DNP Points List and Implementation

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DNP Points List for 5801 Controls

This instruction sheet provides Distributed Network Protocol (DNP) points and DNP implementation information for S&C 5800 Series Automatic Switch Controls applied in an S&C IntelliTeam Automatic Restoration System using the IntelliTeam Network Sectionalizer.

This Points List section is used with **SNCD2A5V Rev. 2.25**. The DNP master station should define the 5801 control with the following **Status**, **Analog Input**, **Analog Output**, **Binary Counter**, **Frozen Counter**, and **Control** points:

Point	Count
Status	50
Analog Input	23
Analog Output	5
Binary Counter	1
Frozen Counter	1
Control	8

The points are defined in Tables 1 through 6. Unless otherwise noted, each point is on when the condition is logically true or active.

Table 1. Status Points

Code #	Name—Definition
0	**Switch Open Contact Status—**On when the switch circuit is open. Otherwise, off.
1	**Switch Closed Contact Status—**On when the switch circuit is closed. Otherwise, off.
2	**Switch Operation Disabled—**On when switch operation is disabled. This may occur when the visual disconnect is open or Status Point 13 **Battery Bad** state is on. Otherwise, off.
3	**Automatic Operation Enabled—**On when automatic control functions have been enabled via either the faceplate switches or SCADA control command. Otherwise, off.
4	**REMOTE/LOCAL Faceplate Switch Position—**On when the switch is in the **Remote** state. In the **Remote** state, local operation of the switch from the faceplate is blocked. In the **Local** state, operation of the switch from the SCADA master station is blocked. Otherwise, off.
5	**Overcurrent Fault Detected—**On when the fault-detection circuitry has detected a line-fault condition that has not been reset by the SCADA operator. For a normally closed switch, line-fault conditions clear automatically when three-phase line voltage has been sensed, the switch is closed, 45 minutes have elapsed, or the faceplate REMOTE/LOCAL switch is toggled. For the normally open switch, toggle the REMOTE/LOCAL switch to clear the condition while the line switch is open or closed. Otherwise, off. **Note:** If the conditions above are met and the switch control is reinitialized using the setup software or a SCADA operator command, the fault condition also clears.
6	**Sectionalizer Tripped—**On when any automatic control function has opened the switch; cleared when the switch is closed for any reason. Also cleared on reinitialization of the switch control using the setup software. Otherwise, off.
7	**Battery Maintenance Required—**Unless the switch control is operating or has recently been operating on battery power, this indicates maintenance is required (probably battery replacement). Otherwise, off.
8	**Maintenance Required—**On when some form of maintenance (other than battery replacement) is required. It is on when the battery charger has failed because of overvoltage, when the switch open/close contacts are not mutually exclusive, or when the team of controls cannot operate as a team. This is a summary bit. The exact cause of the failure can be determined from the inspection of other status points. Otherwise, off.
9	**Open/Close Switch Position Indication Is Inconsistent—**On when both contacts are closed or open. Otherwise, off.
10	**Control Power Failure—**On if ac control power is not available to the battery charger. It indicates the switch control is operating on battery backup. Otherwise, off.
11	**Operator Failure Override Set—**On after the operator has executed the **Failure Override Latch On** command to let the switch be operated even if the battery is bad. This remains set until the override is disabled using the **Failure Override Latch Off** command. Also, the status point will go off and the **Failure Override** state will become disabled after a 15-minute timeout if it was not already turned off by the **Latch Off** command. Otherwise, off.
12	**Battery System Low—**The battery voltage is low, but the switch will operate. Otherwise, off.
13	**Battery System Bad—**On when the battery voltage is too low to operate the switch. This condition blocks the operation of the switch unless the **Failure Override** state is set. The **Bad Battery** status is only set when the battery voltage is too low to operate the switch. Otherwise, off.
14	**Battery Charger Problem—**On when the charging voltage applied to the battery system was too high when the charger was connected and the charger has been turned off. Otherwise, off.
15	**Battery Test in Progress—**On when the switch control is automatically testing the batteries at periodic intervals. Battery voltage fluctuates during the test. Otherwise, off.
16	**Cabinet Door Open—**On when the enclosure door is open. When the door is closed, this point is off and all power to the faceplate LEDs is turned off. Otherwise, off.

TABLE CONTINUED ►

Table 1. Status Points—Continued

Code #	Name—Definition
17	**Temperature Sensor Bad—**On when the temperature sensor is reading out of range. Temperature-related correction factors will not be accurate when the sensor is incorrect. Otherwise, off.
18	**Phase A Overcurrent Fault—**On when the peak current measured on Phase A has exceeded the programmed threshold level continuously for at least the programmed period of time. For a normally closed switch, the bit is cleared automatically once ac power has been restored to all phases, the switch is closed, 45 minutes have elapsed, or the faceplate REMOTE/LOCAL switch is toggled. For the normally open switch, toggle the REMOTE/LOCAL switch to clear the condition while the line switch is open or closed. Otherwise, off. **Note:** If the conditions above are met and the switch control is reinitialized using the setup software or a SCADA operator command, the fault condition also clears.
19	**Phase B Overcurrent Fault—**As noted in Status Point 18, for Phase B. Otherwise, off.
20	**Phase C Overcurrent Fault—**As noted in Status Point 18, for Phase C. Otherwise, off.
21	**Overcurrent Ground Fault—**As noted in Status Point 18, for ground. Otherwise, off.
22	**Loss of Voltage on Any Configured Voltage Channel—**On when a voltage sensor shows a **Loss of Voltage** status. Otherwise, off.
23	**Phase A Reverse Current—**On when the current on Phase A is flowing in the direction opposite to the **Normal Direction** setting configured in the switch control. The switch control identifies a **Reverse Current** condition when the voltage-current phase angle deviates more than 90 degrees from the value set during installation for the **Unity Power Factor**. Otherwise, off.
24	**Phase B Reverse Current—**As noted in Status Point 23, for Phase B, Switch 1. Otherwise, off.
25	**Phase C Reverse Current—**As noted in Status Point 23, for Phase C, Switch 1. Otherwise, off.
26	**Application Layer Confirmation Requests—**On when requests for application layer confirmations by the switch control are enabled. If enabled, the switch control requests a confirmation of receipt from the master station for every application data response generated. If the switch control does not receive a confirmation within the **Time Delay Between Attempts** setting, it issues another data response with a request for confirmation. The **Number of Confirmation Attempts** setpoint determines the maximum number of times the switch control will reissue a request if it does not receive a confirmation. Otherwise, off.
27	**Automatic Transfer Event Status—**On when a transfer operation is in progress. Otherwise, off.
28	**Return to Normal Event Status—**On when a **Return-to-Normal** operation is in progress. Otherwise, off.
29	**Team Mode Enabled—**On when the **Features Enabled** field for this team of switch controls includes **Automatic Team Operation** mode. Otherwise, off.
30	**Removed From Team—**On when the local switch control is not an active member of the team. Otherwise, off.
31	**Clearing Stop Transfer Inhibited—**On when the switch control cannot clear a stop transfer. Otherwise, off.
32	**Stop Transfer Process—**On when the transfer process is stopped. Otherwise, off.
33	**Return to Normal Mode Mismatch—**On when not all team members are configured with the same **Return to Normal** mode. Otherwise, off.
34	**Timestamp Mismatch—**On when the timestamp is mismatched among team members. Otherwise, off.
35	**Database sequence number mismatch—**On when the database sequence number is mismatched among team members. Otherwise, off.
36	**Stop Transfer and Communications—**On when the transfer process and communications are stopped. Otherwise, off.

TABLE CONTINUED ►

Table 1. Status Points—Continued

Code #	Name—Definition
37	**Configuration Process—**On when the configuration process is active. Otherwise, off.
38	**Bad Address Table—**On when the address table is bad. Otherwise, off.
39	**Transfer Process Status—**On when the team is ready to perform an automatic transfer. Otherwise, off.
40	**Synchronization—**On when the team is synchronized in database sequence number and time. Otherwise, off.
41	**Stop Transfer Summary—**On when any switch control in the team is in a stop transfer condition. Otherwise, off.
42	**Stop Transfer and Communications Summary—**On when any switch control in the team is in a **Stop Transfer and Communications** state. Otherwise, off.
43	**Address Table Summary—**On when any switch control in the team has a bad address table. Otherwise, off.
44	**Configuration Process Summary—**On when any switch control in the team is actively in a configuration process. Otherwise, off.
45	**Local Record Status—**On when no record is found corresponding to the local switch control. Otherwise, off.
46	**Return to Normal Mode Summary—**On when not all switch controls in the team are in the same **Return to Normal** mode. Otherwise, off.
47	**Data-Link Layer Confirmation Requests—**On when requests for data-link layer confirmations by the switch control are enabled. If enabled, the switch control requests a data-link confirmation from peer switch controls for every data request generated. This feature only applies to originated messages addressed to other team member switch controls. Otherwise, off.
48	**Voltage Phase Error—**On when the phase angle between the two voltage signals on the same phase of the switch is not effectively zero when the switch is open, within the accuracy of the sensor. Otherwise, off.
49	**Voltage Amplitude Error—**On when the two voltage sensors on the same phase of the switch are not reporting the same voltage amplitude when the switch is open, within the accuracy of the sensors. Otherwise, off.

TABLE CONTINUED ►

Table 2. Analog Input Points

Code #	Name—Definition
0	**90% Voltage Reference Standard—**A constant representing 90% of the full scale value.
1	**0% Voltage Reference Standard—**A constant representing the zero value.
2	**Neutral Current**—Taken as the vector sum of the phase currents on Phases A, B, and C. Current is measured using true RMS techniques. Each count equals one ampere.
3	**Current, Phase A—**Single-phase true RMS current measured on Phase A. Each count equals one ampere.
4	**Current, Phase B—**Single-phase true RMS current measured on Phase B. Each count equals one ampere.
5	**Current, Phase C—**Single-phase true RMS current measured on Phase C. Each count equals one ampere.
6	**Voltage, Phase A Hinge Side—**Single-phase voltage measured on Phase A. Voltage is measured using true RMS techniques and scaled to yield a nominal value of 120 Vac. Configuration of the switch control at installation provides the scaling factors such as voltage transformer turn ratio, etc. In cases where loads are connected in a delta (phase-to-phase) configuration, the switch control sensor conditioning module is jumpered to yield phase-to-phase voltage readings. Voltage is reported in units of one sensor count equals 0.1 Vac RMS. **Note:** (Analog Input Points 6, 7, 8, and 17, 18, 19): The conventional source side of a Scada-Mate® Switching System is the hinge - for Phase A, B, and C reference. Sensor wiring for other switch types may assign Phases A, B, and C to the jaw.
7	**Voltage, Phase B Hinge Side—**As noted in Analog Input Point 6 for Phase B.
8	**Voltage, Phase C Hinge Side—**As noted in Analog Input Point 6 for Phase C.
9	**Phase Angle on Phase A—**Each count equals 0.125 degrees.
10	**Phase Angle on Phase B—**Each count equals 0.125 degrees.
11	**Phase Angle on Phase C—**Each count equals 0.125 degrees.
12	**Single-Phase kvars, Phase A—**Kvars (volt-amperes, reactive) are calculated from single-phase true RMS voltage and current sensor values and the respective voltage-current phase angle. Each count equals one kvar.
13	**Single-Phase kvars, Phase B—**As noted in Analog Input Point 12, for Phase B.
14	**Single-Phase kvars, Phase C—**As noted in Analog Input Point 12, for Phase C.
15	**Cabinet Temperature**—Reported in units of degrees Fahrenheit. Each count equals one degree.
16	**Battery Voltage**—Nominally 24 Vdc. If ac power is on, this value is updated only during battery testing. If ac power is off, this value is continuously updated. One count equals 0.035 Vdc.
17	**Voltage, Phase A Jaw Side**—Single-phase voltage measured on Phase A. Voltage is measured using true RMS techniques and scaled to yield a nominal value of 120 Vac. Configuration of the switch control at installation provides the scaling factors such as voltage transformer turn ratio, etc. In cases where loads are connected in a delta (phase-to-phase) configuration, the switch control sensor conditioning module is jumpered to yield phase-to-phase voltage readings. Voltage is reported in units of one sensor count equals 0.1 Vac RMS.
18	**Voltage, Phase B Jaw Side**—As noted in Analog Input Point 17, for Phase B.
19	**Voltage, Phase C Jaw Side**—As noted in Analog Input Point 17, for Phase C.
20	**Voltage-to-Voltage Phase Angle between the hinge and jaw of the open switch for Phase A—**The kVA value is calculated from single-phase phase angle. Each count equals one eighth of a degree.

TABLE CONTINUED ►

Table 2. Analog Input Points—Continued

Code #	Name—Definition
21	**Voltage-to-Voltage Phase Angle between the hinge and jaw of the open switch for Phase B—**As noted in Analog Input Point 20, for Phase B.
22	**Voltage-to-Voltage Phase Angle between the hinge and jaw of the open switch for Phase C—**As noted in Analog Input Point 20, for Phase C.

TABLE CONTINUED ►

Table 3. Analog Output Points

Code #	Name—Definition
0	**Application Layer Confirmation Retry Time—**This is the length of time the switch control waits for an application layer confirmation on a response message before resending the response. It uses a "timer byte format." The retry time is only in effect when the confirmation process is enabled. **Note:** In "timer byte format," the top two bits are the time units (0 = tenths of seconds, 1 ($40) = seconds, 2 ($80) = minutes, 3 ($C0) = hours). The bottom six bits are the count. A value of one second ($41) can be more accurately specified as 10 tenths ($0A). A value of one minute ($81) can be specified as 60 seconds ($7C). A value of one hour ($C1) can be specified as 60 minutes ($BC). The value $FF generates an "infinite" time value.
1	**Application Layer Confirmation Retry Count—**This is the number of times (0 to 10) the switch control will send an event response message if a confirmation is not received. This number includes the initial response. The retry count is only in effect when the confirmation process is enabled.
2	**Control Point Select Time—**During a **Select-Before-Operate** procedure, the time (10 to 1000 tenths of a second) allowed to elapse between receiving the **Select** function for a point and receiving the **Operate** function for it. If an **Operate** function is not received within this period, the point is de-selected; another **Select** function is required before the point will operate. It uses a "timer byte format."
3	**Real-Time Feeder Loading On Right Feeder—**Total averaged three-phase feeder loading (10 amperes to maximum source capacity minus 10 amperes), measured at the source breaker. This value is used to determine whether the load can be transferred to another source. Each count equals one ampere. **Note:** A DNP device with real-time feeder-loading data can use these analog output points to inform the switch controls in a team of the real-time loading at both sources for the team. The team can use this real-time loading data to determine more accurately whether transferring load can be accomplished safely. See the associated setpoints on the second *Setup>Automatic Operation* screen.
4	**Real-Time Feeder Loading On Left Feeder—**Total averaged three-phase feeder loading (10 amperes to maximum source capacity minus 10 amperes), measured at the source breaker. This value is used to determine whether the load can be transferred to another source. Each count equals one ampere. **Note:** A DNP device with real-time feeder-loading data can use these analog output points to inform the switch controls in a team of the real-time loading at both sources for the team. The team can use this real-time loading data to determine more accurately whether transferring load can be accomplished safely. See the associated setpoints on the second *Setup>Automatic Operation* screen.

Table 4. Binary Counter Points

Code #	Name—Definition
0	**Operation Counter—**This is the number of switch operations. The counter is incremented on each **Close** operation. This is a 16-bit counter and will overflow back to zero at 65,535.

Table 5. Frozen Counter Points

Code #	Name—Definition
0	**Frozen Operation Counter—**This is the number of switch operations before the operation counter received a **Freeze** command.

Table 6. Control Points

Code #	Name—Definition
0	**Issue the Close/Open Command to the Switch—**The **Close/Open** command may be issued using either the **Select/Operate** sequence, the **Direct Operate** function, or the **Direct Operate without Ack** function. Both **Trip** and **Close** commands are valid for this point.
1	**Issue the Shots-to-Lockout Command to the Switch—**Issue the **Shots-to-Lockout** command to the switch. This command may be issued using either the **Select/Operate** sequence, the **Direct Operate** function, or the **Direct Operate without Ack** function. Only a **Close** command is valid for this point. This command is ignored and returns an error if the switch is not open or the **Automatic Operation** mode is not enabled. **Note (Points 0 and 1):** These commands are ignored and return an error if a **Bad Battery** state is active and the **Failure Override** command has not been issued or if the visual disconnect is open. These commands are ignored if the REMOTE/LOCAL switch is not in the **Remote** state.
2	**Reset (clear) Any Outstanding Overcurrent Fault Conditions Present—**This command must be issued using a **Pulse On** request. The fault condition otherwise remains active for 45 minutes after the switch is closed and ac power is fully restored or until the REMOTE/LOCAL switch is toggled.
3	**Begin a Battery Test Cycle—**This command must be issued using a **Pulse On** request. If ac power is on, the charger is disconnected for several minutes while the test is in progress. If ac power is off, a brief battery-impedance test evaluates the battery condition.
4	**Enable or Disable the Failure Override Status.—**This command must be issued using the **Latch On/Off** request in the control relay output block. This allows **Open** and **Close** commands to be processed even if the switch **Not Ready** condition is active.
5	**Enable/Disable Automatic Operation—**This command must be issued using the **Latch On/Off** request in the control relay output block. In **Automatic** mode, the switch control automatically opens the switch if a preconfigured recloser sequence is recognized after a detected fault. **Note:** The **Automatic Operation** state is not disabled when the faceplate REMOTE/LOCAL switch is set to **Local** operation.
6	**Enable or Disable Application Layer Confirmations—**This command must be issued using the **Latch On/Off** request in the control relay output block. When enabled, the switch control requests a confirmation from the master station for every response message generated.
7	**Enable or Disable Data Link Layer Confirmations—**This command must be issued using the **Latch On/Off** request in the control relay output block. When enabled, the switch control uses “confirmed user data” packets for all messages originated by the switch control.

This implementation of DNP and this section of documentation conform to the document "DNP V3.00 Subset Definitions, Version 2.00," available from the DNP Users Group.

Table 7 describes the compatibility of S&C's implementation of DNP with other devices.

Table 7. Device Profile Description	
DNP 3 DEVICE PROFILE DOCUMENT	
Vendor Name: S&C Electric Company	
Device Name: 5800 Series Automatic Switch Control	
Highest DNP Level Supported: For Requests - Level 2 For Responses - Level 2	Device Function: _ _ Master X Slave
Notable objects, functions, and/or qualifiers supported in addition to the highest DNP levels supported (the complete list is described in the attached table): 8-Bit Unsigned Integers _	
Maximum Data Link Frame Size (bytes) Transmitted - 292 Received - 292	Max Application Fragment Size (bytes) Transmitted - 249 Received - 249
Maximum Data link Re-tries: X None _ _ Fixed at _ _ _ _ _ _ _ _ _ _ Configurable, range 1 to 25	Maximum Application Layer Re-tries: _ _ None _ _ Fixed at _ _ _ _ _ _ _ _ X Configurable, range 1 to 25 and infinite
Requires Data Link Layer Confirmation: X Never _ _ Always _ _ Sometimes If "Sometimes," when? - When requested by the master. _ _ Configurable If 'Configurable," how? - Data link confirmations are configured through SCADA communications or through locally connected setup software.	

```
Requires Application Layer Confirmation:
    _ _ Never
    _ _ Always (not recommended)
    _ _ When reporting event data (slave devices only)
    _ _ When sending multi-fragment responses (slave devices only)
    _ _ Sometimes     If "Sometimes," when? - When requested by the master
                                          during a request.
    X _  Configurable   If "Configurable," how? - Response confirmations are
                        configured through SCADA communications or through
                        locally connected setup software.
```

```
Timeouts while waiting for:
    Data Link Confirm         X   None   _ _ Fixed   _ _ Variable   _ _ Config
    Complete Appl. Fragment   X   None   _ _ Fixed   _ _ Variable   _ _ Config
    Application Confirm       _ _ None   _ _ Fixed   _ _ Variable   X   Config
    Complete Appl. Response   X   None   _ _ Fixed   _ _ Variable   _ _ Config
    Others _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
    Attach explanation if "Variable" or "Configurable" was checked
    (see Note 1 for explanation)
```

```
Sends/Executes Control Operations:
    Write Binary Outputs     X   Never   _ _ Always   _ _ Sometimes   _ _ Config
    Select/Operate           _ _ Never   _ _ Always   X   Sometimes   _ _ Config
    Direct Operate           _ _ Never   _ _ Always   X   Sometimes   _ _ Config
    Direct Operate - NO ACK  _ _ Never   _ _ Always   X   Sometimes   _ _ Config

    Count > 1                X   Never   _ _ Always   _ _ Sometimes   _ _ Config
    Pulse On                 _ _ Never   _ _ Always   X   Sometimes   _ _ Config
    Pulse Off                X   Never   _ _ Always   _ _ Sometimes   _ _ Config
    Latch On                 _ _ Never   _ _ Always   X   Sometimes   _ _ Config
    Latch Off                _ _ Never   _ _ Always   X   Sometimes   _ _ Config

    Queue                    X   Never   _ _ Always   _ _ Sometimes   _ _ Config
    Clear Queue              X   Never   _ _ Always   _ _ Sometimes   _ _ Config

    Attach explanation if "Sometimes" or "Configurable" was checked
    (see Note 2 for explanation)
```

FILL OUT THE FOLLOWING ITEM FOR MASTER DEVICES ONLY:	
Master Expects Binary Input Change Events: _ _ Either time-tagged or non-time-tagged for a single event _ _ Both time-tagged and non-time-tagged for a single event _ _ Configurable (attach explanation)	
FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:	
Reports Binary Input Change Events when no specific variation requested: _ _ Never _ _ Only time-tagged X Only non-time-tagged _ _ Configurable to send both	Reports time-tagged Binary Input Change Events when no specific variation requested: _ _ Never X Binary Input Change with Time _ _ Bin In Change Relative Time _ _ Configurable (explain)
Sends Unsolicited Responses: _ _ Never X Configurable (explain) _ _ Only certain objects _ _ Sometimes (explain) _ _ Enable/Disable Unsolicited Function codes supported (see Note 3)	Sends Static Data in Unsolicited Responses: _ _ Never _ _ When Device Restarts X When Status Flags Change No other options are permitted. (see Note 3)
Default Counter Object/Variation: _ _ No Counters Reported _ _ Configurable (explain) X Default Object - 20 _ _ Default Variation - 5 _ _ Point-by-point list attached	Counters Roll Over at: _ _ No Counters Reported _ _ Configurable (explain) X _ 16 Bits _ _ 32 Bits _ _ Other Value _ _ _ _ _ _ _ _ _ _ _ _ Point-by-point list attached
Sends Multi-Fragment Responses (Slave Only): X Yes _ _ No	

Note 1: Timeouts While Waiting for Confirmations

When a data link confirmation (during a request to reset the transmit link) or an application layer response confirmation is requested, the switch control waits before sending another response/confirmation attempt (if the retry number has not been reached) or stopping the confirmation process. Both confirmation requests use the same timeout period ("Time Delay Between Attempts").

The **Time Delay Between Retries** function can be set with the setup software or via SCADA. See S&C Instruction Sheet 1045-530, "S&C 6800 Series Automatic Switch Controls: *Setup*" for more information.

Note 2: Control Operations Executed

For all **Binary Output Relay** operations and **Analog Output** operations, the allowed control functions are:

- Select/Operate
- Direct Operate
- Direct Operate No Ack

The master station can choose which of these three functions to use at any given time.

The **Trip/Close** bits must be used for these functions in the control block. Set the **Count** value to "1" and the **Code** value to "NUL" (0) or "1." The switch control ignores the **On-Time** and **Off-Time** values and the Queue and Clear flags in the control code.

For all momentary bit operations, the **Pulse On** function must be used. When using the **Pulse On** function, set the **Count** value to "1" and the **Code** value to "1." Set the **Trip/Close** state to "NUL" (0). The switch control ignores the **On-Time** and **Off-Time** values and the Queue and Clear flags in the control code.

For all latching bit operations, either the **Latch On** or **Latch Off** function can be used. For either function, set the **Count** value in the control block to "1." Set the **Code** value to "3" for **Latch On** mode or "4" for **Latch Off** mode. Set the **Trip/Close** state to "NUL" (0). The switch control ignores the **On-Time** and **Off-Time** values and the Queue and Clear flags in the control code.

For more details, see the "Control Relay Output Block" section of the document object library in "IEEE std 1815™-2012" available from the DNP Users Group.

Note 3: Unsolicited Responses

The switch control returns unsolicited responses to the configured master station address when a change occurs in any mapped status point or when the device is restarted.

Unsolicited responses can be enabled or disabled from the setup software or via SCADA (function code 20 to enable, function code 21 to disable).

This section describes which objects and requests this implementation accepts and which responses are returned. **Object**, **Variation**, and **Qualifier** codes in the request must exactly match what is expected; otherwise, the switch control flags an error. All application layer responses use the standard response function code 129.

Table 8. Implementation

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
1	0	Binary Input - All Variations	1	06	
1	1	Binary Input			00
2	0	Binary Input Change - All Variations	1	06,07,08	
2	1	Binary Input Change without Time	1	06,07,08	17
2	2	Binary Input Change with Time (see Note 4)	1	06,07,08	17
2	3	Binary Input Change with Relative Time (object parsed but no data to return)	1	06,07,08	
10	0	Binary Output - All Variations	1	06	
10	1	Binary Output (object parsed but WRITE not used)	1	17,28	
10	2	Binary Output Status (only use the on-line bit, see Note 5)			00
12	1	Control Relay Output Block	3,4, 5,6	17,28	Echo of request
20	0	Binary Counter - All Variations	1,7,8, 9,10	06	
20	6	16-Bit Binary Counter without Flag			00
21	0	Frozen Counter - All Variations	1	06	
21	10	16-Bit Frozen Counter without Flag			00
22	0	Counter Change Event - All Variations (object parsed but no data to return)	1	06,07,08	

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
30	0	Analog Input - All Variations	1	06	
30	4	16-bit Analog Input without Flag			00
32	0	Analog Change Event - All Variations (object parsed but no data to return)	1	06,07,08	
40	0	Analog Output Status - All Variations	1	06	
40	2	16-bit Analog Output Status			00
41	2	16-bit Analog Output Block	3,4, 5,6	17,28	Echo of request
50	1	Time and Date	2	07 where quantity = 1	IINs only
60	1	Class 0 Data	1	06	
60	2	Class 1 Data	1	06,07,08	
60	3	Class 2 Data (object parsed but no data to return)	1	06,07,08	
60	4	Class 3 Data (object parsed but no data to return)	1	06,07,08	
80	1	Internal Indications	2	00 index=7	IINs only
102	0	8-Bit Unsigned Integer (see Note 6)	1	04	04
102	1	8-Bit Unsigned Integer (see Note 6)	1,2	04	04
No Object			13		
No Object			13		

Note 4: Binary Input Change with Time

This is the default object returned in the unsolicited report by exception (if enabled) and the default object for a Class 1 data request. The maximum number of records returned in one packet for this object is 29. Returning 29 records will cause 232 bytes of data to be returned; with overhead, this makes almost a full packet. If more than 29 status change records exist, the remaining records can be retrieved with an additional request.

Note 5: Binary Output Status

In a response to a **Binary Output Status** request, the switch control returns a status byte for each control point available. In this implementation of the **Binary Output Status** object, only the **Online** bit is used. All other bits, including the **State** bit, should be ignored.

The state of all digital bits (controlled and not controlled) can be inspected by using the **Binary Input** object.

Note 6: 8-Bit Unsigned Integer

This object provides efficient access to all types of memory-mapped data. All virtual memory locations are addressed using 16-bit absolute address identifiers in the **Range** field (qualifier code 4), least significant byte (LSB) first.

To perform a write to general memory, make sure the high bytes of the addresses do not span virtual memory regions or multiple tables and the low bytes of the addresses are in ascending order.

Note: Switch controls with IntelliTeam systems primarily use this object to share specific records or data with each other. It is available for SCADA implementation but is not required.

Note 7: Polling Class

DNP points are assigned to polling classes. S&C Automatic Controls implement only Class 0 and Class 1 polls. The Class 0 poll contains all DNP points for the control that return static data, the latest value for all data. The Class 1 poll returns event data, any DNP point that has changed since the last event data message was received. Polling frequency is an aspect of the user's SCADA system and is user selectable.

The Class 2 and 3 polls are user defined lists of DNP points that will be returned when the IED receives a Class 2 or 3 poll. S&C Automatic Controls do not support Class 2 or 3 polling. When received, the Class 2 or 3 poll request is understood, it does not elicit an error response, and the response is just the application header with no objects. The SCADA master station can send a Class 2 or 3 poll to other equipment on the system, and S&C Controls will not return an error.