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5th generation Wireless Network using Distributed Power Control, Novel and round Robin Scheduling Algorithms

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Abstract:*The demand for higher networking quality i.e., 5G technology and improved wireless connectivity is increasing rapidly in emerging Cyber-Physical Systems (CPS). In this paper, we looked at the question of reducing total power transmission with power control and resource allocation in 5 G networks where there is mutual interference between cells using the distributed resource allocation algorithm, Packet Scheduling and compared with Round Robin Scheduling algorithm.*

Power control was indeed an efficient way to enhance wireless system ability. It was assumed that energy levels can be allocated from a constant spectrum in prior job on energy control. But energy levels are allocated from a discrete set in practice. In this work, we consider minimizing the complete transmitted energy over specified discrete sets of available energy levels subject to maintaining an acceptable quality of signal for each mobile.

Our algorithm has reduced computational complexity compared to the current optimization algorithm, where each resource is assigned to a maximum of one user over a period of time. Numerical results verify our proposed algorithm's efficiency and convergence.

Keywords: *5G networks, Distributed power control, resource allocation, round robin algorithm scheduling, Packet Scheduling*

I. INTRODUCTION

Algorithms used for scheduling of packet transmission in wireless communication networks is a big issue for research. Differentiation capabilities between distinct classified data flows are of excellent concern in the increasing jungle of wireless and wired platform services provided. This article suggests a new packet scheduling algorithm known as Balanced LTE scheduling algorithm, which allocates resources in such a way to maximize throughput, while achieving acceptable fairness and power efficiency in the allocation. The performance is evaluated by the comparison of simulation results with that of Best Channel Quality Indicator

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1.1 Motivation

With the continuous growth on the number of mobile users, the number of applications to be handled and the amount of data to be conducted by the mobile communication, the role of scheduling becomes more vital. The scheduler directs the distribution of radio resources to users with the consideration on Quality of Service requirements. The packet scheduler should incorporate the intention of maximizing the Data Rate on the link, Resource Allocation between User Equipment's with fairness, maximizing the Quality of Service assistance with least power utilization. In Round Robin scheduling, the resource blocks are assigned to User Equipment's as equally scheduled without interrupting the channel quality. Proportional Fairness algorithms gives a balance among throughput and fairness across the mobile users. Most Excellent Channel Quality Indicator scheduling algorithm is a scheduling method which allocates the RB's for the user with best channel conditions that are indicated by the Channel Quality Indicator.

II. PACKET SCHEDULING

The packet scheduling algorithm specifies the order at the entry point of a packet switch for the packet transmission. The paper includes experiments that show the features of well-known scheduling algorithms.

2.1 Quality-of-Service

Different services require varying parameter constraints. It is possible to define four main parameters: transmission capacity, accuracy, lag, step.Examples of services requiring distinct QoS could include e-mail, high reliability requirements, but rather low delay, jitter and bandwidth requirements.Similar other definition, video-conferencing would have low demands for reliability, a lost packet in a video stream is not a disaster, while steps, delay and transmission capacity requirements would be high.If an entity provides dynamic resource allocation from a non-homogeneous choice of entities with respect to the distinct demands, the entity can be described as an entity providing QoS assistance. The allocation resources may be energy, bandwidth, transmission time, etc.The focus on transmission time allocation as the differentiation between the distinct entities will be created in the scheduling of packets from a queue transmitted over a single connection.In addition, the traffic is split into three distinct classes of Type-of-Service (ToS), depending on the specific QoS demands. The classes used are:

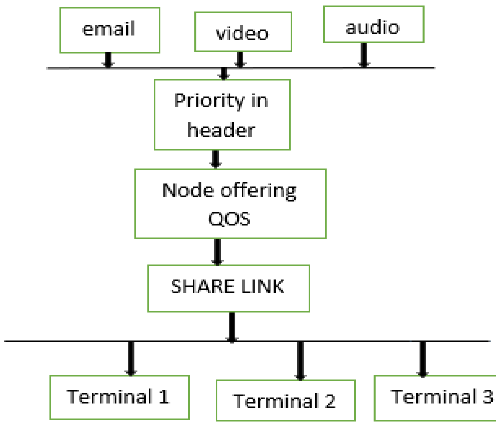
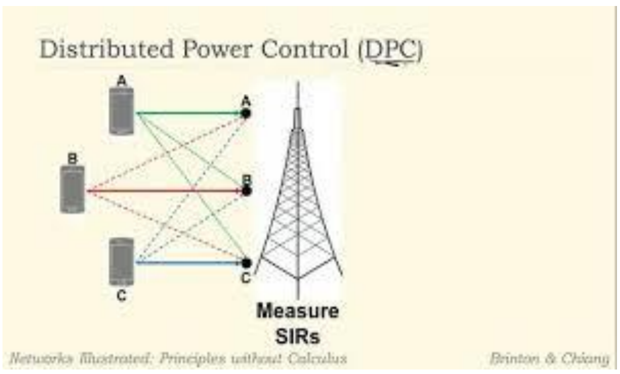


Fig 1:

Examples of scenario where separate data flows are categorized before a network node capable of QoS allocates dynamic resources depending on the prioritized distinct data flows .

III. POWER CONTROL SYSTEM

Any wireless system, power control is an essential element. This is because one of the highlycriticalproblems in most wireless networks are the fact that they must work in limited energy environments. The control of the transmitted energy enables the development of communication links in a channel with a signal-to-interference ratio (SIR) within the specified service quality (QoS). The decrease of interference improves the network capacity through higher channel reuse. Path loss is experienced by electromagnetic waves as they transmit between transmitter and receivers. This becomes a problem when several receivers are trying to communicate with one transmitter because the nearest receiver will overpower all additional receivers. Earlier studies have concentrated on balancing the SIRs on all radio links by centralized power control. However, this model was verycomplicated and is merely used for theoretical analysis. Later, a distributed power control algorithm was developed. The distributed algorithm uses local measurements and is easier to design and it confirms that ultimately all users meet the SIR requirements. Besides that, numerous studies were also accomplished on multicast and broadcast communications such as. we focus on the power control of the transmitter to various receiver nodes of different channels. The Power Control Concept (A), Wireless Communication Model (B) and Distributed Power Control (C) are studied in the following sections.



3.1 Wireless communication model

In the wireless communication system, a node can be formedamong any pair of nodes if the SIR at the receiver side is higher than the threshold [1]. The connectivity of the nodes is defined by the transmitter power, space between the transmitter node and receiver node, error-control schemes, other user interference as well as the background noise.

The transmitter power that is controlled should not go beyond a maximum value power which is designated as Pmax. The transmitter power is signified as Pi and the received power between the transmitter node i and receiver node j is denoted as Pij.

$$P_i(k+1) = \frac{\gamma P_{ik}}{R_{ik}}$$

We assume that the signal power at the receiver varies with r-α, where α is a parameter between 2 and 4 is depending on the characteristics of the communication medium. The objective of this research is to keep the required SIR threshold,as γ, for each transmitter-receiver pair by adjusting the transmitter power so that the interference at nodes that are too far away from the transmitter can be reduced.

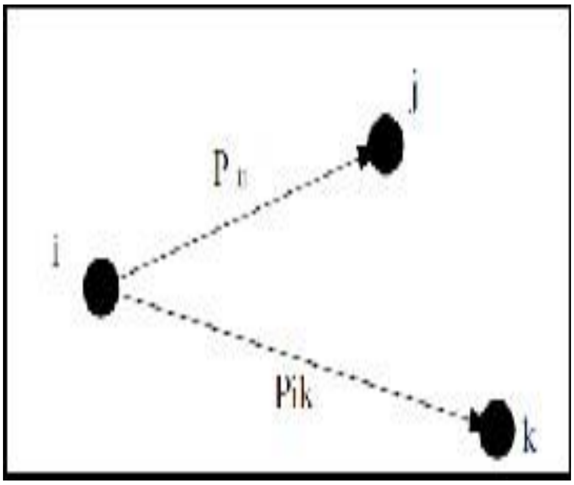
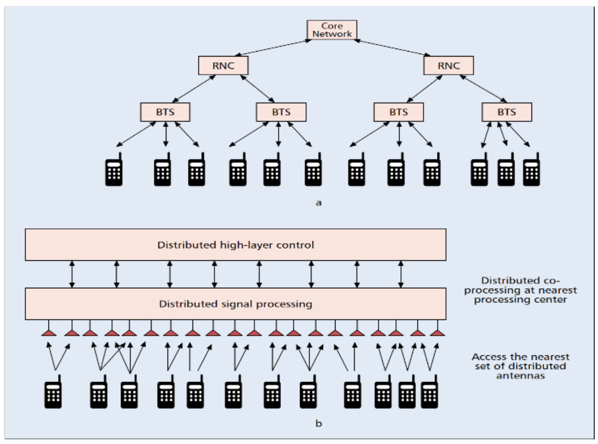


Fig: Wireless network model.

3.2 Distributed Power control



The SIR, Ri at the ith node of the system is evaluated as follows:

$$R_i = \frac{G_{ii} * P_i}{\sum_{j \neq i} G_{ij} * P_j + \eta_i}$$

Where i, j = {1, 2, 3… n} and ηi>0. ηi is the thermalnoise at the receiver side.
Gii is the transmitter's power gain and can be obtained by the following equation:

$$G_{ii} = \frac{g}{r_{ij}^{\alpha}}$$

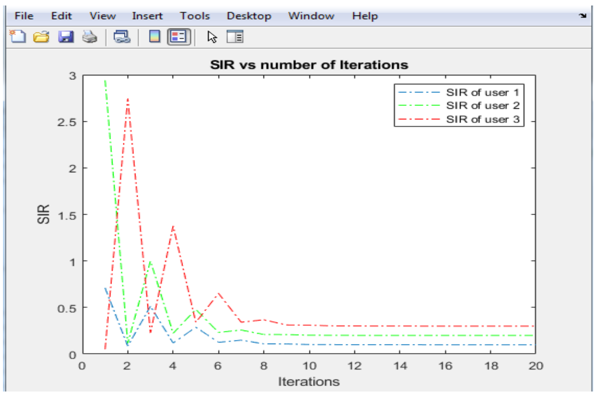
Gij is the power loss from the transmitter to the receiver node. This loss is due to the loss of free space, multi-path fading, shadowing, other impacts of radio wave propagation, as well as the transmission increase in spreading or processing. Hence, we need:

$$R_i \geq \gamma$$ For every i=1, 2, 3… n.

The SIR threshold, γ should be same for every node. The value of γ reflects a certain QoS that the node has to maintain in order to operate correctly. If the Ri obtained is below the γ, the following formula is used in order to increase the transmitted power.
Where k=1, 2, 3… n.
If Pi(k+1) > Pmax, then the new node is not added into the network. Hence a node is only established into the communication network if and only if the system'snew state is stable. In a nutshell, the transmitter power raises independently when its current SIR to a node is below ã
The transmitting power is then decided from:

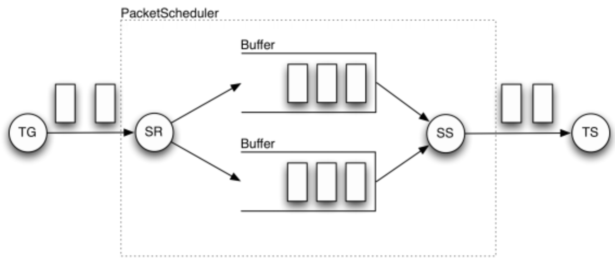
$$P_{ijk} = \max\{P_{ij}, P_{ik}\}$$

Where Pij and Pik are the power transmitted to the jth node and kth node respectively.



IV. PACKET SCHEDULER CLASS

It is possible to implement all packet schedulers by extending the Packet Scheduler class specified.



A Packet Scheduler effectively collects Data-Packets from more than one traffic generators (TG) and forward data-packets to a One traffic sink (TS). There are three components of a Packet Scheduler: a SchedulerReceiver(SR) and a Scheduler Sender (SS) and oneor more FIFO Buffers.The Scheduler Receiver manages incoming TG(s) packets & moves the packet to one of the FIFO buffers. The scheduler inspects, each arriving packet's first byte to conduct a traffic identification that will specify the buffer that should be applied to the packet.

The following segment of code is tell the settings and reading a packet's 1stbyteof information data.

```
// First  Assignto first  byte and create a  data packets  .
byte[] buff=Newbyte[length];
buff[0]= (byte)1;
DatagramPacket = New DatagramPacket
(buff,buff.length, DestAddr, DestPort);
// Read the  packet initial  byte
byte value,  =packet.getData ( )[0];
```

Traffic classification assumes the traffic generator sets the correct value for the packet's first byte which is known as the traffic tagging. Thus, to include traffic tagging, traffic generators used earlier must be changed. Each packet can be marked as "High" Or "Low" Priority in priority scheduler when SR access to reads the Tag, and the packetscan be added to the appropriate FIFO buffer.

The SS part is transmitting packets in one of the backlogged buffers. The main function of SS is To test the FIFO buffer that transmits the next packet. Once the decision is made, at the specified transmission rate, the first packet will be extracted and forwarded to the connection from the selected FIFO buffer.

The Packet Scheduler's reference implementation uses the above features, but some of the components are incomplete:

- SR does not perform traffic classification in the execution of the reference. Rather, it adds packets to the first FIFO buffer accessible (the buffer with lowest index).
- The selection of scheduling is simplified by the fact that a packet is always picked from the Initial 1stFIFO buffer by The reference implementation.

- Recording Times, in a folder do_notinclude Data information on traffic identification(i.e., a priority scheduler would not contain priority data).

The package Packet Scheduler includes implementation, which consisting of four Java classes:

4.1 Class PacketScheduler

Create packet scheduler components and start threads running in SR and SS. The following parameters are used to construct an instant of Packet Scheduler:

- `inPort` – UDP Port number, where SR expects arriving packets.
- `outAddress` – IP address to which SS sends packets.
- `outPort` – UDP port number to which SS sends packets.
- `linkCapacity` – transmission rate of the scheduler (in bits per second).
- `numBuffer` – number of FIFO buffers.
- `maxPacketSize` – Maximum size of packet that can be processed. (in bytes)
- `bufferCapacities[]` – Array containing the capacities of the FIFO buffers (in bytes).
- `fileName` – Name of file, where arrival times are recorded.

4.2 Buffer

This is the same buffer used by FIFO for Leaky Bucket. Packet Scheduler generates a range of buffers that Buffer denotes.

4.3 Scheduler Receiver (SR)

Waits for incoming packets on a designated UDP port. The packet is first categorized when a packet arrives by inspecting the packet'sinitial firstbyte. The output of the byte is mapped to a FIFO buffer Index depending on the scheduler type used. SR records the time of arrival, the size and the queue buffer backlog once classified. The packet is then introduced to the buffer [index]

4.4 Traffic classification:

Class1 = {content of firstbyte};
/// Mapclass of the buffer set list attached to the buffer packet [index] ///

If apacketcannotbe added tothe buffer, for example if the buffer is complete, it will drop the packet and display an error message.

4.5 Scheduler Sender (SS)

Scheduler Sender (SS) selects the buffer from where the next packet transmission will take place which is called as thescheduling decision which dependsOn the type of algorithms used. The Scheduler eliminates the chosen buffer's first packet and sends the packet to the address specified (IP address and port UDP). It is calculated that the time for transmitting a Packet with size "L" bits is L / link capacity. SS will be in sleep position for the remaining time If the original time of transmission is less than the measured time of transmission.

The transmission procedure is as follows:

```
If
(atleast_one_buffer_is_not_ Empty)
// Identify the bufferfromwhich the packet is sent;
// Delete from the selected buffer the first packet
/// determine the packet's calculated transmission time ;
// Rest until the projected transfer time is over;
 Else wait until the packet hits the buffer;
/// When a packet arrives, buffers wake up SS.
```

Note:The Scheduling option of "SS" inspects only the 1st buffer (Buffer[0]) in the reference implementation. Thefollowing section of code demonstrates how to begin the Reference Implementation Packet Scheduler in a process.Implementation Assumes the Packet Scheduler classis in a"Packet Scheduler" sub directory:

```
//import Packet "Scheduler_PacketScheduler" ;

Public  ClassMain
{
Public Static Void Main(String[] args)
{
//*** Create  new packet scheduler.
 * *Scheduler listens to incoming packets on "UDP "Port 4444 and sends outgoingPackets to local host:4445.
* The scheduler transmission rate is 2Mbps. The Scheduler has 2 Queues and accepts maximum size packetsof 1024 bytes.
* 1ST Queue size is 100, 1024, bytes and Capacity * where the 2ND queue is 200, 1024, bytes.
//The  Packetsis  recorded  in to file  name "ps.txt" . */
PacketScheduler  PS =
New Packet_Scheduler(4444, "localhost", 4445, 2000000, 2, 1024,
New Long [] {100*1024, 200*1024}, "ps.txt");
///  *  Start  Packet  Scheduler ,

New_Thread( PS).Start();

 }
}
```

V. THE "WEIGHTED ROUND ROBIN" (WRR) SCHEDULER:

Through regulating the percentage of the allotted bandwidth for each traffic source, most scheduling algorithms seek to achieve a principle of equality.A reasonable scheduler's goals are as follows: If connection is not overloaded, all of its data traffics should be transmitted by a data traffic source.If the link is overloaded, the same rate guarantee, called fair share, is obtained by each traffic source with the following guidelines:

• It can transmit all its traffic if it is less than the fair share from a source;

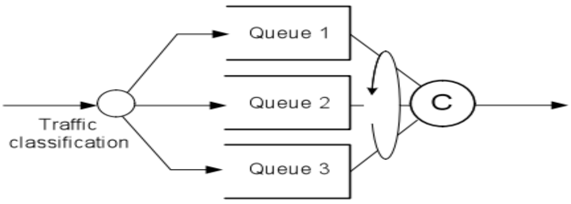
• WhenThe traffic from a source exceeds a fair share, It can be transmitted at a price equal to the fair share.

The fair share relies on the number and traffic speed of active sources. Suppose we have a number of sources where Source i's ri arrival rate and a connection with capacity C (bps).

Processor Sharing (PS) and Weights Generalized Processor Sharing (GPS) is a algorithm that realizes this system without weights. Because they treat traffic as a fluid, both PS and GPS are idealized algorithms. It turns out to be quite difficult to achieve fairness in a packet network, Because packet sizes have different sizes, it is not possible to interrupt packet transmission. Many commercial IP routers and Ethernet switches introduce scheduling algorithms approximating for GPS scheduling.

The Weighted Round Robin (WRR) scheduler is a commonly used (and simple to execute) scheduling algorithm approximating GPA.

The aim of this part is to implement and evaluate a scheduling WRR algorithm



A WRR scheduler, as shown in the above figure, works as follows:

• The scheduler has a variety of FIFO queues. Each incoming packet is allocated to one of the FIFO queues by a traffic management program.

• The WRR scheduler is working in rounds. The scheduler, starting with Queue1, visits the queue in a round-robin fashion in each round. Any or more packets can be serviced during each queue session.

• The WRR assumes that the Average Queue packet size I denoted by Li, can be estimated or established

The WRR determines the amount of packets in each round to be served for:

- Each Queue i: xi = wi / Li
- x = mini { xi }
- Queue i: $packets\_per\_round_i$= xi / x

• The scheduler will visit the next queue once all of a round's packets have been transmitted or no packets left.

VI. CONCLUSION

The proposed scheduling algorithm tries to provide maximum throughput while trying to have a significant fairness and power efficiency with the scheduling as well. Finally, combining numerical results, we present that massive MIMO remarkably improves the energy efficiency and spectral efficiency and was evaluated with simulation.

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