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A REVIEW ON CHALLENGES AND EXPECTED SOLUTIONS FOR GREEN COMMUNICATION

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ABSTRACT

Wireless communication is growing day by day to satisfy the need for voice and high data speed from the industry and users. To meet this demand we are upgrading communication system to 5G networks. This new technology has raised the demand of high data rate with voice and Quality of service (QoS) of signal parameters. These all also leads to the requirement of energy requirements. This high requirements also creates many issues related to human health and environment congestions. This paper is addressing the issue and challenges related to energy consumption, challenges in the development of low energy network, green energy concept in every parameter of 5G communication. We need to make a way to maintain demand and supply ration with green energy in all aspects. Here in this paper survey is done for the energy and resource relevant parameter and techniques for various domain like spectrum allocation and sharing, network density at different level, antenna designs, Internet of things (IoT) future applications, cell traffic, hardware solutions, resource allocations, energy harvesting and transfer, deployment and planning. In this paper, we address the effect of high
energy requirement in upcoming 5G technology, the effect of high energy and power on the environment, green energy solution on different parameters and designs.

INTRODUCTION

GLOBAL wireless data traffic shows no signs of slowing down and is expected to maintain its rapid growth in the near future due to the proliferation of smart devices and applications [1]. Emerging applications such as high-resolution video streaming, tactile Internet, remote monitoring, road safety and real-time control applications, are expected to produce huge amounts of data traffic. In addition, diverse proposed services, such as connected cars and moving robots must be supported in efficient scalable ways [2]. The current 4G wireless communication system is not equipped to meet this explosive growth in traffic demand. Consequently, several consortia, comprising major international mobile operators, infrastructure manufacturers, and academic institutions have engaged in the fifth generation (5G) wireless communication system design, planning, and implementation [3]–[5]. A public-private partnership for 5G (5G-PPP) has been constituted to deliver standards, architecture, and technologies for ubiquitous 5G infrastructure [6]. The aim is to develop, by 2020, a system that can support 1000 times increase in capacity, 1000 times higher mobile data volume per area, 100 times more connected devices, and 5 times reduced end-to-end delay than today's 4G network [7]. To achieve these challenges, some potential design considerations include multi-tier radio access technologies (Multi-RAT), device-to-device communication (D2D), massive multiple-input-multiple-output (MMIMO), network function virtualization (NFV), prioritized spectrum access, and base station (BS) densification [8]. For BS densification in 5G systems, a small cell network (SCN) based heterogeneous network (HetNet), is considered as a potential solution [9]. A HetNet is a mixed wireless infrastructure, with a combination of fewer high power macrocells and many low power small cells (e.g., micro, pico, and femto), that brings the network closer to the end user, thereby offering higher signal-tointerference-plus-noise ratio (SINR), which in turn improves link robustness and quality of service (QoS). In a HetNet, high reuse of frequency can greatly reduce the bandwidth scarcity problem. Another major 5G research challenge is to achieve up to 90% energy savings [6]. Recent evidence suggests that the Information and Communication Technology (ICT) sector itself consumes 4.7% of global electricity production [10], [11], and it is estimated that 4.4 terawatt-hours (TWh) power will be consumed by about 100 million SCNs in 2020 [12]. To address the challenge of increasing power demand, researchers have focused on "Green Communications and Networking" to develop energy-efficient solutions for next generation wireless communication standards [13]. Both access and backhaul network power consumption contribute to total power consumption in 5G HetNet systems. While SCNs help to reduce the bandwidth scarcity problem in HetNet, increasing numbers of uncoordinated and lightly loaded active SCNs can increase the access network power consumption [14]–[26]. There is a resemblance between this scenario in the 5G HetNet and the electric power industry [27], [28]. A smart grid system in the electric power industry consists of sources (e.g., diesel generators,

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renewable sources, coal-fired power stations), sinks (i.e., load/demand) and distribution networks. The demand curve is not uniform across various hours of the day. The smart grid system makes a temporal estimate of demand/load based on its historical data. This estimate is used as a constraint in an optimization model where the objective is to minimize the operational costs while ensuring that a blackout is avoided during various hours of the day. In a HetNet scenario, cells can be considered as sources of bandwidth, users' demand for data dictates the demand curve, and the communication network (similar to the distribution network) makes sure that the available bandwidth provides the required quality of service. It is obvious that maximum bandwidth can be made available by keeping all the small cells active during all hours of the day, but this would result in an oversupply of bandwidth and increased operational costs (i.e., power consumption) during periods of the day when the demand is not at its peak. As such, in a 5G HetNet, the temporal, as well as the spatial variation (e.g., different traffic load at different places) of traffic demand can be used to send cells into sleep mode. The gain would be power savings and reduction in operational costs. This motivated us to investigate and develop an analytical model to calculate the optimum number of active SCNs that are required to meet the data demand during various hours of the day. The aim was to reduce power consumption of 5G access networks without degrading the QoS. The true benefit of power savings can be realized if the savings come from both the access and backhaul segments of a HetNet. In 5G HetNet systems, traffic generated in small cells is required to be backhauled to the core network, and an increasing variety of backhauling solutions are expected to be deployed, including wired, wireless or mixed architecture of existing technologies. Using a direct high-capacity wired connection (e.g., fiber optic cable) from all SCNs to the core network is challenging and expensive [29]. Very high frequency (60-80 GHz) millimeter wave (mmWave) technology is now considered as a promising alternative wireless backhauling solution [30]–[33]. Both of these technologies have their relative strengths and weaknesses, but one major aim that they both share is to facilitate energy-efficient traffic forwarding to the core network. The issue of increasing backhaul power consumption has attracted considerable attention from service providers, because of its impact on overall network power budgets [34]–[42]. Recent evidence suggests that about 56% of providers consider the backhaul as one of the major challenges for future 5G HetNets [43]. In this research, to complement our proposed energy-efficient 5G access networking solution, we investigate power consumption of various backhaul designs and isolate two solutions, one for wired passive optical network (PON) and the other for wireless millimeter wave (mmWave). In our first solution, we present an access-backhaul design,where we show how to connect passive optical network units/terminals with 5G access units to reduce the overall power consumption. In our second solution, we present how to integrate mmWave backhaul units with 5G SCN units to reduce power consumption. We also present analytical models to calculate the total power consumption for both of these solutions. In addition, we analyze the QoS parameters, i.e., the delay and the jitter of the proposed green communication model for a 5G HetNet.

RELATED WORKS the network architecture of a 5G HetNet, where an access network is comprised of a macrocell and several SCNs (e.g., microcells, picocells, and femtocells). A backhaul network is created by connecting the base stations to the core network through various backhauling solutions including wired, wireless or mixed architecture of existing technologies Many research projects have been conducted in recent years to increase the energy efficiency for multi-tier HetNets [14]–[26]. Fehske et al. evaluated the influence of power consumption by varying the microsite density for a required system level performance in a macro-micro HetNet [14]. The optimum deployment strategy in a macro-pico type HetNet was investigated to reduce power consumption in terms of area power consumption with a specified area spectral efficiency [16]. An analysis framework to measure the macro offloading benefits was proposed to increase the energy efficiency for this HetNet [18]. The authors formulated the spectrum sharing and resource allocation as a three-stage Stackelberg game model for improving energy efficiency in heterogeneous cognitive radio networks [19]. To quantify the energy efficiency gain, several issues such as frequency plan, mobility, scheduling are surveyed in [20], [21]. However, all of these studies were conducted for peak traffic demand scenarios in a HetNet system. During peak traffic scenarios, some SCNs can be turned off without creating coverage holes. The QoS of the SCNs can be assured by offloading the traffic either horizontally to neighboring cells or vertically to higher layer cells. Base station sleep mode strategies [22]–[24] and network management schemes [25], [26] have been proposed for traffic-aware energy-efficient HetNet designs. Ashraf et al. [22] proposed three different sleep mode strategies to reduce power consumption in a HetNet based on network element characteristics. In [23], Marsan et al. developed an analytical model for optimal switch-off time based on the dynamic traffic profile. An architecture using two sleep strategies was developed in [24], by vertical offloading of traffic from SCNs to a macrocell. However, none of the above-mentioned articles provide the optimal number of SCNs that need to be active during various hours of the day to meet the traffic demand and minimize power consumption at the same time. In addition, existing energy-efficient techniques [14]–[26] do not take into account the power consumption of backhaul networks. Many authors have addressed backhaul issues including capacity, cost, and power consumption [29]–[42]. A recent survey revealed the ubiquitous unavailability of optical fiber connection around

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the globe [29]. Several studies have identified the millimeter wave (mmWave) technology (E-band or V-band) as a promising alternative backhauling solution on the basis of its high capacity, low cost, and ubiquitous availability [30]–[33]. The throughput and energy efficiency of a 5G wireless backhaul network were analyzed using mmWave and microwave band under two deployment scenarios, i.e., central and distributed [30]. In [31], millimeter wave technology was used for access and backhaul network functions and the authors highlighted a holistic design requirement approach. Mesodiakaki et al. analyzed the backhaul power consumption, with mmWave, microwave, and sub-6 GHz band, for outdoor small cell backhauling under different deployment scenarios [32]. In a related study, the optimal user association problem for HetNet was demonstrated to maximize the energy efficiency and spectrum efficiency by using mmWave technology [33]. Self-backhauling [34] and energy harvesting [35] techniques are also used to further improve the energy efficiency in small cell networks. When low power, small cell base stations are used to increase the capacity of the network, backhaul power consumption also undermines overall network energy efficiency [36]– [42]. This indicates a trade-off between the power saved by using low power small cell base stations and the excess power needed for backhauling their traffic. The impact of the backhaul power consumption model on overall energy efficiency in a heterogeneous network was first evaluated by Tombaz et al. [36], who used optical point-to-point Ethernet for backhauling. Monti et al. considered various topologies (star, tree, and ring) for microwave and optical fiber backhauling [37]. Subsequently, Tombaz et al. explored significant aspects of backhaul technologies using three solutions such as two hybrid solutions (fiber to the node using very high-speed digital subscriber line version 2 and fiber to the building with microwave) and a wireless solution (microwave only) for HetNets [38]. They analyzed the small cell density, backhaul architecture, and area capacity in terms of area power consumption. For the hybrid solutions, a very high-speed digital subscriber line version 2 (VDSL2) modem provided a maximum downlink throughput up to 230 Mbps by using a digital subscriber line access multiplexer (DSLAM) and 4 pair bonding with the phantom mode in the presence of copper wire, but it was vulnerable to electromagnetic interference. Another hybrid backhauling solution combining fiber to the building (FTTB) with microwave was also suggested as a favorable candidate with a high SCN deployment ratio scenario to support the backhauling traffic [38]. A comprehensive estimation model was presented for the total cost of ownership (TCO) calculation of a backhaul network segment when applied to a microwave and 10 GPON architecture with FTTB in [39]. Surez et al. further analyzed the power consumption modeling for the FTTB + 10 Gigabit PON backhauling solution in [40]. They investigated the impact of SCN density and resource capacity in an access network which may have the potential for reducing overall energy consumption and expenditure. The cost optimization of optical fiber point-to-point and PON backhauling for small cell networks was demonstrated [41], [42]. Although the PON solution was mentioned as a cost-effective fiber deployment for small cell backhauling, to the best of our knowledge, the complete backhaul power consumption analysis has not yet been studied. In addition, the influence on backhaul power consumption of traffic variation over a 24- hour period has not yet been investigated. As discussed above, although researchers have attempted to address the power efficiency issue of various backhaul solutions, there is no work in the literature that investigates the total power consumption from SCNs to the core network, based on a 24-hour traffic profile, when using either the mmWave or optical technology as a backhaul solution. The above-mentioned research gaps provided the motivation for this research work. The key contributions of this paper are: • we develop and present an analytical model to calculate the optimal number of required active SCNs during various hours of the day. The proposed solution saves power by putting redundant small cells into sleep mode while maintaining the QoS. • we investigate and introduce two energy-efficient backhaul solutions, to complement our proposed 5G access network solution.

EXISTING SYSTEM:

In existing system, Efficient hybrid energy aware clustering communication protocol for green IOT network Computing; hy-iot, but also provides a real iot network architecture for examining the proposed protocol compared to commonly existed Protocols. Efficient cluster-head selection boosts the utilization of the nodes energy contents and consequently increases the network life time as Well as the packets transmission rate to the base station It is based on Leach Algorithm. The existing system emphasizes the use of energy-efficient components in network infrastructure to reduce power consumption. Renewable Energy Integration: Some networks have started integrating renewable energy sources like solar and wind power into their operations, decreasing reliance on non-renewable energy. Innovative cooling techniques are employed to manage the heat generated by network equipment, improving overall energy efficiency. Deploying small cells in urban areas is a key practice to reduce energy consumption compared to traditional macro cells. Networks implement algorithms that adjust power consumption based on real-time demand and traffic patterns, reducing unnecessary energy usage. Industry-wide standards and certifications are followed to ensure adherence to environmentally sustainable practices. Thorough assessments are conducted to understand the environmental impact of network components from production to disposal, guiding eco-friendly practices. Data centers, a critical part of 5G infrastructure, are designed and operated to be more energy-

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efficient. Advanced planning tools and algorithms are used to optimize network layouts and resource allocation for improved energy efficiency.

DISADVANTAGES

- It is based on Low Energy Consumption.

PROPOSED SYSTEM

In this system, protocols. Efficient cluster-head selection boosts the utilization of the nodes energy contents and consequently increases the network life time as Well as the packets transmission rate to the base station. It is based on Leach for PSO Algorithm and dragonfly Algorithm Performance measures such as network life time and Packet loss.

ADVANTAGES

- It is efficient for Randomized for rotation of Cluster head .
- It is more effective of performance analysis.

IMPLEMENTAION

- Data Selection and Loading
- Data Preprocessing
- Splitting Dataset into Train and Test Data
- Classification
- Prediction
- Result Generation

DATA SELECTION AND LOADING

- Data selection is the process of determining the appropriate data type and source, as well as suitable instruments to collect data.
- Data selection precedes the actual practice of data collection and it is the process where data relevant to the analysis is decided and retrieved from the data collection.
- In this project, the Malware dataset is used for detecting Malware type prediction.

DATA PREPROCESSING

- The data can have many irrelevant and missing parts. To handle this part, data cleaning is done. It involves handling of missing data, noisy data etc.
- **Missing Data:** This situation arises when some data is missing in the data. It can be handled in various ways.
  - ✓ Ignore the tuples: This approach is suitable only when the dataset we have is quite large and multiple values are missing within a tuple.
  - ✓ Fill the Missing values: There are various ways to do this task. You can choose to fill the missing values manually, by attribute mean or the most probable value.
- **Encoding Categorical data**: That categorical data is defined as variables with a finite set of label values. That most machine learning algorithms require numerical input and output variables. That an integer and one hot encoding is used to convert categorical data to integer data.
- **Count Vectorizer:** Scikit-learn's CountVectorizer is used to convert a collection of text documents to a vector of term/token **counts**. It also enables the pre-processing of text data prior to generating the vector representation. This functionality makes it a highly flexible feature representation module for text.

SPLITTING DATASET INTO TRAIN AND TEST DATA

- Data splitting is the act of partitioning available data into two portions, usually for cross-validator purposes.
- One Portion of the data is used to develop a predictive model and the other to evaluate the model's performance.
- Separating data into training and testing sets is an important part of evaluating data mining models.
- Typically, when you separate a data set into a training set and testing set, most of the data is used for training, and a smaller portion of the data is used for testing.
- To train any machine learning model irrespective what type of dataset is being used you have to split the dataset into training data and testing data.

CLASSIFICATION

Classification is the problem of identifying to which of a set of categories, a new observation belongs to, on the basis of a training set of data containing observations and whose categories membership is known.

Random forests or random decision forests are an ensemble learning method for classification, regression and other tasks that operate by constructing a multitude of decision trees at training time and outputting the class that is the mode of the classes (classification) or mean/average prediction (regression) of the individual trees.

Decision Trees are a type of Supervised Machine Learning (that is you **explain** what the input is and what the corresponding output is in the training data) where the data is continuously split

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according to a certain parameter. An **example** of a **decision tree** can be **explained** using above binary **tree**.

The **SVM** is one of the most powerful methods in machine learning algorithms. It can find a balance between model complexity and classification ability given limited sample information. Compared to other machine learning methods, the SVM has many advantages in that it can overcome the effects of noise and work without any prior knowledge. The SVM is a non-probabilistic binary linear classifier that predicts an input to one of two classes for each given input. It optimizes the linear analysis and classification of hyperplane formation techniques.

The NN algorithm is mainly used for classification and regression in machine learning. To determine the category of an unknown sample, all training samples are used as representative points, the distances between the unknown sample and all training sample points are calculated, and the NN is used. The category is the sole basis for determining the unknown sample category. Because the NN algorithm is particularly sensitive to noise data, the K-nearest neighbour algorithm (KNN) is introduced. The main concept of the KNN is that when the data and tags in the training set are known, the test data are input, the characteristics of the test data are compared with the features corresponding to the training set, and the most similar K in the training set is found.

PREDICTION

Predictive analytics algorithms try to achieve the lowest error possible by either using "boosting" or "bagging".

Accuracy − Accuracy of classifier refers to the ability of classifier. It predict the class label correctly and the accuracy of the predictor refers to how well a given predictor can guess the value of predicted attribute for a new data.

Speed − Refers to the computational cost in generating and using the classifier or predictor.

Robustness − It refers to the ability of classifier or predictor to make correct predictions from given noisy data.

Scalability − Scalability refers to the ability to construct the classifier or predictor efficiently; given large amount of data.

Interpretability − It refers to what extent the classifier or predictor understand.

RESULT GENERATION The Final Result will get generated based on the overall classification and prediction. The performance of this proposed approach is evaluated using some measures like,

- Accuracy

Accuracy of classifier refers to the ability of classifier. It predicts the class label correctly and the accuracy of the predictor refers to how well a given predictor can guess the value of predicted attribute for a new data.

$$AC=\frac{TP+TN}{TP+TN+FP+FN}$$

- Precision

Precision is defined as the number of true positives divided by the number of true positives plus the number of false positives.

$$Precision=\frac{TP}{TP+FP}$$

- Recall

Recall is the number of correct results divided by the number of results that should have been returned. In binary classification, recall is called sensitivity. It can be viewed as the probability that a relevant document is retrieved by the query.

- ROC

ROC curves are frequently used to show in a graphical way the connection/trade-off between clinical sensitivity and specificity for every possible cut-off for a test or a combination of tests. In addition the area under the ROC curve gives an idea about the benefit of using the test(s) in question.

- Confusion matrix

A **confusion matrix** is a table that is often used to describe the performance of a classification model (or "classifier") on a set of test data for which the true values are known. The confusion matrix itself is relatively simple to understand, but the related terminology can be confusion.

CONCLUSION:

Green Communication is the prime requirement in the new upcoming technologies. Lots of researches in the different area of wireless communication as well as in wired communication is going to reduce the power requirements. Using this technology advancement using green communication not only power requirement is going to decrease but as well we can also reduce the CO_2 from the environment which is going to be a great help for a human being. Here in this paper, we have discussed a

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few technologies which can help to improve power efficiency and capacity as well and also mention the issues with the implementation. Here we have discussed how we can modify and update the existing communication system by Device to Device Communication, Internet of Things, Massive MIMO and Heterogonous networks to establish green communication for the upcoming 5G technology. All implementation can be applied with the cost of higher investment and after that also there might be a constraint of security of network where secure power optimization is essential. There is lots of areas which can be explored by research in green communication for future purpose.

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Show in Context

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