工业互联网产业联盟
Alliance of Industrial Internet

大数据与雾计算: 端到端工业互联网的重要趋势

Big Data and Fog Computing: Major Trends in E2E Industry Internet

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创新引领 融通发展

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INDUSTRIAL INTERNET SUMMIT 2018

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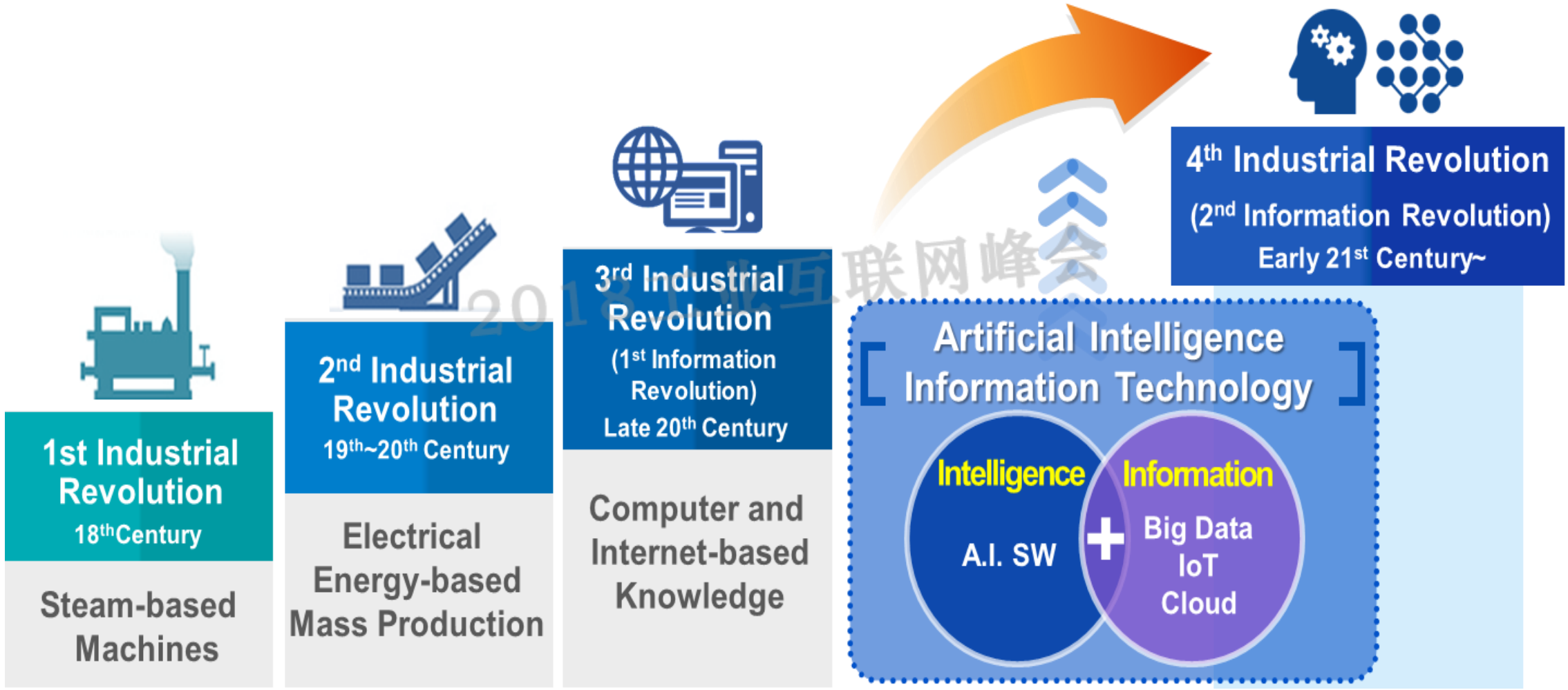
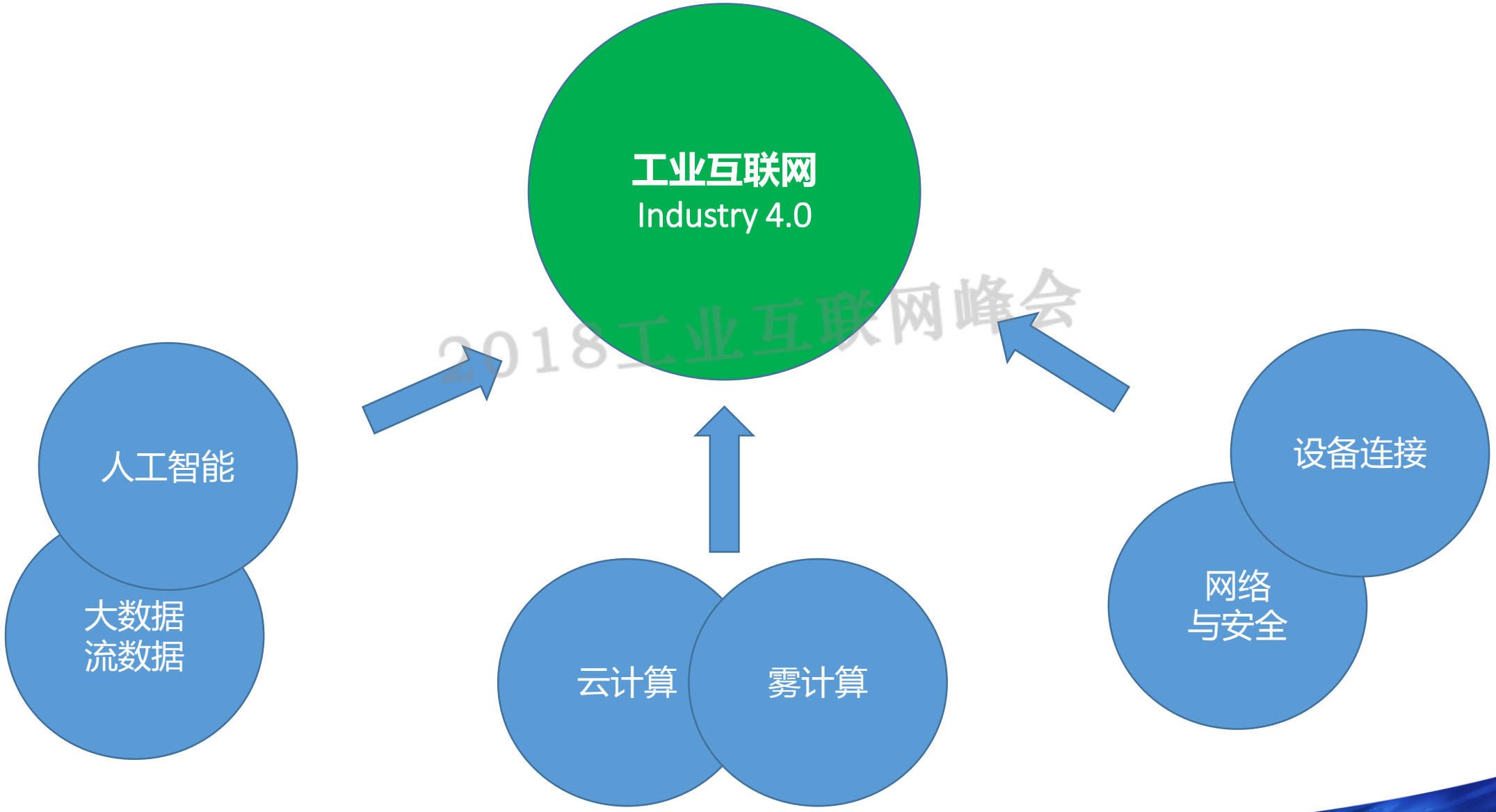


工业互联网及关键技术领域



工业互联网的价值

数据
DATA

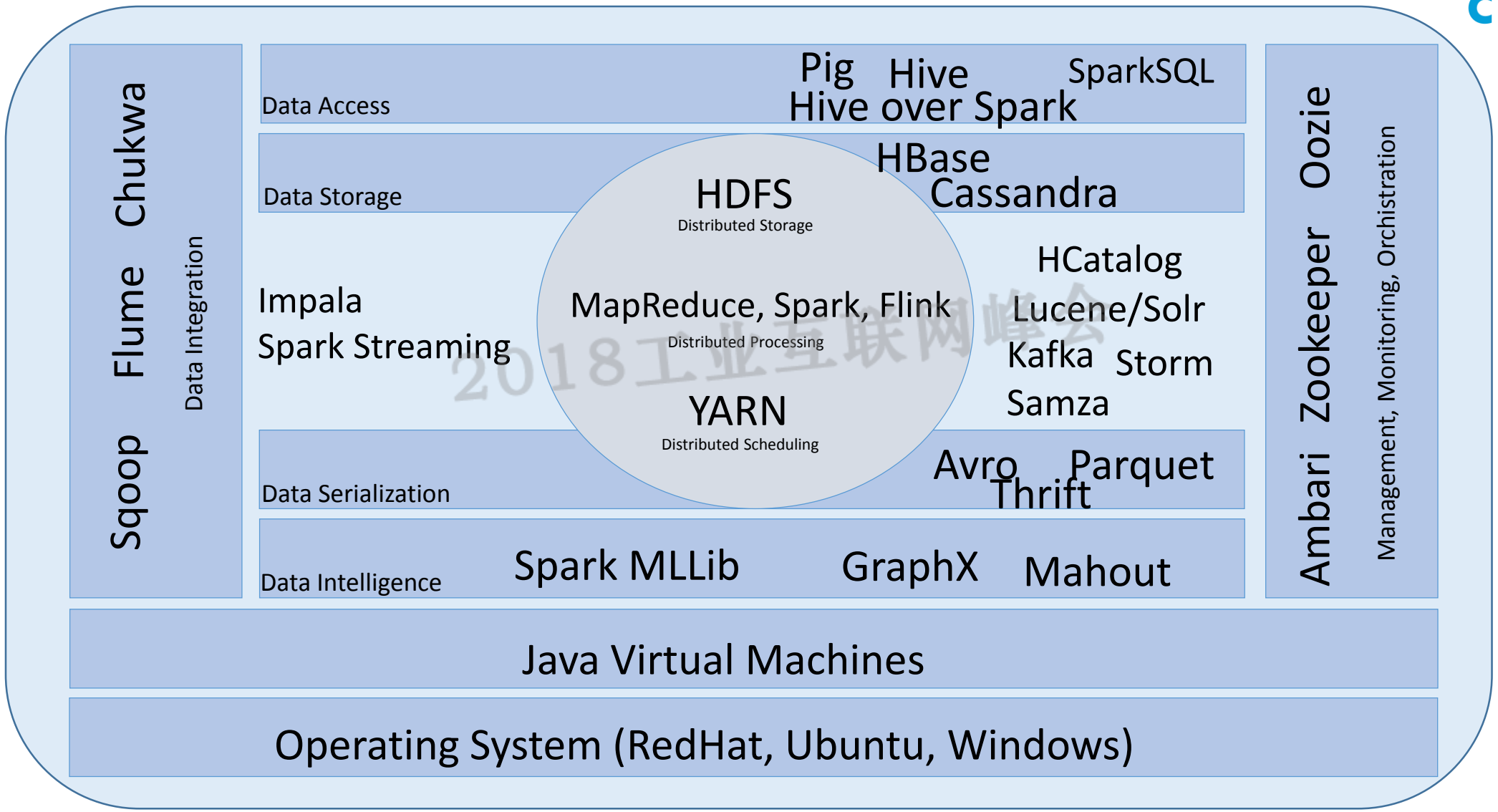
价值
Value

工业互联网的核心价值在于智慧化设备、高级分析和决策支持，而这一切的基础是海量的工业数据。

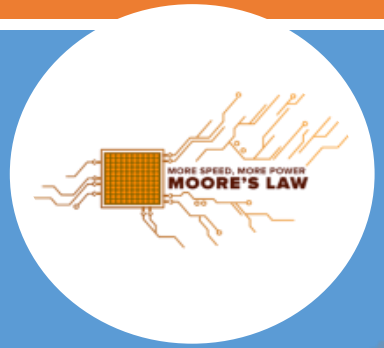
The core value of the Industrial Internet lies in smart devices, advanced analytics and decision support. And all this is based on massive industrial data.

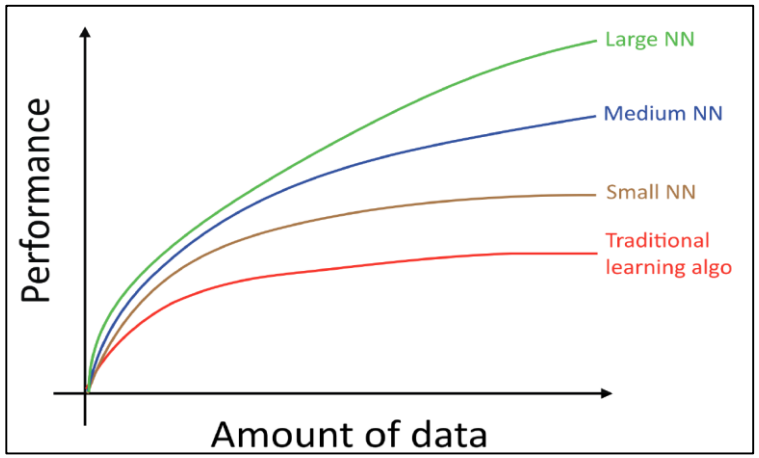
收益
Income

大数据技术

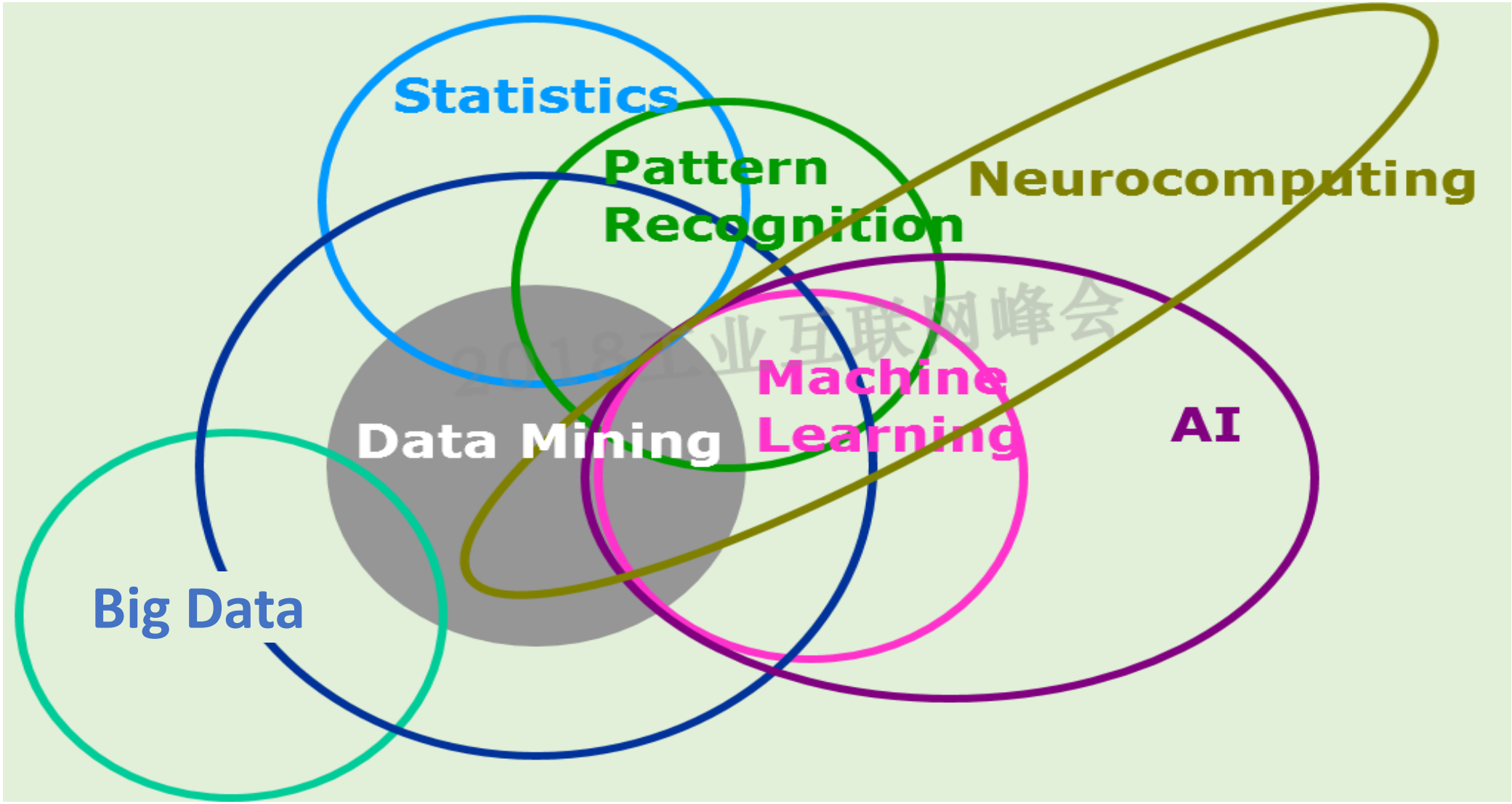


大数据平台的“摇身一变”

Bigger Data	Better Hardware	Smarter Algorithms
		
Image: 1000KB/picture Audio: 5000 KB/song Video: 5,000,000KB/movie	Transistor density doubles every 18 months Cost/GB in 1995:$1000.00 Cost/GB in 2015:$0.03	Advances in neural networks leading to better accuracy in training models



大数据人工智能平台与技术



英特尔的BigDL

Standard Spark jobs

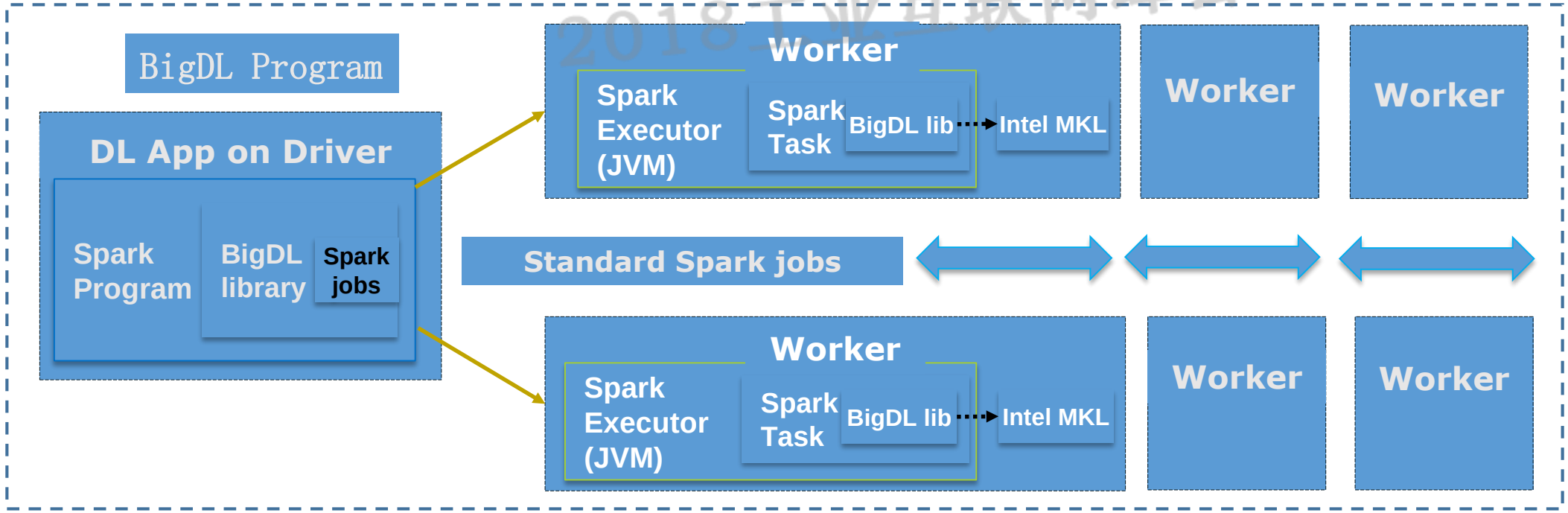
- No changes to the Spark or Hadoop clusters needed

Iterative

- Each iteration of the training runs as a Spark job

Data parallel

- Each Spark task runs the same model on a subset of the data (batch)

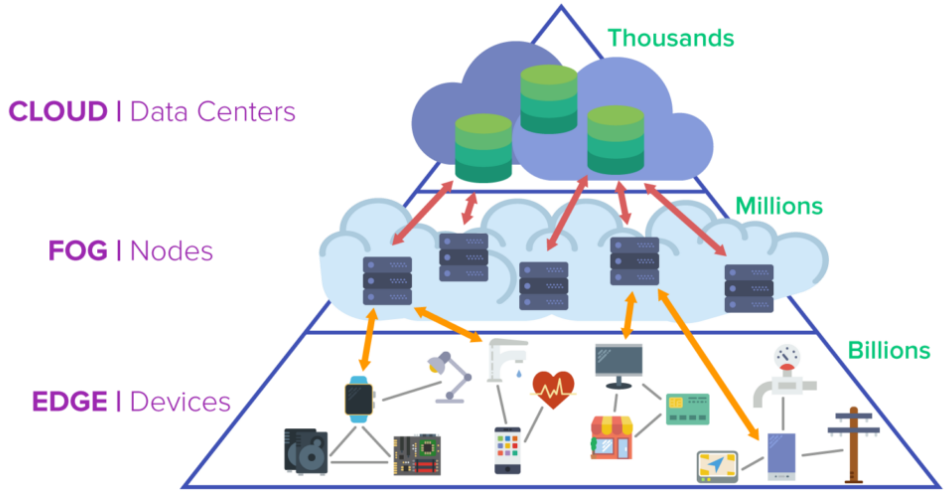


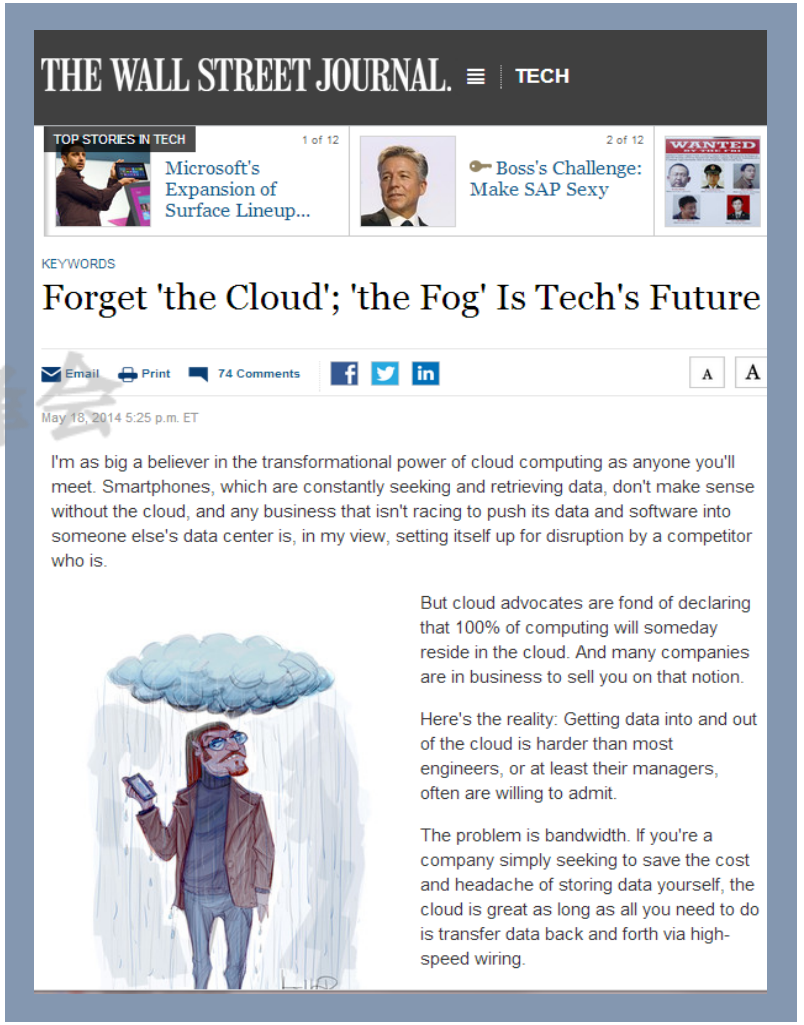
雾计算时代即将到来

IDC (2017年1月)预测:

尽管我们仍在寻找一种公认的边缘计算的定义，但在物联网的成功中，它的重要性已经得到了共识。IDC表示，在两年内， 至少40% 的大量数据将被存储、处理、分析, 并在网络边缘或其附近进行操作。

Gartner: The Edge Will Eat The Cloud（边缘计算正在吃掉云计算）





THE WALL STREET JOURNAL. | TECH

TOP STORIES IN TECH 1 of 12
Microsoft's Expansion of Surface Lineup...
2 of 12
Boss's Challenge: Make SAP Sexy

KEYWORDS

Forget 'the Cloud'; 'the Fog' Is Tech's Future

Email Print 74 Comments

May 18, 2014 5:25 p.m. ET

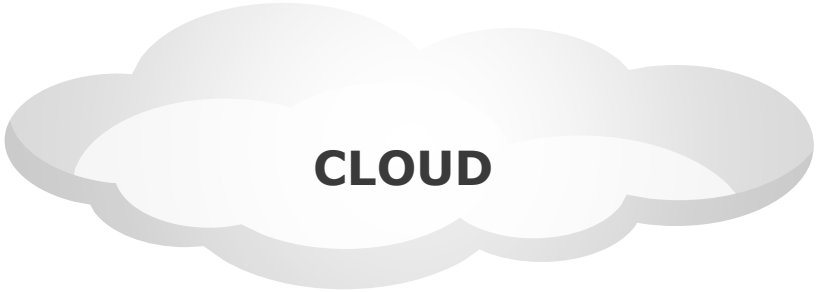
I'm as big a believer in the transformational power of cloud computing as anyone you'll meet. Smartphones, which are constantly seeking and retrieving data, don't make sense without the cloud, and any business that isn't racing to push its data and software into someone else's data center is, in my view, setting itself up for disruption by a competitor who is.

But cloud advocates are fond of declaring that 100% of computing will someday reside in the cloud. And many companies are in business to sell you on that notion.

Here's the reality: Getting data into and out of the cloud is harder than most engineers, or at least their managers, often are willing to admit.

The problem is bandwidth. If you're a company simply seeking to save the cost and headache of storing data yourself, the cloud is great as long as all you need to do is transfer data back and forth via high-speed wiring.

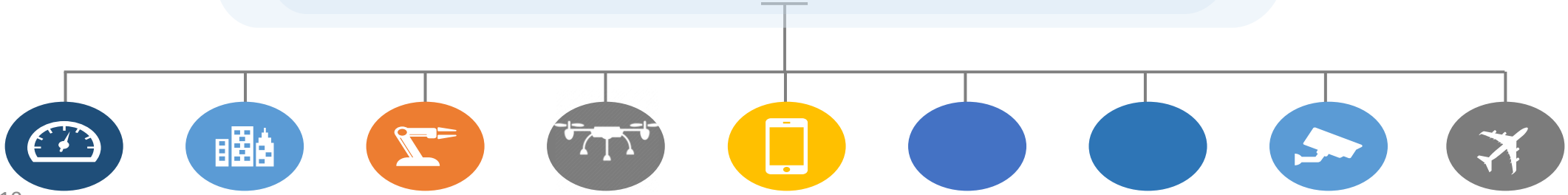
什么是雾计算？



雾是云计算模式的扩展
它类似于云，但离地面更近
雾计算架构将云扩展到物的物理世界
雾计算、网络和存储功能更接近边缘的位置

雾计算

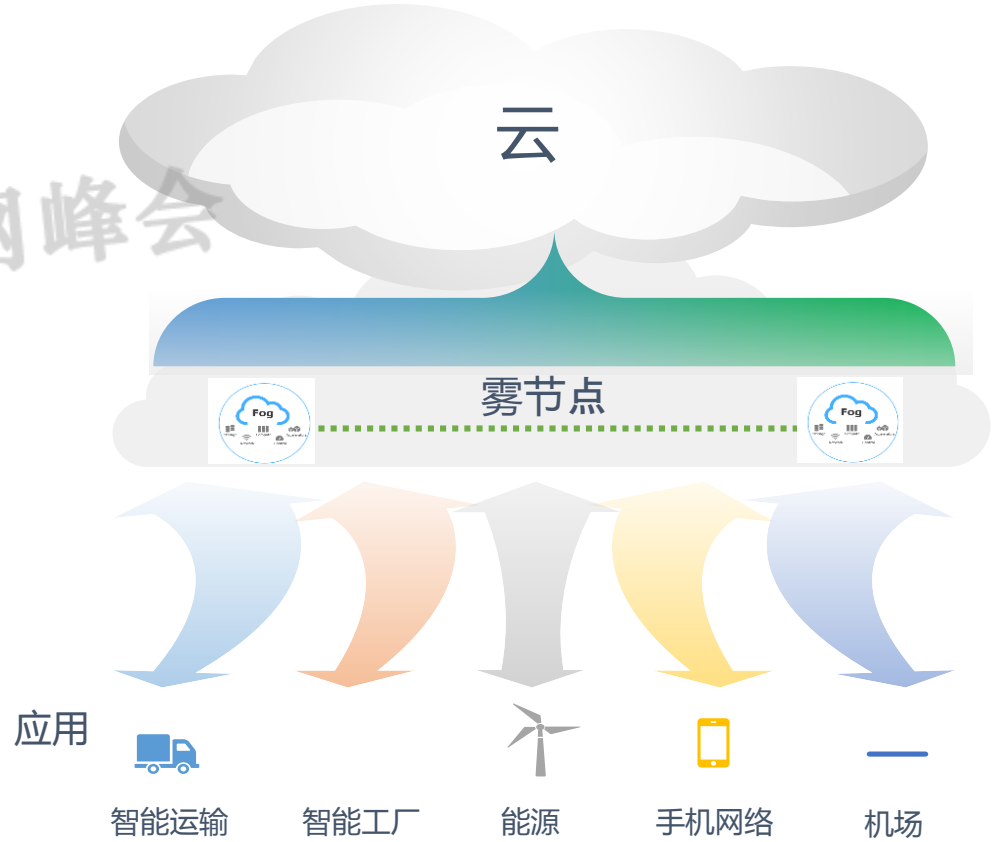
一个系统级的水平架构，它将计算、存储和网络与用户之间的关系更紧密地分配给用户，以及云到物之间的任何地方。



云，雾，边缘和物解释

边缘计算

雾计算



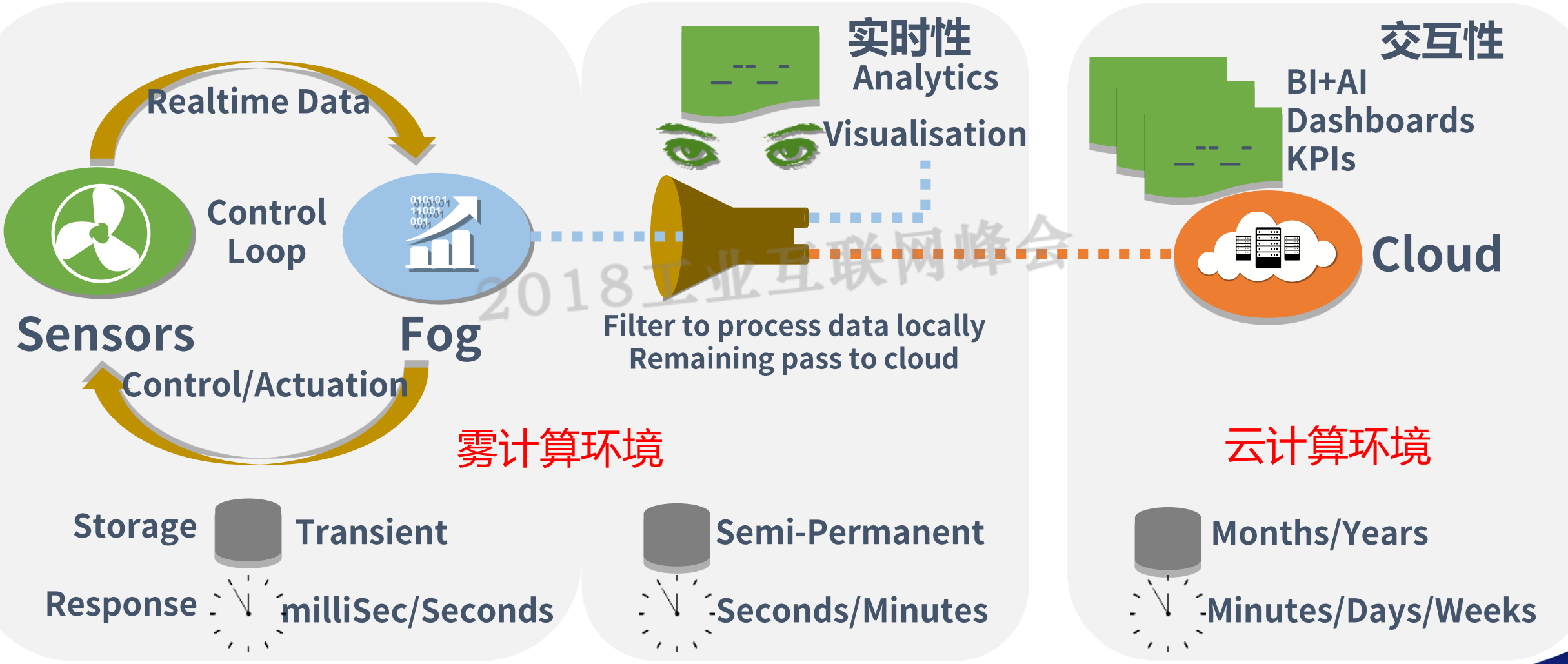
雾计算特征

- 边缘位置，低延迟性，位置和环境感知性
- 地理分布广泛
- 节点数量众多
- 无线接入的主导地位
- 实时分析与控制接近源
- 异质性-不同的形式因素和环境

雾计算

将云计算范式扩展到网络边缘
使新的应用程序和服务能够提供分布式计算、存储和网络服务。

端到端的雾与云结合



雾计算应用案例

G L C O
智能交通信号灯
实时本地控制回路
地理分布编配
多政策协调
本地/全球分析

M G L C O
轨道连接
双层无线访问接入点
快速移动性
低延迟流
实时可行性分析
全球大数据

M L C
运输
实时可行性分析
全球大数据
(批量处理)

M G L C
油 & 气
实时可行性分析
地理分布编配
工业自动化,大数据

G L C
风力发电
实时本地控制回路
现场编配
全球大数据

M G L C O
军事应用
实时本地控制回路
地理分布编配
多政策协调
本地/全球分析

L C
零售
录像分析
本地和全球过程数据
之间的相互作用

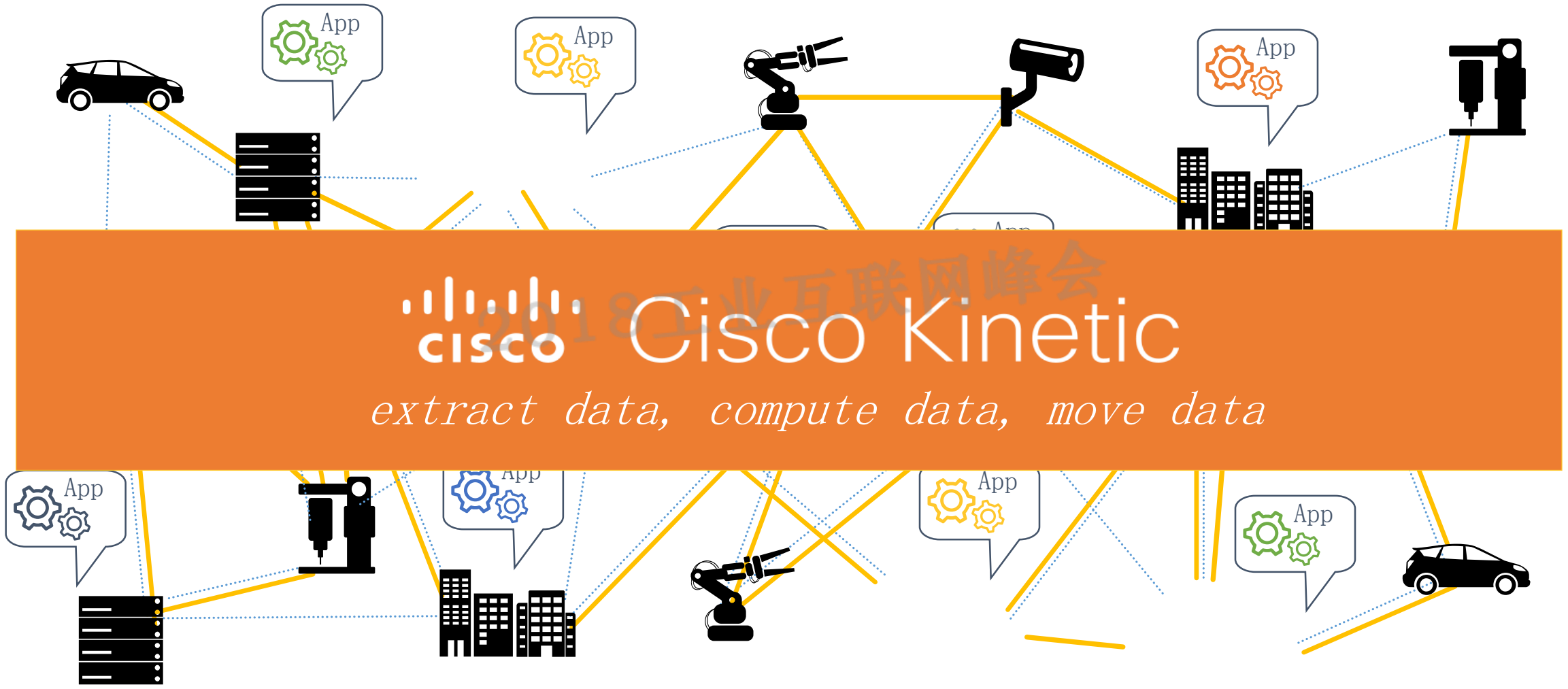
重要属性

M 移动性　G 地理分布　L 低/可预见的延迟性　C 云交互　O 多智能体编排

实现雾计算的挑战

- ✗ Complexity of connecting, securing and managing diverse devices
- ✗ Data remains locked inside its sources
- ✗ No programmatic way to move *right data* to *right apps* at *right time*
- ✗ No software control to enforce data ownership, privacy & security

思科雾计算解决方案Kinetic



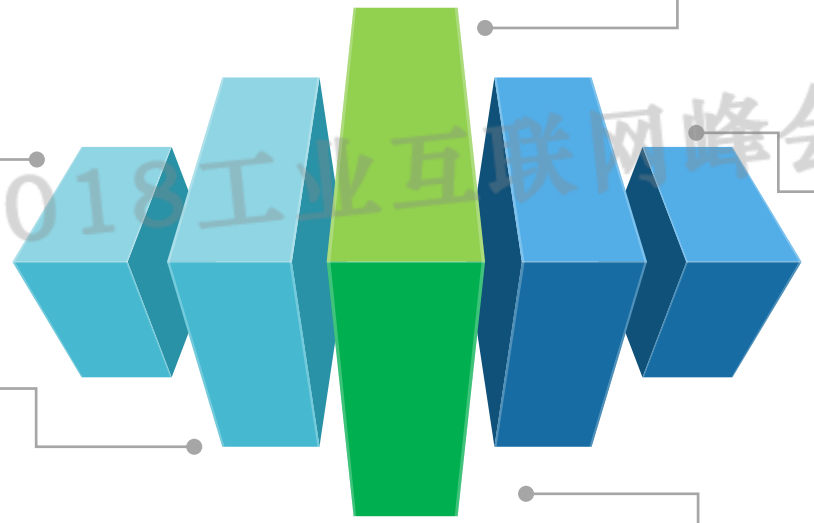
工业互联网的“奇点”

工业系统
OT
System

- 高实时性
- 高安全性
- 面向过程
- 封闭系统

“Singularity”
—Look
—Listen
—Learn

信息系统
IT System



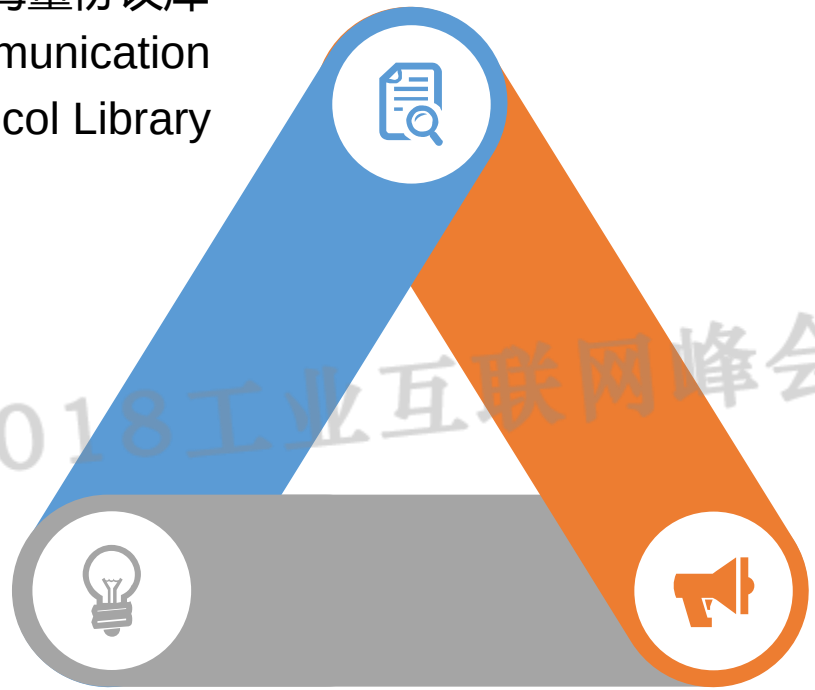
- High real-time
- High security
- Process-oriented
- Closed system

- 低实时性
- 开放性
- 多元性
- 面向数据

- Low real-time
- Openness
- Plurality
- Data-oriented

DAP：驱动工业互联网发展的重要环节

海量协议库
Massive Communication
Protocol Library



Polling协议组态
Polling Communication Protocol
Configuration

PPTA通讯监听分析
Communications
Monitoring Analysis

- 基于数学模型的万能协议转换基本技术框架 Basic technical framework of universal protocol conversion based on mathematical model
- 支持特殊数据/数据接入方式的二次开发 Support special data / data access methods of secondary development
- 资深的技术团队 Senior technical team

支持的工业协议

IEC61850 MMS/GOOSE数据采集通讯规约
IEC61850 MMS/GOOSE Data collection and communication protocol

南京南瑞继保电气公司103通讯规约
NR Electric 103 communication protocol

简单网络管理协议(SNMP)
Simple Network Management Protocol

Ethernet/IP

AB PLC DF1通讯规约
AB PLC DF1 communication protocol

GE Funac 90 系列PLC通讯规约
GE Funac SERIES 90 PLC communicati

三菱PLC FX通讯规约
Mitsubishi PLC SERIES FX communica

通用Polling规约
General polling protocol

珠海泰坦的直流电源、巡检仪、绝
DC power systems、itinerant detecto

欧姆龙CS/CJ型PLC通讯规约
Omron SERIES CS/CJ PLC communicat

GPS通讯规约
GPS communications protocol

Delta 3 Phase UPS Protocol

CJ-188户用计量仪表数据传输规约
CJ-188 household smart meters communicatio

多功能电度表通讯规约DL/T645-1997/2007
Multi-functional Energy-meter communicatior

基于ZigBee的井口无线传感和示功仪数据采
Based on ZigBee wellhead wireless sensor and

公共建筑用能监测系统数据数据上传通讯规
Public building energy monitoring system data

国电南自网络IEC60870-5-03规约
Guodian Nanjing Automation Co., Ltd.103 com

四方CSC2000变电站综合自动化系统通讯规
Beijing Sifang Automation Co. Ltd. CSC2000 sul

SEL的SEL FASTMETER+SER+HST+EVE 通讯规约
SEL FASTMETER+SER+HST+EVE communicatior

ABB SPAbus 通讯规约
ABB SPAbus communication protocol

AREVA公司的Courier通讯规约
AREVA Courier communication protocol

IEC103国际标准规约
The international standard IEC103

IEC103(国标)部颁标准规约
China ministry standards of IEC103

CDT91EX扩展部颁循环式远动规约
China ministry standards of Extende

CDT91标准部颁循环式远动规约
ministry standards of Central Dayligl

部颁DL/T 634.5104-2003/IEC608-7(
China ministry standards of DL/T 63

部颁DL/T 634.5101-2002/IEC608-7(
China ministry standards of DL/T 63

Distribute network Protocal verison

Modbus通讯规约
Modbus communication protocol

PHOCOS太阳能控制器通讯规约
PHOCOS solar controller communica

PHOCOS太阳能控制器通讯规约
PHOCOS solar controller communication protocol

OPC 通讯规约
OPC communication protocol

Profinet

GE爱德华EST3火灾报警监控系统外部通信协议
GE Edward EST3 fire alarm monitoring system external communication protocol

GB698 Q/GDW 1376.1-2012

诚茨气体探测器通讯规约
ChengCi Gas detector communication protocol

MQTT 通讯规约
MQTT communication protocol

IEC104国际标准规约
The international standard IEC104

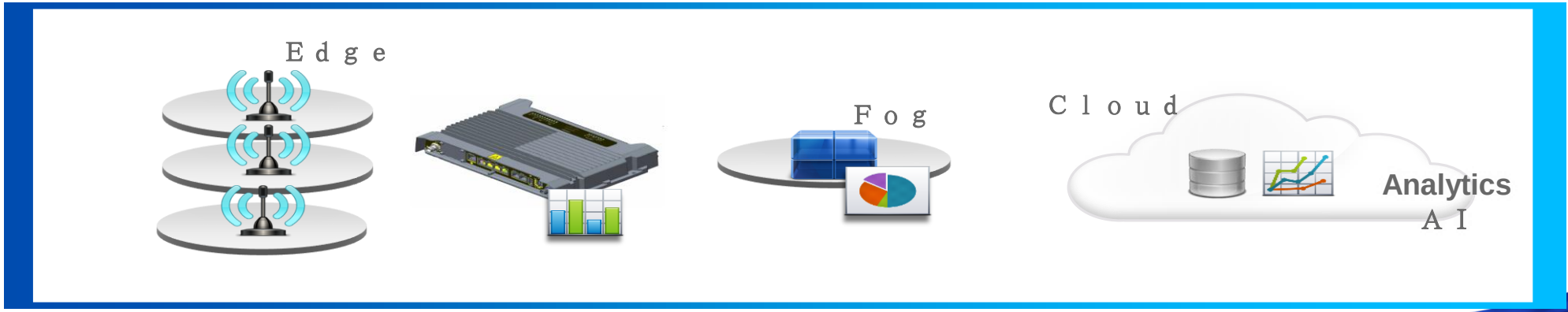
IEC104(国标)部颁标准规约
China ministry standards of IEC104

KEYENCE PLC Protocol

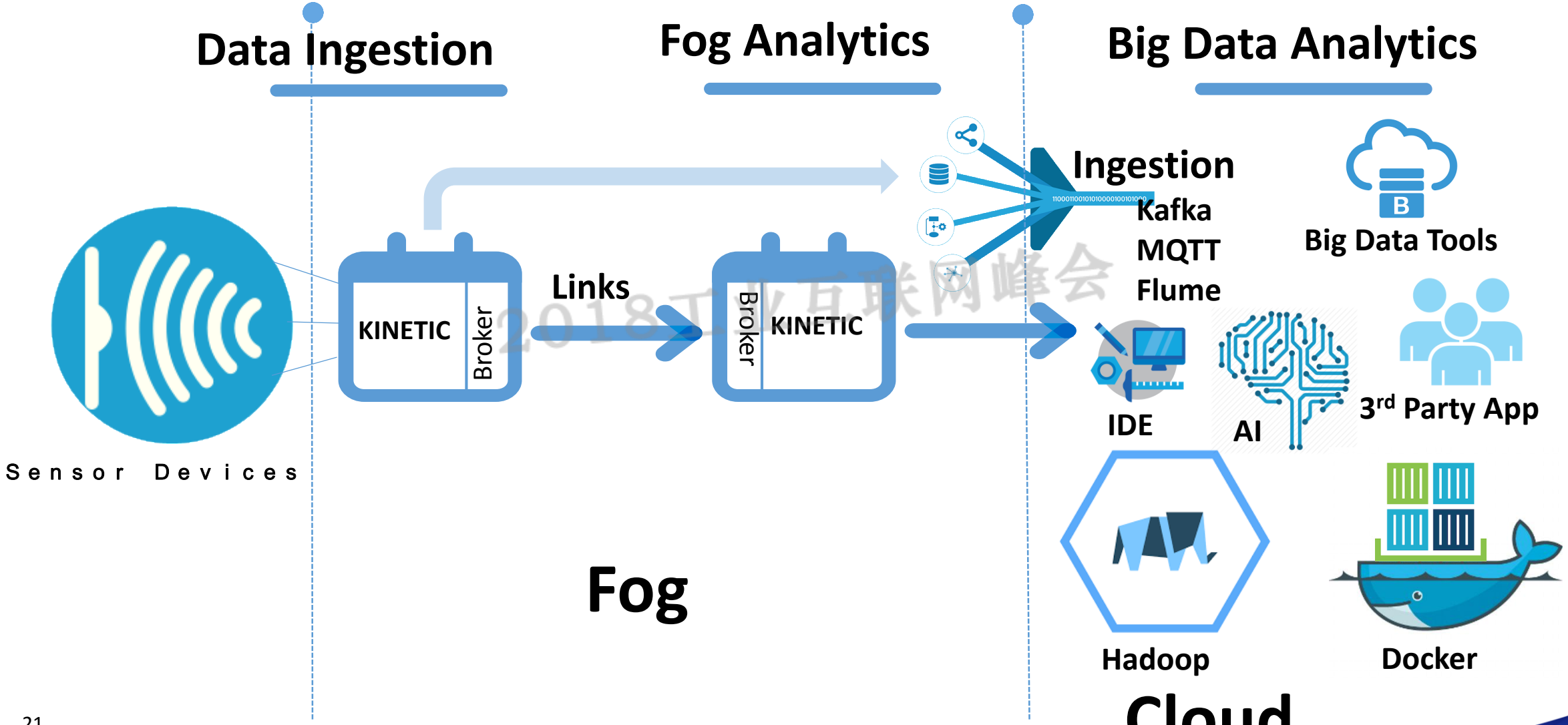
发那科
FANUC

思科IR829工业网管

- 1个千兆广域网口和4个千兆以太网口，IoT设备可通过TCP/IP方式接入数据网关
- 具有5GHz和2.4GHz的无线接入功能，IR829作为AP能够支持无线IoT设备终端
- IR829可以通过馈线和陶瓷天下，扩展无线接入能力，使部署于生产环境中的IoT设备
- 多模3G和4G LTE无线广域网接入能力，IR829可以作为移动终端，将物联网设备与云端实现互联
- RS232和RS485串口，IR829可以广泛使用于生产制造行业，接入各种工业标准协议设备
- 支持多频段Lora设备接入
- 数据接入是通过安装于EFF中的dslink实现的，EFF已支持上百种dslink的数据接入，例如MQTT、MQTT-S、MODBUS、OPC，同时也开放了Java、Python、C、dart等多种语言的开发接口。用户可开发私有协议的dslink，并安装于EFF实现私有协议的数据接入。
- EFF继承了dataflow的服务，在此可以实现边缘计算的功能，其中内置了多种数学、逻辑等运算符号，并支持script方式进行数据处理。以实现对数据的计算、聚集、加密等功能
- DAP解码服务，支持工业所有界常见的各种协议



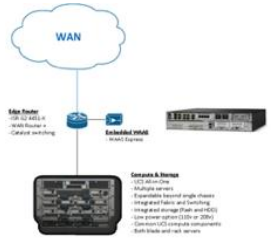
大数据雾计算端到端架构



应用案例：工业设备可预测运维

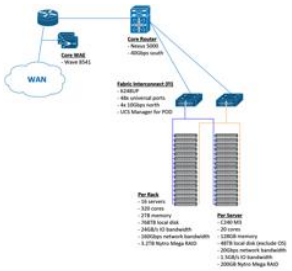
Robots & Cells

- Sensors
- Devices
- Edge Analytics



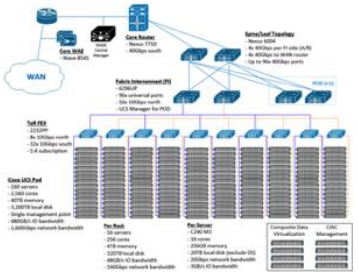
Plant Areas

- Fog Node
- Real-Time Dashboards
- Alerting



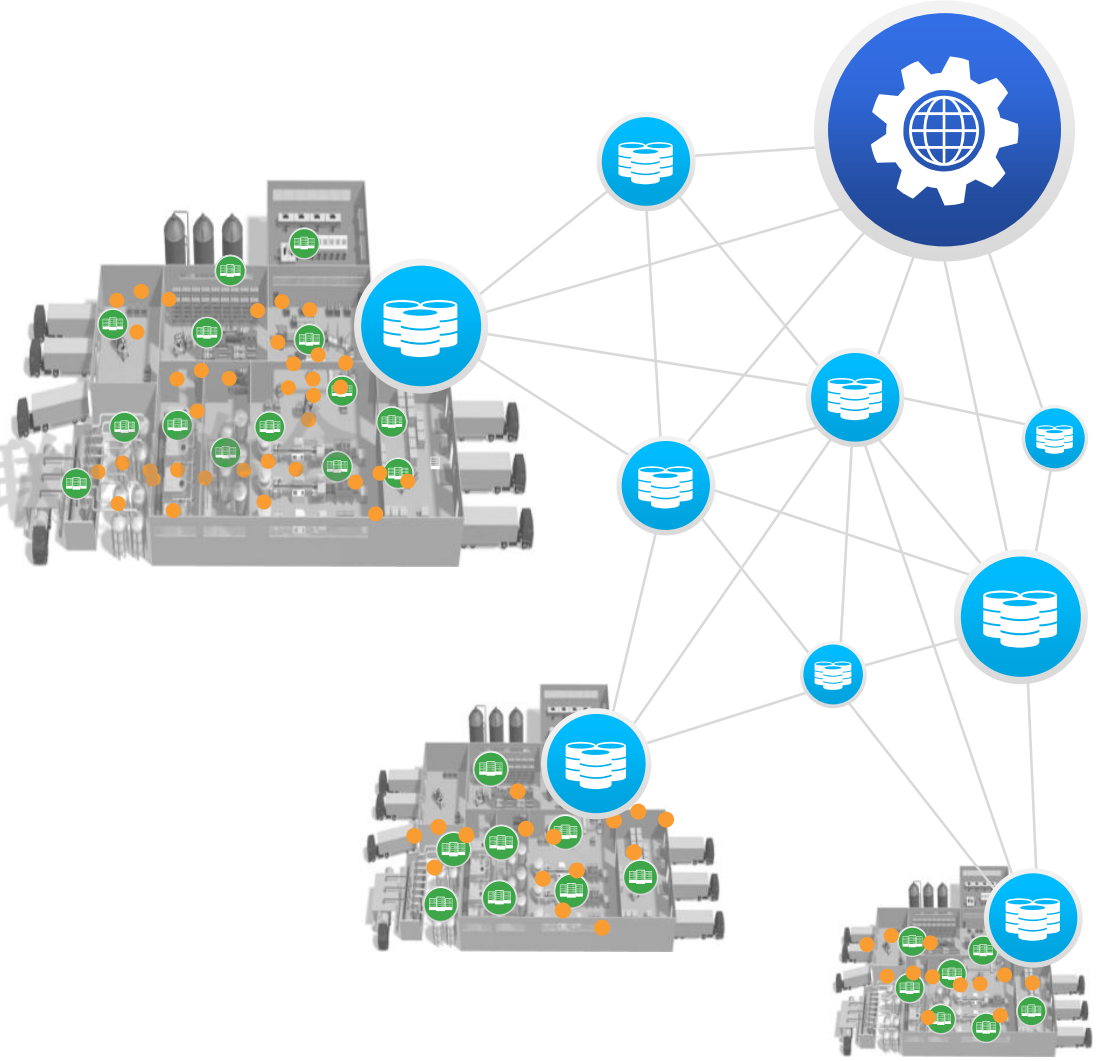
Factory

- Fog Aggregation Nodes
- Factory History & Trends
- Reports & Dashboards



Corporate Cloud

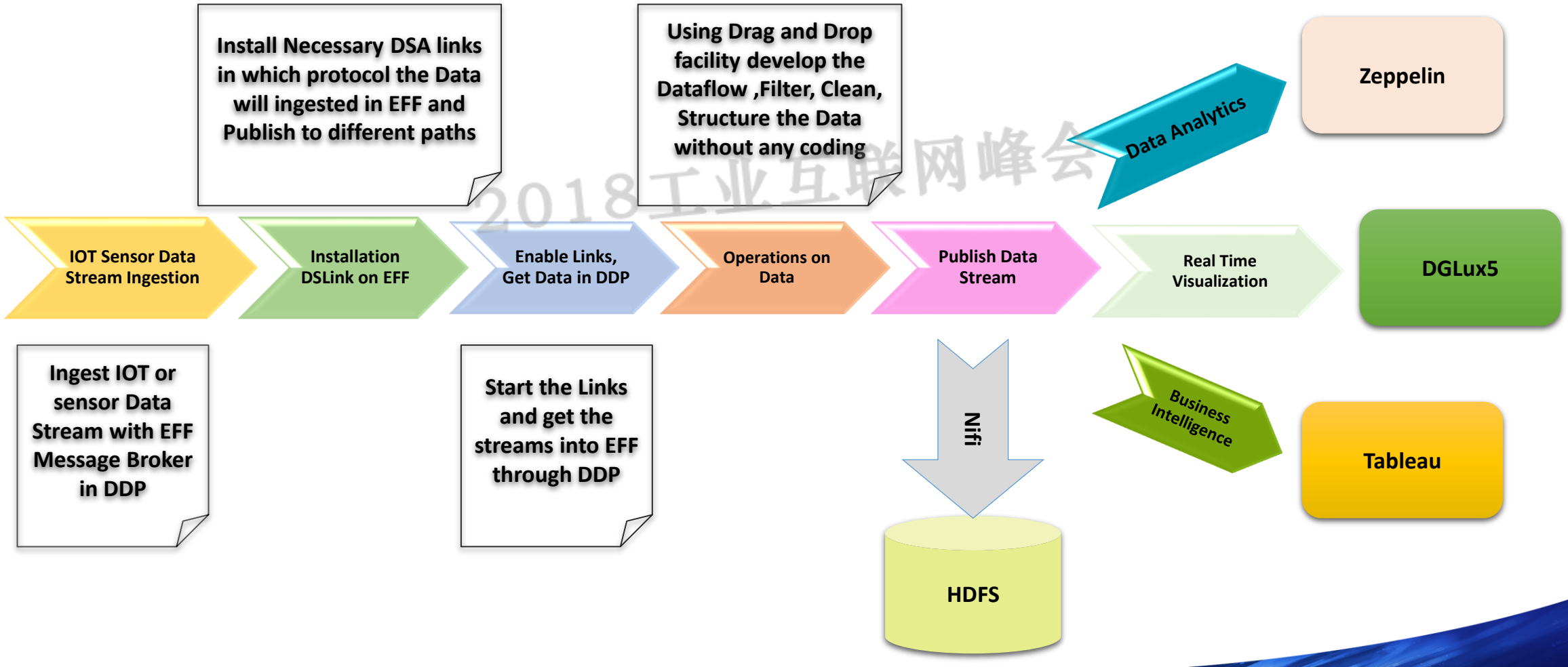
- HPC & DV
- Data Mining & Modeling
- Inter-Cloud Data Lake



应用案例：气体泄漏大数据分析

化工厂生产过程中会产生很多危险气体， 如何有效地监控这些有毒气体的实时浓度对保证工厂的安全生产和人员安全意义重大，通过IoT和Bigdata 分析的技术， 客户可以实时洞察工厂运行的实际状态并作出中长期的预测指导意见，提高企业生产效率.

Hydrogen sulfide(H2S) 硫化氢； **Oxygen(O2)** 氧气； **Lower explosive limit (LEL)**: 爆炸临界点； **Carbon monoxide(CO)一氧化碳**



实时监测危险气体浓度


13.228.30.120:55517
DGLUX5
File
Project
Edit
View
Modify
Insert
Help
dgSuper
Project
Data
GasDetection
Upload
Filter:
assets
lib
palette
Details
Name: GasDetection
Path:
Size: 0 B (0 B)
Modified: 1970年1月1日 上午8:00:00
index
There are no selected objects
Edit
Preview
Hydrogen sulfide
Lower explosive limit (LEL)
Oxygen
Carbon monoxide
Properties
Advanced
Actions
Outline
Symbols
Stage
GasDetection
Dashboard
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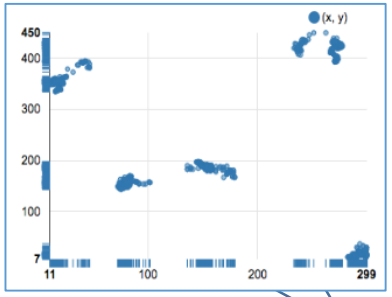
用Zeppelin做交互式分析

Data Preparation

- Read json from HDFS
- Filter N/A values
- Build “features” column
- Build “label” column

```
root
 |-- CO: double (nullable = true)
 |-- H2S: double (nullable = true)
 |-- LEL: double (nullable = true)
 |-- O2: double (nullable = true)
 |-- name: string (nullable = true)
 |-- timestamp: long (nullable = true)
 |-- x: long (nullable = true)
 |-- y: long (nullable = true)
```



SQL Query

- Select * from data
- Select LEL, x, y from data

```
correlMatrix: org.apache.spark.mllib.linalg.Matrix =
1.0                   -0.06940602350892551  0.003991184075476396  -0.0692781383914544
-0.06940602350892551  1.0                   -0.06072914959759728  -0.015391194138340709
0.003991184075476396  -0.06072914959759728  1.0                   0.04191109638431667
-0.0692781383914544   -0.015391194138340709 0.04191109638431667   1.0
```

Correlation Matrix

- Statistics.corr

Machine Learning for Danger Warning

- Select feature & label
- Create Random Forest Classifier (rfc)
- Train rfc
- Predict & evaluate

```
+--------------+-----+--------------------+
|predictedLabel|label|            features|
+--------------+-----+--------------------+
|           1.0|  1.0|[8.528621,4.17452...|
|           1.0|  1.0|[8.521356,1.72316...|
|           0.0|  0.0|[9.497252,0.49642...|
|           1.0|  1.0|[17.601233,4.8139...|
|           1.0|  1.0|[17.601233,4.8139...|
|           0.0|  0.0|[11.210594,3.8536...|
|           1.0|  1.0|[17.498453,0.3237...|
|           0.0|  0.0|[22.120699,2.3015...|
|           0.0|  0.0|[11.210594,3.8536...|
|           0.0|  0.0|[0.0,3.0129893,7....|
+--------------+-----+--------------------+
only showing top 10 rows
evaluator: org.apache.spark.ml.evaluation.MulticlassClassificationEvaluator = mcEval_a220fd769201
accuracy: Double = 0.9774193548387097
Test Error = 0.022580645161290325
```

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THANKS

主讲人：苗凯翔

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