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An Optimal Algorithm for Data Centres to Minimize the Power Supply

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Abstract— Energy crises pose some of the key problems faced by the world today. Power hungry data centers make the problem even worse for power systems. For example, Google's data centers consume more than 260 MWh of power per month, which is more than the power consumed by the entire Salt Lake City. The growing usage of World Wide Web and cloud computing services increases the power consumption and operating costs of data centers. The increase in power consumption of data centers has a significant influence on the operation of the power system. The computational services provided by the data center for stable and reliable operation of the power system are known as ancillary services. The key ancillary services required by the power system are: (a) optimal power flow on all Transmission Lines (TLs), (b) voltage stability, power loss reduction, and (c) identification of endangered TLs and buses. We find an optimal job scheduling technique for executing power systems' jobs on data centers in terms of low power consumption, reduced make span, and fewer preempted jobs. The power systems' jobs include Optimal Power Flow (OPF) calculation, transmission line importance index, and bus importance index. Moreover, a Service Level Agreement (SLA) between data centers and power systems is shown to provide mutual benefits.

Keywords—Service Level Agreement (SLA), Optimal Power Flow (OPF) calculation

I. INTRODUCTION

The power system's revenue is highly dependent on reliability and steady state performance [4]. Unreliable power systems that lack in QoS result in revenue loss. Moreover, the economic factors of power systems, such as demand-supply management, operational cost, and salaries of the utility crew get disturbed. Furthermore, degradation in QoS will prevent the electrical network from further expansion. Therefore, this problem is significantly different from normal cloud computing jobs, because power system jobs need to be computed very fast to prevent the power system from failing or degrading its operation. To accomplish power system jobs, other cloud computing jobs can be preempted. However, preempting other cloud computing jobs could result in a decrease of revenue for the data center [5]. This paper develops an Ancillary Services Model (ASM) and Service Level Agreement (SLA) that maximize data center revenue while ensuring that the power system maintains in stable operation. The problem is a research optimization problem and our model yields a symbiotic and inevitable relationship between the power system and the data center, which is unlike any other relationship between the data center and its jobs (e.g., the power system needs its jobs completed in a timely manner to maintain stability, while the data center needs the power system to be stable for its own continuous reliable power). Therefore, a mutually beneficial ASM is developed in this paper that achieves this while maximizing profit for both the power system and data center. The experimental results show that the research contribution is more versatile and covers a broader area in the field of smart power systems using the ASM compared to prior works.

II. RELATED WORK

A. New Attempt to Optimize Optimal Power Flow based Transmission Losses using Genetic Algorithm

This paper presents a new method using GADS Toolbox in MATLAB (A Genetic Algorithm Approach) to find the optimal solution of optimal power flow based transmission losses. Optimal power flow (OPF) is a key area of concern in electric industries. The basic OPF solution is obtained with objective function as production cost minimization while satisfying a set of system operating constraints. For reactive power optimization the OPF problem is formulated as minimization of system active power losses and improvement in voltage stability of the system. In this paper GA based optimal power flow solution is presented for IEEE 30-bus test power system with objective as transmission losses minimization and optimal results by GA are also compared with solution obtained by using Particle Swarm Optimization Technique.

B. A Survey on Geographic Load Balancing Based Data Center Power Management in the Smart Grid Environment

Power management is becoming an increasingly important issue for Internet services supported by multiple geo distributed data centers. These data center's energy consumptions and costs are becoming unacceptably high, and placing a heavy burden on both energy resources and the environment. Emerging smart grid provides a feasible way for dynamic and efficient power management of data centers. Various power management methodologies based on geographic load balancing (GLB) have recently been

proposed to effectively utilize several features of smart grid. In this paper, we summarize the motivations, current state of the art, approaches and techniques proposed in the recent research works in this discipline. In all of these works, many perspectives of power management have been addressed using various computer science principles. We specifically elaborate on how researchers are exploiting mathematical tools to address these perspectives. Finally, we point out subject matters that need more attentions from the research community and provide our vision on possible future works along this direction.

C.Data Centres to Offer Ancillary Service

Considering the growing number of Internet and cloud computing data centers being built in recent years and given the data centers major and yet flexible electric load, they can be good candidates to offer ancillary services, such as voluntary load reduction, to a smart grid. In this paper, we investigate such potential with in ananalytical profit maximization framework to determine whether participation in an ancillary service market can be beneficial to data centers. The profit model that we introduce includes elements with respect to a) the data center's revenue obtained from the Internet services that the data center offers based on its service-level agreements (SLA), b) the data center's cost of electricity based on time-of-use prices, and c) the monetary compensation that the data center may receive due to offering ancillary services based on the existing ancillary service market models in the ERCOT(Electric Reliability Council of Texas) Independent System Operator. Our simulation results show that data centers can noticeably increase their profit by participating in voluntary load reduction. Their participation can also help the grid better maintain service quality and reliability.

D. Preventive control approach for voltage stability improvement using voltage stability constrained optimal power flow based on static line voltage stability indices

Voltage stability improvement is a challenging issue in planning and security assessment of power systems. As modern systems are being operated under heavily stressed conditions with reduced stability margins, incorporation of voltage stability criteria in the operation of power systems began receiving great attention. This study presents a novel voltage stability constrained optimal power flow (VSC-OPF) approach based on static line voltage stability indices to simultaneously improve voltage stability and minimise power system losses under stressed and contingency conditions. The proposed methodology uses a voltage collapse proximity indicator (VCPI) to provide important information about the proximity of the system to voltage instability. The VCPI index is incorporated into the optimal power flow (OPF) formulation in two ways; first it can be added as a new voltage stability constraint in the OPF constraints, or used as a voltage stability objective function. The proposed approach has been evaluated on the standard IEEE 30-bus and 57-bus test systems under different cases and compared with two well proved VSC-OPF approaches based on the bus voltage indicator L-index and the minimum singular value. The simulation results are promising and demonstrate the effectiveness of the proposed VSC-OPF based on the line voltage stability index

E. On the Connectivity of Data Center Networks

Data Center Networks (DCNs) constitute the communication backbone for the cloud computing paradigm. Recently, network connectivity analysis in terms of reliability has received attention from the network research community. The traditional network features are useful; however, they are insufficient to determine how well-connected or well-designed a DCN is against the node or link removals. In this letter, we present a connectivity analysis of three well-known DCN architectures, namely: (a) ThreeTier , (b) FatTree , and (c) DCell . Our analysis reveals that the classic connectivity measures are inadequate for evaluating DCN connectivity. Therefore, we propose μ-A2TR, a novel metric to characterize network connectivity in the case of node or link failures. Experimental results reveal that the DCNs exhibit a moderate level of connectivity in the case of random node removals. However, connectivity decays abruptly when considering the targeted nodes removal. Moreover, the connectivity analysis depicts significant differences among the considered DCNs.

III. EXISTING SYSTEM

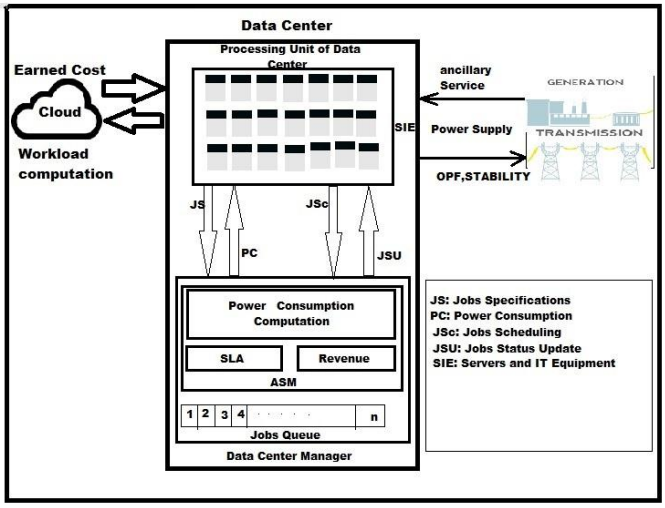
Enormous energy consumption of data centers has a major impact on power systems by significantly increasing the electrical load. Due to the increase in electrical load, power systems are facing demand and supply miss-management problems. Therefore, power systems require efficient and intelligent ancillary services to maintain robustness, reliability, and stability. Data centers can provide the computational capabilities to manage power systems; however, data centers consume a tremendous amount of energy, and energy price accounts for a significant portion of their operational cost. Power system jobs will make this situation even more critical for data centers.

IV. PROPOSED SYSTEM

We seek an Ancillary Services Model (ASM) to service data centers and power systems. In ASM, we find an optimal job scheduling technique for executing power systems' jobs on data centers in terms of low power consumption, reduced makespan, and fewer preempted jobs. The power systems' jobs include Optimal Power Flow (OPF) calculation, transmission line importance index, and bus importance index. Moreover, a Service Level Agreement (SLA) between data centers and power systems is shown to provide mutual benefits. we proposed an analytical model for a mutually beneficial relationship between a data center and its power system. The model ensures data center revenue maximization and power system stability and reliability

enhancement. Our model includes several factors, such as Service Level Agreement (SLA), electricity price, data center revenue model, Optimal Power Flow (OPF) solution for the power system to reduce transmission line losses, and identification of endangered buses and transmission lines. The simulations using a real-world data center's workload and IEEE standard bus systems validate the performance of the Ancillary Services Model (ASM). The proposed ASM will be further extended to multiple data centers attached to the power system. Demand response pricing scheme, such as time-of-use pricing will be incorporated to develop cost reduction models and power management algorithms for the data centers.

A. System Architecture



1) Register and Login:

Register and Login processing Password hashing is everywhere, from web services' credentials storage to mobile and desktop authentication or disk encryption systems. Yet there wasn't an established standard to fulfill the needs of modern applications and to best protect against attackers. We started the Password Hashing Competition (PHC) to solve this problem. This password hashing technique way password all are hashing and stored in database so this password never see admin .Register password are send in email so this password only known Register user only .so never hacking the password details intruder .this highly secure the password details in this proposed systems. This proposed system Login password are also based and compare the Register password. Register password and Login password are same User will be enter in our File Uploading page

2) Job Scheduling For Data Center

Server will be Start and job are Scheduled in Client File uploading sequence. This Job Scheduling process performed in data center . User Uploading File Are Maintain in data Centers. Once the server will be started waiting for file uploading. Client File Uploading process is complete . the Server Will be stop and moving to Sleep mode .until Any response to Admin. Same time User never uploading file in data center the server will be move to sleeping mode . Server Sleep mode before it Will be send Some data to the email. Data Are Server Sleep mode Time And Date . Same time Which File are Uploading in server this Data Also Send Email to server . This Admin Are check that file are Virus are not. Incase this File Are virus that data will be clean this server automatically .Same time Power Flow calculation the maximum power required to upload and download the file is maintained in this module. The power required to do these jobs are taken from the power of the CPU

3) File Storage

Clouds are the new trend in the evolution of the distributed systems, the predecessor of cloud being the grid. The user does not require knowledge or expertise to control the infrastructure of clouds; it provides only abstraction. It can be utilized as a service of an Internet with high scalability, higher throughput, quality of service and high computing power. Cloud computing providers deliver common online business applications which are accessed from servers through web browser the data owner to securely store their secret data on the semi-trusted cloud service providers, and selectively share their secret data with a wide range of data receiver. Data owner upload the several files and data.

4) Authentication:

Cloud brokers have been recently introduced as an additional computational layer to facilitate cloud selection and service management tasks for cloud consumers. However, existing brokerage schemes on cloud service selection typically assume that brokers are completely trusted, and do not provide any guarantee over the correctness of the service recommendations. To check and promote only legalized users, cloud must have right access control policies. Such services must be adjustable, well planned, and their allocation is overseeing conveniently. The approach governor provision must be integrated on the basis of Service Level Agreement (SLA). The authority will verify the data receiver's full details weather person in right person or cloud broker. The data receivers want to send request for the file which he want to download. Data provider check the details if the Owner want to share the original file with the data receiver he will accept the request.

5) Client Processing:

User's Uploading File and Downloading file it will be to send to the Register Mail. This Main Advantage of User . which File Is Upload And Download All the Data will be send our mail .This upload and download the file using our application features. He does no more work than that While he is uploading or downloading The file then shows the File Size And How many times taken to uploading or downloading the file is shown. This same Data will be sending Our Mail. This is main Advantage of this proposed System.

6) Optimal Power Flow Analysis:

This primary objective in a balanced power System is to Minimize generation cost. There are two main Constraints in power Balancing .(i) equality constraints (generation -load balance) and (ii) in equality constraints (upper and lower limits on the output of generating units). In a power system the generating units and loads are not connected to the same bus . therefore , the economic dispatch will result in voltage instability within the power system .moreover ,an optimal solution is required that results in acceptable power flow on all transmission line . the OPF is among the key parameters of power System that provides an optimal solution for the above mentioned problem ,and has a cogent relationship with cascading failures in the OPF the equality constaint is to balance complex power at each bus using power flow equation . the inequality constraints consist of TL flow and Voltages limit itations of control variables,including active power of generators ,voltages of generating units,postions of phase shifters ,status of reactors and switched capacitors , and disconnected loads. This way to checking server power flow and this data will be display server side

V. ALGORITHM

An algorithm is a procedure or formula for solving a problem, based on conducting a sequence of specified actions. A computer program can be viewed as an elaborate algorithm. In mathematics and computer science, an algorithm usually means a small procedure that solves a recurrent problem.

OPTIMAL POWERFLOW ALGORITHM

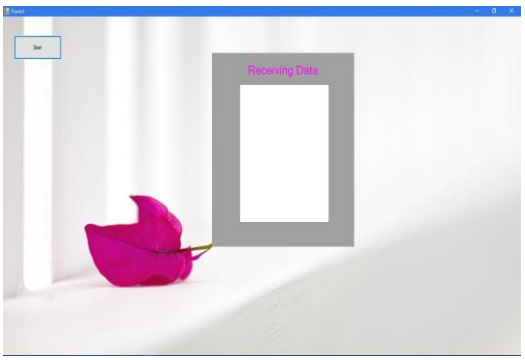
For the planner and operator fixed generation corresponds to a snapshot only. Planning and operating requirements very often ask for an adjustment of the generated powers according to certain criteria. One of the obvious ones is the minimum of the generating cost. The application of such a criterion immediately assumes variable input powers and bus voltages which have to be determined in such a way that a minimum of the cost of generating these powers is achieved. At this point it is not only the voltages at nodes where the loads are supplied but also the input powers together with the corresponding voltages at the generator nodes which have to be determined. The degree of freedom for the choice of inputs seems to be exceedingly large, but due to the presence of an objective, namely to reach the minimum of the generating cost the problem is well defined. Of course the mathematics become more demanding as compared to the original power flow problem, however, the aim still being the same, i.e. the determination of the nodal voltages in the system. They play the role of state variables from which all other quantities can be derived.

JOB SCHEDULING ALGORITHM

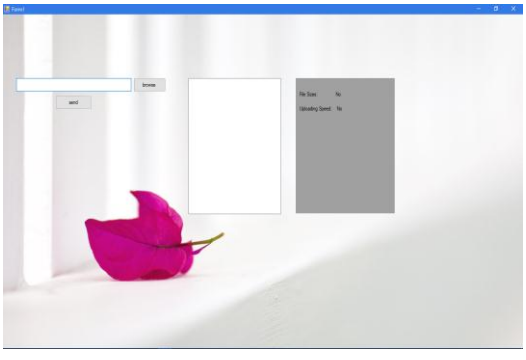
An important function of job shop scheduling is the coordination and control of complex activities, both optimum resource allocation and sequence in the performance of those activities. The job shop scheduling problem in which we must determine the order or sequence for processing a set of jobs through several machines in an optimum manner, has received considerable attention. A variety of scheduling rules and procedures for certain types of job shops have evolved from these efforts. Network planning and control techniques have found wide application to the scheduling problems associated with project activities. Numerous procedures also have been proposed for determining optimal or near-optimal work station assignments for assembly lines. The scheduling problem is difficult to standardize due to the variety of criteria involved. On the other hand, the choice of criteria has also been influenced by the prospects of obtaining a solution. In some models it has been possible to find optimal procedures only by departing from what would be considered the most natural and realistic criteria.

VI. EXPERIMENTAL RESULTS

Server side:



Client Side:



The analytical model for a mutually beneficial relationship between a data center and its power system. The model ensures data center revenue maximization and power system stability and reliability enhancement. Our model includes several factors, such as Service Level Agreement, electricity price, data center revenue model,

Optimal Power Flow (OPF) solution for the power system to reduce transmission line losses, and identification of endangered buses and transmission lines. The simulations using a real-world data center's workload and IEEE standard bus systems validate the performance of the Ancillary Services Model (ASM).The proposed ASM will be further extended to multiple data centers attached to the power system. Demand response pricing scheme, such as time-of-use pricing will be incorporated to develop cost reduction models and power management algorithms for the data centers.

VII. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, we proposed an analytical model for a mutually beneficial relationship between a data center and its power system. The model ensures data center revenue maximization and power system stability and reliability enhancement. Our model includes several factors, such as Service Level Agreement (SLA), electricity price, data center revenue model, Optimal Power Flow (OPF) solution for the power system to reduce transmission line losses, and identification of endangered buses and transmission lines. The simulations using a real-world data center's workload and IEEE standard bus systems validate the performance of the Ancillary Services Model (ASM). The proposed ASM will be further extended to multiple data centers attached to the power system. Demand response pricing scheme, such as time-of-use pricing will be incorporated to develop cost reduction models and power management algorithms for the data centers.

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