**ACLK UCD Requirements**

The ACLK-UCD is front end based ACLK decoding systems with automatic switchover to provide ACLK monitoring along with serving as the source of the AD Network multicast of ACLK. It is required to be a RTOS based system that provides data logging and display of all ACLK events broadcast. It is based on the existing UCDA & UCDB systems that presently monitor TCLK and provide the existing TCLK multicast.

**UCD Event Monitor Application**

An application page is required to allow for the recording/display of accelerator clock events that have been broadcast on the various clock systems within the Fermilab complex. It will need to be capable of reading event data from various UCD front ends (ACLK-UCD, UCDA, UCDB, UCDT, etc.) and displaying the events with supercycle relative time stamps. It will need to provide logging of the most recent 14 days worth of supercycle data as well as saving data from select supercycles for future recall.



Figure 1: ACNET TLG Interface Application

**ACLK-UCD Hardware**

The ACLK-UCD Hardware will consist of a 19” rack mountable field crate with compatible front end computer card/module. It will have a Gigabit ethernet (1000BaseT) or better network interface. It will require an ACLK decoder for event detection.

**General Requirements**

* Highly reliable, fail-safe operation;
* Compatible with the staged PIP-II commissioning;
* Capable of detecting and logging all ACLK events as shown in Appendix A;
* Restricted, documented privileges to access and modify configurations;
* Expandable in order to support modifications and future upgrades without major modifications;

**Other Requirements**

* 19” Equipment Rack mountable Front End
* 120VAC 60 Hz equipment power
* Ethernet Interface (1000BaseT)
* ACLK decoder
* Utilize a Real Time Operating System
* Front End shall support 20 Hz Multicast of ACLK

# APPENDIX A – ACLK/TCLK Event Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ACLK Event** | **TCLK Event** | **Description** | **Priority** | **Event Type** |
| $0000 | $00 | Super Cycle and Master Clock Reset; marks start of supercycle | 1 | I |
| $0001 | $01 | Unassigned |  |  |
| $0002 | $02 | Time Plot Timestamp Reset: generated once every 50,000,000 TCLK cycles (every 5 seconds); not synchronized to any other event | 98 | II |
| $0003 | $03 | MTA Beam Permitted | 101 | II |
| $0004 | $04 | MTA Pulse on next $11 | 26 | I |
| $0005 | $05 | User Friendly Event; intended for short term use; user selectable delay and reference | 174 | III |
| $0006 | $06 | (reserved for 60 Hz synchronized to AC line) |  |  |
| $0007 | $07 | 720 Hz; synchronized to AC line | 69 | II |
| $0008 | $08 | Unassigned |  |  |
| $0009 | $09 | Permitted NTF Beam Cycle; coincident with $11 | 249 | II |
| $000A  | $0A | Permitted 400 MeV Linac Studies Cycle; coincident with $11 | 162 | II |
| $000B  | $0B | Booster Beam Sample Data Ready; referenced to $10 | 160 | III |
| $000C  | $0C | 20 Hz; synchronized to GMPS BMIN Delayed | 61 | I |
| $000D  | $0D | Booster Beam Sample Time; "or" of 8 377 channels referenced to $13,$14,$15,$16,$17,$19,$1C,$1D | 253 | V |
| $000E  | $0E | First Booster Beam Reset After a Pre-pulse Cycle | 8 | I |
| $000F  | $0F | 20 Hz; synchronized to A phase of AC line in MAC room | 2 | II |
| $0010 | $10 | Generic Booster Reset for Accelerating Beam Cycle; "or" of $13,$14,$15,$16,$17,$19,$1C,$1D | 125 | IX |
| $0011 | $11 | Booster Reset for Null Cycle; generated at GMPS BMIN Delayed | 50 | I |
| $0012 | $12 | Booster Reset for Beam Pre-pulse Cycle; generated at GMPS BMIN Delayed; always preceeded by $08 | 51 | I |
| $0013 | $13 | Booster Reset for Fixed Target Beam Cycle; generated at GMPS BMIN Delayed | 52 | I |
| $0014 | $14 | Booster Reset for MI/Muon Studies; generated at GMPS BMIN Delayed | 53 | I |
| $0015 | $15 | Booster Reset for NUMI Beam Cycle; generated at GMPS BMIN Delayed | 54 | I |
| $0016 | $16 | Booster Reset for MI Studies; generated at GMPS BMIN Delayed | 55 | I |
| $0017 | $17 | Booster Reset for Booster Studies Cycle; generated at GMPS BMIN Delayed | 56 | I |
| $0018 | $18 | Booster Sample Time; used for Booster data sampling in front-end; referenced to $10,$11,$12 | 91 | III |
| $0019 | $19 | Booster Reset for NUMI Beam Cycle; generated at GMPS BMIN Delayed | 57 | I |
| $001A  | $1A | Parasitic Beam Permit; made @ positive transition of TLG output | 13 | I |
| $001B  | $1B | Parasitic Beam Inhibit; made @ negative transition of TLG output | 64 | I |
| $001C  | $1C | Booster Reset for MI/RR Studies; generated at GMPS BMIN Delayed | 58 | I |
| $001D  | $1D | Booster Reset for MiniBooNe Beam Cycle; generated at GMPS BMIN Delayed | 59 | I |
| $001E  | $1E | Booster Extraction Sync (BES) for a Pre-pulse Cycle"; generated by BES during a Booster $12 pre-pulse cycle | 150 | II |
| $001F  | $1F | Booster Extraction Sync (BES) for a Beam Cycle"; generated by a BES during a Booster beam cycle | 151 | II |
| $0020 | $20 | MI Reset for 120 GeV Short Flattop Fixed Target Beam | 33 | I |
| $0021 | $21 | MI Reset for 120 GeV Long Flattop Fixed Target Beam | 34 | I |
| $0022 | $22 | Start of MI Ramp Up; "or" of 8 377 channels with separate references to $20,$21,$23,$29,$2A,$2B,$2D,$2E | 124 | V |
| $0023 | $23 | MI Reset for NUMI Beam Cycle | 35 | I |
| $0024 | $24 | MI BP/Abort System Reset | 215 | VIII |
| $0025 | $25 | Start of MI Ramp Flattop; "or" of 8 377 channels with separate references to $20,$21,$23,$29,$2A,$2B,$2D,$2E | 127 | V |
| $0026 | $26 | End of MI Ramp Flattop; "or" of 8 377 channels with separate references to $20,$21,$23,$29,$2A,$2B,$2D,$2E | 128 | V |
| $0027 | $27 | MI Beam Aborted; requested on fall of Abort/Permit loop | 75 | VII |
| $0028 | $28 | MI 8GeV Injected Beam from BSTR; generated by $1F on $13, $14, $15, $16, $19 or $1C cycles | 198 | IX |
| $0029 | $29 | MI Reset for MI Studies/120 GeV to Muon Cycle | 42 | I |
| $002A  | $2A | MI Reset for NuMI Beam with RR Cycle | 43 | I |
| $002B  | $2B | MI Reset for MI Studies | 44 | I |
| $002C  | $2C | MI Sample Time; "or" of 8 377 channels with separate references to $20,$21,$23,$29,$2A,$2B,$2D,$2E | 144 | V |
| $002D  | $2D | MI Reset for 8 GeV Beam to Muon/MI Studies | 46 | I |
| $002E  | $2E | MI Reset for MI Studies | 47 | I |
| $002F  | $2F | MI Cleanup; "or" of 8 377 channels with separate references to $20,$21,$23, $29,$2A,$2B,$2D,$2E | 76 | V |
| $0030 | $30 | Switchyard Reset for 120 GeV, Long Spill Extracted Beam | 20 | I |
| $0031 | $31 | Switchyard Reset for Extracted Beam Cycle; $30 & $32 are usual references | 89 | III |
| $0032 | $32 | Switchyard Reset for 120 GeV, Short Spill Extracted Beam | 25 | I |
| $0033 | $33 | Switchyard Fast Spill/Ping | 178 | V |
| $0034 | $34 | Switchyard SWIC Sample Time | 152 | V |
| $0035 | $35 | Switchyard Beam Sample Time; $31 is normal reference | 175 | III |
| $0036 | $36 | Switchyard Post-Beam Sample Time; $31 is normal reference | 176 | III |
| $0037 | $37 | Switchyard Read Intensity Monitors | 173 | III |
| $0038 | $38 | Switchyard Beam Permit System Reset | 206 | VIII |
| $0039 | $39 | TCLK reflection of MIBS $75: 120GeV Proton extraction from MI to SYWD | 207 | IV |
| $003A  | $3A | Switchyard BPM Write Profile Memory; "or" of 8 377 channels with common $31 reference | 216 | VI |
| $003B  | $3B | Switchyard BPM Write Display Frame | 222 | III |
| $003C  | $3C | Switchyard Variable Event | 135 | III |
| $003D  | $3D | Switchyard Analog Alarm Event | 117 | III |
| $003E  | $3E | SWYD Permit has Dropped; requested on fall of permit | 116 | VII |
| $003F  | $3F | End of Switchyard beam injection | 179 | III |
| $0040 | $40 | Unassigned |  |  |
| $0041 | $41 | Unassigned |  |  |
| $0042 | $42 | Unassigned |  |  |
| $0043 | $43 | Unassigned |  |  |
| $0044 | $44 | Unassigned |  |  |
| $0045 | $45 | Unassigned |  |  |
| $0046 | $46 | Unassigned |  |  |
| $0047 | $47 | Unassigned |  |  |
| $0048 | $48 | Unassigned |  |  |
| $0049 | $49 | Unassigned |  |  |
| $004A  | $4A | Unassigned |  |  |
| $004B  | $4B | Unassigned |  |  |
| $004C  | $4C | Booster Variable Event | 193 | III |
| $004D  | $4D | Unassigned |  |  |
| $004E  | $4E | Unassigned |  |  |
| $004F  | $4F | Unassigned |  |  |
| $0050 | $50 | Begin MI Studies | 156 | III |
| $0051 | $51 | End MI Studies | 157 | III |
| $0052 | $52 | HEP Beam Permitted by BSSB; generated at $10 when beam to Booster is permitted | 204 | II |
| $0053 | $53 | HEP Beam Inhibited by BSSB; generated at $10 when beam to Booster is inhibited | 205 | II |
| $0054 | $54 | Unassigned |  |  |
| $0055 | $55 | Unassigned |  |  |
| $0056 | $56 | Unassigned |  |  |
| $0057 | $57 | TCLK Reflection of MIBS $77: Proton transfer from Booster to Main Injector | 177 | IV |
| $0058 | $58 | RR Gap Clearing Kicker C479 Trigger Clear | 145 | III |
| $0059 | $59 | Unassigned |  |  |
| $005A  | $5A | Unassigned |  |  |
| $005B  | $5B | Unassigned |  |  |
| $005C  | $5C | Unassigned |  |  |
| $005D  | $5D | Unassigned |  |  |
| $005E  | $5E | Unassigned |  |  |
| $005F  | $5F | Unassigned |  |  |
| $0060 | $60 | Unassigned |  |  |
| $0061 | $61 | Unassigned |  |  |
| $0062 | $62 | Unassigned |  |  |
| $0063 | $63 | Unassigned |  |  |
| $0064 | $64 | Unassigned |  |  |
| $0065 | $65 | Unassigned |  |  |
| $0066 | $66 | Unassigned |  |  |
| $0067 | $67 | P1 Permit has Dropped; requested on fall of permit | 113 | VII |
| $0068 | $68 | Unassigned |  |  |
| $0069 | $69 | Unassigned |  |  |
| $006A  | $6A | Unassigned |  |  |
| $006B  | $6B | Unassigned |  |  |
| $006C  | $6C | Unassigned |  |  |
| $006D  | $6D | Unassigned |  |  |
| $006E  | $6E | Unassigned |  |  |
| $006F  | $6F | Unassigned |  |  |
| $0070 | $70 | First $1D of chain | 196 | IX |
| $0071 | $71 | Unassigned |  |  |
| $0072 | $72 | Booster BPM - End of Beam | 218 | III |
| $0073 | $73 | Unassigned |  |  |
| $0074 | $74 | Unassigned |  |  |
| $0075 | $75 | Unassigned |  |  |
| $0076 | $76 | Unassigned |  |  |
| $0077 | $77 | P2 Permit has Dropped; requested on fall of permit | 114 | VII |
| $0078 | $78 | Unassigned |  |  |
| $0079 | $79 | MI BPM - Prepare for Beam; gated by MI Beam Permit | 88 | IX |
| $007A  | $7A | MI BPM - Write Profile Memory | 148 | VI |
| $007B  | $7B | MI BPM - Write Display Frame; "or" of 8 377 channels with separate references to $20,$21,$23,$29,$2A,$2B,$2D,$2E | 118 | V |
| $007C  | $7C | MI BPM Flash Trigger | 81 | IX |
| $007D | $7D | MI BPM - Set Bunch Mode | 190 | III |
| $007E  | $7E | Booster BPM - Begin Closed Orbit | 219 | III |
| $007F  | $7F | Booster BPM - Flash Trigger | 194 | V |
| $0080 | $80 | Muon Reset for non 8GeV protons to Muon via MI | 16 | I |
| $0081 | $81 | TCLK reflection of MIBS $79: Non 8GeV transfer from MI to Muon | 134 | IV |
| $0082 | $82 | Muon variable event 1 | 159 | III |
| $0083 | $83 | Muon BPM Trigger for TBT measurements | 138 | III |
| $0084 | $84 | Muon Delivery Ring prepare for beam | 171 | III |
| $0085 | $85 | Muon Reset for 8 GeV protons to Muon via MI | 7 | I |
| $0086 | $86 | Muon end of Beam Operations | 105 | V |
| $0087 | $87 | Muon Beam Permit has Dropped | 72 | VII |
| $0088 | $88 | Muon Beam Permit System Reset | 161 | VIII |
| $0089 | $89 | Muon Abort Cleanup | 106 | V |
| $008A  | $8A | Unassigned |  |  |
| $008B  | $8B | Unassigned |  |  |
| $008C  | $8C | Muon BPM/BLM Flash Trigger; "or" of 6 377 channels | 83 | VI |
| $008D  | $8D | Muon variable event 1 | 158 | III |
| $008E  | $8E | P1 & P2 Beamline Reset | 23 | I |
| $008F  | $8F | 1 Hz; Generated by GPS RCVR in computer room | 240 | II |
| $0090 | $90 | Muon Reset #1 for 8 GeV Protons from RR to M3 Line | 5 | I |
| $0091 | $91 | Muon Reset #2 for 8 GeV Protons from RR to M3 Line | 6 | I |
| $0092 | $92 | Muon P1/P2 Ramp Reset | 195 | III |
| $0093 | $93 | Muon Reset #1 for 8 GeV Protons from RR to Muon Target | 9 | I |
| $0094 | $94 | Muon Reset #2 for 8 GeV Protons from RR to Muon Target | 10 | I |
| $0095 | $95 | Muon variable Event 2 | 170 | III |
| $0096 | $96 | RR->Muon Transfer #6 | 201 | III |
| $0097 | $97 | RR->Muon Transfer #7 | 202 | III |
| $0098 | $98 | RR->Muon Transfer #8 | 203 | III |
| $0099 | $99 | TCLK Reflection of MIBS $7E: MI to Muon 8 GeV Transfer | 185 | IV |
| $009A  | $9A | RR->Muon Transfer #1 | 186 | III |
| $009B  | $9B | RR->Muon Transfer #2 | 187 | III |
| $009C  | $9C | RR->Muon Transfer #3 | 188 | III |
| $009D  | $9D | RR->Muon Transfer #4 | 189 | III |
| $009E  | $9E | RR->Muon Transfer #5 | 200 | III |
| $009F  | $9F | RR->Muon Kicker Trigger Clear | 192 | III |
| $00A0  | $A0 | MI BLM - Prepare for Beam | 85 | III |
| $00A1  | $A1 | RR BLM - Prepare for Beam | 86 | III |
| $00A2  | $A2 | Fixed Target Sample Trigger | 92 | III |
| $00A3  | $A3 | Fixed Target Sample Trigger #2 | 136 | III |
| $00A4  | $A4 | NuMI Cycle Sample Trigger; $A5 reference | 137 | III |
| $00A5  | $A5 | NUMI Reset for Beam | 18 | I |
| $00A6  | $A6 | NUMI Beam Permit has Dropped; requested on fall of permit loop | 100 | VII |
| $00A7  | $A7 | No Beam to Experimental Areas; consult W Kissel and B Hendricks | 226 | VIII |
| $00A8  | $A8 | NUMI Beam Permit /Abort System Reset | 239 | VIII |
| $00A9  | $A9 | TCLK reflection of MIBS $74: 120Gev Proton Extraction from MI to NUMI | 224 | IV |
| $00AA  | $AA | Unassigned |  |  |
| $00AB  | $AB | Unassigned |  |  |
| $00AC  | $AC | MI Abort Charge Event | 63 | I |
| $00AD  | $AD | NUMI Reset for Beamline Ramp & Extracted Beam | 110 | III |
| $00AE  | $AE | NUMI Beamline Ramp Rest | 22 | I |
| $00AF  | $AF | End of NUMI beam injection | 180 | III |
| $00B0  | $B0 | BNB Beam On Target | 228 | IX |
| $00B1  | $B1 | BNB Beam Off Target | 229 | IX |
| $00B2  | $B2 | RR BPM - Prepare for Beam | 94 | IX |
| $00B3  | $B3 | RR BPM - Write Profile Memory | 149 | VI |
| $00B4  | $B4 | RRBPM - Write Display Frame; "or" of 8 377 channels with separate references to $E0, $E1, $E2, $E3, $E9 | 115 | V |
| $00B5  | $B5 | RR BPM Flash Trigger | 95 | IX |
| $00B6  | $B6 | RR BPM - Set Bunch Mode | 191 | III |
| $00B7  | $B7 | (Reserved for MiniBooNE Beam Permit has dropped) |  |  |
| $00B8  | $B8 | MiniBooNe Beam Permit /Abort System Reset | 252 | VIII |
| $00B9  | $B9 | MI/RR Periodic Data Trigger | 248 | VIII |
| $00BA  | $BA | Test MCO Event | 256 | II |
| $00BB  | $BB | TCLK diagnostics - Start | 245 | VIII |
| $00BC  | $BC | TCLK diagnostics - Stop | 246 | VIII |
| $00BD  | $BD | MI-8 Line BLM Sample Time | 254 | III |
| $00BE  | $BE | Booster beam to Recycler | 28 | I |
| $00BF  | $BF | Booster Beam to Main Injector/MiniBooNE | 29 | I |
| $00C0  | $C0 | Unassigned |  |  |
| $00C1  | $C1 | Unassigned |  |  |
| $00C2  | $C2 | Unassigned |  |  |
| $00C3  | $C3 | Unassigned |  |  |
| $00C4  | $C4 | Unassigned |  |  |
| $00C5  | $C5 | Unassigned |  |  |
| $00C6  | $C6 | Unassigned |  |  |
| $00C7  | $C7 | Unassigned |  |  |
| $00C8  | $C8 | Unassigned |  |  |
| $00C9  | $C9 | Unassigned |  |  |
| $00CA  | $CA | Unassigned |  |  |
| $00CB  | $CB | Unassigned |  |  |
| $00CC  | $CC | Unassigned |  |  |
| $00CD  | $CD | Unassigned |  |  |
| $00CE  | $CE | Unassigned |  |  |
| $00CF  | $CF | Unassigned |  |  |
| $00D0  | $D0 | Unassigned |  |  |
| $00D1  | $D1 | Unassigned |  |  |
| $00D2  | $D2 | Unassigned |  |  |
| $00D3  | $D3 | Unassigned |  |  |
| $00D4  | $D4 | Unassigned |  |  |
| $00D5  | $D5 | Unassigned |  |  |
| $00D6  | $D6 | Unassigned |  |  |
| $00D7  | $D7 | Unassigned |  |  |
| $00D8  | $D8 | Unassigned |  |  |
| $00D9  | $D9 | Unassigned |  |  |
| $00DA  | $DA | RBEX Trigger | 84 | IX |
| $00DB  | $DB | Unassigned |  |  |
| $00DC  | $DC | Unassigned |  |  |
| $00DD  | $DD | 8 GeV BPM Sample Time | 82 | IX |
| $00DE  | $DE | RR Reset for beam to MI | 48 | I |
| $00DF  | $DF | Unassigned |  |  |
| $00E0  | $E0 | RR Reset for RR Studies | 37 | I |
| $00E1  | $E1 | RR Reset for MI Studies | 38 | I |
| $00E2  | $E2 | RR Reset for Fixed Target | 39 | I |
| $00E3  | $E3 | RR Reset for NuMI | 40 | I |
| $00E4  | $E4 | RR 8 GeV Injected Beam from BSTR | 199 | IX |
| $00E5  | $E5 | Unassigned |  |  |
| $00E6  | $E6 | RR End of Beam | 120 | V |
| $00E7  | $E7 | RR Beam Aborted; requested on fall of Abort/Permit Loop | 78 | VII |
| $00E8  | $E8 | RR BP/Abort System Reset | 140 | VIII |
| $00E9  | $E9 | RR Reset for Muon | 41 | I |
| $00EA  | $EA | MTA Pre-Event | 27 | I |
| $00EB  | $EB | Unassigned |  |  |
| $00EC  | $EC | Unassigned |  |  |
| $00ED  | $ED | RR Variable Event | 141 | III |
| $00EE  | $EE | Unassigned |  |  |
| $00EF  | $EF | RR Abort Cleanup | 77 | V |
| $00F0  | $F0 | Unassigned |  |  |
| $00F1  | $F1 | Clear $0E Holdoff | 62 | I |
| $00F2  | $F2 | Unassigned |  |  |
| $00F3  | $F3 | TCLK reflection of RRBS $A3: extract protons from RR into MI | 234 | IV |
| $00F4  | $F4 | Unassigned |  |  |
| $00F5  | $F5 | Unassigned |  |  |
| $00F6  | $F6 | TCLK reflection of RRBS $A6: 8 GeV proton transfer from RR to Muon | 214 | IV |
| $00F7  | $F7 | TCLK reflection of RRBS $A7: Proton transfer from Booster to Recycler | 250 | IV |
| $00F8  | $F8 | Unassigned |  |  |
| $00F9  | $F9 | Unassigned |  |  |
| $00FA  | $FA | TCLK reflection of MIBS $ED: MIBS/RRBS event request denied | 255 | IV |
| $00FB  | $FB | Unassigned |  |  |
| $00FC  | $FC | Do not use: (Booster Low Level Easter Egg) |  |  |
| $00FD  | $FD | Unassigned |  |  |
| $00FE  | $FE | TCLK No-Op: Do not use |  |  |
| $00FF  | $FF | TCLK No-Op |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| $0101 |  | BSSB State | 257 | I |
| $0102  |  | Reserved LINAC State |  |  |
| $0103  |  | Booster State | 259 | I |
| $0104  |  | Recycler State | 260 | I |
| $0105 |  | Main Injector State | 261 | I |
| $0106 |  | Switchyard State | 262 | I |
|  |  |  |  |  |
| $0201 |  | LINAC Start of HEP Beam Event; reflected from LCLK |  |  |
| $0202 |  | LINAC Start of Pulsed Studies Beam Event; reflected from LCLK |  |  |
| $0203 |  | LINAC Start of CW Studies Beam Event; reflected from LCLK |  |  |
|  |  |  |  |  |
| $0211 |  | LINAC Beam Permit has Dropped; reflected from LCLK |  |  |
| $0212 |  | LINAC Beam Permit Reset reflected from LCLK |  |  |