

UP Xtreme

Maker Board
UP-WHL01

User's Manual 1st Ed

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Packing List

Before setting up your product, please make sure the following items have been shipped:

| Item | Quantity |
|----------|----------|
| UP-WHL01 | 1 |

If any of these items are missing or damaged, please contact your distributor or sales representative immediately.

About this Document

This User's Manual contains all the essential information, such as detailed descriptions and explanations on the product's hardware and software features (if any), its specifications, dimensions, jumper/connector settings/definitions, and driver installation instructions (if any), to facilitate users in setting up their product.

Users may refer to the product page at AAEON.com for the latest version of this document.

Safety Precautions

Please read the following safety instructions carefully. It is advised that you keep this manual for future references

1. All cautions and warnings on the device should be noted.
2. Make sure the power source matches the power rating of the device.
3. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
4. Always completely disconnect the power before working on the system's hardware.
5. No connections should be made when the system is powered as a sudden rush of power may damage sensitive electronic components.
6. If the device is not to be used for a long time, disconnect it from the power supply to avoid damage by transient over-voltage.
7. Always disconnect this device from any AC supply before cleaning.
8. While cleaning, use a damp cloth instead of liquid or spray detergents.
9. Make sure the device is installed near a power outlet and is easily accessible.
10. Keep this device away from humidity.
11. Place the device on a solid surface during installation to prevent falls
12. Do not cover the openings on the device to ensure optimal heat dissipation.
13. Watch out for high temperatures when the system is running.
14. Do not touch the heat sink or heat spreader when the system is running
15. Never pour any liquid into the openings. This could cause fire or electric shock.
16. As most electronic components are sensitive to static electrical charge, be sure to ground yourself to prevent static charge when installing the internal components. Use a grounding wrist strap and contain all electronic components in any static-shielded containers.

17. If any of the following situations arises, please the contact our service personnel:
 - i. Damaged power cord or plug
 - ii. Liquid intrusion to the device
 - iii. Exposure to moisture
 - iv. Device is not working as expected or in a manner as described in this manual
 - v. The device is dropped or damaged
 - vi. Any obvious signs of damage displayed on the device
18. **DO NOT LEAVE THIS DEVICE IN AN UNCONTROLLED ENVIRONMENT WITH TEMPERATURES BEYOND THE DEVICE'S PERMITTED STORAGE TEMPERATURES (SEE CHAPTER 1) TO PREVENT DAMAGE.**

Warning!



This device complies with Part 15 FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

Caution:

There is a danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions and your local government's recycling or disposal directives.

Attention:

Il y a un risque d'explosion si la batterie est remplacée de façon incorrecte. Ne la remplacer qu'avec le même modèle ou équivalent recommandé par le constructeur. Recycler les batteries usées en accord avec les instructions du fabricant et les directives gouvernementales de recyclage.

China RoHS Requirements (CN)

产品中有毒有害物质或元素名称及含量

AAEON Main Board/ Daughter Board/ Backplane

| 部件名称 | 有毒有害物质或元素 | | | | | |
|-----------------|-----------|-----------|-----------|-----------------|---------------|-----------------|
| | 铅 (Pb) | 汞 (Hg) | 镉 (Cd) | 六价铬 (Cr(VI)) | 多溴联苯 (PBB) | 多溴二苯醚 (PBDE) |
| 印刷电路板 及其电子组件 | ○ | ○ | ○ | ○ | ○ | ○ |
| 外部信号 连接器及线材 | ○ | ○ | ○ | ○ | ○ | ○ |

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 标准规定的限量要求以下。

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 标准规定的限量要求。

备注: 此产品所标示之环保使用期限, 系指在一般正常使用状况下。

China RoHS Requirement (EN)

Poisonous or Hazardous Substances or Elements in Products

AAEON Main Board/ Daughter Board/ Backplane

| Component | Poisonous or Hazardous Substances or Elements | | | | | |
|---|---|--------------|--------------|------------------------------|--------------------------------|---------------------------------------|
| | Lead (Pb) | Mercury (Hg) | Cadmium (Cd) | Hexavalent Chromium (Cr(VI)) | Polybrominated Biphenyls (PBB) | Polybrominated Diphenyl Ethers (PBDE) |
| PCB & Other Components | ○ | ○ | ○ | ○ | ○ | ○ |
| Wires & Connectors for External Connections | ○ | ○ | ○ | ○ | ○ | ○ |
| <p>O: The quantity of poisonous or hazardous substances or elements found in each of the component's parts is below the SJ/T 11363-2006-stipulated requirement.</p> <p>X: The quantity of poisonous or hazardous substances or elements found in at least one of the component's parts is beyond the SJ/T 11363-2006-stipulated requirement.</p> <p>Note: The Environment Friendly Use Period as labeled on this product is applicable under normal usage only</p> | | | | | | |

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Chapter 1

Product Specifications

1.1 Specifications

System

| | |
|--------------------|--|
| CPU | Intel® WHL-UE (Core i3/5/7 Ultra Low Power - 15 W) Intel® Celeron™ 4305UE (up to 2.0 GHz) |
| Memory | Onboard Single/Dual Channel DDR4 memory, Max 16GB |
| Graphics | Intel® Graphics , GEN 9 |
| Display Out | HDMI 2.0 x1 (CEC support) DP 1.2 x 1 eDP x 1 |
| Storage | eMMC ver 5.1 (64GB) SATA3 (6Gb/s) x 3: - SATA connector x 1 - M.2 2280 SATA (auto-detect) x 1 - Minicard mSATA (auto-detect) x 1 |
| Ethernet | 1x Intel i210/ Intel i211 (optional) 1x i219LM PHY |
| Audio | HDMI Audio x 1 DP Audio x 1 ALC887 for Audio Out/Mic In I2S |
| USB | USB 3.0 x 4 USB 2.0 x 1 |
| COM Port | Fintech F81801, RS232/422/485 x 2 |

System

| | |
|------------------------------|--|
| Expansion Slot | Minicard x 1 (PCIe [x1] Gen 3 x 1 (mSATA optional), USB 2.0 x 1) with SIM card M.2 2230 E Key x 1 (PCIe [x1] Gen 3 x 1, USB 2.0 x 2, CNVI x 1) M.2 2280 (double fixing hole) B/M Key x1 (PCIe Gen 3 x 2 / SATA x 1) |
| Expansion HAT (40pin) | By MAX5: <ul style="list-style-type: none">- GPIO x 28- SPI x 2- I2C x 2- ADC x 1- I2S x 1- PWM x 2- UART x 1- 3V3- 5V- GND |

I/O

Internal I/O Connectors

- eDP with Backlight control Header x 1
- 10 pin x 1 for USB 2.0 x 1 / HSIUART (TTL) x 1
- SATA Connector with power connector x 1
- 4 pin Fan connector x 1
- Power Button header x 1
- Reset Pin header x 1
- M.2 2230/ E Key x 1
- M.2 2280 B+M Key x 1
- 40 pin HAT connector x 1
- 10 pin RS232/422/485 pin header x 2
- 100pin expansion connector x 1

External I/O Connectors

- RJ45 Ethernet Connector x 2
- HDMI/DP STACK Connector x 1
- USB 3.0 STACK Connector for 2 ports (Front) x 1
- USB 3.0 STACK Connector for 2 ports (Rear) x 1
- Power Button / LED x 1
- Audio Jack (Line out + MIC) x 1
- DC connector (Lockable) x 1

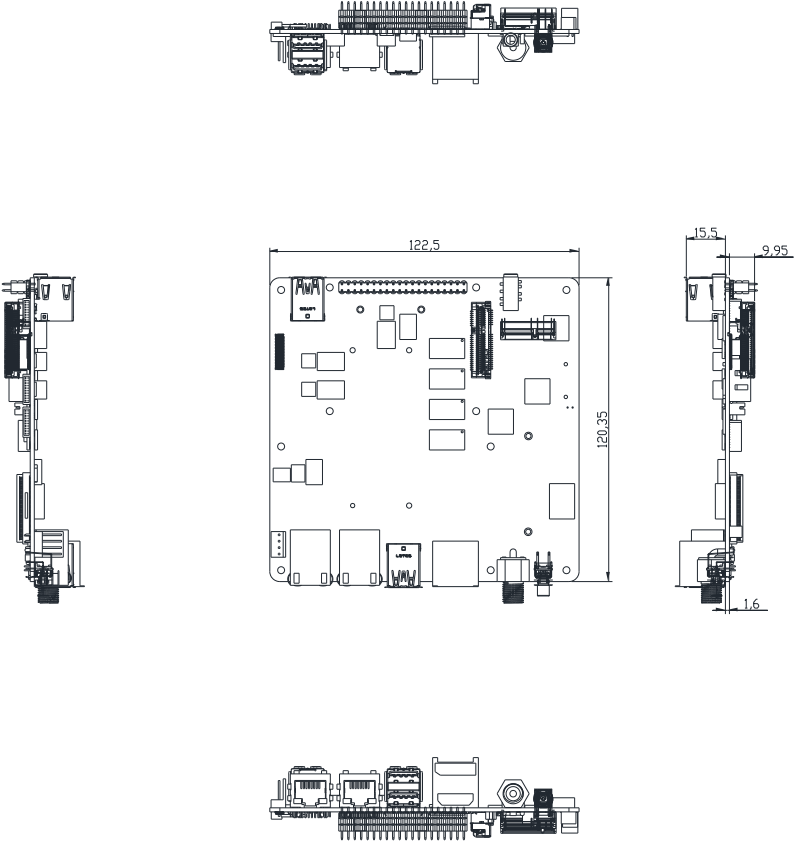
Miscellaneous

| | |
|------------------------------|--|
| Power | 12~60V Input |
| Form Factor | 120mm x 122mm |
| Operating Temperature | 0°C ~ 60°C |
| Operating Humidity | 0% ~ 90% relative humidity, non-condensing |
| Certification | CE, FCC |
| OS Support | Win 10, Linux (Ubuntu, Yocto), Android |

Chapter 2

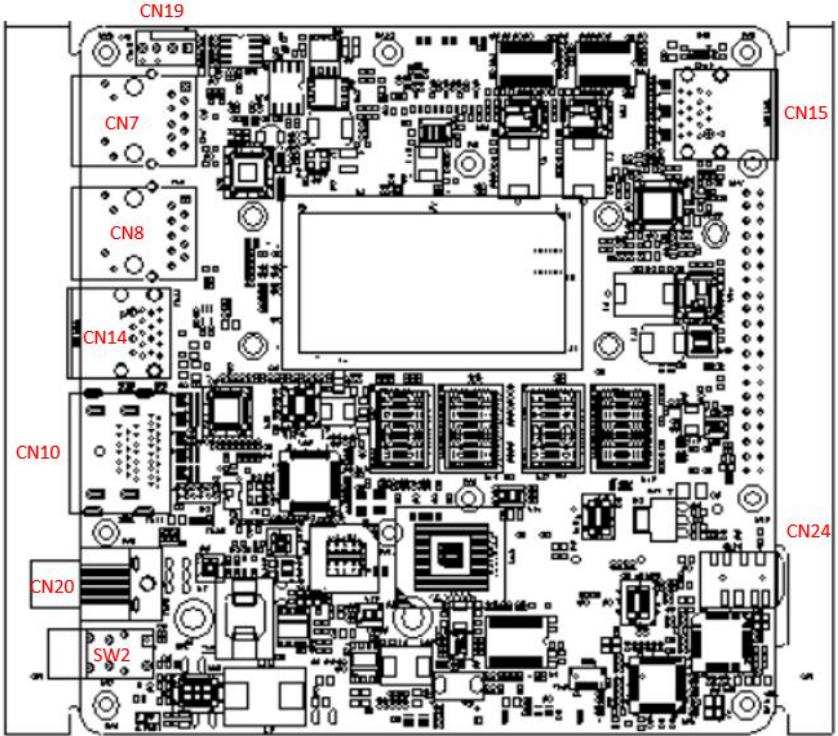
Hardware Information

2.1 Dimensions

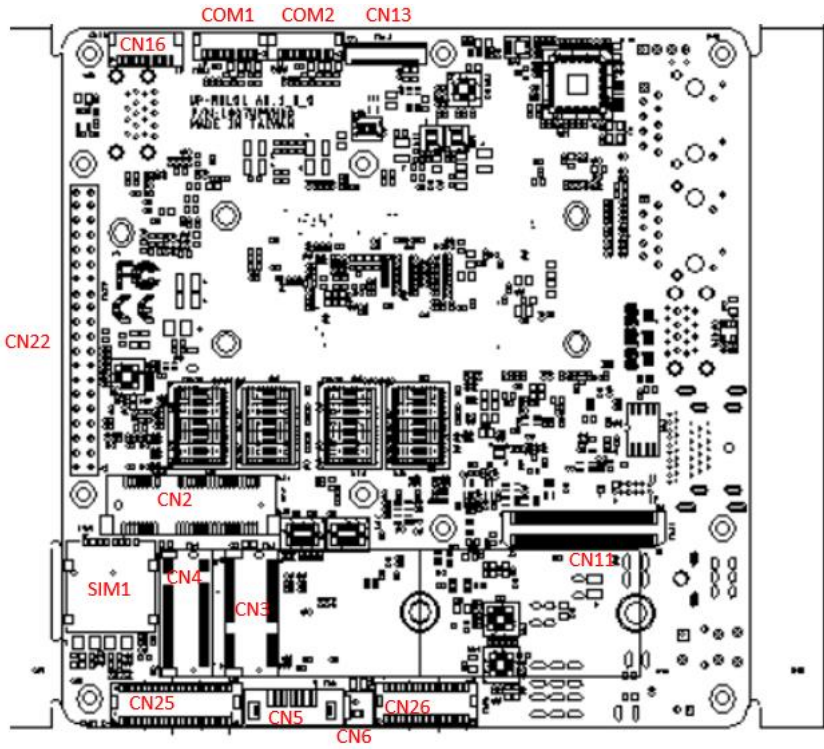


2.2 Jumpers and Connectors

Top:



Bottom:

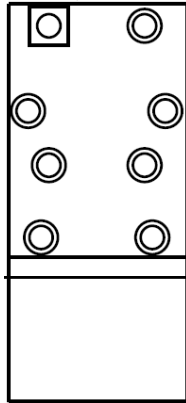


2.3 List of Jumpers and Connectors

Please refer to the table below for all of the board's jumpers that you can configure for your application

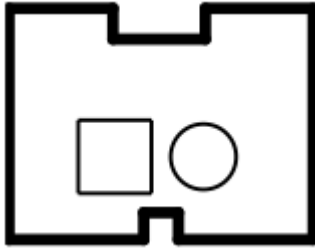
| Label | Function |
|-------|------------------------|
| SW2 | PWR button |
| CN1 | RTC |
| CN2 | MINI-CARD |
| CN3 | M.2_2230_E-KEY |
| CN4 | M.2 SLOT_M key |
| CN5 | SATA Connector |
| CN6 | SATA POWER |
| CN7 | LAN1 |
| CN8 | LAN2 |
| CN10 | HDMI/DP |
| CN11 | DOCKING I |
| CN13 | eDP |
| CN14 | USB Type A Connector 1 |
| CN15 | USB Type A Connector 1 |
| CN16 | USB 2.0 1x10P Wafer |
| CN19 | FAN |
| CN20 | DC JACK |
| CN22 | HAT 40 |
| CN24 | AUDIO JACK |
| CN25 | ADUINO |
| CN26 | DOCKING II |

2.3.1 Power Button (SW2)



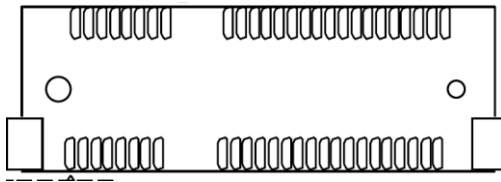
| Pin | Signal | Pin | Signal |
|-----|---------------|-----|---------------|
| 1 | PWR_SW#_CTL_R | 2 | PWR_SW#_CTL_R |
| 3 | GND | 4 | GND |
| 5 | GND | 6 | GND |
| L1 | SW1_LED_P | L2 | SW1_LED_N |

2.3.2 RTC (CN1)



| Pin | Signal |
|-----|---------|
| 1 | RTC_VCC |
| 2 | GND |

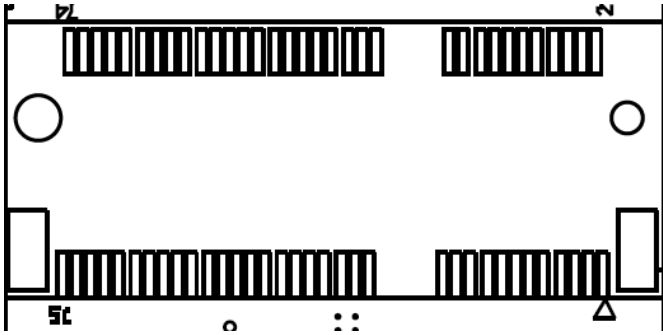
2.3.3 Mini-Card (CN2)



| Pin | Signal | Pin | Signal |
|-----|-------------------|-----|---------------|
| 1 | WAKE_MINI_N | 2 | VCC3_MINIPCIE |
| 3 | NC | 4 | GND |
| 5 | NC | 6 | V1.5S |
| 7 | NC | 8 | P_UIM_PWR |
| 9 | GND | 10 | P_UIM_DAT |
| 11 | PCIE_REFCLK5_P2_N | 12 | P_UIM_CLK |

| Pin | Signal | Pin | Signal |
|-----|-------------------|-----|---------------|
| 13 | PCIE_REFCLK5_P2_P | 14 | P_UIM_RST |
| 15 | GND | 16 | P_UIM_VPP |
| 17 | NC | 18 | GND |
| 19 | NC | 20 | 3G_EN |
| 21 | GND | 22 | 3G_RST |
| 23 | PERN0_MSATA_R+ | 24 | VCC3_MINIPCIE |
| 25 | PERP0_MSATA_R- | 26 | GND |
| 27 | GND | 28 | V1.5S |
| 29 | GND | 30 | NC |
| 31 | PETN0_MSATA_T- | 32 | NC |
| 33 | PETP0_MSATA_T+ | 34 | GND |
| 35 | GND | 36 | USB2_DN_R |
| 37 | GND | 38 | USB2_DP_R |
| 39 | VCC3_MINIPCIE | 40 | GND |
| 41 | VCC3_MINIPCIE | 42 | NC |
| 43 | MSATA_PCIE_SEL_C | 44 | NC |
| 45 | NC | 46 | NC |
| 47 | NC | 48 | V1.5S |
| 49 | NC | 50 | GND |
| 51 | NC | 52 | VCC3_MINIPCIE |

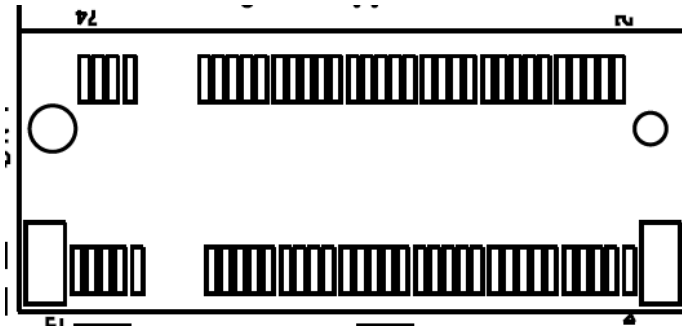
2.3.4 M.2 2230 E-Key (CN3)



| Pin | Signal | Pin | Signal |
|-----|-----------------|-----|-----------------------|
| 1 | GND | 2 | +3.3VAUX_WIFI |
| 3 | BT_DP | 4 | +3.3VAUX_WIFI |
| 5 | BT_DM | 6 | NC |
| 7 | GND | 8 | NC |
| 9 | CNV_WR_LANE1_DN | 10 | CNV_RF_RST# |
| 11 | CNV_WR_LANE1_DP | 12 | NC |
| 13 | GND | 14 | CNV_PCMIOUT_CLKREQ_R |
| 15 | CNV_WR_LANE0_DN | 16 | NC |
| 17 | CNV_WR_LANE0_DP | 18 | GND |
| 19 | GND | 20 | NC |
| 21 | CNV_WR_CLK_DN | 22 | CNV_RGI_RSP_R |
| 23 | CNV_WR_CLK_DP | 24 | NC |
| 25 | NC | 26 | NC |
| 27 | NC | 28 | NC |
| 29 | NC | 30 | NC |
| 31 | NC | 32 | GPP_F6_CNV_RGI_DT_UAR |
| 33 | GND | 34 | CNV_BRI_DT_R |

| Pin | Signal | Pin | Signal |
|-----|-------------------|-----|------------------|
| 35 | PCIE_C_TXP10 | 36 | CNV_BRI_DT |
| 37 | PCIE_C_TXN10 | 38 | NC |
| 39 | GND | 40 | NC |
| 41 | PCIE_P10_RX_DP | 42 | NC |
| 43 | PCIE_P10_RX_DN | 44 | NC |
| 45 | GND | 46 | NC |
| 47 | PCIE_REFCLK5_P1_P | 48 | NC |
| 49 | PCIE_REFCLK5_P1_N | 50 | SUS_CLK_CPU |
| 51 | GND | 52 | WIFI_RST# |
| 53 | PCIE_M2_CLKREQ# | 54 | BT_EN |
| 55 | WAKE_M2_N | 56 | WIFI_EN |
| 57 | GND | 58 | NC |
| 59 | CNV_WT_LANE1_DN | 60 | NC |
| 61 | CNV_WT_LANE1_DP | 62 | NC |
| 63 | GND | 64 | CLKIN_XTAL_LCP_R |
| 65 | CNV_WT_LANE0_DN | 66 | NC |
| 67 | CNV_WT_LANE0_DP | 68 | NC |
| 69 | GND | 70 | NC |
| 71 | CNV_WT_CLK_DN | 72 | 3.3VAUX_WIFI |
| 73 | CNV_WT_CLK_DP | 74 | 3.3VAUX_WIFI |
| 75 | GND | 76 | GND |
| 77 | GND | 78 | |

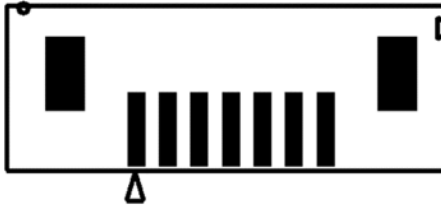
2.3.5 M.2 Slot M-Key (CN4)



| Pin | Signal | Pin | Signal |
|-----|--------------------|-----|--------------|
| 1 | GND | 39 | GND |
| 2 | +3.3V | 40 | SOC_I2C1_SCL |
| 3 | GND | 41 | PCIE_TXN0 |
| 4 | +3.3V | 42 | SOC_I2C1_SDA |
| 5 | NC | 43 | PCIE_TXP0 |
| 6 | FULL_CARD_PWR_OFF# | 44 | NC |
| 7 | NC | 45 | GND |
| 8 | NC | 46 | NC |
| 9 | NC | 47 | PCIE_RXN0 |
| 10 | NC | 48 | NC |
| 11 | NC | 49 | PCIE_RXP0 |
| 20 | NC | 50 | PLT_RST# |
| 21 | GND | 51 | GND |
| 22 | NC | 52 | PCIE_CLKREQ# |
| 23 | NC | 53 | PCIE_CLK_N |
| 24 | NC | 54 | WAKE_M2 |
| 25 | NC | 55 | PCIE_CLK_P |

| Pin | Signal | Pin | Signal |
|-----|-----------------------|-----|--------|
| 26 | NC | 56 | NC |
| 27 | GND | 57 | GND |
| 28 | NC | 58 | NC |
| 29 | PCIE_P15_SATA_P1B_RXN | 67 | NC |
| 30 | NC | 68 | NC |
| 31 | PCIE_P15_SATA_P1B_RXP | 69 | NC |
| 32 | NC | 70 | +3.3V |
| 33 | GND | 71 | GND |
| 34 | NC | 72 | +3.3V |
| 35 | PCIE_P15_SATA_P1B_TXN | 73 | GND |
| 36 | NC | 74 | +3.3V |
| 37 | PCIE_P15_SATA_P1B_TXP | 75 | GND |
| 38 | VPU_EN | | |

2.3.6 SATA Connector (CN5)



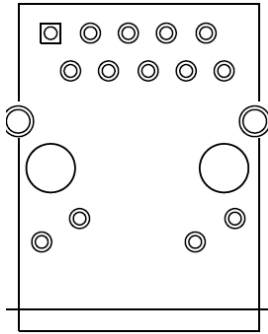
| Pin | Signal | Pin | Signal |
|-----|-------------|-----|-------------|
| 1 | GND | 2 | SATA_TXP0_C |
| 3 | SATA_TXN0_C | 4 | GND |
| 5 | SATA_RXN0_C | 6 | SATA_RXP0_C |
| 7 | GND | | |

2.3.7 SATA Power (CN6)



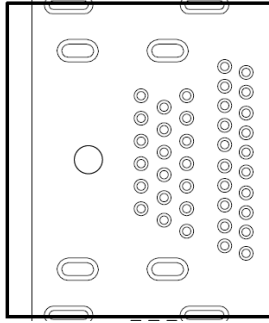
| Pin | Signal | Pin | Signal |
|-----|--------|-----|--------|
| 1 | +V5S | 2 | GND |

2.3.8 LAN1/ LAN2 (CN7/ CN8)



| Pin | Signal | Pin | Signal |
|-----|-------------|-----|-------------|
| 1 | LAN1_TMDI0+ | 5 | LAN1_TMDI2- |
| 2 | LAN1_TMDI0- | 6 | LAN1_TMDI1- |
| 3 | LAN1_TMDI1+ | 7 | LAN1_TMDI3+ |
| 4 | LAN1_TMDI2+ | 8 | LAN1_TMDI3- |

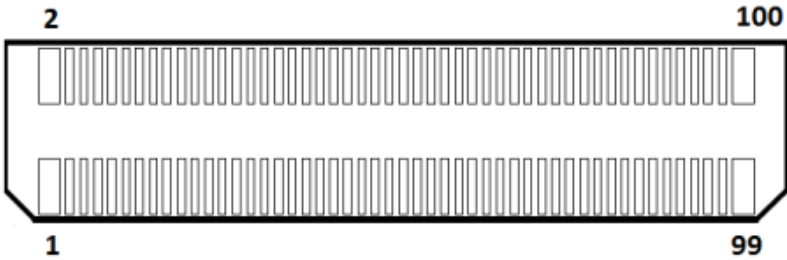
2.3.9 HDMI/ DP (CN10)



| Pin | Signal | Pin | Signal |
|-----|-----------------|-----|-----------------|
| P1 | DDIO_TXP_DP_0 | P2 | GND |
| P3 | DDIO_TXN_DP_0 | P4 | DDIO_TXP_DP_1 |
| P5 | GND | P6 | DDIO_TXN_DP_1 |
| P7 | DDIO_TXP_DP_2 | P8 | GND |
| P9 | DDIO_TXN_DP_2 | P10 | PORT0_CLK+ |
| P11 | GND | P12 | PORT0_CLK- |
| P13 | CONFIG1 | P14 | CONFIG2 |
| P15 | DP_AUX_P | P16 | GND |
| P17 | DP_AUX_N | P18 | DDIO_TYPE_C_HPD |
| P19 | GND | P20 | 3.3V |
| P21 | DDI1_TXP_HDMI_0 | P22 | GND |
| P23 | DDI1_TXN_HDMI_0 | P24 | DDI1_TXP_HDMI_1 |
| P25 | GND | P26 | DDI1_TXN_HDMI_1 |
| P27 | DDI1_TXP_HDMI_2 | P28 | GND |
| P29 | DDI1_TXN_HDMI_2 | P30 | DDI1_CLK+_HDMI |
| P31 | GND | P32 | DDI1_CLK-_HDMI |
| P33 | HDMI1_CEC_D | P34 | NC |

| Pin | Signal | Pin | Signal |
|------------------|---------|-----|----------|
| P35 | DDC_CLK | P36 | DDC_DATA |
| P37 | GND | P38 | 5V |
| DDI1_TYPE_C_HPDP | | | |

2.3.10 DOCKING I (CN11)

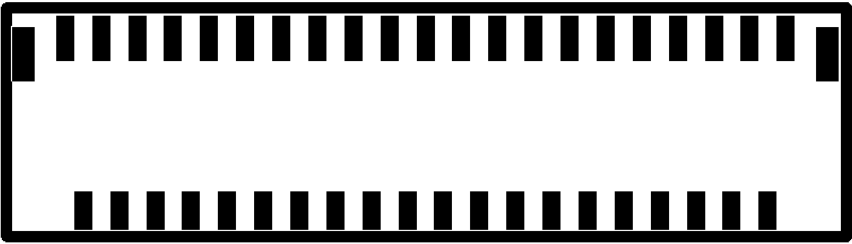


| Pin | Signal | Pin | Signal |
|-----|--------|-----|---------------------|
| 1 | +12V | 51 | PCIE_REFCLK2_N |
| 2 | +12V | 52 | PCIE_P3_TXN |
| 3 | +12V | 53 | GND |
| 4 | +12V | 54 | GND |
| 5 | +12V | 55 | PCIE_TXP2 |
| 6 | +12V | 56 | PCIE_P3_RXP_SWITCH |
| 7 | +12V | 57 | PCIE_TXN2 |
| 8 | +12V | 58 | PCIE_P3_RXN_SWITCH |
| 9 | NC | 59 | GND |
| 10 | NC | 60 | GND |
| 11 | GND | 61 | PCIE_RXP2 |
| 12 | GND | 62 | SATA_P1_USB3_P5_RXN |
| 13 | NC | 63 | PCIE_RXN2 |
| 14 | NC | 64 | SATA_P1_USB3_P5_RXP |

| Pin | Signal | Pin | Signal |
|-----|----------------|-----|---------------------|
| 15 | NC | 65 | GND |
| 16 | NC | 66 | GND |
| 17 | GND | 67 | NC |
| 18 | GND | 68 | SATA_P1_USB3_P5_TXN |
| 19 | NC | 69 | NC |
| 20 | NC | 70 | SATA_P1_USB3_P5_TXP |
| 21 | NC | 71 | GND |
| 22 | NC | 72 | GND |
| 23 | GND | 73 | NC |
| 24 | GND | 74 | SATA_RXN0 |
| 25 | NC | 75 | NC |
| 26 | NC | 76 | SATA_RXP0 |
| 27 | NC | 77 | GND |
| 28 | NC | 78 | GND |
| 29 | GND | 79 | USB2_DP3 |
| 30 | GND | 80 | SATA_TXP0 |
| 31 | PCIE_REFCLK0_P | 81 | USB2_DN3 |
| 32 | PCIE_REFCLK1_P | 82 | SATA_TXN0 |
| 33 | PCIE_REFCLK0_N | 83 | GND |
| 34 | PCIE_REFCLK1_N | 84 | GND |
| 35 | GND | 85 | NC |
| 36 | GND | 86 | NC |
| 37 | PCIE_RXP0 | 87 | NC |
| 38 | PCIE_RXP1 | 88 | NC |
| 39 | PCIE_RXN0 | 89 | GND |
| 40 | PCIE_RXN1 | 90 | GND |
| 41 | GND | 91 | NC |

| Pin | Signal | Pin | Signal |
|-----|----------------|-----|-----------------|
| 42 | GND | 92 | SATA_LED_N |
| 43 | PCIE_TXP0 | 93 | PLTRST_PNLBKLEN |
| 44 | PCIE_TXP1 | 94 | NC |
| 45 | PCIE_TXN0 | 95 | PCIE_WAKE0_N |
| 46 | PCIE_TXN1 | 96 | PCIE_CLKREQ0# |
| 47 | GND | 97 | PCIE_WAKE1_N |
| 48 | GND | 98 | PCIE_CLKREQ1# |
| 49 | PCIE_REFCLK2_P | 99 | PCIE_WAKE2_N |
| 50 | PCIE_P3_TXP | 100 | PCIE_CLKREQ2# |

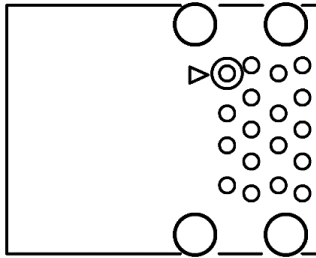
2.3.11 EDP (CN13)



| Pin | Signal | Pin | Signal |
|-----|-----------------|-----|--------------------|
| 1 | NC | 2 | NC |
| 3 | GND | 4 | NC |
| 5 | NC | 6 | GND |
| 7 | NC | 8 | NC |
| 9 | GND | 10 | NC |
| 11 | NC | 12 | GND |
| 13 | NC | 14 | NC |
| 15 | GND | 16 | data positive 0 |
| 17 | data negative 0 | 18 | GND |
| 19 | data positive 1 | 20 | data negative 1 |
| 21 | GND | 22 | data positive 2 |
| 23 | data negative 2 | 24 | GND |
| 25 | data positive 3 | 26 | data negative 3 |
| 27 | GND | 28 | AUX positive |
| 29 | AUX negative | 30 | GND |
| 31 | Hot Plug Detect | 32 | Back Light Control |
| 33 | VDD Enable | 34 | Back Light Enable |
| 35 | I2C_CLK | 36 | I2C_DAT |

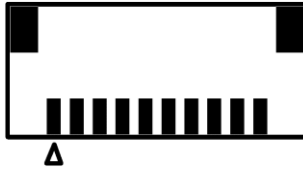
| Pin | Signal | Pin | Signal |
|-----|--------|-----|--------|
| 37 | 3.3V | 38 | 3.3V |
| 39 | 3.3V | 40 | 3.3V |
| 41 | 3.3V | | |

2.3.12 USB Type A Connector (CN14/ CN15)



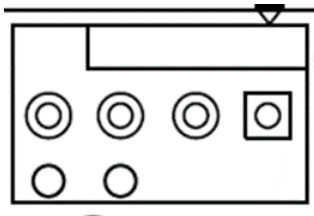
| Pin | Signal | Pin | Signal |
|-----|-----------|-----|-----------|
| 1 | 5V | 2 | USB2_D1- |
| 3 | USB2_D1+ | 4 | GND |
| 5 | USB3_RX1- | 6 | USB3_RX1+ |
| 7 | GND | 8 | USB3_TX1- |
| 9 | USB3_TX1+ | 10 | 5V |
| 11 | USB2_D2- | 12 | USB2_D2+ |
| 13 | GND | 14 | USB3_RX2- |
| 15 | USB3_RX2+ | 16 | GND |
| 17 | USB3_TX2- | 18 | USB3_TX2+ |

2.3.13 USB 2.0 1x10P Wafer (CN16)



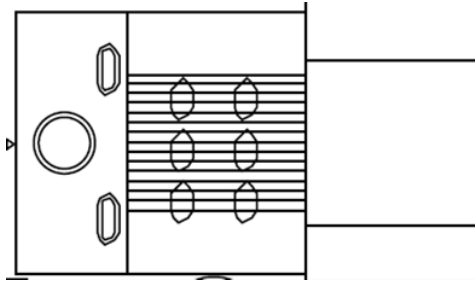
| Pin | Signal | Pin | Signal |
|-----|----------|-----|----------|
| 1 | 5V | 2 | USB2_D1- |
| 3 | USB2_D1+ | 4 | GND |
| 5 | NC | 6 | NC |
| 7 | NC | 8 | NC |
| 9 | UART_RX | 10 | UART_TX |

2.3.14 FAN (CN19)



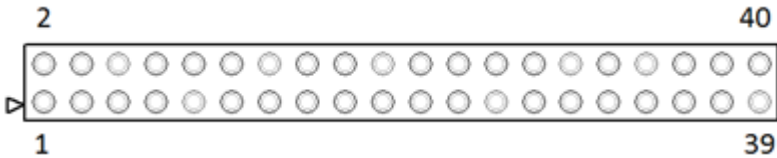
| Pin | Signal | Pin | Signal |
|-----|-----------------|-----|-----------------|
| 1 | GND | 2 | VCC_FAN_CPU_CON |
| 3 | FAN_TAC_CPU_CON | 4 | FAN_CTL_CPU_CON |

2.3.15 DC Jack (DC: 24~50V) (CN20)



| Pin | Signal | Pin | Signal |
|-----|--------|-----|--------|
| 1 | DC_IN | 2 | GND |
| 3 | GND | | |

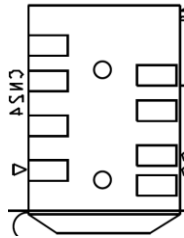
2.3.16 HAT 40 (CN22)



| Pin | Signal | Pin | Signal |
|-----|--------------|-----|----------|
| 1 | 3.3V | 2 | 5V |
| 3 | I2C1_DAT | 4 | 5V |
| 5 | I2C1_CLK | 6 | GND |
| 7 | ANALOG_DATA1 | 8 | UART_TX |
| 9 | GND | 10 | UART_RX |
| 11 | ANALOG_DATA2 | 12 | I2S_BCLK |

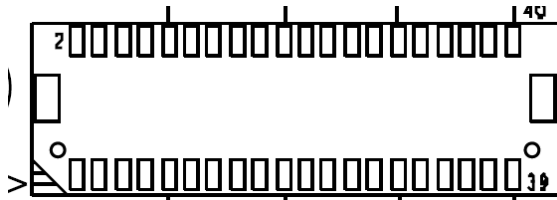
| Pin | Signal | Pin | Signal |
|-----|--------------|-----|----------|
| 13 | ANALOG_DATA3 | 14 | GND |
| 15 | ANALOG_DATA4 | 16 | SPI1_CS1 |
| 17 | 3.3V | 18 | SPI1_RX |
| 19 | SPI0_TX | 20 | GND |
| 21 | SPI0_RX | 22 | SPI1_TX |
| 23 | SPI0_CLK | 24 | SPI0_CS0 |
| 25 | GND | 26 | SPI0_CS1 |
| 27 | I2C0_DAT | 28 | I2C0_CLK |
| 29 | GPIO | 30 | GND |
| 31 | SPI1_CLK | 32 | PWM0 |
| 33 | PWM1 | 34 | GND |
| 35 | I2S_WS_SYNC | 36 | UART_CTS |
| 37 | SPI1_CS0 | 38 | I2S_SDI |
| 39 | GND | 40 | I2S_SDO |

2.3.17 Audio Jack (CN24)



| Pin | Signal | Pin | Signal |
|-----|-----------|-----|--------|
| 1 | MIC_LR_CN | 2 | AGND |
| 3 | LOUT_R | 4 | NC |
| 5 | NC | 6 | NC |
| 7 | NC | 8 | LOUT_L |

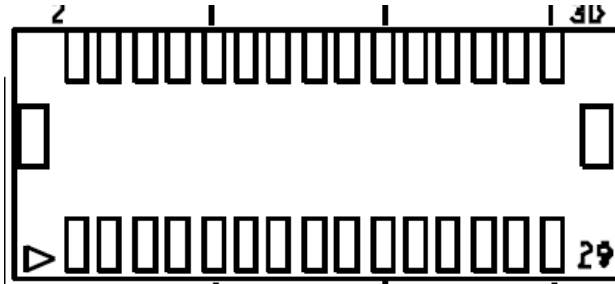
2.3.18 ADUINO (CN25)



| Pin | Signal | Pin | Signal |
|-----|-----------|-----|------------|
| 1 | +3V_MCU | 2 | +3V_MCU |
| 3 | GND | 4 | GND |
| 5 | STM32_PB1 | 6 | STM32_VBAT |
| 7 | STM32_PB7 | 8 | STM32_PC8 |

| Pin | Signal | Pin | Signal |
|-----|------------|-----|--------------|
| 9 | STM32_PB6 | 10 | STM32_PB9 |
| 11 | STM32_PB5 | 12 | STM32_PC15 |
| 13 | STM32_PB4 | 14 | MCU_NRST_R |
| 15 | STM32_PB3 | 16 | MCU_WKUP_R |
| 17 | USB_RENUMn | 18 | STM32_PA1 |
| 19 | SWDCLK_R | 20 | STM32_PA2 |
| 21 | SWDIO_R | 22 | STM32_PA3 |
| 23 | NC | 24 | STM32_PA4 |
| 25 | NC | 26 | STM32_PA5 |
| 27 | STM32_PA10 | 28 | STM32_PA6 |
| 29 | STM32_PA9 | 30 | STM32_PA7 |
| 31 | STM32_PA8 | 32 | HDMI1_CEC_D |
| 33 | STM32_PB15 | 34 | STM32_PB2 |
| 35 | STM32_PB14 | 36 | HOST_I2C_SCL |
| 37 | STM32_PB13 | 38 | HOST_I2C_SDA |
| 39 | MCU_INT_R | 40 | +V5S |

2.3.19 DOCKING II (CN26)



| Pin | Signal | Pin | Signal |
|-----|--------------|-----|----------------|
| 1 | SLP_S3# | 2 | V1.8S |
| 3 | STACK_GPIO1 | 4 | V1.8S |
| 5 | STACK_GPIO2 | 6 | LPC_AD0 |
| 7 | STACK_GPIO3 | 8 | LPC_AD1 |
| 9 | STACK_GPIO4 | 10 | LPC_AD2 |
| 11 | STACK_GPIO5 | 12 | LPC_AD3 |
| 13 | STACK_GPIO6 | 14 | LPC_FRAME_R |
| 15 | BUF_PLT_RST# | 16 | LPC_R_CLKOUT1 |
| 17 | STACK_GPIO7 | 18 | SMB_CLK_A |
| 19 | I2C_SCL4_1V8 | 20 | SMB_DATA_A |
| 21 | I2C_SDA4_1V8 | 22 | INT_SERIRQ_3P3 |
| 23 | GND | 24 | +V3.3S |
| 25 | GND | 26 | +V3.3S |
| 27 | GND | 28 | +V5S |
| 29 | GND | 30 | +V5S |

Chapter 3

Drivers Installation

3.1 Driver Download and Installation

* Please access <https://www.up-community.org> and go to the Downloads section>UP Xtreme to find the relevant drivers.

Appendix A

UP Framework SDK Installation

A.1 Introduction

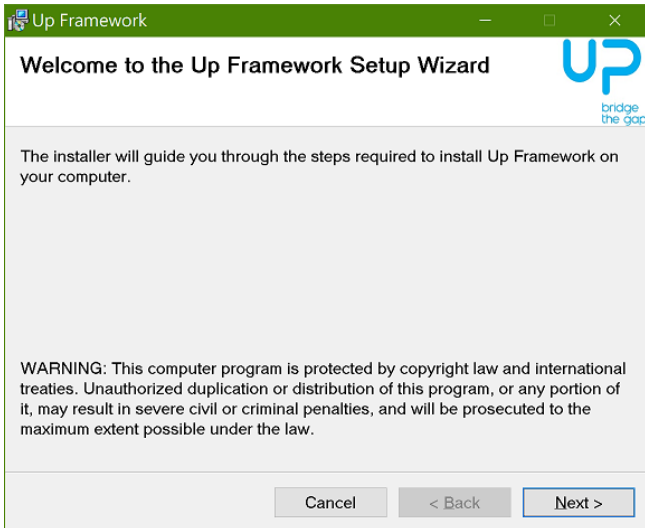
This section provides instructions for the installation of the UP Framework SDK. Instructions are provided for Windows 10 and Windows IoT Core. You can download the latest version of UP Framework SDK from the UP community:

<https://downloads.up-community.org/download/up-sdk-for-windows-10-and-windows-iot/>

A.2 Installation for Windows 10

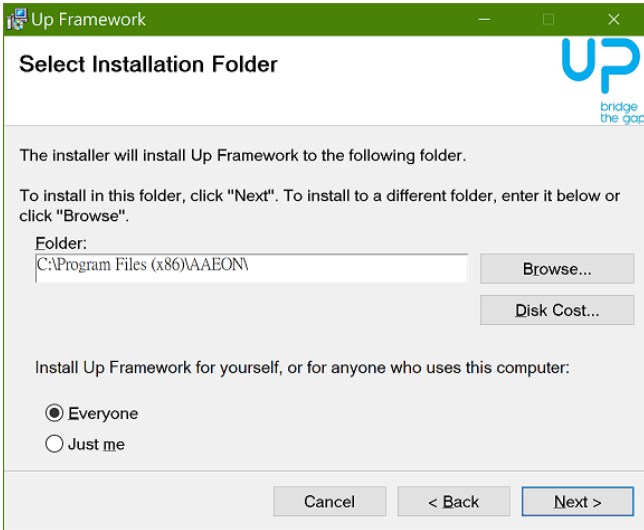
Step 1

Locate the downloaded file UpFrameworkSetup.msi and run the installer. Press “Next” to begin the setup process.



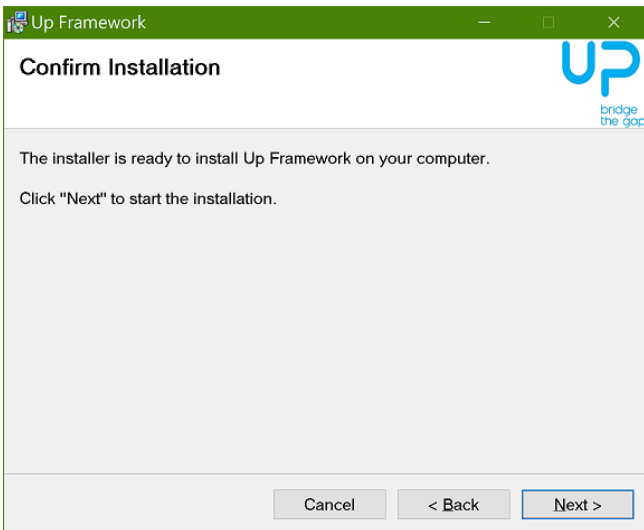
Step 2

Select the installation folder. Default destination path is C:\Program Files(x86)\AAEON\
 You may also choose to install the UP Framework SDK for all users or only the current user. Press "Next" to continue installation.



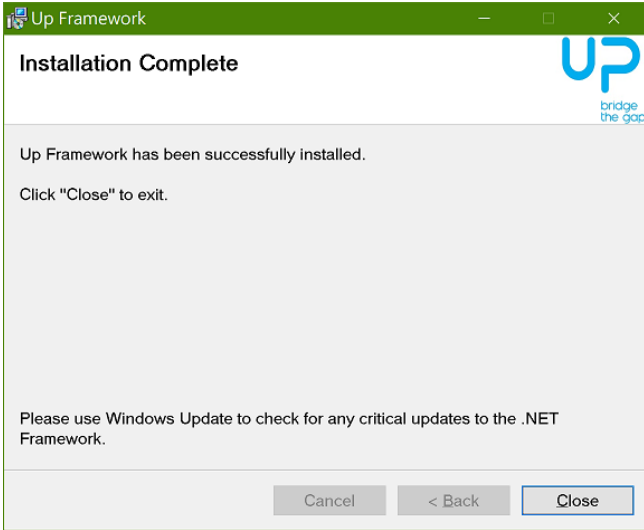
Step 3

Press "Next" to confirm the installation.



Step 4

Press "Close" to exit once setup is complete.



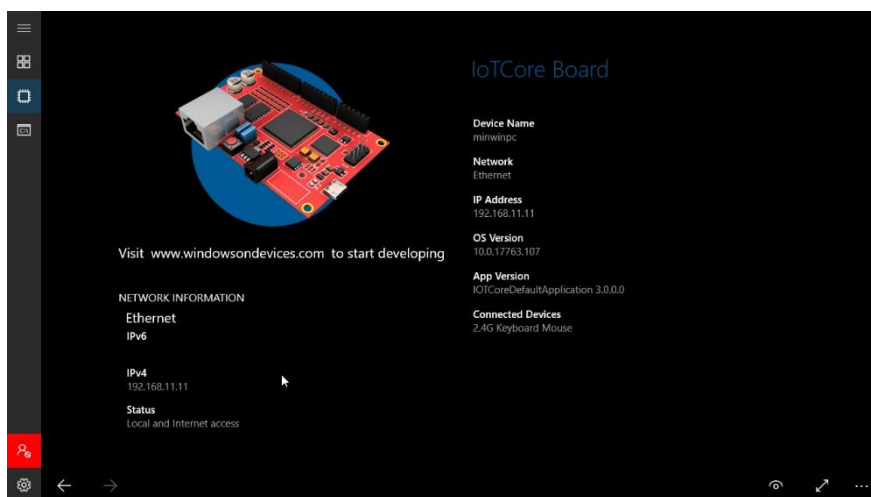
A.3 Installation for Windows IoT Core

Before you begin, make sure you have downloaded and installed the latest version of the Windows IoT Core image from the UP community.

Installation requires using a connected PC with the UP Framework SDK software downloaded and saved. **Note:** Make sure the UP IoT Core device is connected to the same network as the PC you are using to install the software from.

Step 1

Turn on your UP IoT Core device and note the IP address at the home screen.



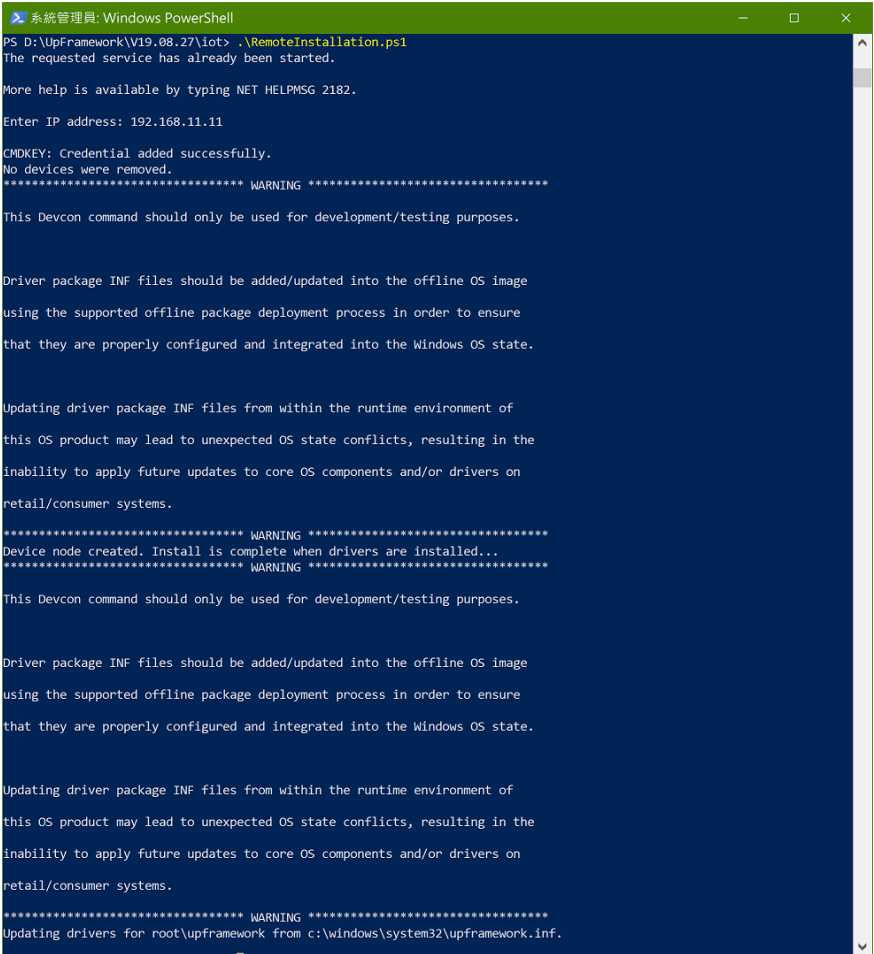
Step 2

Download the UP Framework SDK to your PC and unzip the files.

Open PowerShell as an Administrator. Run the command

`RemoteInstallation.ps1` to install the UP Framework SDK.

Enter the IP address of the UP IoT Core device when prompted.



```
系統管理員: Windows PowerShell
PS D:\UpFramework\19.08.27\iot> .\RemoteInstallation.ps1
The requested service has already been started.

More help is available by typing NET HELPMSG 2182.

Enter IP address: 192.168.11.11

CMDKEY: Credential added successfully.
No devices were removed.
***** WARNING *****
This Devcon command should only be used for development/testing purposes.

Driver package INF files should be added/updated into the offline OS image
using the supported offline package deployment process in order to ensure
that they are properly configured and integrated into the Windows OS state.

Updating driver package INF files from within the runtime environment of
this OS product may lead to unexpected OS state conflicts, resulting in the
inability to apply future updates to core OS components and/or drivers on
retail/consumer systems.

***** WARNING *****
Device node created. Install is complete when drivers are installed...
***** WARNING *****
This Devcon command should only be used for development/testing purposes.

Driver package INF files should be added/updated into the offline OS image
using the supported offline package deployment process in order to ensure
that they are properly configured and integrated into the Windows OS state.

Updating driver package INF files from within the runtime environment of
this OS product may lead to unexpected OS state conflicts, resulting in the
inability to apply future updates to core OS components and/or drivers on
retail/consumer systems.

***** WARNING *****
Updating drivers for root\upframework from c:\windows\system32\upframework.inf.
```

Appendix B

Cables and Connectors

B.1 Cables and Connectors

This table provides detailed information about the cables and connectors used by the UP Xtreme (UP-WHL01). If you have any questions about the configuration of your board, please contact your AAEON sales representative.

| Connector Label | Connector PN | Description | Mating Cable PN | Mating Cable Description |
|-----------------|--------------|---------------------------------|-----------------|--|
| CN1 | 1655902034 | RTC Battery Connector | 175011301K | Lithium Battery.CR2032H.3V.2 40mAH.w/cable 90mm. DIPBattery power.BP-CR2032-M9 0-001 |
| CN2 | 1654226303 | mini-PCIe (PCIe x1) | N/A | |
| CN3 | 1654207533 | m.2 2230 E Key | N/A | |
| CN4 | 165420753B | m.2 2280 M/B Key | N/A | |
| CN5 | 1654907009 | SATA | N/A | |
| CN6 | 1655302025 | SATA Power (DC 5V) | N/A | |
| CN7 | 1652814207 | GbE RJ-45 | N/A | |
| CN8 | 1652814207 | GbE RJ-45 | N/A | |
| CN10 | 1654403931 | HDMI 2.0 + DP 1.2 | N/A | |
| CN13 | 1654904130 | eDP Connector | N/A | |
| CN11 | 1654010006 | 100-pin Docking Connector | N/A | |
| CN14 | 1654801832 | 2x USB 3.1 Gen2 (10Gbps) | N/A | |
| CN15 | 1654801832 | 2x USB 3.1 Gen2 (10Gbps) | N/A | |
| CN16 | 1655810131 | 10-pin USB 2.0+HSUART Connector | N/A | |
| CN19 | 165500401A | CPU Smart Fan Connector (3-pin) | 175920001F | CPU Cooler.Fan+Heat Sink.12V.3P.for UPWH |

| Connector Label | Connector PN | Description | Mating Cable PN | Mating Cable Description |
|-----------------|--------------|---|-----------------|--|
| CN20 | 165250320K | 12 ~ 60 VDC Input (Lockable, OD/ID: 5.1/2.5 mm) | N/A | |
| CN22 | 165302020L | 40-pin HAT Connector | N/A | |
| CN25 | 1655840030 | STM32 I/O Header | N/A | |
| CN26 | 1653215200 | STM32 I/O Header | N/A | |
| COM1 | 1655901000 | 10-pin RS-232/422/485 Header | 1701100180 | COM Cable.D-SUB 9P(M).10P:1.0mm Housing.15cm |
| COM2 | 1655901000 | 10-pin RS-232/422/485 Header | 1701100180 | COM Cable.D-SUB 9P(M).10P:1.0mm Housing.15cm |
| SIM1 | 1654900800 | Micro-SIM Card Slot | N/A | |
| SW2 | 1601615600 | Power Button with LED | N/A | |

Appendix C

CEC-Client Installation

C.1 CEC-Client Installation Manual

The CEC-Client Installation Manual is attached to this manual. It provides information for setting up the CEC-Client to allow the UP Xtreme to communicate with CEC enabled devices through the HDMI port. If you have any questions, please contact your AAEON Sales Representative.

CEC Client Installation

Supplemental Appendix for UP Xtreme

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Chapter 1 Introduction

1.1 About this Document

This document is included as a supplement to the product manual for the UP Xtreme (UP-WHL01). If you do not have the product manual for your device, please visit the product page on AAEON.com to download the full version.

This document is intended for use only with the UP Xtreme product manual and is not for use as a separate document nor for use with any other product. If you have any questions regarding this document or your AAEON product, please contact your AAEON sales representative for assistance.

Chapter 2 CEC-Client Installation

2.1 Introduction

CEC-Client is required to allow your PC to send custom CEC commands to a connected TV using a CEC adaptor. This section details installation instructions for CEC-Client.

2.2 Windows Installation

CEC-Client is an exe file included in the libCEC-AAEON library. Microsoft Visual Studio (for C++) is required to install and run CEC-Client on Windows. During installation, libCEC-AAEON Setup will check for Microsoft Visual Studio during installation. If Microsoft Visual Studio is not detected on your device, the required packages will be installed. Otherwise, only a test application will be installed.

Refer to the following images to perform setup and installation for Windows.

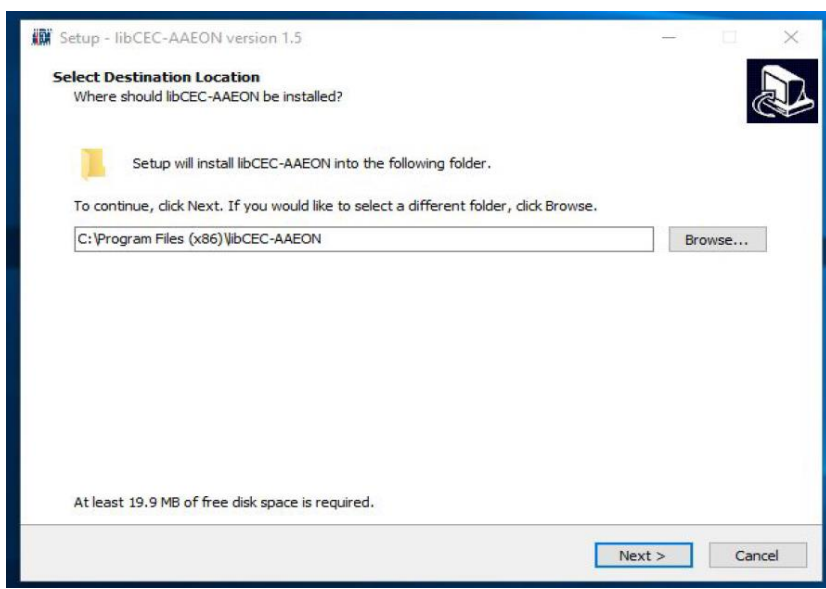


Image 1: Select Installation Path (default path shown)

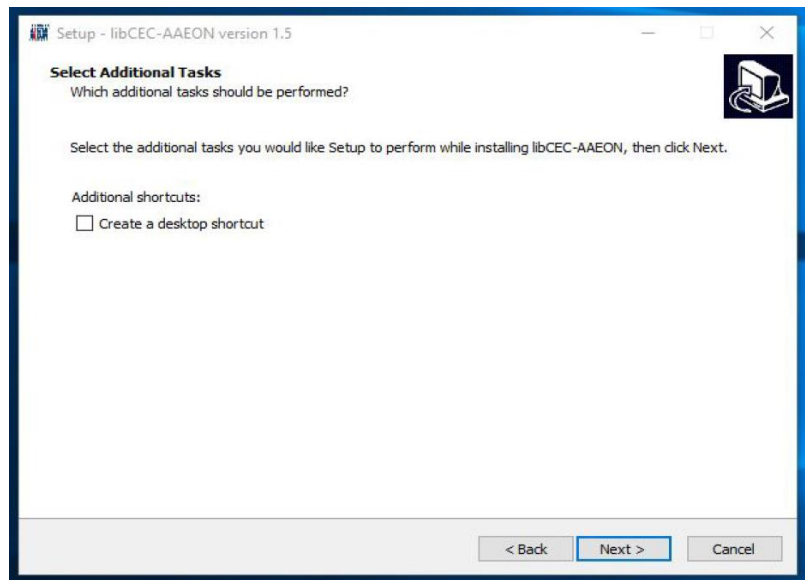


Image 2: Create Shortcut

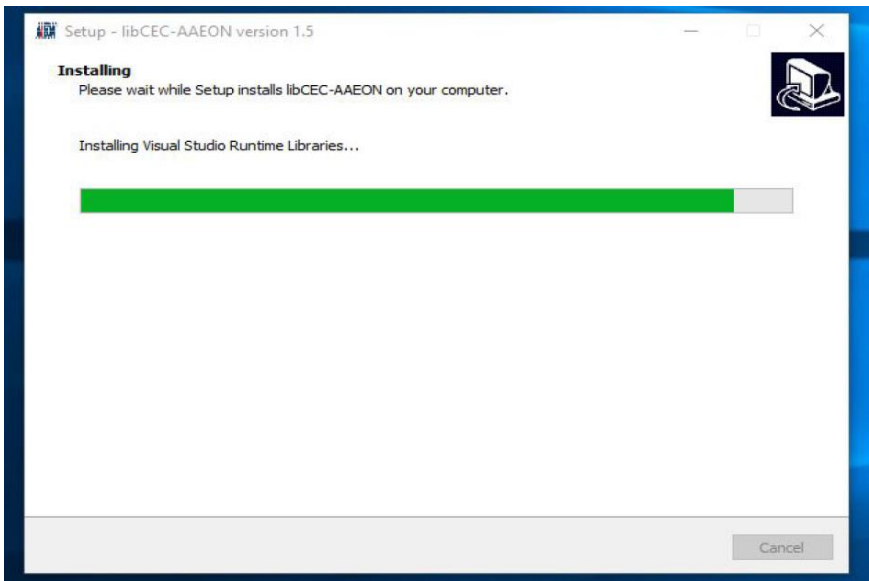


Image 3: Installing Visual Studio Runtime Libraries

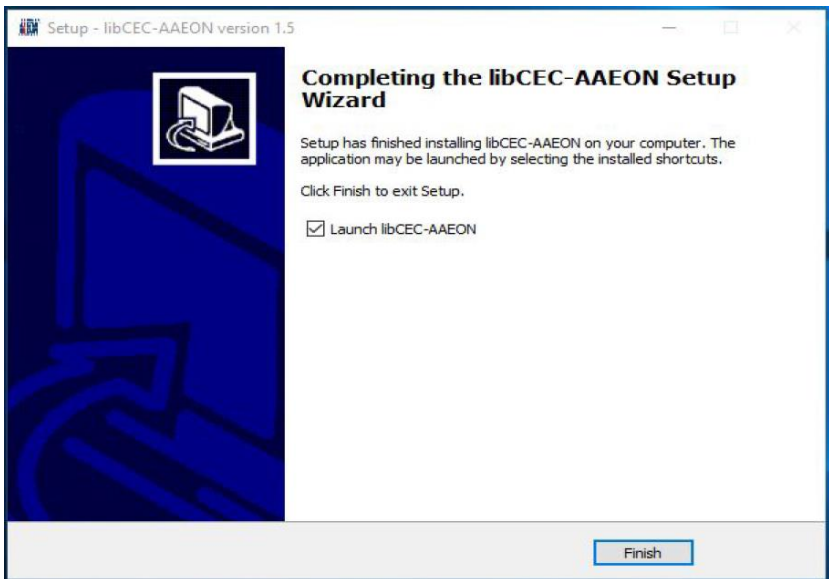


Image 4: Finish Installation

After installation is complete, open the folder location where you installed libCEC-AAEON. The default path location is shown in the image below.

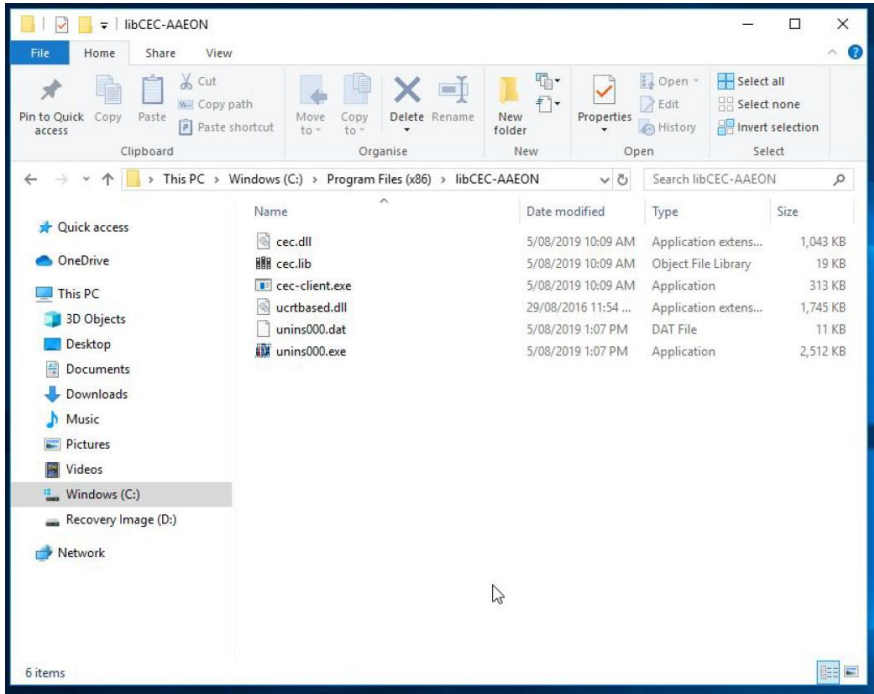


Image 5: CEC-Client File Location

Open a Command Prompt window in the file location. Run `cec-client.exe -h` to display all program options.

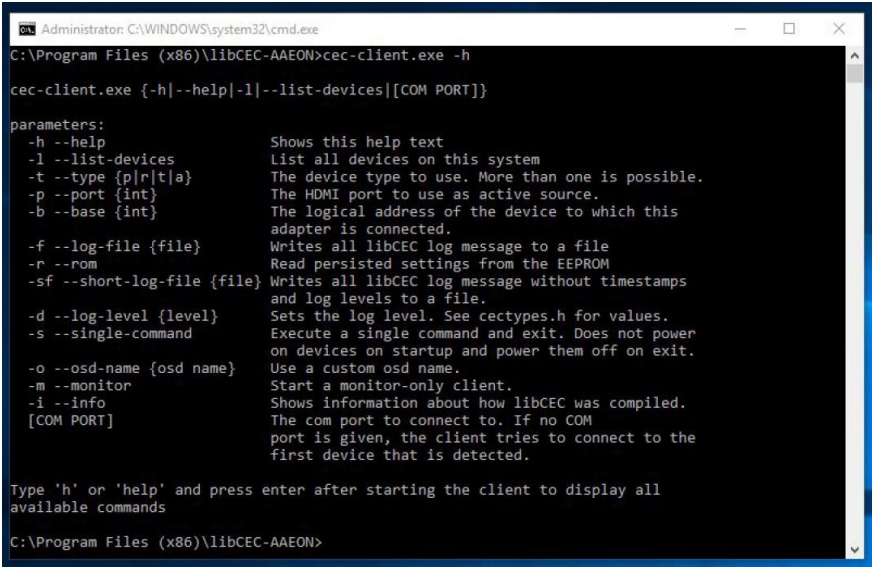


Image 6: CEC-Client Command Prompt

2.2.1 Kodi Installation on Windows

Before running Kodi on Windows, copy `cec.dll` from the CEC-Client folder (Image 5) to the Kodi installation folder. **Note:** You must have Kodi version 18.0 or later to use libCEC-AAEON.

2.3 libCEC and USB-CEC Installation for Ubuntu on UP Xtreme

Follow the instructions below to install CEC-Client and libCEC-AAEON library on Ubuntu.

CEC-Client and libCEC-AAEON require installing GDebi in order to run on Ubuntu. This step is performed in Terminal (Command Line). In Terminal, enter the command:

```
sudo apt-get install gdebi
```

After the process is completed, libCEC can be installed. Run the installer **libcec4_4.0.4.1~bionic_amd64.deb** from the deliverables folder. You may be required to enter the administrator password, after which installation will occur automatically.

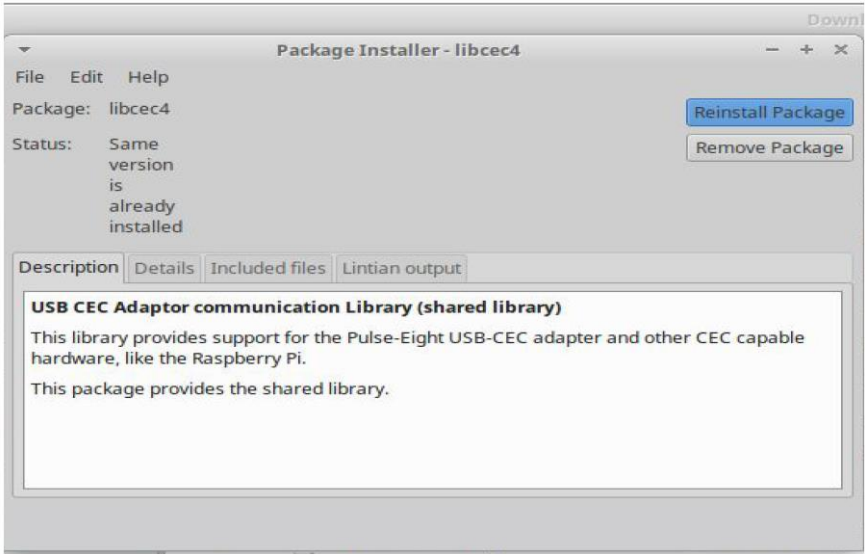


Image 7: Successful Installation

To use libCEC with Kodi, simply install Kodi with the command:

```
sudo apt-get install kodi
```

2.4 Flashing DFU Firmware on STM Board – Windows

This section details the procedures for dropping the .dfu (Device Firmware Update) firmware file on board and MCU's firmware update for delivered firmware on Windows platforms.

Download the .dfu file from the deliverables folder. Extract the files, then connect the board to the PC with a USB-C cable.

Flashing the firmware file on board requires it to be transferred using a DFU Bootloader program. The steps show below use **DfuSe USB Device Firmware Upgrade** to perform these actions.

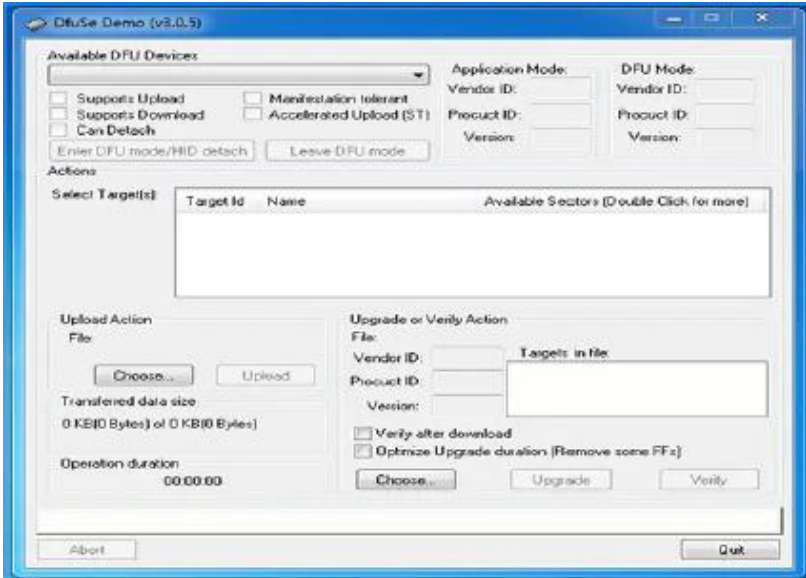


Image 8: DfuSe Utility Program

Note: Firmware can only be placed via the built-in bootloader on the STM32f042k6 board.

2.5 Installation Procedure for DfuSe Demo

This section details how to install DfuSe Demo. First, download and run the installer from <https://www.st.com/en/development-tools/stsw-stm32080.html>

InstallShield Wizard should start automatically and guide you through the installation procedure. When the software is successfully installed, click "Finish".

The DfuSe application drivers for Windows 10 should be installed automatically. If they are not, follow the procedures below to install DfuSe drivers. When starting driver installation for target device, the “Found New Hardware Wizards” should appear as shown:



Image 9: New Hardware Wizard

Choose “Install from a list or specific location (Advanced)” and then press “Next”.

In the next window, select "Don't search. I will choose the driver to install."

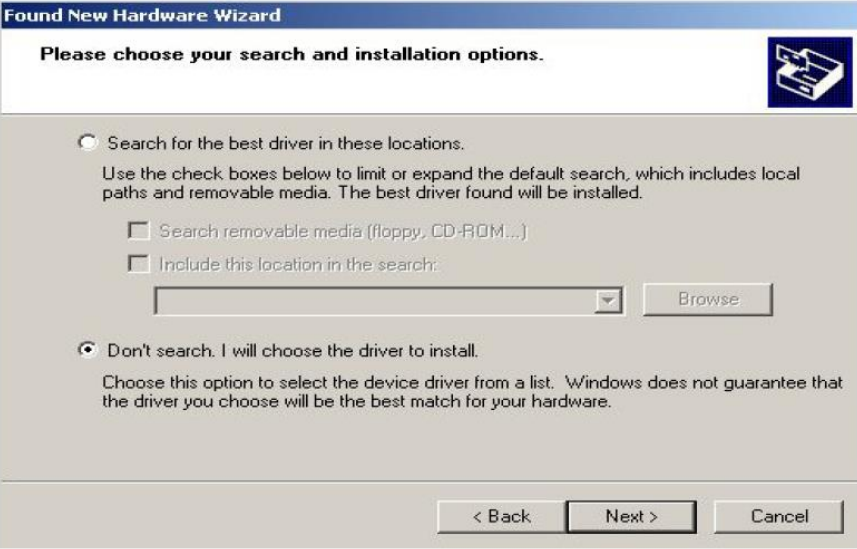


Image 10: Choose Install Options

If the DfuSe drivers are installed, you will see a list of compatible hardware models.

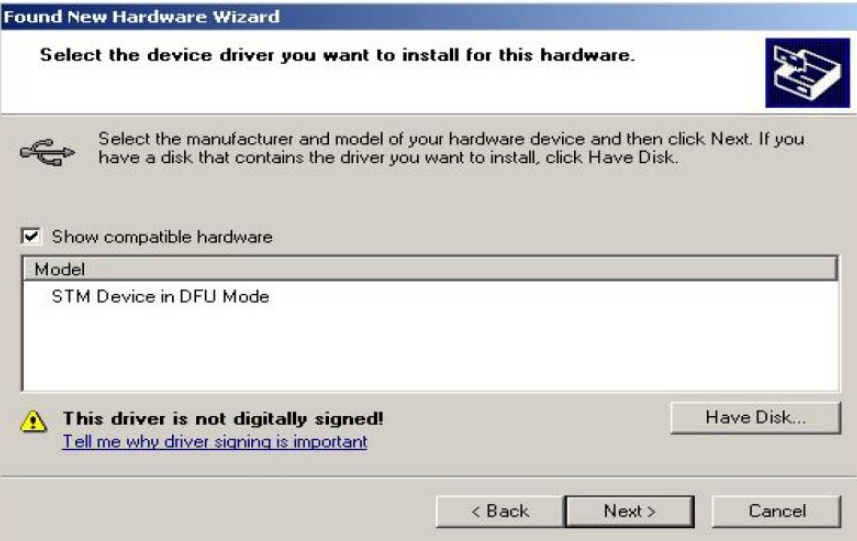


Image 11: DfuSe Drivers are installed

If there are no models listed, the drivers are not installed. Click on "Have Disk..." to select the drivers. In the Install from Disk dialog box, select browse and select the folder where the drivers are located and press "OK". Default location is **C:/Program Files/STMicroelectronics/DfuSe/Driver**

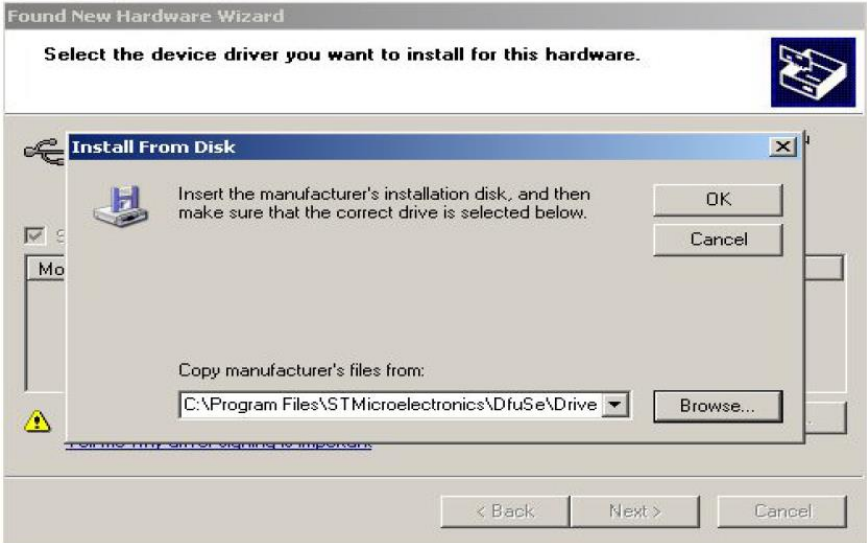


Image 12: Install from Disk

The installer will automatically find and select the .INF and the hardware model will be displayed on the list. Click "Next" to proceed.



Image 13: Installation

During installation, the following error message will appear. Click "Continue Anyway" to finish installing DfuSe drivers.



Image 14: Continue Anyway



Image 15: Installation Finished

DfuSe Installation will complete automatically. Click "Finish" once it is complete.

2.6 Installing dfu-util on Windows

This section details how to install dfu-util for programming the flash memory. It can be used to program both the Device OS and application firmware, as well as save and restore configurations. If you are using Windows, you can use Windows CLI Installer to automatically install dfu-util and the CLI. Otherwise, follow the instructions below.

First, download dfu-util from the release site:

<http://dfu-util.sourceforge.net/releases/dfu-util-0.9-win64.zip>

Extract the files. For this installation you will only need:

- dfu-prefix.exe
- dfu-suffix.exe
- dfu-util-static.exe

First, rename **dfu-util-static.exe** to **dfu-util.exe**. Next, create a location to save the dfu-util installation. The recommended location is **C:\Program Files\dfu-util**

Next, open Windows 10 Settings. In the top search field, type “environment” and select “Edit the system environment variables” when it appears.

Click the “**Environment Variables...**” button at the bottom of the page. In the Environment Variables window, select “**Path**” in the System Variables list (bottom list) and click “**Edit**”. In the Edit window, click “**New**” then add the file path **C:\Program Files\dfu-util** as a new row. Your system must be restarted after editing.

To test it has been completed, open a Command Prompt window and enter:

```
dfu-util -l
```

The descent command for STM32f042k6 firmware:

```
dfu-util -vvv -a 0 -e -t 2048 -s :force:mass-erase:leave -D STM32F042K6_Firmware.dfu
```

The descent command for STM32f103c8 firmware:

```
dfu-util -a 0 -D STM32F103C8_Firmware.bin
```

2.7 Switching Device in DFU Mode

To switch device to DFU mode, send the command “**bootloader**” through the CDC interface. The device should be restarted after this step.

Open DfuSe. The program will automatically detect STM32 board has been connected via USB to the PC and powered up in DFU mode.

In the “**Upgrade or Verify Action**” area, click on “**Choose**” and select the appropriate DFU firmware file which has been delivered, and then click on “**Upgrade**”.

DfuSe will automatically coordinate the firmware process until the entire firmware file has been successfully loaded onto the MCU. After uploading the DFU file to the device, the device will need to be reset.

2.8 Flashing DFU firmware file on STM board on Linux

2.8.1 STM32f042k6

This section details how to load the DFU firmware file onto STM32f042k6 MCU on Linux. First, install the required software tool from Terminal using the command:

```
sudo apt-get install dfu-util
```

After installing the dfu-util software tool, use the following procedure to conduct the firmware upgrade and load the upgraded firmware file using dfu-util onto the board's MCU on Linux software platform.

Switch the device to DFU Mode using the command "**bootloader**" sent through the CDC interface. Restart the device.

Use the following command to drop the DFU firmware file onto the STM board:

```
sudo dfu-util -vvv -a 0 -e -t 2048 -s :force:mass-erase:leave -D STM32F042K6_Firmware.dfu
```

After uploading the file, it is necessary to reset the device.

2.8.2 STM32f103c8

An ST-Link debugger needs to be put in place to lower the firmware. Firmware is loaded via the bootloader using the following command:

```
sudo dfu-util -a 0 -D stm32f103c8_firmware.bin
```

2.9 Flashing Firmware File on STM Board using STM32CubeProgrammer

STM32CubeProgrammer is an all-in-one multi-OS software tool for programming STM32 products. It provides an easy-to-use and efficient environment for reading, writing and verifying device memory through both the debug interface (JTAG and SWD) and the bootloader interface (UART, USB DFU, I2C, SPI, CAN).

The following software needs to be downloaded before beginning:

1. Official Java JRE from the Oracle website, version 8 or higher:

<https://www.oracle.com/technetwork/java/javase/downloads/jre8-downloads-2133155.html>

2. STM32CubeProgrammer from the official ST site:

<https://www.st.com/en/development-tools/stm32cubeprog.html>

3. For Windows, the driver for ST-Link is also needed:

<https://www.st.com/en/development-tools/stsw-link009.html>

2.9.1 Installing STM32CubeProgrammer on Windows

Install Java JRE:

1. Run setup program "jre-8u221-windows-x64.exe"
2. Follow on screen instructions provided by installer

Install driver for ST-Link:

1. Unpack archive "en.stsw-link009.zip"
2. Run setup program "stlink_winusb_install.bat"
3. Follow on screen instructions provided by installer

Install STM32CubeProgrammer:

1. Unpack archive "en.stm32cubeprog.zip"
2. Run setup program "SetupSTM32CubeProgrammer-2.1.0.exe"
3. Follow on screen instructions provided by installer

2.9.2 Installing STM32CubeProgrammer on Linux

Install Java Runtime Environment:

1. Unpack Java JRE archive into your home directory

```
tar -xf jre-8u221-linux-x64.tar.gz -C ~
```

2. Rename directory "jre1.8.0_221" to "jre"

Install STM32CubeProgrammer:

1. Unpack archive "en.stm32cubeprog.zip" with command unzip:

```
unzip en.stm32cubeprog.zip
```

2. Set permissions for executing using command chmod:

```
chmod +x SetupSTM32CubeProgrammer-2.1.0.linux
```

3. Run installer using command:

```
JAVA_HOME=~/.jre ./SetupSTM32CubeProgrammer-2.1.0.linux
```

4. Set install directory to "~/STM32CubeProgrammer"

Configure STM32CubeProgrammer before launching application:

1. Enter STM32CubeProgrammer directory

```
cd ~/STM32CubeProgrammer
```

2. As sudo copy udev rules files to the "/dev/udev/rules.d" directory:

```
sudo cp Drivers/rules/*.rules /etc/udev/rules.d
```

3. Edit file `~/STM32CubeProgrammer/util/openJFXScript.csh`

Change line 4 from:

```
JAVA_PATH=`which java`
```

to

```
JAVA_PATH~/jre/bin/java
```

4. Edit file `~/STM32CubeProgrammer/bin/STM32CubeProgrammer`

Below first line:

```
#!/bin/bash
```

Insert the line:

```
export JAVA_HOME~/jre
```

2.9.3 Flashing Bootloader or Combined Image

The steps for using STM32CubeProgrammer to flash bootloader or combined image is the same for both Windows and Linux. To flash bootloader or combined image (bootloader and firmware in single image) follow these steps:

1. Select ST-LINK from drop-down menu in the top right corner of the window
2. Click refresh button below
3. Select ST-LINK by its serial number
4. Upgrade firmware on your ST-Link if necessary using "Firmware upgrade" button below
5. Connect ST-Link to the board
6. Click on the "Connect" button in the top right corner of the window
7. On the left side of the window click "Erasing & programming" (2nd icon)
8. Select your firmware using "Browse" button in the Download section
9. Click on "Verify programming" check box (optional)

10. Click on "Start Programming" button
11. Restart is needed after flashing combined image to be operative

Note: If you are unable to connect to the device, try changing ST-Link configuration option **Mode** from "Normal" to "Under reset".

The screenshot displays the STM32CubeProgrammer software interface. The main window is titled "Erasing & Programming".

Download Section:

- File path: /home/sasa/Desktop/stm32f10368_usb_bootloa
- Start addr.: 0x08000000
- Buttons: Skip flash erase before programming, Verify programming, Run after programming, Full chip erase, Download file, Option bytes commands: -op
- Buttons: Start Programming..., Start automatic mode

Erase flash memory Section:

| Select | Index | Start Address | Size |
|--------------------------|-------|---------------|------|
| <input type="checkbox"/> | 0 | 0x08000000 | 1K |
| <input type="checkbox"/> | 1 | 0x08000400 | 1K |
| <input type="checkbox"/> | 2 | 0x08000800 | 1K |
| <input type="checkbox"/> | 3 | 0x08000C00 | 1K |
| <input type="checkbox"/> | 4 | 0x08001000 | 1K |
| <input type="checkbox"/> | 5 | 0x08001400 | 1K |
| <input type="checkbox"/> | 6 | 0x08001800 | 1K |
| <input type="checkbox"/> | 7 | 0x08001C00 | 1K |
| <input type="checkbox"/> | 8 | 0x08002000 | 1K |
| <input type="checkbox"/> | 9 | 0x08002400 | 1K |

ST-LINK configuration Section:

- Serial number: ST1000...
- Port: SWD
- Frequency (kHz): 1700
- Mode: Normal
- Access port: S
- Reset mode: No hardware reset
- Shared: Disabled
- External loader: ...
- Target voltage: 0.44 V
- Firmware version: V2.2357
- Buttons: Hardware upgrade

Log Section:

```

13:56:25 - Size: 7972 Bytes
13:56:25 - Address: 0x08000000
13:56:25 - Erasing memory corresponding to segment 0:
13:56:25 - Erasing internal memory sectors [0 7]
13:56:25 - Download in Progress...
13:56:26 - File download complete
13:56:26 - Time elapsed during download operation: 00:00:00.562
13:56:26 - Verifying...
13:56:26 - Read progress...
13:56:26 - Download verified successfully
  
```

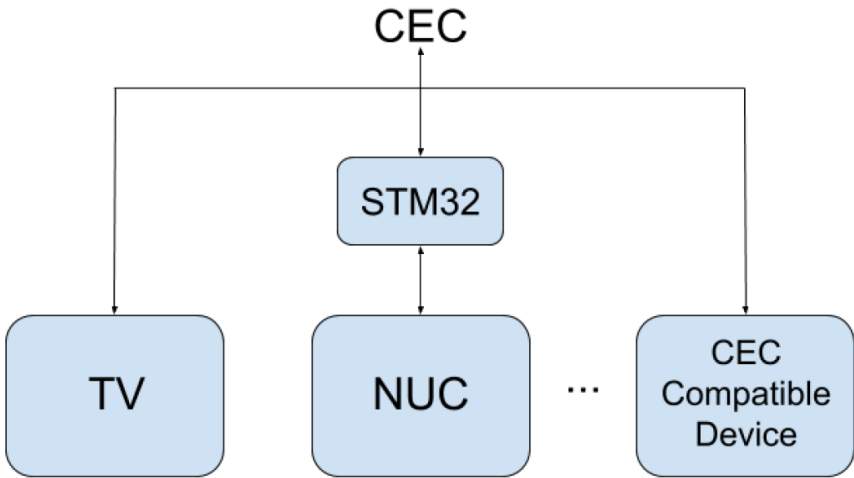


Image 17: CEC Network

STM32F10xxx device should be connected to Host CPU through USB (Communication Device Class) and HDMI CEC pin of baseboard. Firmware application should re-use already available CEC library from ST and provide adaptation layer which should enable access to CEC bus operation from USB host. The following functions should be exposed through USB API:

| API Name | Description |
|------------------------|------------------------------------|
| HAL_CEC_Transmit_IT | Sends a CEC data in interrupt mode |
| HAL_CEC_TxCpltCallback | Tx Transfer completed callback |
| HAL_CEC_RxCpltCallback | Rx Transfer completed callback |
| HAL_CEC_ErrorCallback | CEC error callback |

STM32 device should be detected on USB host as a USB CDC serial device. Each of the API functions and input/output arguments should be serialized in the following way:

- Sending a cec command is executed by sending a string in the following format via CDC:

```
send <address> <hex-string>
```

- If the command is sent successfully, the string **ACK** will be returned via CDC
- Received messages will be displayed as:

```
CEC: <hex-string>
```

- In case of error, string will be received in format:

```
ERR: <error-code>
```

All messages end with **<CR>** **<LF>** characters.

Error messages are generally received if the message was unable to be delivered on device, or if the message was sent in the wrong format.

Example:

Getting CEC version from the TV:

| Terminal | Description |
|--------------------|--|
| > send 0 9F | Send CEC get version command to address 0 |
| ACK | The command was successfully sent |
| CEC: 019E05 | Received from 0 to device 1: cec version 1.4 |

Getting power status from device 2 that is not present on the CEC network:

| Terminal | Description |
|------------------------|---|
| > send 2 8F | Send CEC get power status to address 2 |
| ERR: 0x00001000 | Sending failed: acknowledgement is not received |

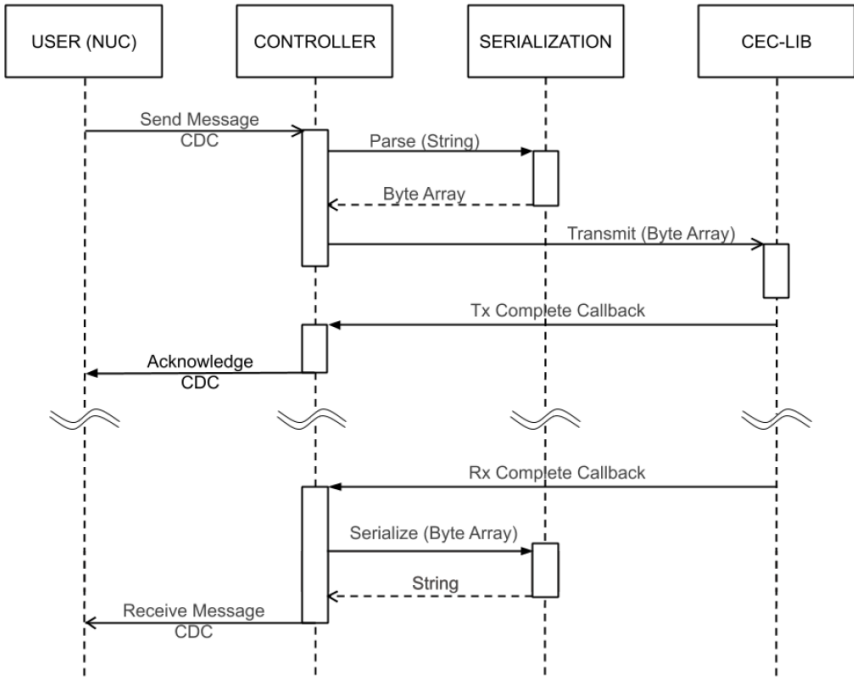


Image 18: Firmware Sending/Receiving Messages

| Firmware Command | Description |
|------------------------------------|--|
| help | View list of available commands |
| get <name> | Returns value of variable with specified name.† |
| set <name> [value] | Set value of variable.‡ |
| send <address> [data] | Send data over CEC network to specified address. |
| bootloader | Call STM bootloader and switch device to DFU mode. |

† Supported names are **logical_address**, **physical_address**, **firmware_version**, **cec_version**

‡ Currently supported names are **logical_address** and **physical_address**.

Chapter 4 libCEC

CEC (Consumer Electronics Control) allows for control of devices through the HDMI port. With the right hardware, libCEC allows control of the device with a TV remote. libCEC is an enabling platform for the CEC bus in HDMI. It allows developers to interact with other HDMI devices without having to worry about communication overhead, handshaking, and various ways of sending a message for each vendor. libCEC communicates with all CEC Bridge branded hardware. libCEC supports Linux and Windows platforms.

4.1 libCEC-AAEON Adapter

libCEC-AAEON Adapter was developed for use with the GitHub download of libCEC (3.1.3 libCEC library) ...\\libcec\src\libcec\adapter

To add a new adapter, it is important to implement the **IAdapterCommunication** interface to communicate with the rest of the CEC library using the **IAdapterCommunicationCallback** interface. This is also necessary for detecting the device for which the new adapter is written. Four new classes will be added to the existing implementation of the libCEC library.

- **CAAEONAdapterCommunication** class is the implementation of the IAdapterCommunication interface. It is a central communication class with an adapter.
- **CAAEONAdapterDetection** class is a class that serves to find the port on which the device is located. It finds COM port based on the VID and PID in Windows through a registry, while on Linux it uses the UDEV library. In the name of the port, the prefix **AAEON:** will be added to differentiate the detection of a new type of device.
- **CAAEONAdapterMessageQueue** is a class that collects CEC messages that need to be sent to the device. It also processes the results that the device returns and manages messages based on it.
- **CAAEONAdapterMessage** is a class that represents a CEC message that contains message data and state, depending on the type of message.

- **CAAEONAdapterCommands** is a class that is used to send and receive data from the CDC, as well as for parsing and serializing data between firmware and libCEC format.

libCEC Driver for Windows is the standard driver for serial communication included with the Windows installation. For using the device, it will use detection from libCEC, which depends on Windows registers.

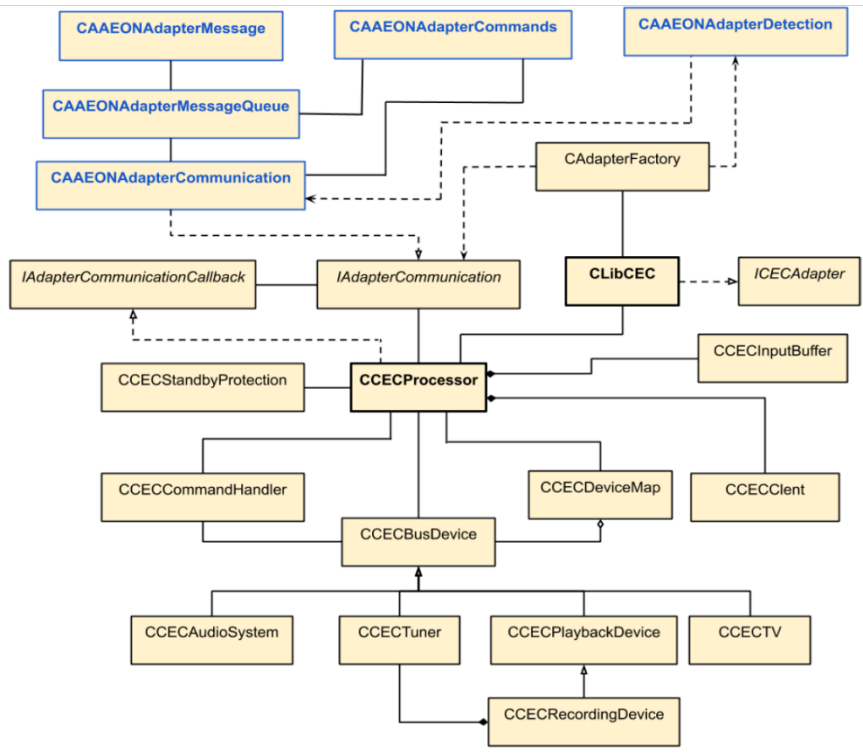


Image 19: libCEC Architecture

libCEC exports an ICECAdapter interface that can be used by various clients, such as cec-client, Kodi, etc. It contains methods such as: open port, transmit CEC message, set logical address, power on CEC devices, get device menu language, etc.

4.2 Demo Application cec-client.exe

To send custom CEC commands from PC to TV through libCEC-AAEON adapter, you will need to install the cec-client. This is an .exe file that is included in the libCEC and Windows driver package. A new CEC-Client was made with libCEC-AAEON adapter and compiled libCEC in which a new adapter was added (3.2.1 Compile libCEC)

4.2.1 CEC-Client

Cec-client is a test client/demo application, used to debug the device. To start the demo application and check whether the device can be detected, execute the command **"cec-client.exe"** in libcec\build\amd64 or run the installed application.

```

Administrator: C:\WINDOWS\system32\cmd.exe - cec-client.exe
No device type given. Using 'recording device'
CEC Parser created - libCEC version 4.0.4
no serial port given. trying autodetect:
path:      USB\VID_0483&PID_5740\318436634248
com port:  AAEON:COM31

opening a connection to the CEC adapter...
DEBUG: [ 29] Broadcast (F): osd name set to 'Broadcast'
DEBUG: [ 29] PORT: AAEON:COM31 SIZE: 6
DEBUG: [ 29] ENTER: CAEONAdapterCommands::Open
DEBUG: [ 81] OPEN: COM31
DEBUG: [ 81] ENTER: CAEONAdapterMessageQueue::Process
NOTICE: [ 81] connection opened
DEBUG: [ 81] processor thread started
DEBUG: [ 81] << Broadcast (F) -> TV (0): POLL
TRAFFIC: [ 82] << f0
DEBUG: [ 82] PUSH: send 0

DEBUG: [ 96] ENTER: CAEONAdapterCommands::Write
DEBUG: [ 96] SENT: send 0

DEBUG: [ 111] RECEIVED: 5 bytes
DEBUG: [ 112] ACK: ACK
DEBUG: [ 127] QUEUE: Size=1, REQ[0]=send 0 , RES[0]=ACK
DEBUG: [ 143] >> POLL sent
DEBUG: [ 143] TV (0): device status changed into 'present'
DEBUG: [ 143] << requesting vendor ID of 'TV' (0)
TRAFFIC: [ 143] << f0:8c
DEBUG: [ 143] PUSH: send 0 8C
  
```

Image 20: Run CEC-Client

4.2.2 Testing CEC-Client

CEC-Client must be run from Terminal. Type **cec-client.exe** to run it. After CEC-Client starts, it will open CEC-Client Terminal Application. From CEC-Client Terminal Application, you can send commands for testing. Some CEC-Client commands for testing libCEC are listed in the following table.

| Command | Description |
|--------------------|------------------------------|
| tx 10:44:41 | TV change volume – volume up |
| on 0 | Turn on TV |
| standby 0 | Put TV in standby mode |

Chapter 5 Supported Commands

This section describes the message transfer and additional details for a number of common features enabled by CEC. Note that where a feature is supported, all messages within that feature should be implemented.

5.1 Limitations

Firmware Limitations:

- We cannot guarantee that commands will be processed if sent at intervals less than 240ms.
- After calling the bootloader, the device needs to be reset. The device also needs to be reset after uploaded the DFU file to the device, after which the firmware device will be operational.
- It is necessary to disconnect ST-Link before using CEC-Client or Kodi.
- Suspend from Kodi is not supported, because TV changes its address to a non-zero number after resume. If this happens, the TV needs to be turned off and turned back on to assign itself a proper address.

libCEC Limitations:

- Some features in libCEC have not been implemented by different brands and/or are not consistently supported across models. The following table highlights some limitations. The list is not final and may vary to support as many vendors as possible.
- Since there is no physical address detection, libCEC will only work on HDMI port 1
- Kodi is only supported with libCEC4.04.1

The tables on the following page detail support limitations. Fields marked with "-" may work but have not been verified.

| | One Touch Play | Routing Control | Standby | One Touch Record | Timer Programming | System Information | Deck Control | Tuner Control | OSD String Display | Device OSD Name Transfer |
|------------|----------------|-----------------|---------|------------------|-------------------|--------------------|--------------|---------------|--------------------|--------------------------|
| Akai | - | - | - | - | - | - | - | - | - | - |
| AOC | - | - | - | - | - | - | - | - | - | - |
| Beng | - | - | - | - | - | - | - | - | - | - |
| Daewoo | - | - | - | - | - | - | - | - | - | - |
| Grundig | - | - | - | - | - | - | - | - | - | - |
| Hitachi | - | - | - | - | - | - | - | - | - | - |
| LG | Yes | Yes | Yes† | - | - | - | Yes | - | No | No |
| Loewe | - | - | - | - | - | - | - | - | - | - |
| Marantz | - | Yes | - | - | - | - | - | - | - | - |
| Medion | - | - | - | - | - | - | - | - | - | - |
| Mitsubishi | - | - | - | - | - | - | - | - | - | - |
| Onkyo | Yes | Yes | Yes | - | - | - | - | - | No | - |
| Panasonic | Yes | Yes | Yes | - | - | - | - | - | - | No |

| | Device Menu Control | Remote Control Passthrough | Power Status | System Audio Control |
|------------|---------------------|----------------------------|--------------|----------------------|
| Akai | - | - | - | - |
| AOC | - | - | - | - |
| Benq | - | - | - | - |
| Daewoo | - | - | - | - |
| Grundig | - | - | - | - |
| Hitachi | - | - | - | - |
| LG | - | Yes | - | - |
| Loewe | - | - | - | - |
| Marantz | - | - | - | - |
| Medion | - | - | - | - |
| Mitsubishi | - | - | - | - |
| Onkyo | - | Yes | - | Yes |
| Panasonic | - | Yes | - | - |

† Supported by all devices except TVs.

| | One Touch Play | Routing Control | Standby | One Touch Record | Timer Programming | System Information | Deck Control | Tuner Control | OSD String Display | Device OSD Name Transfer |
|---------|----------------|-----------------|---------|------------------|-------------------|--------------------|--------------|---------------|--------------------|--------------------------|
| Philips | Yes | Yes | Yes | No | No | Yes | No | No | No | Yes |
| Pioneer | - | - | - | - | - | - | - | - | - | - |
| Runco | - | - | - | - | - | - | - | - | - | - |
| Samsung | Yes | Yes | Yes† | - | - | - | Yes | - | No | Yes |
| Sharp | Yes | Yes | Yes | - | - | - | - | - | - | - |
| Sony | Yes | Yes | Yes | - | - | - | - | - | - | - |
| Toshiba | Yes | Yes | Yes | - | - | - | - | - | - | - |
| Vizio | Yes | Yes | Yes | - | - | - | - | - | - | - |
| Yamaha | - | - | Yes | - | - | - | - | - | - | - |

| | Device Menu Control | Remote Control Passthrough | Power Status | System Audio Control |
|---------|---------------------|----------------------------|--------------|----------------------|
| Philips | - | Yes | Yes | Yes |
| Pioneer | - | - | - | - |
| Runco | - | - | - | - |
| Samsung | - | - | - | - |
| Sharp | - | - | - | - |
| Sony | - | - | - | - |
| Toshiba | - | - | - | - |
| Vizio | - | - | - | - |
| Yamaha | - | - | - | Yes |

† Some models require you to turn on “Auto-Standby” in the Anynet+ settings to enable this feature.

5.1.1 One Touch Play

Command Feature: The One Touch Play feature allows a device to be played and become the active source with a single button press.

The following messages are used for the One Touch Play feature: <Active Source>, <Image View On>, <Text View On>.

| OpCode | Value | Description | Parameters | Response | Supported |
|-----------------|-------|--|--------------------|---|-----------|
| <Active Source> | 0x82 | Used by a new source to indicate that it has started to transmit a stream OR used in response to a <Request Active Source> | [Physical Address] | A current active source should take appropriate Action. TV should switch to the appropriate input. Any CEC switches between source and root shall switch to the appropriate input and come out of standby if necessary. | Yes* |
| <Image View On> | 0x04 | Sent by a source device to the TV whenever it enters the active state (alternatively it may send <Text View On>). | None | Turn on (if not on). If in 'Text Display' state than the TV enters 'Image Display' state. Note: Should not change TV menu or PIP status. | Yes |
| <Text View On> | 0x0D | As <Image View On>, but should also remove any text, menus and PIP windows from the TV's display. | None | As <Image View On>, but should remove PIPs and menus from the screen. The TV enters 'Image Display' state regardless of its previous state. | Yes |

*See Chapter 5.1 for limitations.

5.1.2 Routing Control

Command Feature: This feature is used to control the routing of the HDMI network by controlling CEC Switches.

The following messages are used for the Routing Control feature: <Active Source>, <Inactive Source>, <Request Active Source>, <Set Stream Path>, <Routing Change>, <Routing Information>.

5.1.3 System Standby

Command Feature: The broadcast message <Standby> can be used to switch all CEC devices to standby. The following message is used for the System Standby feature: <Standby>

| OpCode | Value | Description | Parameters | Response | Supported |
|-----------|-------|---|------------|---|-----------|
| <Standby> | 0x36 | Switches one or all devices into standby mode. Can be used as a broadcast message or be addressed to a specific device. | None | Switch the device into Standby. Ignore the message if already in standby. | Yes |

5.1.4 One Touch Record

Command Feature: This feature allows the user to easily start a recording of the source that is being displayed on the TV, just by selecting a Recording Device and giving the record command.

The following messages are used for the One Touch Record feature: <Record Off>, <Record On>, <Record Status>, <Record TV Screen>.

| OpCode | Value | Description | Parameters | Response | Supported |
|--------------|-------|--|------------|-------------------------|-----------|
| <Record Off> | 0x0B | Requests a device to stop a recording. | None | Exit 'Recording' state. | Yes |

Table Continues on Next Page

| OpCode | Value | Description | Parameters | Response | Supported |
|-----------------|-------|---|----------------------|--|-----------|
| <Record On> | 0x09 | Attempt to record the specified source. | [Record Source] | Enter 'Recording' state and start recording if possible. Send the initiator <Record Status>. | Yes |
| <Record Status> | 0x0A | Used by a Recording Device to inform the initiator of the message <Record On> about its status. | [Record Status Info] | | Yes |

5.1.5 Timer Programming

Command Feature: This feature allows a device (e.g. TV) to set a timer recording on a Recording Device. For example, it can be used to set timer blocks of a Recording Device via a TV menu or via an EPG.

The following messages are used for the Timer Programming feature: <Clear Analogue Timer>, <Clear Digital Timer>, <Clear External Timer>, <Set Analogue Timer>, <Set Digital Timer>, <Set External Timer>, <Set Timer Program Title>, <Timer Cleared Status>, <Timer Status>.

| OpCode | Value | Description | Parameters | Response | Supported |
|------------------------|-------|--|-----------------------------------|---|-----------|
| <Clear Analogue Timer> | 0x33 | Used to clear an Analogue timer block of a device. | See <Set Analogue Timer> message. | Clear timer block if possible, then respond with <Timer Cleared Status> | Yes |
| <Clear Digital Timer> | 0x99 | Used to clear a Digital timer block of a device. | See <Set Digital Timer> message | Clear timer block if possible, then respond with <Timer Cleared Status> message | Yes |
| <Clear External Timer> | 0xA1 | Used to clear an External timer block of a device | See <Set External Timer> message | Clear timer block if possible, then respond with <Timer Cleared Status> message | Yes |

Table Continues on Next Page

| OpCode | Value | Description | Parameters | Response | Supported |
|----------------------|-------|---|--|------------------------|-----------|
| <Set Analogue Timer> | 0x34 | Used to set a single timer block on an Analogue Recording Device. | [Day of Month] [Month of Year] [Start Time] [Duration] [Recording Sequence] [Analogue Broadcast Type] [Analogue Frequency] [Broadcast System] | <Timer Status> message | Yes |
| <Set Digital Timer> | 0x97 | Used to set a single timer block on a Digital Recording Device. | [Day of Month] [Month of Year] [Start Time] [Duration] [Recording Sequence] [Digital Service Identification] | <Timer Status> message | Yes |
| <Set External Timer> | 0xA2 | Used to set a single timer block to record from an external device. | [Day of Month] [Month of Year] [Start Time] [Duration] [Recording Sequence] [External Source Specifier] [External Plug] [External Physical Address] | <Timer Status> message | Yes |

Table Continues on Next Page

| OpCode | Value | Description | Parameters | Response | Supported |
|---------------------------|-------|--|-----------------------------|---|-----------|
| <Set Timer Program Title> | 0x67 | Used to set the name of a program associated with a timer block. Sent directly after sending a <Set Analogue Timer> or <Set Digital Timer> message. The name is then associated with that timer block. | [Program Title String] | Recording device stores title for future reference. Ignore message if it is not the immediate next message from this initiator following a <Set Analogue Timer> or <Set Digital Timer> message. | Yes |
| <Timer Cleared Status> | 0x43 | Used to give the status of a <Clear Analogue Timer>, <Clear Digital Timer> or <Clear External Timer> message | [Timer Cleared Status Data] | If the message indicates that the timer was not cleared because there was no matching entry, the device should remove the timer block locally. | Yes |
| <Timer Status> | 0x35 | Used to send timer status to the initiator of a <Set Timer> msg | [Timer Status Data] | None | Yes |

5.1.6 System Information

Command Feature: This feature allows devices to automatically use the same OSD and Menu language settings as the TV and also for a TV to discover the current language when it is being installed.

The following messages are used for the System Information feature: <CEC Version>, <Get CEC Version>, <Get Menu Language>, <Give Physical Address>, <Polling Message>, <Report Physical Address>, <Set Menu Language>.

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| OpCode | Value | Description | Parameters | Response | Supported |
|---------------------------|-------|---|-------------------------------------|---|-----------|
| <CEC Version> | 0x9E | Used to indicate the supported CEC version, in response to a <Get CEC Version> | [CEC Version] | | Yes |
| <Get CEC Version> | 0x9F | Used by a device to enquire which version of CEC the target supports | None | The source responds with a <CEC Version> Message indicating the CEC version | Yes |
| <Give Physical Address> | 0x83 | A request to a device to return its physical address. | None | <Report Physical Address> | Yes |
| <Get Menu Language> | 0x91 | Sent by a device capable of character generation (for OSD and Menus) to a TV in order to discover the currently selected Menu language. Also used by a TV during installation to discover the currently set menu language of other devices. | None | The addressed device responds with a <Set Menu Language> message | Yes |
| <Polling Message> | — | Used by any device for device discovery – similar to ping in other protocols. | None | Shall set a low level ACK. | Yes |
| <Report Physical Address> | 0x84 | Used to inform all other devices of the mapping between physical and logical address of the initiator. | [Physical Address] [Device Type] | | Yes |
| <Set Menu Language> | 0x32 | Used by a TV or another device to indicate the menu language. | [Language] | Set the menu language as specified, if possible. | Yes |

5.1.7 Deck Control

Command Feature: This feature allows a Playback Device (a deck or disc player or recorder) to be controlled by another device (e.g. TV).

The following messages are used for the Deck Control feature: <Deck Status>, <Give Deck Status>, <Deck Control>, <Play>.

| OpCode | Value | Description | Parameters | Response | Supported |
|--------------------|-------|---|---------------------|---|-----------|
| <Deck Control> | 0x42 | Used to control a device's media functions. | [Deck Control Mode] | Perform the specified actions, or return a <Feature Abort> message. It is device dependent whether or not a Skip Forward/Wind or Skip Backward /Rewind command is legal when in the 'Deck Inactive' state. If the device is in standby and receives an eject command, it should power on and eject its media. | Yes |
| <Give Deck Status> | 0x1A | Used to request the status of a device, regardless of whether or not it is the current active source. | [Status Request] | <Deck Status> | Yes |
| <Deck Status> | 0x1B | Used to provide a deck's status to the initiator of the <Give Deck Status> msg | [Deck Info] | | Yes |

Table Continues on Next Page

| OpCode | Value | Description | Parameters | Response | Supported |
|--------|-------|---|-------------|---|-----------|
| <Play> | 0x41 | Used to control the playback behavior of a source device. | [Play Mode] | Perform the specified actions, or return a <Feature Abort> message. If media is available the device enters 'Deck Active' state. If the device is in standby, has media available and the parameter is ["Play Forward"] it should power on. | Yes |

5.1.8 Tuner Control

Command Feature: This feature allows a device (e.g. TV) to control another CEC device's tuner.

The following messages are used for the Tuner Control feature: <Give Tuner Device Status>, <Record On>, <Select Analogue Service>, <Select Digital Service>, <Tuner Step Decrement>, <Tuner Step Increment>, <Tuner Device Status>.

| OpCode | Value | Description | Parameters | Response | Supported |
|----------------------------|-------|---|------------------|---|-----------|
| <Give Tuner Device Status> | 0x08 | Used to request the status of a tuner device. | [Status Request] | Respond with a <Tuner Device Status> message, or stop reporting changes on receipt of the["Off"] message. | Yes |
| <Record On> | 0x09 | Attempt to record the specified source. | [Record Source] | Enter 'Recording' state and start recording if possible. Send the initiator <Record Status>. | Yes |

Table Continues on Next Page

| OpCode | Value | Description | Parameters | Response | Supported |
|---------------------------|-------|---|---|--|-----------|
| <Select Analogue Service> | 0x92 | Directly selects an Analogue TV service | [Analogue Broadcast Type] [Analogue Frequency] [Broadcast System] | Change to the selected analogue service and stream its output on the HDMI connection. If the tuner device is not capable of selecting this service, respond with a <Feature Abort> | Yes |
| <Select Digital Service> | 0x93 | Directly selects a Digital TV, Radio or Data Broadcast Service | [Digital Service Identification] | Change to the selected digital service and stream its output on the HDMI connection. If the tuner device is not capable of selecting this service, respond with a <Feature Abort> | Yes |
| <Tuner Step Decrement> | 0x06 | Used to tune to next lowest service in a tuner's service list. Can be used for PIP. | None | Follower tunes to next lowest service in its service list. | Yes |
| <Tuner Step Increment> | 0x05 | Used to tune to the next highest service in a tuner's service list. Can be used for PIP. | None | Follower tunes to next highest service in its service list. | Yes |
| <Tuner Device Status> | 0x07 | Use by a tuner device to provide its status to the initiator of the <Give Tuner Device Status> message. | [Tuner Device Info] | | Yes |

5.1.9 Vendor Specific Commands

Command Feature: This feature allows a set of vendor specific commands to be used to communicate between devices.

The following messages are used for the Vendor Specific Commands feature: <Device Vendor ID>, <Give Device Vendor ID>, <Vendor Command>, <Vendor Command With ID>, <Vendor Remote Button Down>, <Vendor Remote Button Up>

| OpCode | Value | Description | Parameters | Response | Supported |
|-----------------------------|-------|--|---------------------------------------|--|-----------|
| <Device Vendor ID> | 0x87 | Reports the vendor ID of this device. | [Vendor ID] | Any other interested device may store the vendor ID of the device. | Yes |
| <Give Device Vendor ID> | 0x8C | Requests the Vendor ID from a device. | None | <Device Vendor ID> | Yes |
| <Vendor Command> | 0x89 | Allows vendor specific commands to be sent between two devices. | [Vendor Specific Data] | Vendor Specific | Yes |
| <Vendor Command With ID> | 0xA0 | Allows vendor specific commands to be sent between two devices or broadcast. | [Vendor ID] [Vendor Specific data] | Vendor Specific | Yes |
| <Vendor Remote Button Down> | 0x8A | Indicates that a remote control button has been depressed. | [Vendor Specific RC Code] | Vendor Specific | Yes |

5.1.10 OSD Display

Command Feature: This feature allows a device to transfer a text string to the TV for On Screen Display. The <Set OSD String> message is used to transfer the text string to the TV.

The following message is used for the OSD Display feature: <Set OSD String>

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| OpCode | Value | Description | Parameters | Response | Supported |
|------------------|-------|--|-----------------------------------|--------------------------|-----------|
| <Set OSD String> | 0x64 | Used to send a text message to output on a TV. | [Display Control] [OSD String] | TV displays the message. | Yes |

5.1.11 Device OSD Name Transfer

Command Feature: This feature is used to request the preferred name of a device to be used in any on screen display (e.g. menus), which reference that device.

The following messages are used for the Device OSD Name Transfer feature: <Give OSD Name>, <Set OSD Name>

| OpCode | Value | Description | Parameters | Response | Supported |
|-----------------|-------|--|------------|---|-----------|
| <Give OSD Name> | 0x46 | Used to request the preferred OSD name of a device for use in menus associated with that device. | None | <Set OSD Name> | Yes |
| <Set OSD Name> | 0x47 | Used to set the preferred OSD name of a device for use in menus associated with that device. | [OSD Name] | Store the name and use it in any menus associated with that device. | Yes |

5.1.12 Device Menu Control

Command Feature: This feature allows device menus to be controlled via the TV remote control as if it was using its own remote control, and allow the TV to be aware when another device has a menu on its display.

The following messages are used for the Device Menu Control feature: <User Control Pressed>, <User Control Released>, <Menu Request>, <Menu Status>

| OpCode | Value | Description | Parameters | Response | Supported |
|------------------------|-------|---|--------------|---|-----------|
| <User Control Pressed> | 0x44 | Used to indicate that the user pressed a remote control button or switched from one remote control button to another. | [UI Command] | Update display or perform an action, as required. | Yes |

| OpCode | Value | Description | Parameters | Response | Supported |
|-------------------------|-------|--|---------------------|---|-----------|
| <User Control Released> | 0x45 | Indicates that user released a remote control button (the last one indicated by the <User Control Pressed> message) | None | Update display or perform an action, as required. | Yes |
| <Menu Request> | 0x8D | A request from the TV for a device to show/remove a menu or to query if a device is currently showing a menu. | [Menu Request Type] | May enter or exit the 'Device Menu Active' state if the parameter was "Activate" or "Deactivate". Send <Menu Status> to indicate the current status of the devices menu. | Yes |
| <Menu Status> | 0x8E | Used to indicate to the TV that the device is showing/has removed a menu and requests the remote control keys to be passed though. | [Menu State] | If Menu State indicates activated, TV enters 'Device Menu Active' state and forwards those Remote control commands, shown in Table 26, to the initiator. If deactivated, TV enters 'Device Menu Inactive' state and stops forwarding remote control commands. | Yes |

5.1.13 Remote Control Passthrough

Command Feature: This feature is used to pass remote control commands received by one device (typically the TV) through to another device in the network.

The following messages are used for the Remote Control Passthrough feature: <User Control Pressed>, <User Control Released>.

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| OpCode | Value | Description | Parameters | Response | Supported |
|-------------------------|-------|---|--------------|---|-----------|
| <User Control Pressed> | 0x44 | Used to indicate that the user pressed a remote control button or switched from one remote control button to another. | [UI Command] | Update display or perform an action, as required. | Yes |
| <User Control Released> | 0x45 | Indicates that user released a remote control button (the last one indicated by the <User Control Pressed> message) | None | Update display or perform an action, as required. | Yes |

5.1.14 Give Device Power Status

Command Feature: Several messages, such as <Image View On> and <Play>, bring another device out of standby. The <Give Device Power Status> message is used to determine the current power status of a target device. The target device responds with a <Report Power Status> message containing the Power Status operand.

The following messages are used for the Give Device Power Status feature: <Give Device Power Status>, <Report Power Status>.

| OpCode | Value | Description | Parameters | Response | Supported |
|----------------------------|-------|---|----------------|-----------------------|-----------|
| <Give Device Power Status> | 0x8F | Used to determine the current power status of a target device. | None | <Report Power Status> | Yes |
| <Report Power Status> | 0x90 | Used to inform a requesting device of the current power status. | [Power Status] | | Yes |

5.1.15 System Audio Control

Command Feature: This feature allows an audio amplifier to provide the audio for a source that is being displayed on a TV. When in this mode, the amplifier uses the same source as the video and provides the volume control function, instead of the TV, which mutes its speakers.

The following messages are used for the System Audio Control feature: <Give Audio Status>, <Give System Audio Mode Status>, <Report Audio Status>, <Set System Audio Mode>, <System Audio Mode Request>, <System Audio Mode Status>, <User Control Pressed>, <User Control Released>.

| OpCode | Value | Description | Parameters | Response | Supported |
|---------------------------------|-------|--|-----------------------|---|-----------|
| <Give Audio Status> | 0x71 | Requests an amplifier to send its volume and mute status | None | <Report Audio Status> | Yes |
| <Give System Audio Mode Status> | 0x7D | Requests the status of the System Audio Mode | None | Amplifier sends a <System Audio Mode Status> message indicating status (On or Off) | Yes |
| <Report Audio Status> | 0x7A | Reports an amplifier's volume and mute status | [Audio Status] | | Yes |
| <Set System Audio Mode> | 0x72 | Turns the System Audio Mode On or Off. | [System Audio Status] | If set to On, the TV mutes its speakers. The TV or STB sends relevant <User Control Pressed> or <User Control Released> as necessary. If set to Off, the TV unmutes its speakers. The TV or STB stop sending the volume-related <User Control Pressed> or <User Control Released> messages. | Yes |

Table Continues on Next Page

| OpCode | Value | Description | Parameters | Response | Supported |
|--|-------|--|--|--|-----------|
| <System Audio Mode Request> | 0x70 | A device implementing System Audio Control and which has volume control RC buttons (eg TV or STB) requests to use System Audio Mode to the amplifier | [Physical Address] | The amplifier comes out of standby (if necessary) and switches to the relevant connector for device specified by [Physical Address]. It then sends a <Set System Audio Mode> [On] Message. <System Audio Mode Request> sent without a [Physical Address] parameter requests termination of the feature. In this case, the amplifier sends a <Set System Audio Mode> [Off] message. | Yes |
| <System Audio Mode Status> | 0x7E | Reports the current status of the System Audio Mode | [System Audio Status] | If [On], the device requesting this information can send the volume-related <User Control Pressed> or <User Control Released> messages. | Yes |
| <User Control Pressed> | 0x44 | Used to indicate that the user pressed a remote control button or switched from one remote control button to another. | [UI Command] of "Volume Up", "Volume Down" or "Mute" | Increase or Decrease the volume of the amplifier, or mute/unmute the amplifier. | Yes |
| <User Control Released> | 0x45 | Used to control audio rate from Source Device. | [Audio Rate] | Perform the specified actions, or return a <Feature Abort> msg | Yes |

5.1.16 Audio Rate Control

Command Feature: This feature allows the audio playback rate of a Source Device to be controlled by another device, e.g. an Audio System.

The following messages are used for the Audio Rate Control Feature: <Set Audio Rate>

| OpCode | Value | Description | Parameters | Response | Supported |
|------------------|-------|--|--------------|---|-----------|
| <Set Audio Rate> | 0x9A | Used to control audio rate from Source Device. | [Audio Rate] | Perform the specified actions, or return a <Feature Abort> message. | Yes |