SON for Co Channel Interference and Adjacent Channel Interference Avoidance

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ABSTRACT

The concept of self-organizing networks (SON) was developed by the 3rd Generation Partnership Project (3GPP). The SON is mainly used in Heterogeneous Networks which requires efficient traffic load handling and where wireless environment is drastically changing due to the network and surrounding anomalies. The SON is very efficient tool in undergoing self-healing, self-optimizing and self-configuring without influencing the overall network configuration. In this proposed Algorithm, we have made an attempt to decrease Inter Channel and Co channel Interference.

Keywords

SON-Self Organizing Network, 3GPP-3rd Generation Partnership Project, ICI-Intercell Interference, ICIC-Intercell Interference Coordination

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Introduction

The wireless communication traffic across the globe is increasing significantly day by day , due to number of smart devices such as laptops , mobiles , internet of things . In order to handle such a huge mobile data traffic a HETEROGENEOUS NETWORK is employed [1].

By increasing the number of base stations and repetitive frequency spectrum reuse , we can achieve a high data traffic capacity network but at the cost of Inter Cell Interference . With Inter cell Interference Coordination schemes being employed by using Self Optimising Networks we can substantially reduce the channel interference .[2][3][4]

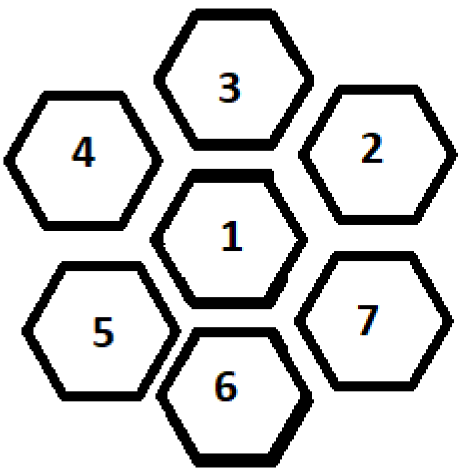

Fig.1-Frequency Reuse pattern

Fig.1 show frequency reuse goes on increasing as data traffic goes on increasing.

The Scheme for achieving SON in the HETNETS in Precoding and 16 bit QAM .The Key Performance Indicators (KPI) are used to optimise the channel capacity to subside the interference arising due to the proximity of the cells . The 2nd generation mobile networks such as GSM , uses the different frequencies for adjacent cells to reduce Inter cell Interference .The 3rd generation mobile networks such as UMTS , uses different codes to compensate the Inter cell

Interference . The 4th generation mobile networks such as " Long term evolution LTE " uses OFDM air interface .

In the preview of ICIC , many approaches and algorithms have implemented with various parameters under consideration . Inter Cell Interference Coordination (ICIC) is a principle issue in long term evolution (LTE) . [5][6]

Inter Cell Interference (ICI) is the effect of using same frequency among the neighboring adjacent cells.

It is very necessary to utilize small cell intelligently, so that they can self-organize and vanish interference automatically .To efficiently reduce manpower and to increase advancement in planning, deployment, maintenance, the self-organizing networks was introduced in ICIC.

There are two main channel interference . They are ,

Co Channel Interference (CCI)

Adjacent Channel Interference (ACI) .

1) Co Channel Interference (CCI) :- It exists only if more devices are using the same frequency channel .It is type of congestion due to usage of same frequency channel by many devices . It reduces the velocity of communication by increasing the wait time . The main causes of CCI are :-

(i) Climatic anomalies

(ii) Network architecture design issues .

The effective way to avoid CCI is Radio Resource Management techniques , which involves algorithms for controlling various parameters such as transmission power , Allocation of the end user , Beam forming , different modulations schemes precoding schemes , etc .

Adjacent Channel Interference (ACI) :- It occurs due to unwanted extraneous power arising from a signal in a neighbouring adjacent channel . ACI is mainly due to less filtering , bad tuning . ACI can be avoided by proper other schemes to handle the ACI effectively is to manage the broadcast spectrum .

Ease Of Use

ICIC in 4G/5G :- Spectral efficiency of a 4G or 5G Network employing ICIC or eICIC is better than its previous counterparts . At higher spectral frequencies , more data can be effectively transmitted with proper usage of same bandwidth without redundant bandwidth . ICIC reduces interference by allocating frequency resource to UE s at each cell . whereas the e ICIC behaves in the same manner by alloting different time resources to femto cells in heterogeneous networks . The inter cell corporation technology aims to increase the service throughput of user equipments UE at cell edge. Radio resources are not only shifted in frequency/time domain but it also can be shifted in spatial domain to improvise spectral efficiency. Precoding matrix explains the individual data streams are connected to the antennas. In radio communication simple information like interference noise is shared and channel information between user equiments and their base cells is shared using coordinated multipoint techniques in order to achieve better spectral efficiency. Two adjacent cells reduces the interference by allocating the main beam to their own user equipment's and null beam to other neighbor equipment's. If two user equipment's are located in adjacent cells then no interference is caused because they use very less power to communicate with one other. If two UE are located in adjacent cells which use high power to communicate causes interference. RB (resource blocks) with high allocated power are used by user equipment at adjacent cells and hence they cause interference for neighboring cells. The important parameters that describe the channel performance are CQI and HII. CQI and HII are information about interference caused by a cell to its neighboring cell. Orthogonal frequency division multiplexed system minimizes the mean square error of a channel. ICIC procedures are not designed to handle multiple optimzation problems. The main objective of ICIC in long term evolution is to mitigate the interference. The 5G LTE is expected to have shorter latency than the current 4G LTE hence suitable for heavy payload traffic.[7][8][9][10][11]

EXECUTION SCENARIO

SL NO	OFDM PARAMETERS(DL-SCH)	VALUE
1.	Antenna system	2*2 MIMO/4*4 MIMO
2.	FFT Size	512
3.	Number of used subcarriers	300
4.	Bandwidth, B	5MHz
5.	Sampling frequency, fs	7.68MHz
6.	Subcarrier spacing	15KHz
7.	Used Subcarrier index	-150 to -1,+1 to+150
8.	Cyclic Prefix duration	4.74µs
9.	Data Symbol duration	66.6 µs
10.	Total Symbol duration	71.3 µs
11.	Modulation	16QAM/BPSK
12.	Subframe Length	1ms
13.	Number of resource blocks	25
14.	Symbols per frame	140
15.	Channel model	Rayleigh/Gaussian channel

Table.1-Execution Scenario

Proposed Algorithm For ICIC

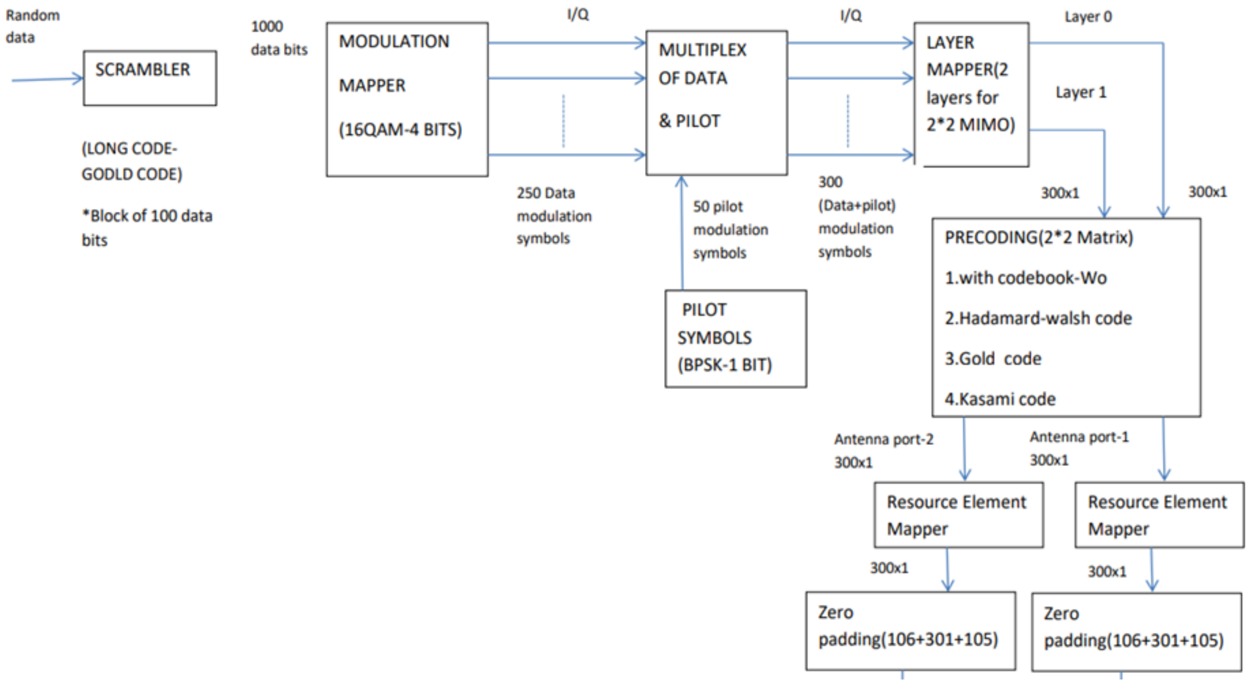

Fig.2-Transmitter Blaock Diagram

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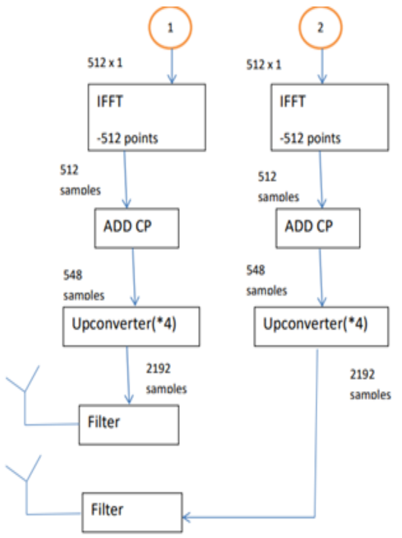


Fig.3-Receiver Block Diagram

Explanation for block diagram

SCRAMBLER:- Scrambling is an encoding technique used at the transmitting end in order to provide better synchronization between transmitter and receiver.
MODULATION MAPPER:- The mapping scheme is a unique technology in which the binary digits are designated to higher complex data using 16 bit QAM or 64 bit QAM or higher version of modulation procedures.
MULTIPLEXING OF DATA:- Many signals are mixed either in frequency or time in order to effectively use the resource channel.
PRECODING:- There are many precoding techniques which are used in order to encode the data to distinguish it from the noise. The following is the precoding technique used.
With codebook

Flow Chart For Proposed Algorithm For ICIC

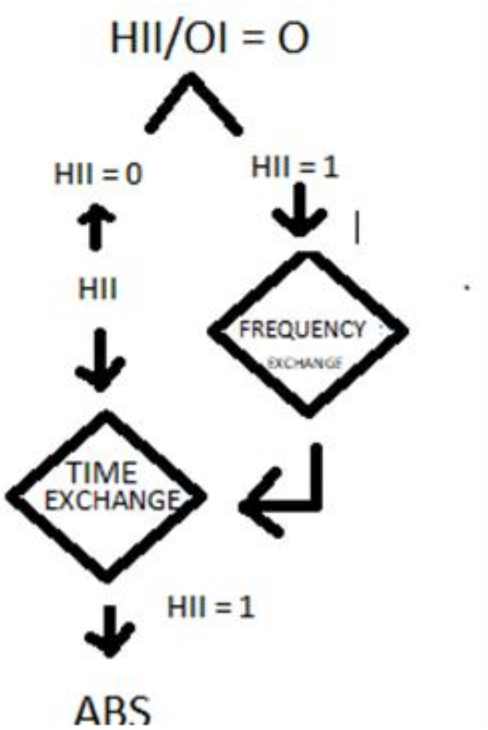


Fig.4-Flow chart of proposed scheme

Flowchart explanation

HII is high interference indicator, when HII is 0 then there is negligible interference and when HII is 1 then we apply resource block frequency exchange.
ARFCN is indicated by four integers that is absolute frequency channel number. There are 65,536 channels operating in 4G technology.
Each elementary resource block is indicated by 15khz.
ARFCN changes the slot in 10 milliseconds.
Now if HII is low (0) we stop. Again if HII is 1 then we apply time exchange .
Or else if HII is high (1) we employ time exchange of resource block. Here also ARFCN changes the time slot in 10 milliseconds. Again if HII is 1 ,then we apply that frequency for ABS meaning we are not using this frequency for further communication of data .

Scenario Of Interference

Below figure shows Interference due to co channel Interference and adjacent channel Interference

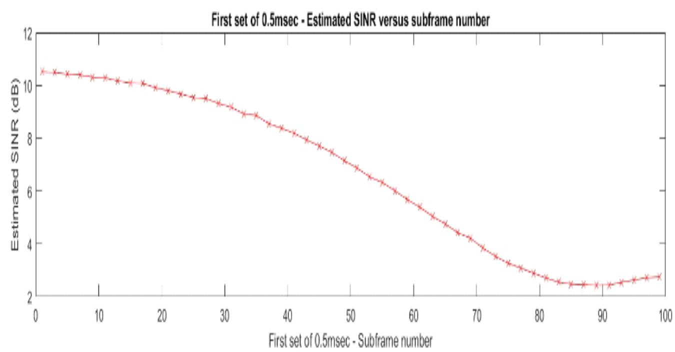


Fig 5- SINR of first time slot

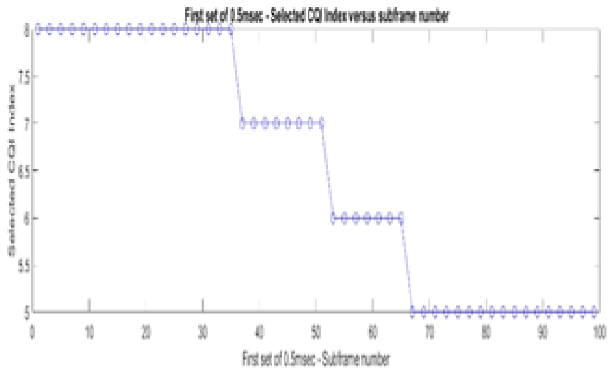
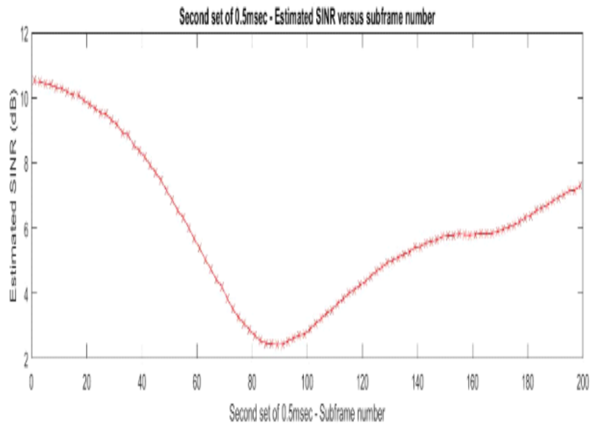


Fig.6-Channel quality indicator of first set of 0.5 ms

Below figure shows Interference due to co channel Interference and adjacent channel Interference



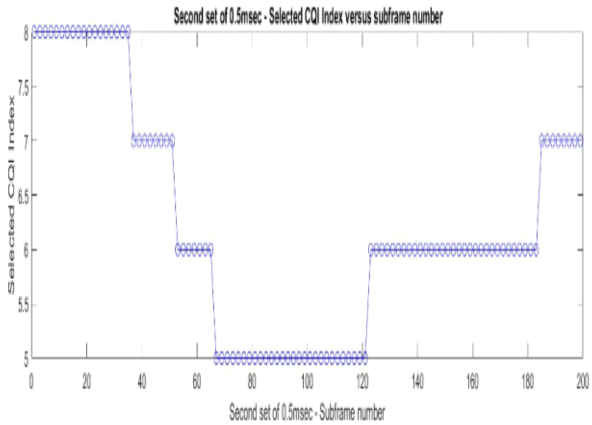
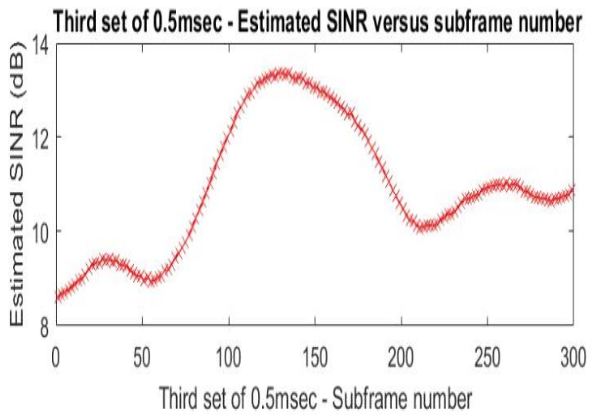


Fig 7 : Estimated SINR for second time slot

Results Of Proposed Scheme



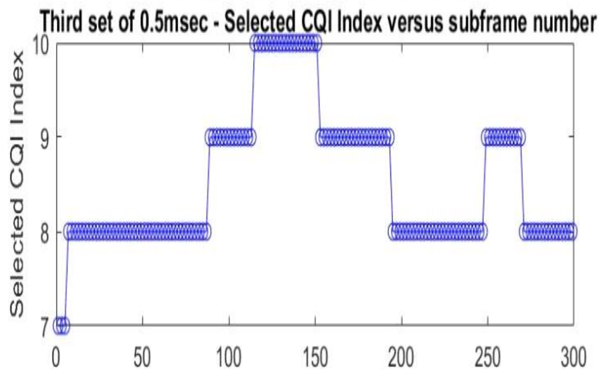


Fig.8- Estimated SINR for the third time slot

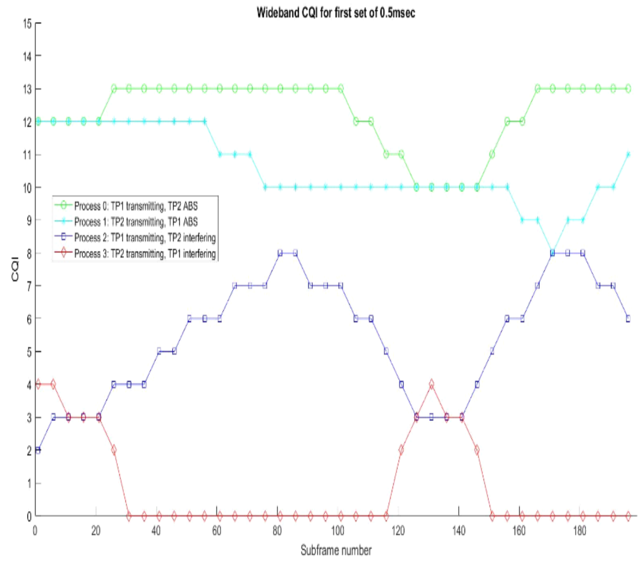


Fig.9- Channel Quality Indicator for the the first time slot

frequency shifting Step : In first iteration, the first set of resource in 0.5 ms gives a throughput of 296328 bits (34.06%) and block error rate(BLER) of 0.487

Time shifting step : In the first iteration, with the first set of resource block of 0.5ms, we achieve the block error rate-BLER: 0.0083333(target is 0.1) and the corresponding ABS Frequency: 483.6719 kbps.

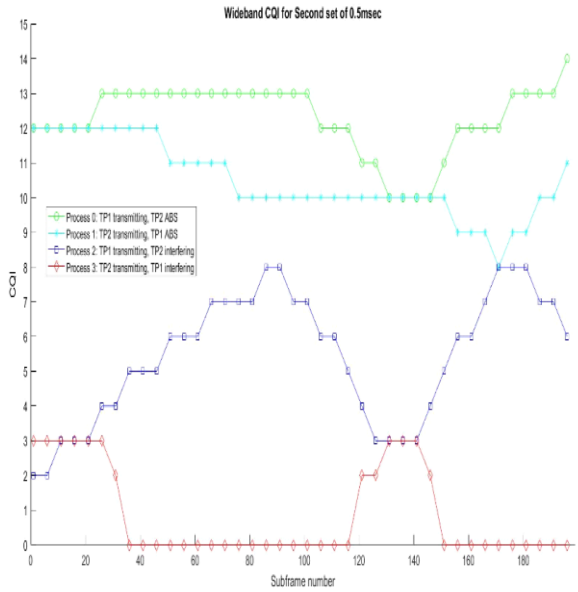


Fig.10-

frequency shifting step : In second iteration, the second set of resource in 0.5 ms gives a throughput of 663048 bits (48.52%) and block error rate(BLER) of 0.442.

Time shifting step : In the first iteration, with the first set of resource block of 0.5ms, we achieve the block error rate BLER: 0 (target is 0.1) and the corresponding ABS Frequency: 485.7422 kbps

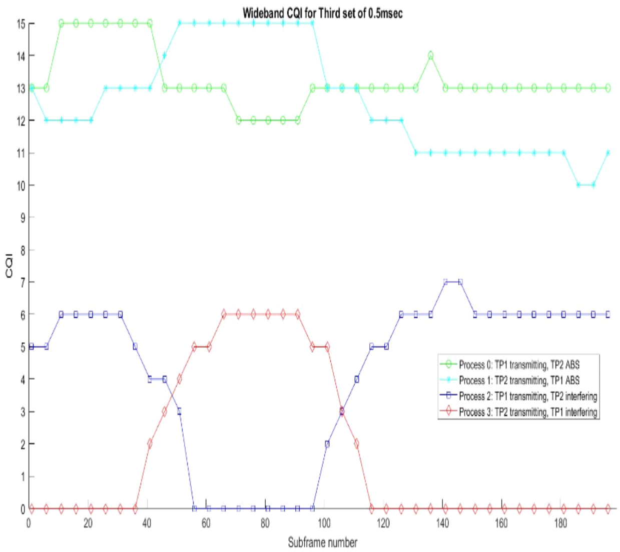


Fig.11-**CQI of third time slot**

frequency shifting step : In third iteration, the third set of resource in 0.5 ms gives a throughput of 3761928 bits (95.78%) and block error rate(BLER) of 0.043

. Time shifting step : In the first iteration, with the first set of resource block of 0.5ms, we achieve the block error rate - BLER: 0.48333 (target is 0.1)and the corresponding ABS Frequency: 251.9531 kbps

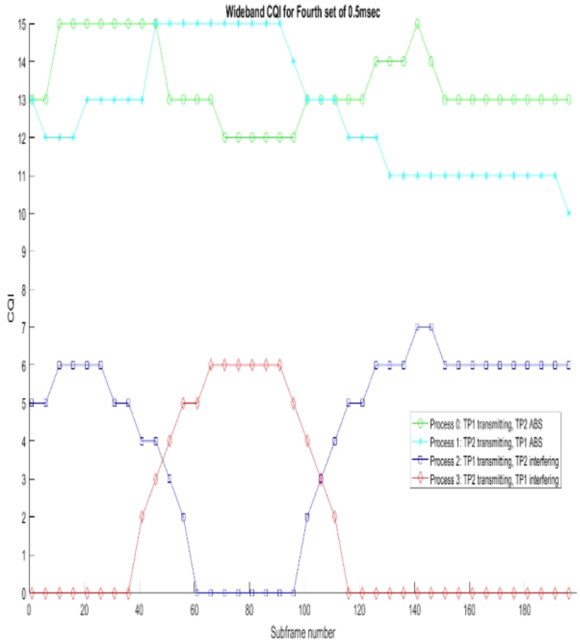


Fig.12- CQI of fourth time slot

frequency shifting step :-In fourth iteration, the fourth set of resource in 0.5 ms gives a throughput of 4775688 bits (34.06%) and block error rate (BLER) of 0.070.

Time shifting step : In the first iteration, with the first set of resource block of 0.5ms, we achieve the block error rate-BLER: 0.45833 (target is 0.1)and the corresponding ABS Frequency:264.4922 kbps

The above figure shows the signal to noise ratio versus BER. The plotted graph shows a close resemblance with simulated values. From this we can take the inference that the proposed model can be further improvise to provide better matching results with the standard enhanced efficient results .

Conclusion

This proposed algorithm model gives an effective algorithm using the KPIs such as HII to enhance the quality of service of LTE networks. Additionally, a SON introduces Co Channel interference avoidance scheme as well as Adjacent Channel interference avoidance scheme by frequency shifting and time shifting the resource blocks in the transmission channels. The performance of the discussed algorithm has been evaluated using a better compiler simulator. The proposed algorithm updates the SON parameters to the receiver in order to differentiate between the signal with the noise. The results shows a compatible comparison between the actual and simulated BER of the transmitted signal .The results have improved after every iteration step by step and finally we are able to achieve a better throughput of 99.96 % .

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