THE EFFECT OF SMART ENERGY SOLUTION'S OPERATION ON BTS AIR COOLING POWER CONSUMPTION CASE STUDY

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INTRODUCTION AND SCOPE

Over the last several years, with the introduction of smartphones and unlimited data plans, mobile operators have seen the cost of maintaining network operations skyrocket, while simultaneously were forced to offer lower prices in order maintain a robust customer base. To remain profitable, operators have had to severely reduce expenses, a near impossibility given the necessity to add costly hardware and components, as well as increase operational expenses (OPEX), to properly maintain data-heavy networks.

One of the most costly expenses faced by operators is the energy consumption of their networks, accounting for 10-30% of total operational costs. The Radio Access Network (RAN) and primarily the base stations, accounts for nearly 90% of total energy consumption across the network and this is expected to grow by 60% by 2020.

eVolution Networks' Smart Energy Solution (SES) empowers mobile operators to advance to an adaptive network resources management world and reduce the RAN power consumption by 35%. With SES, mobile operators can manage their network resources dynamically based on the actual traffic load the network is experiencing, powering only the required base stations and paying only for what is effectively in use.

Another significant energy savings potential exists in the air conditioning of the base stations for operators who are using SES. Since SES reduces the energy consumption of the base station, by powering off unused capacity, it lowers the amount of heat that these base stations emit. This opens a window for operators to reduce the usage of the air conditioning system which cools the base station. Together with SES, the air conditioning energy savings can be significantly increased.

At the end of 2014, eVolution Networks examined the effects of SES' operation on the power consumption of the air conditioning system of a base station in a live European mobile network. The measurements were taken at a duration of two weeks and compared the air-conditioner's power consumption with and without SES operating.

This document provides an in-depth review of the measurements and field results which were observed by eVolution Networks.

COOLING SYSTEMS IN MOBILE NETWORKS

The Radio Access Network (RAN) which is comprised out of base stations which manage the traffic in the mobile network. The base station includes radio units; the elements in the network which are responsible for transmitting and receiving traffic (voice and data). In the process of this operation, the radio units emit heat into the environment, which may result in the radio units and additional equipment over-heating and stopping their operation. In order to avoid this problem, operators install a cooling system, such as fans and air-conditioning systems, next to the radio units to cool them down.

The situation varies between In-door sites and Out-door sites. In-Door sites are especially susceptible to heat, since the radio unit emits heat into the compartment in which it resides. This heat accumulates, without being able to be released at a sufficient rate. One of the equipment elements which is specifically heat sensitive is the Battery. The battery is used to back-up the power supply to the site, in case the regular power supply becomes unavailable.

The cooling system plays a key role in this aspect and is forced to operate at high capacity in order to keep the room at the required temperature. The power consumption of the cooling system becomes a major additional cost for operators, as it unusually doubles the amount of power that is required in order to operate the site.

Operators invest time and effort to minimize the power consumption of the cooling system, including dedicated projects at high costs. eVolution Network's *Smart Energy Solution* plays a significant role in reducing the power consumption of the cooling system by reducing the amount of heat that is being emitted into the room to begin with.

THE EFFECTS OF SES ON AN AIR CONDITIONING SYSTEM

Background

eVolution Networks' *Smart Energy Solution (SES)* is a self-learning engine that uses data mining analytics and artificial intelligence to manage the traffic load of the mobile network in accordance with the network's resources. SES aims to maximize the energy savings of the base station without impacting Quality of Service.

During the fall of 2014, for the duration of two weeks, eVolution Networks examined the effects of its Smart Energy Solution on the power consumption of the air conditioning system in an Eastern European mobile network, which services 4M subscribers and operates various equipment types:
2G equipment (60%), 3G (30%) and 4G (10%).

eVolution Networks selected a typical base station, with a room size of ~8 sq. feet. The equipment type that was operating in the selected room Ericsson RBS 6000, with a new highly efficient air conditioning system.

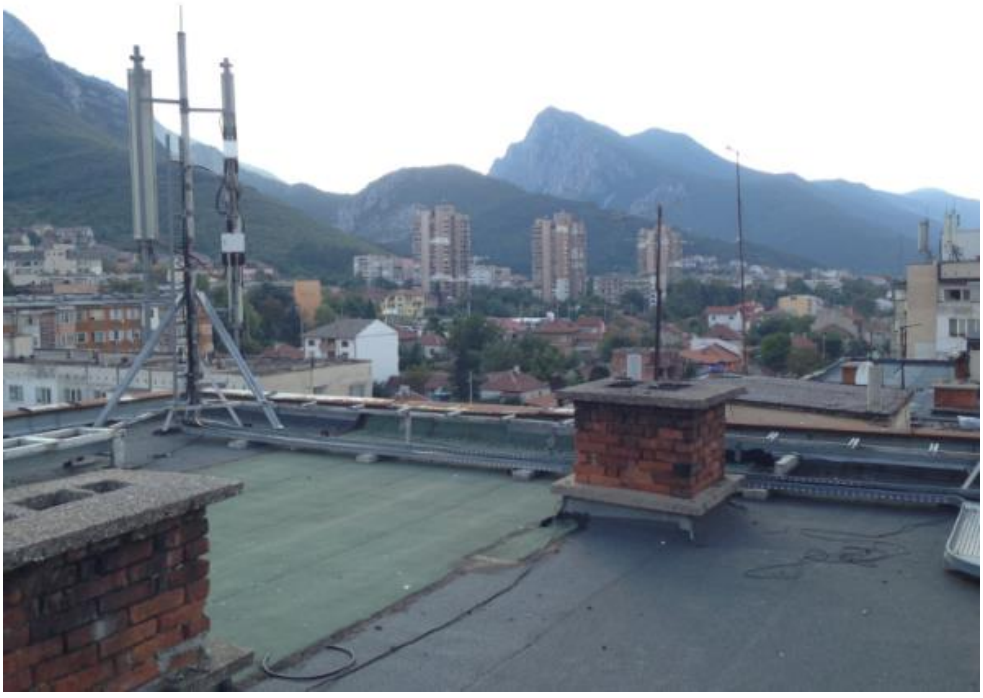


Figure 1: eVolution Networks selected a typical base station for the network and examined the influence of SES on the air-conditioner

The air conditioner's room temperature was set to 23°C - 25°C. In order to measure the temperature in the room eVolution Networks placed three temperature sensors in three the different locations: at the cabinet cooling fan, the battery pack and on the room wall.

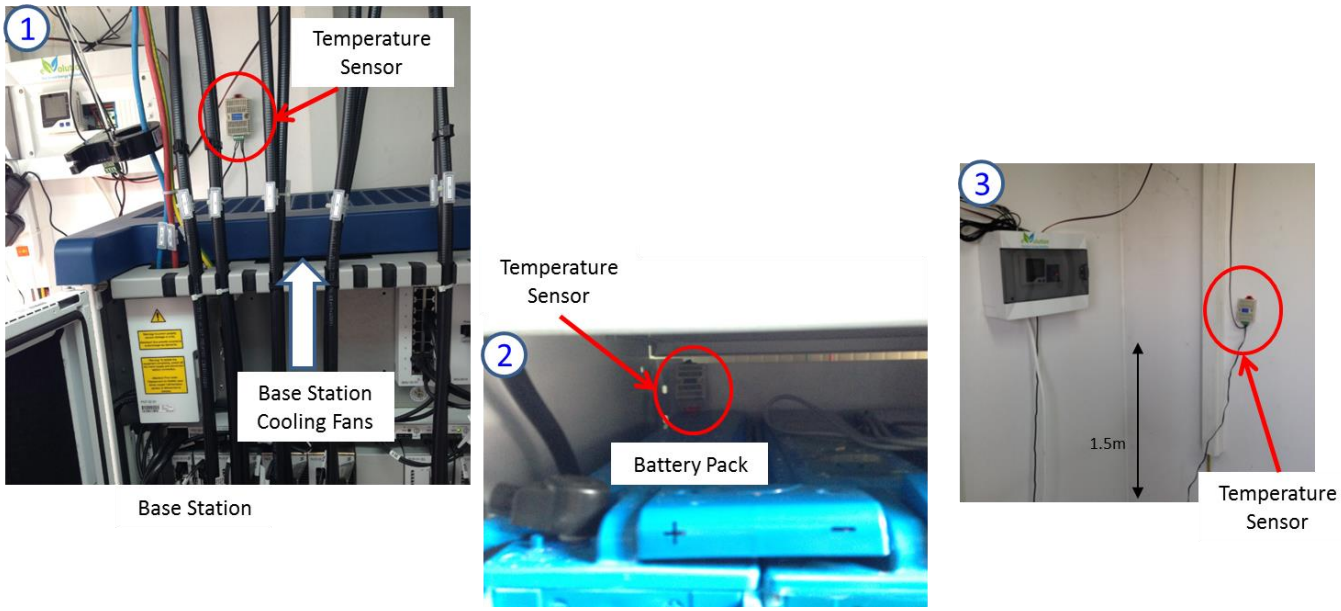


Figure 2: Three temperature sensors were placed in the room to measure the temperature in different locations in the room

eVolution Networks recorded the temperature of the cabinet cooling fan and the battery pack over a 24 hour periods, without SES operation, and created a baseline to compare the effect of SES to. Once the base line was created, eVolution Networks started powering off the base station at night and measured the room temperature and the Air Conditioner's power consumption.

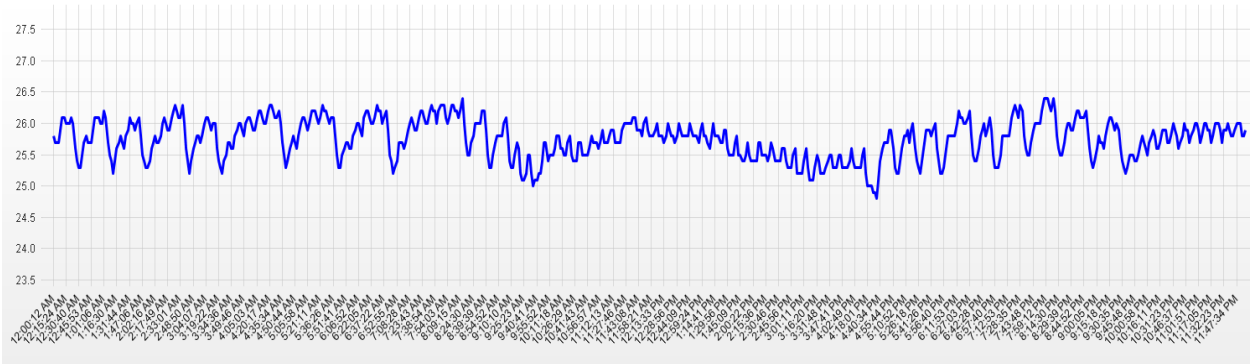


Figure 3: Cabinet's cooling fan temperatures over a 24 hours period of a typical day, without SES

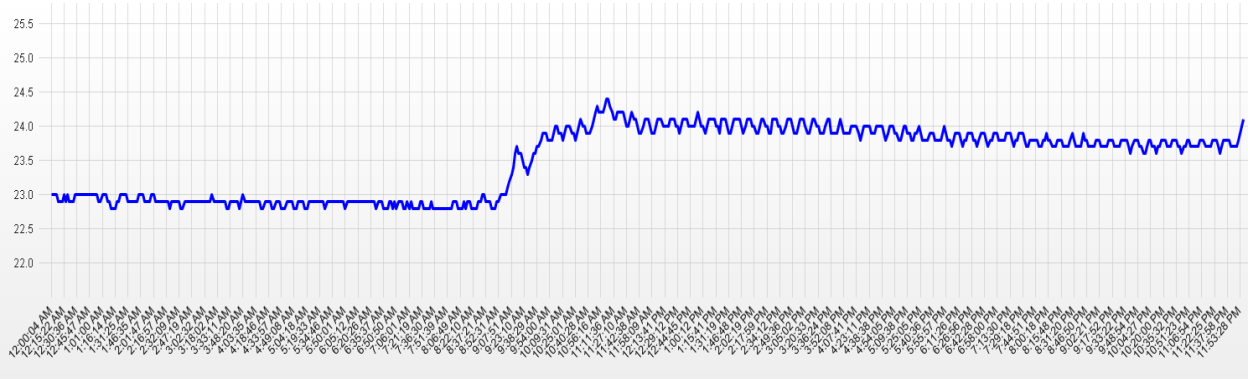


Figure 4: The battery pack temperatures over a 24 hours period of a typical day, without SES

Results

Once SES started powering off the base station overnight eVolution Networks has seen a reduction of 3°C in the room temperature compared to the measurements observed when SES was not operational.

The air conditioner power consumption has been reduced in accordance with the reduction in the temperature, from an average of 3,000 Wh per hour to 2500 Wh per hour, a 16% reduction in the hourly average air condition's power consumption. The total AC power savings during the 24 hour period amounted to 3.6 KWh, thus more than doubling the energy savings achieved by SES. Together with the RAN energy savings this has amounted to a total of 6.1 KWh for the entire base station.

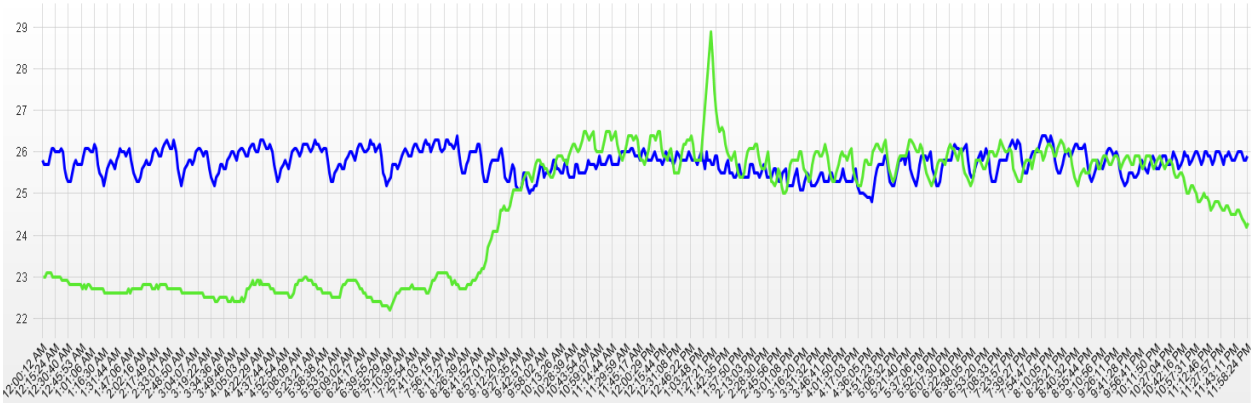


Figure 5: The measured cabinet's cooling fan temperatures,

with SES — without SES

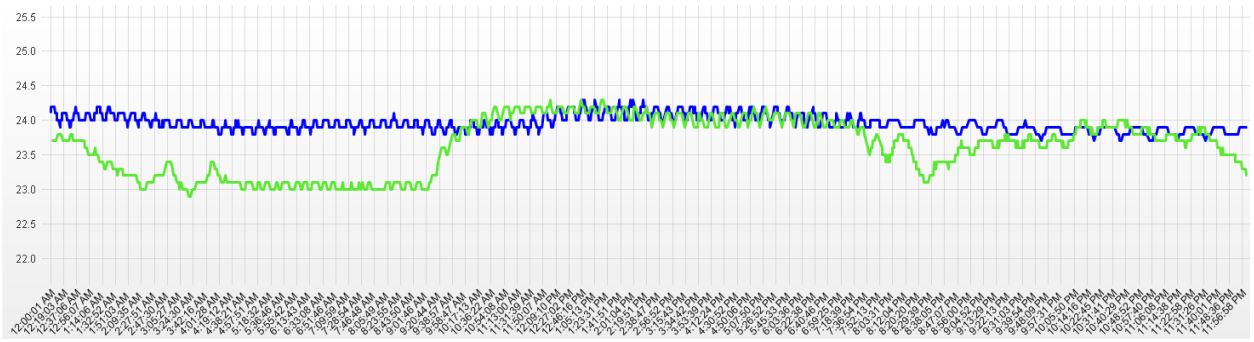


Figure 6: The measured battery pack temperature

with SES without SES

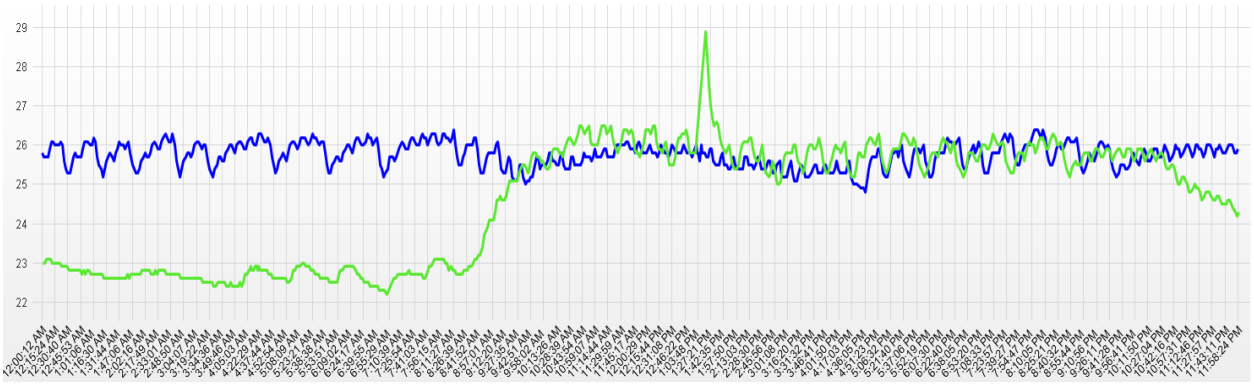


Figure 5: The room temperature decreased by 3°C on average

with SES without SES

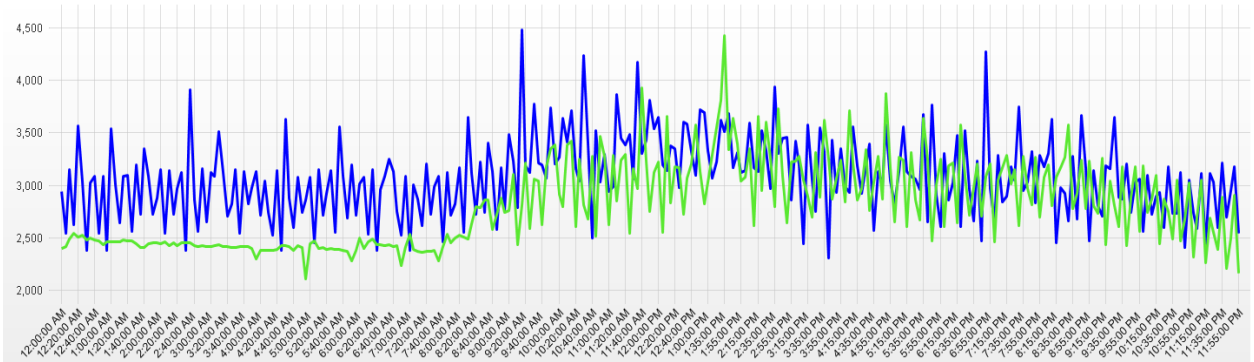
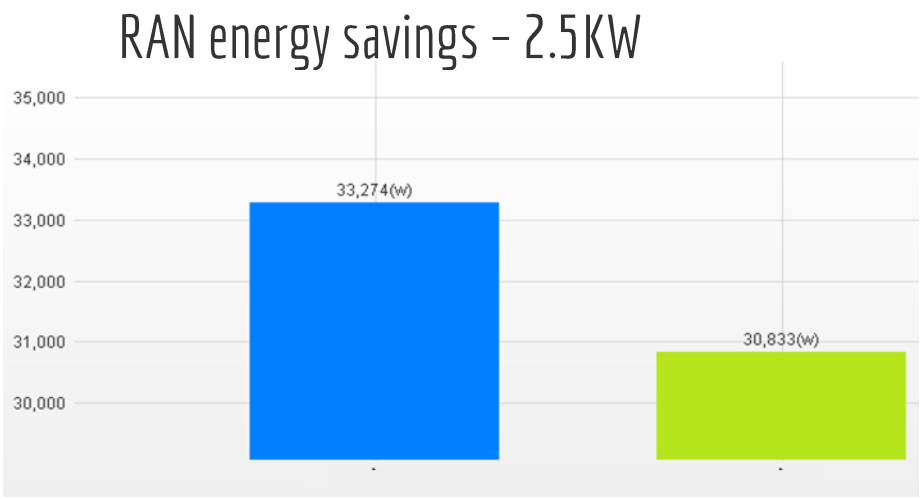


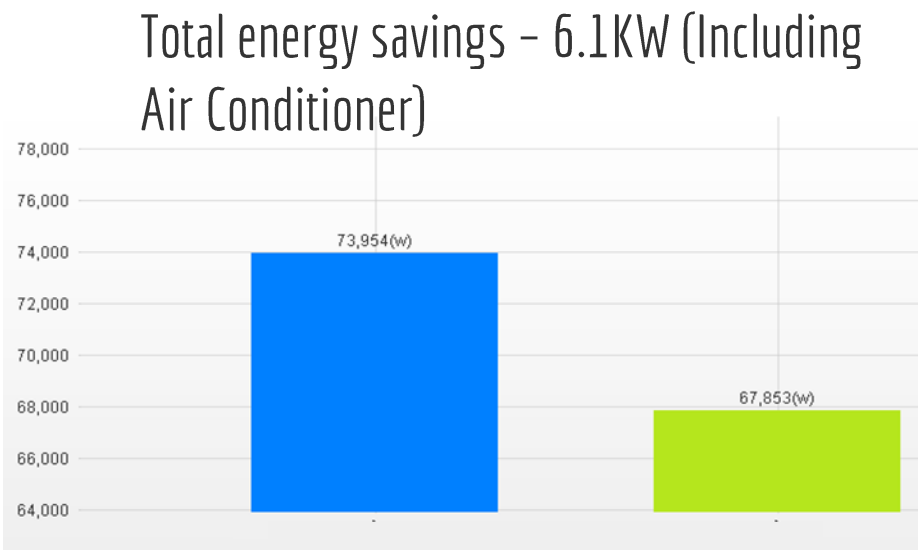
Figure 6: The average power consumption of the AC reduced by 16%

with SES without SES

Results Summary Table

	Without SES	With SES
Average Room Temperature	26°C	23°C
Average AC Power Consumption	3,000 Wh	2,500 Wh
AC Energy Savings	-	3.6 KWh (AC only)
Total Energy Savings	-	6.1 KWh (RAN + AC)





Conclusions

These observations have shown three key facts:

1. Powering off base stations reduces the temperature ejected by RAN elements into the room.
2. Reducing the amount of capacity in base station causes a significant reduction in energy used by air conditioner
3. The air conditioning system is a significant factor in the RAN energy consumption. In certain cases, as seen here, the power savings of the AC can top the power savings of the base station itself. Mobile operators deploying SES will also benefit from a reduction in the power consumption of the AC out of the box.

SUMMARY

The operation of the base station generates a significant amount of heat. In In-Door sites, the heat accumulates, forcing operators to deploy air cooling systems. The air cooling system accounts for a significant portion of the operator's energy costs and has the potential to double the network's power costs.

eVolution Networks' *Smart Energy Solution* reduces the amount of heat which is being emitted into the room and therefore dramatically reduces the power consumption of the air cooling system. Operators who have deployed SES enjoy a significant Opex reduction, almost immediately from the moment of implementation, without incurring additional Capex.