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Abstract

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The Arrowhead project [1] considers to normalize all interactions involving embedded systems by mediating them through services. The Service Oriented Architecture (SOA) paradigm is applied to both the interactions that provide the service requested by the user, and other support actions such as the authentication and registration of the devices, and the services they provide, the look-up of devices and service provided, and orchestration of services for creation of more complex services. To this purpose, services are divided into Core Services, which are present in every environment supporting Arrowhead applications, and user services that implement the applications. The Core Services set comprises, at least, Authentication Service, Registration Service and Orchestration Service.

A particularly important non-functional requirement for SOA applications for embedded systems is guaranteeing the required Quality of Service (QoS) needed by the application services, and in this context we propose to expand the Arrowhead Core Services by defining an architecture to support QoS in such systems. The support of QoS in an Arrowhead application requires the definition of an architecture, which outlines the roles of the involved parties in supporting QoS between service producers (P) and the service consumers (C). Managing QoS involves producers and consumers, and also network elements that are mediating data transfers in the system (switches, routers, gateways, etc) and the nodes that are hosting the services.

The QoS architecture is centered over a QoS Manager, in which: i) the service consumer requests the QoS Manager to configure the QoS level of a connection with a service producer; ii) the QoS Manager verifies, using the information it has about the system setup and status, if the QoS levels can be fulfilled and configures the network and system nodes accordingly, finally; iii) the systems establish a connection between producer and consumer services and starts exchanging data. Fig. 1 presents the main building blocks of the Arrowhead QoS architecture.

In such an architecture each nodes exposes 2 core services: one that make requests to the QoS Manager and another which enables the setting of the node's QoS parameters by the QoS Manager. The QoS Manager knows the network topology, the network actives and node's setting, using the System of Systems Model (SoS Model module) and uses an adequate scheduling algorithm (through the Alg module) to determine the parameter settings which provides the required QoS levels. Obviously, it will inform the requesting node if the required QoS levels cannot be fulfilled. The new system settings are transferred to the network actives using the QoS Drivers modules. These drivers implement the communications with the network actives, in most situations using protocols not compliant with the Arrowhead framework. For the interfaces with the nodes (QoSNodeConfig) we are assuming that, in most cases, Arrowhead compliant interfaces can be developed.

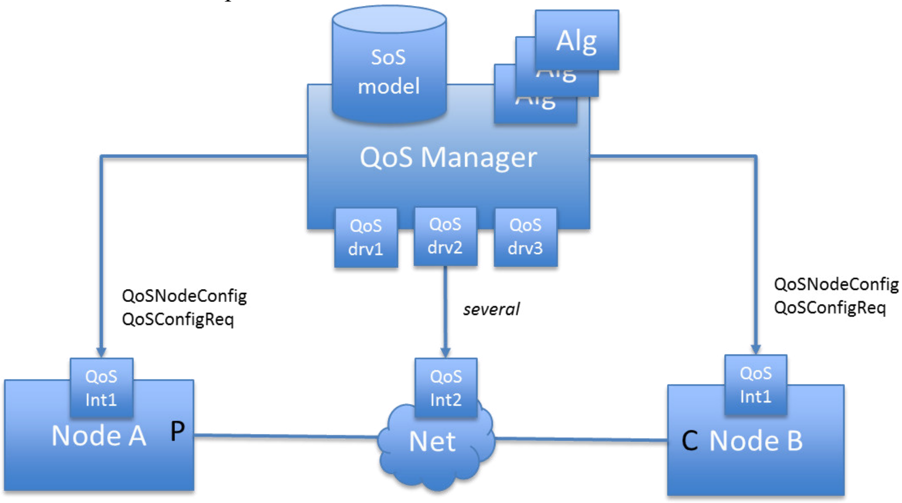

Figure 1 - Main building blocks of the Arrowhead QoS Architecture

In the case of QoS requests and capabilities, an approach that has been commonly used on Service Oriented Architectures (SOAs) and therefore on the Arrowhead QoS architecture is to make use of Service Level Agreements [2][3]. The main non-functional requirements, which drove the definition of the SLA, were the maximum allowed delay, for hard or soft real-time systems, the minimum number of service requests served per unit time, the minimum data bandwidth, the communication semantics to protect the interaction (assurance of delivery of the messages, ordered delivery of data), and the capability of prioritizing some requests over others.

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