A Meta-Model Based Proposal for QOS of WSCDL Choreography

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Abstract—**Quality of service (QOS) of a choreography is dependent on the quality of service of participating roles. Recently, a proposal has been made to extend the meta model of WSDL to include QOS parameters. These parameters include reliability, availability and demand.**
In this paper we propose a multidimensional model of quality of service of a choreography based on above proposed extensions. Our proposal describes the QOS of a choreography in terms of QOS of dominant role, dominant relationship and dominant interaction. Dominant role and dominant relationship are identified by analyzing relationships and interactions where as dominant interaction is based on dominant operation. A dominant operation has maximum arrival rate of request.QOS attributes of dominant role are same as that of roles. Further, we also proposed rules for estimation of QOS of dominant relationship and dominant interaction. We demonstrate our proposal through an example.

Keywords: Quality of sevice,choreography, WSCDL, dominant role, dominant relationship and dominant interaction

1. Introduction

Web service choreography describes interactions between multiple web services to achieve a business goal. Theses business goals may be achieved by several competing choreographies. It becomes an imperative to distinguish between competing choreography based on their quality of service(QOS). QOS covers a wide range of non functional features such as security, reliability, availability and performance efficiency.
The QOS of choreography is dependent on the QOS of participating web services and their mode of interactions. Some models [5, 3] have been proposed to estimate parameters of QOS choreography. Even though, these contribution are significant steps in QOS modeling, they are not based on structural features of choreography. In our opinion, the QOS of choreography should be based on the meta model of WSDL and WS-CDL. A proposal to extend the meta model of WSDL to include QOS parameters has been made in [2].

In this paper, we propose a multidimensional model of QOS for choreography utilizing the QOS model of web service as proposed in [2]. Our proposal describes QOS of choreography in terms of *dominant role, dominant relationship* and *dominant interaction*. These features are evaluated based on QOS of roles, operations and messages.

We have organized our paper in 7 sections. Section 2 describes WS-CDL meta model. QOS attributes of web services are briefly described in Section 3. Section 4 presents our proposed model. Section -5 demonstrates our proposal through an example. Section-6 briefly surveys the related works. The last section concludes the paper.

2. WS-CDL Meta Model

WS-CDL is an XML-based language to describe collaborations between web services. It provides a global view of peer to peer interactions between participating web services. An intuitive meta model of WS-CDL using UML class diagram has been presented in [2]. A part of the above meta model is shown in Figure 1. It contains important entities of WS-CDL and relationships between them which are relevant for modeling of QoS of choreography.
Choreography is viewed an aggregation of set of interactions between roles. These roles are subset of observable behaviors of web services in the context of there relationship with other roles and are specified as roleType. Interactions may involve exchange of messages between roles and execution of operation by them. Since a role can either send or receive a message, it participates in an message exchange either as fromRole or toRole respectively.

3 QOS Model of Web Service

Since our proposal for QOS of choreography is based on a QOS model of web services presented in[1] , we briefly describe the above model in this section.
Figure-2, reproduced from [1], describes components of web services using UML class diagram. These components

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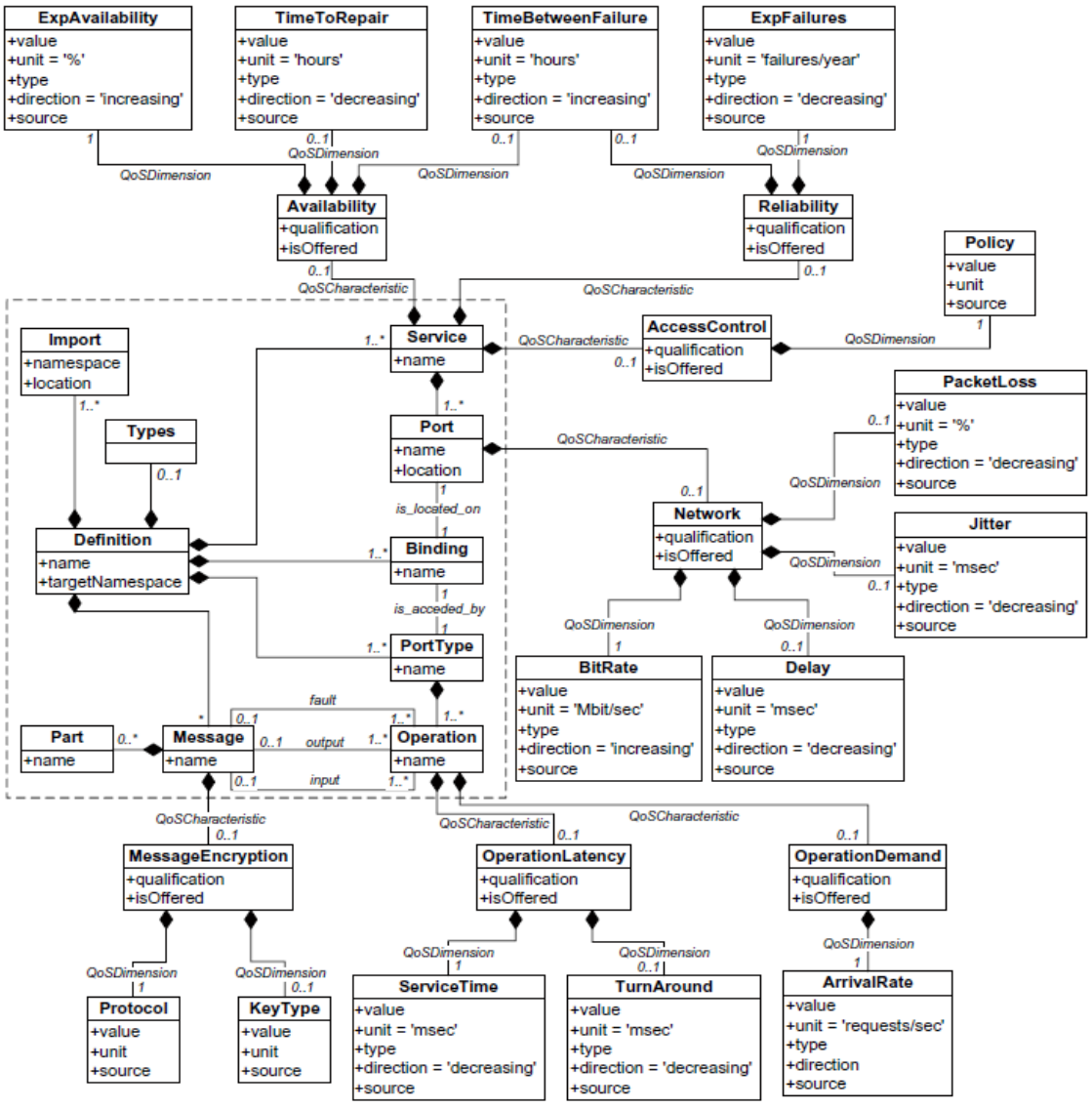

Figure 2. QOS -Enabled WSDL

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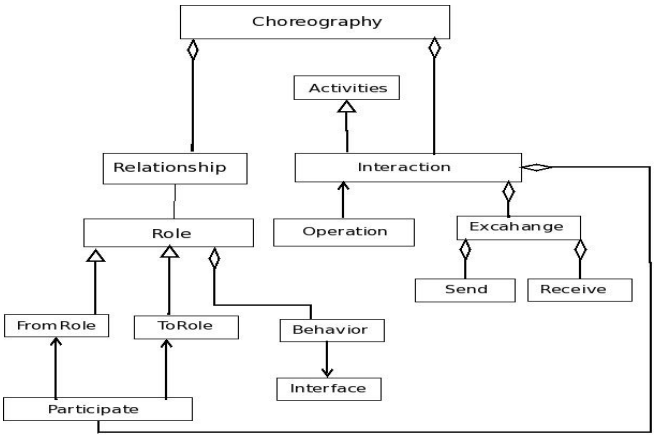

Figure 1. WSCDL-Meta-Model

include name of web service and associated messages, operation, port, portType and bindings. The quality of service attributes associated with service, operation and messages are shown outside dashed line and are summarized in Table-1.

The quality attributes of services are reliability and availability. The reliability is based on expected number of failure over a time interval and time between failure. The availability attribute is an aggregation of expected availability, time to repair and time between failure. Time to repair is the time taken to repair service after failure. Expected availability may be computed as a ratio of uptime and total time which includes uptime and down time both. The quality attribute of operation includes its demand and latency. The demand may be computed in terms of arrival rate of the request for the operation. The latency may be specified in terms of service time and turn around time. The quality attribute of message depends on the protocol used for securing output and input(protocol) and type of keys used for message encryption.

Table 1. Web Service QOS

Web Service QOS		
Role	**QOS Parameter**	**Field**
Service	Service Availability	TTR TBF ExpA
	Service Reliability	TBF Exp Failure
Operation	Latency	Service Time TurnATime
	Demand	Arrival Rate
Message	Protocol KeyType	Send-Receive Send-Receive

4 A QOS Model of choreography

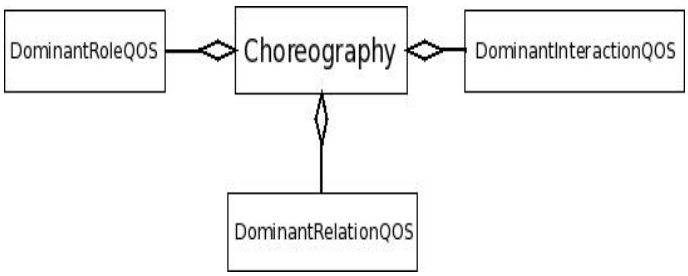

Figure 3. QOS of Choreography

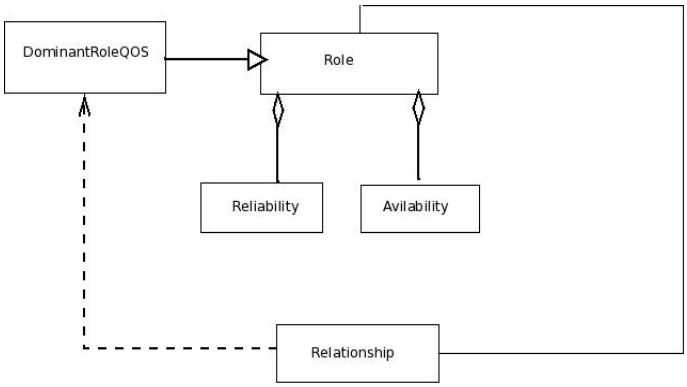

Figure 4. DominantRole-QOS

Our proposed model for QOS of choreography is based on analogy between choreography for performing arts and of web services. In the context of performing art, the quality of its choreography is described in terms of quality of performance of dominant performer and his/her synchronized interactions with other performers. For example to distinguish between two group dance performances, we generally use the names of the main performer, quality of his/her performance and the extent of synchronization between movements of main dancer and other performers. These synchronization involve exchanges either through body language or rhythm of musical instruments.

Accordingly, we propose a multidimensional model of quality of service of choreography. Figure-3 presents different dimensions and associated QOS attributes of a choreography. Dimensions of quality of service include dominant role(s), dominant relationship(s) and dominant interaction(s). We propose to identify dominant role(s) on the basis of its frequency of occurrences in relationships defined in a choreography. This dependency of dominant role(s) is shown as dependency relationship in Figure-4. The QOS attributes of dominant role are same as that of a role (shown in Figure-2).

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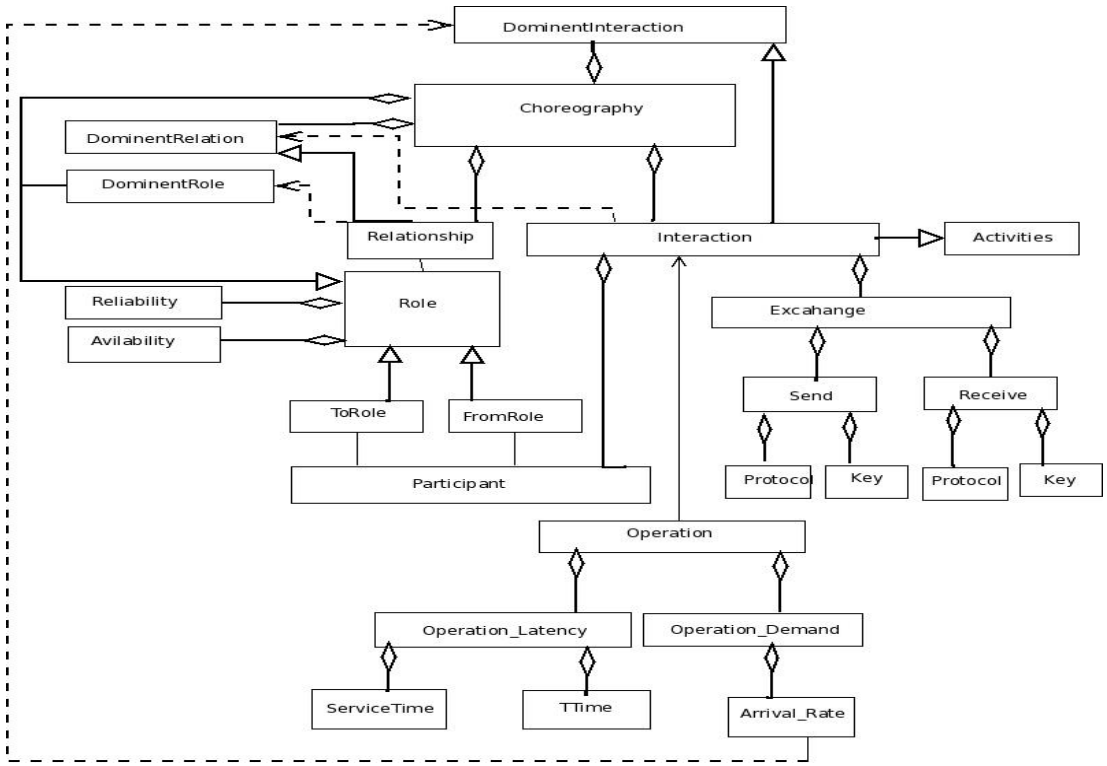

Figure 7. WSCDL Metamodel with QOS

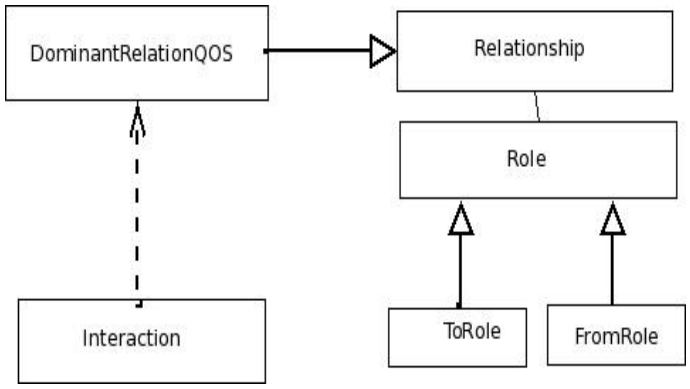

Figure 5. DominantRelation-QOS

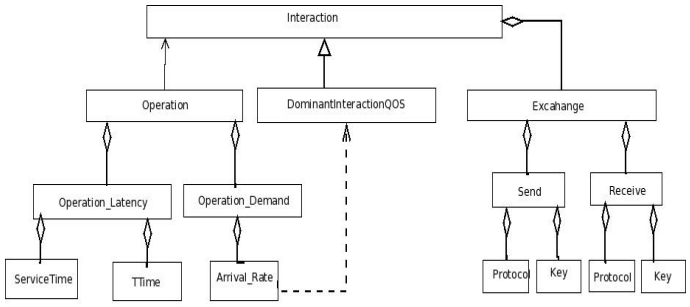

Figure 6. DominantIntraction-QOS

Table 2. Rules for relationship

Role1 Qos	Role2 Qos	Rule
ExpAvailability	ExpAvailability	Minimum
TimeBetweenFailure	TimeBetweenFailure	Minimum
Time To Repair	Time To Repair	Maximum
ExpFailure	ExpFailure	Maximum

Similarly, we propose to identify dominant relationship on the basis of frequency of its usages in an interactions of a choreography. The relationship which have maximum usage is identified as dominant relationship. Its relationship with interaction shown in Figure-5 as dependency relationship. We define QOS attributes of relationship in terms of QOS of participating roles in the relationship. The four attributes of QOS for dominant relationship are same as that of a role and includes Time to Repair(TR) , Expected Failure(EF) ,Expected Availability(EA) and Time Between Failure(TBF). Table-2 presents the rules for computation of these four attributes of dominant relationship from QOS attributes of participating roles. Time to Repair and Expected Failure are maximum of the values of these attributes of participating roles where as the remaining two are minimum values.

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Figure-6, presents relationship between dominant interaction and dominant operation. Dominant operation is characterized on the basis of arrival rate attribute of its QOS. This attribute of QOS is preferred over other attribute (service time and turn arround time) as it reflects its reputation. An interaction having a dominant operation with maximum arrival rate is identified as dominant interaction. QOS attributes of dominant interaction includes QOS attribute of dominant operation and messages exchanged.
These dimensions and attributes of QOS of a choreography are tabulated in Table-3 and also are shown in Figure-7.

Table 3. QOS Attributes of a choreography

Web Service Choreography: WSCDL QOS		
Qos Component	**QOS Parameter**	**Field**
DominantRole: RoleName	Service Availability	TR
		TBF
		ExA
	Service Reliability	TBF
		ExF
DominantRelation: Relation Name	Service Availability	ReQOS
	Service Reliability	
DominantInteraction: Iname	DominantOperation	ST,TT,AR
	DominantMessage	Protocol
		KeyType

5. Example:BookTripchoreography

In this section, we demonstrate our proposal through an example. The example choreography is named BookTrip-Choreography and contains ten roles, six relationships and eleven interactions.Its important features are summarized in Table 3,4,5 and 6. The QOS attributes of Book-Trip is given in Table-7.
BookTripChoreography[book_air_travel,book_accommodation, book_train_travel,register_event, book_plane,book_info,book_shuttle, book_hotel,register_event,book_train]
Table-4 contains role names ,service availability and service reliability quality attributes . We have taken symbolic constants for Time to Repair(TR), Time Between Failure(TBF), Expected Availability(EXA) and Expected Failure(EF).

Table 4. Role Names and QOS attributes

RoleName	**Service Availability**			**Service Reliability**	
	TR	TBF	**EXA**	TBF	**EF**
book_train_travel	t1	**b1**	e1	b1	**f1**
register_event	t2	**b2**	e2	b2	**f2**
book_air_travel	t3	**b3**	e3	b3	**f3**
book_plane	t4	**b4**	e4	b4	**f4**
book_accomod	t5	**b5**	e5	b5	**f5**
book_info	t6	**b6**	e6	b6	**f6**
book_shuttle	t7	**b7**	e7	b7	**f7**
book_hotel	t8	**b8**	e8	b8	**f8**
book_train	t9	**b9**	e9	b9	**f9**
book_limo	t10	**b10**	e11	b10	**f10**

Table 5. Relationship Names

Relationship	**Role**	
	To	**From**
train_travel	book_train_travel	**book_train**
air__plane	book_air_travel	**book_plane**
acc__hotel	book_accommodate	**book_hotel**
event_info	book_info	**register_event**
travel_Limo	book_air_travel	**book_limo**
travel_shuttle	book_air_travel	**book_shuttle**

Table-5 describes the relationship names, participating role names and their role in relationships either as To-Role and From-Role. QOS attribute values of these relationship are tabulated in Table-6 using the rules defined in Table-2.

Table-7 is used for describing interaction names with its components. These components are relationship name, operation name and message name.

In this, example the book_air_travel role has participated in three relationships. These relationships

Table 6. Relationship QOS

Relationship	**Service Availability**			**Service Reliability**	
	TR: Max	TBF: Min	**EXA: Min**	TBF: Min	**EF: Max**
train_travel	t1,t9	**b1,b9**	e1,e9	b1,b9	**f1,f9**
air__plane	t3,t4	**b3,b4**	e3,e4	b3,b4	**f3,f4**
acc__hotel	t5,t8	**b5,b8**	e5,e8	b5,b8	**f5,f8**
event_info	t6,t2	**b6,b2**	e6,e2	b6,b2	**f6,f2**
travel_Limo	t10,t7	**b10,b7**	e10,e7	b10,b7	**f10,f7**
travel_shuttle	t3,t7	**b3,b7**	e3,e7	b3,b7	**f3,f7**

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Table 7. Interaction

Interaction Components			
Interaction Name	**Relationship Name**	**Operation Name**	**MessageName**
PlaneRequest	air__plane	querybookplane	bookPlaneRequestE,booKAvailabilityE
BookPlane	air__plane	bookplane	bookPlaneE,bookPlaneConfirmE
LimoRequest	travel_Limo	querylimo	bookLimoRequest,booKAvailabilityE
BookLimo	travel_Limo	booklimo	bookLimo, bookLimoConfirmE
ShuttleRequest	travel_Shuttle	queryshuttle	bookShuttleRequest,booKAvailabilityE
BookShuttle	travel_shuttle	bookshuttle	bookshuttle, bookshuttleConfirmE
AccoRequest	acc__hotel	queryacco	bookAccoRequestE,booKAvailabilityE
Bookhotel	acc__hotel	bookhotel	bookhotelE,bookhotelConfirmE
TrainRequest	train_travel	querytrain	bookTrainRequest,booKAvailabilityE
BookTrain	train_travel	booktrain	bookTrainE,bookTrainConfirmE
registerinfo	event_info	register_event	registerinfoE,registerinfoConfirmE

are air__plane,travel_Limo and travel_shuttle. Since book_air_travel role has highest frequency, it is identified as dominant role. This role has QOS attributes constants t3,b3,e3and f3 for time to repair, time between failure, expected avilability and expected failure.

Similarly , air__plane relation has appeared in two interactions, so it is identified as dominant relationships. It has also four attributes. According to rules in Table-2, we have selected maximum for time to repair and expected failure and minimum for time betwen failure and availability. The arrival rate of operation bookplane is assumed highest so this operation act as dominant operation. This operation has appeared in Bookplane interaction so it is a dominant interaction. The QOS attributes of dominant operation are service time (s2), turn arround time(tt2), and arrival rate(ar2). Only ar2 is used as QOS attributes.

6. Related Work

L. Zeng et.al.[6] proposed a QOS model for composite service based on quality attributes of component web service. Quality attributes of elementary web services included execution duration, execution price, reliability, availability and reputation. Aggregation functions were defined for composite service based on above attributes.
All the above attributes were also considered in the model of [4]. However, this model considered range of values(min and max value) for qualities parameters and defined vector based aggregation function.
Zaho et.al.[5] proposed extension in WSCDL for including QOS information and provided trace semantics with respect to execution time and cost information of services. Based on this model they also proposed a methodology to estimate time and cost consumption a choreographies using syntax based estimation function. Zeng proposal of QOS is

Table 8. Web Service Choreography QOS

BookTripChoreography: WSCDL QOS		
Qos Component	**QOS Parameter**	**Field**
DominentRole book_air_travel	Service Availability	t3 b3 e3
	ServiceReliability	b3 F3
DominentRelation air__plane	ServiceAvailability	max(t3,t4) min(b3,b4) min(e3,e4) max(f3,f4)
	ServiceReliability	
DominentInteraction BookPlane	DominentOperation bookplane	s2 tt2 and ar2
	bookplane DominentMessage bookplaneE bookplaneC	Protocol s KeyType s

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multidimensional one and focuses on dynamic estimation of QOS of composite web service in contrast with syntax based estimation of Zaho.
Since our proposal is based on extended meta-model of WSDL, it aggregates different features at choreography level.

7. Conclusions

In this paper, we have proposed a meta model of QOS of choreography based on QOS prameters of participating roles and their usage in choreogrphies. QOS attributes are estimated using choreography features such as relationship and interactions. We plane to extend our model to include parameters which are important for business.

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