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Energy Efficient Networks : A Survey

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Abstract: Energy efficiency has become an increasingly important aspect of designing access networks, due to both increased concerns for global warming and increased network costs related to energy consumption. Comparing access, metro, and core, the access constitutes a substantial part of the per subscriber network energy consumption and is regarded as the bottleneck for increased network energy efficiency. One of the main opportunities for reducing network energy consumption lies in efficiency improvements of the customer premises equipment. Access networks in general are designed for low utilization while supporting high peak access rates. This paper outlines the best and improvised energy efficient techniques.

Keywords: wireless; energy; internet; content centric; networking; cognitive; cellular network; wireless mesh infrastructure

I. INTRODUCTION

The vast majority of current Internet usage consists of content being disseminated from a source to a number of users, ranging from distributing conventional multi-media data (e.g., IPTV, Hulu, and Netflix) to sharing user generated data over the web such as text, image, and video data (e.g., Facebook, Twitter, and YouTube). Growing demands for content distribution led content service providers like Google, Yahoo, and Microsoft to invest in large data centers with hundreds of thousands of machines distributed across different geographic regions . Due to the sheer size, it is reported that data centers consume Significant energy — the U.S. Environmental Protection Agency (EPA) estimates that servers and data centers could consume 100 billion kWh at a cost of $7.4 billion per year by 2011. A number of different approaches have been proposed to address this problem, such as introducing efficient cooling methods, dynamically provisioning servers to account for diurnal usage patterns, and scaling power consumption of servers proportional to their utilization (also known as energy-proportional computing). Along with the expansion of data c nn enters, backbone network providers have been increasing network capacity to meet the ever increasing demands, by deploying a large number of high-speed routers and fiber transmission systems. For more efficient content delivery, large content service providers also build their own private networks that interconnect their data centers. The Internet has been rapidly growing and now includes a web of tens of millions of networking devices ranging from routers to home gateways, thus consuming considerable energy overall.

A. Energy efficient enhancement methods in the internet:

Hinton, Jayant Baliga, Michael Feng et.al had proposed a model which gives us a scope to empathize about various segments of internet, that chip in to the network power with the increase of internet access over time. It had also illustrated that the present day network access takes over internet's power consumption with the raise in access speeds; the power consumption which is also being dominated by the core network routers. Discussions about the various effectual approaches for improvising equipment energy efficiency were also held. The model analysis reveals that the Consumption of power is fairly dependent on the requests that are being made for the contents and independent of the number of downloads per hour. It is being said that the prevalent contents that are being accessed by the user must be accumulated nearer to the individual using it, which means that there will be manifold prevalent and popular copies should be made available across the network. On the other hand only a fewer copies should be made available in centralized sites of less popular contents. The promising energy-efficient solution was to concede among the number/location of the preserved copies and in transporting them to the individual's location. In this model it is quite essential summarize about the power consumption management in the internet's infrastructure where the energy is consumed. The intended model had addressed the causes which lead to the effects and they were identified[1].

B. Content centric networking(CCN)approach:

Uichin Lee et.al had reviewed the subsisting content distribution architectures and a survey was carried out on different network devices which are utilized for content delivery. Energy efficiency optimization of various data centers were also studied in the literature and it is interesting to note that less attention was paid so far in analyzing the energy efficiency of different content distribution. Comparison of energy efficiency with the aid of simple trace- based simulations will make us to understand that a change to a content-centric networking through a host-oriented model will improvise the energy efficiency of content dissemination considerably. Energy efficiency improvisation of networking

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devices were given high priority and during the due course of realizing so called energy-proportional networking where the consumption of energy is proportional to the network interfaces utilization. Networking devices energy efficiency was summarized and evaluated which are ranging from edge/core routers to home gate ways. From the model analysis and we can make out that CCN had cut short the hop length effectively, which in turn reduces the energy consumption to a greater extent. It was clear that comparison of energy- efficiency via trace-based simulations reveals us that CCN will significantly will enhances the energy efficiency of content dissemination. It was concluded that efficient implementation of CCN content processing will considerably bring down the energy the consumption. This analysis and results gave scope for their future work in the same direction in which they had yield better results[2].

C. Methodology for Reduction of PON CPE energy consumption :

Bjorn Skubic et.al had focused in minimizing the consumption of network energy efficiency which depends on improvising the efficiency of the places surrounded by the user. In these paper simulations of the two new low power modes that are discussed are capable of supporting the new XG-PON standard, cyclic sleep, involving powering off the ONU transceiver, allows for greater power savings but at the cost of reduced QoS performance for longer sleep intervals. Doze mode, on the other hand, involving only powering off the transmitter part of the transceiver, allows for more limited power savings but without incurring any QoS penalties. Hence, the choice of suitable power saving mode depends on traffic load and service requirements. Considering that most residential traffic will be downstream multicast (TV viewing) with occasional IGMP doze/wake-up indications, which determine the criteria for transitioning between the active state and the cyclic low power states, play an important role in power management operations. Results in this article are based on simple implementations, and more research can be expected in the future on optimal implementations of these functions[3].

D. Enabling backbone network:

Raffaele Bolla et.al proposed a method in which it deals with the use of standby primitives in backbone network devices. It considers the state-of-the-art device architectures and protocol stack usually deployed in current telcos' core networks. This paper also discusses about potential drawbacks on network performance and operational behaviour, and propose a comprehensive approach to smartly support such primitives, avoiding network instabilities and traffic signaling storms. The proposed solution allows dynamic management of standby primitives according to network traffic volume, and some QoS and resilience performance constraints. The proposed approach has been experimentally validated by means of an energy-aware modular router prototype[4].

E. Wireless Mesh Infrastructures :

Yahya Al-Hazmi et.al had come with various different approaches to reduce energy consumption in WMIs, taking into account the heterogeneity of the technologies and the interaction with wired networks. This paper presents an example scenario where the application of these methods is discussed. Cross-layer approaches have high energy saving potential, but, when applied, they should maintain a modular open network structure. In general, methods for improving energy efficiency need to be applied having in mind the different technologies involved, the presence of distributed mechanisms and the different communication layers involved[5].

F. Cellular network energy efficiency model with embodied energy:

Iztok Humar et.al research focuses on embodied energy which accounts for a significant proportion of total energy consumption and cannot be neglected. The simulation results confirm an important trade-off between operating and embodied energies, which can provide some practical guidelines for designing energy-efficient cellular access networks. The new model considering embodied energy is not limited to just cellular networks, but to other telecommunications, such as wireless local area networks and wired networks. Based on the proposed energy efficiency model and simulation results, the findings tend to disagree with suggestions to use an increased number of BSs with lower transmission power and power-down strategy to perform energy savings. Moreover, further solutions of energy efficiency optimization should consider a trade-off between the embodied and operating energies in cellular networks, as suggested. However, to fully estimate and improve the energy efficiency of cellular networks, researchers, manufacturers, operators, and regulatory authorities should work together to establish a framework of energy efficiency covering all telecommunication stages, which include the concept definition, life cycle assessments, standards regulation, expense estimation, and so on[6].

G. Wireless Communications via Cognitive Dimension:

There are two fundamental but entangled aspects of cognitive radios in the green communications context: leveraging CRs for energy efficiency and operation of CRs with energy efficiency. In practice, these two objectives overlap since the improvement of energy efficiency with CRs require efficient CRs, whereas efficient wireless communications require cognitive abilities at different network components and protocols. In this article we present and discuss these issues to highlight the case of CRs for green wireless communication systems. Additionally, some fundamental trade-offs that emerge from these challenges and their impact on greening communications via cognitive functions are outlined. this approach is crucial to cope with global warming and to enable global sustainable development. In this work, we have presented and discussed CRs from the perspective of green wireless communications. We have also outlined the issues and trade-offs entangled with fusion of cognitive dimension and wireless systems[7].

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II. CONCLUSION

We have reviewed existing content dissemination methods and summarized our evaluation results on energy efficiency of networking devices ranging from edge/core routers to home gateways. After illustrating content-centric networking, we have considered energy-efficient content router configurations of different networking devices. The energy efficiency comparison via trace-based simulations shows that content-centric networking can substantially improve the energy efficiency of content dissemination. Our preliminary results are encouraging and will stimulate further research in this direction.

The importance of the Internet and ICT is continually increasing in terms of economic growth. Therefore, to manage the power consumption of the Internet, it is important to understand the energy is consumed in the Internet's infrastructure. This review paper has described some possible approaches to attaining this understanding and used it to identify those parts of the Internet that dominate its power consumption and appropriate solution. This information can then be used to make the Internet more energy efficient. As the world becomes more energy constrained, humankind will need to develop and refine strategies for improving the energy efficiency of the Internet.

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