Streaming Analytics and the Internet of Things: Transportation and Logistics

FOOD WASTE AND THE IoT

According to the Food and Agriculture Organization of the United Nations, every year about a third of food shipments spoil in transit. By reducing the amount of time trucks sit in slow or stopped traffic, food loss can be greatly reduced.

Most companies addressing the Internet of Things (IoT) focus on producing devices that capture data and push it to the cloud. TIBCO®'s focus is on providing companies with the necessary tools for receiving, processing, analyzing, and acting on that data in real time—to connect the physical and digital worlds and create new services.

Using the Transportation and Logistics industry as an example, this paper presents some of the devices in use, the data being generated from them, and the benefits and services the IoT brings. It lists a few common challenges with handling IoT data and presents TIBCO® technologies and example use cases for the transportation and logistics industry.

FUEL, VEHICLES, PACKAGES, DRIVERS, TRAFFIC, WEATHER, LOCATION, TEMPERATURE . . .

As fuel costs continue to rise, transportation and logistics companies need ways to keep their services available, efficient, and competitive. Trains, planes, and automobiles are being equipped with sensors, but also packages and even drivers are being outfitted with them. Palette sensors are being used to monitor weight, temperature, humidity, and the expiration of products loaded on them, while wearable sensors can monitor driver heart rate, body temperature, and even stress levels. All of these devices play an important role in guaranteeing efficiency in the transport of products around the world.

Using devices such as on-board diagnostics (OBD) readers, or even a tablet or cellphone, vehicle performance and driver behavior can be monitored and optimized in real time. This data can provide the opportunity for pre- and in-route schedule adjustments. And operation centers can monitor traffic and weather in real time, providing drivers with the best possible routes to avoid delays.

By knowing delivery truck locations, and the degree of traffic congestion ahead, companies can provide almost exact delivery times. If a truck breaks down or runs into unexpected weather or traffic, delivery time estimates can be adjusted and relayed to the customer in real time. With accurate delivery times, receiving departments can better schedule staff, which in turn allows trucks to reduce time spent at customer locations and get back on the road to continue moving freight.

CHALLENGES AND ADVANCES

As in other industries, it's possible to take advantage of high volumes of streaming data coming from sensors and other devices found on trucks, planes, trains, shipping containers, palettes, and even drivers. At first, companies tried to put this data into a data warehouse, but that method proved too expensive. Data warehouses are simply not designed to handle high velocity streaming data. Plus, much of this new data is different: It's unstructured.

CHALLENGES

Common impediments to receiving, processing, analyzing, and acting on IoT data in real time:

No Common Language

As the IoT grows, standardization struggles to keep up. Device manufacturers and other businesses are building products that use different transports, protocols, and interfaces. How can all these devices be connected?

No Centralized Data Storage and Processing

Devices don't have the storage capacity or the processing power to maintain context of a single truck over time, much less a fleet of trucks over extended periods.

Multiple Versions of the Same Data

When data is copied to different locations, keeping it in sync across all locations is almost impossible. To provide best value, IoT data needs to be stored and referenced from a single location, providing a single source of the truth that is reliable and always up-to-date.

Knowledge of the Past Only

Many vendors offer analytics of historical data, but few provide real-time data analytics. Without analysis of both historical and real-time data, you can't understand scenarios and take appropriate actions to bring about favorable outcomes.

Inability to Take Immediate Action

When you have the ability to analyze and understand IoT data, real benefits come by automatically triggering actions, whether to initiate a workflow, place an order for fulfillment, or manipulate an actuator in a device. Processes need to be performed quickly, autonomously, and without human intervention and error.

ADVANCES: THE FAST DATA PLATFORM

The TIBCO® Fast Data platform was born from more than 20 years of innovation. It provides one unified solution that:

- Identifies key events using predictive analytics
- Deploys results in real time
- Allows an organization to continuously learn and evolve

In addition to providing an integration platform capable of aggregating all types of data using a huge library of connectors, the Fast Data architecture lets you process streaming data in-motion and make decisions quickly to influence a favorable outcome.

Streaming Analytics

Streaming analytics can automate decisions such as turning up a truck's refrigeration unit as it approaches hotter regions. Once a decision like this has been made, an alert can be transmitted to the refrigeration unit controller at the appropriate time. This architecture creates a kind of IT nervous system that can sense and respond in real time to issues that might only last for a few seconds or minutes.

The Fast Data platform can also provide oversight of automated decisions. Take for example a truck driver attempting to make a left turn at a busy intersection. In some cases, it makes more sense for the driver to make three right turns as opposed to one left turn. Doing so could reduce idle time and allow the driver to continue moving freight. It could also reduce fuel costs, lower driver stress, and provide more accurate delivery-time estimates. With so much happening, including unexpected traffic and weather, you can't delay decisions by waiting for a report that's a day or even 10 minutes old.

To allow human oversight, the TIBCO® Live Datamart uses streaming data to allow non-technical staff to pose questions and receive constant updates to those queries millions or billions of times a day, based on each and every event in the stream. When conditions change, users are immediately updated. Results are constantly live and real-time.

TIBCO Live Datamart provides more than results. Users can act on what they see, so they can override automated action in real time. For example, during peak hours of the day or certain times of the year, a savvy operator can monitor real-time traffic and weather and make adjustments to pre- and in-route schedules. The system can push a real-time message to the driver via their cellphone or tablet to notify them of changes.

Data Analytics

Historical data is also a key component for processing of IoT data. TIBCO Spotfire® helps data scientists look at data at rest and spot important (predictive) patterns. An analysis of delivery history could reveal that specific areas should be avoided during certain times of day. Armed with this information, the data scientist can make predictions on traffic conditions of other similar areas for new delivery routes. When predictive analytics are deployed onto the streaming analytics platform, you have come full circle and turned insight into action.

The TIBCO IoT Reference Architecture
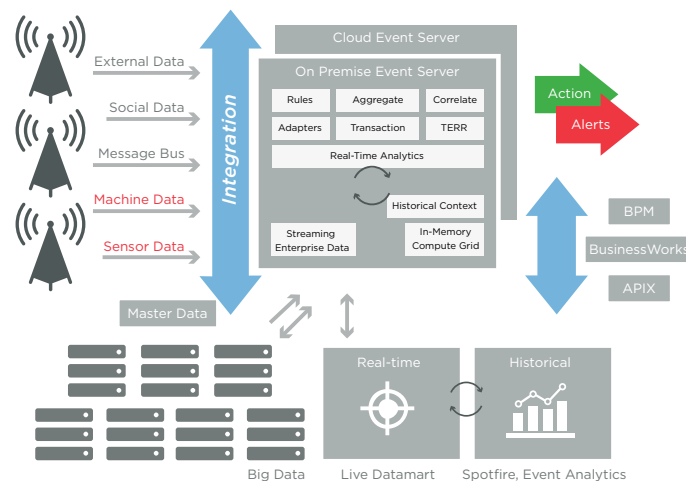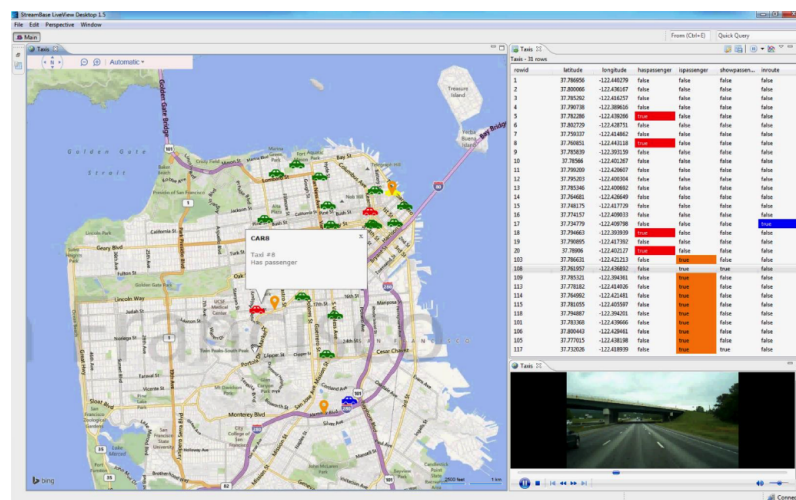
USE CASES AND EXAMPLES

Examples of how TIBCO technologies can be used to extract maximum value from the Transportation and Logistics IoT:

REAL-TIME DIAGNOSTICS

Using an OBD-II adapter, TIBCO StreamBase, and TIBCO Live Datamart, you can monitor vehicles and perform real-time diagnostics without having to take those vehicles off the road. Fuel efficiency (average, minimum, maximum miles per gallon), acceleration (average, minimum, maximum speed), engine load, engine coolant, ambient air temperatures, and other measurements can be monitored. Because this solution uses a cell phone to read the data from a Bluetooth OBD-II adapter and transmit it back to the StreamBase app, GPS can also be obtained from the cellphone and recorded along with the data for future analysis.

FUEL EFFICIENCY

By monitoring real-time vehicle and traffic information, and analyzing historical data, companies can improve fuel efficiency by advising which routes drivers should take, what speeds they should drive at, and how fast they accelerate in specific areas.

Real-time traffic monitoring

PRE- AND IN-ROUTE SCHEDULE UPDATES

Using TIBCO StreamBase®, TIBCO Spotfire, and TIBCO Live Datamart, companies can monitor traffic, weather, and driving behaviors in real-time and adjust routes and schedules based on what is happening in the present moment. By knowing where trucks are and what the road looks like ahead, more accurate delivery estimates can be provided to the end customer.

Route scheduling and adjustments

PREDICTIVE MAINTENANCE SCHEDULING

Unexpected conditions and events, such as pot holes and overheating engines, can be observed from trucks and other equipment and used to predict when they will need maintenance. By scheduling maintenance ahead of time, you can reduce truck downtime and continue moving freight. After all, if you aren't moving freight, you aren't making money.

Predictive maintenance

UTILIZATION OF UNUSED SPACE

Unused floor space can be detrimental to the warehouse owner. The same can be said for unused space in transport vehicles. Sensors placed within planes, trains, and trucks can be used to determine unused space, which can be sold at a discount or used for other purposes.
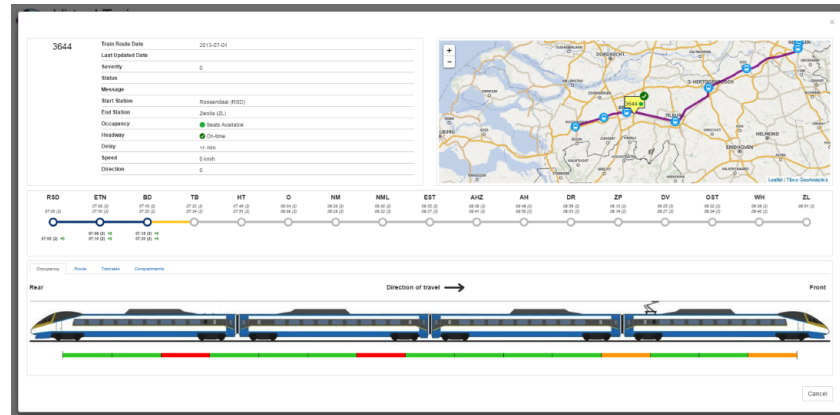
Space utilization

References

On-board Diagnostics: http://en.wikipedia.org/wiki/On-board_diagnostics
Food and Agriculture Organization of the United Nations: http://www.fao.org