ERICSSON

In collaboration with

vodafone

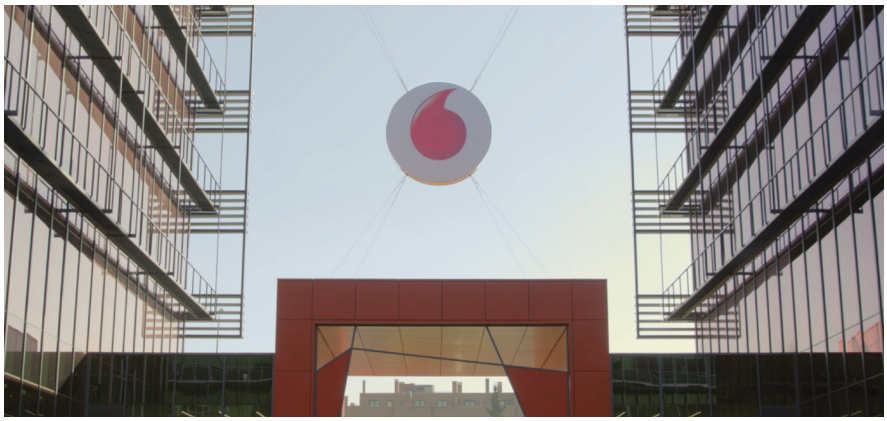
Success story:

Automating MIMO energy management with Machine Learning

March 2019

Saving energy across the network

With increasing network and management complexity, Vodafone partnered with Ericsson to reduce network operating cost using Machine Learning. As the amount of hardware at radio sites increases, advanced automation can help reduce power consumption without sacrificing performance.



Vodafone and Ericsson have collaborated on technical innovation projects for over 10 years

About the customer
Vodafone Group is one of the world's largest telecommunications companies and provides a range of services including voice, messaging, data and fixed communications. Vodafone Group has mobile operations in 25 countries, partners with mobile networks in 44 more, and fixed broadband operations in 18 markets. As of 30 September 2018, Vodafone Group had 531.9 million mobile customers and 20.4 million fixed broadband customers, including all of the customers in Vodafone's joint ventures and associates.

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By the end of 2018, there were close to 6 billion mobile broadband subscriptions active worldwide carrying more than 27 Exabytes (EB) of data per month, and the explosive growth of mobile connectivity shows no signs of stopping – projections chart mobile traffic reaching over 130EB a month by 2024. Customers want to stream and share content with the world, and don't want to wait.

The solution is to increase the capacity of the network by adding more carrier frequencies. This additional hardware can be supplied to existing radio installations, providing a stepping stone in the evolution of 4G networks towards 5G, offering increased capacity, efficiency and speed. However, running more hardware and processes at radio towers to empower more data usage requires more electricity, which comes at a cost.

Saving energy is at the forefront of global consideration, and with 200,000 radio sites across Europe, improving efficiency at each site could make a significant reduction in Vodafone's overall energy consumption.

The challenge
An always-on network consumes lots of energy. Switching masts to Sleep Mode can save energy for towers channelling less traffic, but needs hard-coded rules and, at times, manual intervention.

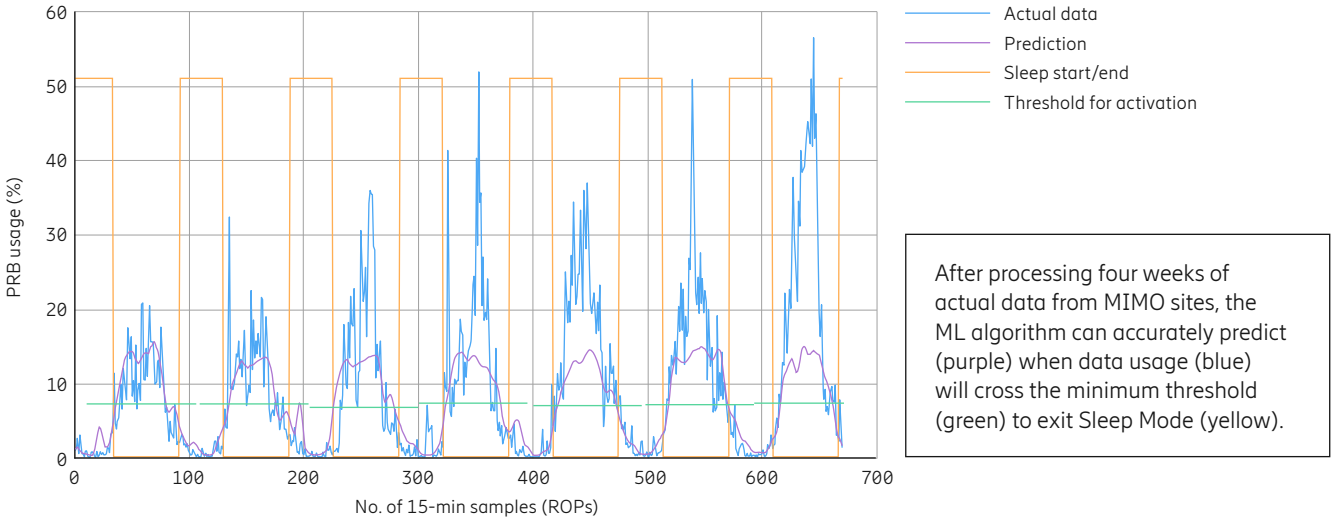
The solution
A Machine Learning (ML) algorithm was trained on site-specific data to learn the patterns of local activity, high traffic times across any given day, and the thresholds at which Sleep Mode should be activated or exited without negatively impacting user experience, all on site and without human intervention.

The result
ML Sleep Mode management delivered 14 percent savings in energy consumption at each site, outperforming manual management, without any impact on consumer KPIs.

"The opportunity for Machine Learning in this case is you can identify patterns. It's a fantastic way to learn from your experience, as when we are children. They will learn from specific cases, and they will be able to identify patterns when they are in a new situation."

Francisco (Paco) Martin,
Vodafone Group Head of Radio Products

Machine Learning prediction vs. actual traffic



After processing four weeks of actual data from MIMO sites, the ML algorithm can accurately predict (purple) when data usage (blue) will cross the minimum threshold (green) to exit Sleep Mode (yellow).

Optimization through automation

This push to improve efficiency and reduce waste comes at a time of greater customer insight, from an ever-increasing pool of consumer data available in the network about who is using how much data, where. When the activity at a cell site falls below a certain threshold, the Multiple Input Multiple Output (MIMO) Sleep Mode feature can be used to conserve energy by deactivating one or more of the transmitter branches used to send user data, and then reactivated when traffic surges once more.

The key to implementation of such a schedule is knowing when to power which unit: misallocated power could either be wasted energy, or lead to phone services not meeting the required performance for customers.

The challenge is managing this process from the service provider side, with thousands of sites reflecting a shifting population of millions of consumers, 24 hours a day.

The answer instead lies with an automated operative, powered by ML algorithms.

"We used to control the network in a very reactive way. Based on this new technology and the information that we get from the network, we can do this parameterization to be more efficient and more proactive."

Elisiario Cunha,
CTO of Networks in Vodafone GCU, Ericsson

"I think one of the benefits of Artificial Intelligence is scalability. The system works, and it does so autonomously – nothing stops you from having this type of solution applied to the more than 200,000 sites that we have worldwide."

Francisco (Paco) Martin,
Vodafone Group Head of Radio Products

ML is a branch of programming that channels Artificial Intelligence (AI) into a set of parameters, and builds a body of behaviors based on a set of example data. The algorithm learns much like people do, by identifying patterns in data and the expected response to different prompts, and predicting future patterns.

The activation threshold of the algorithm maps to mobile data traffic at individual cell sites. This varies from unit to unit, and is a key strength of ML – flexible and scalable implementation, and an algorithm that adapts to wherever it's deployed. Done correctly, the algorithm could be applied to the power management of any tower, learn that unit's individual traffic patterns, and step in to automate Sleep Mode engagement without any human involvement.

Proactive networks

That was put to the test in a sample batch of six radio sites using MIMO technology in Portugal. The ML algorithm was "trained" on four weeks of traffic data at each site, which were situated in a mix of rural and urban locations. After feeding the algorithm data to identify traffic patterns at each site, power allocations were tracked for how closely the ML tracked to real-life demand. The experiment featured three arms – the ML on an "aggressive" power saving setting, the ML at a "conservative" setting, and an arm of manually controlled, human-determined Sleep Mode activation. Energy consumption was tracked alongside key customer performance indicators, to ensure that energy reduction didn't come at the cost of end-user performance.

The results were conclusive, with energy savings of an average 14 percent at radio units using the aggressive ML setting across the 6 selected test sites, which was able to accurately predict when usage would peak and decline, and how to optimize energy allocation for units entering Sleep Mode. All of this energy saving came at no impact to the customer, with latency and bandwidth allocation both staying well within acceptable boundaries.

The unique tailoring of energy efficiency at each site means that proactive energy saving behaviors could be introduced across the Vodafone network, and that 14 percent energy saving scaled up to the global level could make for a significant saving in cost and environmental impact.

"Ericsson and Vodafone are both innovators, we both want to be at the forefront of technology. We both want to bring communication and customer experience, so, by bringing those two forces together, we can really come out with good products and solutions for the end customer."

Camilla Vautier,
Head of Vodafone GCU, Ericsson

Providing fast connections for customers while using less power at radio sites is one of many ways Vodafone and Ericsson are working together to improve customer service

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business, and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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