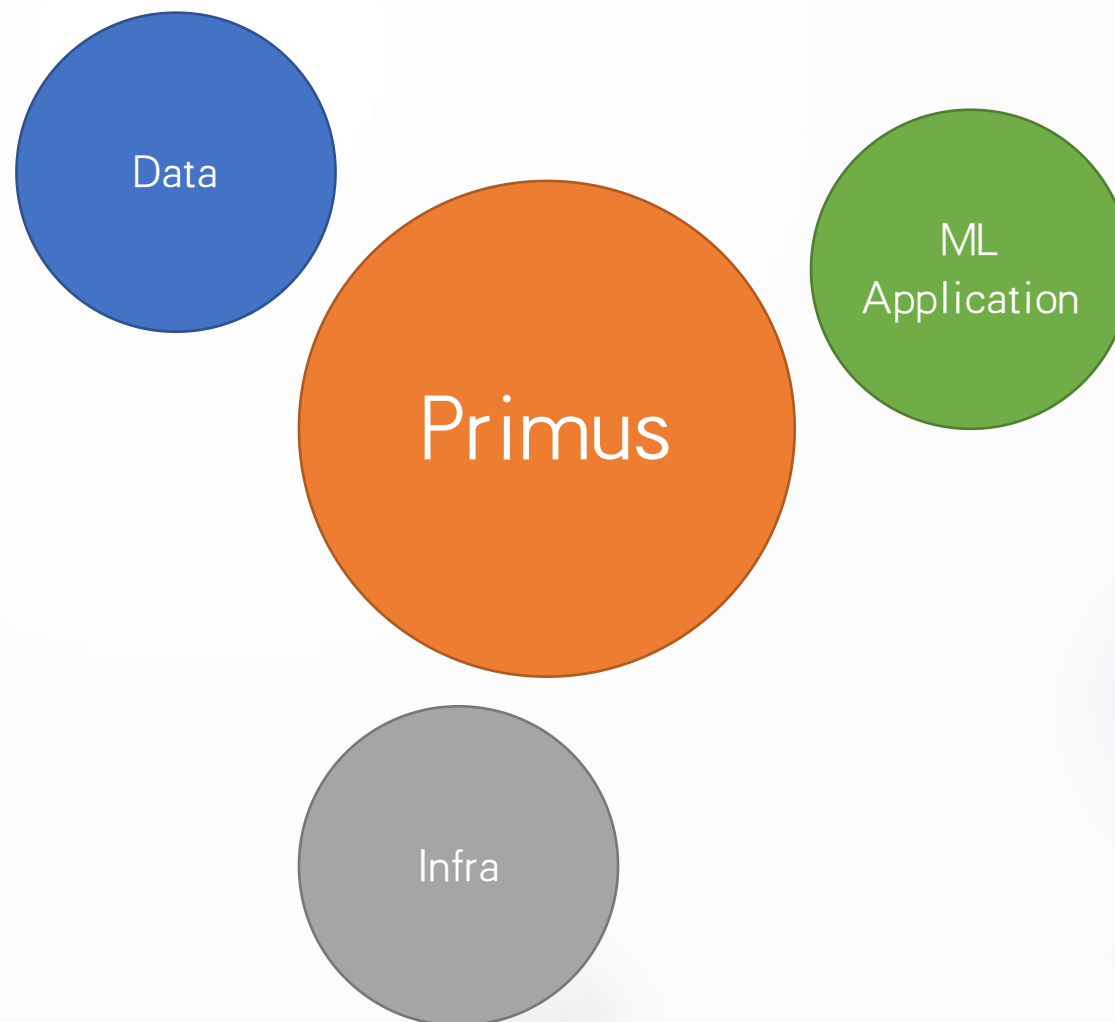
Here comes Primus to serve as a platform to make distributed training easier!

## A Generic Joint Scheduler

- Container
- Data

## Provides Unified Developer Experiences

- Abstracts
  - Underlying infrastructure
  - Data acquisition
  - Fault tolerance mechanisms
  - ...
- Primus UI
- ...



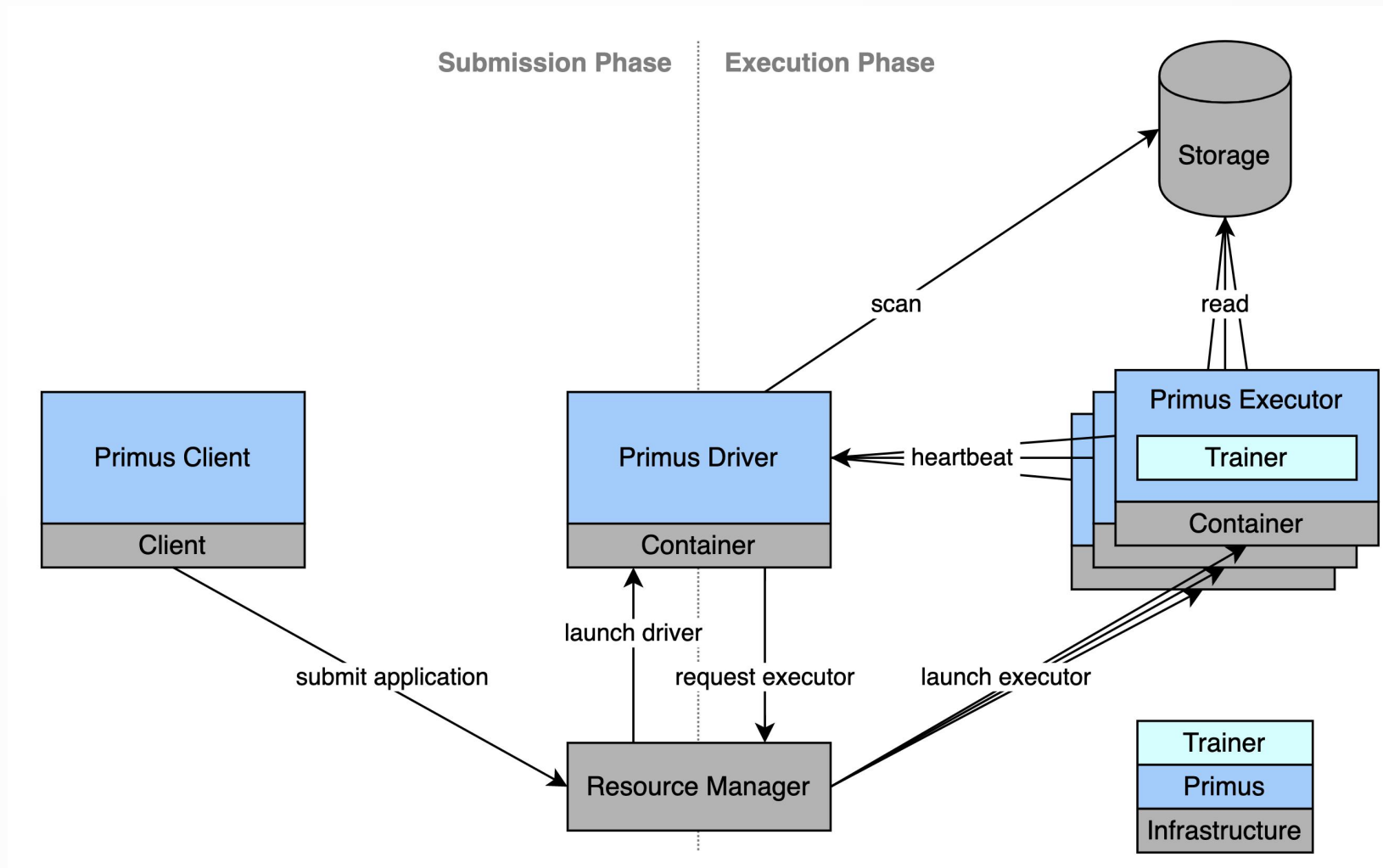
## A Primus Application

### Philosophy

- Layered responsibility

### Phases

- Submission
  - Infrastructure agnostic application definition
- Execution
  - Application Lifecycle
  - Container scheduling
  - Data scheduling
  - Fault tolerances





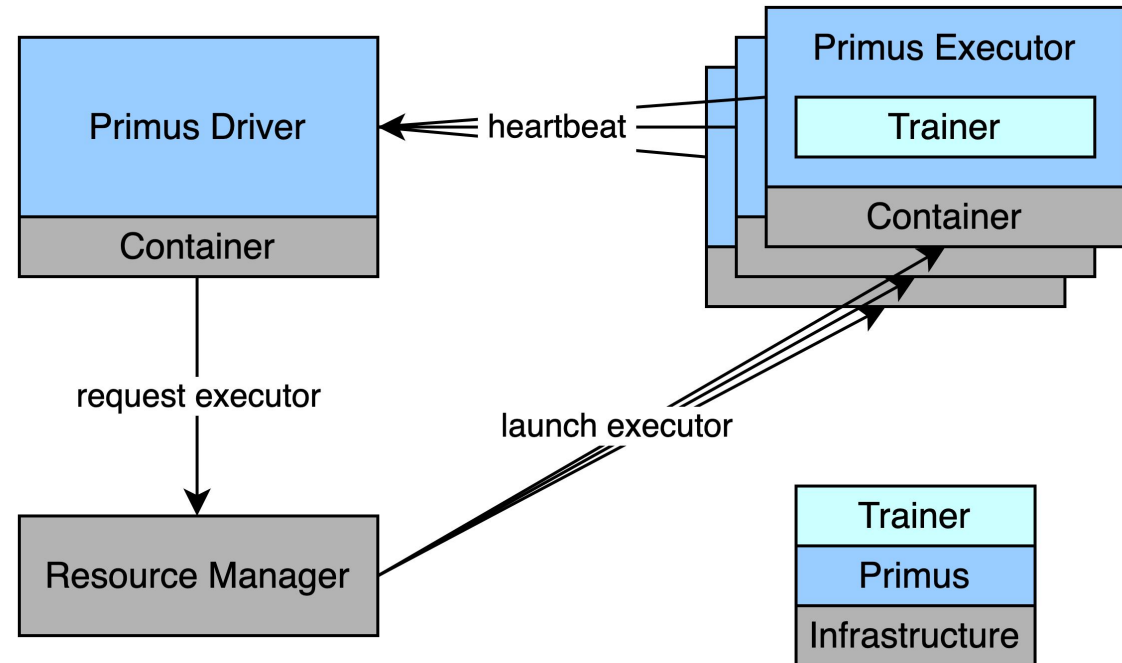
## Container Scheduling

### Heterogeneous Container

- Command
- Number
- Resource requirements
- ...

### Lifecycle Management

- Early Termination
  - Succeed Rate / Failure Rate / ...
- Executor Rescheduling
  - Expired / Long-tailed data tasks / ...
- ...

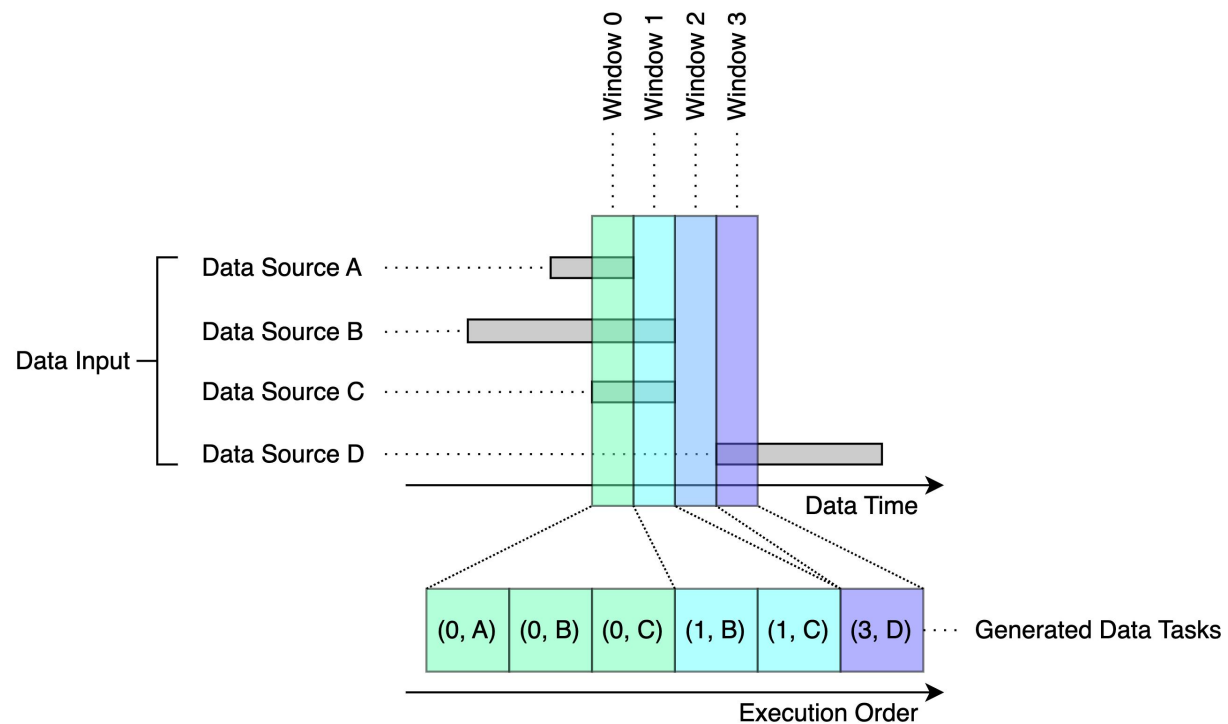
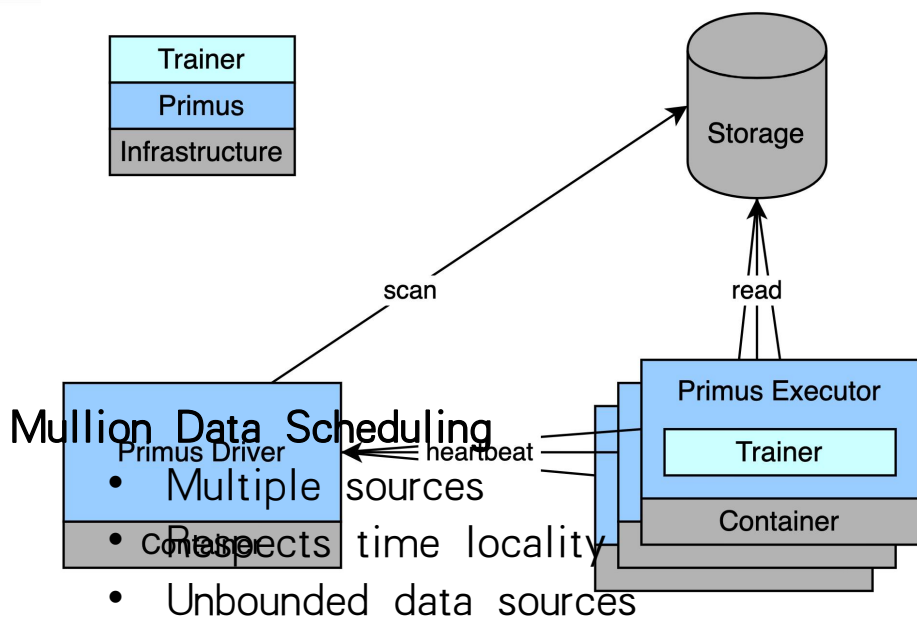


# Design

## Data Scheduling

### Centralized Architecture

- Load balancing
- Checkpointing



## Terminologies

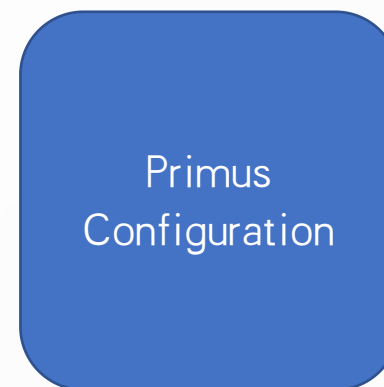
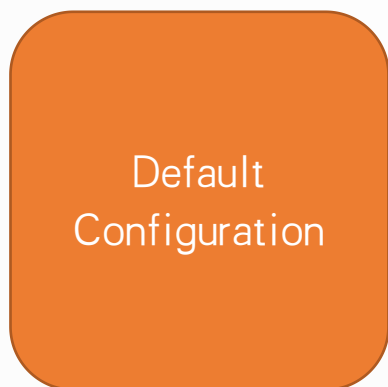


Every **Primus application** is firstly defined in the format of **Primus configuration** and latter submitted to the resource pool via the tailored **Primus client** for the environment according to the underlying infrastructure.

## Primus Configuration

### Provided by Data Scientists

- define training topology
- specify data sources
- override default configuration

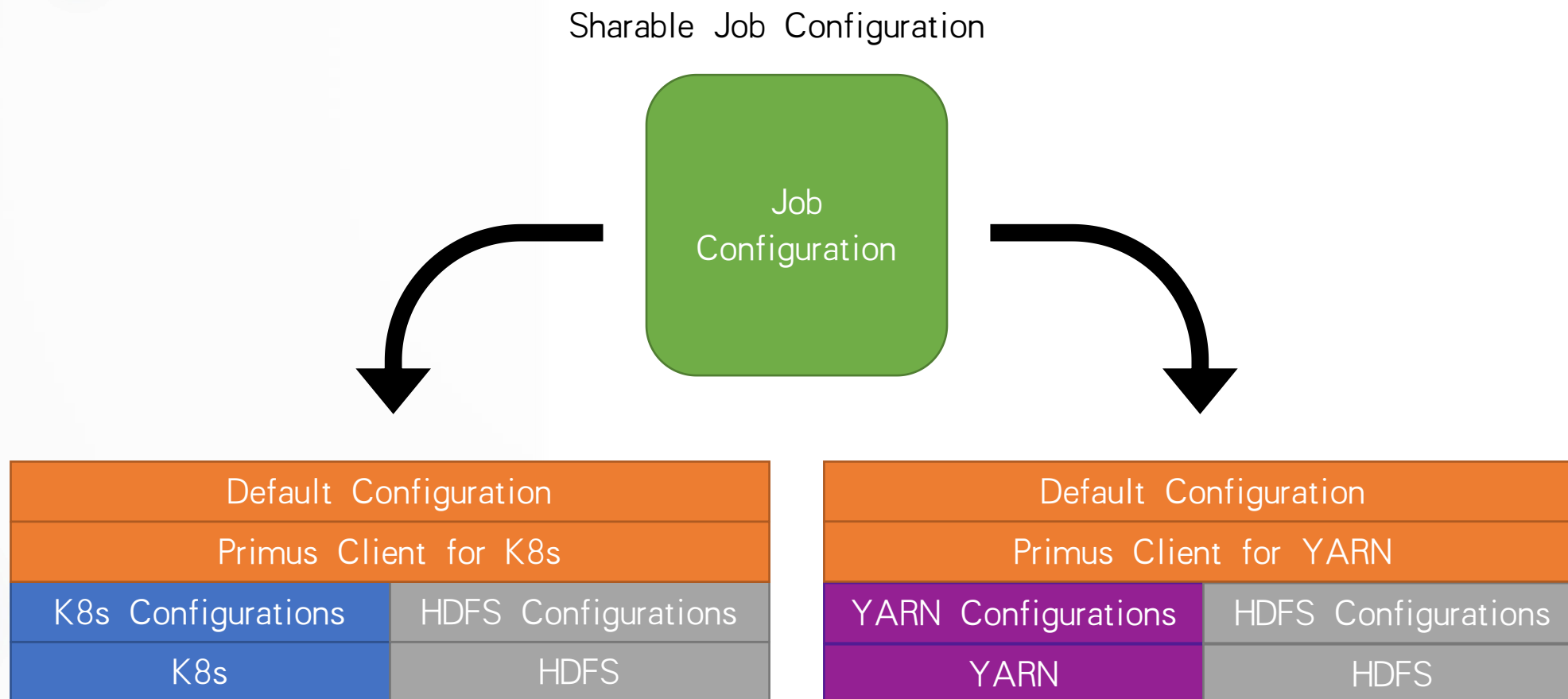


### Provided by Infrastructure to

- abstract the underlying details
- suggest default values

### Full Primus Configuration

## Primus Client & Deployment



# Primus at Work



## Primus Application & Primus UI

```
$ primus-submit --primus_conf primus_config.json
```

The screenshot shows a web browser window with the URL `localhost:7890/app/primus-a8a4156e9cea34fcb4db7dc4837f5434/`. The page displays the following sections:

- Resources:** Includes buttons for downloading 'Conf', 'Job', and 'Data'.
- Summary:** A table showing the execution details of the 'primus-hello' job.
- Ps:** A table showing the state of the 'ps' container.
- Chief:** A table showing the state of the 'chief' container.

| Job          | Progress   | Start Time          | Finish Time         | Status    | ExitCode | Diagnostic              |
|--------------|------------|---------------------|---------------------|-----------|----------|-------------------------|
| primus-hello | 100.00000% | 2023/04/26 13:34:43 | 2023/04/26 13:35:53 | SUCCEEDED | -5040    | All container completed |

| Id | Node  | Launch Time         | Release Time        | State    | Exit Code | Diagnosis |
|----|---|---------------------|---------------------|----------|-----------|-----------|
| 0  | primus-a8a4156e9cea34fcb4db7dc4837f5434-executor-ps-0-1 | 2023/04/26 13:35:11 | 2023/04/26 13:35:47 | RELEASED | 0         |           |

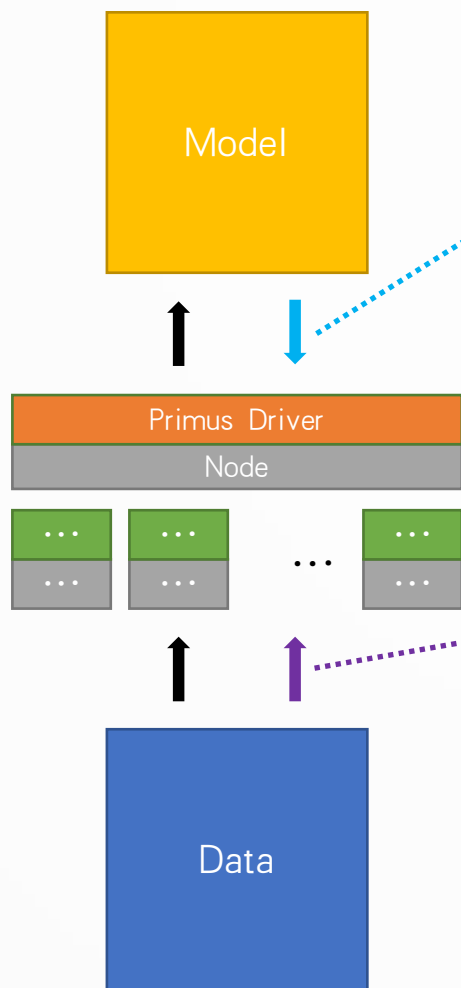
显示第 1 到第 1 条记录，总共 1 条记录

| Id | Node   | Launch Time         | Release Time        | State    | Exit Code | Diagnosis |
|----|--|---------------------|---------------------|----------|-----------|-----------|
| 0  | primus-a8a4156e9cea34fcb4db7dc4837f5434-executor-chief-0-3 | 2023/04/26 13:35:11 | 2023/04/26 13:35:49 | RELEASED | 0         |           |

# 全球开源技术峰会

THE GLOBAL OPENSOURCE TECHNOLOGY CONFERENCE



## Primus API

- Programmable Training Topology
  - Add/Remove Role
  - Scaling up/down
- Programmable Data Source

## Primus Data-IO

- Shared memory data exchange
- Support
  - Streaming data input
  - Data lake technologies
  - Data preprocessing capability

# Wrapping Up

Serving as centralize platform, Primus allows

## Data Scientists

- Freedom to explore new technologies
- Reliability
- Usability

## Infrastructures

- Emphasize on resource utilization
- Adapt to different environments

## Data Engineers

- Able to adopt new technologies easily

And many more with the upcoming features





# THANKS