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This document was prepared by OASIS (as Sparkplug 3.0.0, Sparkplug Specification) and drafted in accordance with its editorial rules. It was adopted, under the JTC 1 PAS procedure, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

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Revision Number	Date	Author	Description
1.0	5/26/16	Cirrus Link	Initial Release
2.1	12/10/16	Cirrus Link	Payload B Addition
2.2	10/11/19	Cirrus Link	Re-branding for Eclipse foundation added TM to Sparkplug
3.0.0	11/16/22	Eclipse Sparkplug Specification Project Team	Reorganized to be in AsciiDoc format and to include normative and non-normative statements

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1. Introduction

1.1. Rationale and Use Case

Eclipse Sparkplug provides an open and freely available specification for how Edge of Network Gateways (Sparkplug Edge Nodes) or native MQTT enabled end devices and Sparkplug Host Applications communicate bi-directionally within an MQTT Infrastructure. This document details the structure and implementation requirements for Sparkplug compliant MQTT Client implementations on both Edge Nodes and Host Applications.

It is recognized that MQTT is used across a wide spectrum of application solution use-cases, and an almost indefinable variation of network topologies. To that end the Sparkplug Specification strives to accomplish the three following goals.

1.1.1. Define an MQTT Topic Namespace

As noted many times in this document one of the many attractive features of MQTT is that it does not specify any required MQTT Topic Namespace within its implementation. This fact has meant that MQTT has taken a dominant position across a wide spectrum of IoT solutions. The intent of the Sparkplug Specification is to identify and document a Topic Namespace that is well thought out and optimized for the SCADA/IIoT solution sector. In addition, Sparkplug defines a Topic Namespace in such a way that it provides semantics which allow for automatic discovery and bi-directional communication between MQTT clients in a system.

1.1.2. Define MQTT State Management

One of the unique aspects of MQTT is that it was originally designed for real time SCADA systems to help reduce data latency over bandwidth limited and outage prone network infrastructures. These can include cellular, satellite, and other radio based networks. In many implementations the full benefit of this "Continuous Session Awareness" is not well understood, or not even implemented. The intent of the Sparkplug Specification is to take full advantage of MQTT's native Continuous Session Awareness capability as it applies to real time SCADA/IIoT solutions.

It is important to note that reducing bandwidth usage and being resilient to network drops is advantageous on more reliable and high bandwidth networks as well. By reducing the bandwidth usage, Sparkplug is able to move more data through the network because of its efficiency. This in turn can reduce network costs.

1.1.3. Define the MQTT Payload

Just as the MQTT Specification does not dictate any particular Topic Namespace, it also does not dictate any particular payload data encoding. The intent of the Sparkplug Specification is to define payload encoding mechanisms that remain true to the original, lightweight, bandwidth efficient, low latency features of MQTT while adding modern encoding schemes targeting the SCADA/IIoT solution space.

Sparkplug has defined an approach where the Topic Namespace can aid in the determination of the encoding scheme of any particular payload. Historically there have been two Sparkplug defined encoding schemes. The first one was the 'Sparkplug A' and the second is 'Sparkplug B'. Each of these uses a 'first topic token identifier' so Sparkplug Edge Nodes can declare the payload encoding scheme they are using. These first topic tokens are:

```
spAv1.0
spBv1.0
```

Each token is divided up into three distinct components. These are:

- Sparkplug Identifier
  - Always 'sp'
- Payload Encoding Scheme
  - Currently 'A' or 'B' but there could be future versions
- Payload Encoding Scheme Version
  - Currently v1.0 but denoted in the event that future versions are released

The original 'Sparkplug A' encoding scheme was based on the Eclipse Kura™ open source Google Protocol Buffer definition. 'Sparkplug B' was released shortly after the release of Sparkplug A and addressed a number of issues that were present in the A version of the payload encoding scheme. Due to lack of adoption and the fact that 'Sparkplug B' was made available shortly after the release of 'A', the Sparkplug A definition has been omitted from this document and is no longer supported.

The 'Sparkplug B' encoding scheme was created with a richer data model developed with the feedback of many system integrators and end user customers using MQTT. These additions included metric timestamp support, complex datatype support, metadata, and other improvements.

1.1.4. Background

MQTT was originally designed as a message transport for real-time SCADA systems. The MQTT Specification does not specify the Topic Namespace nor does it define the Payload representation of the data being published and/or subscribed to. In addition to this, since the original use-case for MQTT was targeting real-time SCADA, there are mechanisms defined to provide the state of an MQTT session such that SCADA/Control Human-Machine Interface (HMI) application can monitor the current state of any MQTT enabled device in the infrastructure. As with the Topic Namespace and Payload the way state information is implemented and managed within the MQTT infrastructure is not defined. All of this was intentional within the original MQTT Specification to provide maximum flexibility across any solution sector that might choose to use MQTT infrastructures.

But at some point, for MQTT based solutions to be interoperable within a given market sector, the Topic Namespace, Payload representation, and session state must be defined. The intent and purpose of the Sparkplug Specification is to define an MQTT Topic Namespace, payload, and session state management that can be applied generically to the overall IIoT market sector, but specifically meets the requirements of real-time SCADA/Control HMI solutions. Meeting the operational requirements for these systems will enable MQTT based infrastructures to provide more valuable real-time information to Line of Business and MES solution requirements as well.

The purpose of the Sparkplug Specification is to remain true to the original notion of keeping the Topic Namespace and message sizes to a minimum while still making the overall message

transactions and session state management between MQTT enabled devices and MQTT SCADA/IIoT applications simple, efficient, easy to understand, and implement.

1.2. Intellectual Property Rights

1.2.1. Disclaimers

1.3. Organization of the Sparkplug Specification

This specification is split into the following chapters and appendices:

- Chapter 1 - Introduction
- Chapter 2 - Principles
- Chapter 3 - Sparkplug Architecture and Infrastructure Components
- Chapter 4 - Topics and Messages
- Chapter 5 - Operational Behavior
- Chapter 6 - Payloads
- Chapter 7 - Security
- Chapter 8 - High Availability
- Chapter 9 - Acknowledgements
- Chapter 10 - Conformance
- Appendix A - Open Source Software
- Appendix B - List of Normative Statements

1.4. Terminology

1.4.1. Infrastructure Components

This section details the infrastructure components implemented.

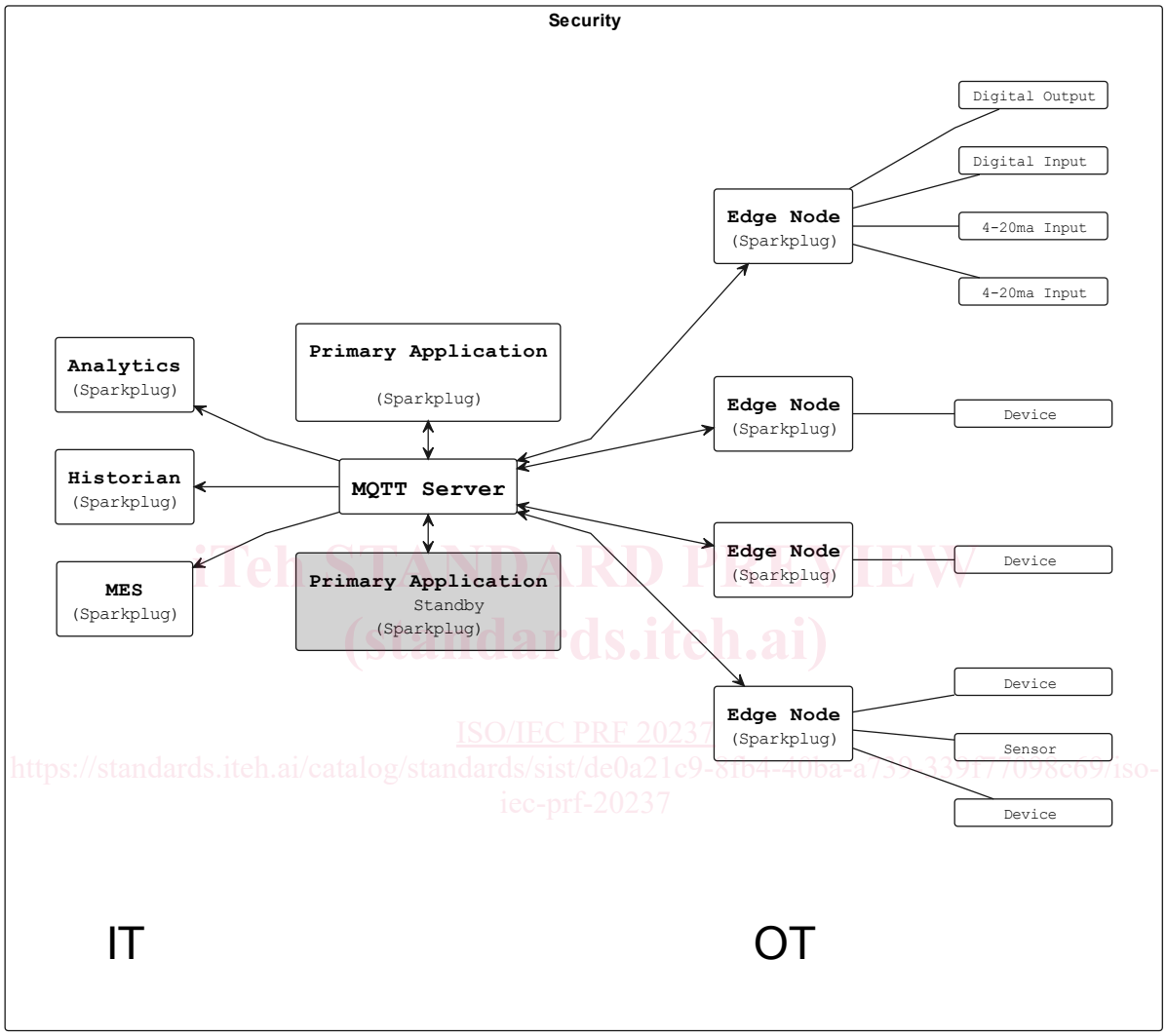

Figure 1 - MQTT SCADA Infrastructure

MQTT Server(s)

Program or device that acts as an intermediary between Clients which publish Application Messages and Clients which have made Subscriptions[MQTTV5-1.2]. MQTT enabled infrastructure requires that one or more MQTT Servers are present in the infrastructure. An MQTT Server must be compatible with the requirements outlined in the Conformance Section. In addition, it must be sized to properly manage all MQTT message traffic.

One can implement the use (if required) of multiple MQTT servers for redundancy, high availability, and scalability within any given infrastructure.

Sparkplug Group

Logical or physical group of Edge Nodes that makes sense in the context of a distributed Sparkplug application. Groups can represent physical groups of Edge Nodes. For example, a