

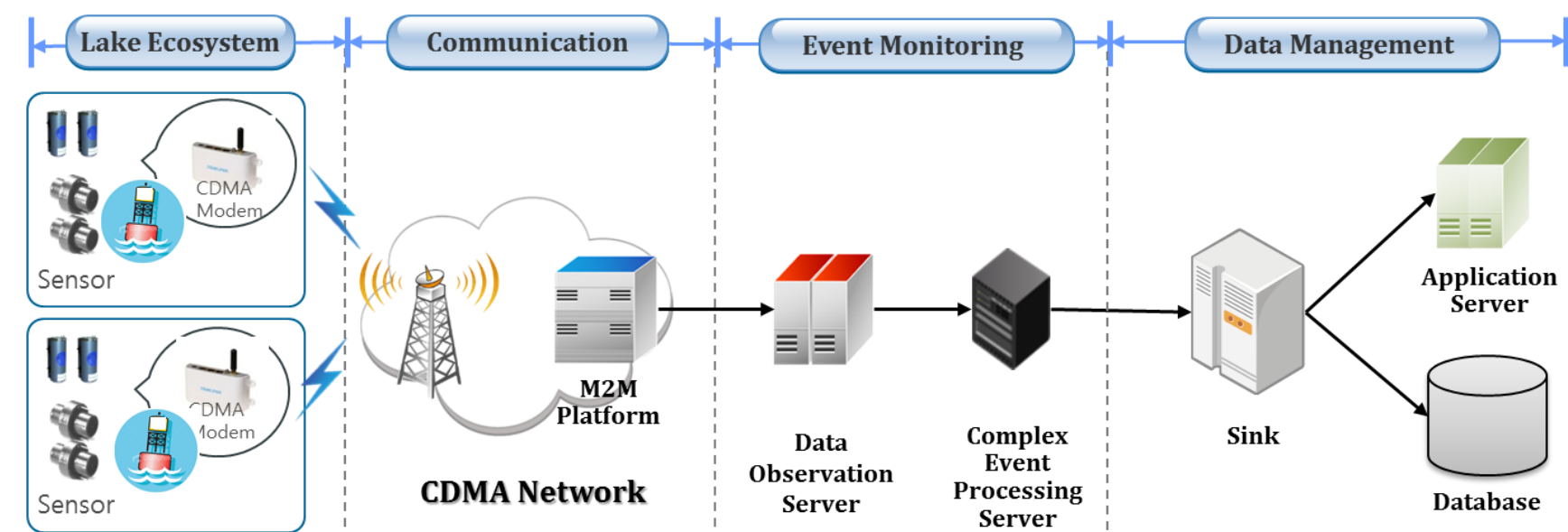
# Real-time Sensor Data Monitoring System

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## Lake Observation System



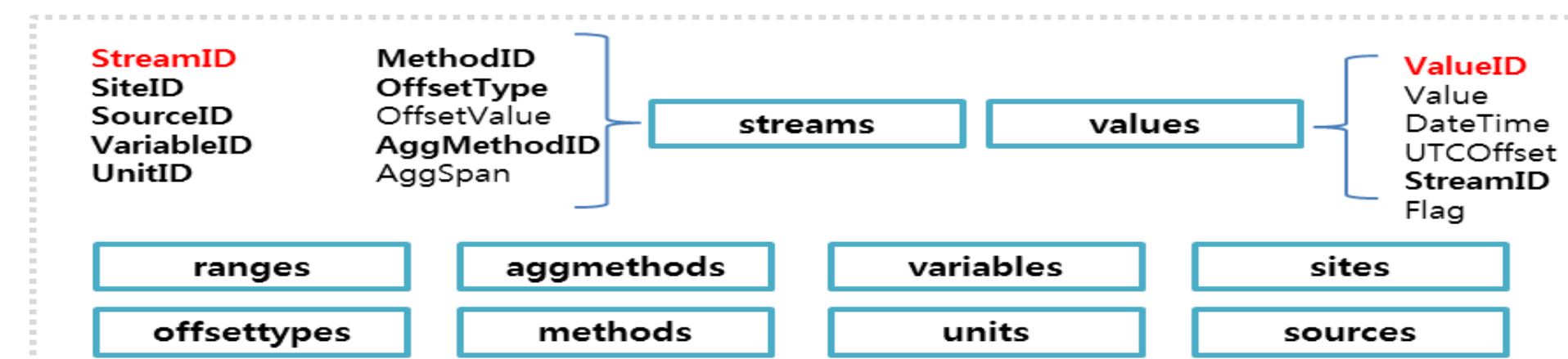
- Data collection - receives data from sensor(Hydrolab MS5).
- Data transfer - send data from lake to lab computer by M2M modem(MPT 800).
- Data processing - process incoming data stream to detect events.



## Observation Data Management

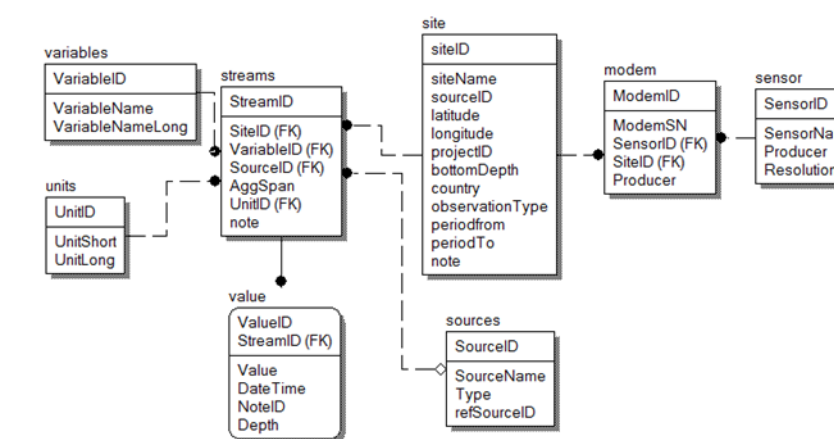
### Environmental Observation Data Model

- The Data Model is based on VEGA Data Model (GLEON, [www.gleon.org](http://www.gleon.org))
- Observation-based data model for high-resolution time series data sampled at frequencies as high as a few seconds



### Challenges for Data Management

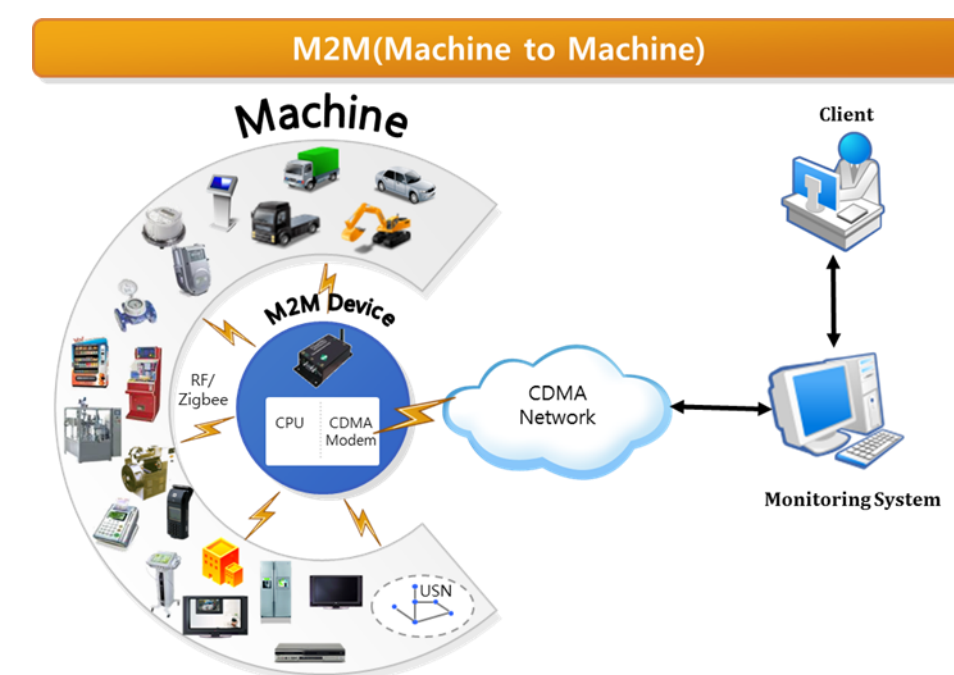
- Integrate large, multi-disciplinary Datasets
- Link Datasets to computational models
- Store increasing data volumes
- Develop tools and application



## Wireless Communication

### SKT M2M Service

- Real-time wireless data transmission solution.
  - Commercial M2M Service
- A particularly effective for remote areas of communications infrastructure as it employs Tele Metering System via CDMA Network



Specifications  
 Maximum CDMA RF Output Power :  $\geq 23\text{dBm}$  CDMA Zero IF  
 CDMA Receiver Sensitivity:  $\leq -104\text{dBm}$  (FET=0.5%)  
 CDMA Power Consumption  
 Receive: about 120mA  
 Transmit: about 350mA @-75dBm RSSI  
 Data Call: about 700mA  
 Nominal Operation Voltage: DC 5V 2A

### M2M Modem

- CDMA stand-alone modem, Suitable for wireless M2M applications
- Capable of communicating through all traditional data services provided by CDMA 2000 1x network

## CEP for Real-time Monitoring

### CEP - Complex Event Processing

- To minimize the time from the event happening to a corrective action or notification being initiated
- Technology for real-time sensor data monitoring
- Applies pattern detection & filtering to the event & streams and their histories
- Focus on high-speed querying of data in streams of events and applying mathematical algorithms to the event data.

#### Event

- Every data observed from sensor
- Event properties capture the useful information

#### Event Stream

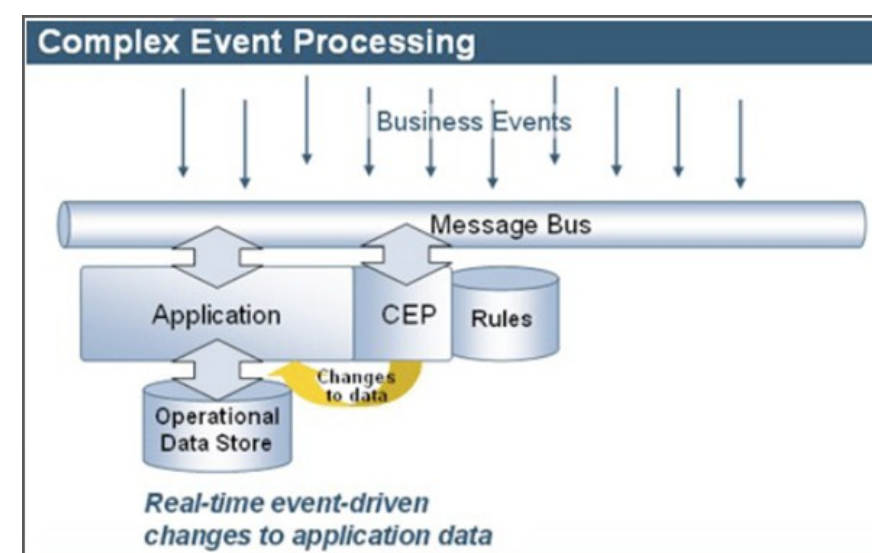
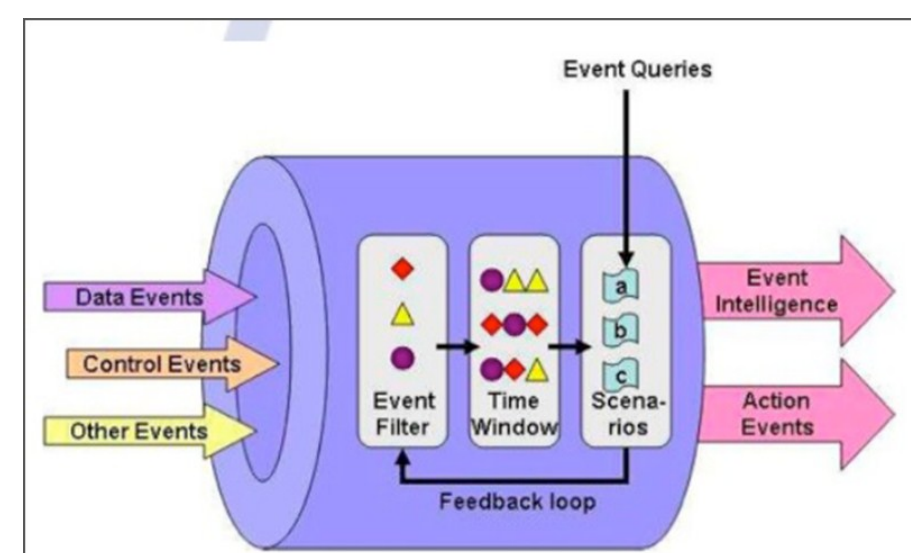
- A sequence of events

#### EPL Statement

- Continuous query on real-time streams

#### Eventlet

- Continually update displays showing the current results of the query



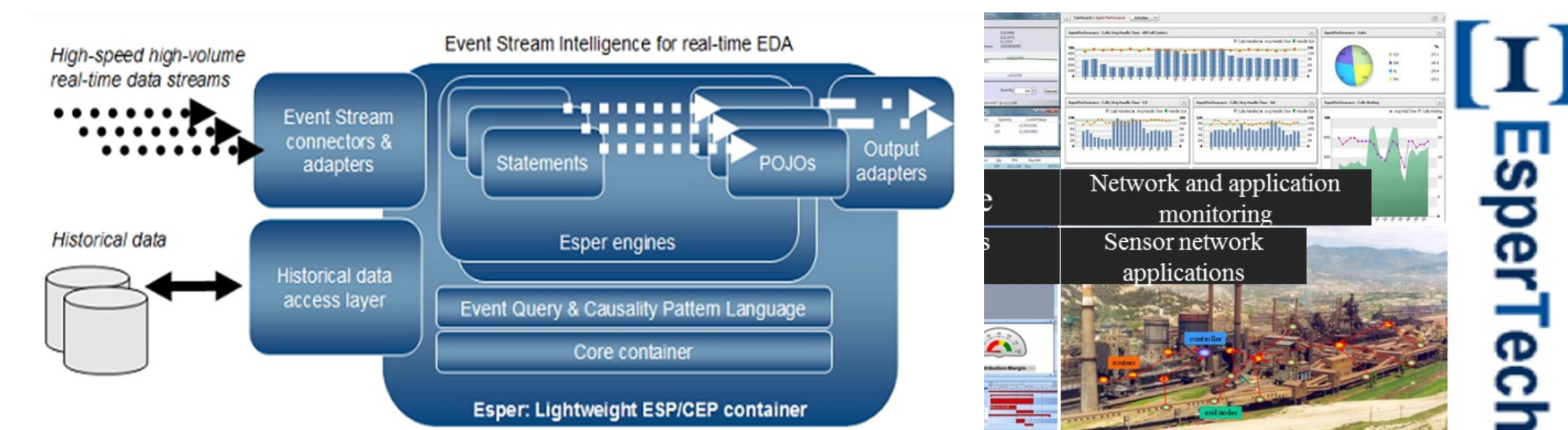
## Esper Engine for CEP

### CEP Engine

- An event processor is an application that performs operations on event objects, including creating, reading, transforming, aggregating, correlating or removing them.

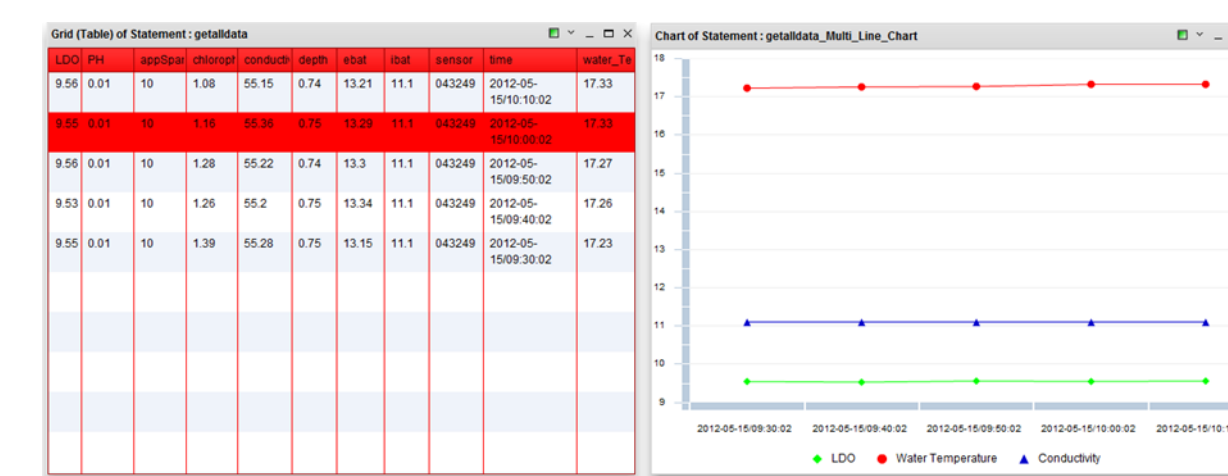
### Esper

- An open-source CEP engine - a set of Java library that can be integrated into multiple systems
- A GPLv2 project with a commercial edition available
- Supports multiple query models
- Based on a SQL-like language
- Grouping, aggregation, sorting, filtering and merging of event streams
- Windows based on time, length, sorted, and others



## Real-time Sensor Data Monitoring

### Monitor Sensor Data



Show all the sensor data  
 Keep 2 Hours sensor data

### Monitor abnormal Event

- Battery issue: if battery voltage is less than 7V, it decrease quickly.
- Event Processing

create schema **Streamibat** as ( sensorID string , ibat double,time string,warning string )

select sensorID, ibat, time, warning from **Streamibat**

