Beyond leak detection:
The added value of predictive network management

By Shiri Kaufman Weiner

Water loss reduction is often the primary motivation for investing in a central event management (CEM) solution. That's hardly surprising, given that the water and cost savings as well as the efficiency gains from improved detection and management of leak events can be immense.

However, once there is an operational CEM system in place, some utilities continue to focus almost exclusively on responding to events the system detects, such as leaks, pressure, degraded water quality, faulty sensors, and data transmission failures. For example, the system identifies an anomaly that suggests a leak and in short order it is defined as an event to be managed, with the goal of identifying and resolving the root cause of the leak.

> Despite its name, central event management is about far more than managing events; it's also about improving the network and monitoring infrastructure.

As the system detects most of the events early in their evolution, utilities no longer operate in 'fire-fighting' they have the opportunity to fix problems before other indications are available. When that happens, consumers don't experience a degradation in water supply service, and fixing the problem is relatively simple. Still, no matter how good the CEM system and event detection is, there will always be sections of the network that do not function well, making the utility blind to asset failure monitoring and events detection in those areas. Considering these blind-spot sections are typically 10-20% of the network, or even more; ignoring them is tantamount to leaving money on the table.

Predictive network management means taking steps to improve both the performance of your monitoring devices and how your network is represented in your CEM system. Doing so dramatically amplifies the visibility of the utility into what's going on in these sections of the network, and it likewise enhances all the benefits of using CEM in the first place. It can make event detection even faster and more accurate, further increase the efficiency of leak investigations and surveys, and ultimately lead to even greater reductions in wastage, operational costs and customer service.

3 predictive steps to improve your network

From the many optional steps available to improve your network, we focus on ones that are based on the information the CEM system calculates, are relatively simple to perform, and that yield high impact on your physical network and on your ability to pick up on meaningful events. We recommend dedicating time on a regular basis to improving the following three key topics:

1. Identify DMAs that need to be improved
2. Identify sensors that need to be improved
3. Identify missing or incorrectly configured sensors

Whether taking those steps is possible and what they involve will depend on the specific CEM solution. This article describes best practices using the TaKaDu central event management solution.

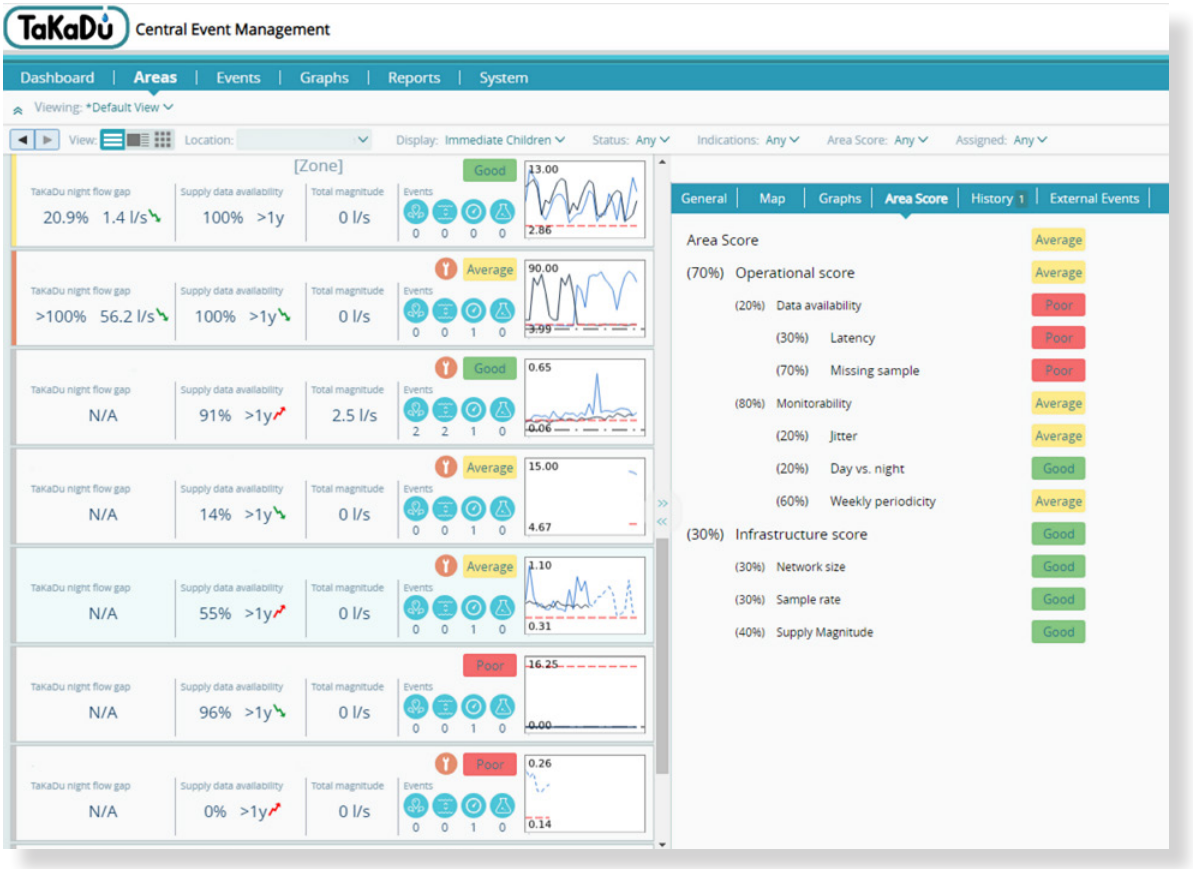
1 IDENTIFY DMAS THAT NEED TO BE IMPROVED

To search for DMAs requiring improvements, you should start by looking at the Area Score, focusing on DMAs with a low or merely average Area Score.

The Area Score is a grade that the TaKaDu system calculates for each DMA. It reflects the ability of the system to detect events accurately and on time. The overall score is a weighted sum of multiple key performance indicators (KPIs). We recommend starting with "Weekly Periodicity" and "Missing Samples", as they are relatively large components of the overall Area Score. The Weekly Periodicity score, expressed as a percentage, measures how much the water supply varies compared with the median of the previous three weeks. Lower variability is a better score, as it enables the historical data to be used to differentiate between normal behavior and abnormal events. The Missing Samples score, expressed as a percentage, is the portion of missing or invalid samples out of the expected number of samples based on the sample rate of each sensor. The smaller the fraction, the better the score, as it provides more insight into the normal behavior of the sensors.

Among the DMAs that have a low or average Area Score, look for those with poor periodicity. These are the first DMAs to investigate in depth, taking the following steps:

01. Review each DMA's water supply graph to identify possible causes, such as jittery sensors, missing or inconsistent data, and mistakes in DMA configuration or sensor configuration.
02. Expand and complement the investigation by looking into external sources of information. For example, you could review SCADA output to verify sensor data is being transmitted and to locate whether the issue is internal to the sensor or is a data processing problem.
03. Implement corrective actions, such as updating DMA or sensor configuration in the CEM system, and create a prioritized maintenance plan for fixing DMAs and sensors. Setting a plan will improve efficiency, ensuring that resources are directed to where fixes will deliver the most benefits.
04. Revisit the targeted DMAs 3-4 weeks after the fixes were implemented to assess if the Area Score has improved, again looking closely at the periodicity KPI.



TaKaDu Area Score view. The left side shows the total area score per DMA*, color coded, where green is a good total Area Score, yellow is average and red is poor. The right side shows the individual components of the Area Score for a single DMA, with the same color coding. The user can scroll through the DMAs to see each one's components. The DMAs to focus on are those that have both a red or yellow total score (on the left) and a red score for periodicity (on the right).

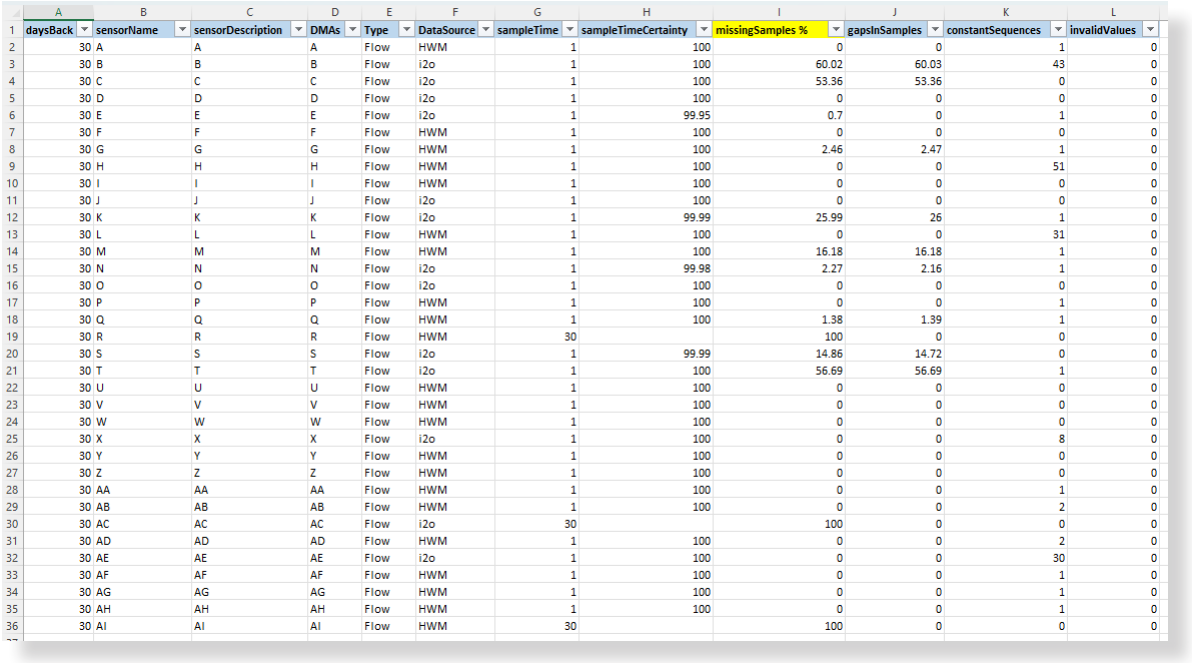
* DMA names are not shown here, to preserve customer privacy.

2 Identify sensors to improve

Reports created by the CEM system can be used to search for sensors that are behaving poorly and may need to be improved, repaired or replaced. As part of standard events management, you are probably already filtering the main events view to show fault and no-data events. But this view doesn't always show all problematic sensors.

For example, sensors that experience repetitive fault events might not show up in the main events view, as the events are constantly opening and closing. If the event is not open at the time you are looking, it will not appear. Using your CEM system, look at the Sensor Quality report to see evidence of such events.

For TaKaDu users, we recommend setting the date range filter to show the past 30 days. The "% Missing Samples" column shows the percentage of samples from that specific sensor that did not arrive. A higher percentage may indicate a problem with that sensor.



	A	B	C	D	E	F	G	H	I	J	K	L
1	daysBack	sensorName	sensorDescription	DMAs	Type	DataSource	sampleTime	sampleTimeCertainty	missingSamples %	gapsInSamples	constantSequences	invalidValues
2	30	A	A	A	Flow	HWM	1	100	0	0	1	0
3	30	B	B	B	Flow	i2o	1	100	60.02	60.03	43	0
4	30	C	C	C	Flow	i2o	1	100	53.36	53.36	0	0
5	30	D	D	D	Flow	i2o	1	100	0	0	0	0
6	30	E	E	E	Flow	i2o	1	99.95	0.7	0	1	0
7	30	F	F	F	Flow	HWM	1	100	0	0	0	0
8	30	G	G	G	Flow	HWM	1	100	2.46	2.47	1	0
9	30	H	H	H	Flow	HWM	1	100	0	0	51	0
10	30	I	I	I	Flow	HWM	1	100	0	0	0	0
11	30	J	J	J	Flow	i2o	1	100	0	0	0	0
12	30	K	K	K	Flow	i2o	1	99.99	25.99	26	1	0
13	30	L	L	L	Flow	HWM	1	100	0	0	31	0
14	30	M	M	M	Flow	HWM	1	100	16.18	16.18	1	0
15	30	N	N	N	Flow	i2o	1	99.98	2.27	2.16	1	0
16	30	O	O	O	Flow	i2o	1	100	0	0	0	0
17	30	P	P	P	Flow	HWM	1	100	0	0	1	0
18	30	Q	Q	Q	Flow	HWM	1	100	1.38	1.39	1	0
19	30	R	R	R	Flow	HWM	30		100	0	0	0
20	30	S	S	S	Flow	i2o	1	99.99	14.86	14.72	0	0
21	30	T	T	T	Flow	i2o	1	100	56.69	56.69	1	0
22	30	U	U	U	Flow	HWM	1	100	0	0	0	0
23	30	V	V	V	Flow	HWM	1	100	0	0	0	0
24	30	W	W	W	Flow	HWM	1	100	0	0	0	0
25	30	X	X	X	Flow	i2o	1	100	0	0	8	0
26	30	Y	Y	Y	Flow	HWM	1	100	0	0	0	0
27	30	Z	Z	Z	Flow	HWM	1	100	0	0	0	0
28	30	AA	AA	AA	Flow	HWM	1	100	0	0	1	0
29	30	AB	AB	AB	Flow	HWM	1	100	0	0	2	0
30	30	AC	AC	AC	Flow	i2o	30		100	0	0	0
31	30	AD	AD	AD	Flow	HWM	1	100	0	0	2	0
32	30	AE	AE	AE	Flow	i2o	1	100	0	0	30	0
33	30	AF	AF	AF	Flow	HWM	1	100	0	0	1	0
34	30	AG	AG	AG	Flow	HWM	1	100	0	0	1	0
35	30	AH	AH	AH	Flow	HWM	1	100	0	0	1	0
36	30	AI	AI	AI	Flow	HWM	30		100	0	0	0

TaKaDu Sensor Quality report. This report shows the rate of missing samples in the past 30 days (column I, highlighted). We can then filter results showing 100% missing samples and proceed with identifying the cause of the lack of data for each sensor.

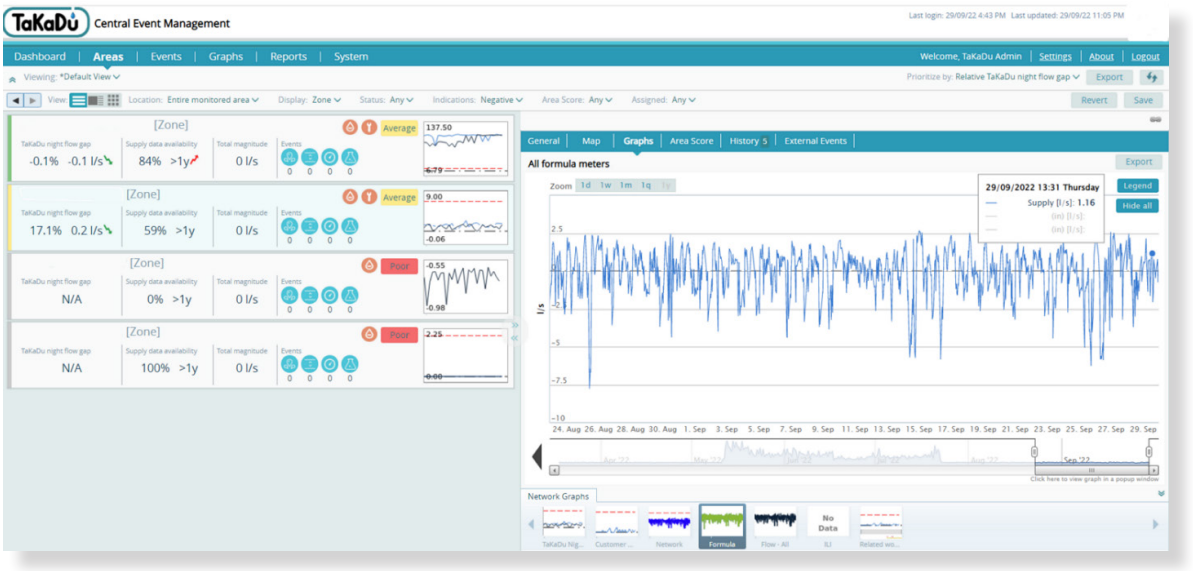
To find the source of the problem, we recommend the following steps:

01. Check to see if the data for the missing samples is in your SCADA (or other input source system), to understand if the problem is with the sensor or with the data transfer from the SCADA to TaKaDu. If the data does not appear in the SCADA, that suggests the sensor is not working correctly and you should schedule maintenance to fix the sensor.
02. Now, check if the sensor itself appears in the SCADA files that are shared with TaKaDu.
03. If the sensor does not appear in the files shared with TaKaDu, check in the network configuration that the sensor identifier (name) is consistent with the identifier in TaKaDu.

3 Identify missing or incorrectly configured sensors

Last, but not least, we recommend looking for DMAs where some of the incoming or outgoing water supply is missing. We do so through negative supply events and by searching for DMAs marked with a negative indicator. By looking at graphs in your CEM system, you should be able to understand the following scenarios relating to negative flow.

01. Is the configuration correct? That is, are all the required incoming and outgoing water supply sensors in the DMA functioning well and are they configured correctly in the CEM system? Frequently, utilities identify they are missing some of the required sensors.
02. Are there any faulty sensors? Any sensors that are sending no data or constant values?
03. Are there bidirectional flow sensors that are not defined correctly in the CEM system?



DMAs filtered for negative supply, as seen in TaKaDu. A list of DMAs filtered by a 'Negative' indication. Having isolated the list of the DMAs with negative supply, we can proceed with reviewing them individually to determine the cause of the negative supply and improve the DMA.

Conclusion

We recommend using your CEM system to review the behavior of DMAs and sensors as outlined above on a routine basis, ideally once or twice each month. By going beyond event management and implementing a regular proactive network management routine, you can ensure your network and system are constantly in optimal health. The result: more water savings, higher operational efficiency, and better customer service.

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