SWINBURNE UNIVERSITY OF TECHNOLOGY

COS20031

Computing Technology Design Project

Week 10-11: Major-specific topics

Internet of Things

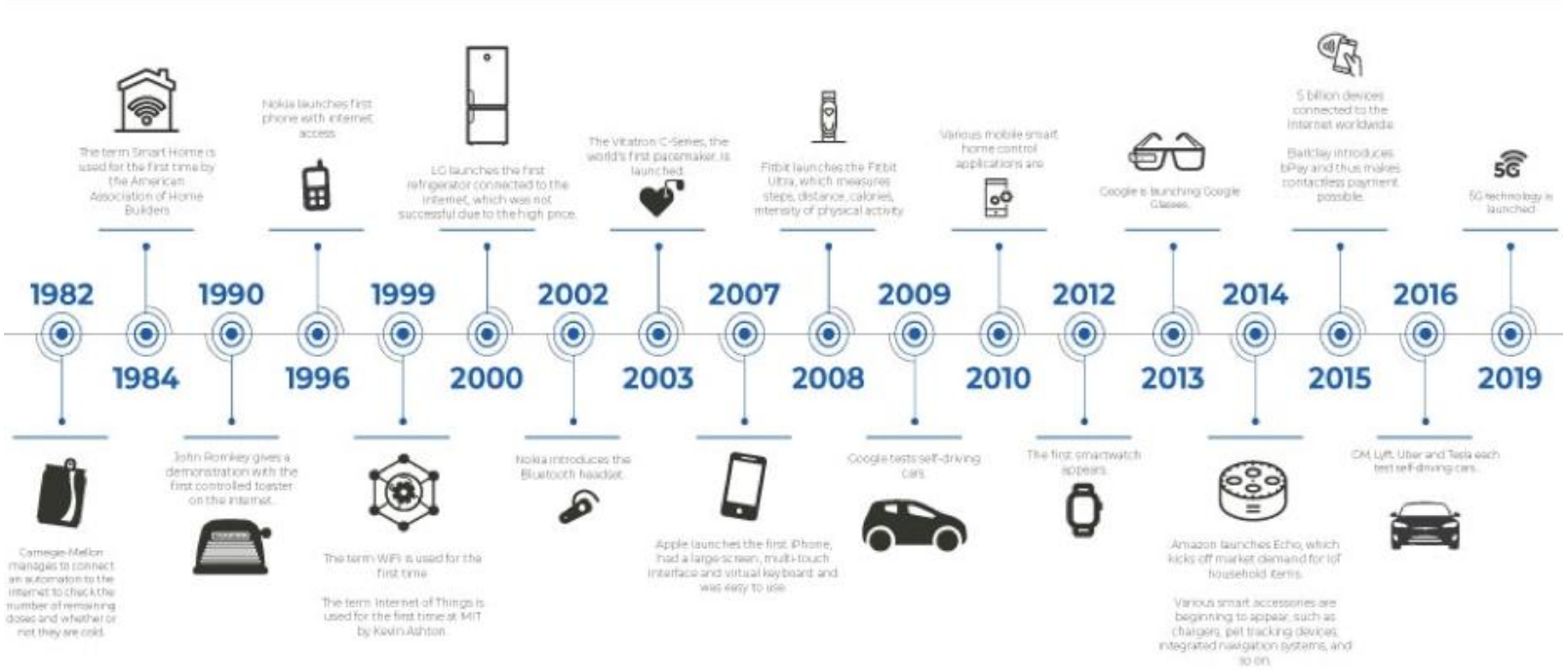
Database Development Lifecycle

1. Planning
2. Requirement gathering
3. Conceptual design
4. Logical design
5. Physical design
6. Construction
7. Implementation and rollout
8. Ongoing support

Outline

- Introduction to Internet of Things (IoT)
- IoT System Architecture
- IoT Applications
- IoT Development Challenges
- Data Management
- A Real-time Database: Kinetica

The history of Internet of Things (IoT)



Source: https://www.stackup.ro/en/timeline-iot-history/

What is IoT?

Origin:

- Internet of Things term was first coined by British pioneer Kevin Ashton in 1999.
- Ashton coined the term IoT to define the power of connecting RFID tags used in supply chain to the Internet to count the goods without human intervention.
- Though the term “Internet of Things” is relatively new but the system of connecting computers and networks to monitor and control devices has been in use since few decades.

Source: http://www.internetsociety.org

What is an IoT (2)

- **Definition**: Internet of Things or IoT denotes a trend where large number of embedded devices employ communication services offered by the Internet protocols.
- In short: IoT is “Smart Object Networking”.

Source: RFC 7452

What is an IoT (3)

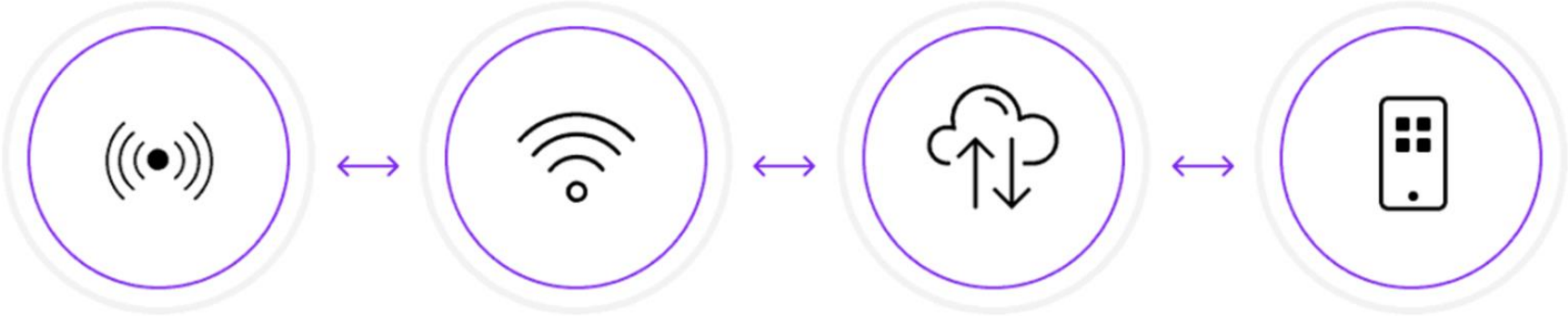
The Internet of Things:

- Connects “things” in the physical world to the internet.
- Collects data for these “things” via sensors.
- Analyses the collected data and provides a deeper insight into the “things”.

Internet of Things: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

Source: Rec. ITU-T Y.2060 (06/2012)

IoT System Architecture



Sensors

Sensors / Devices / Tags & beacons / Actuators / Gateways

Connectivity

Network protocols / WiFi / BLE

IoT Platform

Data storage & processing / Analytics / Visualization / Connectivity & device management / Security

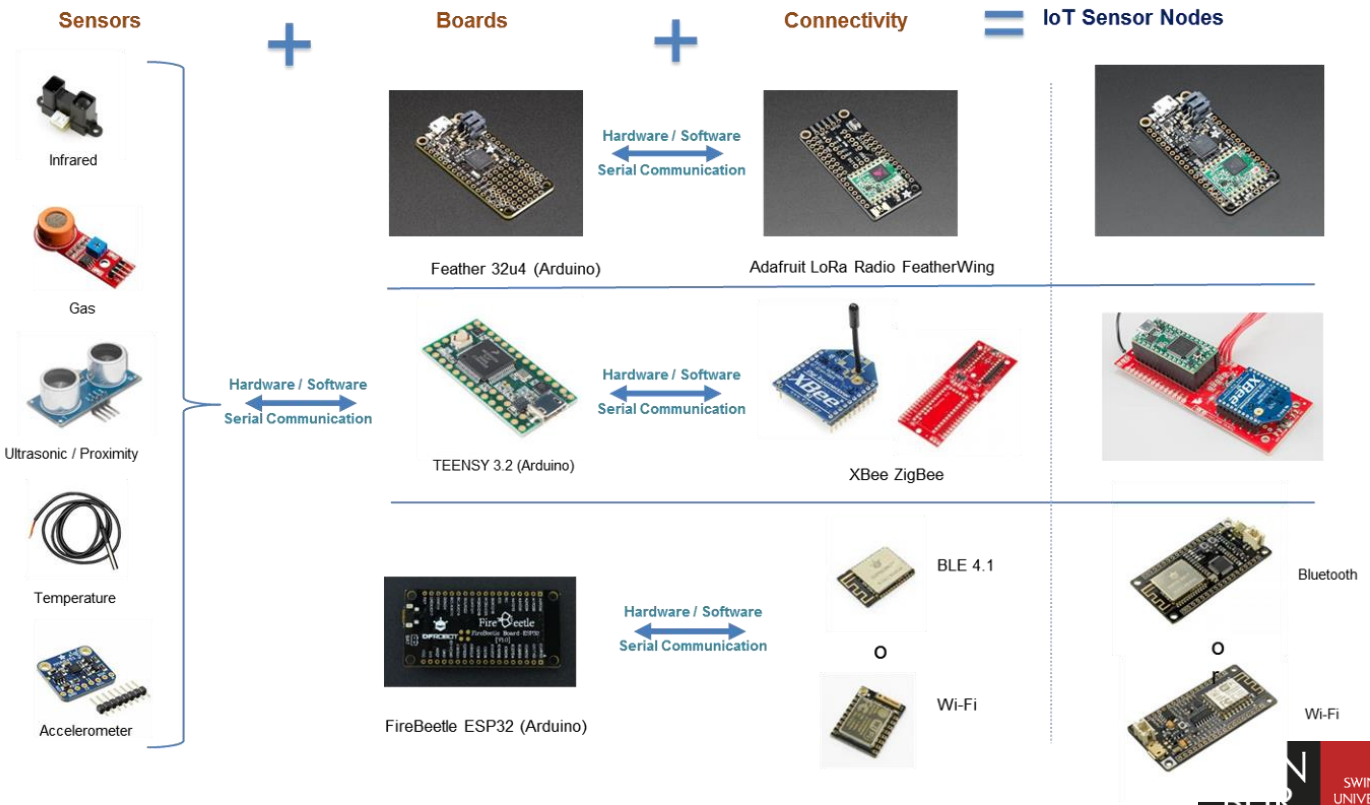
Applications

Apps / APIs/ CRM / ERP

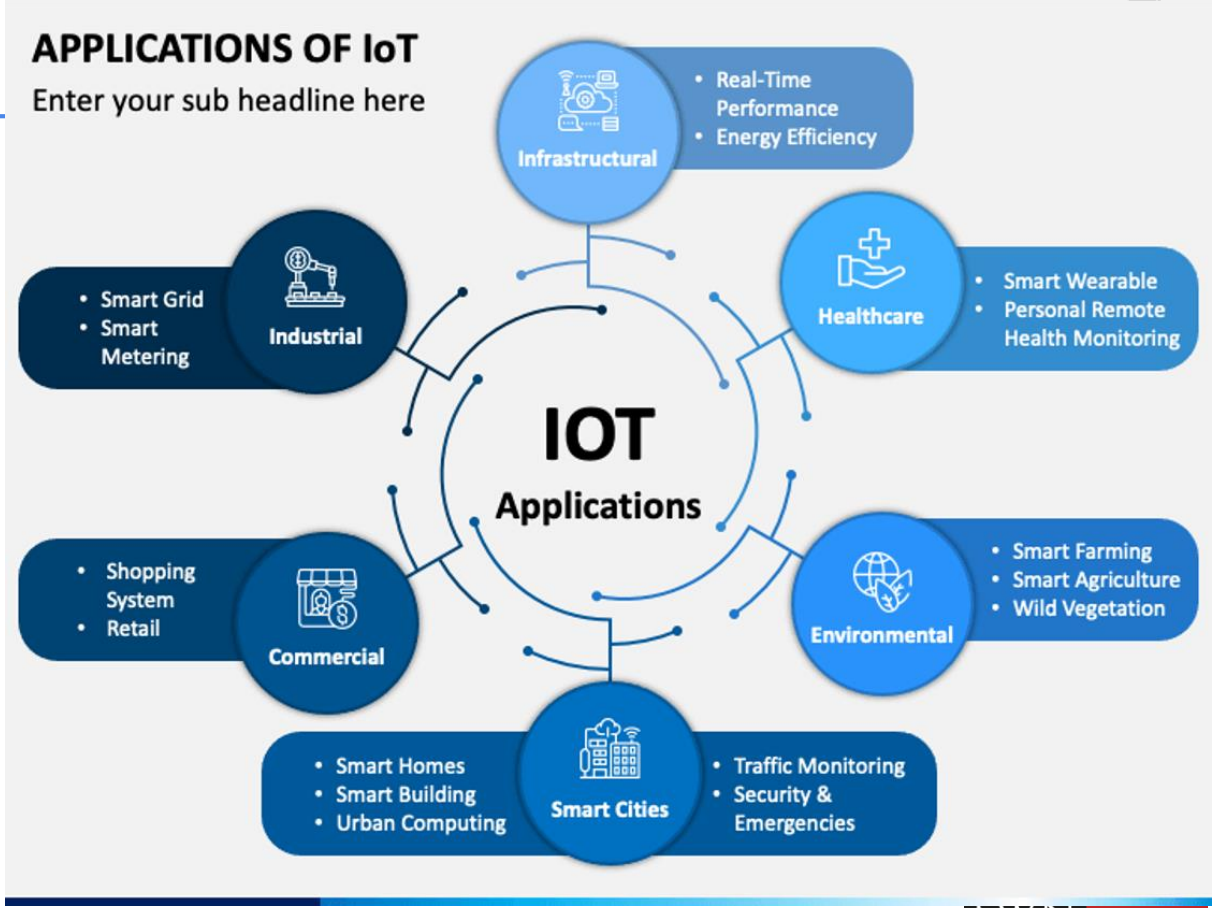
Hardware layer	Connectivity layer	Middleware layer	End-user layer

IoT Devices

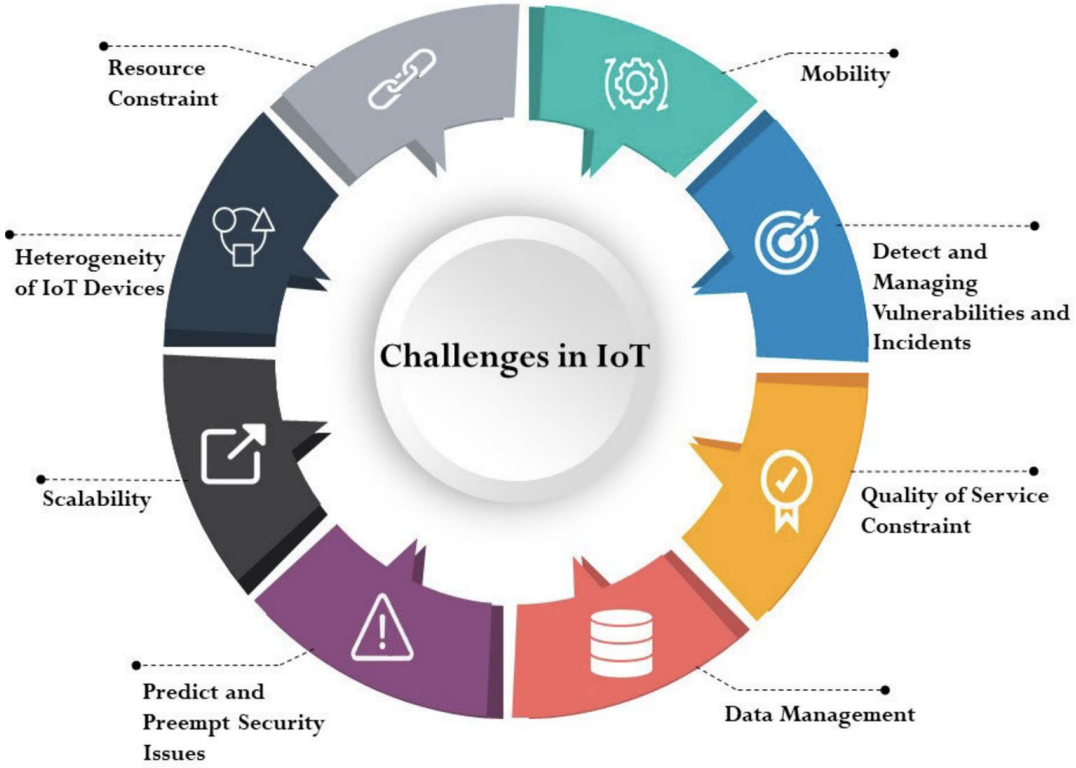
IoT hardware and Software



IoT Applications



IoT Development Challenges



Data Management

WHAT should DBMS be?

Source: https://doi.org/10.1109/ACCESS.2021.3073408

Challenge: Data Management

1.1 Billion
Data points generated by sensors **daily**

500 Gigabytes
Data generated by an offshore oil rig **weekly**

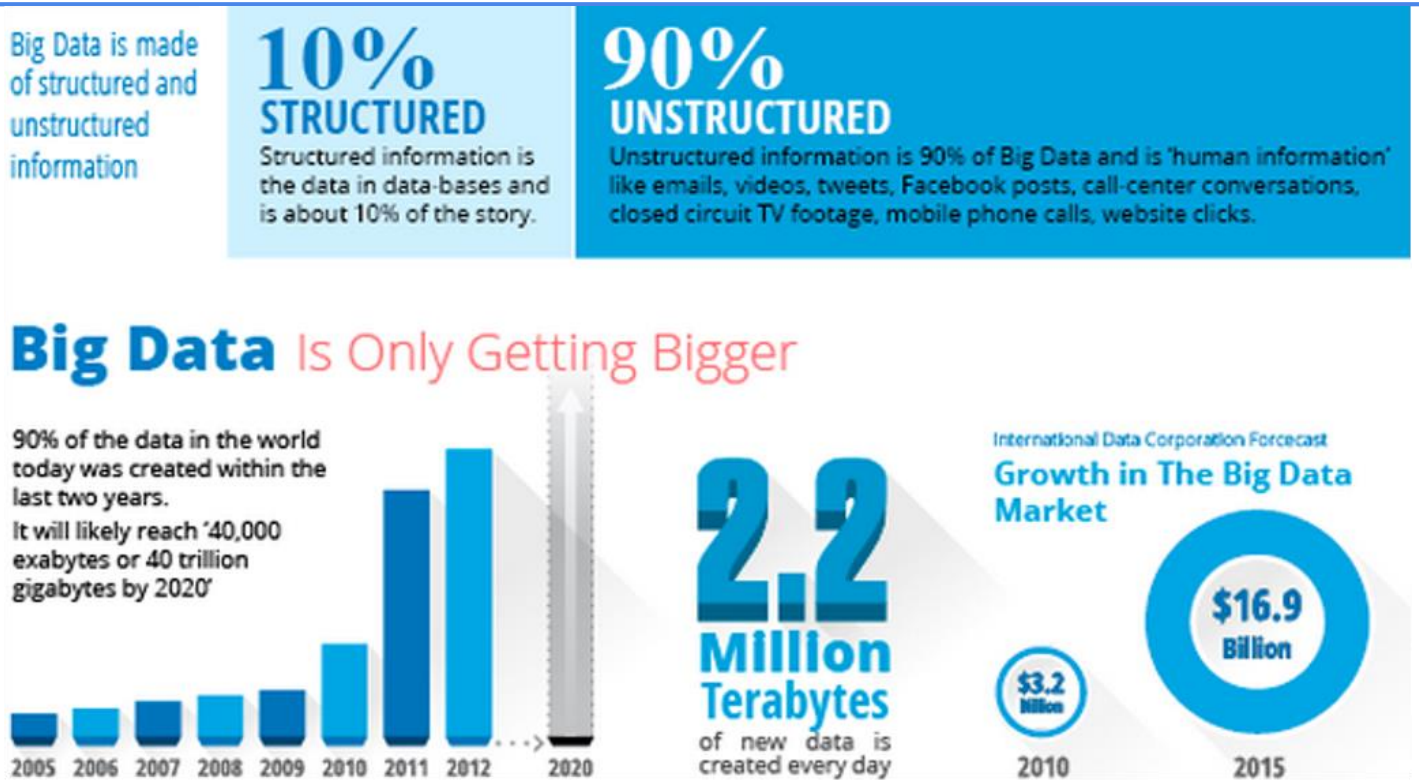
1000 Gigabytes
Data generated by an oil refinery **daily**

10,000 Gigabytes
Data generated by a jet engine every **30 minutes**

2.5 Billion Gigabytes
Data generated worldwide **daily**

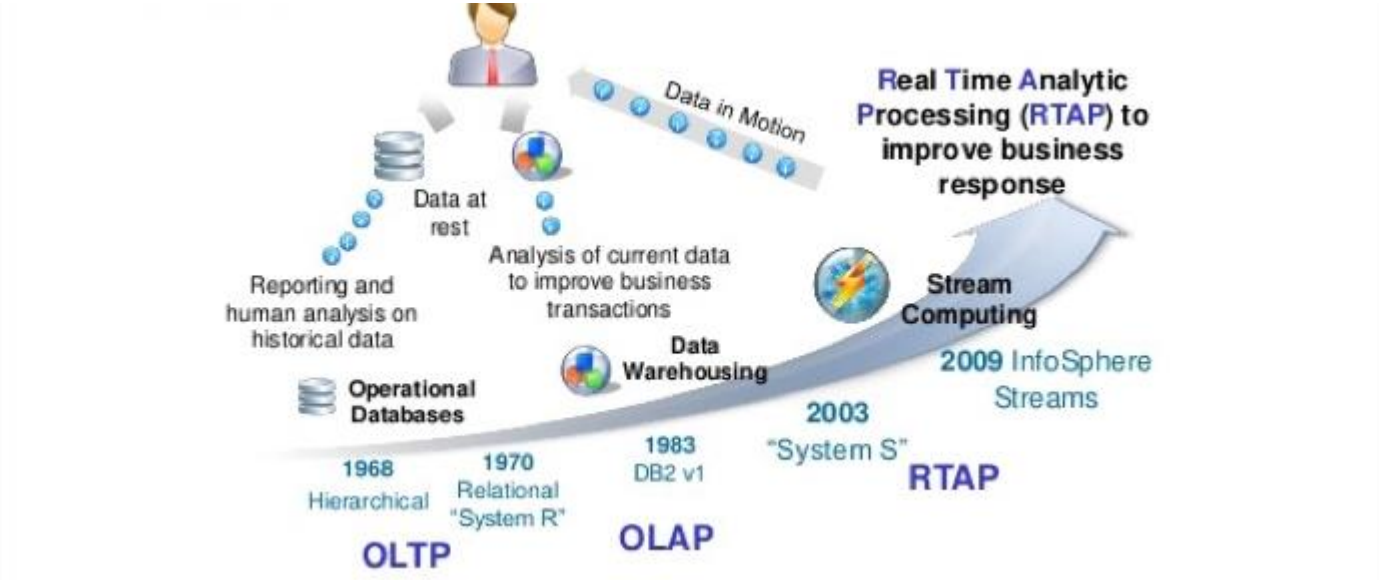
90% of the world's data
Has been created in the last **2 years!**

Increasing Data Generation



Source: http://hrboss.com/hiringboss/articles/big-data-infographic

Real-Time Data Analysis



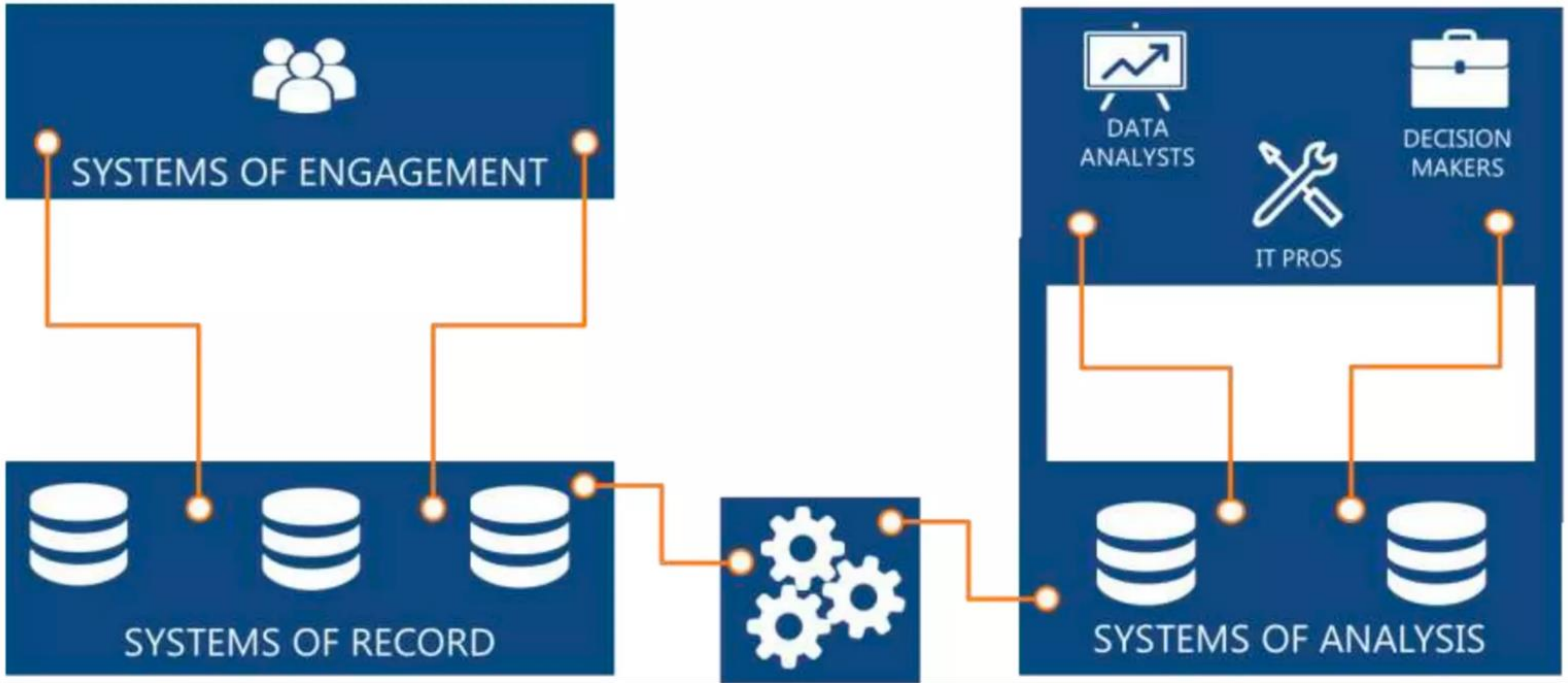
OLTP: Online Transaction Processing (DBMSs)

OLAP: Online Analytical Processing (Data Warehousing)

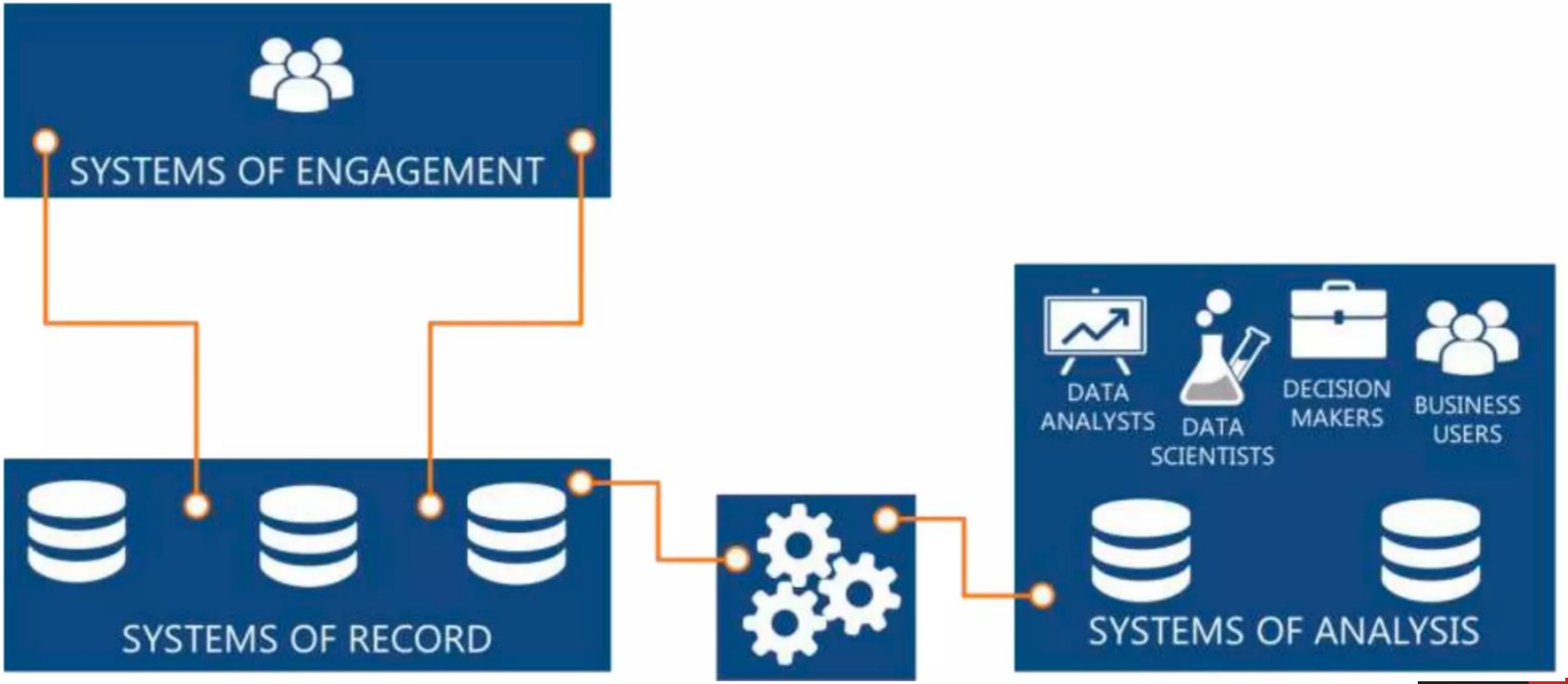
RTAP: Real-Time Analytics Processing (Big Data Architecture & technology)

Source: *http://faculty.bcitbusiness.ca/kevinw/4800/Lecture_Slides/Yallouz_Lectures/2016_BUSA_4800_Big_Data_Lecture.pdf*

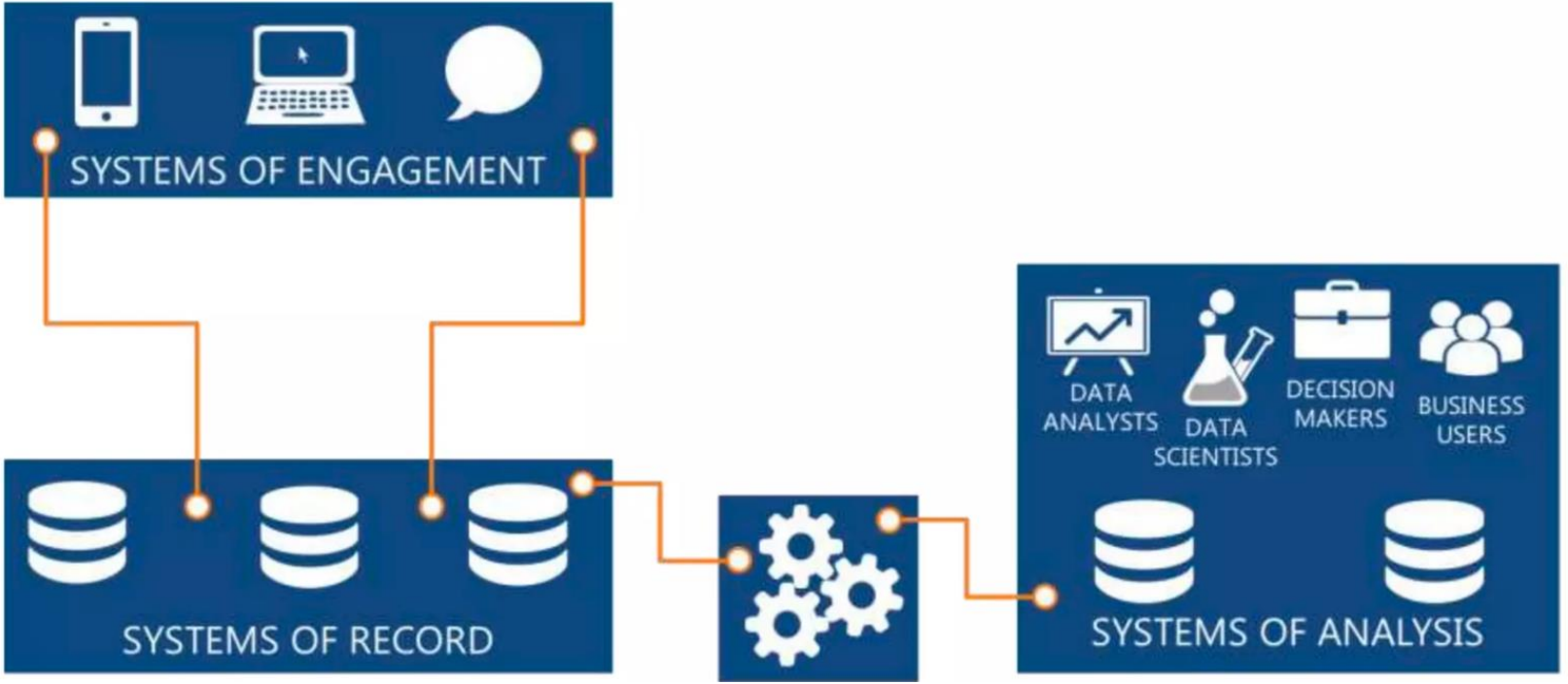
Traditional Systems of Engagement and Analytics



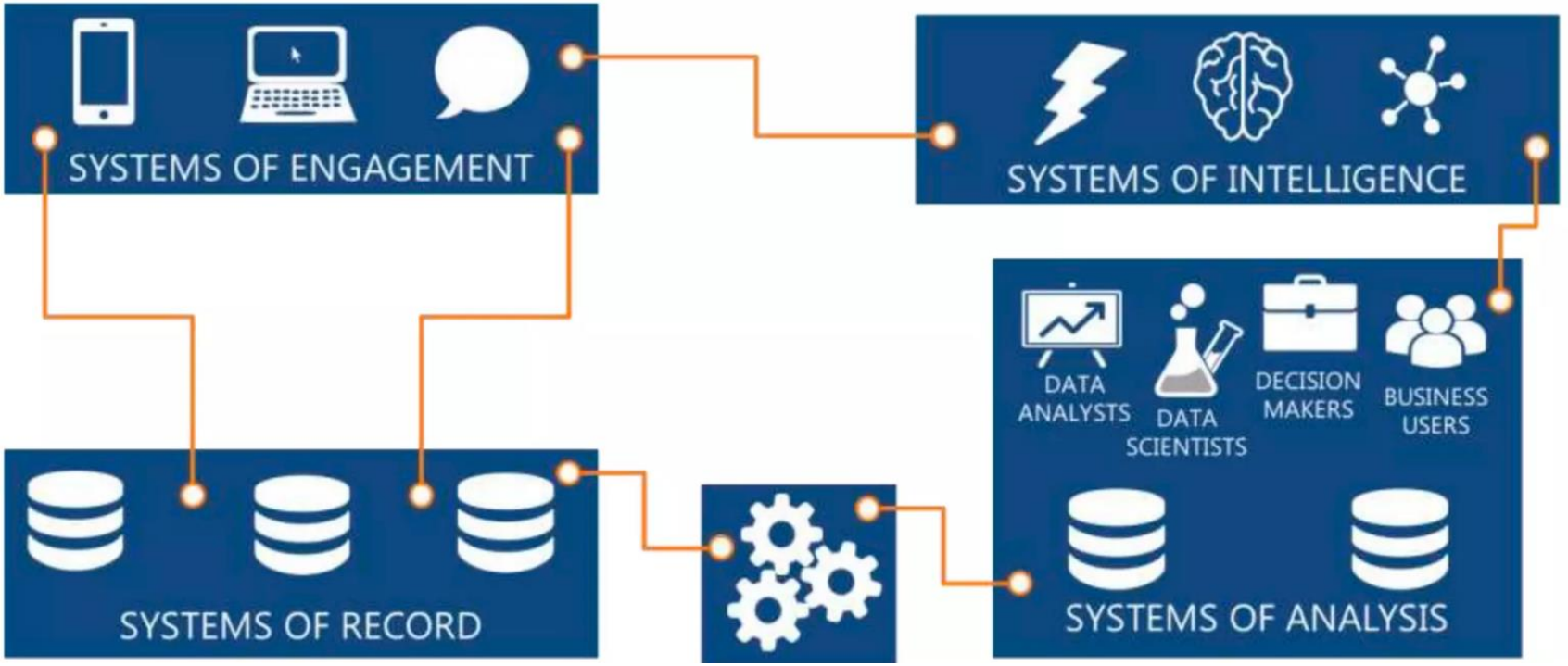
New Systems of Analysis



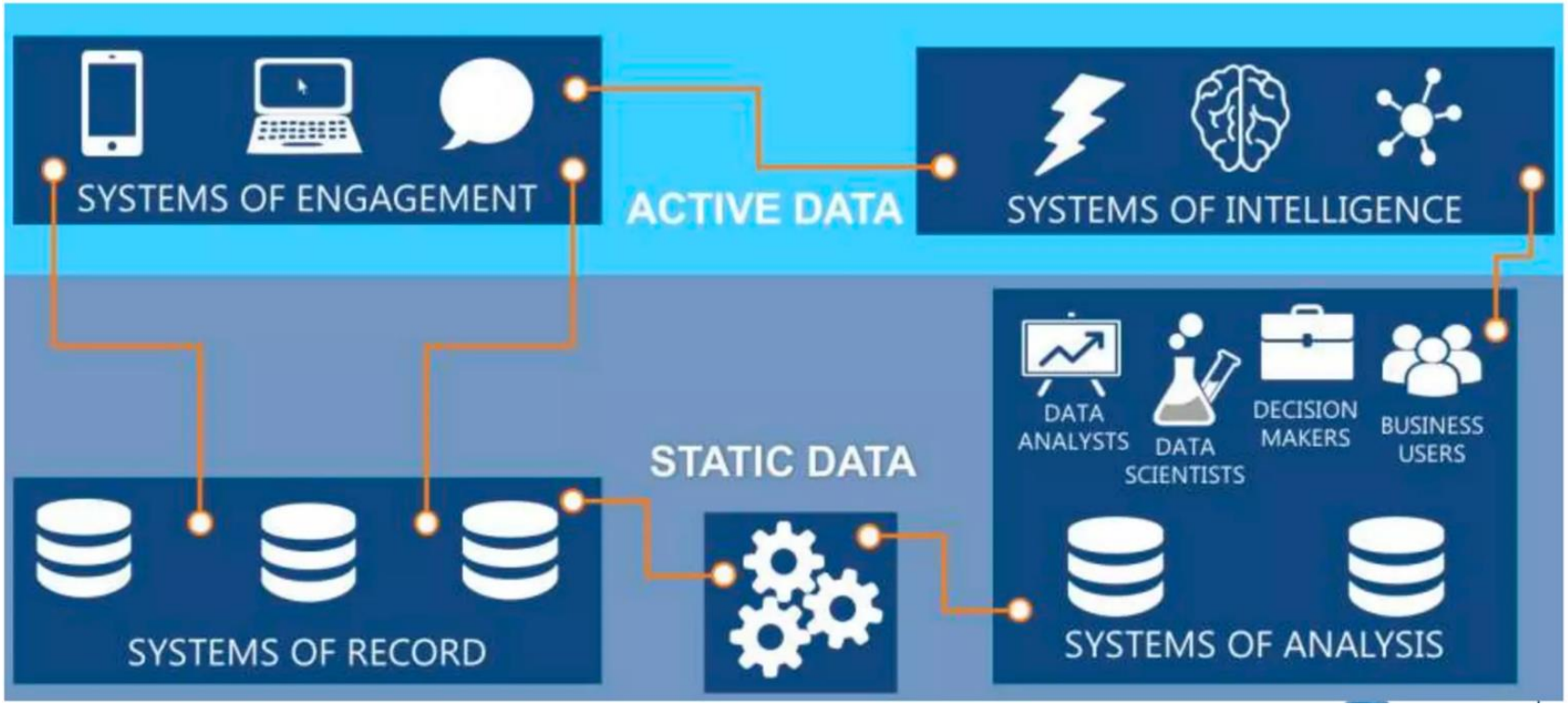
New Systems of Engagement



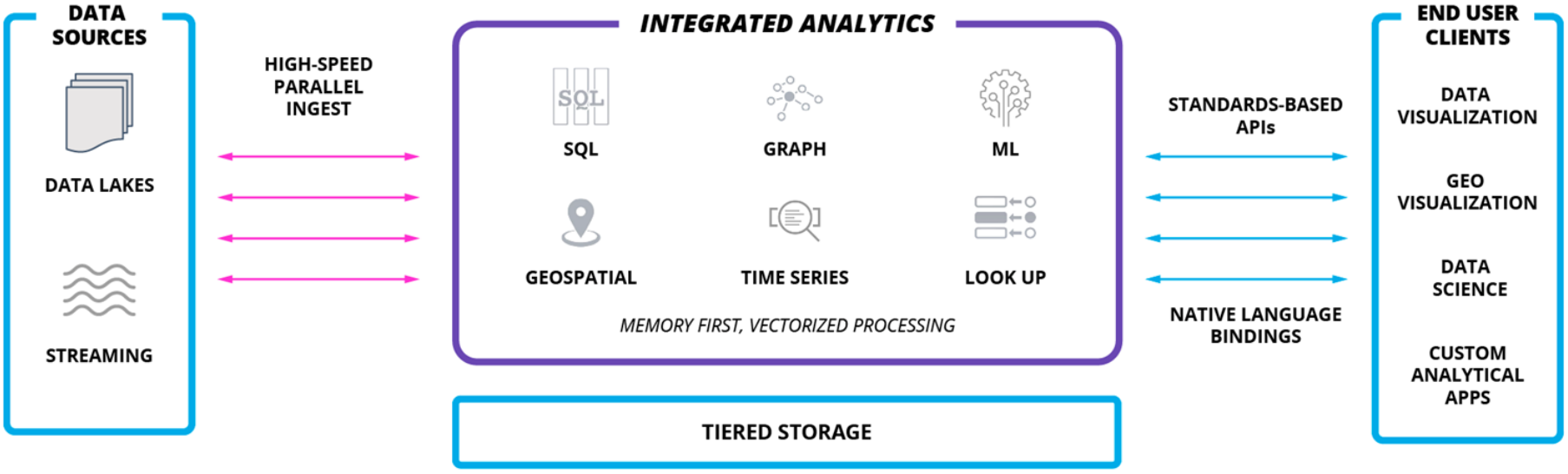
New Systems of Intelligence



New Systems of Intelligence

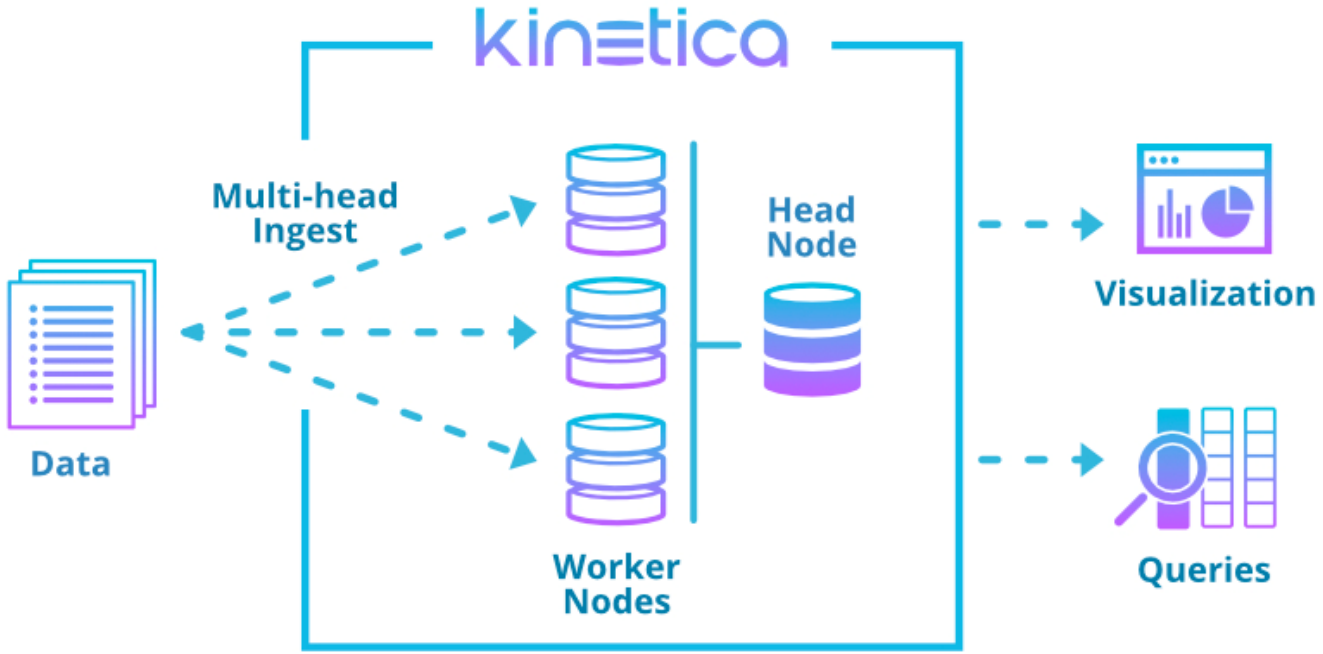


A Real-time Database: Kinetica



Source: https://docs.kinetica.com/7.1/overview/

Kinetica: Distributed Architecture



Source: https://docs.kinetica.com/7.1/overview/

Interact with Kinetica through SQL, APIs and Connectors

Write Queries in SQL

Kinetica has broad support for SQL interaction with a mature suite of SQL functionality. This makes it easy for analysts to be productive quickly.

SQL Query Support »

Use with Popular BI Tools

Connect popular BI tools such as Tableau, Spotfire and PowerBI to Kinetica for real-time analytics using the ODBC/JDBC connector. Or provides streams to systems outside of Kinetica with the Kafka Connector.

REST & Native API's

Data Scientists and Developers can develop sophisticated applications with REST and Native APIs. Language specific APIs are available for C++, C#, Java, Javascript, NodeJS & Python.

API Documentation »

Source: https://www.kinetica.com/features/architecture/

Demo: A Real-time IoT Monitoring System

1. Register on: https://cloud.kinetica.com/
2. Run examples on Workbooks

Source: Demo: a real time IoT monitoring system for cold transit trucks - Kinetica

Project Update

Project update

- Consider how you may extend your app to support IoT functionality:
  - major-specific mark in the project rubric
  - what IoT functionalities can you have?
  - how does your database help?

Tutorial & Workshop

See Canvas.

- Quick Start Guide + SQL GPT | Kinetica Docs