Big Data for Satellite Business Intelligence

GSAW 2015
Loic COULET, Kratos ISE

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Who’s talking?

Loïc COULET
Software Engineer
Kratos ISE

Passionate
10 years

Now Learning
M&C
CSM
Satellite C2

Presenting today
Java
Databases
Web

Computer Science
Big Data
Analytics
NoSQL
Big Data
Business Intelligence

Software
Systems Integration
Kratos Integral Systems Europe (KISE)

Subsidiary of Kratos / Kratos ISI, Toulouse, France
KISE provides Ground stations solutions

Complete Ground Systems Solutions
One-Stop Shop

Satellite Command & Control

Signal & Interference Geolocation

Communications & Carrier Monitoring

Station Monitoring & Control

Network Management

Service Quality Management

Network
Custom facilities & Other facilities

Earth Stations
Modems Antenna Facilities

RF

BBE TT&C Stations

BBE
Why am I talking today?

SBI Press Release caught attention...

September 11, 2014

Kratos Brings Big Data Analysis to Satellite Operations for Es'hailSat

New Satellite Business Intelligence (SBI) Dashboard Correlates Data Across Key Ground Segment Solutions to Enhance Service Level Management

SAN DIEGO, Sept. 11, 2014 (GLOBE NEWSWIRE) -- Kratos Defense & Security Solutions, Inc. (Nasdaq:KTOS), a leading National Security Solutions provider, announced today that its Kratos Integral Systems Europe (Kratos ISE) subsidiary has delivered a powerful new Satellite Business Intelligence (SBI) dashboard to Es'hailSat, the Qatar satellite company. The SBI dashboard will enable the operator to leverage advanced Big Data technology to better manage service levels and optimize satellite operations.

http://ir.kratosdefense.com/releasedetail.cfm?releaseid=870415
Es’hailsat – The Qatar Satellite Company

The Qatar Satellite Company
Why am I talking today?

Kratos Brings Big Data Analysis to Satellite Operations for Es'hailSat

New Satellite Business Intelligence (SBI) Dashboard Correlates Data Across Key Ground Segment Solutions to Enhance Service Level Management
... Using smart keywords...  

**Kratos Brings Big Data Analysis to Satellite Operations for Es’hailSat**

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How Big?
What kind?
What does SBI mean?
How is it presented?
What kind of correlation?
How does it work?
How big is Big?
3 V’s

Volume

Data Size

Data Complexity

Speed of Change

Velocity

Data Sources

Variety
Big Data = 3V’s

Volume

Data Size

STORAGE REQUIREMENTS

Data Complexity

THROUGHPUT

Speed of Change

Data Sources

NUMBER OF METRICS

Velocity

Variety

NUMBER OF METRICS

throughput
Data Source Systems

OUR FLAGSHIP PRODUCTS

Monics CSM
Compass M&C
Epoch IPS Satellite C2
Neuralstar Network Mgmt
Number of metrics

Monics
CSM
Low

Compass
M&C
High

Epoch
Satellite C2
High

Neuralstar
Network Mgmt
High

NUMBER OF METRICS
Storage requirements

- Monics CSM: High
- Compass M&C: Medium
- Epoch Satellite C2: High
- Neuralstar Network Mgmt: High

STORAGE REQUIREMENTS
Big Data problem?

- Store all data for any length of time?
- Correlation between data sources?
- Further analysis to detect unknown information?
- Learning model to anticipate failures?

AND THEN...

Legacy Storage is everything archived?

How efficiently is data stored and used?
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What does “Satellite Business Intelligence” mean?
Satellite Business Intelligence = ?

Business...
Satellite Business Intelligence = ?

+ Intelligence...

- Evaluate
- Analyze
- KPI
- Implement

Business Evaluation
Key Performance Indicator
...For your satellite services
What kind of analysis?
Correlations for services monitoring dashboard

Data Source System

Data Source System

Metrics

KPI

Limit checking Rules

SLA Check Rules

Services Report

+ Business rules

Correlations
1. Generic predictive analysis (in the query engine) is being implemented.

2. Several predictors: linear (exponential Smoothing, holt, least squares), or dynamic with **Dynamic Linear Model (DLM)**.
September 11, 2014

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How is it presented?
How is it presented?

As you like!
A Dashboard

Grafana Time Series Dashboard
Es’hailsat Monitoring Dashboard displays on a Web Browser with real-time information.
The **CMC Monitoring Dashboard** configuration file (**CSV file**) is edited manually by the CMC operator.

Configures:
- KPI Thresholds
- Monitoring Plans
- Monitored Services
CMC Monitoring Dashboard (Views)

The CMC Monitoring Dashboard User can see 2 different tables (one with the KPIs and one with the MARGINs)

Click on the “KPI” button to view the latest Keys Performance Indicators

System A  System B  System C
### CMC Monitoring Dashboard (Margin View)

Click on the **“MARGIN”** button to view the margins.

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<th>DVB Version</th>
<th>MODCOD</th>
<th>Service Status</th>
<th>Time since last status change</th>
<th>IRD - 60 cm</th>
<th>IRD - 3.8 m</th>
<th>Monics</th>
<th>Reset</th>
<th>Noticeable Impact</th>
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CMC Monitoring Dashboard (KPI view – Plots)

Double Click on a KPI to see the real time plot

Carrier: CAR008
KPI:
Source Product: small
CMC Monitoring Dashboard (KPI view – Trend)

Click on the **Trend View** Button to view the historical values of the KPIs
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What kind of Correlations?
Correlations for services monitoring dashboard

- Data Source System
- Data Source System

Metrics → KPI

- Limit checking Rules
- SLA Check Rules

Services Report

+ Business rules

Correlations
Correlate one reference series to many others

**Interactive histogram represents most correlated series**
- The higher the bar, the most correlated the series (first is the reference to itself)
- Green to red colors indicate reliability of the correlation score (based on relative number of samples)

A Single chart is displayed by default presenting the reference data
Visualizing Correlation results

Click on a bar to visualize a correlated series on the bottom of the page.

This shows real data samples...

The first plot always is the reference data

This plot is the second most correlated series

This plot is the fourth most correlated series...
Same query model than in correlations search

*Interactive correlation matrix*

Mouse over a square in the matrix provides information about correlated metrics.
Click shows the two plots.

Change reliability threshold

Do clustering using metric tags
How Big?  
What kind?  
What does SBI mean?  
How is it presented?  
How does it work?  
What kind of correlation?
How does it work?

- Time Series Database (KairosDB)
- NoSQL Database as storage backend (Apache Cassandra)
- Domain expertise and deep integration
How does it work?

- Time Series Database (KairosDB)
- NoSQL Database as storage backend (Apache Cassandra)
- Domain expertise and integration skills
KairosDB is modular

- Real-time KPI & Dashboard Module
- Skyminer Analytics Module
Solution

Carrier Monitoring
Monics

M&C
Compass

Satellite C2
Epoch IPS

NMS
Neuralstar

Data Collector
agent

Data Collector
agent

Data Collector
agent

Data Collector
agent

Data Integration
Frontend

Reporting &
analytics Frontend

Storage

cassandra

KairosDB

Skyminer Web UI

External Analytics
systems

Other Data Sources
Primary Goals

1. Time series monitoring & analytics
2. Fast
3. Flexible & Scalable
4. Fault tolerant
5. Incorporates useful analysis features
6. Open to other systems
7. Cost-controlled
Typical System(s)

Fault-Tolerant Small Cluster

Using Apache Cassandra DB

- Low cost
- Quick start
- Easy administration
- Fault management
- Scale to any size
- Data replication
- Best performances
1. All features are provided as web services (HTTP / REST)
2. Open APIs
3. Interoperable data format based on JSON
4. Intuitive Web UI for starting using the system
5. APIs include:
   - Data acquisition
   - Data querying
   - Analysis features (prediction, correlations)
Query Engine & aggregations

- Ad-hoc queries and statistics calculation
- Business Intelligence features already implemented (aggregate, drill & pivot)
- Data aggregates: Min, Max, Sum, Average, Count, Rate, Std Deviation...etc
- Multi-level Group-by feature using tags, value, or time
- Filter by tags values
Using BIRT reporting tool
September 11, 2014

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Conclusion

- Virtually keep all data forever... Scale to any size!
- Correlation between data sources!
- Automated analysis for new information?
- Learning model to anticipate failures?
Thank You!

lcoulet@integ.com
Any Questions?