Green telecommunications reducing opex and capex engineering essay

In the last 10 years, mobile and wireless communications have seen tremendous growth. The growth in the networks along with fierce competition has led the telecom operators to focus on logistics, security and costs. Since each operator competes to provide the customer the best service possible at minimum price, reducing operating costs is of prime importance. In addition, environment has also become a major issue worldwide affecting most of the telecom operators. Legislative pressures and the potential for Carbon trading revenues are causing the Mobile Telecommunications Industry to become mindful of its impact on carbon emissions. " Green" considerations are coming into prominence in network design. This paper discusses various " eco-friendly" solutions in network design to reduce CO2 emissions leading to reduction in Operating Expense (OPEX) and Capital Expense (CAPEX).

Introduction

Telecommunication Industry has helped the world in a big way to reduce carbon emissions by reducing unnecessary business travel, improving efficiency of freight transport and other logistics. The carbon footprint of a mobile phone call or video conferencing is thousand times smaller than the environmental impact of travel required for personal meeting.

However, running these telecommunication systems also creates a load on the environment contributing to about 0. 5% of global carbon emissions. Though, this is much less as compared to the other industries, it has brought in a lot of criticism from various environmental agencies and green campaigners. In addition, powering these systems makes up half of a telecom operator's operating costs and with energy prices rising, these

expenses are hurting the profits of the operators. The only solution for the Telecom Operators to jump out of this situation is to adopt Green Technology in the networks. This will not only reduce the OPEX and CAPEX of operators substantially but also lead to energy-efficient and self-sustainable telecommunications systems.

Energy Concerns for Telecom Operators

Today, around 50% of the operating costs of a network company goes into electricity. With electricity prices rising, it is eating a lot into the revenues earned by these network companies. The various network elements that contribute to these costs are the Radio Base Stations, the equipments used in the network and the mesh of connecting cables required to interconnect Fixed-Line operations. Out of these, Radio Base Stations account for two-thirds of the power costs with the equipments being the second largest contributor. Along with increasing costs due to excessive power consumption, network operators also contribute significantly to the carbon emissions.

In order to overcome these issues, the operators must look at developing sustainable network solutions. The following steps such as developing energy-efficient products and features, creating energy-efficient site solutions, designing energy optimized networks and harnessing alternative sources of energy can help pave the way for telecommunication operators towards sustainable growth.

Developing energy-efficient products and features

Many network equipment providers these days have developed or are in the process of developing products that are eco-friendly. Apart from this, many new features are also being developed so as to minimize energy consumption during operations. Ericsson, Nokia Siemens Networks and Motorola are some of the significant contributors to this new generation of energy-efficient products.

Ericsson has developed an innovative design for housing Radio Base Stations called the Ericsson Tower Tube. The Tower is made from concrete which has a lower environmental impact than traditional steel, consuming up to 40 percent less power from a life cycle perspective. This is due to the fact that concrete results in less energy consumption and CO_2 emission than steel during production and transport. However, the most important part is that during operation, feeder losses are substantially reduced, and no active cooling is needed. Thus, adopting a solution like this, helps operators to not only reduce their construction and power costs but also reduce their capital expenditure as active cooling units are not required.

Nokia Siemens Networks, on the other hand, has developed the ' award-winning' Flexi Multiradio Base Station. The unique capability of such a Base Station is that it can support all the 3GPP technologies i. e. GSM/EDGE and WCDMA/HSPA to LTE in a single unit with all running simultaneously. This technique of running multiple radio technologies in a single Base Station leads to multiple advantages for operators such as reduced OPEX from fewer site visits, simplified logistics, reduced maintenance and a smaller requirement for trained staff. In addition, this concept can also reduce the

carbon footprint of a single Base Station by 70% which corresponds to approximately 70 GWh of annual energy saving. Another important advantage is that it is only 20% of the size and weight of a conventional base station leading to reduction in the carbon footprint from transportation and installation. Due to reduced size, it is possible to install base stations in places previously considered impossible such as densely populated urban areas thus saving space, installation time and costs. Flexi, as it is called, has been designed so that it can function even without external air conditioning, thus reducing around 30% in site energy consumption. It's other prominent features like software-based capacity and capability upgrades further help in reduction of operating expenses as Flexi can be controlled via remote software whereas conventional base stations require site visits and sometimes hardware replacements. Furthermore, the Flexi Base Station can work on renewable energy such as solar or wind power. Like other Nokia Siemens Networks products, Flexi has been designed so as to facilitate ease of recycling at end of its life. This also helps solve the various end-of-life problems that many operators face.

Apart from hardware products, new software technology can also help to improve energy efficiency of base stations. Ericsson provides the Base Transceiver Station Power Savings feature while Nokia Siemens has it's NetAct™ Service Quality Manager (SQM).

Ericsson has introduced the new Base Transceiver Station Power Savings feature in many of its base stations across the world. Due to this feature, during low-traffic periods, the radio resources of the network that are unused are put into Stand-By mode, thus lowering energy consumption. Depending

on the network traffic patterns, this feature can reduce 25% of energy consumption. The added advantage of this innovation is that it can be installed in any of Ericsson's existing Base Stations by a mere software upgrade. Thus, if this feature is installed in all the existing Ericsson Base Stations, it can reduce carbon emissions by 1 million tons a year.

The Nokia Siemens Networks NetAct™ Service Quality Manager (SQM) is used to provide better control of BTS power settings. The night time power saving feature allows an operator to set a time when traffic prioritization is enabled in the network. NetAct SQM will control the operation automatically according to pre-configured settings, such as Schedule and BSC/BTS list. By using such a feature, a network operator with around 10, 000 base station sites can potentially save the average energy consumption of 1000 households per year. Translating this into monetary values would suggest an estimated €5, 000, 000 annual savings in OPEX, an estimate which naturally depends on the marketplace.

Designing Energy Optimized Networks

Another key aspect for network operators to look into is energy-efficient network design and planning. More often than not, operators tend to design networks with as many as Base Stations in order to provide maximum coverage and signal strength. However, by taking into consideration the challenge of providing almost the same amount of coverage with less number of base stations can help telecommunication operators achieve optimization in their networks. With optimized networks, the operating costs of operators can come down drastically as the number of base stations can be reduced by 30% – 50%.

Now, a sustainable network has its foundation in good design. At the core of any efficient and sustainable network is good design. Without doubt, the best way to achieve an optimized, energy-efficient network is to build it on good foundations, based on sound design principles. Even if a company achieves energy efficiency at the component level it does not mean that it can make up for an inefficiently designed network, in which the number of radio sites could potentially be double than what it needs to be to achieve the same coverage with the same quality. By hiring experienced network designers to become involved from the start of the design process, operators can typically reduce the number of radio sites needed overall by between 30 and 50 per cent.

Energy-Efficient On-Site Solutions

There are many areas on-site where energy efficiency can be achieved. By adopting certain ingenious and innovative solutions, a lot of unnecessary energy wastage can be avoided and thus costs can be reduced.

One of the main causes of power consumption on-site is the air-conditioning required for cooling the telecom shelters that contain the radio equipments. These air-conditioning units consume anywhere between 1200W – 2000W. However, with recent developments, the radio base stations can endure higher temperatures thus enabling new cooling techniques to be used. One solution is to have heat exchangers which can efficiently transfer heat from one medium to another. Thus the heat generated by using the Radio Base Stations can be captured by the heat exchangers and transferred to the water kept outside in a tank. This method of heat removal can help maintain temperatures 20oF to 15oF less than ambient. Also, it does not require any

power source as heat is dissipated by means of natural convection. This method can be used in dry regions mainly in North-Western India. Another innovative solution that can be used in tropical regions is Phase Change Materials (PCM). These help in maintaining temperatures in the shelters between 20oC to 35oC without use of any air conditioning system. Thus, implementing innovative solutions for cooling telecom shelters, a telecom operator not only reduces its OPEX (due to reduced energy costs) but also CAPEX by minimizing the amount spent on equipment needed for cooling.

Another area where power can be conserved is by minimising the Feeder losses. This can be established by placing the Radio Base Stations closer to the antenna. Since feeder loss is minimised, it helps in improved network coverage and capacity. This, in turn, helps the operator to reduce the number of RBS in the region leading to network optimization. The Ericsson Tower Tube discussed above implements this solution in an efficient manner. The tower consists of an elevator. The base stations are installed at the bottom of the tower and then lifted by the elevator to top where they are operated. Thus by being close to the antenna the feeder loss decreases.

Harnessing Alternative Sources of Energy

With conventional energy prices rising, operating telecom networks is becoming very difficult for the operators. The rising operating costs are affecting the bottom lines of the network operators. Apart from this, there are various sites which are beyond the reach of electricity or have unreliable electricity provision. Thus, operators need to set up diesel powered base stations in these regions. However, regular maintenance and refuelling the diesel becomes a very costly affair. In order to overcome these issues, a

single solution is available at hand i. e. harnessing alternative sources of energy to power the telecommunication systems. There are various renewable energy sources that can be used efficiently these days. This includes Solar, Wind, Biofuels, Fuel Cells etc.

Solar

As the cost of Solar technology continues to fall, it is becoming a very popular technology to be used as primary power source for various base stations. Though the initial capital expense (CAPEX) is higher for a solar-powered site, however, over a period of 5 years the Total Cost of Ownership (TCO) for such a site is 30% less than a conventionally powered site. Also the life span of a solar powered BS is higher than a usual BS, thus in the longer run the network operators can reap more benefit out of this solution. A key point in using Solar technology is also the fact that its maximum outputs align with the maximum load on the telecom networks. In other words, the peak of mobile phone calls overlaps with the peak of solar power and at night when the mobile phone usage tends to drop, the solar power switches to battery phase.

Solar energy can be prominently used to its best effect by regions coming in the equatorial sun-belt. And this is where most of the emerging markets, like India and China are located. Thus network operators in these markets can readily adopt solar technology and reduce their OPEX by huge amounts. With the extensive competition in these markets, an operator adopting this technology can forget about the power related costs of the OPEX and focus on improving customer satisfaction.

Major network solution providers like Motorola, Ericsson and Nokia Siemens have developed various techniques to provide solar technologies to various network operators.

Ericsson has developed a special Radio Base Station (RBS) for solar power called SunSite. A typical RBS requires 142 W of power; 110W the RBS itself, 20W transmission equipment and 12W Obstruction lights. Thus, Ericsson developed a solar system that can provide this much amount of power. The first solar powered site delivered by Ericsson was in the year 2000. Since then it has delivered 200 SunSites in various countries. Now that Ericsson has also developed energy-efficient RBS, sites have become more energy-lean. As a result, the large solar panels are no more used. Instead small solar panels are effective enough to provide the required amount of power. This is reducing the costs for setting up SunSites and thereby reducing CAPEX for the operators. A very good example in case of Ericsson Sunsite was the set up for Telekom Indonesia which was a 100% solar powered site. The SunSite helped Telekom Indonesia reduce its energy consumption by 60% and also made the site almost maintenance free. This led to decrease in power costs, fuel costs and maintenance cost leading to reduction of 40% in the OPEX.

Nokia Siemens has also developed its Renewable Energy Source (RES) Autonomous site solutions. It provides various options like Standalone Solar Sites, Solar-Wind hybrid sites and sites with a combination of Solar-Diesel Generator. Motorola has also recently developed its solar solutions under the name Horizon II DC Macro/Mini BTS.

Wind

Wind is a plentiful resource across all regions of the world with varying degrees of intensity albeit considerably stronger in coastal regions. The main drawback to wind energy is the reliability of the source which is the main reason we do not use wind as a standard power source. Coupled with solar energy and the reserves in battery bank storage, wind does continue to provide an abundant, free-to-use, easy to access and environmentally friendly means of supplying power for the Autonomous Sites.

Wind turbines can be placed in different configurations at the site. An early site analysis will determine the ideal turbine configuration as well as the correct direction and height to maximize the energy output from the turbines. Moreover, many governments offer tax benefits and direct subsidies for wind and solar energy expenditures making wind an ideal solution in most situations. Wind power has very low operation expenditure.

BioFuels

Biofuels are liquid fuels that are derived from plant materials. These fuels are entering into the market, driven by factors such as fuel price rise, reducing carbon emissions and the need for increased energy security.

Ericsson has pioneered the use of biofuels in telecoms. For instance, Ericsson, Idea Cellular and the GSM Association Development Fund have launched several base stations powered by locally produced biofuels to extend Idea's commercial mobile network in rural India. They are being deployed at greenfield sites that have not previously had access to a mobile network and are located in areas with unreliable power supply. The biodiesel

for these base stations comes from used cooking oils from restaurants. Idea currently has 23 sites running on biodiesel in India, and hopes to expand this to 40 to 50 sites. In the long term, it is expected that locally produced jatropha oil will be used, as soon as this is available in sufficient quantities. The selected sources for biodiesel have low environmental impact and follow responsible environmental practices for the production of biodiesel.

Fuel Cells

Fuel cells are also being developed so as to efficiently use them as a source of energy for telecom networks. In recent years, a lot of improvement has been done in the Fuel Cell technology which has led to many benefits over generators such as fuel efficiency, climate resistance, reliable start-up, and compact size. They operate at very low noise levels. Due to this, there is no indication of a power source running on the site and hence reducing the likelihood of theft also. With development, fuel cells are being manufactured in great numbers due to which its cost have come down considerably as compared to engine driven fuel cells.

Operation of a fuel cell is to convert any fuel, like Hydrogen into electricity without combustion. There are several types of fuel cells, of which the most useful telecommunications is the Proton Exchange Membrane Fuel Cell (PEMFC). The PEMFC operates at low temperatures and runs at 40-60% efficiency.

Motorola, which is involved in fuel cell research for networks and mobile devices, is also exploring micro fuel cell technologies as a replacement for

rechargeable batteries in mobile devices. In partnership with various companies, Motorola is developing technologies such as:

Hybrid fuel cell technologies for radios

A hydrogen generator as a miniature fuel-cell power source5

Improving PEM fuel cell performance, durability, and manufacturability using single wall carbon nanotubes (SWNTs)

Fuel cell technology is maturing and advancing rapidly. However, a disadvantage for fuel cells is that at higher loads, cooling is required. Thus a trade-off has to be made in reducing the OPEX due to low operating costs for using fuel cells and increasing CAPEX due to extra cooling units required.

End-of-life Solutions

Technology, today, is changing so rapidly that in a very short span time the network equipment becomes old and needs upgradation. In these situations, network operators often feel pressurized to dispose old equipment and set up the latest one. However, this can create a lot of strain on the OPEX and CAPEX and also have a negative impact on the environment.

Thus, the network equipments providers these days provide solutions to cater to the end-of-life scenarios as well. Nokia Siemens provides Asset Recovery Service which is based on recycling of old equipment and refurbishment of existing network elements.

There are two modules in the Asset Recovery Service. Recycling Service module looks into the proper waste disposal of old equipments in an

environment friendly manner. The Refurbishment Service Module looks into the upgradation or extension of lifetime of existing network equipments.

The benefits to the customers include:

Reduced obsolescence cost – Development of new technology is always good for the industry. However, the problem is the piling of obsolete equipment. Using Asset Recovery Service, the obsolete inventory can be converted into useful, re-usable equipment.

Environmentally Responsible Approach – Due to tight regulations regarding disposal, it creates a problem for the companies to get rid of old elements. Thus, this service helps customer to dispose in an environmentally sound manner.

OPEX and CAPEX savings – By reducing warehousing cost for obsolete inventory, OPEX can be saved. Also due to the Refurbishment Service, the need to spend on new equipments reduces, thus CAPEX can also be saved.

Carbon Credits

By reducing their carbon emissions, telecom operators can also exchange them for carbon credits. One carbon credit is equivalent to one tonne of carbon dioxide. And one carbon credit is priced in the markets at around 22 Euros (price fluctuates according to market).

This concept of carbon credits is very favourable for companies operating in the developing countries as according to Kyoto Protocol, there is no restriction on these companies to limit their emissions. However, all the

developed countries (except US as it has not signed the Kyoto Protocol) have to restrict their emissions by 2012. They can achieve this by either implementing new technology to reduce their emissions or by helping companies in the developing countries to reduce their emissions and buying the carbon credits that are obtained.

As there is a very huge scope for reduction of carbon emissions in the Telecommunications industry, all operators in developing countries can immensely benefit from carbon credits. Also, as the deadline year 2012 nears, it is expected that there will be a surge in the demand of these carbon credits and hence the price of one carbon credit will also increase. Thus, if the telecom operator companies act quickly to reduce their carbon emissions, they can accumulate carbon credits now and reap the benefits in the future. Hence, implementing Green solutions in their networks, will not only benefit the network operators to reduce their OPEX and CAPEX but also act as means to generate more revenue.

Conclusion

As the World moves towards Greener solutions, it has not only reduced the carbon emissions but has also helped to provide ample new opportunities for business. As we have seen in this paper, network operators have ample amount of opportunities to reduce their OPEX and CAPEX.

By using energy efficient products and features, optimizing networks, smart innovative energy-saving solutions and powering Telecommunication systems with renewable sources of energy, the Telecommunication network operators can reduce their power consumption by 50% – 70%. This can in

turn lead to proportional reduction in the energy costs. As the energy costs make up for around 50% of the OPEX, the operators can drastically reduce their operating expenditure and improve the bottom line of their companies. This also gives operators a chance to venture into new markets, provide better services for their customer and also come up with innovative cost-effective schemes to retain their customers.

Adopting green methods, also leads to reduction in the CAPEX as has been discussed in the above topics. Though, the initial investment in Eco-friendly solutions is higher, the reduction in energy consumption and costs brings the Total Cost of Ownership (TCO) much less than in conventional networks.

With tremendous potential for curbing CO_2 emissions, Telecommunication operators can also generate a lot of revenue by using their Carbon Credits. In India, Bharti Airtel is one of the operators, who has entered into the carbon credit venture with partner ACME Telepower. This partnership has brought about $30- $40 million revenue to the both companies involved. Hence, Carbon trade is also another major incentive for the operator s to adopt environment friendly solutions within their networks.