Technical Committee

mioty® Base station Service Center Interface V1.0.0 Revision 1

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mioty® Base station Service Center Interface V1.0.0

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1.0.0	1	2024-07-17	New document format, Subchannels removed to separate document	Approved

Note: Change of Version indicates a change in the interface specification, change of edition indicates a change in the document.

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1 Scope

This document is the baseline specification of the interface between mioty Base Station and mioty Service Center. This interface can be extended by so called sub-channels. The sub-channels are specified in attachments to this document.

2 Sub-channels

2.1 Overview

BSSCI allows to integrate other functionality via sub-channels. Sub-channels use a dedicated command prefix which allows to route sub-channel operations to the according handler. Sub-channels are specified in amended documents to this specification. Support for sub-channels is optional, if sub-channels are not supported or no handler for a sub-channel is available, the operation must be answered with an error, the standard BSSCI communication specified in this document remains unaffected.

2.2 List of Sub-channels

The following table lists the available sub-channels:

Sub-channel	Date	Version	Document title
ReCon	2024-07-17	1.0.0	mioty® Base Station Service Center Interface (BSSCI) attachment – Sub-channel for ReCon Support
Variable MAC	2023-07-20	1.0.0	mioty® Base Station Service Center Interface (BSSCI) attachment – Sub-channel for Variable MAC Support

3 Overview

The MIOTY Base Station Service Center Interface (BSSCI) describes the communication between a MIOTY Base Station and the MIOTY Service Center.

The BSSCI is based on a persistent TLS secured TCP connection between the Base Station and the Service Center. This connection is established by the Base Station after system startup and is reestablished at connection loss.

The Service Center must be available at a fixed network location and this network location must be provided to the Base Station during system configuration. The Base Station is not required to accept any incoming connections and can thus i.e. be located behind a NAT firewall.

TLS provides industry standard encryption and authentication for the BSSCI communication. Digital certificates are required for the Base Station and the Service Center to establish the TLS connection.

In the case of a connection loss and reestablishment, the Base Station and Service Center evaluate the consistency of the previous session. If both devices agree on a consistent state, the previous session is resumed and only operations, which had not been completed before the connection loss are reissued. Otherwise a new session is started, discarding any state information of the previous session.

Messages exchanged between Base Station and Service Center over the TLS connection are encoded with JSON/MessagePack. MessagePack is a widely used serialization protocol, specification and implementations for various programming languages can be found at http://msgpack.org.

4 Versioning

The BSSCI protocol uses a version number comprising major, minor and patch version. Compatibility between the versions is defined in the following sections. Additionally a protocol identifier is used in the protocol framing to indicate, that the same versioning rules apply and that at least the version discovery and arbitration is compatible.

4.1 Major version

A change in the major version implies no guarantee for any backwards compatibility to previous versions. Meaning and availability of any protocol field or operation beyond the version arbitration might be altered. If both parties cannot agree on a common major version, the connection must be terminated.

4.2 Minor version

A change in minor version implies addition or removal of protocol fields or operations. Though no changes in the meaning of fields or operations are permitted. If both parties cannot agree on a common major and minor version, the connection should be terminated.

4.3 Patch version

A change in patch version guarantees backwards compatibility within the same major and minor version of the protocol. Accordingly patch versions may only add or remove optional fields without changing the meaning of any existing fields or operations. The patch version must be omitted when determining protocol compatibility.

4.4 Message interpretation

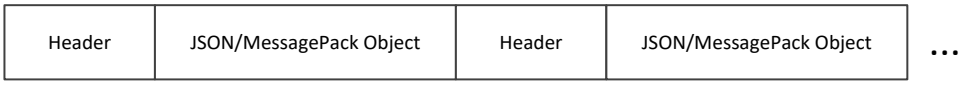
When protocol messages are interpreted, any additional fields, beyond the protocol specification in the employed version must be ignored graciously for forward compatibility. Missing optional fields must be substituted silently with the specified defaults if applicable. Missing mandatory fields or present optional fields with invalid values must be considered a protocol error.

4.5 Message assembly

When assembling protocol messages, every mandatory field must be inserted. Optional fields might be inserted if applicable. If default values are present for optional fields, the omission of the according field must be considered equal to adding the field with the default value. No extra fields, beyond the protocol specification must be added to the message to ensure forward compatibility.

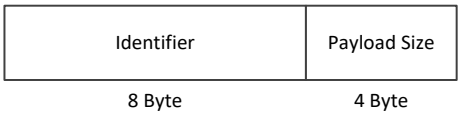
5 Protocol

The BSSCI protocol is based on JSON objects and MessagePack encoded. Every operation is transferred as a separate object containing the type of the operation and all required meta information. Each JSON/MessagePack object is preceded with a binary header section for simplified data stream packetization.



5.1 Header

The header includes an identifier and a size field.



Field	Description
Identifier	“MIOTYB01” ASCII encoded, 0x 4d 49 4f 54 59 42 30 31
Payload size	Size of the following JSON/MessagePack object in bytes, little endian

5.2 Core fields

Core fields are mandatory fields in the JSON object for all BSSCI messages.

Name	Type	Description
command	String	Type of operation as specified in the following sections
opId	Numeric	ID of the operation, identical during operation

Operations initiated by the Base Station must use positive, strictly incrementing 64 bit operation IDs. Operations initiated by the Service Center must use negative, strictly decrementing 64 bit operation IDs. All messages of the same operation must use the same operation ID. Operation IDs assignment must continue from the previous states if a session is resumed.

5.3 Connect operation

The connect operation is initiated by the Base Station immediately after establishing the network connection with the Service Center. No other operations may be started by either the Base Station or the Service Center until the connect operation is completed. The initial connect operation must use ID 0. This still applies if a previous session shall be resumed.

5.3.1 Connect

Name	Type	Description
command	String	“con”
opId	Numeric	ID of the operation
version	String	Requested protocol version, “major.minor.patch”

bsEui	Numeric	Base Station EUI64
vendor	String	Vendor of the Base Station, optional
model	String	Model of the Base Station, optional
name	String	Name of the Base Station, optional
swVersion	String	Software version, optional
info	Object	Additional Base Station information object, might contain arbitrary key-value-pairs, optional
bidi	Boolean	True if Base Station is bidirectional
geoLocation	Numeric[3]	Geographic location [Latitude, Longitude, Altitude], optional
snBsUuid	Numeric[16]	Base Station session UUID, must match with previous connect to resume session
snBsOpId	Numeric	Minimum required known Base Station operation ID to resume previous session, optional
snScOpId	Numeric	Maximum known Service Center operation ID to resume previous session, optional

5.3.2 Connect response

Name	Type	Description
command	String	“conRsp”
opId	Numeric	ID of the operation
version	String	Supported protocol version, “major.minor.path”, optional, default is the requested protocol version
scEui	Numeric	Service Center EUI64
vendor	String	Vendor of the Service Center, optional
model	String	Model of the Service Center, optional
name	String	Name of the Service Center, optional
swVersion	String	Software version, optional
info	Object	Additional Service Center information object, might contain arbitrary key-value-pairs, optional
snResume	Boolean	True if a previous session is resumed
snScUuid	Numeric[16]	Service Center session UUID, must match with previous connect to resume session

5.3.3 Connect complete

Name	Type	Description
command	String	“conCmp”
opId	Numeric	ID of the operation

5.4 Ping operation

The ping operation can be initiated by either the Base Station or the Service Center to verify an established connection during idle times where no other operations are initiated.

5.4.1 Ping

Name	Type	Description
command	String	“ping”
opId	Numeric	ID of the operation

5.4.2 Ping response

Name	Type	Description
command	String	“pingRsp”
opId	Numeric	ID of the operation

5.4.3 Ping complete

Name	Type	Description
command	String	“pingCmp”
opId	Numeric	ID of the operation

5.5 Status operation

The status operation can be initiated by the Service Center to retrieve status information from the Base Station.

5.5.1 Status

Name	Type	Description
command	String	“status”
opId	Numeric	ID of the operation

5.5.2 Status response

Name	Type	Description
command	String	“statusRsp”
opId	Numeric	ID of the operation
code	Numeric	Status code, using POSIX error numbers, 0 for “ok”
message	String	Status message
time	Numeric	Unix UTC system time, 64 bit, ns resolution
dutyCycle	Numeric	Fraction of TX time, sliding window over one hour
geoLocation	Numeric[3]	Geographic location [Latitude, Longitude, Altitude], optional
uptime	Numeric	System uptime in seconds, optional
temp	Numeric	System temperature in degree Celsius, optional
cpuLoad	Numeric	CPU utilization, normalized to 1.0 for all cores, optional
memLoad	Numeric	Memory utilization, normalized to 1.0, optional
config	Object	Configuration object, to be defined, optional

5.5.3 Status complete

Name	Type	Description

command	String	“statusCmp”
opId	Numeric	ID of the operation

5.6 Attach operation

The attach operation is initiated by the Base Station after receiving an over the air attachment request from an End Point.

5.6.1 Attach

Name	Type	Description
command	String	“att”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
rxTime	Numeric	Unix UTC time of reception, center of last subpacket, 64 bit, ns resolution
rxDuration	Numeric	Duration or the reception, center of first subpacket to center of last subpacket in ns, optional
attachCnt	Numeric	End Point attachment counter
snr	Numeric	Reception signal to noise ratio in dB
rssi	Numeric	Reception signal strength in dBm
eqSnr	Numeric	AWGN equivalent reception SNR in dB, optional
profile	String	Name of the Mioty profile used for reception, i.e. “eu1”, optional
subpackets	Object	Subpackets object with reception info for every subpacket, as specified in 5.10.1, optional
nonce	Numeric[4]	4 Byte End Point nonce
sign	Numeric[4]	4 Byte End Point signature
shAddr	Numeric	End Point short address, only if assigned by the Base Station
dualChan	Boolean	True if End Point uses dual channel mode
repetition	Boolean	True if End Point uses DL repetition
wideCarrOff	Boolean	True if End Point uses wide carrier offset
longBlkDist	Boolean	True if End Point uses long DL interblock distance

5.6.2 Attach response

Name	Type	Description
command	String	“attRsp”
opId	Numeric	ID of the operation
nwkSnKey	Numeric[16]	16 Byte End Point network session key
shAddr	Numeric	End Point short address, only if not assigned by the Base Station

5.6.3 Attach complete

Name	Type	Description
command	String	“attCmp”

opId	Numeric	ID of the operation

5.7 Detach operation

The detach operation is initiated by the Base Station after receiving an over the air detachment request from an End Point.

5.7.1 Detach

Name	Type	Description
command	String	“det”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
rxTime	Numeric	Unix UTC time of reception, center of last subpacket, 64 bit, ns resolution
rxDuration	Numeric	Duration or the reception, center of first subpacket to center of last subpacket in ns, optional
packetCnt	Numeric	End Point packet counter
snr	Numeric	Reception signal to noise ratio in dB
rssi	Numeric	Reception signal strength in dBm
eqSnr	Numeric	AWGN equivalent reception SNR in dB, optional
profile	String	Name of the Mioty profile used for reception, i.e. “eu1”, optional
subpackets	Object	Subpackets object with reception info for every subpacket, as specified in 5.10.1, optional
sign	Numeric[4]	4 Byte End Point signature

5.7.2 Detach response

Name	Type	Description
command	String	“detRsp”
opId	Numeric	ID of the operation
sign	Numeric[4]	4 Byte signature for the End Point

5.7.3 Detach complete

Name	Type	Description
command	String	“detCmp”
opId	Numeric	ID of the operation

5.8 Attach propagate operation

The attach propagate operation is initiated by the Service Center to propagate an End Point attachment to the Base Station. The attachment information can either be acquired via an over the air attachment at another Base Station or in the form of an offline preattachment of an End Point (as required for unidirectional End Points).

5.8.1 Attach propagate

Name	Type	Description

command	String	“attPrp”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
bidi	Boolean	True if End Point is bidirectional
nwkSnKey	Numeric[16]	16 Byte End Point network session key
shAddr	Numeric	End Point short address
lastPacketCnt	Numeric	Last known End Point packet counter
dualChan	Boolean	True if End Point uses dual channel mode
repetition	Boolean	True if End Point uses DL repetition
wideCarrOff	Boolean	True if End Point uses wide carrier offset
longBlkDist	Boolean	True if End Point uses long DL interblock distance

5.8.2 Attach propagate response

Name	Type	Description
command	String	“attPrpRsp”
opId	Numeric	ID of the operation

5.8.3 Attach propagate complete

Name	Type	Description
command	String	“attPrpCmp”
opId	Numeric	ID of the operation

5.9 Detach propagate operation

The detach propagate operation is initiated by the Service Center to propagate an End Point detachment to the Base Station.

5.9.1 Detach propagate

Name	Type	Description
command	String	“detPrp”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64

5.9.2 Detach propagate response

Name	Type	Description
command	String	“detPrpRsp”
opId	Numeric	ID of the operation

5.9.3 Detach propagate complete

Name	Type	Description
command	String	“detPrpCmp”

opId	Numeric	ID of the operation

5.10 UL data operation

The UL data operation is initiated by the Base Station after receiving uplink data from an End Point. Telegrams carrying control data exclusively are considered as empty data.

5.10.1 UL data

Name	Type	Description
command	String	“ulData”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
rxTime	Numeric	Unix UTC time of reception, center of last subpacket, 64 bit, ns resolution
rxDuration	Numeric	Duration or the reception, center of first subpacket to center of last subpacket in ns, optional
packetCnt	Numeric	End Point packet counter
snr	Numeric	Reception signal to noise ratio in dB
rssi	Numeric	Reception signal strength in dBm
eqSnr	Numeric	AWGN equivalent reception SNR in dB, optional
profile	String	Mioty profile used for reception, i.e. “eu1”, optional
mode	String	Mioty mode and variant used for reception, i.e. “ulp”, “ulp-rep”, “ulp-ll”, optional
subpackets	Object	Subpackets object with reception info for every subpacket, optional
userData	Numeric[n]	n Byte End Point user data, might be empty
format	Numeric	User data format identifier, 8 bit, optional, default 0
dlOpen	Boolean	True if End Point downlink window is opened
responseExp	Boolean	True if End Point expects a response in the DL window, requires dlOpen
dlAck	Boolean	True if End Point acknowledges the reception of a DL transmission in the last DL window (packetCnt - 1)

Subpackets object

Name	Type	Description
snr	Numeric[m]	Subpacket signal to noise ratio in dB
rssi	Numeric[m]	Subpacket signal strength in dBm
frequency	Numeric[m]	Subpacket frequencies in Hz
phase	Numeric[m]	Subpacket phases in degree +-180, optional

5.10.2 UL data response

Name	Type	Description

command	String	“ulDataRsp”
opId	Numeric	ID of the operation

5.10.3 UL data complete

Name	Type	Description
command	String	“ulDataCmp”
opId	Numeric	ID of the operation

5.11 UL data transmit operation

The UL data transmit operation is initiated by the Service Center to transmit uplink data via the Base Station. Support for UL data transmissions is optional.

5.11.1 UL data transmit

Name	Type	Description
command	String	“ulDataTx”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
nwkSnKey	Numeric[16]	16 Byte End Point network session key
shAddr	Numeric	End Point short address
packetCnt	Numeric	End Point packet counter
profile	String	Name of the Mioty profile used for transmisstion, i.e. “eu1”, optional
userData	Numeric[n]	n Byte End Point user data, might be empty
format	Numeric	User data format identifier, 8 bit, optional, default 0

5.11.2 UL data transmit response

Name	Type	Description
command	String	“ulDataTxRsp”
opId	Numeric	ID of the operation

5.11.3 UL data transmit complete

Name	Type	Description
command	String	“ulDataTxCmp”
opId	Numeric	ID of the operation

5.12 DL data queue operation

The DL data queue operation is initiated by the Service Center to schedule downlink data at the Base Station for an End Point. This might be done either within the interval between an uplink message and the according downlink window for direct responses or a priory for predefined downlink data. Counter dependent downlink data (i.e. due to application encryption) must be provided for one or multiple specific packet counters. It can only be transmitted in a downlink window with a matching counter. Only one downlink packet is transmitted for one queue operation, using the first available and suitable downlink window. If user data is empty, a pure acknowledgement downlink is queued.

5.12.1 DL data queue

Name	Type	Description
command	String	“dlDataQue”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
queId	Numeric	Assigned queue ID for reference, 64 bit
cntDepend	Boolean	True if userData is counter dependent
packetCnt	Numeric[m]	End Point packet counter for which the according userData entry is valid, omitted if cntDepend is false
userData	Numeric[m][n]	n Byte End Point user data for each of the m packet counters, single user data entry if cntDepend is false
format	Numeric	User data format identifier, 8 bit, optional
prio	Numeric	Priority, higher values are prioritized, single precision floating point, optional, default 0
responseExp	Boolean	True to request End Point response, optional
responsePrio	Boolean	True to request priority End Point response, optional
dlWindReq	Boolean	True to request further End Point DL window, optional
expOnly	Boolean	True to send downlink only if End Point expects a response, optional

5.12.2 DL data queue response

Name	Type	Description
command	String	“dlDataQueRsp”
opId	Numeric	ID of the operation

5.12.3 DL data queue complete

Name	Type	Description
command	String	“dlDataQueCmp”
opId	Numeric	ID of the operation

5.13 DL data revoke operation

The DL data revoke operation is initiated by the Service Center to revoke previously scheduled downlink data at the Base Station.

5.13.1 DL data revoke

Name	Type	Description
command	String	“dlDataRev”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
queId	Numeric	Queue ID of the scheduled data

5.13.2 DL data revoke response

Name	Type	Description
command	String	“dlDataRevRsp”
opId	Numeric	ID of the operation

5.13.3 DL data revoke complete

Name	Type	Description
command	String	“dlDataRevCmp”
opId	Numeric	ID of the operation

5.14 DL data result operation

The DL data result operation is initiated by the Base Station after queued DL data has either been sent or discarded.

5.14.1 DL data result

Name	Type	Description
command	String	“dlDataRes”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
queId	Numeric	Queue ID of the scheduled data
result	String	“sent”, “expired”, “invalid”
txTime	Numeric	Unix UTC time of transmission, center of first subpacket, 64 bit, ns resolution, only if result is “sent”
packetCnt	Numeric	End Point packet counter, only if result is “sent”

5.14.2 DL data result response

Name	Type	Description
command	String	“dlDataResRsp”
opId	Numeric	ID of the operation

5.14.3 DL data result complete

Name	Type	Description
command	String	“dlDataResCmp”
opId	Numeric	ID of the operation

5.15 DL RX status operation

The DL RX status operation is initiated by the Base Station after receiving a DL RX status response control segment from an End Point.

5.15.1 DL RX status

Name	Type	Description
command	String	“dlRxStat”

opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64
rxTime	Numeric	Unix UTC time of reception, center of last subpacket, 64 bit, ns resolution
packetCnt	Numeric	End Point packet counter
dlRxSnr	Numeric	End Point DL reception signal to noise ratio in dB
dlRxRssi	Numeric	End Point DL reception signal strength in dBm

5.15.2 DL RX status response

Name	Type	Description
command	String	“dlRxStatRsp”
opId	Numeric	ID of the operation

5.15.3 DL RX status complete

Name	Type	Description
command	String	“dlRxStatCmp”
opId	Numeric	ID of the operation

5.16 DL RX status query operation

The DL RX status query operation is initiated by the Service Center to schedule a DL RX status query control segment for the next downlink transmission of the Base Station to an End Point.

5.16.1 DL RX status query

Name	Type	Description
command	String	“dlRxStatQry”
opId	Numeric	ID of the operation
epEui	Numeric	End Point EUI64

5.16.2 DL RX status query response

Name	Type	Description
command	String	“dlRxStatQryRsp”
opId	Numeric	ID of the operation

5.16.3 DL RX status query complete

Name	Type	Description
command	String	“dlRxStatQryCmp”
opId	Numeric	ID of the operation

5.17 Errors

An error message might be send in any operation in case of an error condition. The error message terminates the regular operation sequence of initiation, response and completion after either the initiation or the response, depending on where the error condition occurs. In both cases the operation then follows

the sequence of error and error acknowledgement instead, with the error acknowledgement completing the operation.

5.17.1 Error

Name	Type	Description
command	String	“error”
opId	Numeric	ID of the operation
code	Numeric	Error code, using POSIX error numbers
message	String	Error message

5.17.2 Error Acknowledgement

Name	Type	Description
command	String	“errorAck”
opId	Numeric	ID of the operation

6 Bibliography references

[1] ETSI TS 103 357 V1.1.1 (2018-06): “Short Range Devices; Low Throughput Networks (LTN); Protocols for radio interface A”

[2] mioty® alliance, "Mioty Radio Protocol Specifications", revision 1.1.1, 2021 February 25th