Architecture 201103221100

UPAMD architecture consists of a set of UPAMD ports connected with UPAMD cables. The ports may be sources of power or sinks of power, or capable of being either a source or sink of power. Some devices may have a permanently attached cable. Some adapter/sources, may have permanently attached cables.

## UPAMD Ports

A port is a connection point in a UPAMD system.  A port may be a source of power or a sink of power. In the case of Bidirectional devices the port may switch function from sink to source or from source to sink based on the priority of the ports and the negotiations between the ports.

## UPAMD Device Classes

Device classes are transmitted with Requested Power and Available Power messages to identify the type of device on the cable. This information is transmitted as a single byte with the possible hexadecimal range of 00 to $FF_h$.  The first nibble is the general class with the second byte being the sub classification.

The following General Device Classes are defined:

Class $1(0\text{-}F)_h$ = Adapter, or Source of power.

Class $10_h$ = Default Adapter/Source Class

Class $2(0\text{-}F)_h$ = Device, or Power sink.

Class $20_h$ = Default device/sink class

Class $28_h$ = Non-Communicating power sink Device (Dumb Device)

Class $3(0\text{-}F)_h$ = Bidirectional power flow, capable of being sink or source.

Class $30_h$ – Default bi-directional port

Class $31_h$ – Power Storage – UPS, Rechargeable power source

Class $4(0\text{-}F)_h$ = Power distribution Hubs and Docking stations

Class $40_h$ – Default Hub

Class $41_h$ – Docking Station

Class $5(0\text{-}F)_h$ = Intermittent Sources – Solar, Wind, Human powered

Class $50_h$ – Default intermittent, un-reliable source.

Class $51_h$ – Solar Powered, un-reliable source.

Class $52_h$ – Wind Powered, un-reliable source.

Class $53_h$ – Human Powered, un-reliable source.

Other major classes are reserved for future use.

UPAMD Capabilities

Port capabilities detail the level of implementation of the standard. Low levels implement basic communication with limited number of messages.

Level $00_h$ – No communication capabilities for dumb loads. Defined by load on signal pins.
Level $01_h$ – Basic messages processed for Fault, Power Available/Requested, UPAMD ID. Capable of basic default voltage operation only. Not certified as no ID available.
Level $10_h$ – Full message capability, default voltage only
Level $20_h$ – Full message capability, Adjustable voltage capable

UPAMD Priorities

All ports within the UPAMD link operate at a priority between 0 and 255. The higher priority is the lowest value. Device start with an assumed priority of 120 and adapters/sources start with an assumed priority of 150. Depending on operational needs within the source or load, the priorities may change to alter the power demand, power available, and the power direction.

UPAMD Messages

Communications between UPAMD ports is contained in a series of messages. Each message has a payload of 0-8 bytes of data. This protocol is based on the CAN bus protocol. The following messages are defined. Other messages can be defined as needed. The message number is transmitted as the first 5 bits of the identifier.

Fault message with an identifier of 0 is the highest priority message and will always win a bus arbitration.

**Message Numbers**

0 – Fault message – 8 Bytes
1 – Available Power – 8 Bytes
2 – Requested Power – 8 Bytes
3 – Data Transfer Request – 5 Bytes
4 – Data Transfer – 8 Bytes
5 – Vendor Identification – 8 Bytes
6 – Model Number – 8 Bytes
7 – Device Serial Number 8 - Bytes
8 – Unique Identifier - 8 Bytes

9 – Manufacture Date – 7 Bytes
10 – Software Version – 8 Bytes
11 – Firmware Version – 8 bytes
12 -- Heartbeat – 8 Bytes
13 – Timestamp NTP – 8 bytes
14 – UPAMD Version message – 8 Bytes
15 – Null message – 0 Bytes
16 – Load device power state – 8 bytes
17 – 31 Reserved for Future use

## Fault Message (0)

Highest priority message, guaranteed to win CAN bus Arbitration. The purpose of this message is to convey a fault condition and fault action. This message has 8 bytes of data, with 5 bytes defined as follows.

Byte 0 – Fault condition – encoded data up to 255 fault conditions – defined in fault conditions table.
Byte 1 – Required Fault Action – encoded data up to 255 fault actions – defined in fault actions table.
Byte 4 – Device Priority level – 0-255 with 0 highest, 255 lowest.
Byte 6 – Device Class
Byte 7 – Message request – Request for message from attached device. This may be a Null message.
Bytes 2,3,5 are undefined and set to 0.

## Available Power Message (1)

This message is transmitted to the power sink from the power source. It defines the status of the source and the maximum, and temporal, capabilities of the source. The message is 8 bytes long, defined as follows:

Byte 0 – Maximum available power from source device in Watts: Valid range is 0-240 Watts. Value 255 is defined as unknown.

Byte 1 – Current available power from source device in Watts: Source may have a current restriction on available power with this byte defining the current available power.

Bytes 2:3 – Available stored power defined in Watt-Hours. Range is 0-65534 Watt-Hours. This is the energy stored in the device that can be delivered. Value $FFFF_h$ is defined as unlimited maximum Watt-hours based on power available from larger bulk power facility such as AC/DC power grid. Normal value is $0000_h$ when connected to a power source with no storage capability.

Byte 4 – Device Power priority level. Range 0-255 with highest priority of 0. This priority is used to resolve conflicting power requirements. Highest priority device determines power flow if possible. Normal starting priority for sources is 150.

Byte 5 – Available Voltage – Range 0-63.75 Volts in ¼ Volt steps. 0-255 count. Values above 60V are valid for operational voltage. This value defines the maximum voltage available from sources that are capable of the higher voltage levels. Field will be set nominal value of 84 for default 21 volt operations for minimal adapter operation. When device requests a specific voltage that is within the range of the source, it is confirmed by setting this voltage to the requested voltage.

Byte 6 – Current Device Class. Defined in Device Class description. Interpretation of content of this message is based on the device class.

Byte 7 – Requested message number – Requests the connected device to forward the requested message number.  If no message is specifically needed the request will be for a Null message (14) with not answer expected.

Example

## Requested Power Message (2)

Transmitted from the power sink to the power source, this message defines the status of the sink and the requests/requirements of the power sink.

Byte 0 – Maximum requested power from sink/load device in Watts. Valid range is 0-240 Watts. Value 255 is defined as unknown.

Byte 1 – Current requested power from source device in Watts. Valid range is 0-240 Watts.  Sink/load may have a lower current power need with this byte defining the current requested power.

Byte 2 – Minimum power requirement for device/sink. Valid range is 0-240 Watts. Defines the minimum power needed by device.  For systems, this defines the minimum value that the source can request a lowering of power to.  If minimum power cannot be met by Source a fault will be declared. Minimum low energy communications power will be maintained.

Byte 3 – Minimum voltage requirements for device/sink.  Valid range is 0-60 Volts in ¼ Volt step count. Defines the minimum voltage needed by device.  For systems, this defines the minimum value that the source must supply for proper device operation.  If minimum voltage cannot be met by Source a fault will be declared. Minimum low energy communications power will be maintained.

Byte 4 – Device Power priority level.  Range 0-255 with highest priority of 0. This priority is used to resolve conflicting power requirements. Highest priority device determines power flow if possible.  Normal starting priority for loads/sinks is 120.

Byte 5 – Voltage Requested from source – Range 0-60 Volts in ¼ Volt step count.  This byte defines the requested voltage from a source that is capable of the higher voltage levels.  Field will be set nominal value of 21V (84 count) for default operations.

Byte 6 – Current Device Class.  Defined in Device Class description section. Interpretation of content of this message is based on the device class.

Byte 7 – Requested message number – Requests the connected device to forward the requested message number.  If no message is specifically needed the request will be for a Null message (14) with not answer expected.

## Data Transfer Request Message (3)

A data transfer is established by this message.  It is used to frame the message. Messages will need to be transferred between the ports on the link.  This message format defines the total message length and current position. This makes not specification on the content of the message, its encryption or error checking functions.

Bytes 0:1 - Total byte count for the transfer in range 0-65535 bytes.

Bytes 2:3 – Current byte pointer for the next 8 byte data transfer.

Byte 4 – Length of last transfer to specify the number of bytes in range 1 to 7 to follow.

## Data Transfer Message (4)

Transfer of information is accomplished at up to 8 bytes at a time through this message. Successive message type 4 transfers are used to push the data across the link. Any break in the steam will use a message type 3 to reset the counters and expectations.

Bytes 0:7 – Eight data bytes

## Vendor Identification message (5)

Identification of the vendor of the port is conveyed to the other port on the link through this message. Vendors may use up to eight ASCII bytes to identify themselves. (Not really friendly to Unicode). To expand this to longer names, this could be used as a pointer into an registration table. OUI can be used as a lookup for company.

Bytes 0:7 – Eight bytes (ASCII format assumed)

## Model Identification Message (6)

Device Model identification message contains up to eight bytes of model number.

Bytes 0:7 – Eight bytes (ASCII format assumed)

## Device Serial Number message (7)

The serial number of the device is conveyed through this eight byte message.

Bytes 0:7 – Eight bytes (ASCII format assumed)

## Extended Unique Identifier Message (8)

The Extended Unique Identifier, a worldwide unique identifier, derived from the vendor Organizationally Unique Identifier (OUI), obtained from the IEEE Registration Authority. The OUI request may be for an OUI-24 ($2^{40}$ identifiers) or an OUI-36 ($2^{28}$ identifiers). This is a EUI-64 and is transferred in an eight byte transfer.

Bytes 0:7 – OUI derived EUI-64 as 8 octets starting with the OUI (OUI-24 or OUI-36)

## Date of Manufacture message (9)

Date of device manufacture message defines the time of manufacture in standard YYYY:MM:DD:hh:mm:ss format.  Example shown for 2012:12:21:23:59:59.

Bytes 0:1 – Year of manufacture “YYYY” Hex digits example “20” and “12”.

Byte 2 – Month of manufacture “MM”, range 1-12, example “12” for December.

Byte 3 – Day of manufacture “DD”, range 1-31, example “21” for twenty first day.

Byte 4 – Hour of manufacture “hh”, range 0-23, example “23” for 11pm.

Byte 5 – Minute of manufacture “mm”, range 0-59, example “59”.

Byte 6 – Second of manufacture “ss”, range 0-59, example “59”.

Byte 7 – not defined, set to “00”.

## Software Version Message (10)

This eight byte message specifies the Software version in this device. Vendor supplied Software version.

Bytes 0:7 – Eight byte ASCII string defining the current software version running in port.

## Firmware Version Message (11)

This eight byte message specifies the Firmware version in this device. Vendor supplied Firmware version.

Bytes 0:7 – Eight byte ASCII string defining the current operating firmware version.

## HeartBeat Message (12)

The heat beat message is used to assure communications is still active. Loss of Communication indicates the failure of the connection or one of the devices. Elements of the heart beat include time since last heart beat received, in the NPT Short Timestamp format, current device priority, device class, and message request. Short Timestamp format is low 16bits of NPT Timestamp seconds and high 16bit of NPT partial seconds for a range of $2^{16}$ seconds (18.2hrs) and partial seconds is $1/2^{16}$ increments (15.26us).

Bytes 0:3 – Time stamp in IETF RFC 5905 NPT Short Timestamp format.

Byte 4 – Priority level (0-255)

Byte 5 – unused set to 00

Byte 6 – Device Class

Byte 7 – Message number request.

## Time Stamp (NTP) Message (13)

This is the Network Time Protocol Timestamp Format from IETF RFC 5905 NTPv4 protocol. This allows time synchronization if needed. It is also used to time stamp a message if needed. The time stamp contains two 32 bit parts, the first is the number of seconds from the reference time and the second part is the fraction of that second. Reference time 0 starts at 0 hours 1 January 1900; the second part is the number of $1/2^{32}$ intervals in the current second. Each interval is approximately 232 picoseconds.

Bytes 0:3 – Number of seconds from 0 hours 1 January 1900.

Bytes 4:7 – Part of a second divided into $2^{32}$ parts. Each count is ~232ps.

## UPAMD Version - Capabilities Message (14)

This message defines the version of the UPAMD/1823 standard that this port supports and Capability level.

Bytes 0:1 – “1823h” to indicate the IEEE 1823 standard.

Byte 2 – Major version of standard 0-255 range 1 for current major version. 0 for test.

Byte 3 – Minor version of standard range 0-255.

Bytes 4:5 – Capabilities as source.

Byte 4 – Class of port

Byte 5 – Level of implementation

Bytes 6:7 – Capabilities as sink.

Byte 6 – Class of port

Byte 7 – Level of implementation

## Null Message (15)

The null is the no-message operation.  Most exchanged messages specify the message requested from the other port. When this message is not needed the null message is specific. The null message serves the purpose of if no specific data is required or requested.

This message is defined as Null message and has a field length of 0 in the CAN DLC field.  Is purpose is to have a null message as a request message in the other message types.

## Load Device Power State (16)

This message allows the connected device to access the power state of the attached sink device. Attached source devices broadcast power state through Available Power Message.

Byte 0 – Percentage of storage capacity available – 0-255 in 0.04% steps in binary byte.

Byte 1 – Priority level 0-255

Bytes 2,3 – Available power in watt-hours 0-65535.

Byte 4 – Port Class

Byte 5 – Working Voltage – voltage in 1/4Volt steps 0 – 60VDC

Byte 6 – Working Current – 0-255 in 40ma steps (0-10.2A)

Byte 7 - undefined

## Undefined Messages – Messages 17 through 31

Extensions to the CAN bus message structure, message numbers 17 through 31, are reserved for future definition.

## Fault messages:

1. Available power does not meet minimum required power
2. Available voltage does not meet minimum required voltage
3. Communications lost
4. Connection lost

## Message Summary

UPAMD Messages - 201102211400

| Message Type | Message | Data Byte 0 | Data Byte 1 | Data Byte 2 | Data Byte 3 | Data Byte 4 | Data Byte 5 | Data Byte 6 | Data Byte 7 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Fault message | Fault condition | Fault Action | unused (00) | unused (00) | Device Power priority Level | unused (00) | Device Class | Request message |
| 1 | Available power | Max Available Watts | Current Available Watts | Available power (Watt hours) MSB | Available power (Watt hours) LSB | Device Power priority Level | Available Voltage (0-60) | Device Class | Request message |
| 2 | Requested Power | Max Request Watts | Current Request Watts | Minimum Power | Minimum Volts | Device Power priority Level | Voltage Request | Device Class | Request message |
| 3 | Data Transfer Request up to 64KB | Total Byte count MSB | Total Byte Count LSB | Current position MSB | Current position LSB | Transfer data length 0-8 of odd transfer | | | |
| 4 | Data Transfer | Data Byte 0 | Data Byte 1 | Data Byte 2 | Data Byte 3 | Data Byte 4 | Data Byte 5 | Data Byte 6 | Data Byte 7 |
| 5 | Vendor Identification | Vendor name byte 1 | Vendor name byte 2 | Vendor name byte 3 | Vendor name byte 4 | Vendor name byte 5 | Vendor name byte 6 | Vendor name byte 7 | Vendor name byte 8 |
| 6 | Model Number | Model byte 1 | Model byte 2 | Model byte 3 | Model byte 4 | Model byte 5 | Model byte 6 | Model byte 7 | Model byte 8 |
| 7 | Serial Number | Serial No byte 1 | Serial No byte 2 | Serial No byte 3 | Serial No byte 4 | Serial No byte 5 | Serial No byte 6 | Serial No byte 7 | Serial No byte 8 |
| 8 | EUI64 8 octets | EUI64 [63:56] | EUI64 [55:48] | EUI64 [47:40] | EUI64 [39:32] | EUI64 [31:24] | EUI64 [23:16] | EUI64 [15:8] | EUI64 [7:0] |
| 9 | Manufacture Date YYYY:MM:DD:hh:mm:ss | Year most significant digits - Hex "Y" "Y" | Year least significant digits - Hex "Y" "Y" | Month digits - Hex "M" "M" | Day digits - Hex "D" "D" | Hours digits - Hex "h" "h" | Minutes digits - Hex "m" "m" | Seconds digits - Hex "s" "s" | 00 |
| 10 | Software Version | software Ver byte 1 | software Ver byte 2 | software Ver byte 3 | software Ver byte 4 | software Ver byte 5 | software Ver byte 6 | software Ver byte 7 | software Ver byte 8 |
| 11 | Firmware Version | Firmware ver byte 1 | Firmware ver byte 2 | Firmware ver byte 3 | Firmware ver byte 4 | Firmware ver byte 5 | Firmware ver byte 6 | Firmware ver byte 7 | Firmware ver byte 8 |
| 12 | Heart Beat NTP Short | TimeoutSEC [15:8] | TimeoutSEC [7:0] | TimeoutPSEC [8:15] | TimeoutPSEC [0:7] | Power priority Level | 0 | Device Class | Request message |
| 13 | Time Stamp NPT RFC1305 | EpochTime [31:24] | EpochTime [23:16] | EpochTime [15:8] | EpochTime [7:0] | PartialSEC [31:24] | PartialSEC [23:16] | PartialSEC [15:8] | PartialSEC [7:0] |
| 14 | UPAMD Version | "18" | "23" | "V" | "0" | "1" | "." | "0" | "0" |
| 15 | NULL message | na | na | na | na | na | na | na | na |