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Real-Time, Integrated, and High Priority Wireless Network Focused on Devices and Networks Selection

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Abstract:
In this process proliferation of mobile computing devices, there has been a tremendous increase in the data usage by mobile subscribers. This has quite often resulted in network congestion, forcing the operators to either increase the available bandwidth or reduce the data rate per subscriber. To overcome this problem, network operators have been deploying different radio access networks including Wi-Fi and small cells across their coverage areas. To remain always best connected. In this process of proliferation of mobile computing devices, there has been tremendous, several techniques have been proposed over the period for efficient network selection. All these techniques can be broadly categorized into either device-centric or network-centric solutions. However, both device-centric and network-centric solutions have their disadvantages: In the network-centric solution, the offloading decision taken by the operator does not take into account the subscriber's optimal preferences. Similarly, the device-centric solutions do not bother about the challenges faced by the network operators. In this paper, a 'dual priority' scheme is proposed and developed that takes into account the preferences of both the subscribers and the network operator. Notably, the proposed 'dual priority' scheme offers a combined decision for the efficient handover of subscribers from cellular to Wi-Fi. In this work, every device has its mechanism of ranking its preferred networks; after which the network decides for offload based on the preferences and its resource availability. It has been observed that the proposed dual priority scheme results in up to three times reduction in the time taken for offloading decisions as compared to state-of-the-art network-centric solutions. It is based on Genetic and ACO Algorithms. Finally Calculated the Best node and Best Rank.

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I. INTRODUCTION

Over the last 5 - 7 years, with the advent of smart computing devices like tablets, smartphones, notepads, etc. there has been an explosion in data consumption. This can be mainly attributed to the ability to use high data-rate services like video streaming, video calls, etc. anywhere, anytime. This has resulted in exponential growth in the data traffic by the subscribers, leading to network congestion and connection drops. This broadband data explosion forced the telecom operators to look for alternate resources to decrease the network traffic while providing maximum quality of service (QoS) to the subscribers. In addition to cellular networks, the network operators have been aggressive in deploying different radio access technologies (RATs) which include: Wi-Fi, small cells (micro cells, pico cells, nano cells), etc. to share the traffic load across the networks [1]. In recent times, there has been exponential growth in the world of Internet of Things (IoT). The number of sensors deployed to perform sensing, monitoring, and actuation tasks has increased tremendously. These IoT-based devices would collect large volumes of data that have to be communicated through the network to some central cloud. However, cellular networks with huge data traffic are already congested and this IoT-based traffic would further add to the congestion. Having said that, a significant portion of the data traffic could be offloaded/moved to be communicated through another network [2]. With the number of IoT devices expected to be billions in the next decade, no single base station (BS) will. be able to manage the computational load for all devices in the network. Also, not all devices in itself can do the resource allocation and network selection by themselves [3]. Fig: System architecture Hence, there must be a new efficient and alternate mechanism for connectivity and load sharing that takes into account the best practices of both device-centric and network-centric mechanisms. Further, the work in [4], [5] discusses how to combat this problem of data explosion through the coexistence of multiple RATs in overlapping areas; also called heterogeneous networks. Some of the advantages of such a heterogeneous environment include a reduction in traffic congestion, efficient use of existing infrastructure, and seamless mobility. Fig. 1 illustrates a heterogeneous wireless environment where the subscriber is in the range of different RATs covering an area. As can be observed from Fig. 1, there are several radio access networks (RAN), with a subscriber being in a range of not only multiple RANs; but also in presence of different other networks like small cells, Wi-Fi, etc. which would use to connect to different applications and devices with different operating systems. Over the years, the IEEE 802.21 standard has been developed which facilitates the handover optimization process between heterogeneous networks including cellular and other IEEE 802-based networks. However, it does not specify any network selection algorithm in particular; and is left to the designers and architects for the development. In this regard, there has been a lot of work done in proposing algorithms for efficient handover in heterogeneous wireless networks. With the increase in the popularity of smart devices such as mobile phones, tablets, laptops, etc. many users have started using these devices for watching videos online anywhere, anytime. Given that it is much more difficult to provide seamless connectivity and good-quality multimedia over wireless transmission, most works focused mainly on video streaming and proposed adaptive multimedia solutions. Most of the techniques investigated maintaining acceptable user-perceived quality while few techniques looked at conserving the energy of the device. Recently, there has been significant effort in the movement of subscribers from one network to another. In a notable investigation, the work in [6] showed that on-the-spot offload the solution typically offloads 65% of total traffic from cellular to Wi-Fi networks which could result in around 55% power-saving for mobile devices. Further, another study [7] has shown that, given the humongous increase in traffic, the selection of a Wi-Fi network is largely dependent on the practical and economic incentives provided to subscribers and operators. In an important study, Leung et al [8] carried out a detailed survey of the different networks over which cellular traffic can be moved onto. These included small cells, Wi-Fi, heterogeneous networks, and other opportunistic networks. However, it does not focus on how the network selection would be done. Typically, all existing handover solutions of heterogeneous networks can be broadly classified into two types: device-centric solutions and network-centric solutions.

II. LITERATURE SURVEY

C¸ agrı G˘oken [2017] An Analysis of the Network Selection Problem for Heterogeneous Environments with User-Operator Joint Satisfaction and MultiRAT Transmission. The trend in wireless networks is that several wireless radio access technologies (RATs) coexist in the same area, forming heterogeneous networks in which the users may connect to any of the available RATs. The problem of associating a user with the most suitable RAT, known as the network selection problem (NSP), is of capital importance for the satisfaction of the users in these emerging environments. However, also the satisfaction of the operator is important in this scenario. In this work, we propose that a connection may be served by more than one RAT by using multi-RAT terminals. We formulate the NSP with multiple RAT associations based on utility functions that take into consideration both user satisfaction and provider satisfaction. As users are characterized according to their expected quality of service, our results exhaustively analyze the influence of the user's profile, along with the network topology and the type of applications served. A Density-Based Offloading Strategy for IoT Devices in Edge Computing Systems Victoria Kostina, and François Gagnon[2017] Collaboration spaces formed from edge servers can efficiently improve the quality of experience of service subscribers. In this paper, we first utilize a strategy based on the density of Internet of Things (IoT) devices and the k-means algorithm to partition the network of edge servers, then an algorithm for IoT devices' computation offloading decisions are proposed, i.e., whether we need to offload IoT devices' workload to edge servers, and which edge server to choose if migration is needed. The combination of locations of edge servers and the geographic distribution of various IoT devices can significantly improve the scheduling of network resources and satisfy the requirements of service subscribers. We analyze and build mathematical models about whether/how to offload tasks from various IoT devices to edge servers.To better simulate operations of the mobile edge servers in more realistic scenarios, the input size of each IoT device is uncertain and regarded as a random variable following some probability distribution based on long-term observations. Based on that, an algorithm utilizing the sample average approximation method is proposed to discuss whether the tasks are to be executed locally or offloaded. Besides, the algorithm proposed can also help decide whether the service relocation/migration is needed or not. Finally, simulation results show that our algorithm can achieve 20% of global cost less than the benchmark on a true base station dataset of Hangzhou. Optimal Channel Switching For Average Capacity Maximization Ahmet Dundar Sezer, Sinan Gezici, and Hazer Inaltekin Optimal channel switching is proposed for average capacity maximization in the presence of average and peak power constraints. A necessary and sufficient condition is derived to determine when the proposed optimal channel-switching approach can or cannot outperform the optimal single-channel approach, which performs no channel-switching. Also, it is stated that the optimal channel-switching solution can be realized by channel-switching between at most two different channels. In addition, a low-complexity optimization problem is derived to obtain the optimal channel-switching solution. Numerical examples are provided to exemplify the derived theoretical results. Design and Performance Analysis of a Signal Detector Based on Suprathreshold Stochastic Resonance V. N. Hari, G. V. Anand, A. B. Premkumar, and A. S. Madhukumar This paper presents the design and performance analysis of a detector based on suprathreshold stochastic resonance (SSR) for the detection of deterministic signals in heavy-tailed non-Gaussian noise. The detector consists of a matched filter preceded by an SSR system which acts as a preprocessor. The SSR system is composed of an array of 2-level quantizers with independent and identically distributed (i.i.d) noise added to the input of each quantizer. The standard deviation σ of quantizer noise is chosen to maximize the detection probability for a given false alarm probability. In the case of a weak signal, the optimum σ also minimizes the mean-square difference between the output of the quantizer array and the output of the nonlinear transformation of the locally optimum detector. The optimum σ depends only on the probability density functions (pdfs) of input noise and quantizer noise for weak signals, and also on the signal amplitude and the false alarm probability for non-weak signals. Improvement in detector performance stems primarily from quantization and to a lesser extent from the optimization of quantizer noise. Detector Randomization and Stochastic Signaling for Minimum Probability of Error Receivers Berkan Dulek Optimal receiver design are studied for a communications system in which both detector randomization and stochastic signaling can be performed. First, it is proven that stochastic signaling without a detector, randomization cannot achieve a smaller average probability of error than detector randomization with deterministic signaling for the same average power constraint and noise statistics. Then, it is shown that the optimal receiver design results in a randomization between at most two maximum a-posteriori probabilities (MAP) detectors corresponding to two deterministic signal vectors. Numerical examples are provided to explain the results. It is that, for a given detector, an optimal stochastic signal can be represented by a randomization of no more than three different signal values under second and fourth-moment constraints. In addition, the joint optimal design of stochastic signals and a detector is studied under an average power constraint, and it is proven that the optimal solution results in stochastic signals with at most two distinct signal values and the corresponding maximum a-posteriori probability (MAP) detector. Optimal Noise Benefits In Neyman-Pearson And Inequality-Constrained Statistical Signal Detection Ashok Patel and Bart Kosko This paper presents theorems and an algorithm to find optimal or near-optimal "stochastic resonance" (SR) noise benefits for Neyman-Pearson hypothesis testing and more general inequality-constrained signal detection problems. The optimal SR noise distribution is just the randomization of two noise realizations when the optimal noise exists for a single inequality constraint on the average cost. The theorems give necessary and sufficient conditions for the existence of such optimal SR noise in the inequality-constrained signal detectors. There exists a sequence of noise variables whose detection performance limit is optimal when such noise does not exist. Another theorem gives sufficient conditions for SR noise benefits in Neyman-Pearson and other signal detection problems with inequality cost constraints. An upper bound limits the number of iterations that the algorithm requires to find near-optimal noise. An appendix presents proof of the main results. Its signature often takes the form of an inverted curve or a no-monotonic plot of a bit count or SNR against the variance or dispersion of the noise process. We focus first on the special case of SR in signal detection that uses Neyman-Pearson (N-P) hypothesis testing to decide between two simple alternatives. We define the noise as N-P SR noise if adding such noise to the received signal before making a decision increases the signal detection probability PD while the false-alarm probability PFA stays at or below a preset level α for a given detection strategy. This type of noise benefits a suboptimal receiver and does not involve the typical inverted-U curve of SR (but would if it used uniform noise and we plotted the detection probability against the noise variance). An SR noise benefit does not occur in an optimal receiver if the noise is independent of the concurrently received signal and the hypotheses. The first SR result gives the necessary and sufficient conditions for the existence of optimal N-P SR noise. The existence of some N-P SR noise does not imply the existence of optimal noise. But there exists a sequence of noise variables whose detection performance limit is optimal when the optimal N-P SR noise does not exist. The second SR result is a sufficient condition for SR noise benefits in N-P signal detection. The third SR result is an algorithm that finds near-optimal N-P SR noise from a finite set N˜ of noise realizations. This noise is nearly optimal if the detection and false alarm probabilities in N˜ and the actual noise space N ⊃ N˜ are sufficiently close. An upper bound limits the number of iterations that the algorithm needs to find near-optimal noise. Symbol Error Rates of Maximum-Likelihood Detector: Convex/Concave Behavior and Applications Sergey Loyka, Victoria Kostina Convexity/concavity properties of symbol error rates (SER) of the maximum likelihood detector operating in the AWGN channel (non-fading and fading) are studied. Generic conditions are identified under which the SER is a convex/concave function of the SNR. Universal bounds for the SER 1st and 2nd derivatives are obtained, which hold for arbitrary constellations and are tight for some of them. Applications of the results are discussed, which include optimum power allocation in spatial multiplexing systems, optimum power/time-sharing to decrease or increase (jamming problem) error rate, and implication for fading channels. Many practical problems, including optimization problems of various kinds, simplify significantly if The functions involved have some convexity/concavity properties. Not only numerical but also analytical techniques benefit significantly if such properties hold. Powerful analytical and numerical techniques exist for convex/concave problems. Significant insight into the problem is often provided by convexity/concavity, even if an analytical solution is not found. Symbol error rate (SER) is an important performance measure of digital communication systems and, as such, is often subject to optimizations of various levels. Motivated by these arguments, this paper studies the convexity/concavity properties of SER of the maximum-likelihood (ML) detector in non-fading and frequency-flat slow-fading AWGN channels. The problem is equivalent to max ln(1 ( )){ ... }α α1 m ∑ im=1 − α γPe i. If Pe is convex, Pe and − Pe is concave. Thus, the objective function is concave and hence the problem has a unique solution. Theorems 1 and 9, hold for 1-D or 2-D constellations in the AWGN channel, or Rayleigh, Rice, or Nakagami fading channels if the average BLER is used. For M ≥ 1 and a symmetric constellation, the uniqueness in terms of instantaneous BLER follows from Corollary. the corresponding results to nonbinary multidimensional constellations. Since the proofs of these results follow along the same lines. we omit them for brevity. Considering Pe as a function of PN, one may formulate the following jamming optimization problem using power/time sharing.

III. EXISTING SYSTEM

The paper is organized as follows. Section II introduces the proposed integrated 'dual priority' solution, and then describes the device-centric aspect; called DE-SMART in detail. Section III describes the proposed 'dual priority' technique; wherein the network-centric MCS-NS is developed that takes input from device-centric DE-SMART and then does the analysis for deciding to offload the subscribers This work proposes an integrated hybrid architecture for real-time network selection. Fig. 2 shows the block diagram of the 'dual priority' architecture. It has two distinct components: DE-SMART (Device Energy based Signal Measurement oriented Adaptive Ranking Technique) architecture and MCS-NS (Multi-Stage Clustering for Network Selection). The proposed solution considers the objective from both the device side and the network side. Hence, the technique has two sub-modules: a clientside technique called DE-SMART and the network side technique called MCS-NS which takes inputs from the device. DE-SMART has multiple steps as can be seen later. However, an important point to be noted is that DE-SMART is independent of the network-centric solution. Further, the process of MCS-NS is independent of DESMART though the values of DE-SMART determine the clustering techniques in MCS-NS. Given that MCS-NS has been developed such that, it functions based on the inputs received from DE-SMART, the output of MCS-NS will provide priority to both device-based and network-based preferences.

IV. PROPOSED SYSTEM

In this stage, certain possible networks for offload are eliminated from the available list of networks; based on the network performance. Once the list of available networks is received, the device also gets the characteristics of each of these networks; such as throughput, signal strength, monetary cost, and any other parameters. Those networks which do not have the minimum bandwidth required for the application; or those networks which provide the required services at a monetary cost exceeding the subscriber's budget are eliminated at this stage. All those networks which satisfy the required thresholds are considered for the next step in the network selection process. It should be noted that the network elimination stage reduces the computation complexity and decision time as some of the networks are eliminated at this stage. So the decision module has to work on only a small set of available networks. After this stage, the remaining list of networks is sent to the Energy Prediction and Score Calculation step. The expanding use of data for various services like high-rate services such as multimedia, social networking, etc. has put enormous pressure on network operators to use heterogeneous wireless environments. In such a scenario, the seamless movement of the subscribers between different cellular and between cellular and Wi-Fi network would reduce traffic congestion and provide improvement in the QoS. The dual priority scheme proposed in this paper investigates the use of both device and the network to rank the available networks and select the best possible network for offloading each subscriber. It has been found that such a mechanism results in an extremely less time requirement, up to 3 times less, as compared to other network-centric techniques.

Importantly, the dual priority scheme provides the much-needed flexibility in taking into account the device's preferences and also providing the best available network, based on the network operator's perspective.

V. CONCLUSIONS

In this project the expanding use of data for various services like high rate services such as multimedia, social networking, etc. has put enormous pressure on network operators to use heterogeneous wireless environments. In such a scenario, the seamless movement of the subscribers between different cellular and between cellular and Wi-Fi network would reduce traffic congestion and provide improvement in the QoS. The dual priority scheme proposed in this paper investigates the use of both device and the network to rank the available networks and select the best possible network for offloading each subscriber. It has been found that such a mechanism results in an extremely less time requirement, up to 3 times less, as compared to other network-centric techniques. Importantly, the dual priority scheme provides the much-needed flexibility in taking into account the device's preferences and also providing the best available network, based on the network operator's perspective. Finally, the Genetic Algorithm and Aco Algorithm Find the Best node and Best Rank of the list.

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