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Distribution of resources beyond 5G networks with heterogeneous parallel processing and graph optimization algorithms

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Abstract

In this paper, a design model for resource allocation is formulated beyond 5G networks for effective data allocations in each network nodes. In all networks, data is transmitted only after allocating all resources, and an unrestrained approach is established because the examination of resources is not carried out in the usual manner. However, if data transmission needs to occur, some essential resources can be added to the network. Moreover, these resources can be shared using a parallel optimization approach, as outlined in the projected model. Further the designed model is tested and verified with four case studies by using resource allocator toolbox with parallax where the resources for power and end users are limited within the ranges of 1.4% and 6%. Furthermore, in the other two case studies, which involve coefficient determination and blockage factors, the outcomes of the proposed approach fall within the marginal error constraint of approximately 31% and 87%, respectively.

Keywords Resource allocation · Parallel processing · Cluster computing · Graph optimizaiton

1 Introduction

The concept of resource allocation plays an important role in all developing networks as in the existing network operations for each end user the maximum amount of resources is allocated, thereby maximizing the data rate [1–3]. During the process of resource allocation foremost advantage that is considered to each end user is that the same level of energy can be utilized for delivering multiple packets without any delay [4, 5]. Moreover if resources are utilized in a proper way then other networks can remain at individual state where bandwidth and frequency within the allocated spectrum can be saved.[5–9]. Further the resource allocation process is handled based on three types of operations such as centralized coordinated, decentralized uncoordinated and decentralized uncoordinated, where

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resources are not properly allocated in this mode as every user utilizes the allocated resources of other user thus demanding additional resources for transmission to end users [10, 11]. Whereas in centralized coordinated system a good level of resource allocation can be established as allocated amount of parameters are utilized, and at a later state the remaining resources that remains unutilized is transmitted to central controller which is allocated to other users based on request. In most of the developing generation networks all users are located in a spectrum where the centralized coordinated approach is assured [12, 13]

Additionally, if a centralized coordinated mode of establishment is implemented, all constraints of heterogeneous networks can be met, thereby achieving an information model that prevents the utilization of hidden resources [14]. Therefore, in the proposed method, resources are allocated in networks beyond 5G using graph-based and parallel optimizations with an independent transfer process [15]. The process of resource allocation in different generation networks such as fourth and fifth generation provides a proper way for defining data in distinct structures. In a data processing system, resource allocation represents a unified approach where data is transmitted to end users without any waste. However in current network operation due to increased transmission speed more amount of resources that corresponds to power, end user and other parameters are allocated without any limitation which causes network wastage and cost of implementation is also maximized in such cases.

Therefore, the aforementioned shortcomings in data transmission for all future networks must be addressed appropriately to prevent the loss of valuable resources that can be utilized by all individuals at a later state. Further in every resource allocation process it is always essential to distribute various resources according to defined functions in an equal way therefore each user can able to utilize all resource at higher speed. Figure 1 portrays block diagram of resource allocations that is carried out with data transmission networks. From Fig. 1, it can be seen that the resource allocation for dynamically moving cells is connected to the 5G core network. The connection that is present in the core networks is interconnected with allocated resources that are stored in the cloud for use in different application. Additionally the gateways are connected after allocating resources that is processed by heterogeneous graph nodes and finally a parallel processing unit is established for allocating separate resources in the system.

1.1 Research gap and motivation

There are many methods that are available for supporting extended operations beyond 5G networks where several networking features are incorporated thus making the system to be highly flexible and even at the output unit each system will be connected with proper configuration modes. Moreover some of the methods incorporates an optimization algorithm in order to convert the available resources to useful systems thereby wastage of resources is not present. However some of the major gaps that leads to resource minimization that are carried out with respect to energy, power, data allocation and blocking. is missing in existing works. It is well known that 5G and beyond 5G networks can able to handle interconnections where output response with respect to data points will be much higher with allocated resources at it will be utilized to maximum extent. But the following queries are not solved in existing methods therefore a unique system model is created in the proposed method to overcome various gaps as follows.

- RG1: Can the system model be created with necessary support beyond 5G networks with limited amount of data?
- RG2: Is it possible to extend the network operation with minimized amount of resources thereby end user data remains at protected mode?
- RG3: Whether the change in amount of resources affect the data in direct or indirect way without creating homogeneity conditions?

1.2 Major contributions

To overcome the aforementioned research gaps beyond 5G networks in the process of resource allocation a system model is projected with heterogeneous conditions where data allocation process is carried out with minimized time period of transmission thus satisfying the following objectives.

- To allocate minimum power and bandwidth to all nodes thereby each subcarrier transmits the data to end users at minimized time period.
- To maintain limited amount of coefficients thus all end user resources are shared with respect to each other with blocking capability.
- To operate the system with heterogeneous optimization algorithm thereafter preventing resource overlay conditions beyond 5G networks.

2 Related works

Since the existence of different networks that is operated with dissimilar resources the development process beyond 5G is a challenging task to be introduced with several useful characteristics. However some of the researchers have examined the case of connecting network features

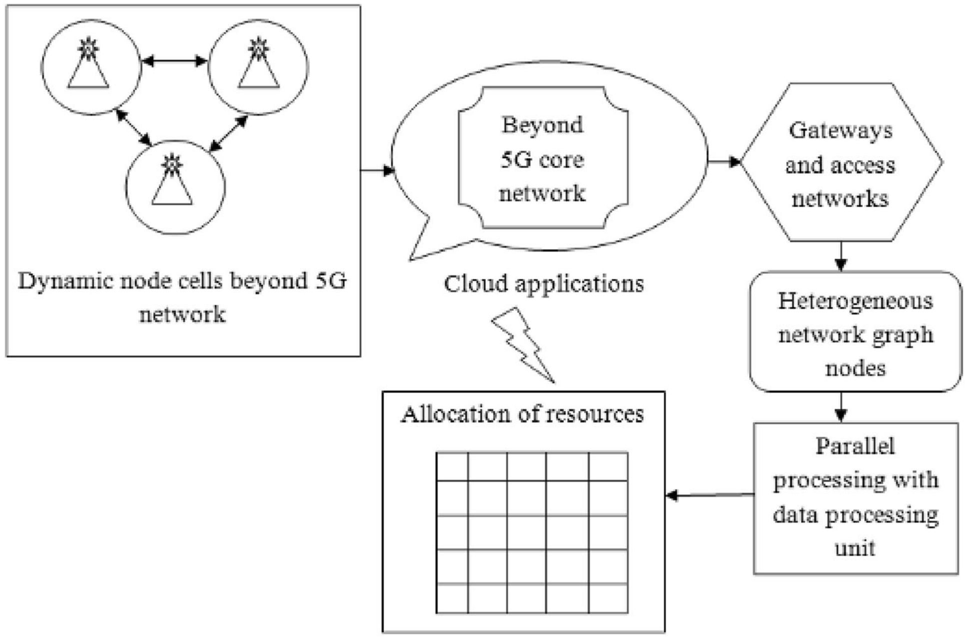

Fig. 1 Block diagram of resource allocation beyond 5G networks

with available resources where different configurations are provided in real time without any external effect. Therefore this section provides a clear overview on all related works that is present for configuration networks where resources are allocated under different modalities. In a mathematical model for 5G networks are formulated with terahertz cellular systems where reliable services are provided with proper interfacing unit. During the process of terahertz modeling it is observed that multiple connections are provided thus neglecting all traffic types in entire unit. Even if multiple connections are provided the number of users accessing the spectrum is much lesser thus a two parametric separation process is made with both deployment and enhancement techniques whereas in real time the terahertz communication system fails to prove the implementation and only attraction cases are provided in a manageable way. Further in machine type communication is accessed by developed network that is operated with multiple input and output connections thereby the system responds to various parametric relationships such as data rate and reliability. With the introduced system beam forming is associated where feasibility beyond 5G network increases to great extent however wide beam formation cannot be completed in case of orthogonal access spectrums.

As an alternate to beam forming edge computing devices are introduced and it is found that it is suitable for all network applications thus satisfying the optimization goals with extended figure of merit3. One of the best optimization goal that is provided with edge computation system is that on board computation can be provided but it must be combined in several forms to increase the privacy of system operations. The above mentioned on board computation is not suitable in real time as privacy of 5G networks with minimum amount of resources cannot be guaranteed if multiple operating units are present.

A multicarrier waveform design for 5G network analysis is implemented with non-orthogonal multiple access where estimated average power ratio is increased4. During the network operation the user must provide average power to make the connection arrangements in a feasible way. But due to the presence of more amount of power the system suffers from failure thereby a complementary function is introduced that causes additional effect on other working system that needs to be avoided beyond 5G networks. Contrariwise to non-energetic resource allocation model that is provided by non-orthogonal methods that uses beam forming as major implementation case there is an alternate solution that is provided by mobile units with energetic sources5. During the process of mobile energy collection more number of resources are needed by 5G networks where it is not possible to provide a clustering operation in collected networks. Whereas in case of dynamic process instead clustering process it is possible to implement a slicing period where resources are separated and provided to individual users and there arises a huge demand among different user groups which is considered as major drawback of slicing principle. Further with energy efficient resource allocation a threshold control access is provided to share the resources with end users and during the control technique a better quality of service is established6. With the process of resource control a user can get benefit in terms of cost whereas in case of other network parameters it is much difficult to achieve similar outcomes therefore sub carrier levels cannot be extended to higher extent. Moreover the control method fails during resource collection process as only low powered devices are connected in case of mobile to mobile transmission cases.

Instead of establishing a control technique another alternate solution is provided by co-operative orthogonal multiple access [7] where a full duplex operation is carried out without any resource interference. In this case even if resources are shared among different users it is possible to avoid duplication process that prevents multiple utilizations. Moreover if interference is present then co-operative resource allocation can able to amplify some of the resource and forwards it to corresponding destination. Still it is not possible to achieve remarkable solution due to the presence of relaying operation that is carried out using enhanced features set where channel conditions must be checked properly. As a replacement of co-operative techniques a policy gradient method using deep learning algorithm can be established in order to allocate resources with gradient deterministic cases8,9. During this process all users can follow certain policy and establish a boundary region for defining various resources that prevents additional usage of allocated resources. The major drawback in boundary allocation is that if limits are exceeded then entire network process will be stopped and other users will be prevented to enter or perform certain task functionalities. Table 1 provides a deep insight on existing methods that describes the objective functions that is achieved in real time with low number of resources.

In [18] it is observed that multiple resources are utilized which are represented in terms of hybrid algorithms where according to particular schedule it necessary resources are allocated for data transmission. Even though resources are allocated with respect to schedule more number of individual resources are shared to users which is considered as major drawback. In addition for managing power allocation more amount of resources are provided by using multiple levels[19] therefore at each stage distinct resources are present thereby increasing the data transmission to end users with high wastage. Further an individual channel is allocated for sharing the resources through virtualization procedure [20] where the cost of allocation in separate channels is much higher. Moreover if virtualization procedure is followed amount of resources will increase further as uplink and downlink transmissions needs to be increased in this case. But in proposed method as an alternate to channel, power and virtualization procedures fifth generation networks are chosen in a proper way thereby constant resources are provided for data allocation, transmission and other necessary requirements. The above mentioned type of resource allocation is considered as one of the innovative procedure in future generation networks that require more amount of resources to be allocated to end users and it is prevented by proposed method.

3 Problem formulations

The system model that is designed for the operation beyond 5G networks provides a clear overview on implementation case studies that needs to be incorporated in real time conditions without any external effect. In addition the system model is an alternate way of establishing necessary resources in terms of parametric features therefore minimum amount of resources are guaranteed for entire operational unit even if the system is updated using current operational conditions. In the proposed system model the possibility of 5G and beyond 5G networks will be tested with seven different parameters that provide great support for experimental study cases.

3.1 Limited data allocation

For a network to provide effective operation with connected users the available number of data must be checked before transmission. In case if the amount of allocated data is much higher then some amount of data must be dropped which is defined using carving principle as indicated in Eq. (1)11.

$$A_i = min \sum_{i=1}^{n} \frac{T_d(i)}{T_a(i)} * 100 \tag{1}$$

Equation (1) describes that if minimum resources are provided for a particular data then data transmission and reception is possible at minimized time periods therefore every data with additional resource units can be neglected.

3.2 Resource power

For all updated network operations minimum amount of resource power must be supplied to prevent wastage of power allocations in the network therefore for transmission between mobile to end users the resource power can be allocated as follows.

$$P_i = min \sum_{i=1}^{n} N_p(i) - N_s(i) * b_r \tag{2}$$

3.3 Data resources

For each data to be transmitted beyond 5G networks the bandwidth must provide proper support thereby preventing failure rate in the system. Hence the supporting subcarrier bandwidth can be allocated based on Eq. (3) as follows.

Table 1 Existing vs. proposed

References	Methods/Algorithms	Objectives			
		A	B	C	D
[10]	A unique framework with edge computing resource management	✓	✓		
[11]	Slicing resource allocation model	✓		✓	
[12]	Multi stage edge computing under low latency	✓	✓	✓	
[13]	Multiple slice bi-resource allocation	✓		✓	✓
[14]	Reconfigurable device model with super Internet of Things (IoT)		✓	✓	
[15]	Ultra wide band resource allocation with multiple inputs and outputs		✓		✓
[16]	Feasibility of 5G networks with channel allocation techniques	✓	✓		
[17]	Heterogeneous resource allocations with recommendation algorithms		✓	✓	
[18]	Multiple application for resource allocation using scheduling algorithms			✓	✓
[19]	Multiple heterogeneous network optimization using genetic algorithms	✓			✓
[20]	Virtualized channel allocation for wireless network applications using dynamic channel allocation		✓		✓
[21]	Data security for individual resources with offload allocation techniques		✓	✓	✓
[22]	Data classification for resource allocation with learning procedures	✓	✓		✓
[23]	Artificial intelligence algorithm for automated resource allocations for data transmission schemes		✓	✓	
[24]	Colum generations and flow analysis with resource distribution using heterogeneous networks		✓		✓
[25]	Distributed machine learning with resource based service level agreements for various applications	✓	✓		
Proposed	Multi-objective resource allocation framework using heterogeneous optimization algorithm	✓	✓	✓	✓

Where A: Allocation of data and power; B: End user resources; C: Coefficient establishment; D: Blocking and overlays

$$RS_i = min\sum_{i=1}^{n}(BW_i * b_r) + RS_p \tag{3}$$

Equation (3) describes that for all data resources necessary bandwidth must be allocated based on individual blocks where exact data rate can be achieved to prevent failure of each node.

3.4 Resource coefficients

Some of the allocated resources will be faded due to additional consumption power that is present in each unit thereby a separate resource coefficient needs to be maintained between network base station and user as indicated in Eq. (4).

$$RC_i = max\sum_{i=1}^{n} f_c * l_f(i) \tag{4}$$

Equation (4) describes that with maximum limitations on resource coefficients it is possible to achieve fading constants thereby appropriate connection between base station and user can be provided.

3.5 End user resources

Even though there is a connection establishment in terms of coefficients between base station and end user it is always necessary to have a separate end user resource therefore sharing of resources can be enabled between different users. The possibility of sharing resources is reserved by end users at initial state in order to fit beyond 5G networks12.

$$EU_r = min\sum_{i=1}^{n}(U_t(i) + Ini_t) \tag{5}$$

Equation (5) determines that resources can be shared based on first user initialization as it is essential to share the resource by checking the utilization rate. If resources are not utilized by first user then it will be transferred to other users upon request

3.6 Resource blocking

If the users are not interested to share the remaining resources to other end users then blocking process can be carried out thereby it is possible to store the resources for future use. This parametric model can be considered as alternate to sharing resources as indicated in Eq. (6).

$$RB_i = max\sum_{i=1}^{n}\frac{\tau_i}{UA_i} \tag{6}$$

Equation (6) describes that if blocking probability is higher then access for each user is maximized to certain extent. However in case if the user rejects certain request then allocated resources will be blocked and it will be provided to other initial users.

3.7 Resource overlay

All allocated resources beyond 5G networks can be covered to prevent the external users access thereby it is possible to save the resources under attack. In order to save all resources from other types of attacks two possible ways of separation can be made as indicated in Eq. (7).

$$OY_i = max\sum_{i=1}^{n}(SP_i * b_r) + MC_i \tag{7}$$

Eq. (7) describes that for all multiple carriers in each block resources the allocated resources must be separated from the users thus preventing complete overlays.

3.8 Objective functions

All the above mentioned seven parameters that provides support for minimum resource allocation beyond 5G networks can be formulated as objective function that is indicated as multi-objective functions as follows.

$$obj_1 = min\sum_{i=1}^{n} A_i, P_i, RS_i, EU_r, block_i \tag{8}$$

$$obj_2 = max\sum_{i=1}^{n} OY_i, RC_i \tag{9}$$

The min-max objective functions in Eqs (8) and (9) must be achieved beyond 5G networks therefore all blocks in the network must be available for end users with maximized usage. Hence to incorporate the objective functions in real time optimization algorithm must be integrated as described in Sect. 3. Figure 2 depicts the flow chart of proposed methodology.

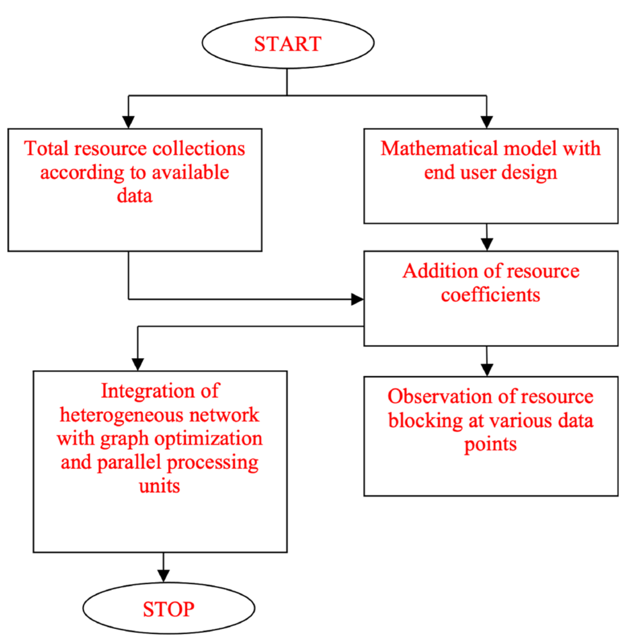

Fig. 2 Methodology flow for resource allocations in proposed method

4 Methodology

In this section the heterogeneity for beyond 5G networks is checked by using heterogeneous algorithms where a set of instructions are processed with minimized resource allocations. Since beyond 5G networks more than one processors are used it is essential to combine existing processors therefore additional resource allocations can be prevented. The major advantage of heterogeneous algorithm is that every task functions can be executed at minimum time period thereby incorporating a special processor to handle complex resource allocation problems. Moreover the amount of scaling is increased to further extend due to resource in-built logic where appropriate interfaces are provided with programmable nodes beyond 5G networks. The heterogeneity in network connections indicates that the system remains at flexible mode only with minimum number of resources where a prevention case can be established to end users. In addition the heterogeneity of networks indicates that every resource can be allocated based on certain schedule where time period measurements are carried out. Due to such allocations it is possible to divide number of users thereby establishing a stable connection in the network that prevents over usage of bandwidth. Further all operations beyond 5G networks are carried out only with decentralized mode where the difference in exact characteristics can be found without any delay. The above mentioned difference indicates that it is possible to establish dynamic configuration network where manual changes can be provided to share all network resources thus preventing failure of connected networks. Additionally the allocated resources must ensemble corresponding network points thereby heterogeneous conditions are satisfied with low resource allocations.

4.1 Heterogeneous graph optimization

For providing best recommendation beyond 5G networks in case of resource allocation process it is essential to use a graphical orientation procedure thereby all functional features are converted to useful technique and with the help of connectivity features it is much easier to transform every network to have general intelligent technique [17]. The major reason for choosing graph optimization process is to minimize the number of routes for data transfer where energy can be minimized even if multiple nodes and edges are used. In addition the graph representation provides a clear overview on data association other than defined classification techniques therefore all conventional networks can be associated with pre-existing data. In heterogeneous graph optimization a separate mapping function is defined with n number of nodes thereby every edges are marked with corresponding labels. Further for every connected node the network utility functions are described with graphical mapping as objects are aggregated over a fixed size to reduce network complexities. Since mapping functions are defined the network can able to learn the updated resource parameters in an automated way thereby manual changes are blocked from system units thereby improving structural aggregation beyond 5G networks. Additionally every network operation can be decomposed into various forms based on characteristics of allocated resources where a sematic model is needed for resource separation and addition of various components. Furthermore a special structure will be formed during this recommendation set thus decomposing every network feature into individual information transfer unit that converts the system factors to multiple layers with minimized resources that can be used for different applications.

4.2 Heterogeneous information model

The set of information for allotted resources is transformed to separate structure where network hidden resources are converted to open source feature by direct conversion model thereby information is passed using the channel model as indicated in Eq. (10).

$$IM_i = \sum_{i=1}^{n} n_w(i) + (h_1 + .. + h_i) \tag{10}$$

Equation (10) describes that the representation of hidden units are carried out with white noise therefore every information is activated with side unit that is represented with high dimensional features.

4.3 Hidden heterogeneous resources

Even though a special structure is formed most of the hidden sets remain with special sematic features where shared resources are not displayed with supplied resources. Hence total hidden unit must be changed by using a resource scoring matrix as indicated in Eq. (11) [21].

$$L_h r = \sum_{i=1}^{n} (z_i n + y_i) \tag{11}$$

Equation (11) describes that if hidden resource values are added thereafter first scored values will be compared and if any hidden resources are found then it will be added in the network matrix.

Heterogeneous transfer process From the normal operational resources it is essential for a network system to be converted to heterogeneous operation by using a representation factor that describes the nature of network systems in a clear way. The conversion of the entire system model to heterogeneous indicates that processing of each data can be completed with minimum number of available resources where a certain path can be established as indicated in Eq. (12).

$$SNP_i = \sum_{i=1}^{n} \frac{1}{TP_i} * wt_i \tag{12}$$

Equation (12) describes that if every data is separated according to weight functions then it is possible to establish a transfer function with indicated heterogeneous point functionalities. The block representations of heterogeneous algorithm are represented in Fig. 3 and implementation flow is as follows

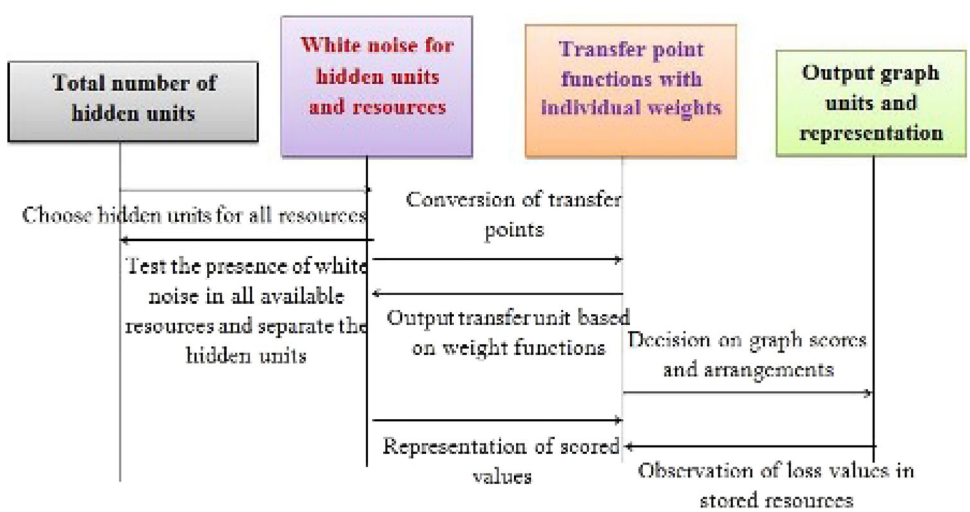

Fig. 3 Heterogeneous graph optimization for resource along beyond 5G networks

Algorithm 1 Graph optimization

```
procedure HGO
    Given:
    h_1 + ... + h_i : Number of hidden feature sets
    z_in : First scored resource values
    for i = 1 : n do
        IM_i to establish the information model based on hidden resource units
        L_hr for calculating total number of scoring functions
        Determine actions with GN_i
        a ← np.zeros( user_num + ( edge_num × user_num)
        a ( user_num) ← R/r
    end for
    for all i = 1 : n do
        SNP_i for providing transfer functions based on data weight conditions
        a ( user_num) ← B/b
        count ← onetable^(i) / (b_bound × 10)
        count + = 1
        count ← user_ID / 100
        count + = 1
    end for
end procedure
```

4.4 Parallel distributed genetic algorithm

For estimating all model parameters a genetic algorithm with isolation step must be followed in heterogeneous algorithms thereby all parallel operations can be carried out without any delay. However the process of parallel distribution is regarded as trial and error method where unknown parameters are included with selected parallel units18. As a result of distributed unit and by following heterogeneous environmental conditions a mutation probability can be provided with a set of unique functionalities thereby with low resource it is possible to converge the network system at most primitive constraint. The major advantage of parallel genetic in heterogeneous network operation is that all robust parameters can be established and connected by achieving an intermediate solution. The above mentioned intermediate solutions provides various information about characteristics of network thereby processing off spring functionalities which indicates a rate limited process. Further in theoretical setup the parallel processing system establishes a separate pathway thus speed of processing system is increased and the data is provided in a sequential way. In case if parallel information is processed in a sequential way then a general convergence solutions for resource unit can be achieved with low sensitivity effect. Conversely the aforementioned process is carried out only if a scheduling resource allocation is followed with minimum number of populace units. Even it is possible to establish a schedule for large scale systems but sequential parallel processing cannot be completed at estimated time period.

4.5 Heterogeneous data speed

In case of multiple establishment the data speed must be raised thereby an estimate can be provided with actual time period. For the projected estimate the data speed must be higher thus solving the benchmarking problems as indicated in Eq. (13).

$$sd_i = \sum_{i=1}^{n} \frac{\vartheta ST_i}{\vartheta PT_i} \tag{13}$$

Equation (13) describes that if sequential time period is increased then it is possible to control it by parallel time periods where a separate run time can be established.

4.6 Heterogeneous parallel operations

In case of sequential data processing units every parallel operation can be completed by using fractional resource supply where it is possible to establish efficient outcomes by using linear speed up units. In this type of fractional parallel operation the efficiency can be calculated using Eq. (14) as follows.

$$FPO_i = \sum_{i=1}^{n} \frac{npr_i}{1 - f_r(i))} \tag{14}$$

Equation (14) describes that for all fractional resources the number of processing units must be increased thereby establishing a higher bound values beyond 5G networks.

4.7 Heterogeneous parameter estimation

In parallel processing system proper resources can be supplied only of resources are separated by using random parametric values. This case is usually established for different devices as configuration in each unit changes and if next generation networks needs high resource for some devices an alternate solution can be arranged.

$$HPE_i = \sum_{i=1}^{n} dr_{low}(i) * dr_{high}(i) \tag{15}$$

Equation (15) describes that if all parameters need to be estimated, then a high and low resource factor can be allocated, and the other units can be neglected before conditional establishments. Table 2 describes the significance of variables that are indicated in the proposed system model and optimization algorithms. The block representations of parallel heterogeneous algorithm are represented in Fig. 4, and the implementation flow is as follows.

4.8 Big-O-notation (time forecast)

To measure the complexities of allocated resources after integrating with parallel optimization the heterogeneous network is checked whether every data is transmitted at minimized space and time complexities. The above mentioned complexities are analysed in order to increase the performance metrics that are related to data processing applications hence the possibility of optimization with appropriate outcomes can be maximized. The mathematical model of Big-O notation is as follows.

$$O_i = \frac{(t_1 + .. + t_i)}{10} * iter_i \tag{16}$$

Equation (16) describes that for changing time periods and iterations constant number of resources must be allocated in such a way by observing the data structure and end user behavior in a proper way therefore time complexity in parallel processing units can be reduced.

5 Analysis of results

In this section real time resource allocation problems are analyzed by using a network model that interconnects more number of users. The network model in proposed method is designed beyond 5G operations where a information model with graph optimization approach is connected based on hidden feature set. Since there is a possibility of resource sharing end users are allowed to share the unused resource therefore in each connected graphs a user can share up to

Algorithm 2 Parallel genetic algorithm

procedure MLP
  Given:
  ST_i, PT_i : Sequential and parallel time periods
  npr_i : Number of resource processing units
  for $i = 1 : n$ **do**
    f_r for estimating the number of fractional units
    FPO_i for calculating total number of heterogeneous parallel operations
    const long double delta1 = (data1[$i*$ stride1]− mean1)
    const long double delta2 = (data2[i* stride2]− mean2)
    A- > size1! = $A-$ > size2
  end for
  for all $i = \underline{1 : n}$ **do**
    HPE_i for parametric estimation of parallel units with high and low resources
    gsl matrix long double swap rows(A, j, i pivot);
    gsl permutation swap (p, j, i pivot);
    $*_{signum} = -(*_{signum})$;
  end for
end procedure

Table 2 Variable representations

Variables	Implications
T_d, T_a	Average time period of data transmission and reception
N_p, N_s	Allocated power to network nodes and subcarriers
b_r	Total number of resource blocks
BW_j	Bandwidth of each resource block
RS_p	Resource power
f_c	Fading coefficient
l_f	Limited fading
U_t	Total user time period
Ini_t	Initialization period
τ_i	Precluded end users
UA_i	End user access
SP_i	Separation of user resources
MC_i	Multi carrier resource communications
$h_1 + .. + h_i$	Hidden feature set
n_W	White noise
Z_{in}	First scored resource value
y_i	Total hidden resource values
TP_i	Transfer point function
Wt_i	Separate data weight functions
$\vartheta ST_i, \vartheta PT_i$	Sequential and parallel time
npr_i	Total number of resource processing units
f_r	Fractional resources
dr_{low}, dt_{high}	High and low resource allocations
$h_1 + .. + t_i$	Corresponding time periods
$iter_i$	Total number of iterations

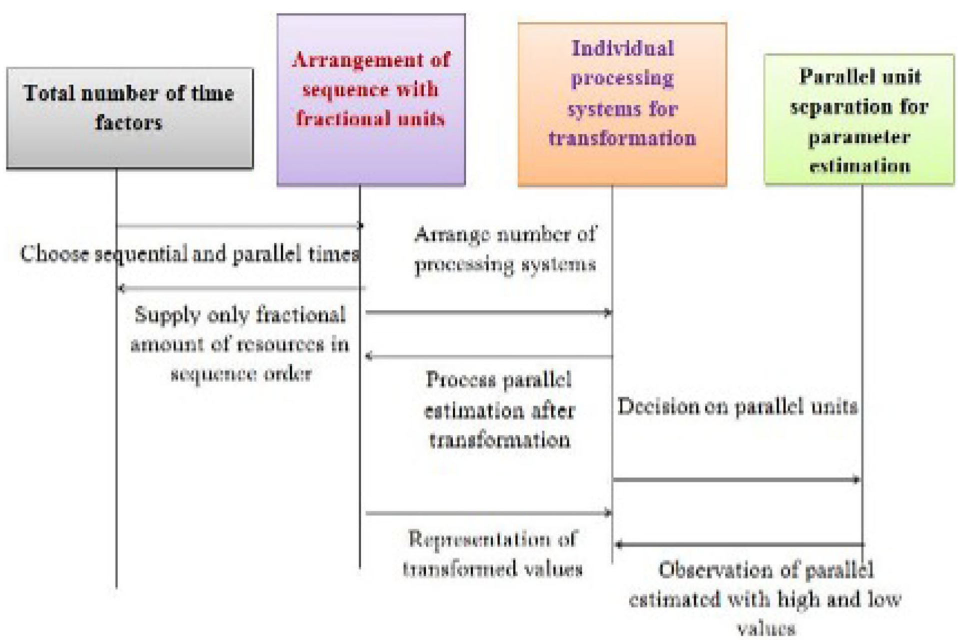

Fig. 4 Parallel genetic algorithms for resource along beyond 5G networks

81 resources thus leading to effective data transfer. In the proposed method 5 different networks with 5000 users are connected in a graph where for each network a maximum of 1000 users remains interconnected. If more number of users are added in any system then connected graph with resources are changed hence to maintain stable point only constant number of users are maintained until complete network connection or channel is disconnected. Moreover an average initial time period is maintained to make every data for reaching the receiver without any delay therefore allocated data resources are utilized at proper time periods. Additionally beyond 5G network model requires a constant bandwidth with parallel processing technique with connected graph optimization model. Hence blocking resource probability for each subcarrier is maximized where if a user regrets a particular connection then the resources will be allocated to secondary users without any delay. This type of time saving in resource allocation prevents a network from reaching complete failure state thereafter each user beyond 5G network can benefit from high operational speeds where heterogeneous conditions are convinced. Furthermore the coefficients in allocated resources can able to save high resource types that remains in used conditions thereby separating the low used resources by estimating average consumption in corresponding systems. To analyze the real time outcomes in proposed method four case studies are considered for resource allocation problems and the importance of case study design is provided in Table 3.

Case study 1: Analysis of data and power Case study 2: Resources for end users Case study 3: Coefficient determination Case study 4: Resource blocking and overlays.

5.1 Discussions

To discuss the efficiency of output with respect to varying parameters the real time network connectivity beyond 5G networks are converted with simulation outcomes where all designed objective patterns are analyzed with number of networks and users. Moreover the simulation is made by establishing n independent loops that prevents useful resources from entering blocking states. Further the network connections are provided in a direct way by establishing nodes with separate subcarriers that denotes the information model in the system representations. Table 4 provides the information about supporting environments for proposed system in case of simulation outcomes and corresponding simulation setup is illustrated in Fig. 5.

The type of simulator for resource allocation that is used in proposed method will be connected by using cloud monitoring units with MATLAB. Hence for both forecasting and resource analysis parallax simulator is used which predicts various resources for each data that is allocated to end users. The major advantage in using parallax simulator is that according to changing capacities it is possible to allocate resources and confidentiality can be maintained for all transmitting data. In addition the parallax simulator in offloading analysis is conducted in accordance with four case studies and a ten time repetition factor is considered for changing iteration periods from 10 to 100. Hence all errors at initial stage iterations are solved therefore in experimental validation low error values are found for each transmitted data with allocated resources.The supporting parameters that are provided for heterogeneous operation is connected by combining all networks thereby every graph connections are optimized for parallel distributed operations. A brief description on output analysis of case studies is as follows.

5.1.1 Case study 1: analysis of data and power

In this case study the value of power for appropriate data transfer is measured by considering average time periods. Most of the high speed network operations requires high power for transmission during data transmission state where it will be mostly affected if low power is provided. In case if low power is provided then data operations between end users results in unsuccessful state whereas if allocated power is much higher then wastage of resources will be present and it cannot be prevented. Hence it is necessary to supply power beyond 5G networks based on certain time periods hence average measurements of time in both transmission and reception stages are considered in the proposed system. For all data transfer beyond 5G

Table 3 Importance of designed scenarios

Case studies	Significance
Analysis of data and power	To allocate equal amount of power to each data for maintaining average time periods
Resources for end users	To analyze the utilization time period of each resource beyond 5G networks
Coefficient determination	To determine fading coefficient to separate each resource for establishing boundaries
Resource blocking and overlays	To block unnecessary resources thereby minimizing the weight of data transfer

Table 4 Simulation parameters and metrics

Bounds	Requirement
Operating systems	Windows 7 and above
Platform	MATLAB and Simulink network tool box
Version (MATLAB)	2015 and above
Version (Simulink network)	5.3
Applications	Data networking and graph optimization
Data sets	Heterogeneous parallel computing with 81 resource model
Metrics (MATLAB)	
Summary of MATLAB libraries	
Number of.c files	8
Number of.h files	12
Number of code generating files	2
Total line numbers of main code	103
Total line number of function code	354
Number of users	204
Number of connected entities	127
Number of simulation repetitions	6
Summary of library commands	
Code name	Line of code
Resource action generations.h	12
np.zeros.h	18
Bound resources.h	25
Data weight.c	13
Data count.h	29
Edge value count.c	19
Edge value count.h	37
Resource function information	
Function name	Stack size (in bytes)
Long double delta1	14
Long double delta2	17
Long double swap rows	27
Gsl permutation swap	54

networks the allocated power is based on resource blocks and subcarriers that are present inside every block. During the above mentioned process if subcarrier allocation is much higher then ratio of average time period from transmission to reception must be measured and maintained at same interval rate. Figure 6 and Table 5 illustrates the allocated power for considered data for both proposed and existing approach.

From Fig. 6 it is obvious that allocated data and power is minimized for proposed method as compared to existing method. In Fig. 6, the colour coding represents the various parameters being studied, including the total number of subcarriers, block resources, and the power distribution between existing and suggested approaches. Figure 6 provides parametric comparisons between subcarriers and block resources. The blue bar indicates subcarriers, while the purple bar shows the quantity of block resources. In the next state, the number of subcarriers shown by the purple bar varies, while the percentage of power for the existing technique is simulated and represented by the blue bar. In the concluding simulation scenario, the blue bar represents the proportion of power allocated to the proposed approach. The major reason in such limitation process is that number of nodes during data allocation is considered to be mobile thereby with the use of parallel optimization it is possible to transmit multiple data with same amount of

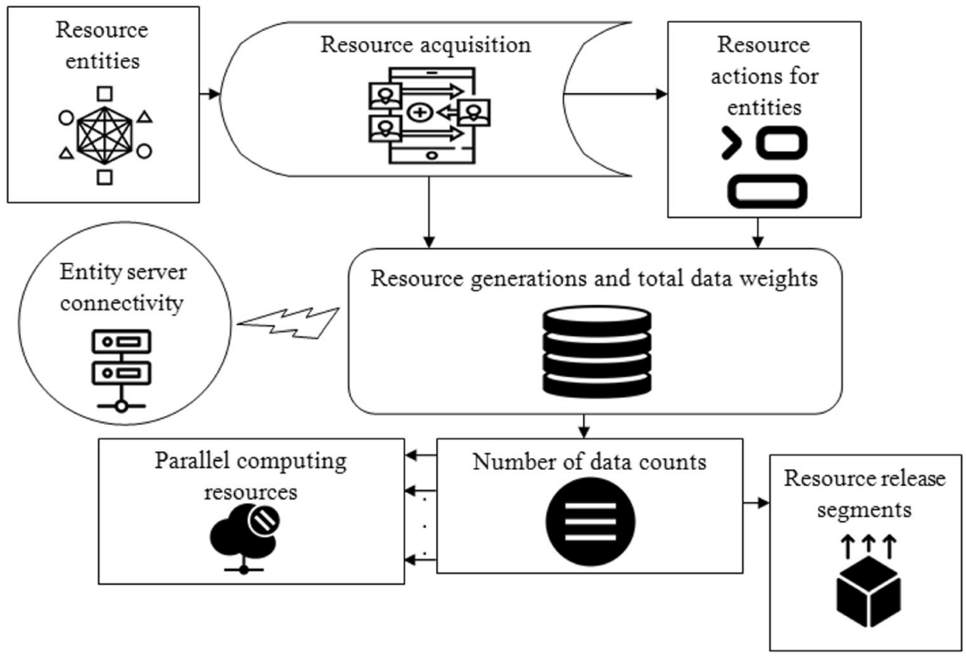

Fig. 5 Resource allocation simulation setup for proposed method

power. However during this process duplication of data is avoided thereby more amount of resources are saved in the system thus causing appropriate graph representations to be made. To verify the amount of allocated data and power number of subcarriers are considered to be 2,4,8,16 and 32 that indicates parallel processing of inside block resources. Hence total number of block resources is considered to be 123,145,161,187 and 204 and with limited amount of block resources it is possible to establish data connected at minimized power ranges. For the above mentioned subcarriers and block resources the amount of power is limited to 3.3% and 1.4% for existing and proposed approach respectively. Hence with limited power resource the data allocation can be processed at both transmission and reception ends in projected model.

5.1.2 Case study 2: resources for end users

In accordance with average time period that is provided with respect to power another major concern must be provided to end users based in initial and total time periods therefore each user will be allocated with minimum resources. Moreover as compared to separate resource allocation, total end user resource allocation plays an important role in maintaining heterogeneous conditions where grids are separately used for avoiding usage of additional resources. In this case study the amount of allocated resources is checked with respect to time period for each user and a distinct divided frame is provided to each user. Hence it is possible to reduce the amount of time period for each user without any delay and if any user utilizes the resources after data transmission then it can also be prevented. Further this method of time period analysis provides a clear insight about necessary and unnecessary resources that are present in entire spectrum ranges. Figure 7 and Table 6 provides a clear overview on resources for end users. Figure 7 identifies the parametric link between the time period of resource utilization and the time of initialization for different resources. Therefore, in order to represent the changes, three distinct metrics are taken into account in the same simulation plots. The brown line represents the overall user period, whereas the pale yellow line represents the simulated outcome for the end resources in the previous technique. In the ensuing subplot, the blue line represents the whole duration of user activity, while the green line represents the decreased amount of available resources at the end. Instead of following common strategies the proposed design beyond 5G networks are provided with unique resource sharing technique based on demand. Hence for a particular time period the resources will be shared and it will be returned back to primary user thereby more number of changes in data cannot be found. To verify the end user resources number of utilized resources at corresponding time periods are considered to be 1063,2476,4179,5891 and 6766 with data initialization period as 3,4,6,7 and 9 respectively. During the above mentioned case it is observed that percentage of end user resources in case of existing method is 21,18,16,13 and 12 whereas in proposed method end user resources are limited to 14,11,9,7 and 6 respectively. Hence with limited end user resource operations beyond 5G networks can be carried out in projected model thus a heterogeneous condition is maintained.

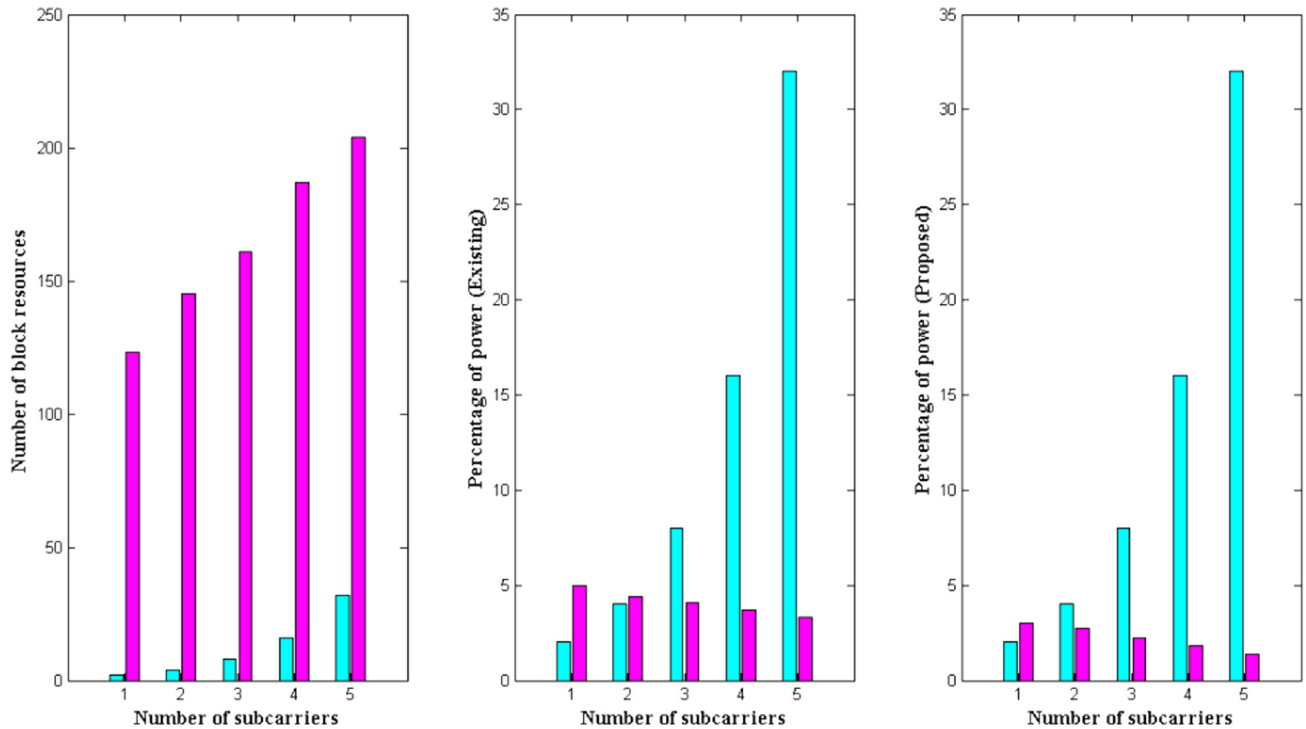

Fig. 6 Allocated power to the number of subcarriers with blocked resources

Table 5 Power representations with subcarriers and block resources

Number of subcarriers	Number of block resources	Percentage of power [6]	Percentage of power (Proposed)
2	123	5	3
4	145	4.4	2.7
8	161	4.1	2.2
16	187	3.7	1.8
32	204	3.3	1.4

5.1.3 Case study 3: coefficient determination

It is much important to determine the amount of coefficients that are present in the process as amount of resources will vary if more number of coefficients is present. To determine the amount of coefficients separate block resources are considered with fading coefficients where if fading constants are much higher then resources cannot be minimized. The reproducible rates of fading and limited fading conditions provide total number of coefficients beyond 5G networks and in this case network fading conditions will be prevented permanently. If the data in the network is continuously faded then it is essential to change the coefficients hence a real time possibility of establishing complete data with low coefficients can be made without any external effect. However if a high speed network functions with more number of coefficient then updates for next generation can only be provided with end-to-end connectivity. Figure 8 depicts number of coefficients that are determined for proposed and existing approach.

From Fig. 8 it is observed that total number of coefficients is maximized with reduction in fading coefficients. The ribbon simulation results, displayed in three-dimensional units, reflect the quantity of fading coefficients with restricted fading resources. This allows for determining the total number of coefficients required to allocate appropriate resources based on network specifications. The blue, violet, and green ribbon-shaped structures represent the coefficients related to 5G networks in both the existing and suggested approaches. These coefficients are optimised through parallel processing, resulting in a reduction in the overall number of coefficients for more efficient system operations. The major reason in proposed method for reduction in fading is that allocated resources that are

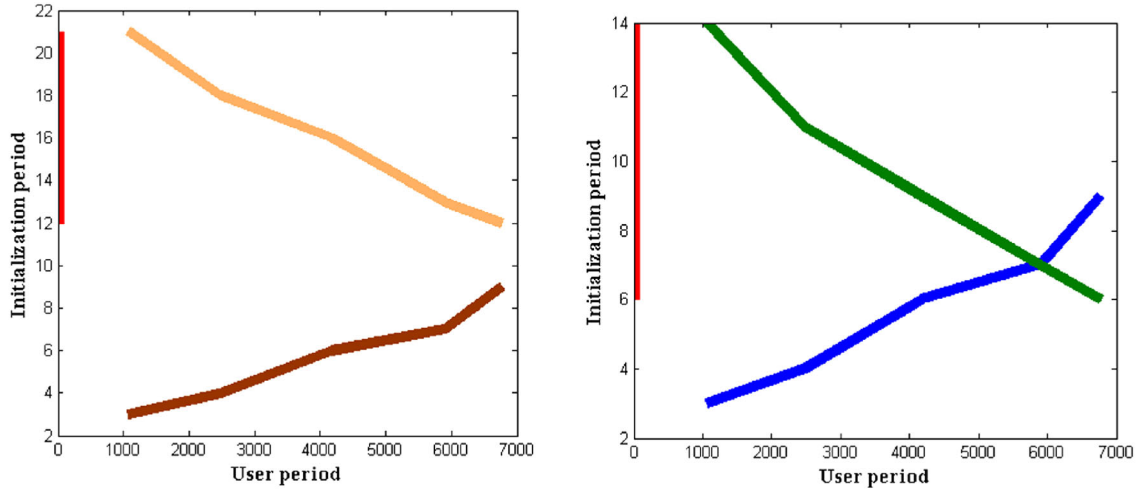

Fig. 7 End user resource allocation with initialization periods

Table 6 Total number of end user resources in accordance with user periods

User period	Initialization period	Percentage of end user resources [6]	Percentage of end user resources (Proposed)
1063	3	21	14
2476	4	18	11
4179	6	16	9
5891	7	13	7
6766	9	12	6

established between base station and mobile user tends to move at stationary speed thereby the networks remain unladed. During the above mentioned point a determination is made to be established with limited fading points where it is possible to prevent utilization of coefficients. To verify this case study number of fading coefficients are considered to be 4,6,8,10 and 12 with limited fading coefficients as 1,2,3,4 and 5 respectively. As limited fading coefficients are increased in step manner it is possible to establish maximized coefficients with a maximum of 51% and 43% in case of existing and proposed method. However in proposed method the considerations are provided only to seven resources that are considered beyond 5G operation and the increase in coefficients for existing method considers all resources. Table 7 gives the coefficient variations for fading analysis.

5.1.4 Case study 4: resource blocking and overlays

The amount of unnecessary resources that are shared in every network medium to various users beyond 5G networks must be blocked without any overlay problem hence in this case study the percentage of resources that are blocked from availability is observed. In this type of blocking probability maximum number of resources from every user end will be checked and if it remains unused for

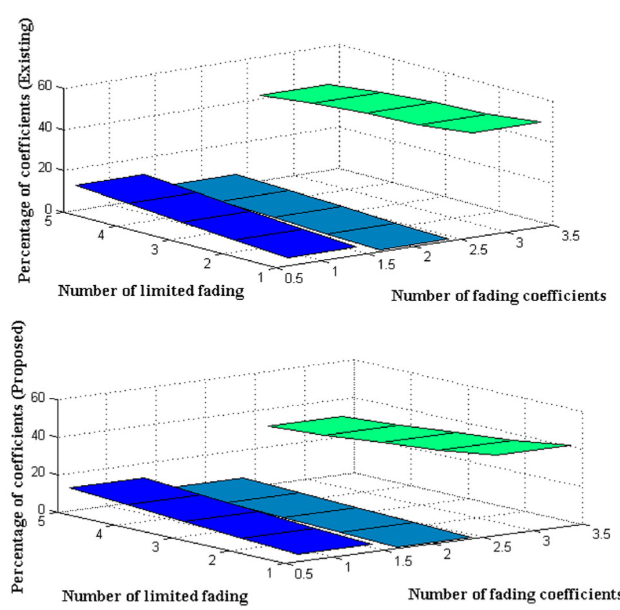

Fig. 8 Determination of coefficients based on limited fading conditions

Table 7 Coefficient variations for fading analysis

Number of fading coefficients	Number of limited fading	Percentage of coefficients [6]	Percentage of coefficients (Proposed)
4	1	51	43
6	2	48	39
8	3	47	36
10	4	45	33
12	5	32	41

Table 8 Percentage of blockage for end users with resource separations

Number of end users	Percentage of separation	Percentage of blockage [6]	Percentage of blockage (Proposed)
12	7	47	63
20	10	49	69
27	13	53	75
35	17	56	81
44	20	59	87

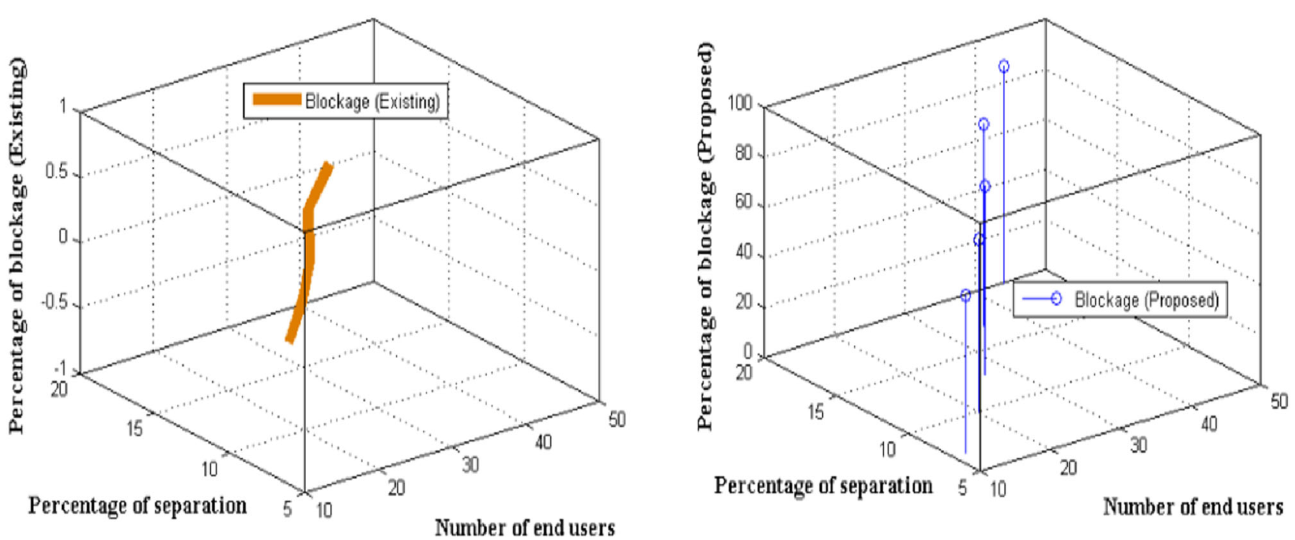

Fig. 9 Probability of blocking resources from end-user separation

long period of time then it will be blocked. In order to block unnecessary usage of resources a multi resource allocation strategy is followed where every user resources are separated from determined block resources. However during this separation case most of the blocks remains occupied by necessary resources thereby a ratio that represents the end users without accessing the resources to the end users accessing the resources throughout the network operation. Table 8 represents the precentage of blockage foe end users with resource applications. Figure 9 illustrates the amount of blocking resources with overlay conditions that are compared with existing approach.

From Fig. 9 it is pragmatic that more number of resources are blocked thus increasing the probability of blocking in proposed method. In addition to resource blocking the overlay conditions for resources are maximized as every useful and ineffective resources are separated from end users. Further the blocking probability provides appropriate amount of resources beyond 5G networks thus reducing the cost of implementation as compared to existing approach. To verify this case study number of end users are considered as 12,20,27,35 and 44 with percentage of separation as 7,10,13,17 and 20 respectively. Hence with above mentioned separation values the percentage of blocking probability remains at 87% and 59% for proposed and existing approaches respectively. In every separation value from minimum to maximum the proposed method maximizes the blocking probability due to end user useful resource utilizations thereby reaching a precise overlay conditions.

6 Conclusions

The process of resource allocation beyond 5G networks for every data transfer operation plays an important role in current generation system where end user access is operated based on certain conditions. Hence for updating the networks from 5G to beyond 5G operations some of the parametric examinations with respect to various resources are designed with respect to certain constraints. Whenever a resource model is analyzed then limited data allocation must be provided for effective operation at both transmitter and receiver thereby making every data to reach the receiver based on average time period estimation. In addition for maintaining limited number of resources a heterogeneous supporting environment is needed therefore a graph optimization and parallel computing algorithms are integrated in projected model thus forming an useful information channel beyond 5G networks. Conversely the process of parallel computing increases the speed of resource allocated networks where every data is transmitted in sequential order. One of the unique characteristics that is represented in proposed method is that the sequential transmission of data is followed by number of allocated resources thereafter for remaining data supplemental resources are shared in the medium.

The aforementioned characteristics beyond 5G makes it to differentiate from conventional networks where parallel processing of limited data is not processed. To analyze the real time outcomes the parametric resource model is separated in to four case studies where outcomes of each study are compared with one similar existing approach. The first case study that corresponds to primary resource allocation for power in accordance with number of data must be minimized for utilizing the resource in an effective way hence in the proposed method 1.4% of total power is utilized as compared to existing approach that utilizes 3.3%. In the second case study resources for end users are allocated separately according to data usage of distinct users where an effective allocation of 6% is provided for all data transmissions in projected model but in compared methodology wastage of resources are found where additional allocation of 12% is observed. Conversely in third case study total weighting factor for each resource which are represented in terms of parameters are measured and it must be minimized to carry out large scale data transmission hence 31% of weightage is provided to resources in proposed method whereas large weighting factor greater than 40% is allocated for each data in existing approach. In last designed case study total blockage that is removed by allocating resources in each data is observed and more blockage for about 87% is removed in projected approach as compared to existing model that can able to remove only 59%. In future the proposed method can be extended for minimizing other relevant resources where non-heterogeneous features can be formed with machine learning algorithms.

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Data availability The datasets used and/or analysed during the current study are available from the corresponding author on request.

Declarations

Conflict of interest The authors declare that they have no Conflict of interest.

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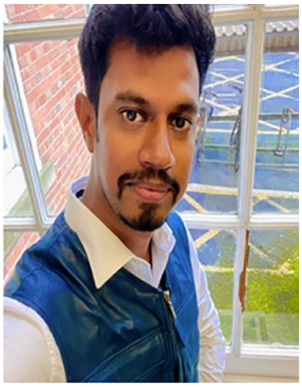

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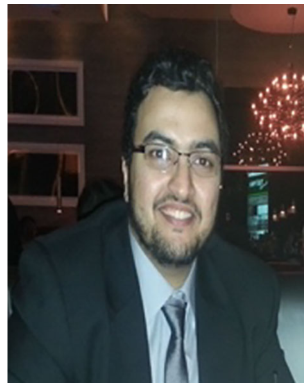

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