Airline Disruption Management

In a world of crowded planes and crowded skies, and where operational problems are quickly magnified by tight systemic constraints, one of the few ways airlines can truly improve the passenger experience and reduce costs is by early detection of problems and prompt, optimal recovery. TIBCO's Airline Disruption Management system makes this possible with state-of-the-art complex event processing (CEP) technology that has been extensively tested in mission-critical scenarios in numerous industries. Integrated with a service-oriented architecture (SOA), TIBCO Airline Disruption Management system can help managers detect disruptions earlier and respond faster to prevent escalations. In fact, several airlines worldwide are already using this innovative approach to deliver quality of service that is truly a defining competitive advantage.

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While airlines are logging record passenger-miles and enjoying record revenue, passenger satisfaction with airline service is at an all-time low. During 2007, several high-profile problems, especially long delays at various airports – both in the terminal and on the tarmac – have attracted the attention of consumer groups and the U.S. Congress. In addition, record lows in on-time flight departures and arrivals has drawn the ire of passengers and caused them to push for greater regulation of the airline industry.

These problems have multiple causes – many of which are systemic – but passengers view the airline as the chief culprit, even in cases of weather delays or air traffic control mandated by airports or government agencies.

One challenge faced by the airlines is how to avoid letting events they cannot control erode schedule integrity, skyrocket operational costs, and ultimately hurt customer loyalty. This issue is particularly problematic because the airlines can control only a few factors in the web of problems to gain a competitive advantage. Moreover, even in these areas, the ability to maneuver can be limited. Regulations largely determine crew availability, airport hours, flying routes, and maintenance constraints. Oil prices are similar for all airlines, weather data and ATC affects them in similar ways. This leaves only a few areas where airlines can improve schedule integrity and customer experience to distinguish themselves from their competitors and maintain the loyalty of long-time customers. One of the areas where airlines can be most responsive is detecting problems early and preventing their escalation and disruption of the schedule.

Maintaining schedule integrity, in particular, is a competitive advantage that resonates with passengers more than many other benefits. In addition to the customer satisfaction component, dealing with unscheduled disruptions is expensive. While most airlines already have existing recovery engines in place, these systems are inherently reactive solutions. They are not designed to anticipate problematic events and respond to them in real time. Moreover, the recovery engines are focused primarily on aircraft or "tail" management; while in many cases, solutions can fall outside aircraft rescheduling or rerouting.

In most cases, a developing problem must still be recognized through point-to-point forwarding across various systems until the recovery engine can respond to it. This approach is currently standard operating procedure, but hardly ideal in a world where most flights are nearly completely booked and airlines have few resources to handle the cascading effects of delays. It also puts the burden on the operator to capture everything relevant that happens and to deal with it.

Complex event processing software can absorb numerous input data streams, process millions of events, and automatically correlate events of interest in the context of known constraints.

What is needed is an integrated system that can automatically process inputs from multiple sources and identify an emerging problem or risks that can affect multiple flights in real time. Software that can absorb numerous input data streams, process millions of events, and automatically correlate events of interest in the context of known constraints is an emerging area of technology known as complex event processing (CEP).

This whitepaper discusses TIBCO's CEP software and how it can be used by airlines to recognize problems before they affect operational and schedule integrity.

Current Situation at Airlines

Most airlines today rely on legacy software systems that are in part custom-developed in-house to provide the response to scheduling and operational anomalies and problems. This software includes planning packages as well as highly complex recovery engines. While these systems work well within their assigned responsibilities, they lack the ability to capture events that happen across all systems and to automate early detection of problems. They also lack the capability to project possible resulting scenarios based on real-time data.

In too many cases, problem detection still requires manual recognition of a burgeoning issue, and the projection of escalating effects remains largely a manual process based on the past experiences of airport staff and operations managers.

CEP software can automate much of this process. The CEP engine can be configured to capture all events across the operations environment. It collects events across the network and filters them for relevancy using business criteria defined by company experts. CEP software also scans incoming data for patterns that it recognizes can lead to events that will eventually trigger alerts. By this means, the software can track and trace events before they become problems. CEP software uses a rules engine to apply constraints and decisioning as defined by business analysts. Situations that exceed certain parameter values are recognized immediately. If enough elements of a problem begin to coalesce, the CEP software can flag the problem, display it in a dashboard, or even respond to it directly. It can do this in part because of its ability to see the full scope of incoming data (as well as the full panoply of constraints) and compare it with historical data. This ability to detect problems and recognize the full range of options makes CEP software an ideal tool to process disruptions in real time and serve as a front end to a recovery engine.

EXAMPLE: UNSCHEDULED FLIGHT DISPLAY UNIT MAINTAINANCE

During a pre-flight check, the system recognizes a fault and signals an alert. The pilot responds to this alert and notifies the operator. The pilot knows the aircraft cannot leave the gate as is, so he informs the dispatcher. Meanwhile, the operator requests a mechanic to diagnose and fix the problem and begins a search for an FDU replacement. The gate person informs the operations manager that the flight will be late. The operations specialist needs to check when the next plane is scheduled for the gate and whether that will cause a gate reassignment. He also needs to check with maintenance for an update on the part's ETA. He needs to find a qualified mechanic with the proper certifications to perform the required tasks. And he needs to check the schedule to see how much slack they have and what effect further delays will have on the flight take-off slot. If the repair takes longer than expected or a different aircraft must be brought in, what tails are available that can take the current passenger load?

Consider the same scenario with CEP software: When the airplane check system recognizes the fault, the CEP software picks up the message, runs it against all rules (constraints), correlates them (FDU defect, status of regular maintenance mechanic), and provides the operations manager with full system knowledge in real time. The pilot and gate manager do not have to call to figure out what the status is, and the operation managers can see the complete picture on their screens, including such information as:

- A working FDU is in stock, and it can be delivered to the aircraft in 15 minutes.
- The regular maintenance mechanic is not available, but a replacement can be on site in 30 minutes based on historical data.
- The next aircraft is scheduled to pull up at the gate in 70 minutes, which leaves enough time for the FDU replacement.
- The FDU replacement for this error code usually takes about 10 minutes, so the flight can stay scheduled for take-off in 55 minutes.
- All can proceed, if the decision is made now to move ahead with the replacement.

In the absence of a CEP system, time would be lost gathering the data via a series of disjointed communications. The solution would have emerged detail by detail, rather than being captured immediately as a whole. The delay in putting together the necessary data might have pushed the repair past the scheduled 55-minute take-off time and the 70-minute window before the next flight arrives and caused repercussions throughout the system. By having real-time information from all involved parts and parties, correlated with relevant historical data, the solution can be optimized – immediately.

Because CEP software uses real-time data and can provide prioritized possibilities quickly, it can be used in circumstances where a decision has to be made fast so as to avoid disruption to the normal flow of operations. In other words, CEP software is a significant aid in maintaining schedule integrity.

TIBCO's Airline Disruption Management system provides an additional benefit: it can capture the decision and its results and use these data points in future scenarios, thereby providing increasingly accurate models based on the airline's previous experience.

TIBCO Complex Event Processing

TIBCO's CEP software is already in use at several airlines, where it serves as the first line of detection for myriad problems, as a solution engine for items that do not fit the recovery engine, and as a front end to the recovery engine. It can detect threshold violations for thousands of simultaneously monitored variables and so respond to events immediately as they occur. The solutions draw from data that comes from crew assignment and tracking systems, hub control, movement control, flight dispatch, pairing maintenance, maintenance control, baggage services, ATC and weather feeds, among others.

Data items and threshold violations are filtered through a high-speed rules engine that attempts to establish the severity of the possible outcomes from a developing situation and identify what steps can be taken to minimize the effects and disruptions. For example, it can detect a flight delay's impact on crew schedules, or what the effect of delays in maintenance will be on flight schedule, and how those changes might be affected by weather patterns. As such, CEP software is a tuned pre-processor for existing recovery systems and has been designed to work efficiently with these engines to deliver optimized solutions quickly. This last point is important: CEP software not only identifies realistic solution scenarios, but it helps staff identify the least disruptive course of action, based on established airline operational criteria.

EXAMPLE: MISSING PASSENGER

One event that frequently causes delays is when a passenger who has checked bags and received a boarding pass fails to show up by the last boarding call. What should be done? Normally, the best course of action would be decided by the gate manager in consultation with others, including the pilot. However, a CEP system can analyze the possible solutions in real time and take into account variables based on real-time data: the length of time before the departure slot is lost, the amount of time required to off-load the baggage based on historical data as well as real-time data from other gates earlier in the day, the effect of waiting longer or removing the luggage in light of emerging weather patterns along the flight route, and the passenger's loyalty-program status. These results can be matched with flight crew constraints, ATC flow control, noise-curfew rules, and additional factors. Rather than having the airline gate managers examine the various factors and sort them into a priority scheme based on previous experience (which depending on the individuals might lead to conflicting solutions), CEP software can factor the various scenarios using real-time data, identify the options with the fewest drawbacks, and help the person in charge make a better decision.

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Benefits of TIBCO's Airline Disruption Management System

The CEP capabilities of TIBCO's Airline Disruption Management approach are particularly well suited to airlines' need to deal with unscheduled disruptions. The software enables better schedule integrity by providing aircraft routing solutions that work well with existing recovery engines. It does this through a rules-based engine that contains all the constraints within which a given airline, flight, aircraft, crew, gate, and airport must operate. Because of this knowledge it is in a position to check all incoming data feeds for violations of constraints, or even the possibility that seemingly normal events might combine to cross a threshold and trigger a situation.

This ongoing multi-variate analysis of high volumes of real-time data means that TIBCO's Airline Disruption Management system is frequently the first line of defense to recognize a problem and to signal the alert. Because it takes into account historical patterns and current constraints of the system – such as the schedule, ATC, and weather data – it can automatically detect events that could cause delays and propose solution scenarios that are realistic and actionable. While all airlines are affected by weather, ATC, and scheduled maintenance in a similar way, it leaves the unscheduled disruptions as the single most important factor to deal with when targeting to improve schedule integrity and improving the rate of on-time flights. This is the chance to gain a competitive advantage, keep costs under control, and really make a difference for the passengers.

CEP software is certainly not limited to this kind of firefighting role. At many installations, it is heavily involved in managing maintenance implications, crews and schedule, optimizing management of assets (gates, crews, aircraft), generating least-cost solutions to day-0 operational issues, and solving day-of-operations issues using a defined global objective instead of a web of disparate local solutions.

EXAMPLE: GIVING PASSENGERS MORE

An airline can use TIBCO's CEP software to prevent disruption on the customer side and to improve service after a problem has been detected. For example, when baggage has been rerouted and is not on the same aircraft as the passenger, the software can send out a text message or e-mail to passengers' mobile phones, alerting them to the situation and providing them with a special identification code and a toll-free number to call at the destination airport to indicate the baggage delivery address. When the passenger leaves the airplane and switches on his phone, he immediately gets the notice, and can then decide to either go to the lost baggage booth or just call the number. By communicating this way, the airline saves the passenger time finding out something the airline already knows. This communicates to the passenger that the airline is aware of the problem, has already taken the necessary steps to remediate it, and values the customer's time and business. As a result, ill-will is educed and passenger loyalty is bolstered.

TIBCO's CEP software uses a model-driven approach to collect, filter, and correlate events and deliver real-time operational insight. It is used in many industries where the immediate detection and resolution of events is a mission-critical function. For example, it is widely used in the financial services industry for fraud detection and for identifying upsell or cross-sell opportunities; in the airlines, railroad, and trucking industries for maintaining schedule integrity and optimization; in complex logistical contexts for operational integrity; and in telecom for capacity management, order fulfillment, and problem mitigation.

Beyond the benefits TIBCO's Airline Disruption Management system delivers to airline operations, it is a good citizen in any airline IT infrastructure. It works with existing software and tools, whether off-the-shelf or custom-developed. It is generally installed and brought incrementally online as an adjunct to the recovery engine and other tools for recovery optimization and schedule integrity. It is not a rip-and-replace solution.

Moreover, the rules used in TIBCO's CEP software can be written, tested, and implemented by airline analysts rather than by software developers. This option means that operations management can create and update constraint parameters and thresholds without having to involve the IT department. This approach also means that new regulations can be implemented quickly and, once brought online, their effect on existing operations can be determined at once. (A sandbox option enables analysts to see these effects without actually changing run-time rules and constraints.)

In a world of crowded planes and crowded skies, and where operational problems are quickly magnified by tight systemic constraints, one of the few ways airlines can truly improve the passenger experience and reduce costs is by early detection of problems and prompt, optimal recovery. TIBCO's Airline Disruption Management system makes this possible with state-of-the-art CEP technology that has been extensively tested in mission-

critical scenarios in numerous industries. Integrated with a service-oriented architecture, TIBCO's Airline Disruption Management system can help managers deal with detecting disruptions earlier and preventing escalations. This is why several airlines worldwide today have started to use this TIBCO solution to deliver quality of service that is truly a defining competitive advantage.

For more information, about TIBCO's Airline Disruption Management system, email vse@tibco.com or call 1-800-420-8450.

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