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Table of Contents

1. Introduction 2
1.1. Rationale and Use Case 2
1.1.1. Define an MQTT Topic Namespace 2
1.1.2. Define MQTT State Management 2
1.1.3. Define the MQTT Payload 2
1.1.4. Background 3
1.2. Intellectual Property Rights 4
1.2.1. Disclaimers 4
1.3. Organization of the Sparkplug Specification 4
1.4. Terminology 5
1.4.1. Infrastructure Components 5
1.5. Normative References 8
1.6. Consolidated List of Normative Statements 9
1.7. Security 9
1.7.1. Authentication 9
1.7.2. Authorization 9
1.7.3. Encryption 9
1.8. Normative Keywords 10
1.9. Leveraging Standards and Open Source 10
2. Principles 10
2.1. Pub/Sub 10
2.2. Report by Exception 10
2.3. Continuous Session Awareness 11
2.4. Birth and Death Certificates 11
2.5. Persistent vs Non-Persistent Connections for Edge Nodes 12
3. Sparkplug Architecture and Infrastructure Components 12
3.1. MQTT Server(s) 13
3.2. MQTT Edge Node 13
3.3. Device/Sensor 14
3.4. MQTT Enabled Device (Sparkplug) 14
3.5. Primary Host Application 14
3.6. Sparkplug Host Application 14
4. Topics and Messages 14
4.1. Topic Namespace Elements 15
4.1.1. namespace Element 15
4.1.2. group_id Element 15

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4.1.3. message_type Element 15
4.1.4. edge_node_id Element 16
4.1.5. device_id Element 16
4.2. Message Types and Contents 17
4.2.1. Edge Node 17
4.2.2. Device/Sensor 21
4.2.3. Birth Certificate Message (STATE) 24
4.2.4. Death Certificate Message (STATE) 25
5. Operational Behavior 26
5.1. Timestamps in Sparkplug 26
5.2. Case Sensitivity in Sparkplug 26
5.3. Host Application Session Establishment 27
5.4. Edge Node Session Establishment 30
5.5. Edge Node Session Termination 34
5.6. Device Session Establishment 36
5.7. Device Session Termination 39
5.8. Sparkplug Host Applications 40
5.9. Sparkplug Host Application Message Ordering 40
5.10. Primary Host Application STATE in Multiple MQTT Server Topologies 41
5.11. Edge Node NDATA and NCMD Messages 43
5.12. MQTT Enabled Device Session Establishment 46
5.13. Sparkplug Host Application Session Establishment 46
5.14. Sparkplug Host Application Session Termination 47
5.15. Sparkplug Host Application Receive Data 48
5.16. Data Publish 49
5.17. Commands 50
6. Payloads 52
6.1. Overview 52
6.2. Google Protocol Buffers 53
6.3. Sparkplug A MQTT Payload Definition 53
6.4. Sparkplug B MQTT Payload Definition 53
6.4.1. Google Protocol Buffer Schema 54
6.4.2. Payload Metric Naming Convention 59
6.4.3. Sparkplug B v1.0 Payload Components 60
6.4.4. Payload Component Definitions 60
6.4.5. Payload 60
6.4.6. Metric 61

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6.4.7. MetaData ... 64
6.4.8. PropertySet ... 64
6.4.9. PropertyValue ... 65
6.4.10. PropertySetList ... 66
6.4.11. DataSet ... 66
6.4.12. DataSet.Row ... 67
6.4.13. DataSet.DataSetValue ... 67
6.4.14. Template ... 68
6.4.15. Template.Parameter ... 70
6.4.16. Data Types ... 71
6.4.17. Datatype Details ... 72
6.4.18. Payload Representation on Host Applications ... 77
6.4.19. NBIRTH ... 78
6.4.20. DBIRTH ... 80
6.4.21. NDATA ... 83
6.4.22. DDATA ... 84
6.4.23. NCMD ... 85
6.4.24. DCMD ... 86
6.4.25. NDEATH ... 87
6.4.26. DDEATH ... 89
6.4.27. STATE ... 89
7. Security ... 90
7.1. TLS ... 90
7.2. Authentication ... 91
7.3. Authorization ... 91
7.4. Implementation Notes ... 91
7.4.1. Underlying MQTT Security ... 91
7.4.2. Encrypted Sockets ... 91
7.4.3. Access Control Lists ... 91
8. High Availability ... 92
8.1. High Availability for MQTT Servers ... 92
8.1.1. MQTT Server HA Clustering (non-normative) ... 93
8.1.2. High Availability Cluster ... 93
8.1.3. High Availability Cluster with Load Balancer ... 94
8.2. Multiple Isolated MQTT Servers (non-normative) ... 94
9. Acknowledgements ... 96
10. Conformance ... 97

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10.1. Conformance Profiles 97
10.1.1. Sparkplug Edge Node 97
10.1.2. Sparkplug Host Application 97
10.1.3. Sparkplug Compliant MQTT Server 98
10.1.4. Sparkplug Aware MQTT Server 98
11. Appendix A: Open Source Software (non-normative) 99
11.1. OASIS MQTT Specifications 99
11.2. Eclipse Foundation IoT Resources 100
11.3. Eclipse Paho 100
11.4. Google Protocol Buffers 100
11.5. Eclipse Kura Google Protocol Buffer Schema 100
11.6. Raspberry Pi Hardware 100
12. Appendix B: List of Normative Statements (non-normative) 100
12.1. Host Applications 100
12.2. Sparkplug Identifiers 101
12.3. Report by Exception 101
12.4. Birth and Death Certificates 101
12.5. Persistent vs Non-Persistent Connections for Edge Nodes 101
12.6. Sparkplug Host Application 101
12.7. Topic Namespace Elements 101
12.8. namespace Element 102
12.9. group_id Element 102
12.10. edge_node_id Element 102
12.11. device_id Element 102
12.12. Topic (NBIRTH) 102
12.13. Payload (NBIRTH) 102
12.14. Topic (NDATA) 103
12.15. Payload (NDATA) 103
12.16. Topic (NDEATH) 103
12.17. Payload (NDEATH) 104
12.18. Topic (NCMD) 104
12.19. Payload (NCMD) 104
12.20. Topic (DBIRTH) 104
12.21. Payload (DBIRTH) 104
12.22. Topic (DDATA) 105
12.23. Payload (DDATA) 105
12.24. Topic (DDEATH) 105

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12.25. Payload (DDEATH) 105
12.26. Topic DCMD) 105
12.27. Payload (DCMD) 105
12.28. Birth Certificate Message (STATE) 106
12.29. Birth Certificate Topic (STATE) 106
12.30. Birth Certificate Payload (STATE) 106
12.31. Death Certificate Message (STATE) 106
12.32. Death Certificate Topic (STATE) 106
12.33. Death Certificate Payload (STATE) 106
12.34. Case Sensitivity in Sparkplug 107
12.35. Host Application Session Establishment 107
12.36. Edge Node Session Establishment 108
12.37. Edge Node Session Termination 109
12.38. Device Session Establishment 110
12.39. Device Session Termination 111
12.40. Sparkplug Host Application Message Ordering 111
12.41. Primary Host Application STATE in Multiple MQTT Server Topologies 112
12.42. Sparkplug Host Application Session Establishment 112
12.43. Sparkplug Host Application Session Termination 113
12.44. Data Publish 113
12.45. Commands 114
12.46. Payload 115
12.47. Metric 115
12.48. PropertySet 116
12.49. PropertyValue 116
12.50. Quality Codes 116
12.51. DataSet 116
12.52. DataSet.DataSetValue 117
12.53. Template 117
12.54. Template.Parameter 118
12.55. NBIRTH 118
12.56. DBIRTH 119
12.57. NDATA 119
12.58. DDATA 120
12.59. NCMD 120
12.60. DCMD 120
12.61. NDEATH 120

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12.62. DDEATH 121
12.63. STATE 121
12.64. Sparkplug Host Application 122
12.65. Sparkplug Compliant MQTT Server 122
12.66. Sparkplug Aware MQTT Server 122

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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:

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```
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

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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

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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