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RENEWABLE ENERGY RESOURCES TO REDUCE CO2 EMISSIONS IN DATACENTERS WITH IP-OVER-WDM NETWORK IN CLOUD COMPUTING

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ABSTRACT

As cloud computing consent increases, the energy consumption of the network and of the computing resources that underpin the cloud is growing and causing the emission of enormous quantities of CO2. Research is now focusing on novel "low-carbon" cloud computing solutions. Renewable energy source are rising as a promising solution both to achieve drastic reduction in CO2 emissions and to cope with the growing power requirements of data centers. These infrastructures can be placed near renewable energy plants and data can be effectively transferred to these locations via reconfigurable optical networks, based on the rule that data can be moved more efficiently than electricity. This paper focus on how to dynamically route on-demand optical circuits that are established to transfer energy-intensive data processing towards data centers powered with renewable energy.

KEYWORDS: renewable energy, optical networks,cloud computing,datacenters.

INTRODUCTION

We consider a scenario of an IP-over-WDM network interconnecting a set of geographically distributed DCs (also called DC federation). DCs can be either brown-powered(i.e., powered by energy produced through fossil fuels) or green co-powered, (i.e., DC is co-located with a renewable energy plant which provides green energy to the DC). Since the production of renewable energy is variable in time, the green DCs are also provided with brown energy supply to be used when green energy is not available. The goal of this paper is to devise novel routing algorithms that allow us to reduce the $CO2$ emissions of the DCs connected to IP-over-WDM networks, or, in other words, that allow to minimize the utilization of brown energies in the DCs. This means that routing should be performed such that utilization of green co-powered DCs is maximized in those periods when they have availability of green energy. As a first contribution and preliminary analysis for the rest of the paper, we model the various terms of power consumption of an IP-over-WDM network interconnecting DCs. We provide: *i*) an approximated formula to estimate the energy consumption of a specific case of a cloud-computing service, called Processing as a Service; *ii*) a case-study dimensioning of the size and capacity of renewable energy plants (wind and solar) to power an entire DC subject to a certain traffic; *iii*) a set of formulas to capture the energy consumption of different IP-over-WDM transport network architectures. We also perform an analysis on regular networks to evaluate how some important network parameters can affect our work. The objective of this preliminary phase is to evaluate how convenient is to transport bits to remotely located green DCs, instead of routing data to brown DCs closer to users. Then, as a main contribution of the paper, we propose and evaluate two new routing strategies, designed to route optical connections supporting (aggregation of) CC service requests, that are able to follow the current availability of renewable energy and consequently to reduce the $CO2$ emissions. Note that, in order to move this huge amount of data towards (usually) remote locations, the energy consumption for the data transfer arises and it may neutralize all the savings in terms of $CO2$ emissions coming from using renewable energy. So our algorithms are designed to carefully address the tradeoff between the energy consumption of data

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transport and the energy consumption to process the CC requests inside DCs.

EXISTING SYSTEM

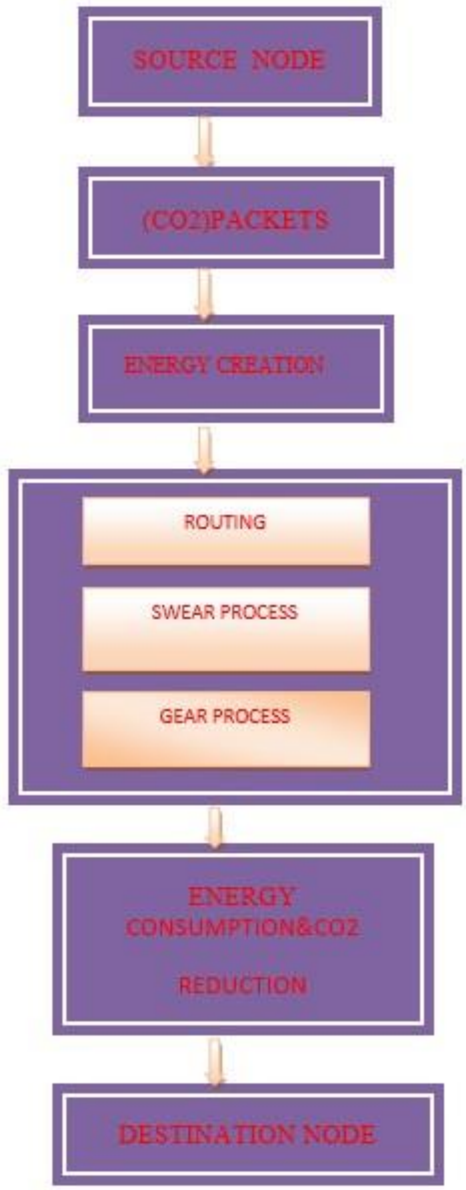
As cloud computing acceptance increases, the energy consumption of the network and of the computing resources that underpin the cloud is growing and causing the emission of enormous quantities of *CO2.*As Internet traffic is estimated to substantially grow in the near future, one of the most tough issues will concern the reduction of its power requirement. For the core/transport segment of the Internet, different network architectures can be considered, typically multi-layer architectures poised of an optical wavelength division multiplexing (WDM) transport layer under the classical electronic IP layer.

PROBLEM STATEMENT

The energy consumption of the network and of the computing resources that underpin the cloud is growing and causing the emission of enormous quantities of *CO*2. Information and Communication Technology (ICT) industry is rapidly developing worldwide, and this growth is inevitably associated to an increase of its carbon emissions. Energy consumption in telecommunication networks keeps growing fast, mainly due to emergence of new Cloud Computing (CC) services that need to be supported by large datacenters that consume a huge amount of energy and, in turn, reason the emission of enormous quantity of *CO*2.

WORKING OF PROPOSED SYSTEM

Renewable energy sources are emerging as a promising solution both to achieve drastic reduction in *CO*2 emissions and to cope with the growing power requirements of data centers. These infrastructures can be situated near renewable energy plants and data can be effectively transferred to these locations via reconfigurable optical networks, base on the principle that data can be moved more efficiently than electricity.This paper focus on how to dynamically route on-demand optical circuits that are established to transfer energy-intensive data processing towards data centers powered with renewable energy. Our major contribution consists in devising two routing algorithms for connections supporting CC services, expected at minimizing the *CO*2 emissions of data centers by following the current availability of renewable energies (e.g., coming from sun and wind). The trade-off with energy consumption for the transport equipments is considered. We also evaluate three different IP-over-WDM network architectures. The results prove that relevant reductions, up to about 30% in *CO*2 emissions can be achieved using our approaches compared to baseline shortest path- based routing strategies, paying off only a marginal raise in terms of network blocking probability.



System Architecture

Topology Construction

It always forces the routing towards the "greenest" data center, tends to create capacity bottlenecks that raise the *pb*values. We observe the lowest blocking with Shortest Path algorithm(as expected since SP used the lowest amount of network resources), but SWEAR and GEAR return very satisfactory blocking

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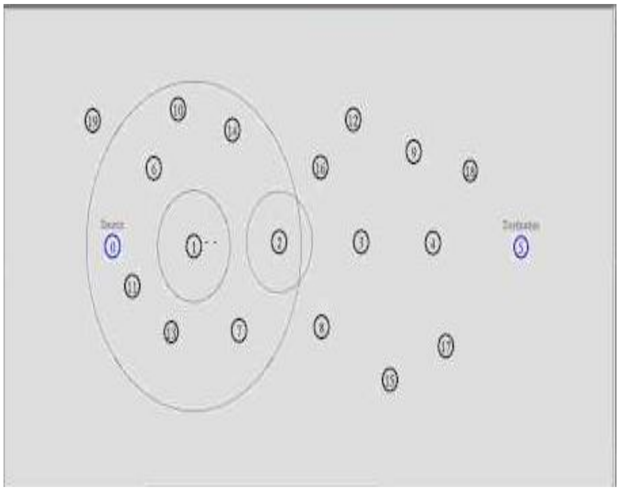
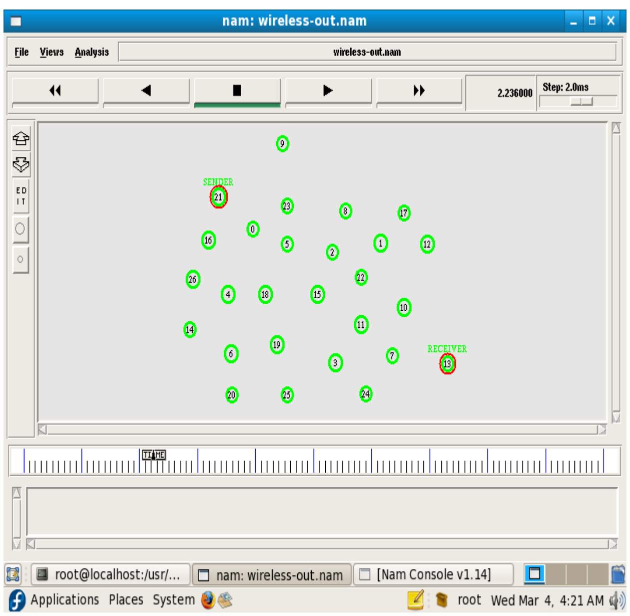
performance, especially in the case of SWEAR, that benefits of its load balancing phase.



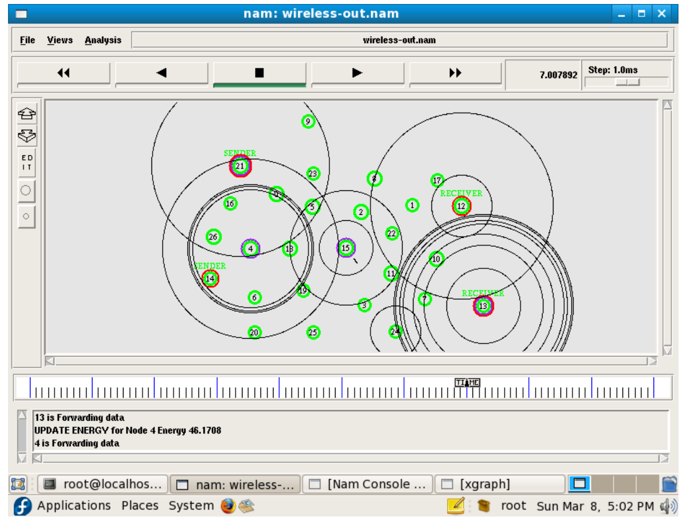
Energy creation of node

The utilization of renewable energy source is maximized, but, in return, the chosen path may have an excessive number of hops, leading to an increase in total transport and switching power consumption which overcomes the $CO2$ reduction coming from the renewable source.



Path selection with SWEAR

Fostering utilization of renewable resources through renewable-energy-aware routing is desirable, but care must be taken in avoiding an excessive increase of the average length of paths, especially if power-hungry transport network architectures are used.



Allocation monitoring with GEAR

The aim of GEAR is to directly find the path with the lowest non-renewable (brown) energy consumption. GEAR assigns as weights of a transport link the transport power, and as weight of the any cast link the current brown power of the DC connected to the network by that any cast link.

Over WDM process

The power consumption of IP-over-WDM networks that contain DCs (that process Cloud Computing requests) powered by renewable energy sources (wind and solar energy) by providing simple formulas to derive the energy consumption of different types of CC services and to perform a realistic dimensioning of capacity of renewable energy plants. Then, we propose and evaluate new routing strategies, designed to route optical connection supporting (aggregation of) CC service requests, that are able to follow the the current availability of renewable energy and consequently to reduce the CO2 emissions, without affecting other performance metrics such as blocking probability or delay. Note that, in order to move this huge amount of data towards (usually) remote locations, the energy consumption for the data transfer arises and it may neutralize all the savings in terms of CO2 emissions coming from using renewable energy.

CONCLUSION

In this paper, We have proposed two routing algorithms, SWEAR and GEAR, to perform low-carbon routing of dynamic connections in IP-over-WDM architecture with data centers equipped with renewable energy plants. Simulation results show in our case study that compared to the Shortest Path and

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Best GreenData Center, our algorithms SWEAR and GEAR have reduced the $CO2$ emission to serve traffic and process data by 25%- 27% while maintaining blocking probability at an acceptable level. We have also compared different IP over WDM network architectures to evaluate how the benefit by our algorithms. As expected, configurations with larger transport energy requirements (such as IP basic and IP-over-SDH) benefit less from renewable-energy-aware algorithms.

REFERENCES

[1] M. Gattulli, M. Tornatore, R. Fiandra, and A. Pattavina, "Low-carbon routing algorithms for cloud computing services in IP-over-WDM networks" in IEEE International Conference on Communications (ICC 2012), Ottawa, Canada, June 2012.

[2] P. Leisching and M. Pickavet, "Energy footprint of ICT: Forecasts and network solutions," in OFC/NFOEC'09, San Diego, march 2009. "SMART 2020: Enabling the Low Carbon Economy in the Information Age," 2008.

[3] G. Shen and R. Tucker, "Energy-minimized design for IP over WDM networks," IEEE/OSA J.Lightwave Technol., vol. 29, no. 1, pp. 3–14, jan. 2011.

[4] C. Cavdar, "Energy-efficient connection provisioning in WDM optical networks," in IEEE Optical Fiber Communication Conference (OFC), Los Angeles, USA, mar. 2011. "The GreenStar Network Website," http://www.greenstarnetwork.com/, 2011.

[5] X. Dong, T. El-Gorashi, and J. Elmirghani, "IP over WDM networks employing renewable energy sources," IEEE/OSA J. Lightwave Technol., vol. 29, no. 1, pp. 3–14, Jan. 2011.

[6] X. Dong, T. El-Gorashi, and J.Elmirghani, "Energy-efficient IP over WDM networks with data centres," in IEEE International Conference on Transparent Optical Networks (ICTON), Stockholm, Sweden, 2011.

[7] S. Ricciardi, D. Careglio, F. Palmieri, U. Fiore, G. Santos-Boada, and J. Sol´e-Pareta, "Energy-aware RWA for WDM networks with dual power sources," in IEEE International Conference on Communications (ICC 2011), Kyoto, Japan, june 2011.

[8] R. Carroll, S. Balasubramaniam, D. Botvich, and W. Donnelly, "Dynamic optimization solution for green service migration in data centres," inIEEE International Conference on Communications (ICC 2011), june2011.

[9] Tzanakaki, M. Anastasopoulos, K. Georgakilas, J. Buysse, M. D. Leenheer, C. Develder, S. Peng, R. Nejabati, E. Escalona, D. Simeonidou, N. Ciulli, G. Landi, M. Brogle, A. Manfredi, E. Lopez, J. F. Riera, J. A. Garc´ıa-Esp´ın, P. Donaldio, G. Parladori, and J. Jimenez, "Energy efficiency in integrated it and optical network infrastructures.

[10] The geysers approach," in INFOCOM 2011 workshop on Green Communications and Networking, Shanghai, China, 1O-15 Apr. 2011.

[11] C. Despins, F. Labeau, T. L. Ngoc, R. Labelle, M. Cheriet, C. Thibeault, F. Gagnon, A. Leon-Garcia, O. Cherkaoui, B. St. Arnaud, J. Mcneill, Y. Lemieux, and M. Lemay, "Leveraging green communications for carbon emission reductions. Techniques, testbeds, and emerging carbon footprint standards," IEEE Commun. Mag., vol. 49, no. 8, pp. 101 –109, aug. 2011.

[12] M. Delucchi, "Wind, Water, and Solar Power for the World," IEEE Spectrum, sept. 2011.

[13] B. Bathula, V. Vokkarane, C. Lai, and K. Bergman, "Load-aware anycast routing in IP-over-WDM Networks," in IEEE International Conference on Communications (ICC 2011), june 2011.

[14] T. Stevens, M. De Leenheer, F. De Turck, B. Dhoedt, and P. Demeester, "Distributed job scheduling based on multiple constraints anycast routing," in3rd International Conference on Broadband Communications, Networks and Systems (BROADNETS 2006), oct. 2006.