
	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

Contents

1 Document Purpose	2
2 Document Scope	2
3 Responsibilities	2
4 Verification Approach	2
4.1 General Verification Approach	2
4.2 Sample Size Rationale	3
4.3 Verification Variances	3
4.4 Verification Finding	3
4.5 Verification Execution Flow	4
5 Requirements to be Verified	4
6 References	4
7 Approvals	5
8 Appendix 1: Software Verification Summary	6
8 Appendix 2: Test Protocols	22
8 Appendix 2.1 Automated Test	22
8 Appendix 2.2 Demonstration	22
8 Appendix 2.3 Inspection	22

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

1 Document Purpose

The purpose of this Software Verification Plan is to describe the activities and resources required for confirming the OMNI Summit Microservice meets its design inputs, as defined in OMNI-SM-002 Software Requirements Specification.

2 Document Scope

This software verification plan applies to the OMNI Summit Microservice and the software requirements defined in the OMNI-SM-002 Software Requirements Specification. Verification of the OMNI Summit Microservice relies heavily on automated unit and integration testing. These tests are run automatically each time the OMNI Summit Microservice is released.

3 Responsibilities


Function	Responsible For
Software Developers	<ul style="list-style-type: none"> • Develops and executes verification protocols • Writes protocol-specific reports
Lead Developer	<ul style="list-style-type: none"> • Develops the software verification plan • Develops and executes verification protocols • Reviews completed datasheets and protocol-specific reports • Writes protocol-specific reports • Writes the verification summary report

4 Verification Approach

4.1 General Verification Approach

Production or production equivalent software and devices are used for software verification activities.

The software requirements are logically grouped and allocated to verification protocols. For each requirement, one or a combination of verification methods is assigned: Inspection, Analysis, Demonstration and/or Test (IADT). Where the verification method is analysis, a protocol is not required and the analysis may be documented directly in a verification report. Where a requirement is a

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

duplicate of a system or subsystem requirement, verification may be allocated to any level and the results adopted by the other level(s). Appendix 1 is a matrix listing each requirement, the protocol allocation, and the verification method(s).

Verification is performed using approved protocols. The protocols define the test methods, acceptance criteria, test procedure and data to be collected. Where custom test tools are used that could affect test results, those tools are validated for their intended use or verified to meet their requirements as part of the test protocol.

4.2 Sample Size Rationale

Software operation is inherently deterministic (i.e., yields the same output under the same input and operational conditions). Therefore, a single sample (instantiation) of the OMNI Summit Microservice software running on a Windows development machine.

Characteristics verified using code inspection or analysis do not involve test samples. Code inspection is performed on the released source code and analysis is performed using documentation of the design implementation.


4.3 Verification Variances

Appendix 1 defines the intended allocation of requirements to protocols, the test method(s), etc. As protocols are developed the actual implementation may vary from this plan (e.g., requirement may be reallocated to a different protocol, verification method changed, etc.). The actual implementation will be documented in the trace matrix included in the Software Verification Summary Report. Such changes are not considered variances that require justification in the summary report.

Any variances from the approved protocols associated with this plan, the software requirements, and/or the intended product for verification will be addressed in the verification summary report. The information documented in the report will include the justification for the variance, the impact on the verification results, and any regression testing required to address the variance.

4.4 Verification Finding

If a verification activity does not create a “Pass” result, the finding shall be entered into the GitHub issue tracking system and resolved prior to completing software verification. The information documented in

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

the report shall include the root cause for the finding, corrective action, the impact of the issue and corrective action on the verification results, and any regression testing required to address the finding or corrective action.

4.5 Verification Execution Flow

There are no dependencies among the protocols in this plan, none are potentially destructive to the test samples, and they may be executed in any convenient order.

5 Requirements to be Verified


Each requirement defined in OMNI-SM-002 Software Requirements Specification is listed in the Software Verification Plan Summary (Appendix 1). Requirements are listed in numerical order by requirement number.

The Software Verification Plan Summary in Appendix 1 includes the following information:




- Software requirement identification number
- Text of the requirement
- Method(s) for verification: Inspection (I), Analysis (A), Demonstration (D), Test (T)


6 References

Document Identifier	Title
OMNI-SM-002	Software Requirements Specification, OMNI Summit Microservice

 Open Mind	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

7 Approvals


Approver Role	Signature and Date
Project Lead	DocuSigned by:  5/19/2022 3:21:56 PM EDT
Quality	DocuSigned by:  08/09/2022 10:06 AM EDT
Lead Developer, Author	DocuSigned by:  5/19/2022 10:30:23 AM PDT

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

8 Appendix 1: Software Verification Summary

Requirement text is for reference only. The SRS is the definitive source for requirement content. Specific protocols referenced are in Appendix 2.


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
4.1	Application Interface	The Microservice shall include an application programming interface (API) based on gRPC. This is defined in the OMNI Summit Microservice Interface Control Document (ICD) v1.x.	T	8 Appendix 2.1 Automated Test
4.2	Device Interface	The Microservice shall interface with a Medtronic Summit System via the Summit DLLs: Medtronic.SummitAPI.dll, Medtronic.TelemetryM.dll, Medtronic.NeuroStim.Olympus.dll	I	8 Appendix 2.3 Inspection

 Open Mind	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
4.3	Console Interface	The Microservice shall run in a standalone command console interface, indicating that it is active by writing a start-up message, and allowing for graceful shutdown via keypress or via the exit button on the terminal window.	T	8 Appendix 2.1 Automated Test
5.1.1	Start-up Mode	<p>During start-up the microservice shall:</p> <ul style="list-style-type: none"> Initialize a gRPC server with three gRPC-defined services: <ul style="list-style-type: none"> A device service A bridge service A supporting info service Write to the console the current version number and supported devices before entering the 'Active Mode'. 	T	8 Appendix 2.1 Automated Test

 Open Mind	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.1.2	Active Mode	<p>While in ACTIVE mode, the microservice shall:</p> <ul style="list-style-type: none"> • Allow a connected client to request a function to be called on a device or bridge instance. • If the device or bridge does not exist, the request will be denied. • If the device or bridge does exist, the function call is forwarded on to the Summit DLL defined instance, which after completion of execution returns the response to the client. 	T	8 Appendix 2.1 Automated Test

 Open Mind	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.1.3	Shut-Down Mode	<p>When the user enters 'q' into the command console or presses the 'x' button to close the window, the microservice shall enter shut-down mode. In shut-down mode the microservice shall:</p> <ul style="list-style-type: none"> • Safely close all connections to gRPC clients and connections to devices and bridges • Close the port the microservice was listening on and terminate the process. 	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.2.1	Support Commands	<p>The Microservice shall provide an interface for querying the state of the microservice itself through:</p> <ul style="list-style-type: none"> • Version, which shall return the microservice major, minor, and patch version numbers, and supported devices. • SupportedDevices, which shall return the class of supported implantable neurostimulators (i.e. Medtronic Summit RC+S). • InspectRepository, which shall return all cached device and bridge connections the microservice is currently storing in the in memory repository. 	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.2.2	Bridge Query Commands	<p>The Microservice shall provide an interface for querying and managing the state of Telemetry Bridges through:</p> <ul style="list-style-type: none"> • ListBridges, which shall return a list of the known bridges and discover new bridges. • ConnectedBridges, which shall return a list of the bridges currently connected to by the microservice. • DescribeBridge, which shall return the telemetry information of the bridge device 	T	8 Appendix 2.1 Automated Test
5.2.3	Bridge Management Commands	<ul style="list-style-type: none"> • ConnectToBridge, which shall initiate connection to the bridge, and set the number of reconnect attempts before failure. • DisconnectFromBridge, which shall dispose of the device and remove the details of the connection from the repository. 	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.2.4	Bridge Configuration Commands	<ul style="list-style-type: none"> ConfigureBeep, which shall enable telemetry sound state of bridge. 	T	8 Appendix 2.1 Automated Test
5.2.5	Bridge Connection Status Streaming	<p>The Microservice shall provide an interface for streaming bridge related status:</p> <ul style="list-style-type: none"> CreateBridgeConnectionStream, creates a streaming connection from the bridge connection status updates to be sent to the client application. 	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.2.6	Device Query Commands	<p>The Microservice shall provide an interface for querying the state of INS devices through:</p> <ul style="list-style-type: none"> • ListDevices, which shall return a list of devices connectable by a given bridge. • DeviceStatus, which shall return the battery status of the device connected • LeadIntegrityTest, which shall return the impedance values between given pairs of electrodes 	T	8 Appendix 2.1 Automated Test
5.2.7	Device Management Commands	<p>The Microservice shall provide an interface for querying and managing the state of INS devices through:</p> <ul style="list-style-type: none"> • ConnectToDevice, which shall establish a connection between the device, bridge, and the server. • DisconnectFromDevice, which shall disband a connection between a given device, bridge, and the server. 	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.2.8	Device Configuration Commands	<ul style="list-style-type: none"> ● SenseConfiguration, which shall configure all sense settings. The configurable settings shall include: <ul style="list-style-type: none"> ○ Time Domain Channel Configuration ○ Fourier Transform Channel Configuration ○ Power Channel Configuration ○ Linear-Discriminant Classifier Configuration ○ Accelerometer Configuration ○ Miscellaneous Summit Configuration ○ Sense State Enabling 	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


5.2.9	Device Data Streaming Commands	<p>The Microservice shall provide an gRPC interface to provide data streaming through the following commands:</p> <ul style="list-style-type: none"> • StreamEnable, which shall enable streaming capabilities from the device, through the bridge, to the client application. • StreamDisable, which shall disable streaming capabilities from the device, through the bridge, to the client application. • TimeDomainStream, which shall create a stream for Time Domain data updates to be sent from the device, through the bridge, to the client application. • FourierTransformStream, which shall create a stream for Spectral data updates to be sent from the device, through the bridge, to the client application. • BandPowerStream, which shall create a stream for Band Power data updates to be sent from the device, through the bridge, to the client application. • InertialStream, which shall create a stream for Inertial data updates to be sent from the device, through the bridge, to the client application. 	T	8 Appendix 2.1 Automated Test
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	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
		<ul style="list-style-type: none"> • AdaptiveStream, which shall create a stream for Adaptive Status updates to be sent from the device, through the bridge, to the client application. • LoopRecordUpdateStream, which shall create a stream for Loop Recorder Status updates to be sent from the device, through the bridge, to the client application. • EchoStream, which shall create a stream for Echo data updates to be sent from the device, through the bridge, to the client application. 		

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
5.3.1	Summit System Connection Monitoring	<p>When a connected Summit System throws a disconnected event, the Microservice shall begin to send a battery status request every 10 seconds to monitor the connectivity status of the bridge and device. If the Summit System indicates that the connection is not automatically recoverable, the microservice shall then:</p> <ul style="list-style-type: none"> • Send a message to connected clients via the bridge connection status streaming endpoint. • Make an attempt to reconnect to the device automatically up to a specified number of retries. • Abort the connection attempts after the specified number of retries are exceeded. 	T	8 Appendix 2.1 Automated Test
6.1.1	Multiple clients to communicate with Summit Systems	The microservice shall allow multiple connected clients to initiate gRPC-enabled functionality utilizing bridge/device name pairs.	T	8 Appendix 2.3 Inspection

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
6.1.2	Each stream can communicate to single endpoint	The microservice shall allow each streamed data type to be sent to a single client.	T	8 Appendix 2.1 Automated Test
6.2.1	Microservice will support two Summit Systems Simultaneously	The microservice shall support at least two Summit Systems to be simultaneously communicated with by client applications.	T	8 Appendix 2.3 Inspection
7.1	The Microservice shall run on Windows	The microservice shall run on Windows 10 with 64 bit depth.	D	8 Appendix 2.2 Demonstration

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1


Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
7.2	The Microservice shall support gRPC	The microservice shall support gRPC clients using version gRPC 1.0.0 or greater.	D	8 Appendix 2.2 Demonstration
7.3	The Microservice shall serialize messages using protobuf	The microservice shall serialize/deserialize all outgoing/incoming messages using protobuf version 3.	D	8 Appendix 2.2 Demonstration
8.4.1	The Microservice shall use a localhost-only default address	The microservice shall default all network listening interfaces to be localhost only unless overwritten at the user's discretion. It shall be the user's responsibility to ensure that HIPAA related information is secure in the case where this is overwritten with a non-localhost only address.	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
9.1	Installer	The microservice shall be distributed via an installer program. The installer program shall install the microservice binary, as well as ask for location of Summit RC+S DLLs for the microservice to use.	D	8 Appendix 2.2 Demonstration
10.1	Version Numbering	The microservice shall follow semantic versioning (i.e. 1.2.3 where 1 is major version, 2 is minor version, 3 is patch version, or 1.0.0-beta for a beta release of version one. More information can be found: https://semver.org/spec/v2.0.0.html). The version shall be displayed during microservice start-up, and shall be available via the version endpoint.	D	8 Appendix 2.2 Demonstration
10.2	Packaging Labeling	The installer's version shall reflect the version of the microservice.	D	8 Appendix 2.2 Demonstration

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

Req #	Software Requirement Heading	Software Requirement	Method (IADT)	Protocol Number
10.3	Documentation Generation	The documentation shall be updated and deployed automatically with each new release.	D	8 Appendix 2.2 Demonstration
10.4	Protobuf Documentation	The messages, endpoints, enums, etc. in the protobuf interface files shall be documented in a format that allows for auto generation of documentation.	T	8 Appendix 2.1 Automated Test

	OMNI Summit Microservice V1.X Verification Plan	Doc. Number	Rev.
		OMNI-SM-005	1

8 Appendix 2: Test Protocols

8 Appendix 2.1 Automated Test

Automated tests are run as part of every merge into the main branch. If any of these tests fails, the branch cannot be merged back into the main branch. This allows us a high confidence that the OMNI Summit Microservice is running correctly. SOUP behavior is mocked so automated tests can more easily test different code paths.

8 Appendix 2.2 Demonstration

Certain requirements are demonstrated by the ability to run automated tests. If the automated tests failed, these demonstration tests would also fail. Demonstration test examples include “The microservice supports Windows 10.”

8 Appendix 2.3 Inspection

Some requirements require inspection of build artifacts.