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EVALUATION OF DUAL DECOMPOSITION AS A METHOD OF SIMULTANEOUS ROUTING AND RESOURCE ALLOCATION (SRRA)

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ABSTRACT

The optimal data routing relies on capacities of link which in turn decided by communication resources allocation to the links in wireless data networks. The networks optimal performance can be accomplished by simultaneous resource allocation and routing optimization. In this study the author formulate the SRRA (simultaneous routing and resource allocation) issue and use problem structure to acquire effective methods of solution. The author utilized a capacitated model of multi-commodity flow to explain the flows of data in network. The author regards that the wireless link capacity is a concave and developing communication resources function assigned to the link and the resources of communication for set of links are restricted. These considerations permit the author to plan the simultaneous routing and resource allocation as a convex optimization issue over the communication variables and network flow variables. These two groups of variables are matched through limitations of link capacity. The author uses this separable framework by dual decomposition. The resulting method of solution meets the data routing optimal coordination in the layer of network and allocation of resource in radio control layer through pricing on capacities of link.

Keywords: Dual Decomposition, SRRA, Optimal Resource Allocation, Multi Commodity Flow

Introduction:

As the wireless services demand develops effective utilization of radio resources develops in importance. One way of developing the resource utilization in wireless networks of data is to move from optimizing every layer of network in separation to coordinating the operation optimally across the stack of networking. In this study the author evolves a process for routing's joint optimization in the layer of network and allocation of resource in radio control layer. Traditionally the routing issues for networks of data have always been planned as convex multi-commodity network flow issues for which several effective methods of solution occurs. The data flows optimal routing relies on capacities of link which are generally fixed. The link capacities are not essentially fixed but can be adjusted by communication resources allocation such as bandwidths, powers of transmit or fractions of time slot to varied links in wireless data networks. Adjusting the allocation of resource alters the capacities of link impacts the data flows optimal routing and changes the complete network utility. Hence the routing issue in the layer of network and allocation of resource issue in radio control layer are matched through capacities of link and the overall network's optimal performance can be accomplished only by SRRA.

Both optimal resource allocation and optimal routing issues have been learnt in isolation. Data networks routing has a big tradition while optimal resource allocation issues for wireless systems have been regarded presently. Joint optimization of capacity assignment and routing has been learnt in context of provisioning and design of communication network. The capacities acquire one of the numerous discrete values and the routing is always limited to paths which lead to programs of non linear integer in this case.. However these methods do not report for non trivial rapport between resulting capacities and resource allocation of wireless connection. A system process for joint configuration across two layers of networking is required. In this study the author learnt the SRRA issue for networks of wireless data within a convex optimization structure and uses the problem structure through dual decomposition. The resulting method of solution can be described as a pricing process on capacities of link which meets data routing's optimal coordination in the layer of network and allocation of resource in radio control layer. Because of their convex planning of simultaneous routing and resource allocation issue and related powerful duality outcomes the dual decomposition process acquires the global optimal solution. This is compared to program of non linear integer planning and similar methods application in acquitting suboptimal solutions for capacity assignment and joint routing issues in networks of computer communication.

Model of Network Flow:

The author exploit the model of standard directed graph to indicate the topology of network and a model of multi-commodity flow for the average data transmission behavior across the network.

Topology of network:

The author indicates the data network topology by a directed graph. A set of nodes represented n = 1, …….., N can receive, send and relay data across links of communication in this model. A link of communication is indicated as distinct nodes ordered pair (i, j). The existence of (i,j) link refers that network is capable to send data from i (initiation node) to j (end node).

Multi-commodity flows of network:

The author utilizes a flow model for data packets routing across network. Such models are utilized vastly in optimization and network routing literature. Every node can send data to numerous places and acquire data from numerous sources but multicast is not assumed in this model. The author regards that the flows of data are lossless across links and they fulfill laws of flow conservation at every node. The author recognizes the flows by their place that is the flows within same place are regarded as an individual commodity nevertheless of their resources. The author regard that the nodes of destination are represented by d = 1, ……., D where D <= N. This model explains the data transmissions average behavior that is average rates of data on links of communication and avoids packet level details of forwarding and transmission protocols processes. In practical communication systems the link capacity must be referred properly considering retransmission and packet loss so the law of flow conservation owns for efficient good-put or throughput.

Multi-commodity Flow issues with capacities of fixed line:

The capacities are generally fixed in traditional issues of multi-commodity network flow and one is to reduce certain convex function of the variables of network flow subject to the group of limitations.

There is a wide literature on issues of convex multi-commodity network flow and numerous effective methods of solution have been evolved. In this study the author is interested in interplay between link capacities, optimal routing and allocation of resources existing in wireless networks of data.

Model of communication and assumptions:

The author acquires a wireless communication system model that assists the traffic of data. The individual links capacities rely on media access scheme in a wireless system and the preference of some critical parameters such as bandwidths, fractions of time slot or powers of transmit allotted to set of links or individual links. The author defines to these critical parameters of communication collectively as variables of communication and represents the communication variables vector by the symbol r. The author regards that the methods of medium access and modulation and coding communication systems schemes are fixed but the author optimize over the variables of communication denoted as r. The variables of communication are themselves restricted by different limitations of resource such as restrictions on total power of transmit at every node or the complete bandwidth signal accessible across the complete network.

Simultaneous Routing and resource allocation issue:

For wireless data network a model can be acquired by integrating the communication model and network flow model. This model reflects how the capacities of link rely on communication resources allocation and how the overall network's optimal performance can be accomplished by SRRR.

Formulation of Generic Convex Optimization:

Consider the wireless data network operation explained by the model of network flow and the model of communication and suppose that the objective is to reduce the cost function of convex f (x, s, t, r). Here the variables are the variables of network flow x, s, t and r as the variables of communication. Since the limitations in refer a convex set and the objective function is convex the simultaneous optimization of routing and resource allocation issue is a convex optimization issue. This implies that it can be resolved effectively and globally by developed interior point methods. In the above model the F and A matrices are highly structured and sparse which can be used to evolve far much effective algorithms. The simultaneous optimization of routing and resource allocation issue is general and involves numerous essential design issues for wireless data networks. Minimum power simultaneous optimization of routing and resource allocation is a group of fixed source sinks vectors to be assisted by network and it is natural to predict the resource allocation and joint routing that reduces the complete transmit power utilized by the network. It is valuable to mention that this study's formulation of simultaneous optimization of routing and resource allocation permits a feasible expansion of work on congestion control based on optimization in computer networks to link power and flow control in wireless networks. In these cases it is natural to maintain the routes between the fixed pairs of source destination and optimize over rates of surface on varied routes and allocation of resource on links of communication.

Method of Dual decomposition:

The author turns their focus to growth of effective methods of solution for simultaneous optimization of routing and resource allocation issue. Their approach is based on using problem structure through the method of dual decomposition.

Hierarchical dual decomposition:

Hierarchically the method of dual decomposition can be used to use the simultaneous routing and resource allocation issue varied levels. The author decompose the simultaneous optimization of routing and resource allocation problem into a problem of resource allocation and a problem of network flow and integrate them by master dual problem at the first level. The network flow problem is decomposed naturally into individual commodity network flow issues for every place in second level. The resource allocation problem can be decomposed further into sub-problems at every node including variables of local communication of outgoing connections. These local allocation sub-problems are coordinated feasibly through the cost for globally shared resources as in solution of classical water filling. In this study, the author has concentrated on first level, such as two networking layers of vertical decomposition.

Conclusion:

The author has regarded the simultaneous optimization of routing and resource allocation issue in wireless data networks. Their model seizes interplay between the issue of resource allocation and the routing issue in varied layers of networking and their solution introduces a pricing process on communication link capacities to coordinate two layers operation optimally. The author have focused on a theoretical model that explains the network's average behavior and disregards numerous brief aspects such as retransmissions and packet loss, time difference fading of wireless channels and changes in topology in network. The model seems to be helpful for network planning, provisioning and greater level network management. While most of the requirements to be performed to expand this work to link dynamic routing and real time power control in wireless networks and the author trust that the methodology and the model described in this study gives solution towards this direction. One promising approach is to examine the feasibility of integrating distributed algorithms for master dual issues with those for resource allocation and routing sub problems under the hierarchical framework of dual decomposition. It is essential to point out that the author considers fixed technique and predicts the parameters of system that meet the optimal performance within specified infrastructure. Although the simultaneous optimization of routing and resource allocation formulation gives essential performance developments over classical approaches it does not mention the question of information theory about the major wireless network capacity. In addition this study does not directly mention certain essential practical problems in wireless data networks such as service quality. In this direction, an extension of simultaneous optimization of routing and resource allocation formulation appears very catchy and requires further examination. Lastly in this study the communication model does not involve certain essential wireless systems using random access protocols and code division multiple access protocols such as CSMA/CA (carrier sense multiple access with avoidance of collision). Presently the author have expanded the simultaneous optimization of routing and resource allocation structure to code division multiple access wireless networks and routing, power allocation and joint link planning in wireless networks .

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