

**APPENDIX B: QNM META-MODEL
META-ENTITIES**

META-ENTITY: Arc

NAME.....Arc

SUBTYPEOF.....

CDIFMETAIDENTIFIER.....QNM001

DESCRIPTION..... An Arc connects two Nodes in a QNM. Traversal of an Arc represents completion of a service request at the FromNode and a new request for service at the ToNode.

USAGE.....

ALIASES

CONSTRAINTS

TYPEAssociative

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....

Description
FromNode
ToNode

INHERITED META-RELATIONSHIPS

LOCAL META-RELATIONSHIPS

META-ENTITY: BranchPoint

NAME.....BranchPoint
SUBTYPEOF.....Non-ServerNode
CDIFMETAIDENTIFIER.....QNM002
DESCRIPTION.....A BranchPoint is a convenient way to represent the
origin or destination of multiple arcs.
USAGE.....
ALIASES
CONSTRAINTS
TYPEKernel

INHERITED META-ATTRIBUTES.....
 Name.....from Node
 IDfrom Node
 NodeType.....from Non-ServerNode

LOCAL META-ATTRIBUTES.....

INHERITED META-RELATIONSHIPS
 Node.IsConnectedTo.Node

LOCAL META-RELATIONSHIPS

META-ENTITY: ClosedWorkload

NAME.....ClosedWorkload
SUBTYPEOF.....Workload
CDIFMETAIDENTIFIER.....QNM003
DESCRIPTION.....An ClosedWorkload is a workload with a fixed
population that circulates among the Servers.
USAGE.....
ALIASES
CONSTRAINTS
TYPEKernel

INHERITED META-ATTRIBUTES.....
 WorkloadNamefrom Workload

LOCAL META-ATTRIBUTES.....
 NumberOfJobs
 ThinkTime
 TimeUnits

INHERITED META-RELATIONSHIPS
 Server.ProvidesServiceFor.Workload

LOCAL META-RELATIONSHIPS

META-ENTITY: DemandServiceRequest

NAME.....DemandServiceRequest
SUBTYPEOF.....ServiceRequest
CDIFMETAIDENTIFIER.....QNM004
DESCRIPTION.....A DemandServiceRequest specifies the average
service demand (service time multiplied by number of
visits) provided for each workload that visits the
Server.
USAGE.....
ALIASES
CONSTRAINTS
TYPEKernel

INHERITED META-ATTRIBUTES.....
 WorkloadNamefrom ServiceRequest
 ServerID.....from ServiceRequest
 TimeUnitsfrom ServiceRequest

LOCAL META-ATTRIBUTES.....
 ServiceDemand

INHERITED META-RELATIONSHIPS

LOCAL META-RELATIONSHIPS

META-ENTITY: Node

NAME.....Node
SUBTYPEOF.....
CDIFMETAIDENTIFIER.....QNM005
DESCRIPTION.....A Node represents an entity in the
QueueingNetworkModel of the execution
environment that either provides service or
designates model topology.
USAGE.....
ALIASES
CONSTRAINTS
TYPEKernel

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....
Name
ID

INHERITED META-RELATIONSHIPS

LOCAL META-RELATIONSHIPS
Node.IsConnectedTo.Node

META-ENTITY: Non-ServerNode

NAME.....Non-ServerNode
SUBTYPEOF.....Node
CDIFMETAIDENTIFIER.....QNM006
DESCRIPTION.....A Non-ServerNode represents a Node of the execution environment that designates model topology but does not provide processing service.
USAGE.....
ALIASES
CONSTRAINTS
TYPE.....Kernel

INHERITED META-ATTRIBUTES.....
 Name.....from Node
 IDfrom Node

LOCAL META-ATTRIBUTES.....
 NodeType

INHERITED META-RELATIONSHIPS
 Node.IsConnectedTo.Node

LOCAL META-RELATIONSHIPS

META-ENTITY: OpenWorkload

NAME.....OpenWorkload
SUBTYPEOF.....Workload
CDIFMETAIDENTIFIER.....QNM007
DESCRIPTION.....An OpenWorkload is a workload with a potentially infinite population where transactions or jobs arrive from the outside world, receive service, and exit. The population of the OpenWorkload at any one time is variable.

USAGE.....
ALIASES
CONSTRAINTS
TYPEKernel

INHERITED META-ATTRIBUTES.....
 WorkloadNamefrom Workload

LOCAL META-ATTRIBUTES.....
 ArrivalRate
 TimeUnits

INHERITED META-RELATIONSHIPS
 Server.ProvidesServiceFor.Workload
 SourceNode.RepresentsArrivalsFor.OpenWorkload

LOCAL META-RELATIONSHIPS

META-ENTITY: QueueingNetworkModel

NAME.....QueueingNetworkModel

SUBTYPEOF.....

CDIFMETAIDENTIFIER.....QNM008

DESCRIPTION..... A QueueingNetworkModel represents a network of connected servers that provides processing service for Workloads.

USAGE.....

ALIASES

CONSTRAINTS

TYPEKernel

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....

 Name

 Description

INHERITED META-RELATIONSHIPS

LOCAL META-RELATIONSHIPS

META-ENTITY: Server

NAME.....Server
SUBTYPEOF.....Node
CDIFMETAIDENTIFIER.....QNM009
DESCRIPTION.....A Server represents a Node of the execution environment that provides some processing service.
USAGE.....
ALIASES
CONSTRAINTS
TYPEKernel

INHERITED META-ATTRIBUTES.....
 Name.....from Node
 IDfrom Node

LOCAL META-ATTRIBUTES.....
 Quantity
 SchedulingPolicy

INHERITED META-RELATIONSHIPS
 Node.IsConnectedTo.Node

LOCAL META-RELATIONSHIPS
 Server.ProvidesServiceFor.Workload

META-ENTITY: ServiceRequest

NAME.....ServiceRequest
SUBTYPEOF.....
CDIFMETAIDENTIFIER.....QNM010
DESCRIPTION.....A ServiceRequest specifies either the average
TimeService or DemandService provided for each
workload that visits the Server.
USAGE.....
ALIASES
CONSTRAINTS
TYPE.....Associative

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....
 WorkloadName
 ServerID
 TimeUnits

INHERITED META-RELATIONSHIPS

LOCAL META-RELATIONSHIPS

META-ENTITY: SinkNode

NAME.....SinkNode
SUBTYPEOF.....Non-ServerNode
CDIFMETAIDENTIFIER.....QNM011
DESCRIPTION.....A SinkNode represents a Node of the execution environment that designates where OpenWorkloads terminate.

USAGE.....
ALIASES
CONSTRAINTS
TYPE.....Kernel

INHERITED META-ATTRIBUTES.....
 Name.....from Node
 IDfrom Node
 NodeType.....from Non-ServerNode

LOCAL META-ATTRIBUTES.....

INHERITED META-RELATIONSHIPS
 Node.IsConnectedTo.Node

LOCAL META-RELATIONSHIPS
 SourceNode.IsPairedWith.SinkNode

META-ENTITY: SourceNode

NAME.....SourceNode
SUBTYPEOF.....Non-ServerNode
CDIFMETAIDENTIFIER.....QNM012
DESCRIPTION.....A SourceNode represents a Node of the execution environment that designates where OpenWorkloads originate.

USAGE.....
ALIASES
CONSTRAINTS
TYPE.....Kernel

INHERITED META-ATTRIBUTES.....
 Name.....from Node
 IDfrom Node
 NodeType.....from Non-ServerNode

LOCAL META-ATTRIBUTES.....

INHERITED META-RELATIONSHIPS
 Node.IsConnectedTo.Node

LOCAL META-RELATIONSHIPS
 SourceNode.IsPairedWith.SinkNode
 SourceNode.RepresentsArrivalsFor.OpenWorkload

META-ENTITY: TimeServiceRequest

NAME.....TimeServiceRequest
SUBTYPEOF.....ServiceRequest
CDIFMETAIDENTIFIER.....QNM013
DESCRIPTION.....A TimeServiceRequest specifies the average service
time and number of visits provided for each workload
that visits the Server.
USAGE.....
ALIASES
CONSTRAINTS
TYPE.....Kernel

INHERITED META-ATTRIBUTES.....
 WorkloadNamefrom ServiceRequest
 ServerID.....from ServiceRequest
 TimeUnitsfrom ServiceRequest

LOCAL META-ATTRIBUTES.....
 ServiceTime
 NumberOfVisits

INHERITED META-RELATIONSHIPS

LOCAL META-RELATIONSHIPS

META-ENTITY: Workload

NAME.....Workload
SUBTYPEOF.....
CDIFMETAIDENTIFIER.....QNM014
DESCRIPTION..... A Workload represents a collection of transactions or
jobs that make similar service requests from servers in
the queueing network model.
USAGE.....
ALIASES
CONSTRAINTS
TYPEKernel

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....
WorkloadName

INHERITED META-RELATIONSHIPS

LOCAL META-RELATIONSHIPS
Server.ProvidesServiceFor.Workload

META-ATTRIBUTES

META-ATTRIBUTE NAMEArrivalRate
CDIFMETAIDENTIFIER.....QNM015
DESCRIPTION.....The average rate at which transactions or jobs arrive
from the outside world, receive service, and exit.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Float
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMEDescription
CDIFMETAIDENTIFIER.....QNM016
DESCRIPTION.....A textual description of an entity.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....String
DOMAIN
LENGTHVARIABLE
ISOPTIONALTrue

META-ATTRIBUTE NAMEFromNode
CDIFMETAIDENTIFIER.....QNM017
DESCRIPTION.....The ID of the origin Node of an Arc.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Integer
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMEID
CDIFMETAIDENTIFIER.....QNM018
DESCRIPTION.....A unique identifier for a QNM entity.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Integer
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMEName
CDIFMETAIDENTIFIER.....QNM019
DESCRIPTION.....The name of a QueueingNetworkModel entity.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....String
DOMAIN
LENGTH32
ISOPTIONALTrue

META-ATTRIBUTE NAMENodeType
CDIFMETAIDENTIFIER.....QNM020
DESCRIPTION.....The type of a Non-ServerNode.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Enumerated
DOMAINSource | Sink | Branch
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMENumberOfJobs
CDIFMETAIDENTIFIER.....QNM021
DESCRIPTION.....The fixed population that circulates among the servers.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Integer
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMENumberOfVisits
CDIFMETAIDENTIFIER.....QNM022
DESCRIPTION.....The average number of visits in a service request.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Float
DOMAIN 0
LENGTH
ISOPTIONALNo

META-ATTRIBUTE NAMEQuantity
CDIFMETAIDENTIFIER.....QNM023
DESCRIPTION.....The number of instances of a given Server in the model. Multiple servers have one queue for service requests.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Integer
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMESchedulingPolicy
CDIFMETAIDENTIFIER.....QNM024
DESCRIPTION.....The policy used to select the next service request to be served from a queue.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Enumerated
DOMAINFCFS | PS | IS
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMEServerID
CDIFMETAIDENTIFIER.....QNM025
DESCRIPTION.....The ID of the Server.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Integer
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMEServiceDemand
CDIFMETAIDENTIFIER.....QNM026
DESCRIPTION.....The total demand for a service request. Demand is the product of ServiceTime and NumberOfVisits.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Float
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMEServiceTime
CDIFMETAIDENTIFIER.....QNM027
DESCRIPTION..... The amount of time required for a server to perform one unit of service. A unit of service is the amount provided for each visit to the server.

USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Float
DOMAIN 0
LENGTH?
ISOPTIONALFalse

META-ATTRIBUTE NAMEThinkTime
CDIFMETAIDENTIFIER.....QNM028
DESCRIPTION..... The average interval of time that elapses between the completion of a transaction or job and the submission of the next transaction or job.

USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Float
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMETimeUnits
CDIFMETAIDENTIFIER.....QNM029
DESCRIPTION..... The unit of time specified in a service request or workload intensity.
USAGE..... If time units are omitted, all specifications are assumed to be the same relative units.

ALIASES
CONSTRAINTS
DATATYPE.....Emumerated
DOMAINDay | Hr | Min | Sec | Ms | Ns
LENGTH
ISOPTIONALTrue

META-ATTRIBUTE NAMEToNode
CDIFMETAIDENTIFIER.....QNM030
DESCRIPTION.....The ID of the destination Node of an Arc.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....Integer
DOMAIN 0
LENGTH
ISOPTIONALFalse

META-ATTRIBUTE NAMEWorkloadName
CDIFMETAIDENTIFIER.....SPE031
DESCRIPTION.....The Name of the workload.
USAGE.....
ALIASES
CONSTRAINTS
DATATYPE.....String
DOMAIN
LENGTH32
ISOPTIONALFalse

META-RELATIONSHIPS

Node.IsConnectedTo.Node

NAME.....IsConnectedTo
CDIFMETAIDENTIFIER.....QNM032
SUBTYPEOF.....
SUPERTYPEOF.....
MINSOURCECARD.....1
MAXSOURCECARD.....1
MINDESTCARD.....0
MAXDESTCARD.....1
DESCRIPTION..... Relationship to connect one Node to another in a
QNM. This relationship is described by the
associative entity Arc.
USAGE.....
ALIASES.....
CONSTRAINTS.....

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....

QueueingNetworkModel.IsComposedOf.Arc

NAME.....IsComposedOf

CDIFMETAIDENTIFIER.....QNM033

SUBTYPEOF.....

SUPERTYPEOF

MINSOURCECARD1

MAXSOURCECARD1

MINDESTCARD0

MAXDESTCARDN

DESCRIPTION..... A QueueingNetworkModel is a composite object composed of one or more Nodes and zero or more Arcs.

USAGE.....

ALIASES

CONSTRAINTS

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....

QueueingNetworkModel.IsComposedOf.Node

NAME.....IsComposedOf

CDIFMETAIDENTIFIER.....QNM034

SUBTYPEOF.....

SUPERTYPEOF

MINSOURCECARD1

MAXSOURCECARD1

MINDESTCARD1

MAXDESTCARDN

DESCRIPTION..... A QueueingNetworkModel is a composite object composed of one or more Nodes and zero or more Arcs.

USAGE.....

ALIASES

CONSTRAINTS

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....

Server.ProvidesServiceFor.Workload

NAME.....ProvidesServiceFor

CDIFMETAIDENTIFIER.....QNM035

SUBTYPEOF.....

SUPERTYPEOF

MINSOURCECARD0

MAXSOURCECARDN

MINDESTCARD0

MAXDESTCARDN

DESCRIPTION..... Relationship to connect a Server to its provision of service for a Workload. This relationship is described by the associative entity ServiceRequest.

USAGE.....

ALIASES

CONSTRAINTS

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....

SourceNode.IsPairedWith.SinkNode

NAME.....IsPairedWith
CDIFMETAIDENTIFIER.....QNM036
SUBTYPEOF.....
SUPERTYPEOF.....
MINSOURCECARD.....1
MAXSOURCECARD.....1
MINDESTCARD.....1
MAXDESTCARD.....1
DESCRIPTION.....Relationship to connect the SourceNode and the SinkNode in the QNM.

USAGE.....
ALIASES.....
CONSTRAINTS.....

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....

SourceNode.RepresentsArrivalsFor.OpenWorkload

NAME.....RepresentsArrivalsFor
CDIFMETAIDENTIFIER.....QNM037
SUBTYPEOF.....
SUPERTYPEOF.....
MINSOURCECARD.....0
MAXSOURCECARD.....N
MINDESTCARD.....0
MAXDESTCARD.....N
DESCRIPTION.....Relationship to connect the SourceNode and the
OpenWorkload arrivals in the QNM.
USAGE.....
ALIASES.....
CONSTRAINTS.....

INHERITED META-ATTRIBUTES.....

LOCAL META-ATTRIBUTES.....
