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MCC based Energy Efficiency Check for The Hierarchical Resource Management

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Abstract - *Mobile Cloud Computing (MCC) is an advance technology that assists in improving the standard of the mobile services. Since the rise in mobile resources, the researchers have taken the initiative to require into contemplation resource sharing among heterogeneous mobile devices.. Therefore, to design structure for mobility models and resource sharing are key issues that require utmost efforts to be solved to achieve predicted objectives. Therefore, keeping in view the craved aim, in this paper, we present a system architecture based on the hierarchical resource sharing mechanism for MCC. The projected system architecture is divided into three domains, such as Global Cloud Server (GCS), Local ISP Server (LIS), and Gateway Server (GWS). Also, the new paradigm for minimizing the delay in the network based on deploying Foglets at each desire algorithm of clustering mechanism is also presents. The fuzzy rule-based method is suggested to eliminate the inappropriate foglets before deciding an optimal foglet for handover. A foglet selection scheme is developed supported the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) decision mechanism. Different frameworks such as delay, Bit Error Rate (BER), packet loss, communication cost, request and response time, and work load are considered for finding an optimal network. To check the feasibility and performance of the proposed system architecture, mobility scenario is considered with different speed of a mobile node ranging from very high to very low. The simulation results and an analytical model are compared with existing scheme for foglet selection by a mobile node.*

Key Words: **Mobile Cloud Computing (MCC),Global Cloud Server (GCS), Local ISP Server (LIS),Gateway Server (GWS), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Bit Error Rate (BER),**

1. INTRODUCTION

Mobile Cloud Computing (MCC) assimilating different heterogeneous mobile devices with the cloud computing. Mainly, it is classified into two broad architectures, i.e., client-server and cooperation based architecture. In a client-server based scenario, data centers (cloud) provide resource management for mobile devices along with the rapid development of software and hardware technologies. Whereas, in the cooperation based cloud computing architecture, mobile devices are considered as a part of the cloud, where overall resources are shared among themselves using the wireless link. Thus, MCC helps in increase the production of mobile applications by divesting data processing from mobile devices to the cloud. Such facilities are offered by service providers (mobile cloud), where servers are located in data centers in the cloud The developing of resource sharing through the virtual machine, which is used to share the resources through virtual machine to physical machine. In this system Foglet formation is the main phase. It is a clustered designed architecture. The selection of cluster is performed at the initial stage. Foglet-based cluster assists in efficient resource sharing as well as forwarding to data to their GCS in an efficient manner. During each round, a certain number of clusters are formed depends on the number of mobile devices. The data transmission and resource sharing session start within a cluster in the same fog serves under local or global cloud server. Drawing system architecture for mobility models and resource sharing are key issues that require most efforts to be solved to achieve anticipated objectives. The architecture is based on the hierarchical resource sharing mechanism for MCC. The present system architecture is divided into three domains, such as Global Cloud Server (GCS), Local ISP Server (LIS), and Gateway Server (GWS). Moreover, the fuzzy rule-based scheme is offered to eliminate the inappropriate foglets before deciding an optimal foglet for handover. A foglet selection scheme is designed based on the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) decision mechanism.

Once the foglet is formed, the next phase is to select an optimal foglet for handover among different foglets. The target foglet is carried out by using Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). The TOPSIS is the most advanced technique for categorizing the networks by different parameters. TOPSIS decision model needs a Fuzzy-based technique to remove the unnecessary information from the input parameters. The mobile cloud computing (MCC) consists of cloud server that helps in aggregating information from their customers. The below figure shows the hierarchical resource sharing mechanism in mobile cloud computing. The figure shows the communication of three servers through the network. GCS has a main cloud server that is connected with neighboring cloud servers located at the large geographic location. LIS act as a bridge between GCS and GWS, where a network for Fog servers can share their resources with each other. And finally, GWS comprises of gateway server and a network of Foglets.

First, what is the optimized resource allocation for the mobile device to meet its requirements? Second, how to share their resources using cooperative Foglets? Third, how many mobile users are welcome by the cooperative Foglets? To address the research above for MCC, we propose a hierarchical resource management scheme for MCC with major components of resource allocation to mobile users and their application. The proposed scheme is composed of system architecture comprises of three function domains, such as Global Cloud Server (GCS), Local ISP Server (LIS), and Gateway Server (GWS). GCS has a main cloud server that is connected with neighboring cloud servers located at the large geographic location. LIS act as a bridge between GCS and GWS, where a network for Fog servers can share their resources with each other. And finally, GWS comprises of gateway server and a network of Foglets. A mobile user in a network form a cluster based on received signal strength (RSSI) and elect clusters that eventually work as a virtual machine (VM). All the mobile users and VM at each cluster are connected to their Foglets based on their unique ID that uses the resource of Foglets and generates a request for the desired data.

2. RELATED WORK

A literature review is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews are secondary sources, and do not report new or original experimental work. A narrow-scope literature review may be included as part of a peer-reviewed journal article presenting new research, serving to situate the current study within the body of the relevant literature and to provide context for the reader. In such a case, the review usually precedes the methodology and results sections of the work.

In [2] Mobile Cloud Computing (MCC) is aimed at integrating mobile devices with cloud computing. How to establish architecture of resource sharing is one of the most important issues need to be solved to achieve this goal. This paper presents an energy efficient method that establishes resource sharing overlay networks in wireless mobile networks. Theoretical models and a heuristic algorithm are presented. Simulation results demonstrated the effectiveness of the proposed models and heuristic algorithm. The characteristics of mobile wireless networks: (1) Resources from multiple devices need to be gathered to facilitate task processing because resources in mobile devices are still limited compared with traditional devices. (2) Physical network conditions should be integrated, e.g., stable routes are preferred. (3) Energy efficiency is important since battery capacity cannot cope with modern mobile applications. A design of energy-efficient mobile resource sharing overlay networks in MCC was proposed in this paper. The simulation results proved that the proposed model and method were efficient on both energy consumption and time.

In [3] this paper build a framework for sharing resources in Mobile cloud computing. In this paper, consider the resource sharing problem to support mobile applications in a mobile cloud computing environment. The resources can be better utilized and the revenue of the mobile cloud service providers can be increased. To maximize the benefit of the mobile cloud service providers, propose a framework for resource allocation to the mobile applications, and revenue management and cooperation formation among service providers. For resource allocation to the mobile applications, formulate and solve optimization models to obtain the optimal number of application instances that can be supported to maximize the revenue of the service providers while meeting the resource requirements of the mobile applications. A resource pool can be created. Specifically, multiple cooperative mobile cloud service providers can share their radio and computing resources in the pool. The resources that are not used by one service provider can be used by other service providers. The resource utilization can be increased. In this section, briefly describe the concept of mobile cloud computing (MCC). In [4] Cloud computing is a new paradigm in which computing resources such as processing, memory, and storage are not physically present at the user's location. Instead, a service provider owns and manages these resources, and users access them via the Internet. For example, Amazon Web Services lets users store personal data via its Simple Storage Service (S3) and perform computations on stored data using the Elastic Compute Cloud(EC2). This type of computing provides many advantages for businesses. Reports suggest that there are several benefits in shifting computing from the desktop to the cloud. The primary constraints for mobile computing are limited energy and wireless bandwidth. Cloud computing can provide energy savings as a service to mobile users, though it also poses some unique challenges.

In [5] the paper considers the problem of extending the battery lifetime for a portable computer by off loading its computation to a server. Depending on the inputs, computation time for different instances of a program can vary significantly and they are often difficult to predict. Different from previous studies on computation off loading, the approach does not require estimating the computation time before the execution. To execute the program initially on the portable client with a timeout. If the computation is not completed after the timeout, it is off loaded to the server. First set the timeout to be the minimum computation time that can benefit from off loading. This method is proved to be 2- competitive. It is further consider collecting online statistics of the computation time and find the statistically optimal timeout. Finally, it provides guidelines to construct programs with computation offloading.

In [6] advanced service oriented systems, complex applications, described as abstract business processes, can be executed by invoking a number of available Web services. End users can specify different preferences and constraints

and service selection can be performed dynamically identifying the best set of services available at runtime. In this paper, introduce a new modeling approach to the Web service selection problem that is particularly effective for large processes and when QoS constraints are severe. In the model, the Web service selection problem is formalized as a mixed integer linear programming problem, loops peeling is adopted in the optimization, and constraints posed by stateful Web services are considered. Moreover, negotiation techniques are exploited to identify a feasible solution of the problem, if one does not exist. Experimental results compare the method with other solutions proposed in the literature and demonstrate the effectiveness of approach toward the identification of an optimal solution to the QoS constrained Web service selection problem.

3. EXISTING SYSTEM

There is an absolute need to ensure the performance of MCC is not affected by time-varying nature of the resources above. Therefore, an important paradigm to maintain the Quality of Service is the reservation of resources that is essential for the MCC applications with the requirements in real-time scenarios. Hence, enhancements of the existing resources as well as newly desired resources generally maximize the utilization of efficient resource management technique. Also, it also helps in maximizing the revenues of the mobile cloud service providers. Therefore, the selection criteria for the selection of resource providers is still an open research issue that needs to be solved to attain cooperation based MCC three major properties were ignored shall be considered due to exclusive features of mobile networks. These properties are:

- There is a need for gathering resources from multiple devices since mobile device has limited resource than traditional wired networks.
- Physical characteristics of a network are required to b integrated, i.e., stable routes.
- Energy constraints are important in mobile network since modern applications require more battery.

3.1 Problems In Resource Sharing

In computing, a shared resource, or network share, is a computer resource made available from one host to other hosts on a computer network. It is a device or piece of information on a system that may be remotely accessed from another computer, typically via a local area network or an enterprise intranet, transparently as if it were a resource in the local machine. Network sharing is formed doable by inter-process communication over the network. Some samples of shareable resources are computer programs, data, storage devices, and printers. E.g. shared file access (also called disk sharing and folder sharing), shared printer access, shared scanner access, etc. The shared resource is termed a shared disk, shared folder or shared document.

3.1.1 Uneven Distribution of Teaching Resources

Although, there are some undoubtedly high-quality teaching resources, the allocation of such resources to economically backward areas are not effective as compared to the developed region due to which there has not been a significant development in these areas. Thus, the allocation of such resources needs to be balanced and evenly distributed. The most typical use of this idea has not been in examining the unequal distribution of resources among nation states. Such unequal distribution of resources was unremarkably associated with to land for agriculture, necessary increase.

3.1.2 Slow Update on Teaching Resources

The incessant and rapid development of various technologies and cut-throat competition for employment require schools to provide their students with the latest state-of-the-art laboratories, IT infrastructure, and relevant curriculum to prepare them for industry ready skills so that the students can stay at par with the latest developments. But the main obstacle faced is that the construction of educational resources is not done keeping in mind the latest industry requirements and developments. The teaching resources are therefore not fully up to date.

3.1.3 Low Degree of Sharing between Teaching Resources

The development of modem distance education and the combined scope expansion of college course make the digital teaching resources such as exquisite course library, courseware database, examination database, etc. integrated to a certain degree and a certain range. However, due to the different hardware, software, network programming language used by various universities in the design and development of teaching resources, there has been a poor generalization and compatibility between the various resources of the teaching platform, therefore leading to a limitation in the sharing level of a variety of resources. Moreover, hardware resources are still unable to realize integration between universities and enterprises.

Therefore, the current service system of university digital teaching resources can't meet the demand of university teachers and students either for learning or scientific research. It is necessary to create a regional digital learning model and sharing service system with new comprehensibility and diversity. This will lead to an effective and integrated university digital teaching resources model and would give the best equilibrium configuration on regional digital teaching resources. We, therefore, propose a solution to overcome the above problems.

3. PROPOSED SYSTEM

A cloud provider company own cloud data centers that consist of a large number of servers, known as physical machines (PM). These PMs are grouped in a way to form a cluster where each cluster manages and control a large number cloud provider companies provide different resources to their customers, where they can charge according to their requirements. These customers generate their requests based on their resources to perform task of PMs. The VM then allocate requested resource and then selects of the cluster to host VM. Afterward, assign one VM to one PM within a particular cluster.

3.1 Implementation

The creation of the designed system takes place in the implementation phase. Development phase overview, preparation of implementation, computer program development, development phase report and overview. It also performs activities like writing, testing, debugging and documenting the programs. This is to review the performance of the system and to evaluate against standard or criteria. A study is conducted for measuring the performance of the system against pre-defined requirements. Database design forms an important part of every project. The management of data involves both the definition of structure for the storage of information and provision of mechanisms for manipulation of information. The database system must provide safety for the information stored; despite system crashes or attempts of unauthorized access the database used in this project is MYSQL.

3.2 Algorithms

The algorithm is work based on a decision-making matrix. The TOPSIS method starts with the parameters obtain from different foglets in a decision matrix. The rows of the matrix represent the parameters of a particular network, and the column represents a parameter in each network. Here integrate the TOPSIS method with the MADM method to make the TOPSIS process as fast as possible. In order to determine the negative and positive ideal situation of a foglet, every parameter of the foglet must be assigned a particular weight.

3.2.1 Algorithm: Working of proposed Foglet Selection based on **TOPSIS** and **MADM**

1: Initialization of decision-making Matrix Mrc (r = rows, c = cols)

$$Mrc = P_{i,j}\sqrt{\Sigma}\ Prc2\ \text{m}r=1\ r = 1, 2, \cdots,; = 1,\cdots,n$$

2. Computing the Normalizing Matrix M'

$$Pc* = \max 1 \le r \le (prc)$$

$$Pc\ ° = \min \le r \le (prc)$$

3. Computing the Weighted Normalized Matrix$M"$

$$Mrc\ '' = \text{□}c * Mrc\ ', = 1, 2, \cdots, \text{□}; c = 1, \cdots,n$$

$$\text{w}p = p/\ \Sigma\ p\text{i}\ 7\ \text{i}=1\ /p\text{i}$$

4. Computing the Ideal Situation

$$I+ = (\min M"rcc \in C \mid r = 1,\cdots,m = [zr +,zr+1 + ,\cdots,zm +]$$

$$-=(\max M''rcc \in C \mid r = 1,\cdots,m = [zr +,zr+1 + ,\cdots,zm +]$$

5. Distance with Hypothetical Ideal Situation D

$$D_i+ = \sqrt{\Sigma}\ (\text{“k}c - \text{m”k} +)2nk=1\ ,k = 1,2,\cdots,m$$

$$D_i- = \sqrt{\Sigma}\ (\text{“k}c - \text{m”k}-)2nk=1\ ,k= 1,2,\cdots,m$$

4. SYSTEM DESIGN

System design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture and systems engineering.

4.1Module Description

A cloud provider company own cloud data centers that consist of a large number of servers, known as physical machines (PM). These PMs are grouped in a way to form a cluster where each cluster manages and control a large number of PMs. These clusters are homogeneous (sharing same resources) or heterogeneous (sharing different resources).

4.1.1 Foglet Formation

Hall thought of it as a nano technological replacement for car seatbelts. The robots would be microscopic, with extending arms reaching in several different directions, and could perform three-dimensional lattice reconfiguration. Grabbers at the ends of the arms would allow the robots (or foglets) to mechanically link to one another and share both information and energy, enabling them to act as a continuous substance with mechanical and optical properties that could be varied over a wide range. Each foglet would have substantial computing power, and would be able to communicate with its neighbors.

In the original application as a replacement for seatbelts, the swarm of robots would be widely spread out, and the arms loose, allowing air flow between them. In the event of a collision the arms would lock into their current position, as if the air around the passengers had abruptly frozen solid. The result would be to spread any impact over the entire surface

of the passenger's body. While the foglets would be micro-scale, construction of the foglets would require full molecular nanotechnology. Hall suggests that each bot may be in the shape of a dodecahedron with twelve arms extending outwards. Each arm would have four degrees of freedom. The foglets' bodies would be made of aluminum oxide rather than combustible diamond to avoid creating a fuel air explosive.

Hall and his correspondents soon realised that utility fog could be manufactured en masse to occupy the entire atmosphere of a planet and replace any physical instrumentality necessary to human life. By foglets exerting concerted force an object or human could be carried from location to location. Virtual buildings could be constructed and dismantled within moments, enabling the replacement of existing cities and roads with farms and gardens. While molecular nanotech might also replace the need for biological bodies, utility fog would remain a useful peripheral with which to perform physical engineering and maintenance tasks. Thus, utility fog also came to be known as "the machine of the future"

In this phase Foglet will be formed

- **Join routers -**A router[a] is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. Data sent through the internet, such as a web page or email, is in the form of data packets. A packet is typically forwarded from one router to another router through the networks that constitute an internetwork (e.g. the Internet) until it reaches its destination node. A router is connected to two or more data lines from different networks.[b] When a data packet comes in on one of the lines, the router reads the network address information in the packet to determine the ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey. Foglet-based cluster assists in efficient resource sharing as well as forwarding to data to their GCS in an efficient manner. In a given scenario, to assume that the system has different base stations/access points deployed in a small geographical location.
- **Time Scheduling-**Time-sharing is a technique which enables many people, located at various terminals, to use a particular computer system at the same time. Processor's time which is shared among multiple users simultaneously is termed as time-sharing Time will be calculated scheduling time for getting optimal result for foglet selection.

In the proposed Foglet-based cluster designing architecture, the selection of cluster is performed at the initial stage. Foglet-based cluster assists in efficient resource sharing as well as forwarding to data to their GCS in an efficient manner. In a given scenario, we assumed that we have different BS/AP deployed in a small geographical location. One round of route constitutes of resource sharing, communicating with Foglets and Fog servers performs aggregation of access requests of resource sharing, and data, and ultimately destines it to GCS. During each round, a certain number of clusters are formed depends on the number of mobile devices. And in each cluster, there is a selection of cluster head that acts a VM in that particular cluster. In our proposed scenario, the VM controls and manages all the mobile users' activities in that cluster. Initially, the battery level of all the devices is equal, and there is a uniform distribution of load among all the mobile users.

The battery consumption nature of the VM is more exhaustive as compared with the other members. Therefore, we have introduced a notion of rotation of VM based on the residual energy. The node with the second highest battery information will be selected as VM. We assumed that all the nodes, in particular, cluster know each other batter information. Once the VM is selected, all other non-cluster members are attached to their nearest VM based on the received signal strength (RSSI).

Once VMs are selected in each cluster, the remaining nodes know about other nodes in their vicinity. The nodes that are located in the vicinity are not acting as VM for the current round. For this reason, each VM broadcasts a message that contains node's ID and a header. This broadcast message is used to distinguish another announcement message from others. For the current round, each member in a network chooses a VM for itself. This selection has been made on the basis of the minimum energy required to communicate with the Foglets in a particular GWS. Such information is revealed upon receiving a broadcast message from VM. For instance, if the RSSI is same between two competitors than a random selected is made as shown in Figure 5.1.

Once the decision of attached node to a particular VM is made, all nodes in a cluster inform their VM about their attachment. This attachment announcement message consists of node's ID and VM's ID. The VM is then started controlling and managing its cluster by getting access request from their user's resources. And the data transmission and resource sharing session start within a cluster in the same Fog serves under local or global GCS. A self-explanatory flow chart for formation of cluster and working of generating request message is given in Figure 5.1 respectively.

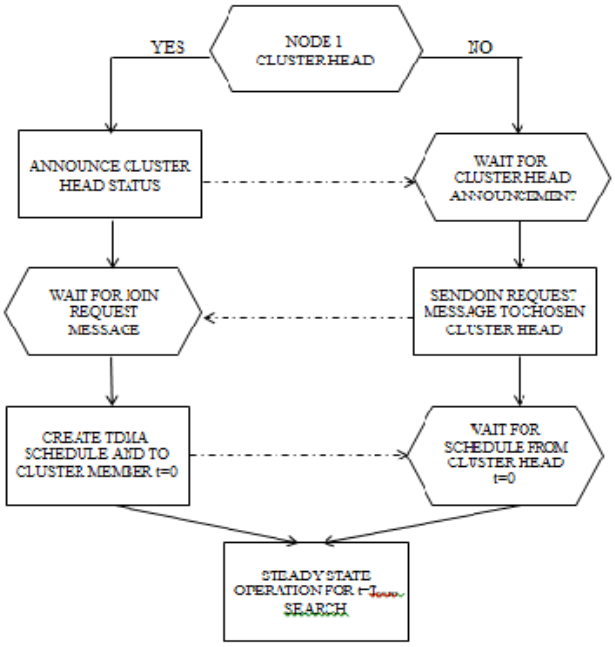

Fig -5.1: Flow chart of foglets formation

4.1.2 Foglet Selection

Foglet based cluster designing architecture, the selection of cluster is performed at the initial stage. Foglet-based cluster assists in efficient resource sharing as well as forwarding to data to their GCS in an efficient manner.

The possible application scenario that paybacks from Foglets are immense. The point of difference between a cloud model and Foglet is that Foglets applications can influence the relationship between the user and a cloud model, where resources and other information can efficiently be delivered using hop-by-hop communication to establish end-to-end connectivity. Therefore, the incorporation of clusters of Foglets to the architecture of the cloud model – leading to several potential mobile cloud computing application scenarios. In a given model, the proposed architecture is broken down into three domain, i.e., Global Cloud Server (GCS), Local ISP Server (LIS), and Gateway Server (GWS). By using the domains above, the local user efficiently generates an access request message to its Foglet via VM. Afterward, all the required resources are assigned that particular user. The detail description of the application is explained with the help of GCC, LIS, and GWS.

5. RESULT ANALYSIS

In this section, we performed simulation to test the performance and feasibility of the proposed system. In the simulation, we have implemented the mobility management in dense and low coverage of the mobile nodes in MCC environment. . For our simulation scenario, we assumed that different mobile nodes are considered that form a Foglet and they move with the velocity of 1 to 180 m/sec. Each Foglet selects their cluster head using the proposed Foglet algorithm. Simulation time varies with the mobile node density. We have tested four sets of mobile nodes, such as 25, 50, 75, and 100, having simulation time of 2 hours. For the above simulation scenario, we have considered below data sets, i.e., data rate (0-1200, and 0-1500), energy (4.0 and 3.0), cost (0-30, and 10-50), and RSS (1-20, and 1-20). For our simulation, the energy values are different for different interfaces, which are considered randomly. Also, the RSS values depend on the data rates. The communication cost has taken by the architecture of the underlying technology. In the case of UMTS, its value is high and similarly low in the case of WIFI because it is a low-cost and easily accessible technology. Although, it is also changed with the nature of the context of a user,

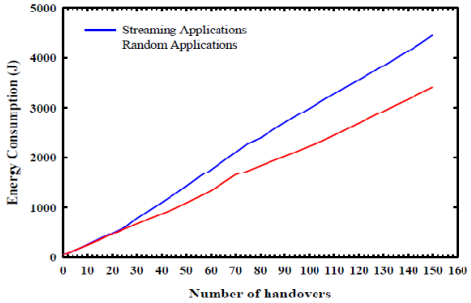

Chart -6.1: Application dependent energy consumption

6. CONCLUSIONS

In mobile cloud computing (MCC), the various mobile applications require computing resources along with the servers in the data centers. In addition, the bandwidth is also an important commodity between various mobile devices as well as servers. Therefore, MCC have to provide sufficient resources related to radio and computing resources in order to optimize them to provide maximum benefit to the user. The proposed system 'Hierarchical Resource Management For MCC to Check Energy Efficiency' architecture for MCC comprises of three domains that efficiently minimizes delay and establishes an end-to end connection between two networks. These domains include GCS, LIS, and GWS. GWS is formed by a number of entities including mobile nodes, Foglets, and Fog servers. The selection of VM and cluster based on RSSI is also performed in this domain. Where the, LIS provides a backbone of establishing a connectivity between GWS and GCS. Additionally, GCS consists of cloud servers that help in sharing huge volume of resources of their neighbouring GCS.

Future Enhancement

For future work, the project planning to enhance the proposed scheme toward green mobile cloud computing for 5G in a new paradigm, which can efficiently analyse a stream of big data. Moreover, the communication protocol stack also

requires serious attention in term of reliability, which uses optimal packet size in order to tackle big data.

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