Improving energy efficiency, Lower CO_2 emission and TCO

Whitepaper, Huawei energy efficiency solution

HUAWEI TECHNOLOGIES CO., LTD.

Content




Executive summary

According to the International Energy Agency (IEA) statistics in 2008, global energy consumption increased 73% and CO_2 emissions increased 79% from 1973 to 2006. Energy consumption and resulting enhanced greenhouse effect is thought to have led to a series of natural disasters. Environmental concern, declining natural resources and climate change has become an important concern to the world. After accounting for several energy crises during the past 30-40 years, we today find our selves in a world where energy price does not truly reflect the damage caused to the environment. As more and more manufacturing utilizes increasing amounts of energy, the industry is increasingly coming under pressure to reduce its energy demand in order to find cost savings.

From a global perspective, compared with coal, iron and steel, nonferrous metals industries, the telecommunications industry is not the most prominent industry of energy consumption or CO_2 emissions. However, according to data in annual reports and CSR of leading telecom operators, telecommunication industry consumes rather a large amount of energy, and some operators were listed in the largest energy-consumption companies in their countries.

Pressure from the community, public, as well as government's commitment to improve energy efficiency in international organizations, is a result of both dwindling reserves of primary energy such as fossil fuels and increasing CO_2 emissions, and this has resulted in pressure being placed on industry to reduce demand. The expected, rise in the cost of primary fuels, especially with rising coal and oil costs, has had a negative impact on industry. Punitive measures such as differential pricing launched in some countries contribute to energy price as well. On the demand side, the communication industry, is in a development phase in most emerging and third world economies, and being pressurized to reduce energy demand in first world economies. Subscriber and service growth in emerging market and the explosion in bandwidth growth within developed markets, will inevitably lead to new network renewal and expansion programs. The ever increasing number of peripheral equipment running online has and will continue to lead to increased demands for energy supply. Energy costs have risen as a result of this growth putting operators under long-term financial pressure to reduce energy costs.

As a result of the market pressures and government planning operators and equipment vendors have begun to look at emission reduction and developed energy efficiency plans based on sustainable development. In the past 10 years, the telecommunications industry has made great progress within this field. Technology innovation and recent product updates has led to continued declining energy consumption per unit, with some operators having saved more than 50% of their previous energy demand.

Huawei along with some of our operator partners have cooperated in research and have investigated several areas of energy efficiency and emission reduction. We have found that in the life cycle of telecommunications products, the operational phase consumes most energy. In this stage, CO_2 emission accounts for about 60% of total emission during a whole life cycle. During the operational phase, energy consumption and CO_2 emissions generated by the access network, including mobile and fixed access networks account for the largest energy demand and emissions. In different operating environments energy consumption as a proportion of the access network varies, usually ranging from 50% to 70%.

The modern telecommunication network can generally be divided into three parts, namely the access network, the core network and the transmission network. The energy consumption of these three parts is very different.

- Access network is a key focus area for energy efficiency within the network. It includes the access and auxiliary equipment, in particular the cooling facility. The use of sustainable energy is often applied in this part of the network.
- The equipment within the core network is usually more concentrated in central physical locations. With old network architecture often in need of optimization. Legacy hardware equipment is usually high in energy consumption, with traditional servers having high energy demands.
- Finally the transmission network, where network routing and route optimization occurs, this is a key part of the network where energy efficiency can be found. This area mainly consists of routers and optical networking equipment.

In addition to the operations energy cost of the network, the supply chain consisting of additional items such as packaging materials and the need to reduce material consumption for transportation and other demands is also an area of concern.

Introduction

When considering the holistic picture, the development of a comprehensive telecommunications infrastructure has the potential of reducing energy consumption and CO_2 emissions across other sectors of society. Telephone calls, video conferencing, and other means of telecommunication can help to reduce the travel requirement of the consumers, whether this be enterprise of for private use. SMS, Internet and other electronic means of telecommunications can also play a part in reducing the dependency on other media such as postcards, greeting cards, letter and so forth. The sustainable development of these kinds of services should continue to reduce the carbon footprint of individuals and businesses. In short, telecommunication services can support and contribute a lot to a greener GDP and to the development of a harmonious society.

Huawei believes that improved energy efficiency and reduces emissions brought about by the solutions delivered to market by the telecommunications industry could support the development of a Carbon Neutral industry. This will contribute to the development of a greener national GDP, while also reducing the cost of operations for telecommunication companies in the long-term. We believe that TCO (Total Cost of Ownership) is key and should be considered in the network's energy reduction and solution design.

Huawei has developed several life cycle analysis assessments (LCA) for products, and have focused on access sector, with the base station within the mobile network and the access hub within the broadband network of initial concern. Our conclusion from the LCA assessment is that for typical access products, the operation phase is the largest contributor to carbon emissions, accounting for about 60% of the whole life cycle. That means that operators will face significant pressure to find energy-saving as they build out their networks with expected demand.

From the energy consumption point of view, Huawei analyzed a number of customers' network energy consumption data and found that main form of energy consumed by operators is electricity power. And access network, including wireless site and broad / narrow-band access site, is the main part of power consumption. Energy consumption of wireless sites account for up to 70%+ of the total energy consumption in a number of mobile operators. Energy consumption ratio of access part in fixed carriers is lower compared to the mobile, but also, in general, accounts for more than 40%.

To sum up, the energy saving potential was found to be most feasible as a product of usage demand within the access part of the network thereby also offering the highest energy efficiency potential, followed by the core network and then the transmission network.

In the rest of this paper we outline some of the key points to enhance energy efficiency within the access, core and transmission networks. We also explore in the field of transport and packaging to reduce energy consumption and carbon emission.

Wireless sites

Within mobile networks, the number of base station sites is far greater than the equipment deployed in the central office and it is rising fast as demand for greater coverage and capacity increases. The energy demand in mobile networks has accounted for over half of the mobile network demand, peaking in some instances up to 80% of overall consumption. This is a key area in mobile networks where energy saving can be sought and addressed. When analyzing the energy efficiency of base stations, this can be analyzed from two different perspectives, first the network topology level and second the network elements level.

One theory of energy-saving at the network topology level is to enhance the unit of energy efficiency by reducing the number of sites in the network. There are two ways to reduce the number of sites, the first is by increasing the coverage efficiency and lowering the system spending through efficient network planning, thereby serving the most users with least number of sites. The second is to enhance the capability of the base station equipment allowing it to cover and serve a greater area. As with any technology, there are trade-offs that will need to be considered. Several key technologies, such as Transmitting Diversity, Adaptive Multi-Rate (AMR), High Receive Sensitivity and other, all contribute to increasing the radius of base station coverage. In practice, the two ways mentioned are usually used to reinforce each other. The result being that with suitable network planning and strong coverage-capable equipment one can save more than 25% of the energy consumption, and realize a significant TCO saving in a wide area coverage scenario.

Compared to the network planning method described above, the energy saving at the network element level is often more feasible in more scenarios and has less limitation. Usually, there are only a few network elements within a mobile site. In most cases these are only the base station, transmission and cooling equipment. Among them, the power consumption of the base station is normally much larger than the other devices. It's the key point where energy efficiency can be examined and implemented. In addition, the energy consumption of the cooling system needs to be considered. After analyzing several of our customer's networks we determined that at a typical site with air-conditioning, the energy consumption by the air-condition can account for about 30% of the total energy consumed at that site; so the cooling system is also a key focus for energy saving.

Sustainable energy is also another topic for consideration in the energy-saving of a site, as in remote areas, it's often feasible to introduce a new energy system from the perspective of both emission reduction and energy cost saving.

Our focus now will be on the possible energy saving within the base station, the cooling systems and on new energy systems.

Energy efficiency of base station equipment:

The base station is made up of three parts, the baseband unit, the radio component and the feeder. The radio part is the largest energy-consuming entity of the base station consuming more than 80% of the base stations energy demands. In the radio, it is the power amplifier that is the largest energy consumer, accounting for about 50% of the radio's power consumption. Therefore, improvement in the efficiency of the power amplifier is one of the key areas that needs to be considered in order to enhance energy efficiency within the base station equipment.

Multi-carrier technology is one way to improve the efficiency of the power amplifier. New multi-carrier base station products (such as: GSM QTRU BTS technology) can help to improve efficiency and reduce power consumption. In the case of using 6 carriers, Quadruple transceiver unit (QTRU) technology can reduce the maximum energy consumption of the PA by up to 30%. Other ways to improve the efficiency of the power amplifier include intelligent match; a smart regulator; and a new high-performance amplifier and etc.

Reducing energy waste is another aspect that can enhance energy efficiency at base station sites. Traffic levels and demand for service

within the busy and leisure time of the mobile network is often very uneven. How to reduce network power consumption during leisure time is the second key consideration for energy saving. This can be accomplished by optimizing the power distribution by utilizing smart turn off technology.

In a typical dual-band GSM network, the most effective energy saving technology is the "site-level" turn-off. The high frequency site is switched off in low-traffic periods and re-powered to an on status when the traffic levels pick up based on a predetermined demand threshold. Turning off of the base station in periods of low or zero demand results in significant power consumption savings. The base station turn off technology also includes the options for carrier turn off and time slot turn off. The difference in options being dependant on the size of the particular site with time slot turn-off being easier to realize and refine through low-flow management processes, than carrier turn off.

A third key point in base stations energy-saving options is to reduce the energy waste of the feeder. Energy consumption of the feeder itself is not large, but it has a significant impact on the coverage ability of a particular base station site. Because it greatly reduces the power consumed at the top of the tower, it results in a substantial decline in the efficiency of the overall base station. Feeders can lead to about on average a 50% loss of power at a typical site. This problem can be solved by deploying distributed base station architecture and through the design of smaller base stations. In actual deployment scenarios of mobile networks, we found that replacing a traditional macro base station with a distributed base station we could achieve more than 40% power consumption savings without impacting the output power. The distributed nature of the architecture can bring savings in location, room leasing and in the auxiliary cooling system. These all help to reduce the site power consumption either directly or indirectly.

The Huawei high-performance base station products and the distributed architecture all help to realize a decline in TCO, with these two factors achieving about a 10% reduction in the network TCO.

Energy Efficiency of Auxiliary equipment at the BTS site:

The cooling system is normally the largest energy consumption item of the sites auxiliary equipment. To reduce the demands of the cooling systems energy consumption is therefore a key consideration for energy-saving.

For indoor macro stations, smart direct ventilation systems are a good way to pump fresh air in and hot air out to reduce the demand and thus power consumption of air condition systems. If the outdoor temperature is too high, and the direct ventilation can not meet the requirements for cooling, the smart air-conditioning system will start in order to protect the stability of the Base station equipment.

For outdoor macro-station plants, the demands of the cooling systems power consumption may also be reduced by utilizing a ventilated outdoor cabinet.

There are two typical problems in the use of direct ventilation, the first is that the battery backup plant usually has a strict temperature range requirement and doesn’t work well in some cases of the direct ventilation. The second problem is the quality of the air. In practice, we have found that the battery problem can be solved by the introduction of a low-power battery air-conditioning cabinet to manage the plants operating temperature. In regions where the air quality is low, a "heat exchange system" can substitute for the direct ventilation system to prevent the harmful effects of dust. "Heat exchange systems" are roughly similar in principle to direct ventilation, with the advantage that the air does not enter the equipment enclosure thereby ensuring that the equipment and the dust-protecting grid is not affected by dust pollution and minimizing manual cleaning costs.

Renewable energy systems:

The most direct way to reduce CO_2 emission is through the introduction of renewable energy systems, such as solar energy, wind energy and bio-energy plants. These emission-free energy or low-emission energy are the most effective choices for companies to reduce carbon emissions. Application of wind and solar energy is limited by local climatic factors. They are usually used in remote small sites where the wind and solar resources are enough to support the system at those particular sites. Renewable Energy may also be used as a supplementary energy source in a location where the public power supplies are unstable.

For these small remote sites, use of public power is usually expensive and difficult to obtain because of high cost of power transmission and distribution. On the other hand, small sites do not consume much energy, so operators can use oil generator systems to solve the energy problem. However, most generator systems have relatively low energy conversion rates, high purchasing cost and short life expectancy, while requiring high levels of maintenance. The cost of fuel consumption in a generator is normally several times higher than the public power system. Depending on the circumstance the introduction of new energy can be economically viability. Based on current data from our Africa region, the TCO of renewable energy system such as wind and solar energy, they will equal generator system costs in 3-4 years. At this point, the renewable energy system can save significant OPEX costs because it no longer consume any electricity or diesel, with the added benefit of both the carbon emissions and the TCO being reduced.

Fixed access

Currently, based on research from most countries, the prediction is that the replacement of traditional POTS access equipment is imminent. xDSL has developed rapidly and many countries now support sizable broadband data networks. The deployment of FTTx increasingly seems likely with the predicted trend being that FTTH may substitute copper cable over the next few years in many economies. Our research shows that narrow-band, broadband (BB) access is normally the highest energy consumer in fixed networks. These two parts, the POTS and BB access network consumes up to 50% of the whole network power consumption. Making the narrow-band and broadband access nodes a key point of seeking to reducing energy consumption within fixed line networks.

With the traditional POTS narrow-band access node, there is not much room to improve the energy efficiency; however the narrow-band access still consumes a large proportion (about 25%) of the overall energy consumption in the typical fixed-network. Huawei believes that network migration to more effective and efficient access solutions may be the best way to solve this dilemma. According to our data of previous network transitions, a NGN migration can reduce about 40% of network energy consumption.

A large number of newly deployed xDSL access equipment transitions is currently in progress across several regions. We would recommend that fixed network operators focus on xDSL is a key part of their energy efficiency plans. A recent EU Code of Conduct standard (on energy efficiency) has given strict guidance for DSLAM and MSAN products. The CoC guidance provides for a L2 low-power mode for DSLAM equipment being utilized during what is described as leisure time. Equipment meeting this guidance will greatly reduce the demand for power and ensure less waste of power, leading to cost savings. Conventional methods for DSLAM equipment to reduce energy consumption also include dynamic fan speed adjustment which can reduce noise as well as energy consumption. A fanless MxU design at the aggregation of the access network is also an effective way to reduce power on noise in the network, saving about 20% of energy consumption and creating a quieter environment.

For xDSL equipment, Dynamic Spectrum Management (DSM) technology can reduce unnecessary power consumption by eliminating crosstalk and allowing networks to utilize less amplification, or line power. Power consumed by the line side of the DSL line accounts for 40% of the total port power. With most of the power consumed by DSL lines being energy wasted due to the disproportionate amplification required to overcome high margins of line noise. DSM technology automatically adjusts the DSL line power spectrum densities (PSD) template, thereby eliminating crosstalk and improving the line rate by at least 15%.

Cooling is also very important issue to the distributed access network equipment. Thousands of air-conditioning systems spurting out CO_2 emission and utilizing energy is putting pressure on operators to find alternative ways to solve the issue. For new BB access nodes, the ideal way to cool is to use a natural direct ventilation system. For example, an outdoor directly ventilated cabinet can provide all of the cooling and reduce the energy consumption demand if the air quality and temperature are able to meet local requirements. In other circumstances in order to meet stricter local requirements we may need to adapt to an alternative ventilated cabinet. Based on our tests, our equipment can support a temperature range in the direct ventilated system of up to 46 degrees.

Utilizing ground-source heating in a cabinet is also an alternative way of using natural cooling. Based on tests in a customer's network, the coefficient of performance (COP) (Energy Efficiency Ratio - EER) of the ground-source heating cabinet was 108. It showed ground-source heating as an effective way of providing cooling. The effect is better than the direct ventilation method which had a COP = 60 as a comparison.

Structure for the Geothermal Unit

Central office

The central office is often a large scale room with many different kinds of equipments in it; these could be access, aggregation, transmission or any other form of product used in the development of a network solution. Taking a holistic view of the above network, much of their service architecture is based on servers. Traditional server technology has reached a high-level of maturity after being deployed for several years. But it hasn't evolved as much to offer many advantages in energy efficiency as it consumes a lot of energy, takes up a large area and has a very strict temperature requirement.

The most effective way to reduce energy consumption in central office is often through network reconstruction. ALL-IP network architectures can effectively reduce energy consumption and TCO more than when compared to traditional TDM architectures. Based on statistics, and compared to TDM architectures, the ALL-IP architecture can reduce about 20% of the TCO, of which 20 percent comes from the energy (electricity) consumption reduction.

At the equipment level, Huawei believes that the first key energy-saving measure in the central office should be on replacing the traditional servers with blade servers so as to achieve a significant reduction of hardware energy consumption. In practical applications with our customer, a service platform based on ATCA blade servers instead of traditional servers reduced 40% of the total power consumption and reduced the footprint by 50%while raise the performance by 40%.

In the core network equipment, the software can also be improved to achieve a reduction in power consumption. As an example MSC CCU software by activating the switch off technology can achieve an 18% energy saving.

In addition, network equipment like the MSC and HLR can make use of the new features within the framework to achieve a reduction in power consumption. In dense urban scenario's, the MSC can share the equipments capacity by means of MSC Pooling. Traffic in the dense urban areas is often concentrated in commercial zone during office hours and concentrated in the residential area in non-office hours. The traditional way of MSC deployment will waste capacity. Using the MSC Pool mode, the system capacity can be shared between different areas allowing a 20% energy savings to be realized across the solution. For the HLR, the new ngHLR is based on a distributed architecture, with actual deployment scenario's showing that distributed HLR's can save up to 50% energy as well as meet the additional needs of disaster recovery and increased reliability.

Besides savings in equipment power consumption, the heat management as a solution in the central office is another very important part of energy saving. Today the cooling power consumption of a central office or data center can be as high as 45% to 50% of the total power consumption.

The key in heat management is design, including the ventilation mode, the distribution of a cold / hot-channel and optimization of the power equipment layout. For example air flow from the bottom to the top has a 20% higher cooling efficiency than air flowing from top to bottom. In the design of the air flow path, the way the heat path vs cool path is designed could raise cooling efficiency. A simple example is to how the cabinets are arranged face-to-face and back-to-back and ensuring the heat flows from one side and the cooling from the other.

The past typical power consumption for a cabinet in most central offices was between 1-2KW. However, with the development of chip and integration technology as well as the rapid deployment of large scale power equipment, power consumption of certain rack may rise up to 8-10KW. This brings challenges to traditional room cooling. Therefore, if there are a small number of large-power cabinets in a central office they should be scattered throughout the room, so that cooling redundancy can be used to reduce the probability of equipment downtime.

As verified in an actual network, the Power Usage Effectiveness (PUE) of the central office can be improved significantly with the above measures. Reconstruction of the old room with, small-design-changes could reduce the PUE from 1.95 to 1.8. That means that cooling system could save about 16% of there energy demand. If the large-design-change are incorporated such as precision air flow systems are designed in, the cooling system can even save more than 30% of its energy demand.

TDM Equipment Central Office

NGN Equipment Central Office

Transmission network

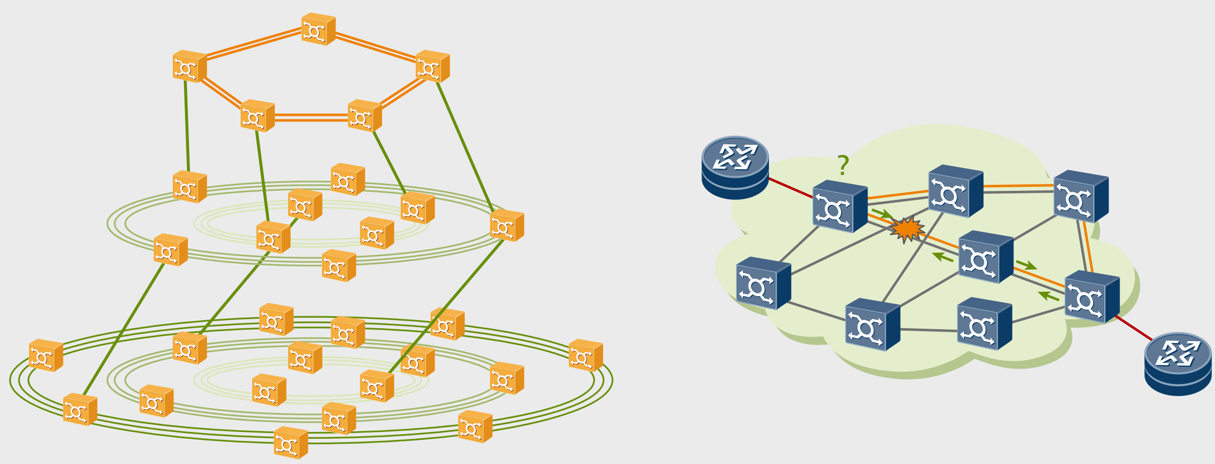
Transmission networks are the most important foundation part of current communication networks. The transmission network consists mainly of core backbone routers and optical networking equipment. Equipment in this domain are usually bulky with power consumption up to 1 kilowatt. Looking at the energy efficiency of transmission networks we can discuses this at three levels, that of network, equipment and devices.

At the network level, resources utilization of the traditional circular network SDH is low, as often half of the bandwidth is set aside to use as protection. For example, in a STM-64 loop, after the deduction of half for the protection slot, there are only 32 VC4 channels that can be used to carry business between any two adjacent nodes in the ring network. If the 32 slot are loaded and there is new demand for business, the only way to support this is to build a new circuit, which raises the network costs and energy consumption. In addition, the traditional network routing algorithm needs a large number of ports and bandwidth resources for new business, making it difficult to raise the efficiency (bandwidth utilization) of the optical line.

Compared to ring networks, a mesh network has a high resource utilization rate. New bandwidth for the purpose of protecting is only 1 / (N-1) (N is the number of optical connections for the nodes) at the ideal state. For example, a node with a 6-ray direction only need 20% of the bandwidth reserved for the purpose of protection. While the traditional ring network will need 50% of new bandwidth resources for the purpose of protection. Bandwidth saved could be used directly to load new services, ensuring that the investment from operators is protected effectively.

The introduction of the Open Transport Network (OTN) makes it possible for an automatically-switched optical network (ASON) to be applied at the optical level. The limitation of the ring network is broken by the MESH network. Optimization of intelligent algorithms for network routing can raise the rate of direct connection, service protection and flexibility of restoration. The work notes passed through to operations and the required bandwidth and port resources could be reduced, resulting in savings. The efficiency of the optical line (bandwidth utilization rate) is raised resulting in the efficiency of the network load being increased. After the introduction of ASON, by changing the network topology and with reasonable allocation of service load, bandwidth utilization can be raised from about 33.6% of the MSP / PP protection method to 75% of protection and resumption method. As a result, energy efficiency is significantly increased. As the bearer layer of core routing, flexible OTN and □ exchange come together with GMPLS scheduling, it will be possible that services of the core router may bypass the optical transmission level, raising the possibility of direct connection services. As a result, the overall cost and power consumption of "Router + send" get optimized. The overall power consumption can be reduced by more than 20%.

On the equipment level, the complexity of network equipment, low integration and poor compatibility are common problems faced by the transmission network. They not only cause unnecessary power consumption and space consumption but also increase the costs of network management and maintenance.



Traditional Network vs. ASON Network

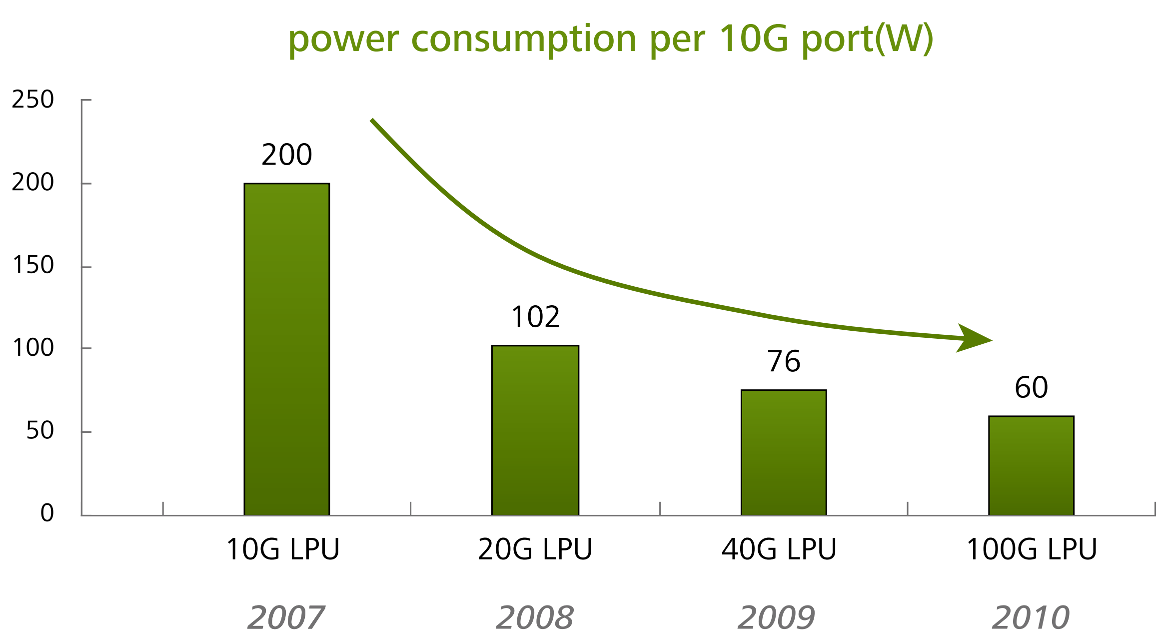
Router cluster system is generally used in the core telecommunication network, as a large system with large power consumption. Traditional high-capacity core router systems are commonly formed by multiple frame clusters, generally only 1 +2 cluster model are supported. That is to say, a central exchange rack is required in order to make the interconnection of two general core routers, this increases the power requirement. Cluster core routing is the solution for this problem. By using this technology a single frame cluster can smoothly evolve into a back-to-back two frame cluster and into Multi-frame clusters. Data shows that compared to the 1 +2 cluster model, back-to-back cluster models with the same dealing capacity can reduce power consumption by about 30%. At the same time, material consumption and the area required decreases by one third.

On the device level, the transmission network equipment providers must ensure that the devices in the transmission network meet a variety of international environmental standards. They must reduce the device's toxic waste which is hard to recover and, if possible, implement a variety of energy-saving and emission reduction design criteria.

By contrast, at the equipment level, more equipment slots and flexible configuration of single boards means flexible configuration of the network node and improved redundancy. The compatibility of the product family design also means that fewer single board species and fewer varieties of spare parts. providing the most appropriate equipment for each network node, network optimization, reducing equipment, reducing the over design of the network, which not only works towards reduced energy consumption, but also simplifes network management and maintenance, thereby reducing maintenance costs.

At the device level, there are some designs that can achieve the purpose of energy-saving and emission reduction. These designs include:

- PID technology that can significantly enhance the integration of the WDM OUT unit, reducing power consumption by more than 40% compared to common OTU units;
- Advanced cooling technology that could enable long-term running of equipments in a 30°C - 35°C temperature environment, thus greatly reducing the power demands of room air-conditioning;
- Smart fan technology that can adjust the speed of fans precisely based on equipment temperature monitoring, to reduce the power consumption of fans, which accounts for as high as 10% of the total power consumption;
- Simplifying the voltage types and using high-performance DC / DC power modules can increase the power conversion efficiency to a maximum of 85-90%;
- Built-in temperatureλ control chip which can implement intelligent monitoring combined with intelligent power consumption software for configuration management of the equipment, together with technologies like CPU adjustment, automatic switch-off of ports during low demand periods, making power consumption manageable and configurable.



Improving Energy Efficient through ASIC

Packaging and transportation

In the transportations of communications equipment, packaging consumes a large amount of natural resources – for example timber, with continued industry use seen as a long-term threat for forests. In order to reduce the consumption of timber, the industry's leading suppliers are working hard to promote renewable packaging materials and improve the recycling of these resources. At the same time, we have reduce the consumption of packaging materials by utilizing lightweight materials and smaller packaging, continually investigating more appropriate packaging, and extending the life cycle of the packaging products through the establishment and improvement of an effective Recovery System. These can be summarized by using the 6 R concept, that of: rational design, reducing supplies, recycle, reuse, recovery, and renewable.

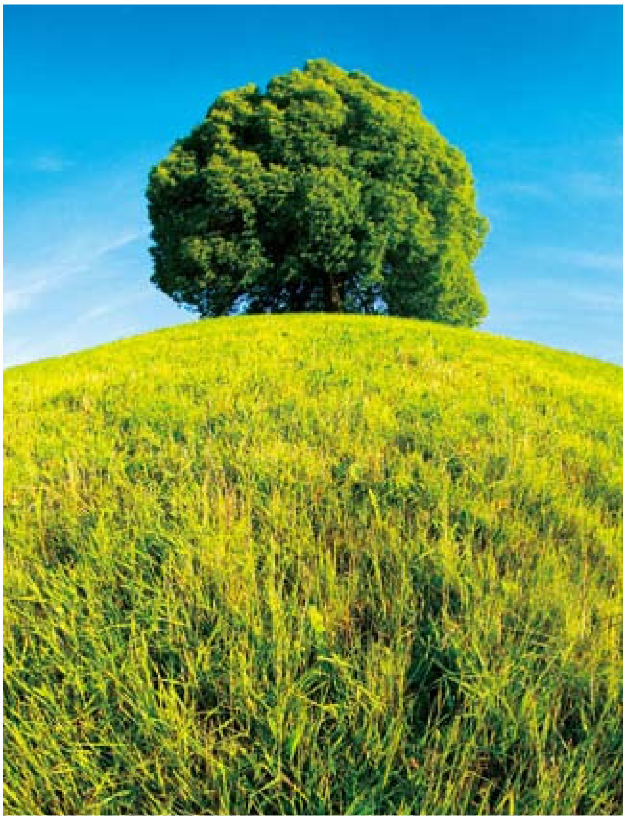
The "Transportation cabinet" is typically a reusable unit with associated reusable packaging. This solution is based on recycled wood materials, visualized packaging technology, assembly technology, standardization and appropriate design. Together with a universal logistics platform, the "Transportation cabinet" solution reduces the consumption of natural resources such as wood from forests in the packaging and logistics stage, and promotes sustainable development of resource-saving and environmentally friendly packaging and logistics within the industry.

By working in partnership with our customers on their network implementation projects we have shown that, compared to the legacy packaging solution, the "Transportation cabinet" solution can save about 50% of timber, reduce about 20% to 30% of the packaging weight, and extend up to 2 to 4 times the service life of the Packaging, while reducing about 5% to 10% the life-cycle cost, and raising operational efficiency about 80% to 90%.

According to Huawei shipment statistics, using this solution and our ongoing continuous improvement program, 12,000 cubic meters of timber consumption, 2,700,000 liters of oil consumption, 750,000 KWH power, and 6,172,000 tons carbon dioxide emissions will be saved every year. This is equivalent to an annual reduction of 14,700 square meters Deforestation, saving fuel consumption of 6,750,000 ordinary family cars in China, or saving electricity consumption of 2,080,000 ordinary Chinese families.

Conclusions

Communication network will continue to expand in the future due to increasing demand for mobile subscribers in developing market, FTTx broadband build-out in developed markets and continuing demand for high bandwidth services. This means that increasing number of equipment will be deployed in networks, putting emission and finance under pressure. Operators, equipment manufacturers and other related industry participants will continue to search for solutions to reducing costs and emissions.



Huawei is committed to continuous efforts:

1. Continuously improving the energy efficiency of our products to help our customers and partners reduce carbon emissions and improve their TCO.
2. The development of a highly efficient closed-loop control system in the supply chain management, and limiting our environment impact in the manufacturing and transport process.
3. Cooperating with operators, to develop and launch more user-friendly ICT services that reduce unnecessary travel and logistics for our global society, while at the same time actively promoting the use of clean energy and reduced carbon emissions for the whole of society.

Glossary

AMR – Adaptive Multi-Rate

ATAE – Advanced Telecom Application Environment

BSS – Base Station Subsystem

BSS – Business Support System

CoC – Code of Conduct

COP – Coefficient of Performance

CSR – Corporate Social Responsibility

DSM – Dynamic Spectrum Management

DSLAM – Digital Subscriber Line Access Multiplexer

EER - Energy Efficiency Ratio

FTTx – Fiber to the x

GDP – Gross Domestic Product

IEA – International Energy Agency

ICT – Information and Communication Technologies

LCA – Lifecycle Assessment

NGN – Next Generation Network

OTU – Optical Transmit Unit

PBT – Power Boost Technology

POTS – Plain old telephone service

PSD – Power Spectrum Densities

PUE – Power Usage Effectiveness

QTRU – Quadruple. Transceiver Unit

RRU – Remote Radio Unit

TCO – Total Cost of Ownership

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