International Journal of Computing Science and Information Technology, **2017, Vol.5,Iss. 1, 01-06**
ISSN: 2278-9669, January 2017 (http://ijcsit.org)

An Implementation of Downlink Scheduling Algorithm for Improving UMTS Network

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Abstract

In this paper improved support for packet-switched information in UMTS mobile networks. Introduced in recent 3GPP a release presents opportunities for service suppliers to introduce novel broadband services. In High-Speed Downlink Packet Access (HSDPA) is that the 3GPP unharness five specifications that enhances UMTS networks to produce higher information rates and multiplied capability for bigger support of broadband services. Like multimedia system conferencing, VoIP, audio/video streaming, mobile multimedia system gambling, high-speed web access.

Keywords UMTS, Downlink, Network, HSDPA, Transmission.

1.1 Introduction

In this paper HSDPA considerably reduces downlink transmission latency, whereby totally different modulation and secret writing schemes are chosen for transmission of traffic to the User Equipments (UE) among the serving HSDPA cell. AMC theme choice is predicated on the veteran radio channel quality of the UE. Alternative options of HSDPA embody channel dependent quick planning. Minimum allocation time or TTI (Transmission Time Interval) on the shared channel is 2ms that improves the trailing of quick channel variations .In UMTS Network each sector are provided by Node-B that have forward their calls and transmit there sectors and additionally complete the procedure packet Downloading. We have a tendency to created this thesis for the fulfill of gaps or the demerits of cellular Network and it's additionally created to extend the “quality of services”.

1.2 Following Square measure the explanations for the gaps or demerits of the cellular Network

If in any sector, the regular numbers of UE (user equipment) square measure inflated then that point the downlink and decision has failing and conjunctions square measure inflated**.**

In the each sector has provided by single Node-B that have done all the work of decision transmission of their sector.

1.3 Packet Scheduling and Quality of Services

Packet programming is that the mechanism determinative that user will transmit in a very given amount. it's a key component within the style of packet-data system because it to an oversized extent determines the behavior of the system. most system output is obtained by distribution all accessible radio resources to the user with the presently best radio-channel conditions, whereas a sensible hardware ought to embody some extent of fairness. By choosing totally different programming algorithms, the operators will tailor the behavior of the system to suit their desires.

In HSDPA, programming is performed as near the air interface as attainable, within the base station, supported info regarding the channel quality, terminal capability and Quality of Services category and power/code accessibility. The goal of the Packet programming is to maximise the Network output whereas satisfying the standard of Services demand from the users. With the aim of enhancing the cell output, the HSDPA programming algorithms make the most of the instant channel variations and quickly increase priorities of the favorable users. HSDPA is meant to supply not solely the normal circuit switched services, however additionally new transmission services with prime quality pictures and video for private communication.UMTS permits a user/application to barter the bearer characteristics that square measure the foremost applicable for carrying the knowledge. Totally different categories of bearers are standardized to supply best service to the application's Quality of Services needs. The amount of categories is restricted to four to confirm that the system is capable of providing cheap Quality of Services resolution.

2. Literature Review

Beginning of standard mobile communication system is typically designed by choosing one or a lot of channels from a selected frequency allocation to be used in autonomous geographical zones. A serious downside long-faced by the radio telecommunication trade is that the limitation of the on the market of tenness spectrum. In setting allocation policy, the federal communications commission (FCC) seeks systems which require marginal information measure however give high usage and shopper satisfaction. the best mobile communication system would operate among a restricted appointed waveband Associate in Nursingd would serve an virtually unlimited range of users in unlimited areas.

In paper is conferred in up HSDPA network performance Building a HSDPA system simulation with OPNET by Marius Brinzea, University of Irish capital This paper, provides a background on the High Speed Downlink Packet Access (HSDPA) technology a feature that has been enforced since 2002 as a part of the discharge five specifications of the 3GPP WCDMA/UTRA-FDD standards. The network parts that have an instantaneous influence on performance is that the programming formula utilized in the bottom station (Node B).

Scheduling algorithms projected by the analysis community haven't been real-world surroundings or on an business commonplace network machine, thus unable to achieve a lot of sensible utility. The author to style a brand new HSDPA model library victimisation the OPNET system machine surroundings. The model ought to be capable of supporting implementation of current programming algorithms for thorough testing. To support associate evolution toward a lot of subtle network and transmission services, the most target of HSDPA is to extend user peak information rates, quality of service, and to usually improve spectral potency for downlink asymmetrical and shapely packet information services. This can be accomplished by introducing a quick and complicated channel management mechanism supported a brief and stuck packet coordinated universal time interval (TTI), Adaptative modulation and cryptography (AMC), and quick physical layer (L1) hybrid ARQ. This provides background of WCDMA systems, a lot of specifically their evolution to UMTS and HSDPA. It continues with a discussion on the influence of packet programming and Quality of services needs on the planning of HSDPA systems.

3 Quality of Services Architecture

3.1 UMTS Quality of Services Classes

The Quality of Services refers to the collective effect of service performances that determine the degree of satisfaction of the end-user of the service. The four classes are.

3.2 Conversational Class

The traffic corresponding to the conversational class refers to real time conversation where the time relation between information entities of the stream must be preserved. The conversational pattern of this type of communication requires a low end-to-end delay to satisfy the stringent requirements of human perception. A service example is telephony speech, voice over IP or video conferencing Focuses on streaming, interactive, and background traffic classes**.**

3.3 Streaming UMTS Quality of Services

Class 3GPP defines this theme as a unidirectional transport that applies to time period streaming. The basic characteristic of this Quality of Services category is that the communication needs to preserve the time relation (or variation) between data entities (i.e. samples or packets) of the stream, though it doesn't have any necessities on low end-to-end transfer delay. so as to permit end-to-end delay variations larger than accepted by the human perception, 2 days streaming applications apply time alignment before decipherment at the receiving finish. The time alignment operate at the start delays by buffering the received stream before beginning the decipherment method, that allows to deal with delay variations up to the bounds provided by the buffering capabilities. Then, the consumer will begin enjoying out the info before the whole file has been transmitted.

3.4 Interactive UMTS Quality of Services lasses

The interactive category may be a Non Real Time communication wherever a web user requests information from remote instrumentality. The communication is characterised by the request response pattern of the top user. Therefore, one in all the key properties of this theme is that the service reaction time. The service latency|time interval|interval} are often outlined because the period irreligious since the moment of the info request till the top of the message reception, that determines the degree of satisfaction perceived by the top user. Another characteristic of the interactive services is that the message should be transparently transferred. Moreover, interactive traffic are often full-bosomed. Typical services of interactive category area unit internet browsing, wap, e-mail service (server access), and information base retrieval, Ecommerce, Network games, etc.

3.5 Background UMTS Quality of Services categories

The background category may be a Non Real Time communication sort that's not delay sensitive and optimized for machine-to-machine information exchanges. The key note is that this category is targeted for applications that don't need a right away action, and message delays within the order of seconds, tens of second, or perhaps minutes is also acceptable as a result of the destination isn't expecting the info at intervals a particular time. This theme is that the most delay insensitive of all the UMTS Quality of Services categories. Some service examples area unit background delivery of e-mails (server to server), Short Message Service (SMS), transmission electronic messaging Service (MMS), FTP file transfers, fax, etc.

3.6 Packet Scheduling Input Parameters

The packet scheduler has access to various input information that it can use to serve the users in a cell. This information can be classified in resource allocation, UE feedback measurements, and Quality of Services related parameters. The Cellular Network users report channel quality indicator (CQI) measurements and pilot measurements. The pilot measurement is made available to the RNC for quality based cellular Network access decisions, while the CQI reports are only accessible in the Node-B

3.7 Resource Allocation

HS-Packet scheduling channel and HS- scheduling channel Total Power: Indicates the maximum power to be used for both HS-PDSCH and HS-SCCH channels. This amount of power is reserved by the RNC to cellular Network. Optionally, the Node-B might also add unused amount of power (up to the maximum base station transmission power). Note that the HS-SCCH represents an overhead power which could be non negligible when signaling users with poor radio propagation conditions. Parameter interface between the RNC, the Node-B, and the UEHS-PDSCH codes Specifies the number of spreading codes reserved by the RNC to be used for HS-PDSCH transmission.

3.8 Maximum Number of HS-SCCHs

Identifies the maximum number of HS-SCCH channels to be used in HSDPA Network. That having more than one HS-SCCH enables the Packet Scheduler to code multiplex multiple users in the same TTI, and thus increases the scheduling edibility, though it also increases the overhead.

3.9 UE Channel Quality Measurements

The UE channel quality measurements are used to abstract information about the user's achievable data rates on a TTI basis. Methods used for link adaptation are also valid for packet scheduling purposes.

4. Quality of Services Parameters at Node-B

4.1 Allocation and Retention Priority (ARP)

The Node-B has information of the UMTS Quality of Services attribute ARP, which determines the bearer priority relative to other UMTS bearers.

4.2 Scheduling Priority Indicator (SPI)

This parameter is set by the RNC when are to be established or modified. It is used by the Packet Scheduler to priorities.

4.3 Common Transport Channel Priority Indicator (CmCH-PI)

This indicator allows differentiation of the relative priority of the MAC-d PDUs belonging to the same flow.

4.4 Discard Timer

The Node-B Packet Scheduler to limit the maximum Node-B queuing delay to be experienced any MAC-d PDU

4.5 Guaranteed Bit Rate (GBR)

Indicates the guaranteed number of bits per second that the Node-B should deliver over the air interface provided that there is data to deliver. It is relevant to note that the corresponding mapping from UMTS Quality of Services attributes to Node-B. Furthermore no specifications are given for the interpretation of these Node-B Quality of Services parameters by the Packet Scheduler.

4.6 Packet Scheduling in HSDPA

Quality of Services aware packet scheduling channels is traditionally conducted as a function of the users traffic class (TC), traffic handling priority (THP), allocation retention priority (ARP), and potentially also other UMTS bearer attributes. However, for HANDOFF, the TC and THP information is not available in the Node-B for MAChs packet scheduling, so a new Quality of Services interface has been defined for cellular Network between the RNC and the Node-B.The HSDPA Quality of Services parameters that can be used to guide the behavior of the MAC-hs scheduler include the guaranteed bit rate (GBR), the scheduling priority indicator (SPI), and the discard timer (DT). The carriers transmit power, the average non-HSDPA power, the HS-DSCH required power, and the HS-DSCH provided bit rate. The feedback measurements from the Node-B to the RNC in can be used for HSDPA admission control.

4.7 Packet Scheduling Principal

We can outline the operation task of the packet hardware as to select a user to be served in each TTI, from those connected to the cell. Then maximize the cell outturn satisfying the standard of Services attributes happiness to the UMTS Quality of Services categories of the cell bearers The Node-B hardware selects the user to be served. To be noted that CQI represents Channel Quality Indicator whereas protocol stands for Transmit Power management. The Node-B hardware dictates the distribution of the radio resources among the users within the cell. A key side within the behavior of packet schedulers has been pointed. The programing algorithms that reach the very best system outturn tend to cause the starvation of the smallest amount favorable users. This behavior interacts with the fairness within the allocation of the cell resources, that ultimately verify the degree of satisfaction among the users within the cell.

5. Packet Programming Method

The programming method, conjointly divides the strategies in 2 main groups:

1. Packet programing strategies that base the programing choices on recent UE channel quality measurements that permit chase the fast variations of the user's endurable rate. These algorithms have to be compelled to be dead within the Node-B so as to accumulate the recent channel quality data. These strategies will exploit the multiuser choice diversity, which might give a big capability gain once the amount of your time multiplexed users is adequate.

2. PS strategies that base their programming choices on the typical users signal quality.

5.1 Scheduling Methods

1. Average C/I (Avg.CI)

This scheduling algorithm serves in every TTI the user with largest average C/I with backlogged data to be transmitted. The default averaging window length employed in various studies for the average C/I computation is 10.

2. Round Robin (RR)

In this scheme, the users are served in a cyclic order ignoring the channel quality conditions. This method outstands due to its simplicity, and ensures a fair resource distribution among the users in the cell

3. Algorithm Description

In this algorithm, we have assumed that the downlink channel is shared between users using channel-dependent scheduling to make the best use of available radio conditions (quality). Each user device continually transmits an indication of the downlink signal quality. Using this information from all devices, the base station (Node B) decides which users will be sent data on the next TTI. The base station (Node B) decides which users will receive data on the next TTI, while measuring the fair distribution and based on channel quality for each user.

Algorithm

```
If RNC is not available
{
   QUIT WITH ERROR;
}
ELSE
{
   WHILE (NO UE IS LOGGED IN) WAIT INFINITELY;
   CHECK FOR DEFAULT TTI;
   CHECK FOR CQIi, FOR ALL UEi'S;
   CHECK FOR MAX(HS-SCCH), STORE IT TO MXHS;
   IF MXHS≠1, CALL ARHSDPA() RECURSIVELY FOR EACH RNC INSTANCE;
   ELSE CALL ARHSDPA();
}
ARHSDPA()
{
FOR EACH TTI, DO
   {
      CHECK FOR SPI;
      IF SPI EXIST()
{
FWD PACKET OF MAXIMUM SPI
INCREMENT THE CTRi OF SELECTED UEi;
      }
      ELSE
      {
            FOR ALL UEi
            {
            GET UEi
                  GET RUEi
   PUEi=(UEi/RUEi)MOD NUMBER_OF_(UEi);
                  CUEi = CQIi *    PUEi;
                  SORT CUEi
```

RE-SORT THE UEI ACCORDING THE COMMUNICATION CLASSES

CHECK FOR AVAILABLE CHANNEL BANDWIDTH AND EMPTY SLOTS

FOR ALL EMPTY SLOTS IN CHANNEL, DO

{

FWD PACKET OF MAXIMUM CUEI;

INCREMENT THE CTRI OF SELECTED UEI (S);

}

}

}

}

}

6.1 EXPLANATION

In this algorithm, we have assumed that the downlink channel is shared between users using channel-dependent scheduling to make the best use of available radio conditions (quality). Each user device continually transmits an indication of the downlink signal quality. Using this information from all devices, the base station (Node B) decides which users will be sent data on the next TTI. The base station (Node B) decides which users will receive data on the next TTI, while measuring the fair distribution and based on channel quality for each user.

7. Simulation Results

Downlink and uplink graphs are shown of UMTS Network with HSDPA procedure. OPNET modular is used to implement the Downlink procedure in which simulation entities are as follows.

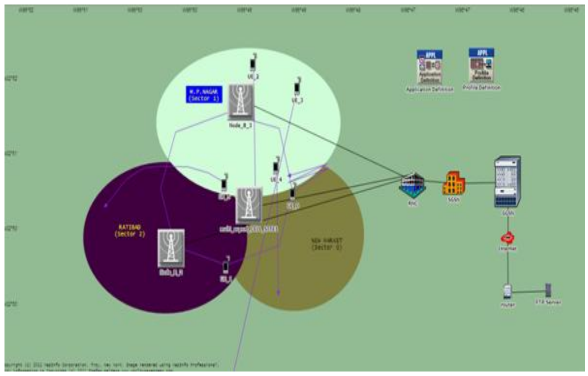
Table S. No.	Simulation Entities	Entities Value
1.	Duration	10 hours
2.	Seed	128
3.	Value per statistics	100
4.	Update Interval	50000 Events
5.	Speed Average	206,521Events/sec

Downlink Traffic Received Graph

The given graph, the downlink Network and the increasing packet receiving in the downlink of Improved Network are given.

Table in Downlink 5 Hours receive data

Packet	Duration in Downlink	Duration in Improved Downlink
5,000	0.32	0.29
10,000	1.28	1.15
15,000	2.15	2.2
20,000	3.05	2.27
25,000	3.58	3.4
30,000	4.45	4.31



Overlaid Downlink and Improved Downlink Graph

Figure 7.1 Simulate Downlink and Improved Downlink

In this graph, the packet receiving shown in 5hrs (5x60=300 minutes). In it the number of packet is starting at (x1000).

8. CONCLUSIONS

In this paper building a Network model that is capable of mapping the HSDPA specifications to a working system needs to take into careful considerations the aspects if the system that need to be tested. A model that can be used for packet scheduling performance testing needs to have an accurate mapping of the MAC-HS layer in the HSDPA specifications, as well as implement the short TTI and move the retransmission functionality of the Node-B module. Extending the OPNET Modeler Network models, which are rich in features and implemented concepts, requires in depth knowledge of the design used for their coding. Besides the 3GPP standards, an advanced knowledge of C++ and pointer structure use is essential in understanding the Modeler's work flow.

The model created in OPNET is a proof of concept with implemented features of HSDPA rather than a full fledged model, but it shows the capabilities of the simulation environment and means of extending it. Future extensions to the model could follow the industry evolution to next generation UMTS Releases as it will become challenging not only to model just single technology models, but also emulate the use of hybrid UEs running in different Networks

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