IoE-Driven Smart Street Lighting Project Allows Oslo to Reduce Costs, Save Energy, Provide Better Service

EXECUTIVE SUMMARY

Objectives

- Control lighting and electrical costs
- Become more energy efficient and environmentally friendly

Strategy

- Use mayoral support to generate funding
- Change EU law that did not allow dimming of streetlights

Solution

- Monitor and control lighting levels from any Internet-connected location
- Enable automatic "dimming" of streetlights during dawn and dusk time periods to save costs and energy
- Brighten or dim streetlights based on weather conditions or special needs

Impact

- US $1.3 million in electricity savings annually, which is roughly 20% of the cost to light streets prior to the new capabilities being added
- Reduced maintenance costs and improved lighting service
- New system will pay for itself in less than three years

Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

About the Oslo Smart Street Lighting Project

The Oslo Smart Street Lighting project is an evolving citywide initiative to improve the efficiency of the city's streetlighting system. Oslo connected the city's streetlighting into a single, remotely accessible network that allows monitoring and control of streetlighting levels through Internet-based applications. Future vision for the project includes installing sensors in the lights that will enable automatic lighting control based on weather conditions, street use, and natural light availability.

Oslo's smart streetlighting system incorporates 650 processing stations (cabinets) that connect to 65,000 light points in the city. The cabinets each collect data and allow control of 5 to 30 different lights via hard-wired connections across power lines connected to the lights. The cabinets then connect to central lighting system servers via ruggedized GPRS modems. Through this network, light output is remotely accessed and controlled using Internet-based interfaces.

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Joakim Hjertum,
Head of Section,
Oslo Street Division

Joakim Hjertum serves as head of section for the city of Oslo's Street Division. He is responsible for street maintenance and overall operation of the street system. Mr. Hjertum has been with the Street Division for eight years, and began working there after receiving an undergraduate degree in engineering.

Mr. Siamak Vafa is the chief engineer for Oslo's Street Division.

Objectives

According to Mr. Hjertum, prior to the Smart Street Lighting project, the Street Division paid the electric company to install and maintain streetlighting for the city. This arrangement left the city with little control over lighting levels, and little incentive for the electric company to look for efficiencies. "We were paying a lot of money and we had no control over the things we owned because, over the years, we had paid the loan on the streetlights; we owned the lights, but we had no control over them," Mr. Hjertum said. "A couple of years ago, the city of Oslo took control of the streetlights [from the electric company] and started upgrading the entire system. One of the main issues that we focused on was monitoring our streetlights. We had no control and didn't know how much power they used. We had absolutely no control of our lights at all."

Initially, Oslo's desire to become environmentally friendly also drove the initiative. According to Mr. Hjertum, city research concluded that Oslo used "way too much light. We don't need that kind of light for the road to be safe – especially during some parts of the day when you can have lower light and still have enough. We figured out that you can dim your lights just as you dim them in your house – they don't need them to be fully lighted all the time. That is where we started this project: finding a system that enables us to dim our lights and also have control over how much electricity the lights are using."

Strategy

The project received some funding from the European Union as an environmentally friendly initiative, and the project was championed by Oslo's mayor based on his green agenda. Additional funding came from the annual city budget. The installation costs of the system were between 18 and 20 million Norwegian kroner (US $3 million to $3.3 million).

Oslo backed the Smart Street Lighting project because of the environmental, energy-saving benefits and changes to EU laws, but the cost-saving component was an unseen benefit; electrical bill savings allowed the streetlight system to be updated and better maintained. "We are still using money in the maintenance [of the system] because we want to have a high standard on our streetlights," Mr. Hjertum said. "So the money we have saved on our electrical bill we have used on maintenance and other upgrades in the light system."

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The Oslo Smart Street Lighting project operations and maintenance is administered by the Oslo Street Division, which is overseen by the local city government. The city provides funding through its annual budget. The city of Oslo owns the hardware and infrastructure for the project.

"Our mayor was very fond of this, and he also saw the potential energy savings," Mr. Hjertum explained. "He took this project forward and gave us a lot of money to do this because he saw that in the end, it was Oslo leading the way. He also saw that it was a way to highlight Oslo and make it an environmentally friendly city."

Because this is a municipal project providing a basic service, Mr. Hjertum does not think the whole citizenry is aware of the changes. But, he says those knowledgeable about the project have been happy about it. "I think people are happier because we can now deliver more for our money and we can fine-tune our maintenance. People see that we fix faults faster." Generally, Mr. Hjertum indicated that public engagement has not been a large part of this project, other than to help market the concept of Oslo being a green city.

Solution

The Smart Street Light system, which began in 2011, includes 650 processing stations (cabinets) that monitor more than 65,000 streetlights. The processing stations and lights are controlled remotely by administrators via Internet-based applications. City officials can control lighting levels and the timing of light adjustments via computer workstations, tablets, or even smartphones. The system also provides maintenance data, such as bulb replacement information, to better enable city officials to provide systemwide maintenance and servicing.

According to Mr. Hjertum, the new lighting system has connected city officials to the actual lights in ways that did not exist previously. Now, city officials can view status of individual lights from an Internet-enabled terminal. Previously, city officials had to drive to the specific light location in order to see if a light was on. This has vastly improved the maintenance capabilities of the city because it learns about outages and burnouts much quicker, in real time. "We have saved a lot of money on this

because we are now able to put the maintenance efforts where we need them and be more effective with what we need to do," said Mr. Hjertum. "We know that a bulb has been illuminated for [a length of time] and now know when we need to change it before it goes black .... Now we know exactly and we pay for the exact use and not for theoretical use."

The city uses the dimming feature to save electricity by changing the lighting levels depending on time of day and the amount of natural light. It can also increase or decrease light levels in certain areas based on a particular need, such as incident response or large-scale activity. The previous system was either fully on or fully off, which, according to Mr. Hjertum, resulted in significant energy waste because the lights were turned on at full power during dawn and dusk periods, when lower levels of lighting were sufficient to meet the city's safety and security needs.

"We can override the normal procedure," Mr. Hjertum explained. "If we know that a day will be cloudy, we can turn the lights on earlier and more heavily. So the system is 99 percent working on its own and we are just going in and checking it and making fine, small adjustments when we want to. It's no problem in the system if, on a certain stretch of lights, eight are dimming down but two lights in the road crossings are at max all of the time."

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The system also allows the city to monitor how much electricity it is using for its streetlights, which has helped to cut costs because city officials have more insight into how much energy the system is using and how different conditions and lighting levels achieve the city's lighting goals.

The City of Oslo has a maintenance team that services the lights ias well as the network. In the case of significant network issues, the city brings in suppliers to assist in maintenance and repairs. One important technology issue was the challenge of ensuring that the outdoor cabinets were sufficiently ruggedized to withstand Oslo's climate. Frost and freezing temperatures required that the cabinets be heated. Initially, the heating element on the cabinets started melting surrounding cabling. That problem has since been solved by reconfiguring the cable layout. In addition, the antennae for the system had to be moved outside the cabinet due to too much electrical interference inside.

Mr. Hjertum indicated that the system initially included street-level sensors that changed lighting levels dynamically, based on monitored traffic conditions. It also included other sensors to monitor natural light levels. According to Mr. Hjertum, these sensors had a number of difficulties and faults. Consequently, the project scope was scaled back to simplify the effort and "take smaller steps," although he anticipates that "the next phase of reducing our costs will be to get our lights exactly where we need [them]."

Mr. Hjertum indicated future tech expansion would likely include the ability to control each light individually (versus controlling groups of lights), and the ability for each light to dynamically light according to lighting and weather conditions sensed through a monitoring system. While city officials can do this now via the control features added to the lights, having an automatic system would provide an added benefit. Mr. Hjertum indicated that given the open architecture of the system, installing sensors and implementing such capability is relatively simple.

Figure 1. Oslo: New and Better Connections.

Source: Cisco Consulting Services, 2014

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Impact

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Maintenance of the streetlight system has also become easier and cheaper. A significant aspect of this is the ability of the application to remotely pinpoint malfunctioning or dead streetlights. “We know when the lights are illuminated or when they are not working,” Mr. Hjertum said. “So instead of driving around, looking up in the sky to see where there are black lamps, we can just go to our map and we can get the specific info on each lightbulb point, when it goes black, when it gets fixed; we have a complete history on the lighting system.”

Other less tangible benefits include the ability to vary streetlighting levels during specific periods of high need, such as when an accident occurs. City officials can turn lights up or down in response to various incidents to enable emergency personnel or construction crews to work more effectively.

Lessons Learned / Next Steps

Mr. Hjertum says a key lesson learned was the difficulty of being a pioneer in the field, and dealing with unforeseen issues such as customizing the housing cabinets for optimal usage. “It is tough to be the first to do things and be a pioneer, but it is also fun,” Mr. Hjertum said. “You learn a lot and you get a lot of acknowledgement in different areas and different forums.”

Another lesson has been the ability to take control of the city’s streetlight system autonomously, rather than relying upon the electric company, because, according to Mr. Hjertum, “they want to make the most money and are not very fond of efficient lighting and reducing costs.”

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In the future, Oslo wants to incorporate a counter to measure electrical use in each light point and have the ability to communicate directly with each light point. “After that, we [will] have the controls in the cabinet controlling a lot of lights. We want to put those in each light point and have a direct connection to each light point, and dim those completely dynamically [so that we can] be completely reliable in everything.”

By using these dynamic controls and sensors, the city also wants to utilize the accuracy of lighting depending on weather and traffic. This will also require use of sensors to measure actual natural light in locations around the city at any given time. “What would be really nice is if in the middle of the night when there are no cars, you can dim the lights down,” Mr. Hjertum says. “A sensor picks up a car coming and you can turn the lights up.” This will allow optimal energy efficiency and cost saving for the city within its streetlighting system.

“We are saving money, we are saving electricity, and we are getting more environmentally friendly. You can save big money by doing this, and you get control. Internet is the future and this is the way to do things,” Mr. Hjertum concluded.

More Information

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