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Survey on Networking architecture and protocols for Green Smart Environments

S.Radha, Asst.Prof,ECE Dept,Karunya University.P.Nagabushanam,Asst.Prof,EEE Dept,Karunya University,CBE

Abstract— The problem of green energy saving in wireless routing technology is to be solved.for which the new energy efficient survivable routing protocol (ES-AODV) i.e.Energy-efficient Survivable AODV can be used for unicast demand in (WMNs) green Wireless Mesh Networks. To improve the performances of traditional AODV routing protocol,ES AODV routing protocol uses the hop penalty strategy and flooding delaying strategy.Proposed ES-AODV can be simulated and performance can be verified by QualNet. ES-AODV utilizes more energy and is more efficient about 13% Compared with the traditional AODV.However, ES-AODV is more load-balancing which reduces the number of energy depletion nodes and the appearance of the first energy depletion node is postponed, and thus improves effectiveness of the network survivability.

Introduction

In the past three decades, research and development in **green energy** has exploded, yielding to promising new technologies in hundreds that can reduce depending on coal, oil, and natural gas. But **Meaning of green energy**, and reason for it being a better option than fossil fuels?

Green energy defined

Green energy comes from natural sources like sunlight, wind, rain, tides, plants, algae and geothermal heat. These energy resources are in general renewable, meaning they're replenished. In contrast, fossil fuels are a finite resource that take millions of years to develop and will continue to diminish with use.

Renewable energy sources also have a much smaller impact on the environment than fossil fuels, which produce pollutants like greenhouse gases as a by-product, and contribute to climate change. Gaining fossil fuels access ,typically requires either mining or drilling deep into the earth, ecologically sensitive locations very often.

Green energy, however, utilizes energy sources that are readily available all over the world, rural and remote areas are included that don't otherwise have access to electricity. Advances in renewable energy technologies have lowered the cost of solar panels, wind turbines and other sources of green energy, the ability to produce electricity in the hands of the people rather than that are of oil, gas, coal and utility companies.

Fossil fuels can be replaced by Green energy in all major areas of use including electricity, water and space heating and fuel for motor vehicles.

Responsible use of energy has become a crucial issue in large networks and information systems in general in the last few years. Energy efficiency is now very critical in the list of performance metrics of networking equipment and networked systems. Understanding and economizing energy use has emerged as a high-impact research area in networking system of all kinds. Recent studies suggest that the core network expends the largest fraction of the energy consumed by a large network system, and network energy expenditure can be a significant part of planetary computing and communication, contrary to earlier belief that the bulk of energy expenditure is at end-systems or at most the edge network. The role of interaction between end-systems and the network has also been recognized in achieving better energy economy. The OSN special issue on Green Communications and Networking was envisioned to archive timely research in this area particularly relevant to optical networking design and technologies. Energy efficiency considerations cut across multiple traditional areas of optical networks, so we were prepared for a broad range of topics in submissions.

The U.S. Energy Information Administration has predicted that the worldwide energy consumption will increase by 53% from 2008 to 2035 if nothing is done to change the current trends and the behavior of energy consumers. Traditional energy generation tends to be carbon intensive, which has a strong impact on the environment. The ICT sector consumes in the range of 1% to 2% of the total electricity in developed countries and the trend goes upwards. In April 2011, Greenpeace presented a report on the energy consumption of the ICT sector, entitled ''How Dirty Is Your Data?''. The report criticized the sector for using electricity produced by carbon intensive sources and for its lack of transparency about its energy footprint and practices. Since the sector is growing rapidly, it needs to adopt green practices in order to reduce its impact on the environment (e.g., its greenhouse gas emissions and its usage of non-renewable resources) and its share of the worldwide electricity consumption. All experts rank the potential of the ICT sector to reduce its worldwide electricity consumption as very high.

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The ICT sector is very diverse and will require major initiatives in many areas. We focus in particular on the worldwide ‘‘greening’’ effort of wireless networking technologies, which is believed to be one of the major consumers of electricity. Considering the significant predicted growth of the smartphone market as well as the predicted increase in mobile Internet traffic (requiring the deployment of a large number of smaller cells), the relevance of this effort becomes very clear. Research and standard development activities to meet the expected future demands in an energy-efficient manner have already started and are on a promising path for the wireless industry.

Energy consumption of network operators can be minimized by the dynamic and smart relocation of networking resources. We propose to take advantage of network virtualization to enable a smart energy aware network provisioning. The virtualization of networking resources leads to the problem of mapping virtual demands to physical resources, known as Virtual Network Embedding (VNE). Our proposal modifies and improves existing energy aware VNE proposals where the objective is to switch off as many network nodes and interfaces as possible by allocating the virtual demands to a consolidated subset of active physical networking equipment. As exact energy efficient VNE approaches are hard to solve for large network sizes and have an adverse effect in the number of successful embeddings, an heuristic approach is to reconfigure the allocation of already embedded virtual networks,to minimize the energy consumption.

In recent years, various high-speed network architectures have been widespread deployed. Dense Wavelength Division Multiplexing (DWDM) has gained favor as a terabit solution. The optical circuit switching has been provided for ‘‘sub-rate’’ aggregation. The granular types of demands tend to be diverse and must be evaluated. However, current dedicated optical networks do not offer sufficient flexibility to satisfy the requirements of demands with such wide range of granularities. The traffic grooming increases power-efficient only when it does not utilize the aggregation of Coarse-Granularity (CG) demands. The waveband switching clearly provides port-cost-effective connections for CG demands regardless of fine-granularity ones. Consequently, we devise a heterogeneous grooming method called traffic partition grooming. It includes the power efficiency advantage of the traffic grooming under fine-granularity environment and the port savings advantage of the waveband switching under coarse-granularity environment to provide green provisioning. In addition, optical virtual topology self-reconfigures along with various optimization objectives variation and has the robustness to determine the pre-unknown information. The effective green provisioning and OPEX savings of our R2HON can be demonstrated by numerical simulations.

We claim that energy management should be incorporated at the planning stages to produce an effective energy-management operation. For this, we propose a mathematical framework that takes into account the trade-off of capital expenditures vs. energy-related operational ones when designing the network. The results can be put into relevance the impact of different coverage policies on energy efficiency.

1. Green Networking Research

Reduction of unnecessary energy consumption becoming a major concern in wired networking, because of the benefits in potential economical areas and of its expected environmental impact. These are usually referred to as “green networking”,relate to embed the energy-awareness in the design, in the protocols and in the devices of networks.In this we first formulate more precise definition of the “green” attribute. We furthermore identify few paradigms that are the key enablers of energy-aware networking research.We then overview the current state or status of the art and provide taxonomy of the relevant work, with special focus on wired networking. At high level, we identify four branches of green networking research that stem from different observations on the oot causes of energy waste, namely (i) Adaptive Link Rate, (ii) Interface proxying, (iii) Energy-aware infrastructures and (iv)Energy-aware applications. In this work, we do not only explorspecific proposals pertaining to each of the above branches, but also offer a perspective for research.Index

Green communications using Adaptive Link Rate

The Information and Communication Technology sector is considered to be a major consumer of energy and has become an active participant in Green House Gas emissions. Lots of efforts are devoted to make network infrastructure and network protocols power-aware and green. Among all these efforts, Adaptive Link Rate (ALR) is one of the most widely discussed approaches.

The reduction of energy consumption has become a key issue for industries, because of environmental ,economical and marketing reasons. If this concern has strong influence on electronics designers, the communication and information technology sector, and specifically the networking field, also concerned. For instance, data-centers and networking infrastructure involve high-performance and high-availability machines. Therefore they rely on powerful devices, which require energy-consuming air conditioning to sustain their

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operation, and which are organized in redundant architecture.As these architectures are designed often to endure peak load and degraded conditions, they are under-utilized in normal operation, leaving large room for energy savings. In recent years, valuable efforts have indeed been dedicated to reducing unnecessary energy expenditure, which is nicknamed as a greening of the networking technologies and protocols.As energy-related studies in wireless networks are very specific and would require a dedicated study, this survey focuses on wired networks, even though a section exposes some wireless technologies optimizations. In these networks,energy saving often requires to reduce network performance or redundancy. Considering the compromise between the network performance and energy savings, determine efficient strategies to limit the network energy consumption is real challenge. However, although the green networking field is still in its infancy, a number of interesting works have been carried out, which are overviewed in present survey.

2. MOTIVATIONS AND OBJECTIVES

A. Why save energy Consciousness of environmental problems tied to Green- House Gases (GHG) increased during the recent years. All around the world, various studies started highlighting the devastating effects of massive GHG emissions and their consequences on the climate change. According to the report published by the European Union , a decrease in emission volume of 15%–30% is required before year 2020 to keep the global temperature increase below 2C.GHG effects are not limited to the environment, though.

Their influence on economy have also been investigated and their financial damage has been put in perspective with the potential economical benefits that would follow GHG reduction.In particular, projected that a 1/3 reduction of the GHG emissions may generate an economical benefit higher than the investment required to reach this goal. Political powers are also seeking to build a momentum around a greener industry, in the perspective of enforcing a sustainable long-term development, and as a possible economic upturn factor on a shorter perspective.

GHG reduction objectives involve many industry branches, including the Information and Communication Technology (ICT) sector, especially considering the penetration of these technologies in everyday life. Indeed, the volume of CO emissions produced by the ICT sector alone has been estimated an approximate 2% of the total man-made emissions in .when considering only developed countries such as the United Kingdom, this figure rises up to 10% . As the precise evaluation of these numbers is a difficult process, these projections are likely neither entirely accurate, nor up-to-date. Nevertheless, these studies all agree on the fact that ICT represents an important source of energy consumption and GHG emissions. Even if the incentives are still not clear (e.g., in term of regulations), there seems to be a clear innovation.

Opportunity in making network devices and protocols aware of the energy they consume, so that they can make efficient and responsible (or “green”) decisions. B. Where to save energy .Before attempting to reduce energy consumption, or to understand by what means such reduction can be achieved, it is necessary to identify where the largest improvements could take place. The Internet, for instance, can be segmented into a core network and several types of access networks. In these different segments, the equipment involved, its objectives and its expected performance and energy consumption levels differ. As such, one may reasonably expect that both the consumption figures and the possible enhancements are considerably different. In 2002, analyzed the energy consumption contributions of different categories of equipment in the global Internet. Local area networks, through hubs and switches, are responsible for about 80% of the total Internet consumption at that time. In 2005, the authors of estimate the relative contribution of the Network Interface Cards (NICs) and all the other network elements and conclude that the NICs are responsible for almost half of the total power consumption.More recently, studies have started suggesting an increase of the consumption in the network core: for instance, in 2009 Deutsche Telekom forecasts that by year 2017, the power consumption of the network core will be equal to that of the network access (the study also suggested a stunning 300% rise in power consumption of the network core in coming decade). Not surprisingly, everything evolves rapidly in the ICT domain, which makes the aforementioned figures and estimations quickly out-dated and possibly inaccurate. As a consequence, there is a true need for a permanent evaluation of this consumption, in order to point out and update regularly the most relevant targets for potential energy-savings. However, such an evaluation requires a collaboration of equipment manufacturers, Internet service providers and governments, which is clearly not an easy process. From a strict environmental point of view, the objective of green networking is to aim at the minimization of the GHG emissions. An obvious first step in this direction is to enforce as much as possible the use of renewable energy in ICT. Yet another natural track is to design low power components, able to offer the same level of performance.

3. ENERGY AWARE APPLICATIONS

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In the last years, the increasing need for containing energy consumption has caught the interest of both the industrial and academic communities. In this scenario, the communication networks - and more generally the whole ICT world - may be considered both a significant energy consumer and a potential actor in steering a more clever usage of energy resources.

These new challenges require innovative and effective optimization solutions for minimizing power consumption in the next generation telecommunication and computing systems, such as energy-efficient devices, resource scheduling algorithms and control plane protocols. On the other hand, energy awareness may also introduce new dimensions in security menaces since energy-efficient technologies may provide attackers with new opportunities for exploiting specific power-related vulnerabilities by introducing new energy-based denial of service attacks based on raising the target facility power consumption and consequently its greenhouse gases (GHG) emissions and costs.

NIC Energy-Aware Networking

While ICT is seen as a large part of the solution towards reducing the world's carbon footprint (e.g., video-conferencing reducing air-miles, dynamic energy monitoring and control, multi-modal transport logistic solutions, etc.), ICT in itself needs to become more energy efficient. For example the EU Commission is pushing for ICT to reduce its own carbon footprint by 20% by 2015. Energy Efficient ICT refers to all efforts to "Green" ICT, to reduce power consumption and carbon emissions of ICT networks and systems. Given the growth rate in internet traffic, this is important both for environmental and financial reasons.

In NIC in DCU energy efficient ICT research covers a multitude of work from wired to wireless technologies, physical to application layer schemes, from energy-saving network-wide schemes to saving energy at individual component level, all for future next generation networks.

4. Types of green energy

Research into renewable, non-polluting energy sources is advancing at such a fast pace, it's hard to keep track of the many types of green energy that are now in development. Here are 6 of the most common types of green energy:

Solar Power - The most prevalent type of renewable energy, solar power is typically produced using photovoltaic cells, which capture sunlight and turn it into electricity. Solar energy is also used to heat buildings and water, provide natural lighting and cook food. Solar technologies have become inexpensive enough to power everything from small hand-held gadgets to entire neighborhoods.

Wind Power - Air flow on the earth's surface can be used to push turbines, with stronger winds producing more energy. High-altitude sites and areas just offshore tend to provide the best conditions for capturing the strongest winds. According to a 2009 study, a network of land-based, 2.5-megawatt wind turbines in rural areas operating at just 20% of their rated capacity could supply 40 times the current worldwide consumption of energy.

Hydropower - Also called hydroelectric power, hydropower is generated by the Earth's water cycle, including evaporation, rainfall, tides and the force of water running through a dam. Hydropower depends on high precipitation levels to produce significant amounts of energy.

Geothermal Energy - Just under the earth's crust are massive amounts of thermal energy, which originates from both the original formation of the planet and the radioactive decay of minerals. Geothermal energy in the form of hot springs has been used by humans for millennia for bathing, and now it's being used to generate electricity. In North America alone, there's enough energy stored underground to produce 10 times as much electricity as coal currently does.

Biomass - Recently-living natural materials like wood waste, sawdust and combustible agricultural wastes can be converted into energy with far fewer greenhouse gas emissions than petroleum-based fuel sources. That's because these materials, known as biomass, contain stored energy from the sun.

Biofuels - Rather than burning biomass to produce energy, sometimes these renewable organic materials are transformed into fuel. Notable examples include ethanol and biodiesel. Biofuels provided 2.7% of the world's fuels for road transport in 2010, and have the potential to meet more than 25% of world demand for transportation fuels by 2050.

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Mrs.S.RADHA received her B.Tech. degree in 2005 from the Department of Electronics and Communication Engineering, SKIT, Srikalahasthi, Chittoor ,Andhra Pradesh and M.Tech degree in 2011 with Specialization in VLSD,TKRCET,Hyderabad,Andhra Pradesh. She worked in GKCET from 2005 to 2006 and worked in TKRCET from 2006 to 2009 as Assistant Professor. She Qualified in GATE exam in the years 2008,2009,2012, 2013 and presently working in Karunya University,Coimbatore,India as Assistant Professor.Her general research interests include Green Communication Networks , with emphasis on OFDM and MIMO techniques, cross-layer optimization, and signal processing issues in cognitive radios.Mrs.S.Radha may be reached at radharaju47@gmail.com.

Mr.P.Nagabushanam received his B.Tech. degree in 2005 from the Department of Electrical and Electronics Engineering, SKIT, Srikalahasthi, Chittoor ,Andhra Pradesh and M.Tech degree in 2013 with Specialization in Electrical Power Systems ,JBIET,Hyderabad,Andhra Pradesh. He worked in BEML,Bangalore from 2006 to 2007 as Graduate Trainee and worked in Rythwik Technologies,Private Ltd from 2007 to 2008 as Junior Engineer. He Qualified in GATE exam in the years 2010 , 2013 and presently working in Karunya university,Coimbatore,India as Assistant Professor.His general research interests include Smart Grids and its applications in Power systems , with emphasis on Voltage Stability and Energy saving techniques and signal processing issues.Mr.P.Nagabushanam may be reached at nagabushanam@karunya.edu.

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