IoT83 Connect. Automate. Optimize.

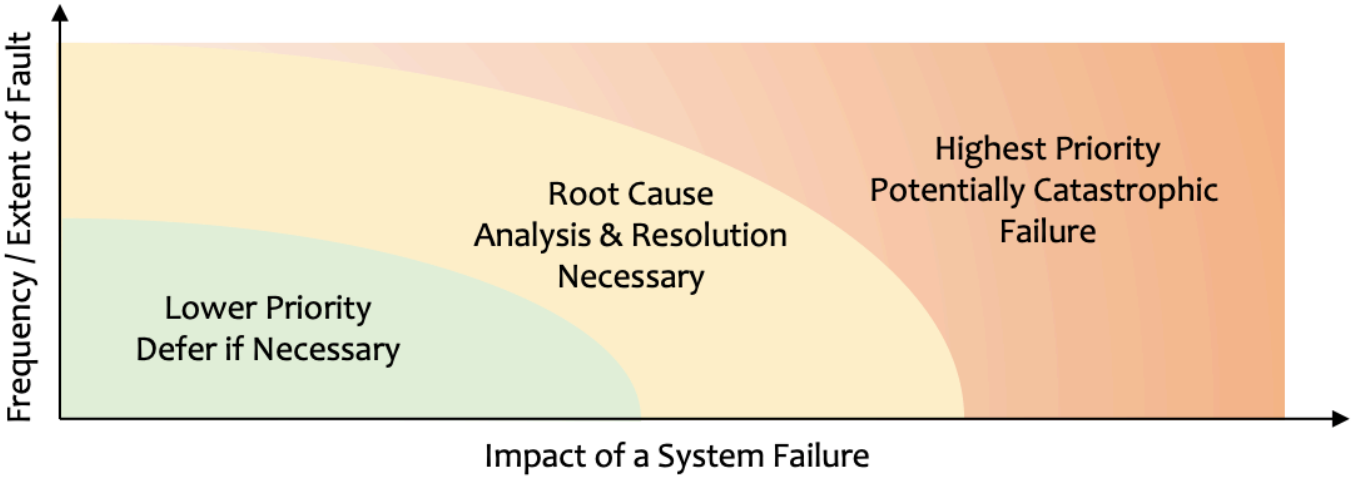
IoT Fault Management, Prioritization, and Resolution

For almost all of our customers' IoT deployments, the first order of business is the basics - Connecting, Visualizing, and Monitoring IoT Devices and Device Data. Our IoT Application Enablement Platform (AEP) makes this stage of the process quite easy to do, and involves:

1. Secure device connectivity of IoT elements to the IoT system.
2. Implementing dashboards to enable effective monitoring & visualization.
3. Creating thresholds to trigger on IoT device "out of bounds" system events.

But from our experience, right after this is done, users & operators are quickly overwhelmed with number of "out of bounds" events – alarms, alerts or outright faults – that are being flagged by the system. If not handled right, this overwhelming influx of events can seem to defeat the purpose of IoT – where IoT systems are intended to reduce work, not to create more! But as the alarm and alert conditions occurring are quite real, this leads to the second critical order of business for IoT deployments – the effective prioritization, processing, and management of alerts, alarms and faults, as well as putting in place fault management automation wherever possible.

The best starting place in this effort is to recognize that not all device alerts, alarms, and faults are equal. Some are critical and require immediate human attention. Some may be important to prioritize, but not urgent. Some are less critical and can be managed more casually or routinely. Some may be handled via IoT automation raising the importance of implementing such automated system tuning. And some, after review and inspection are really not important at all and setpoints can be changed to eliminate them altogether. The following illustrates this:



Regardless, to avoid having one's staff processing overwhelming numbers of alerts, alarms, or faults, implementation of programmatic and algorithmic processes are essential to effectively manage IoT automation and fault management.

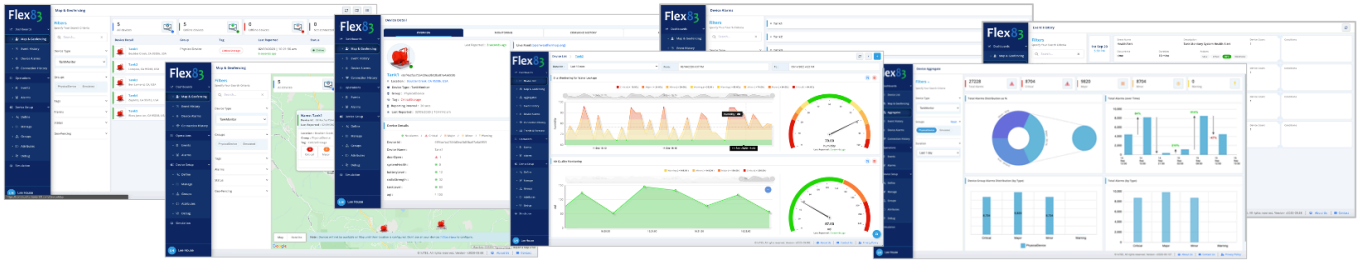
At IoT83 we have as set of guidelines for this that are supported in the Flex83 Alarms & Alerts management Click-Through Features & Workflows we provide. Our modules, processes and

workflows include tracking not only that a fault occurred, but also tracking and analyzing the details of the faults:

- We measure how far above or below the telemetry data set-point for each alarm or alert event to log the "range" or "extent" of the fault condition.
- We measure how long the fault condition lasted as another metric for fault prioritization.
- We also measure how often a given fault occurs as another means of fault prioritization.
- Our tools & workflows also simplify prioritization of a given device, device group, or set of device types because all devices are not assigned to equally critical processes.
- Finally, we allow classification of fault types into groups to allow comparison of fault conditions across devices, device groups, and devices for additional sorting and prioritization.

So, for every device telemetry data being monitored for alarm or fault conditions, a set of meta-data is created that becomes a key element to the effective prioritization, processing, and resolution of alarms, alerts, and faults. And, for every device type, device group, and individual device, we create and analyze meta-data to prioritize, process, and resolve issues associated with that device, device group, or device type. All of this helps users and operators truly understand the potential impact of alerts, alarms and faults and the urgency associated with identifying and resolving root cause.

On a per-device-type, per-device, or per-application basis, users and operators can set a weighting for each of these fault metrics to optimize fault management prioritization and triage. For example, a frequently occurring fault, with a high "out of bounds" reading, a long "duration", and on a critical device has a higher prioritization than other faults. By recording, storing, and analyzing faults by telemetry data attribute, device, device type, group, as well as other custom tags (which can be set using the AEP tools & workflows), fault management becomes exponentially more effective.



With these tools, users and operators can easily view, sort, prioritize, organize and execute intelligent fault management triage and failure avoidance. And, once an issue is prioritized for resolution, Flex83 enables users and operators to drill-down into the data to examine the likely causes of the fault with 1) Multi-axis line graphs showing the relevant time-series telemetry data at the time of the fault, 2) the ability to move from fault to fault to track common causes, 3) the ability to create custom analytics for better insight or fault management, along with multiple other options.

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As a coherent system, the Flex83 fault prioritization, analysis and triage approach dramatically reduces the overwhelming nature of IoT fault management and allows users to triage the most important issues first, and "shelve" the less critical until resources are available to address those issues. In effect users and operators can optimize resolution of the problems that matter most to the limited available operations resources at their disposal.

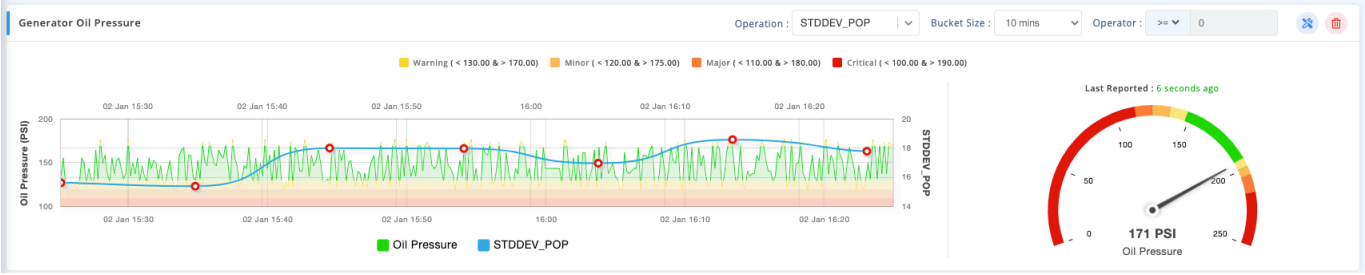
But there is another important fault management, prioritization, and processing concept that many other IoT fault management systems ignore, which is the concept of state-based alarm triggers and prioritization. To understand the importance of state in fault management, consider the following examples:

- First, imagine that you have a plant that requires heating of liquid pipelines. In moderate weather, the efficiency of operations is far less critical than during extreme cold. So here, the "cold state" drives analytical and automation priority.
- Next, imaging that you have a process where multiple sensor readings are physically & logically linked. For example, the current used by a pump is directly proportional to the flow in the pipeline as well as the percent full of an end reservoir. So, when the reservoir is low, backpressure is low, so current should be low and flow should be high. Here the reservoir provides a "state" context for fault management.

There are multiple examples of this that we have seen with our customers, and implementation of state-based fault management automation and analytics need not be overly complex, particularly when using the tools available in our Flex83 Application Enablement Platform to add State as a key element in fault management.

The last essential element of alarm, alert, and fault management implementation is the Automation & Processing of problems, issues and fault events. The Flex83 platform provides existing templates and workflows for this as well as the tools to create custom solutions depending on your needs. For example, Flex83 enables:

- Automated triggering of SMS, emails, logs or reports on defined "Events"
- Triggering automated Remote Procedure Calls (RPCs) to respond to defined "Events"
- Remote equipment emergency shut off or process bypass procedure automation
- Secure APIs and Connectors to interwork with third party systems for ticket management
- Advanced Analytics, and ML tools to build Preventative Maintenance prescriptions



And, with 1) Smart prioritization of alarm & alert management and prioritization, including state-based analytics and fault prioritization, 2) Analytical tools to better understand the causes

of system alarms, alerts and faults, and 3) Intelligent automation of fault handling, implementation of **Preventative Maintenance Intelligence** is the obvious next step and Flex83 provides the workflows to implement this – more unique & custom solution - as well.

In summary, Flex83's Application Enablement Platform modules and workflows greatly simplify how users and operators can transform complex and overwhelming information into streamlined and intelligent processes and automation that has immediate impact to operational efficiency and the business bottom line. Smart IoT implementation protects your industrial assets, streamlines work, increases uptime, and improves worker safety, all with a direct impact on profitability.

Give us a ring at IoT83 and let us get you started with on the next phase of your IoT journey today! Our AEP simplifies continual enhancements to your processes letting you continually compound the benefits of your IoT deployments – all using intuitive and effective tools and processes – or by leveraging our experienced team to jump-start you in achieving your goals.