Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 4, Issue. 4, April 2015, pg.216 – 220

SURVEY ARTICLE

Survey on Publish-Subscribe Based Communication Middleware

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Abstract— In the modern world there is demand in real time communication because in some situation any delay while communicating would leads to catastrophic results especially in defence operations and other military applications. Several middleware designs came to picture like client-server, message-passing, Publish-Subscribe architecture. Hence there is need to assess the communication needs in distributed systems. The Object Management Group's Data Distribution Service (DDS) uses the specifications of Publish Subscribe model to standardise the data-centric publish-subscribe programming model. The paper concludes the DDS is best network communication solution.

Keywords— middleware, DDS, client-server, message-passing, publish-subscriber

I. INTRODUCTION

Today there exist many distributed applications and many more applications are being planned for future. There is an enormous opportunities in the real-time application. The list goes on such as Traffic control system, military systems, share market, factory automations. All the industries just listed are in dilemma how to construct single system from so many available distributed parts. If the data is present and the network is fast, reliable and inexpensive then we could develop new distributed application to get the data. It sounds simple but it practically complex. The main challenge is the application must send the data to nodes such that it should carry right information at right time. It is possible by publish-subscribe implementation but there are multiple options available to implement for the cause, choosing the appropriate method is the key to success.

II. LITERATURE SURVEY

Generally there are three types of communication middleware namely Client-server, Message-Passing and Publisher-Subscriber [11]. Any new protocol will come under these three types as shown in figure 1.

Client-Server: As we know it includes client machine which request the data and server machine which responds to the request. This approach works fine for centralized processing systems such as transactions and databases. Here if multiple clients send the data then client-server architecture directs the information to server. Hence sometimes there will be an unknown delay in the system for servers to react and another issue is architecture has high rate of single point failure.

Message Passing: Supports direct peer-peer connection enabling efficient communication between the nodes. The major disadvantage is it does not support data-centric model.

Publish-Subscribe: It adds a particular model to the messaging where publisher "publishes" the data they produce and the subscriber "subscribes" the data which they need. The publisher-subscribe generally has both discovery and messaging capability. In the next section we see the more details of the technologies which often based on publish-subscribe message exchange pattern.

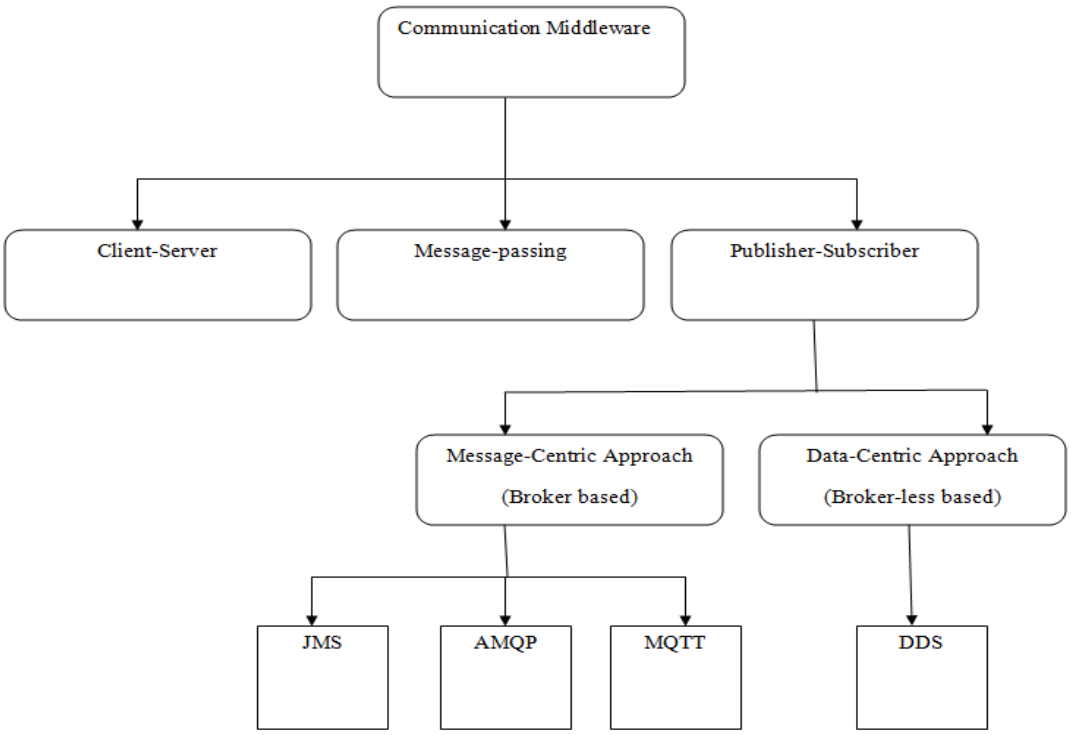

Figure.1 Types of communication Middleware

III. PUBLISHER-SUBSCRIBER BASED TECHNOLOGIES

1. JMS

a. It is the acronym for Java Message Service.
b. It is message centric approach, the infrastructure really have no idea about the content.
c. The JMS server must be determined and configured either with Queues or Topics.
d. Does not support interoperability.
e. It supports only broker based architecture.
f. Not suitable for real time applications.

2. AMQP

a. It is acronym for Advanced Message Queuing protocol.
b. It is message centric approach, the infrastructure really have no idea about the content.
c. Unlike JMS it supports wire protocol.
d. Supports Interoperability.
e. It supports only broker based architecture.
f. Not suitable for real time applications.

3. MQTT

a. It is an acronym for Message Queuing Telemetry Transport.
b. It is message centric approach, the infrastructure really have no idea about the content.
c. It provides light weight device data collection.
d. It supports partial interoperability.
e. It supports only broker based architecture.
f. Not suitable for real time applications.

4. DDS

a. It is an acronym for Data Distribution Service.
b. It is Data centric approach, the infrastructure does aware of the contents and also maintains it.
c. It supports multicast.
d. No need to specify end points.
e. Provides QOS policies such that ease tailoring of communication behaviour.
f. No need to specify the end points.
g. Perfectly suites for real time applications.

IV. WHY DO WE NEED DDS?

- As shown in the figure 1, JMS, AMQP, MQTT are the protocols which is used for communication between the nodes or the applications but they are broker based (single queues or double queue) and also message-centric but DDS is based on data-centric and also provides decentralized broker less architectures ensures reliable, scalable, real-time and efficient communication between the publisher and subscriber.
- The DDS is specifications that standardize the application program interface with Data-Centric publish-subscribe paradigm. In this approach the endpoints would communicate anonymously in the sense the sender sends the data

without the knowledge of receiver location in the same way the receiver receives the data without knowledge of sender location.

- DDS completely based on Global Data Space (GDS) concept where publisher and subscriber would join and leave any time as shown in figure 2, the publishers are represented as p1, p2,...pn and subscribers are s1,s2....sn. Topic(T1,T2,..Tn) is an entity is plays crucial role in logically connecting publisher and subscriber. There are no intermediate brokers available between publisher and subscribers which makes efficient for data sharing.
- The single packet can be sent to multiple nodes supporting multicasting thus increasing the throughput of the network.

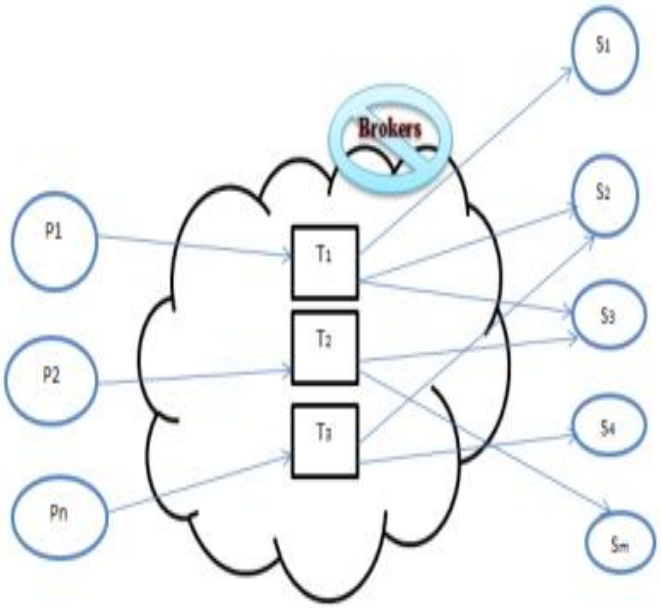

Figure 2.Global Data Space

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- DDS supports direct peer-peer connection. The connections are established by the topic. When the node is known where to send the data then the sending process would be highly effective.
- The redundancy of publishers and Subscribers are generally built thus eliminating single point failure.

V. CONCLUSIONS

The number of messaging technologies discussed in this paper which includes AMQP, JMS, MQTT and DDS .Each of the messaging technologies are used to connect the devices for communication in the distributed network. However considering operational scenarios like intra and inter device communication and device to cloud communication, some of the essential system requirements like Quality of service, reliability and fault tolerance is taken into account. For device to device application which concentrates interoperability, real-time and high performance then DDS has greater advantage over other technologies.

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