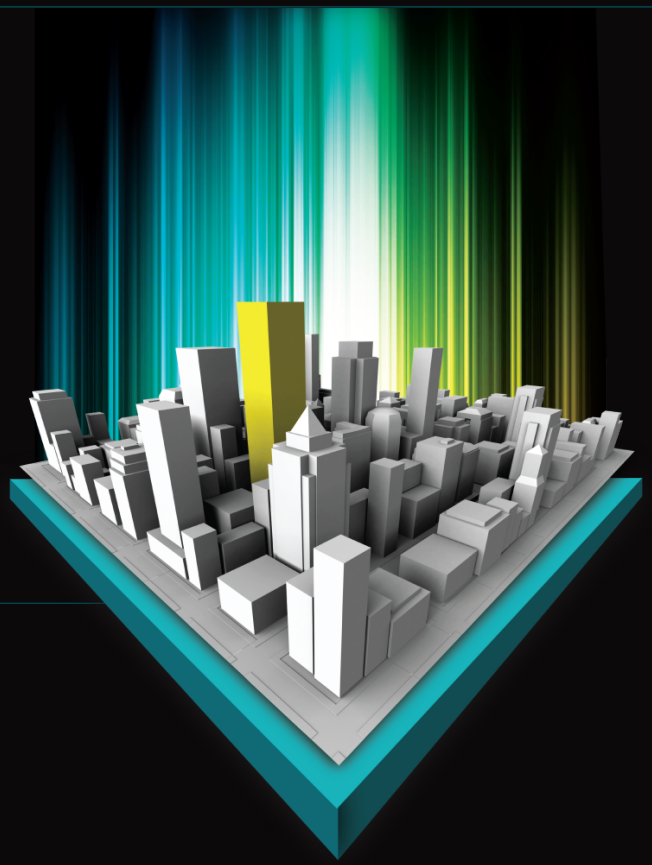
NIAGARA SUMMIT 2014

POWERED BY POSSIBILITIES



TRIDIUM

NIAGARA SUMMIT 2014

POWERED BY POSSIBILITIES

Working with BACnet Networks

TRIDIUM

NS 14

NIAGARA SUMMIT 2014

POWERED BY POSSIBILITIES

Lou Jones and John Hutchey

Honeywell Industry Specialists

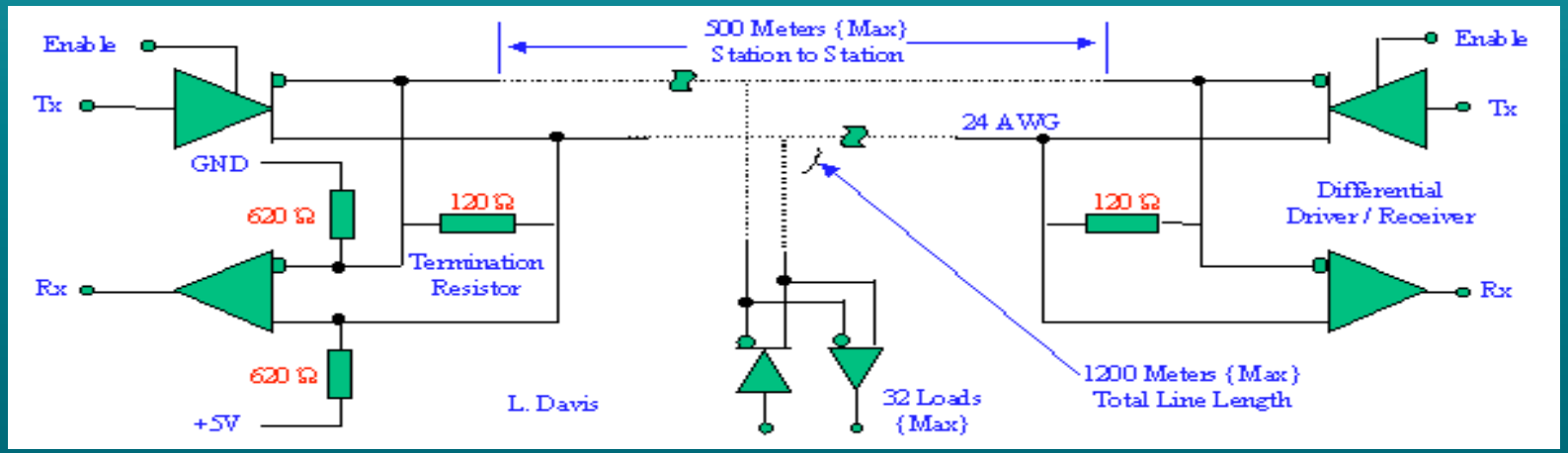
TRIDIUM

Agenda

- MSTP Bus Wiring
- MSTP Bus Troubleshooting
- MSTP Bus Tuning
- Questions and Answers

BACnet MS/TP

- MS/TP is built on the ANSI/TIA/EIA-485-A Standard.
- Typically just referred to as RS-485.

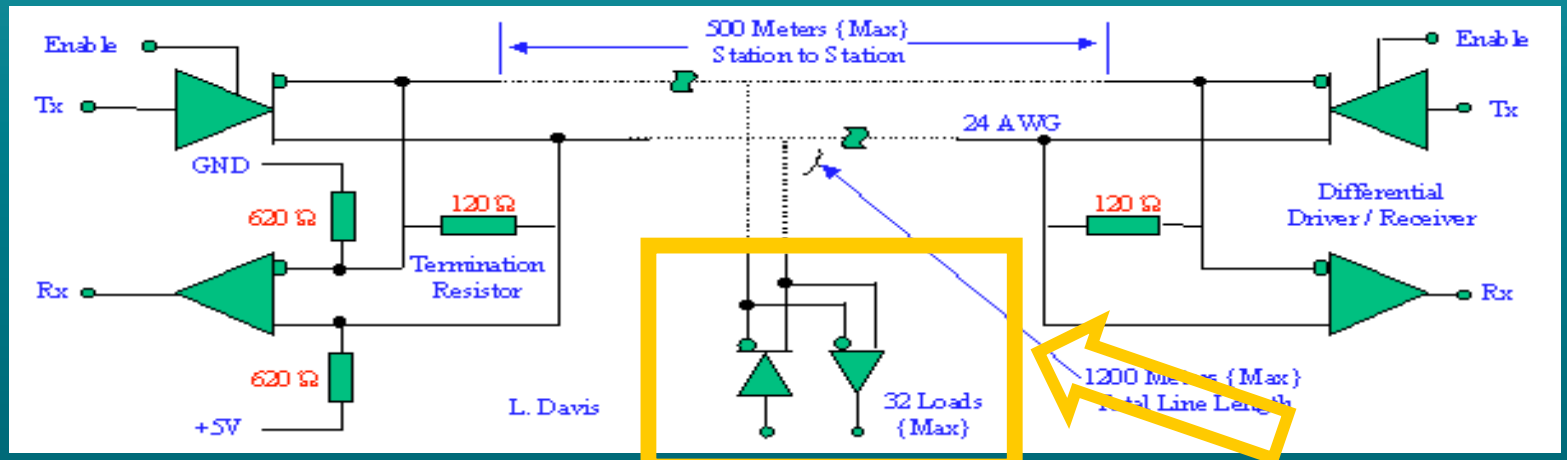


BACnet MS/TP

- Common baud rates are 19200, 38400, and 76800. All devices must operate at the same baud rate.
- Niagara 3.8 now supports the 115,200 baud rate.
- BACnet MS/TP is a licensable feature on the JACE controller.

BACnet MS/TP Unit Load

- BACnet MS/TP (EIA-485) supports a maximum of 32 Unit Loads.



BACnet MS/TP Unit Load

- Each BACnet MS/TP Device can be rated at 1, ½, ¼, or 1/8 Unit Load based on the transceiver used in the device.

1 UL 1/2 UL 1/4 UL 1/8 UL

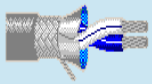
BACnet MS/TP Cable Requirements

- A MS/TP EIA-485 network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 130 ohms.
- Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot).
- Distributed capacitance between conductors and shield shall be less that 200 pF per meter (60 pF per foot).

BACnet MS/TP Cable Requirements

- Foil or braided shields are acceptable.
- The maximum recommended length of an MS/TP segment is 1200 meters (4000 feet) with AWG 18 (0.82 mm2 conductor area) cable.
- The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485."

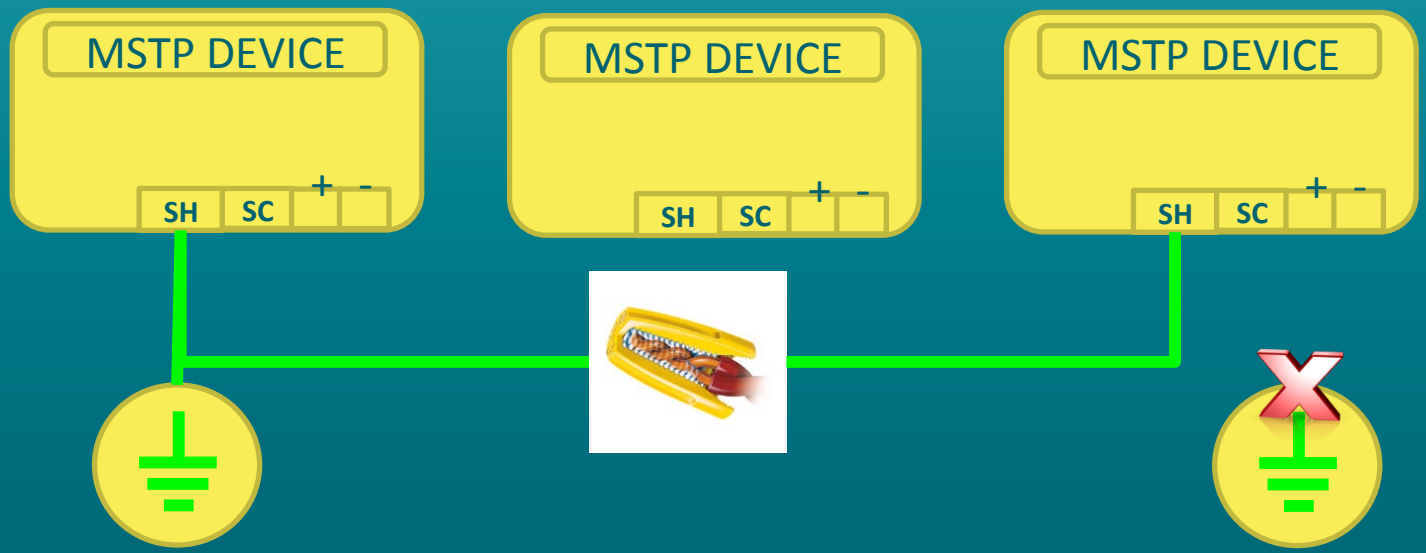
BACnet MS/TP Cable Requirements

9841 	**Low Capacitance Computer Cable for EIA RS-485 Applications** # Pairs: 1 AWG: 24 Stranding: 7x32 Conductor Material: TC - Tinned Copper Insulation Material: PE - Polyethylene Outer Jacket Material: PVC - Polyvinyl Chloride Outer Shield Trade Name: Beldfoil® Outer Shield Material: Aluminum Foil-Polyester Tape, TC - Tinned Copper Plenum (Y/N): No Plenum Number: 82841, 89841 Impedance: 120 Ohm Voltage: 300 V RMS, 30 V RMS (UL AWM Style 2919) Part Number = **9841** Title = Low Capacitance Computer Cable for EIA RS-485 Applications Keywords = LOW , TEMPERATURE , CABLE , COMPUTER , INTERCONNECT , RS , 232 ...

EIA RS-485 CAN open	Construction	Nominal Impedance	Nominal Capacitance	
9841	1 pair AWG 24 PVC	120 Ω	42.0 pF/m	75.5 pF/m
9841NH	1 pair AWG 24 LSNH	120 Ω	42.0 pF/m	75.5 pF/m
9841LS	1 pair AWG 24 LSNH steel wire armoured	120 Ω	42.0 pF/m	75.5 pF/m
3105A	1 pair AWG 22 PVC/PLTC	120 Ω	36.1 pF/m	65.5 pF/m

BACnet MS/TP Shielding

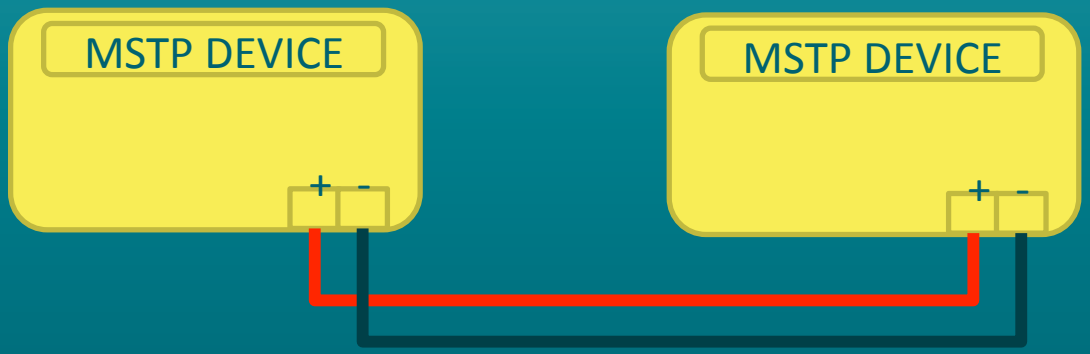
- The Shield wire must be one continuous run.
- Terminate one end of the shield wire to Earth Ground.



TRIDIUM

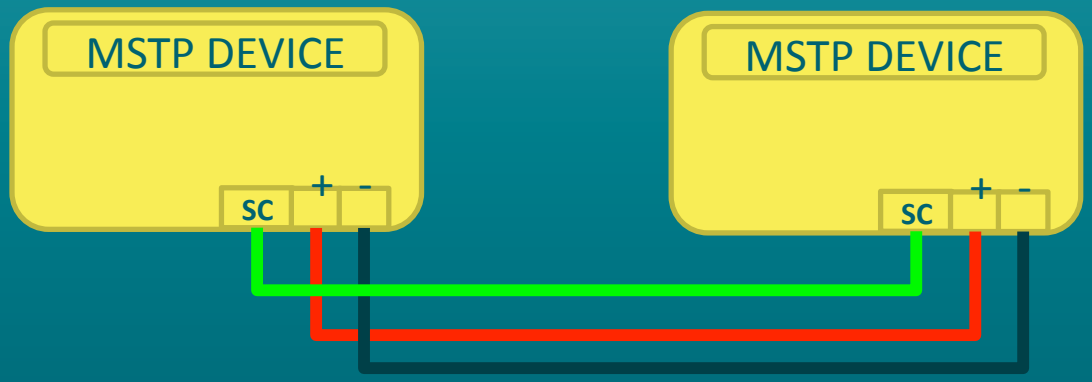
BACnet MS/TP Bus Polarity

- The MS/TP bus is polarity sensitive. Damage to the transceiver may occur if connected backwards.



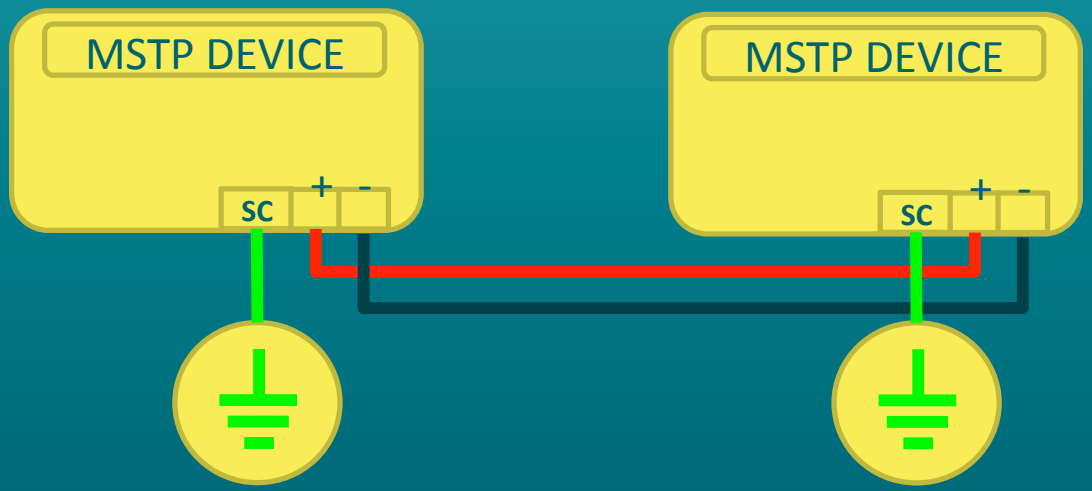
3 Wire MS/TP

- MSTP requires two signal wires plus a reference wire typically referred to as the source common or SC.



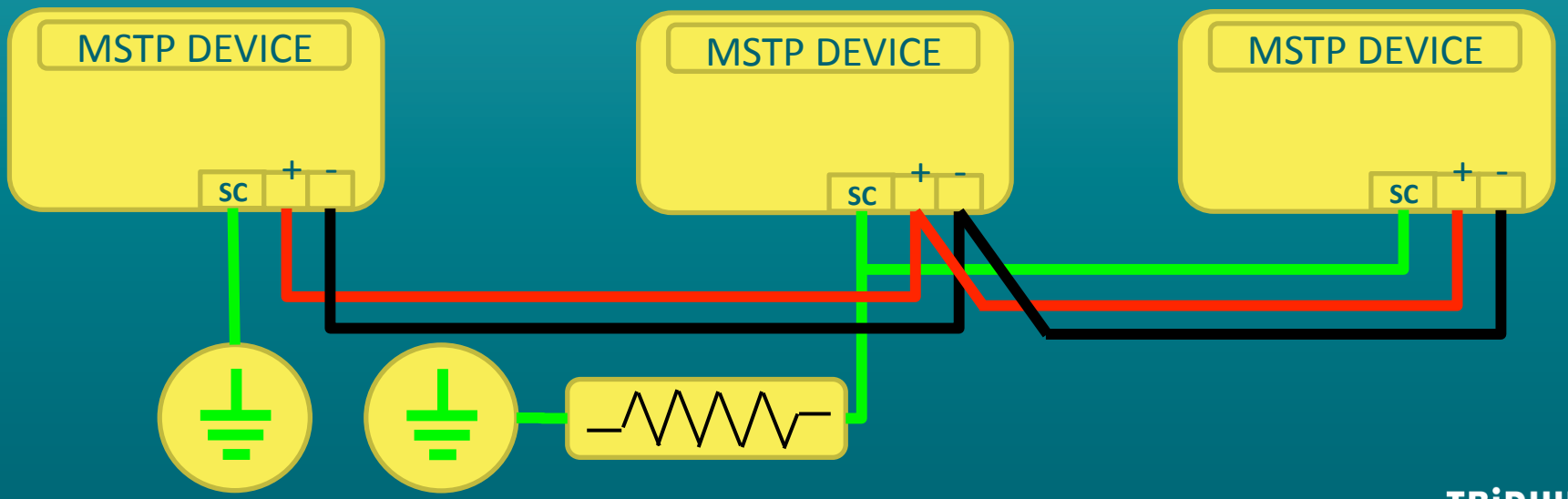
2 Wire MS/TP

- Two Wire MSTP uses Earth Ground as reference in place of the third wire.

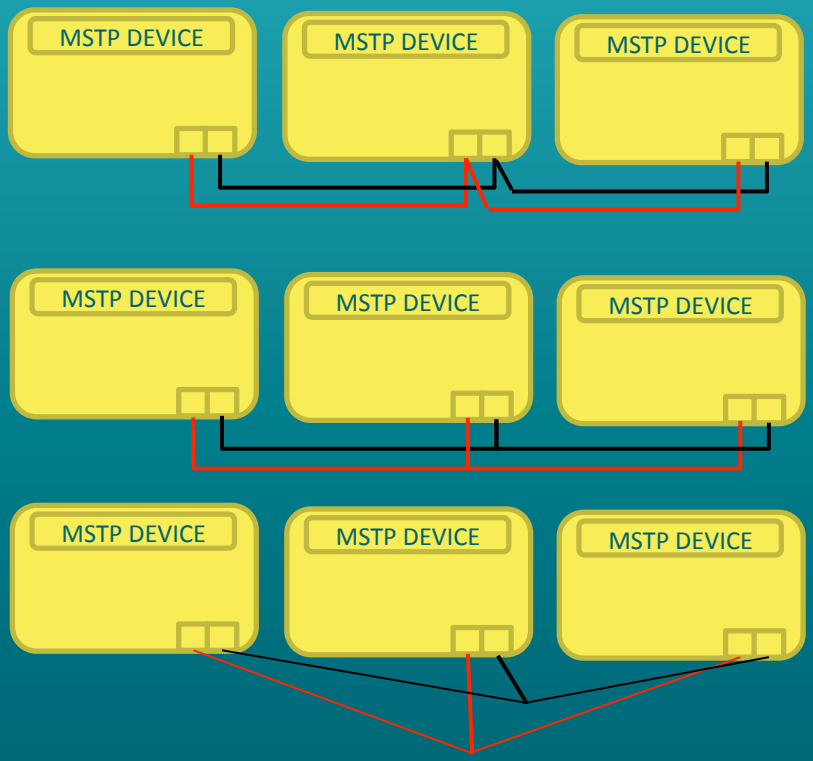


Mixing 2 and 3 Wire MS/TP

- Add a 100 Ohm resistor between SC and Earth Ground to the 3 wire MSTP Device



MS/TP Correct Bus Layout



Daisy Chain

T - Tap

Star

TRIDIUM

MS/TP Bus Termination

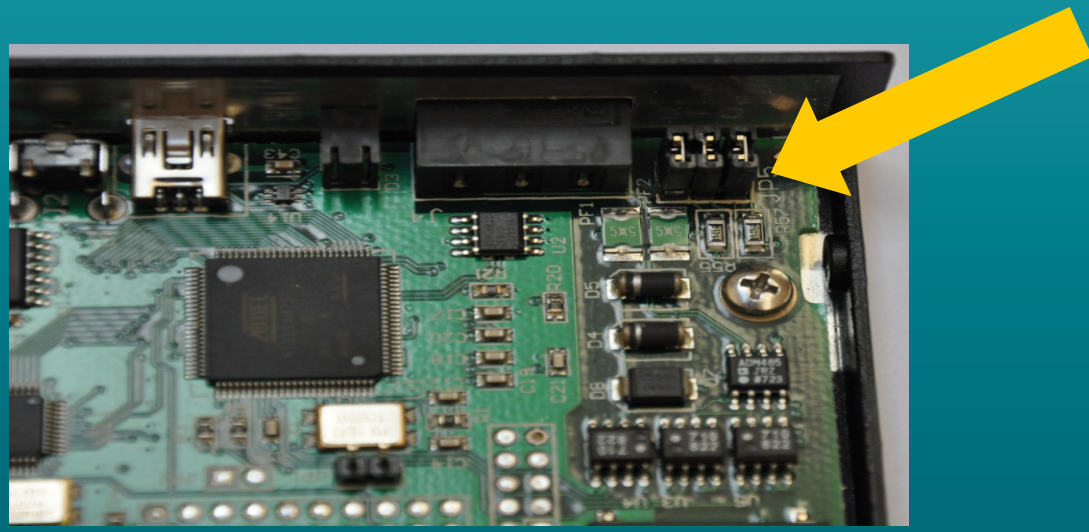
- The purpose of the termination is to prevent adverse transmission-line phenomena, such as reflections.
- Termination requires a single resistor across the conductor pair at each end of the Bus.
- It is important to match the terminating resistance and the characteristic impedance of the cable as closely as possible. If you terminate the bus in this way, no reflections occur, and the signal fidelity is excellent.

MSTP Biasing Requirements

- Biasing is required on all MSTP buses to insure proper communications.
- The JACE may be used to provide Bias.
- Many BACnet Routers can provide Bias.
- A Discrete Circuit or Designated Bias Device can also be used.

Router Biasing Example

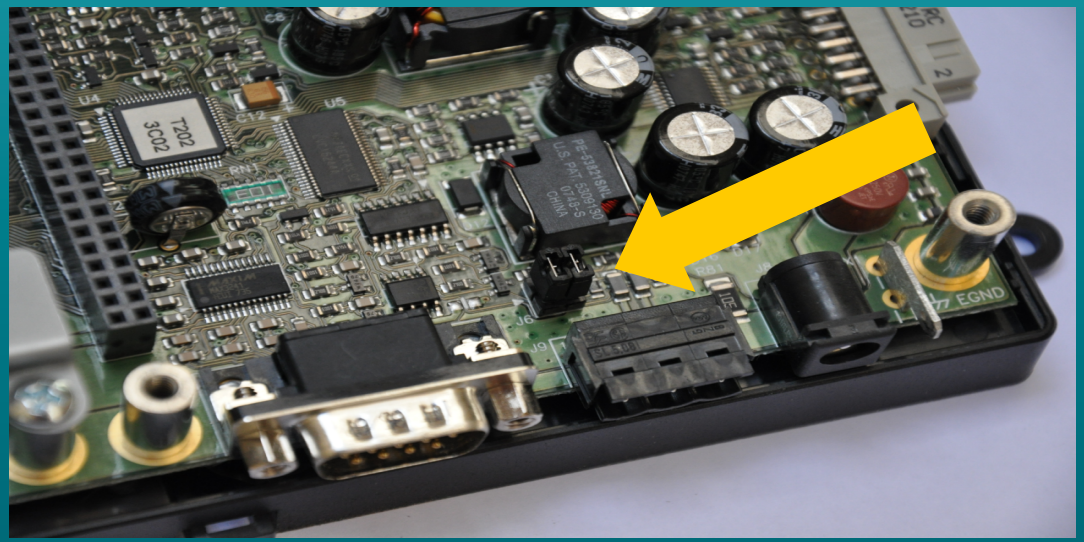
- Using a Contemporary Controls router for biasing.
  - Jump J5 U and D pins (this is the default configuration)



TRIDIUM

JACE Biasing Example

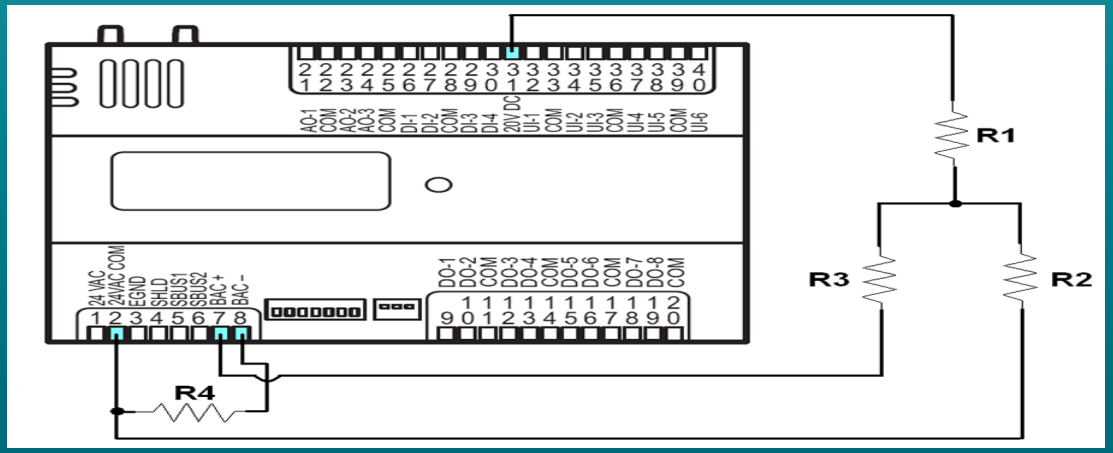
- Using a JACE for biasing.
  - Jump as depicted (this is not the default configuration)



TRIDIUM

Discrete Biasing Example

- Build your own biasing circuit
  - A simple Resistor Divider Network may be used to achieve the required Bias levels.



Bus Troubleshooting– Live Demo

Oscilloscope

Model:	DSO-2250 USB
Channels:	Two with Math
Bandwidth:	100 MHz
Sampling Rate:	250 MS/s

TRIDIUM

BACnet Tuning Policies

- Min Write Time
  - Applies to writable proxy points
  - Specifies the minimum amount of time allowed between writes.
  - Provides a method to throttle rapidly changing value so that only the last value is written.
  - If this property value is 0 (default), this rule is disabled
  - All value changes attempt to write.

BACnet Tuning Policies

- Max Write Time
  - Applies to writable proxy points.
  - Specifies the maximum "wait time" before rewriting the value.
  - Any write action resets this timer.
  - If property value is 0 (default), this rule is disabled.

BACnet Tuning Policies

- Write On Start
  - Applies to writable proxy points.
  - Determines behavior at station startup.
  - If true, (default) a write occurs when the station first reaches "steady state."
  - If set to false, a write does not occur when the station reaches "steady state."

BACnet Tuning Policies

- Write On Up
  - Applies to writable proxy points.
  - Determines behavior when proxy point (and parent device) transitions from "down" to "up."
  - If true, (default) a write occurs when the parent device transitions from down to up.
  - If set to false, a write does not occur when the parent device transitions from down to up.

BACnet Tuning Policies

- Write On Enabled
  - Applies to writable proxy points.
  - Determines behavior when a proxy point's status transitions from "disabled" to normal (enabled).
  - If true, (default) a write occurs when writable point transitions from disabled.
  - If set to false, a write does not occur when writable point transitions from disabled.

BACnet Poll Service

- Fast Rate, Normal Rate, Slow Rate
  - Applies to proxy points.
  - Determines how often a point will be polled.
  - Default values may be too frequent.
  - Use a Tuning Policy to apply a specific rate to a point.

BACnet Poll Service

- Total Polls, Fast Polls, Normal Polls, Slow Polls
  - Indicates activity in each poll bucket.
- Dibs Count, Fast Count, Normal Count, Slow Count
  - Indicates number of points in each bucket.
  - Dibs bucket has “first dibs” and gets polled ahead of the others.

BACnet Poll Service

- Busy Time
  - Percentage of time spent by the poll thread actually polling points.
  - >95% indicates the thread is polling continuously.
  - Target ~60% steady-state busy time to allow headroom for other activities like downloading, etc.
- Reset Statistics (Action)
  - Used to reset counters.
  - Should be invoked after making changes to poll rates in order to better assess their impact.

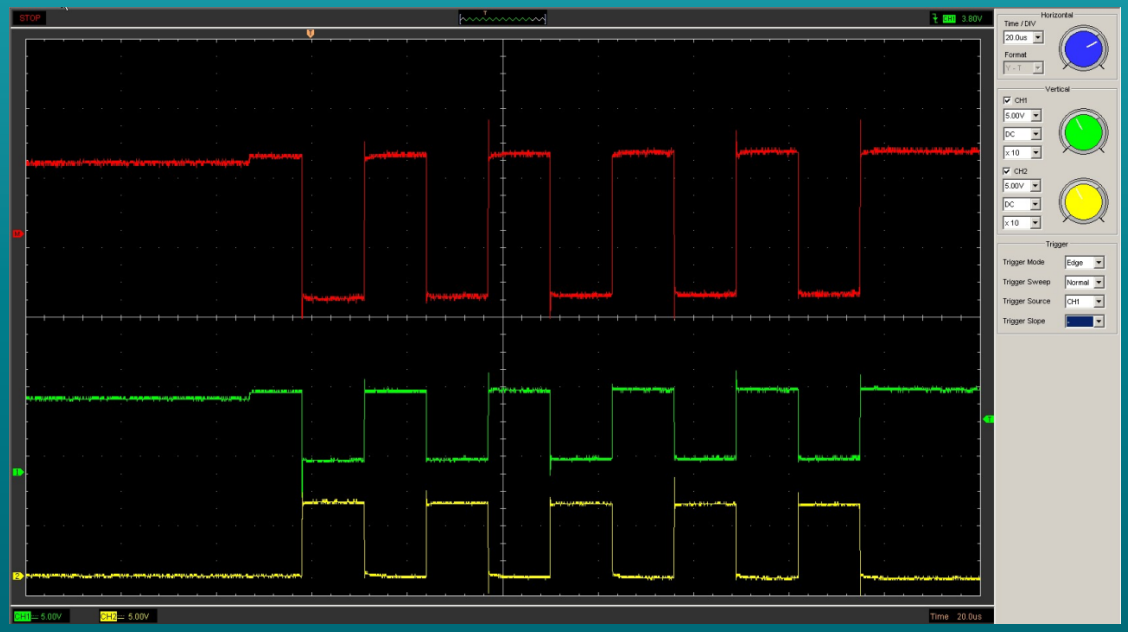
BACnet Tuning – Live Demo

Live Demo Backup slides

TRIDIUM

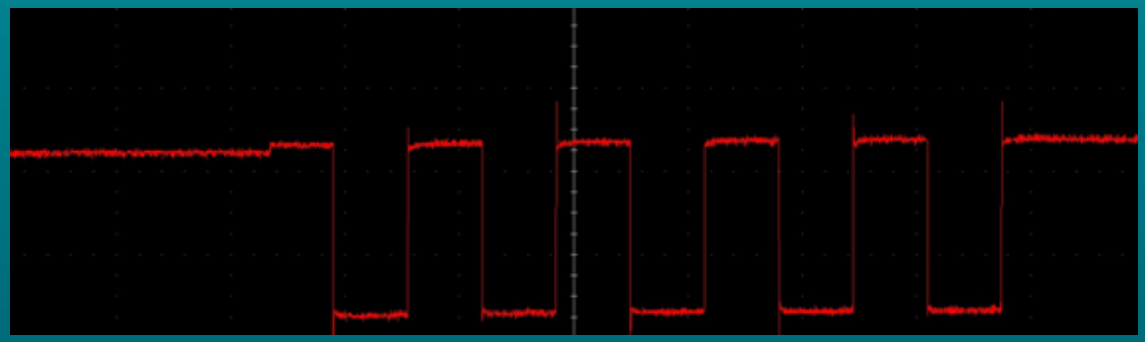
Troubleshooting - Live Demo

- Best troubleshooting tool is an Oscilloscope



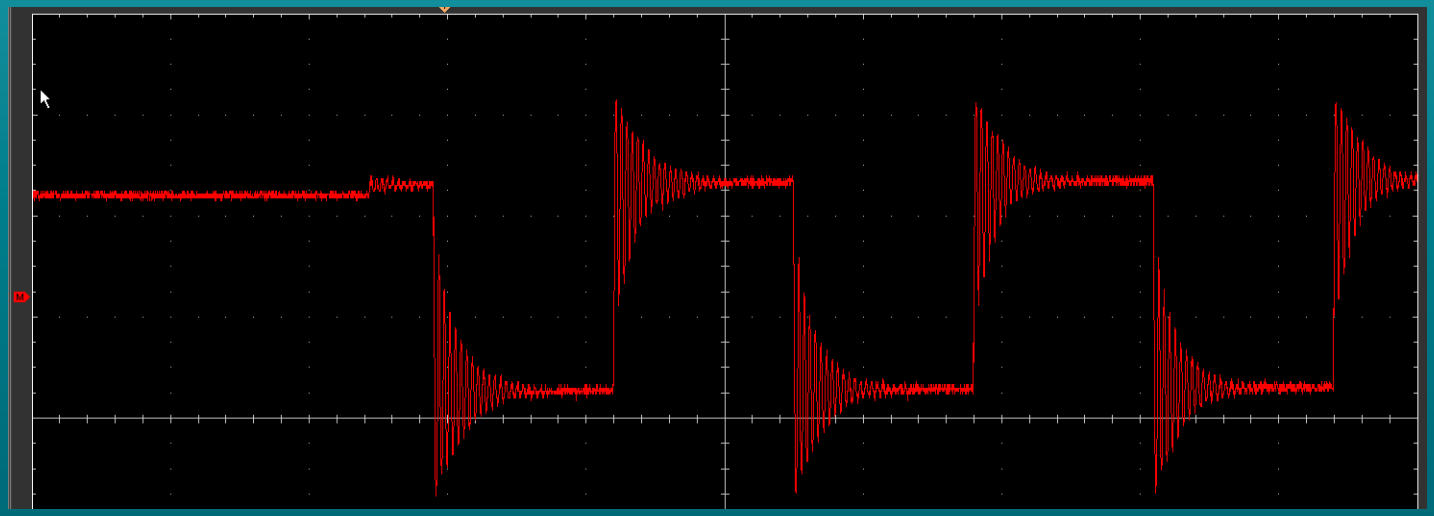
Live Demo – Good bus signals

- Idle >200mV, Peak-to-peak > 1.5V
- Clean square wave, No rounding of edges, No overshoot, No ringing, No noise ripple.
- Bit width → baud rate



Live Demo – Un-terminated 2000 ft

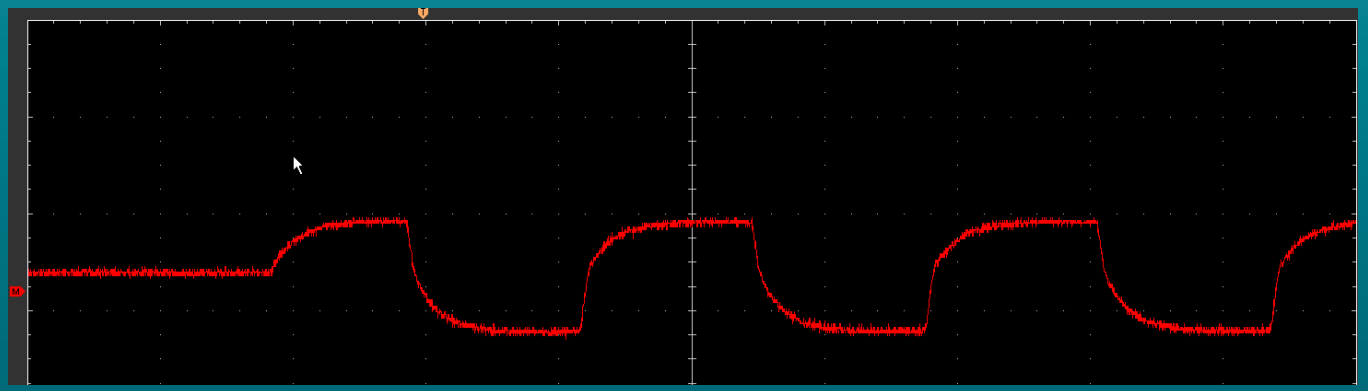
- Ringing on rising and falling edges
- Missing termination on one or both ends of segment



TRIDIUM

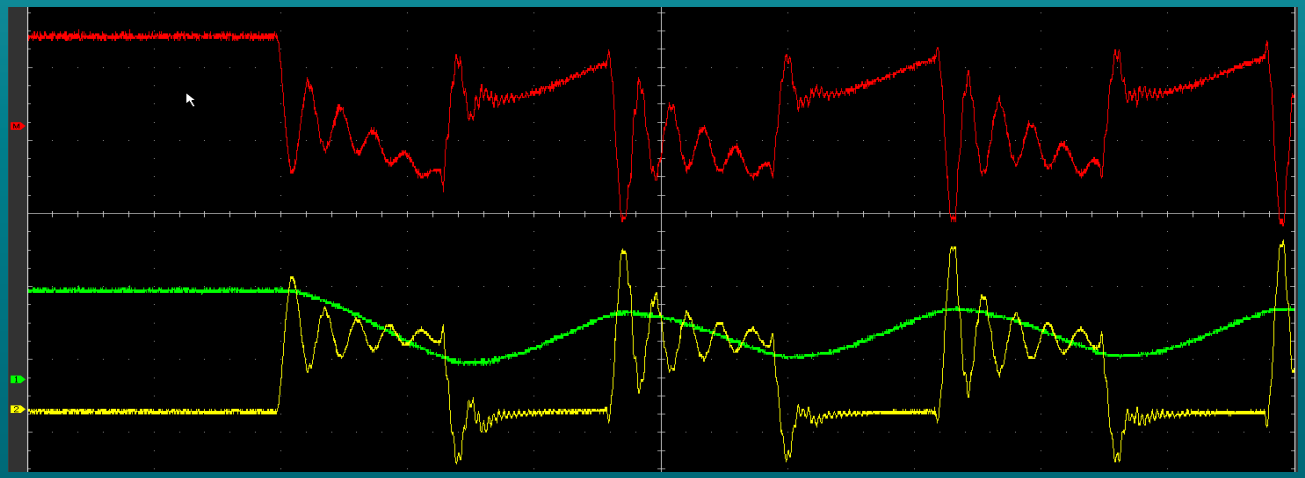
Live Demo – Terminated 2000 ft

- No ringing after termination is applied
- Rounded edges are due to cable capacitance
- Peak to peak is smaller, but still more than 1.5V
- Idle voltage is smaller, but still more than 200mv



Live Demo – Un-terminated 4000 ft

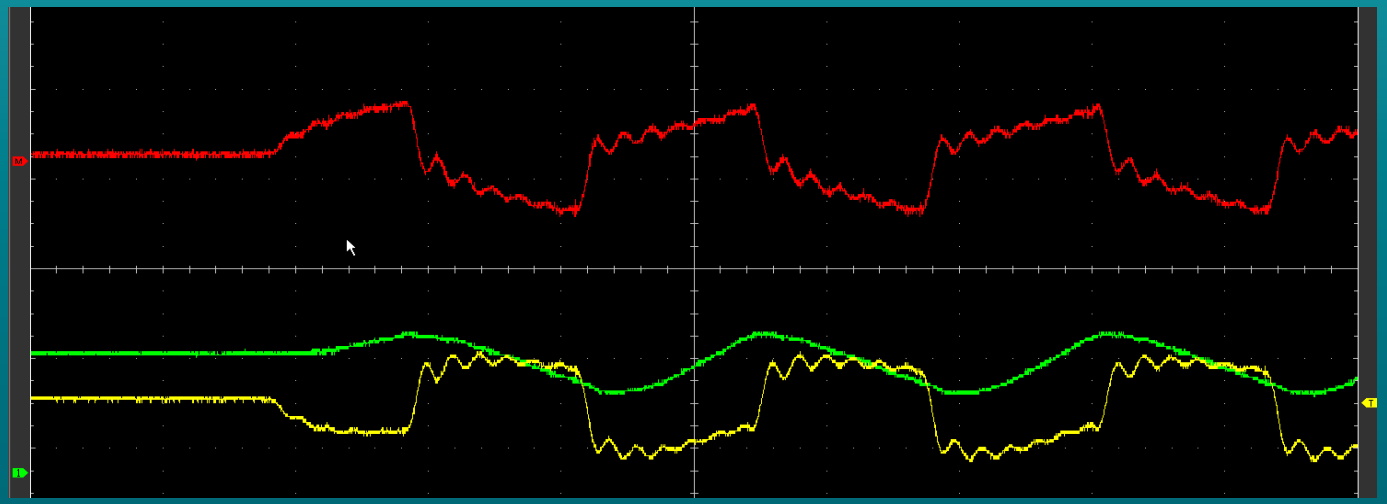
- Large ringing that does not end by end of bit
- Asymmetrical signal: ch1 (Data+) is extremely rounded
  - Data+ has too much capacitance, probably due to damage on that wire



TRIDIUM

Live Demo – Over Termination 4000 ft

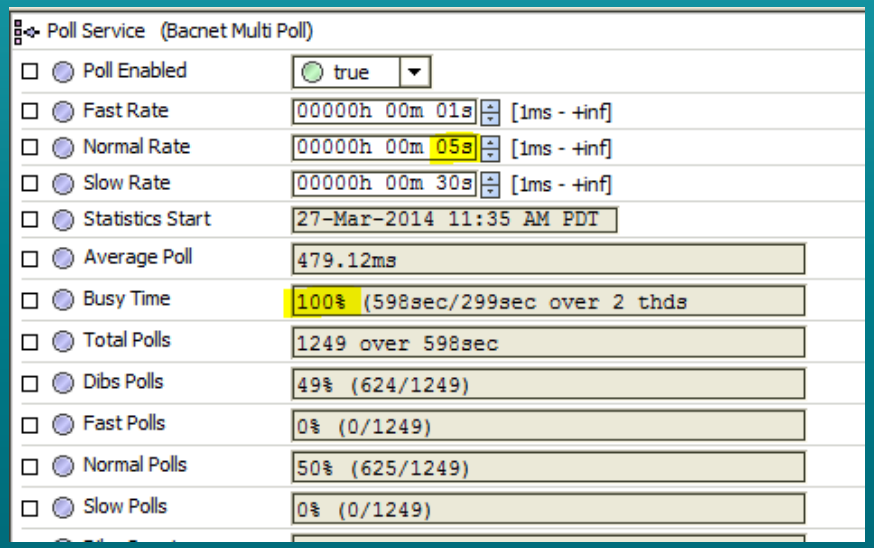
- Termination almost eliminates ringing
- Peak-to-peak amplitude down but OK
- Idle voltage too low, insufficient biasing

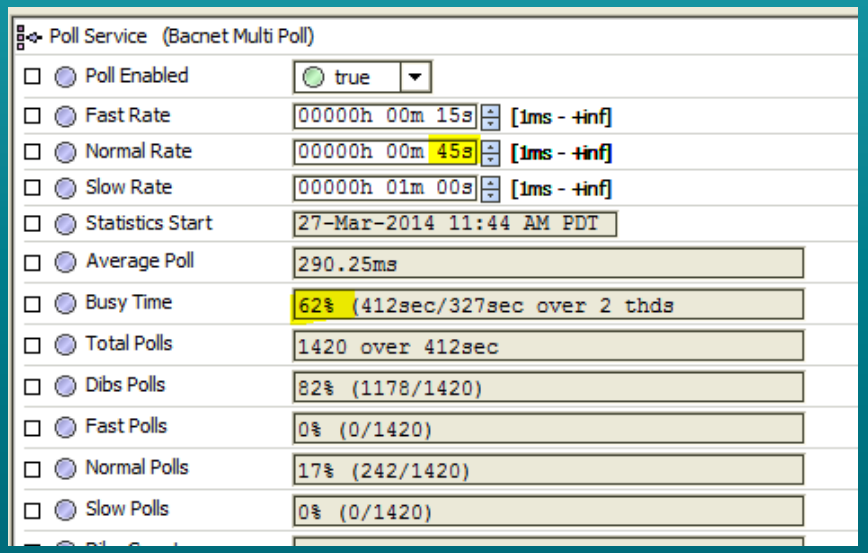


TRIDIUM

Bus Tuning

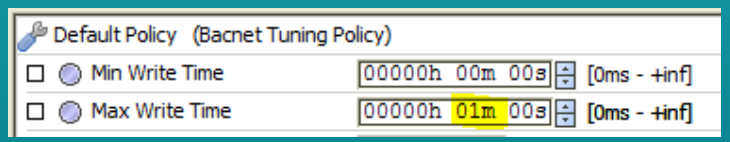
- Adjust poll rates to achieve ~60% Busy Time

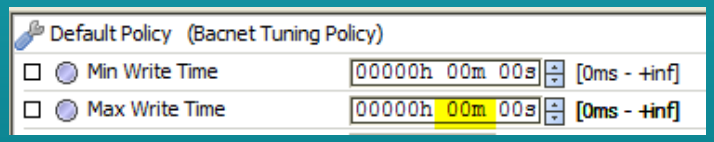


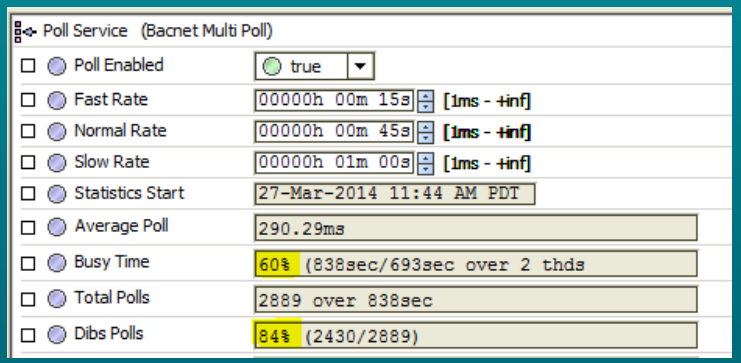


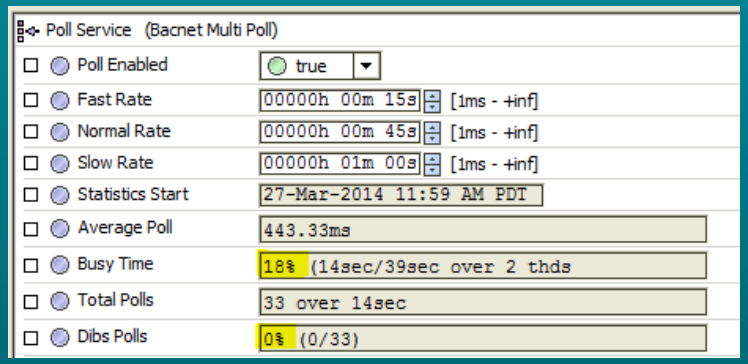
Bus Tuning

- Apply Max Write Time with caution



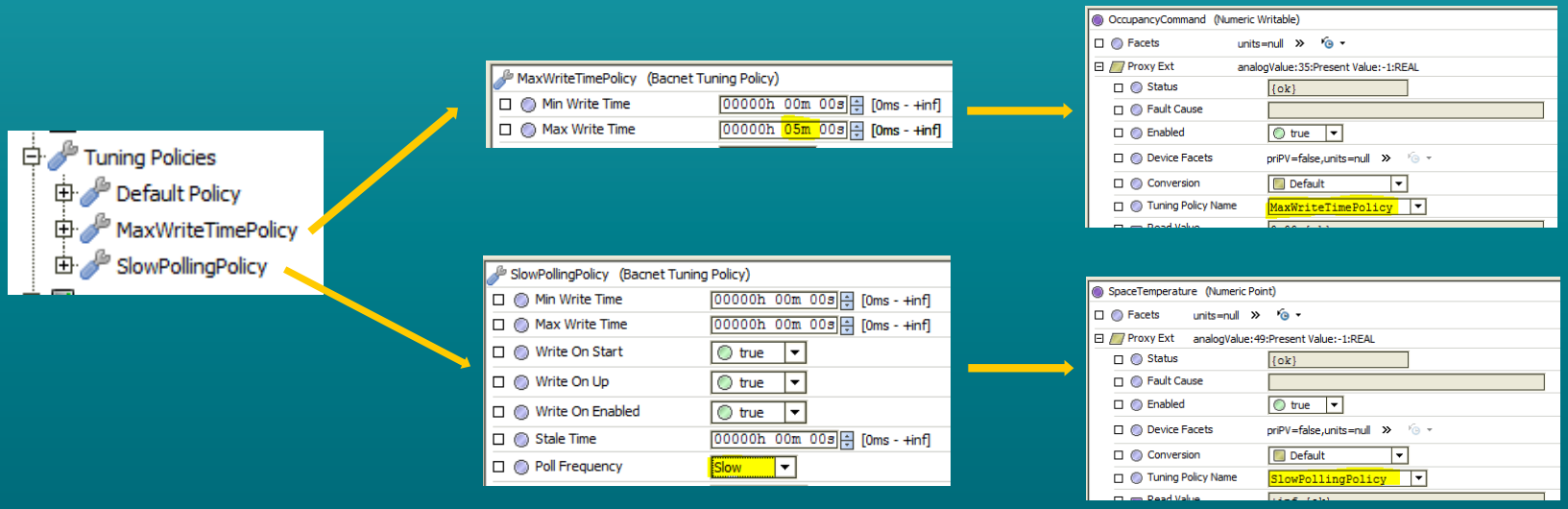






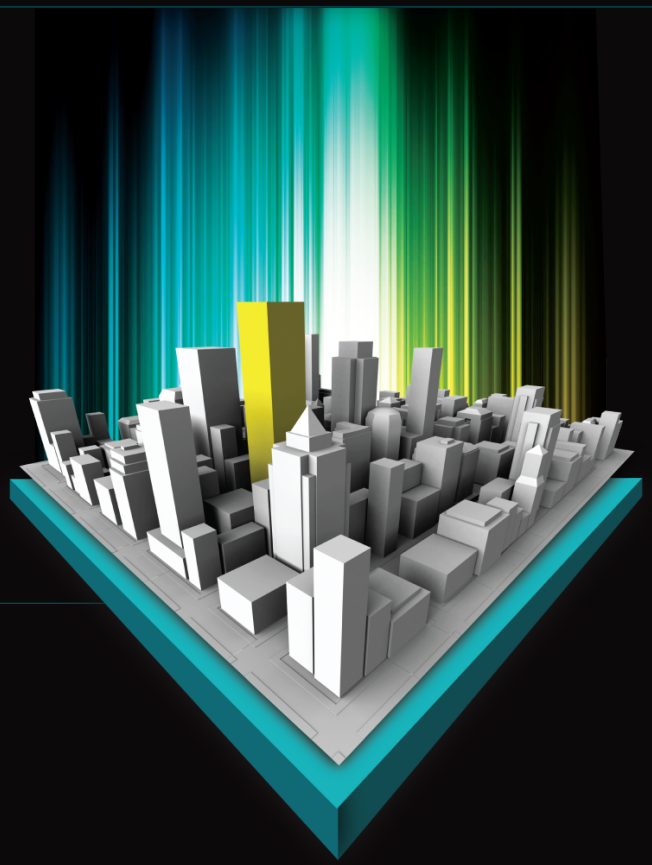
Bus Tuning

- Use multiple Tuning Policies to optimize polling



NIAGARA SUMMIT 2014

POWERED BY POSSIBILITIES



TRIDIUM