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Survey on QoS for Applications

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ABSTRACT:

Any application designed to provide service in certain field, the application should design to satisfy user need. The user's needs satisfaction level evaluates the application quality. Iftheir failure at user satisfaction the application considers fail at achieving the purpose which design for the needs of users called requirements for application, and the satisfaction of user from certain application called Quality of Service. So, this paper summarizes studies related to this topic.

*Keywords:*Quality of service, Application,QoS requirements

1.Introduction

Quality of service (**QoS**) is the description or measurement of the overall performance of a service, such as telephony or computer network or Cloud computing service, particularly the performance seen by the users of the network. To quantitatively measure quality of service, several related aspects of the network service are often considered, such as error rates, bit rate, throughput, transmission delay, availability, jitter, etc.
According to the ITU-T standard E.800, QoS is defined as "the collective effort of service performances, which determine the degree of satisfaction of a user of this service"[1]. QoS is also defined as "a set of service requirements to be met by the network while transporting a flow". Services can have qualitative and quantitative QoS parameters [2]. Qualitative parameters are security mechanisms, manageability, *etc*. Quantitative parameters are bandwidth, jitter, delay, *etc*. These parameters together determine the Quality of Service (QoS).QoS level may use to evaluate the services and help customers to select between applications which provide the same services. The customer select the services has an advantage over other applications that do not provide this feature [3].Also QoS can be used by customer to choose between services providers [4].The rest of the paper is structured as follows: Section II discusses the related work. Section III presents motivated studies. Section IV represents theQoSrequirements for applications. Section Vdemonstrates the measurement and evaluation of QoSand section VI include the conclusion and future work.

2.Related work:

a quality of services is important research area, ithas big number of studies available.According to purpose of studieswhich taken at this review can divide to three areas, although there more area research related to this topic:Use QoSto assess the level of quality of services to show if the level of service meet user requirements: in [1] the researcher propose evaluation strategy to ensure the expected QoS performance for radio services is similar to actual QoS because the main challenge faced services provider is that the QoS requirements differ from one application to another.The result from used this strategy in which use eight data transfer from two applications is that the expected QoS differ from actual and this information can be used in various issues related to each application.In [5]the TETRA network which designed to provide telecommunication services to public safety & security organizations there need to provide client required QoS.In [6] the researcher to accurate QoS prediction for web service proposed probabilistic matrix factor model, this model depend on users' properties and their physical neighbors' performance, the result of experiment explain that the proposed method performed better than state-of-the-art approaches.In [7] when migration from traditional to cloud model clients and Software as a Services (SaaS)provider need to establish Service Level Agreement (SLA) to certify the quality of service.In [9]QoS prediction of web services, the method used for QoS prediction called Collaborative Filtering (CF),this method depend on historical QoS data contributed by similar users and services.In [10] the modern software system late discovers of defects led to less quality of system delivered to user, system high maintenance cost and negative impact on their user. The late discover may lead to disaster when application relate to business and safety, this disaster case financial loss or human life loss. In[14]the certify of component of software to ensure that it conform to precise standard. The certification is process of bring quality to certain software product.to assurance of quality process for software component the authors use quality model to describe quality characteristics that will be taken into account during quality process assurance. In [15] the author study QoS requirement for e-learning application like video on demand, video conferencing, files transfer and virtual laboratory over Wifi-based Long Distance (WiLD). They analyzed application using simulation. In [20] the task of resource management and scheduling for customers in cloud computing is complex while delivering QoS. In [23]The wireless environment was

added to Software Defined Network (SDN) so to achieve more deterministic network behavior QoSprovisioning is necessary consideration. In [22]the systems deployed in the internet the QoS requirement interpolation is substantial. These systems are varying on workload, so to avoid wasteof resources, the resources are allocated according to load dynamically. In [24]The performance evaluation of Voip for mobile user and how the QoS parameter vary for different speed. They used simulation and emulation method for validity. In [26] they proposed personalized and accurate QoS approach namely PAOMF. In [36][44] they solve this problem using collaborative framework and the Matrix Factorization (MF)to accurately predict QoS.The main problem which studied in [40][45] work is dynamic fog services provisioning; it means how deploy and release services in fog computing dynamically.to solve this problem the authors, propose two heuristics, they are evaluated using simulation based on the real-world traffic traces and mobile augment reality as the IoT application. The result obtained from simulation is achieving the required quality, minimizing delay and violation of SLA.Cloud system is the solution for admission software products of the companies. At this field there more cloud provider to admission the software product to companies, the problem is how companies select whose satisfy their QoS requirement. To solve this problem the authors [8][46] suggest various QoS metrics for services provider to evaluate QoS for provider and select the best. The metrics associated with services provider named performance, economics and security. The same problem in [3] but here the authors propose another mechanism to select between web services providers or applications called Hidden Markov models are probabilistic methods allow to predict behavior of web services in the near future.Also in field of selecting between cloud providers in[16][47] the author propose prediction of cloud services QoS approach which address limitation on old prediction approaches these limitations represented on the three-layer structure on the influence of the cloud service QoS(The CPU usage, physical memory usage and the number of processes of infrastructure layer have definitely.Extending on cloud services in [19][48] they proposed a multi-valued collaborative approach for the time-aware QoS prediction of cloud services to address challenge facing consumer in selecting optimal cloud service provider (CSP) from large numbers available.In[21][49] theyproposed ranking system to select web services depend on the functional relevance, user behavior, QoS and service usage factor.Continuing in field of how to fit suitable services for consumer, in [25][50] they proposed QoS architecture based on set of attributes which considered when building concrete grid network for provide service.In[27] the author proposed solution to address the problem of discovering and selecting configurable of cloud services and resources. To select web service which has the optimal QoS the[28][51] presentedan advanced a fully polynomial time approximation scheme(A2-FPT AS) to balance between precision and overhead.In [29][52] they proposed trustworthy service selection approach integrating cloud model and interval number theory of potential users. To solve this problem in [30][53] they propose QoS prediction taken into account mobility of mobile edge because the mobility affected on the QoSprediction.The author in [31][54] proposed online QoS prediction to accurately adapt the service to change with guarantee of QoS. This problem in [32][55] proposed combination between two technique to solve all issue related. They use filtering base collaborative filtering extend slopeone model (FB-CF) and filtering base and matrix factorization (FB-MF).To select services from multi services has same functionality, in [42][56] they used modified Analytic Hierarchical Process (AHP) combined with obtaining probability distribution function of QoS parameter.When manufacturing cloud service composition, must consider the ability of correlation amongdifferent manufacturing cloud service. With similar function but different QoSthe authors of thepaper [11] were presentedcorrelation –aware manufacturing cloud services description model to distinguish QoS dependence of an individual services on other related services.In [12][57] dynamically composition web services depend on QoSparameter to select the most relevant using genetic algorithm.In [13] author addressed the problem of composition when there are large amount of possible composition depending on services functionality and QoS.In [18][58] the authors proposedservice selection approach based on QoS prediction to composition optimal services. To predict QoS for web service they consider historical QoSinformation as a time series and predict QoS valuesusing the autoregressive integrated moving average model to provide more accurate QoS attribute values.In [17][59] the authors proposed solution to composition problem focused on three dimensions.In [33] the authors proposedsolution for balancing the tradeoff betweencompute efficiency and optimality in service composition, the optimality mean the composition services satisfaction of QoS required by user. They used abstraction refinement methods which give speedup compared to traditional composition techniques.In [34][60]They addressed the problem of finding optimal QoS available services for composition, it considers is optimization problem, they presented meta-heuristic bio-inspired to QoS-aware web service composition.In [35][61]they solved this problem by used method based on modified algorithm of graph coloring. they implement MGC-TOP K and MGC-K.In [37][62]they provided wide range of composite cloud services providers need to establish mutual agreements, so providers can compose effective and efficient service workflow, the authors proposed reputation model to support the composition of complex cloud services considering costand measure QoS. The model evaluated by set of experiments.In [38][63]they address the problem of composition by reducing optimal QoS that satisfy the customer requirement in big services environment. In[39][64] researchersused an ant colony optimization algorithm to composition cloud manufacturing services considering quality of services. They applied novel ACO algorithm to QoS-aware manufacturing cloud service composition problem. The simulation used to evaluate the approach explains that; the ACO algorithm has good convergence speed and stability.

3.Motivationsof Studies

According to the studies released to this research area, there more motivations stated by researcher to studies released. As depicted in figure1 and table 1to address these motivations at this review categorized the point taken in research papers, this point mentioned below:

1- Measure QoS for certain service to evaluate it and decide if provide the required level or not.
2- Assessing QoS for applications or services are providing the same services to choose between them and decideit the optimal.
3- Measure QoS to decide another action (compositions).

The main problem of QoSresearcher'sstudies is evaluations of QoSfor services todecide ifmeet the required level which specify by services consumers the key point is how to evaluate and what is the techniques used by different researchers. The second problem is assessing QoS for similar services which provided by deferent provider or applications to select between them. The third motivation is the composite many services provide the same

solution to meet user requirements because the one service cannot provide optimal solutionso there need for composition more than one service which has optimal features.According to the number of papers released at each point, the maximum number was found in the first point.

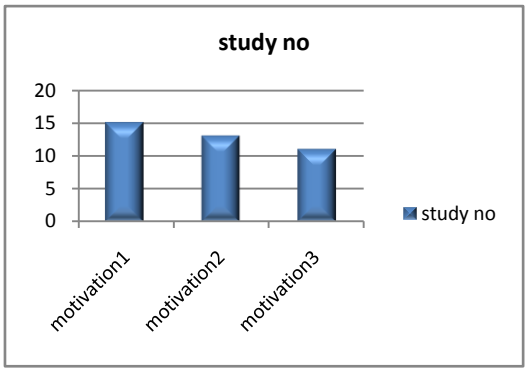

Figure 1 Motivation of Studies

Table1Number of Studies in Each Motivation

Motivation	**Number of studies**	**Studies**
Measure QoS for certain service to evaluate it and decide if provide the required level or not.	15 pages	[1,5,6,7,9,10,14,15, 20,22,23,24,26,36,40]
Assessing QoS for applications or services are providing the same services to choose between them and decide it the optimal.	13 pages	[3,8,16,19,21,25,27, 28,29,30,31,37,42]
Measure QoS to decide another action (compositions).	11pages	[11,12,13,17,18,33, 34,35,37,38,39]

4.QoS Requirements for Applications

Quality of service is a very popular and overloaded term that is very often looked at from different perspectives by the networking and application-development communities [41].Any application has its own parameters which used to evaluate performance.These parameters must be at certain level to meet the user satisfaction that called OoS requirements.QoS requirements vary from one application to another so the parameters vary from one application to another.To define the Quality of Service a customers of a services need to establish service level agreements (SLA)[7].At below sections describe QoS requirements for each type of application.Many network applications work with Best-Effort services, while others have strong QoS requirements and only work with guaranteed QoS, or at least benefit significantly if QoS guarantees are possible. They give an overview of application requirements for audio, video and data applications[43].

1- Audio Applications:

Audio applications QoS requirement parameter which called bandwidth, delay and packet loss determined according to audio transmission type, like telephony and high fidelity music.in addition to above factor. The bandwidth also affected by the encoded audio data, protocol overhead by IP, User Data Datagram (UDP), and Real-Time Transport Protocol (RTP) headers.The delay specified according to sensitivity of transmission to delay such as telephony strong delay requirement exists.

2- Video Applications:

Similar to audio applications, but there several deferent between audio and video applications, video require much higher bandwidth depend on quality level required by a user or supported by equipment (PC and mobile hand held).

3- Data Applications:

Non-video and non-audio application classified as data application, there multi type of data applications each of it deferent at QoS requirement. So QoS specified according to services provide across application.

5.Measurement and Evaluation of QoS

Here will present the different techniques used by researcher to measure or evaluate QoS at different applicationsandcomparison between these techniques.

At [1] they put strategy to evaluate delay in packet radio services; they divided delay to classes and assign number to each class. Any radio application requires certain delay to fulfill acceptable level and according to required delay decide what class is. So they monitor delay for certain applications to classify it.To evaluate QoS in TETRA network in [5] they used key performance indicators (KPI) depending on counters associated with each parameter, these counters recorded during observation time which configure by operator. The counters used in mathematical equation to calculate the network performance.Matrix factorization used by [6] to predictQoSfor web services, the matrix used is user service and then considering network location to predict QoS.The matrix factorization is more effective technique to discover latent underlying features, so it used more in field of predict QoS. In [8] they proposedQoS metrics for cloud computing services, the metrics build depend on cloud services feature to be evaluated.QoS predictions techniques widely used on evaluating QoS for services before selected to use. In [9] they predictedQoS of web services using two-phase k-mean clustering, this to discover untrustworthy users affects when considering historical information to predict futureQoS.One of studies use probabilistic model to early evaluate QoS at design stage. In [10] they usedEvoChecker open source. This approach more effective because it reduced cost of developing application.In manufacturing cloud service composition, the researchers in [11] they used descriptive model to describe the correlation-aware service and then usedcorrelation mapping model to get correlation QoSvalues among services automatically.To select optimal one, they used genetic algorithm. The genetic algorithm has ability to generate high quality solution to optimization and search problems, so it suitable to use above.Also,in [12] they used genetic algorithm to dynamically composition web service depending on QoSparameters.To measure QoS in [13] they used computation model depend on workflow patterns, they used path algebra to compute QoS, the result used in composition.To choose web service satisfy user needs from multi web services provide same functionality in [3] they usedprobabilistic method has ability to build behavior model for services to predict near future behavior. To measure QoS they usedfuture behavior, the technique has this ability named Markov model. That evaluation process of certification of component-based software as in [14] they proposed unstructured weighted technique.It used to assign weights to seven factors which given by ISO as standard to evaluate software components, the assigned weighted technique used to evaluate the seven factors. In [15]authors They used simulation of environment like network and running application to evaluate customer satisfaction level in E-learning applications overWiFi-based Long Distance. The result of simulation is there need more effort to improve E-learning application environments.To predict QoSfor cloud services for choose the optimal one [16] they use Bayesian network model considering the three layers of cloud architecture to more accurate prediction

The Bayesian network model is probabilistic directed a cyclic graphical model(type of statistical model) represent a set of variable and their conditional dependencies via directed acyclic graph.To address the problem of composition and dimensions simultaneously for web services [17][65] they propose approach based on harmony search algorithm, this algorithm for search for the optimal from many available. The optimality result used as QoS for application. Using historical QoS record to predict QoSbased on auto regressive integrated moving average (ARIMA)[18], this approach is more effective in predict future values of QoS. Also [19] they use collaborative filtering algorithm based on historical QoS data, they use user-service QoS matrix. [21] they used consumption history and QoS based web services to choose the best one, they using ranking techniques, to select the best they use QoS as one of factor to the selection. So there need to calculate QoSwhich evaluated by weighted adaptive strategy. To efficient QoS analysis [22] use marckov modulated poisson process, this method is type of mathematical object consist of points randomly located on a mathematical space.to analysis of QoSin software defined wireless network mininetwifi network simulate. also [24] to evaluate performance of VOIP for mobile user use simulation and emulation using software exata,exata is wireless emulator that lets you evaluate on-the-movecommunication networks faster and with more realism than any other emulator.In [26] to accurate predict QoSthey build prediction model by employing matrix factorization which previously mentioned their ability and stochastic gradientdescent algorithm.to rank candidate services [27] they use directed weighted graph matching algorithms, these algorithm used to match between user QoS requirement and provided services to select the best.[28] they use A^2-FPAS to solve the discover and selection problem. It adopts strategy of calculating the unequal error bound for each abstract web service, the strategy improves performance and precious result.Because the key potential user in cloud computing is the nonprofessional users,the techniques used earlier to select optimal services be not effective, [29] analyzing batch computing mode and stream computing mode, in batch computing filtering poor performance based on deviation degree and possibility degree of trustworthiness interval number.in stream computing mode the poor services neglected based on proximity degree and geometrical analysis.In mobile edge to predict QoS for services recommendation [30] use collaborative filtering algorithm taken into account user mobility.[31] they use adaptive matrix factorization(AMF) to online predict QoS, the online QoS prediction to granteeQoS.

In QoS prediction for mobile services [32] they propose two models compound from three models, these compound models to more accurate prediction of QoS, first they use filtering base collaborative filtering (FB_CF) and matrix factorization (FB_MF) these three model derived from slopeone model which is collaborative filtering algorithms.To select best web service to composition based on QoS [34] they use Elephant Herding Optimization (EHO) is a new of swarm-based metaheuristic search method, these search method inspired from swarm system in nature have produced remarkable results while solving complex optimization problems.While there need to search in large scale service to find optimal services to composition according to user requirement. In [35] they use modified algorithm of graph coloring based on implement MGC-TOP K and MGC-K, these algorithm used to filtering incompatible services with user requirement.In IoT to predict QoS [36] they use collaborative framework and then use MF to accurately predict QoS. Depending on this prediction can also predict QoS of system, so the QoSprediction depends on probabilities used in building of behavior model. [3] and [10] use this techniques to benefits from its ability in prediction.Another technique used in evaluating QoS is strategies; the strategies aredividing the evaluation of QoS process to steps to reach to values. The steps begin from specifythestandard values of QoSto monitor the real values and then comparison between standard values and monitored values to classify the QoS for the system. The strategies method is effective in classifying

performance of system. This technique used by researcher in [5].In [7] the researchers not use QoS evaluation technique but use algorithm to provide required QoS resources for system.Thealgorithm depends on (SLA) Service Level Agreements and (CSL) Customer Satisfaction Level. The algorithm is more effective in provisioning resources. In study [8] the author use metrics to evaluate QoS, the metrics is features of services need to be evaluated,and this metrics consider as standard for assessing service, this is good in evaluating service in comparison services.

[9] the author use key-mean clustering to identify untrusted data, because this data used in predicting QoS, so must use trust data, this technique is type of unsupervised learning which is used when you have unlabeled data (data without defined categories or groups) the good of this algorithm is to fined groups in the data, with the number of groups represented by the variable k. clustering allows you to find and analyze the groups that have form organically.Another technique used by researcher [14] is unstructured weighting technique; this technique is used to assign weight to standard factors used in assessing the quality of software. The weight is given depending on common understanding of the system and their experience, so this technique is imprecise hundred percent. Consequently can say this technique is un effective.In [15][23][24] the author use simulation software and emulator tools to represent the real environment which need to analyze his Quality, and then observe the quality parameters.These mechanisms consider more effective because the results were given specify what the component need to improve or what is cause the degradation and the plan to develop.This technique used by researchers in [16] to predict QoS for cloud computing because they take into consideration the characteristic of cloud computing itself (software and hardware) so this technique is most effective in predict QoS.The researchers in[18] use technique Autoregressive Integrated Moving Average (ARIMA) this technique is time serial analysis model which is generalize of ARMA model, this two models are fitted to time series data either to better understand or to predict future points in series it applied in some case where data show evidence of nonstationary.it is inflexible and not accurate.One of technique used in predict QoS is Collaborative Filtering(CF), it is a way of making automatic prediction (filtering) about the interest of user by collecting preference from many other users(collaborative) the author of [19] and [30] use CF based in neighboring users, they use historical data to predict QoS, so they finding similar users and services and mining their similarities and calculate unknown data of similar users or services.Consequently CF is most effective in calculating QoS.

Weighted Additive is strategy used calculate QoS score, is found the summation of the product of each QoS constraint with the QoS weight obtained from correspond QoS preference specified. This strategy use by author of [21]. The author of[6],[26],[31]and [36] use technique in predicting QoS, this technique is matrix factorization MF, also called matrix decomposition is factorization of matrix in to a product of matrices.is dimensionality reduction technique, it used to predict QoSfrom matrix constructed from users and services, if there services un run from matrix using matrix factorization to predict this un use service.th MF is more accurate technique in predicting QoSbecause can use any factor effect on QoS in predicting using matrix.The author of [37] use reputation feedback and measure system to evaluate services, this method not effective because depend on user opinion.This technique used by author of [38] and [42]. Directed weighted graph technique used by author of [27], is graph has nodes (vertex) and edges, the properties represented using edges, assign weight to represent quality attribute value, the graph can transfer to matrix.Below table 2 shows the statistics of techniques

Table-2 statistics of techniques and No of studies used.

No	Technique Name	Number of Study	Studies
1.	Probabilistic model	2	[3][10]
2.	Strategy	1	[5]
3.	Provisioning Algorithm	1	[7]
4.	Metrics	1	[8]
5.	Key-Mean clustering	1	[9]
6.	Unstructured Weighted	1	[14]
7.	Simulation and emulation	3	[15] [23] [24]
8.	Bayesian Network	1	[16]
9.	ARIMA	1	[18]
10.	CF	2	[19][30]
11.	Weighted Additive	1	[21]
12.	MF	4	[6][26][31][36]
13.	Reputation	1	[37]
14.	Weighted techniques	3	[27][38][42]

The table shows that the most technique used is matrix factorization,this technique is used across deferent years, the first paper consider at thisreview

released in 2014,andthe last paper released in 2017, that lead to substantiation of efficiency of this technique.
According to main contributions of studies we classify these studies to five classes.Below table-3 show studies and their contribution

Table-3 proposed solution of studies

Contribution	No of studies	Studies
Model	15	[3,6,7,8,9,10,11,12,13,14.16,17,18, 22,27,38]
Framework	3	[26,31,38]
Approach	5	[19,30,40,34,39]
Strategy	1	[5]
System	1	[21]

To evaluate QoS for applications or network or any services presented to users or customers, there to types of measurements, these types are quantitative (ex: bandwidth, delay and jitter) and qualitative (ex: reliability and security), and may called functional and nonfunctional QoS, each one has parametersused to evaluate the QoS. According to applications or purpose of evaluation specify the parameters used in the process of evaluation.Most of studies at this review concern about measure response time and throughput because they are web application or cloud services addition to another parameters. Other parameters also used in evaluation of QoS is reliability, availability, and in case of cloud services the security is a most important parameter. The twenty-nine studies from thirty-nine use response time and throughput as indicator to QoS.Theauthors of studies at this review are concern about evaluation of QoS, each one-use different technique to achieve evaluation process perfectly as possible; the techniques chosen according to problem side they concern about solve it and the level of accuracy of solution they aim to achieve. The researcher of studies at this review has main problem is the QoSmeasurement but they different in the purpose of measurements. Some of the studies need the measurements to evaluate services quality, while other studies need the measurement for achieved another task.
From all mentioned above conclude to that, all studies concern about QoS measurements or evaluation but different at the main purpose of measurements, and to achieved their purpose use different techniques.
All studies which used in this review paper to verification from the proposed solution use experimental method to sure the proposed.

6.Conclusion

The QoS requirements for application or services is wide area of research, but here summarization from many of research about how to specify these requirements and evaluation if the application satisfy these requirements. Each of research solves the problem area by deferent mechanism; they measure QoS for multi reasons, so the measurements of QoS sometimes for support in diction make. Therefore, any defect in measurement may lead to disaster.to avoid any mistake or inaccuracy in the result of measurements they must use atechnique that gives precise results.

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