



LAN eXtensions for Instrumentation

Efficient Triggering on LXI-based ATE System

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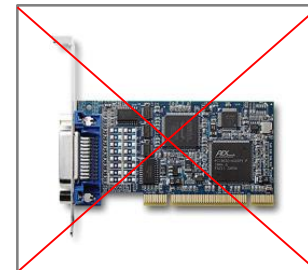
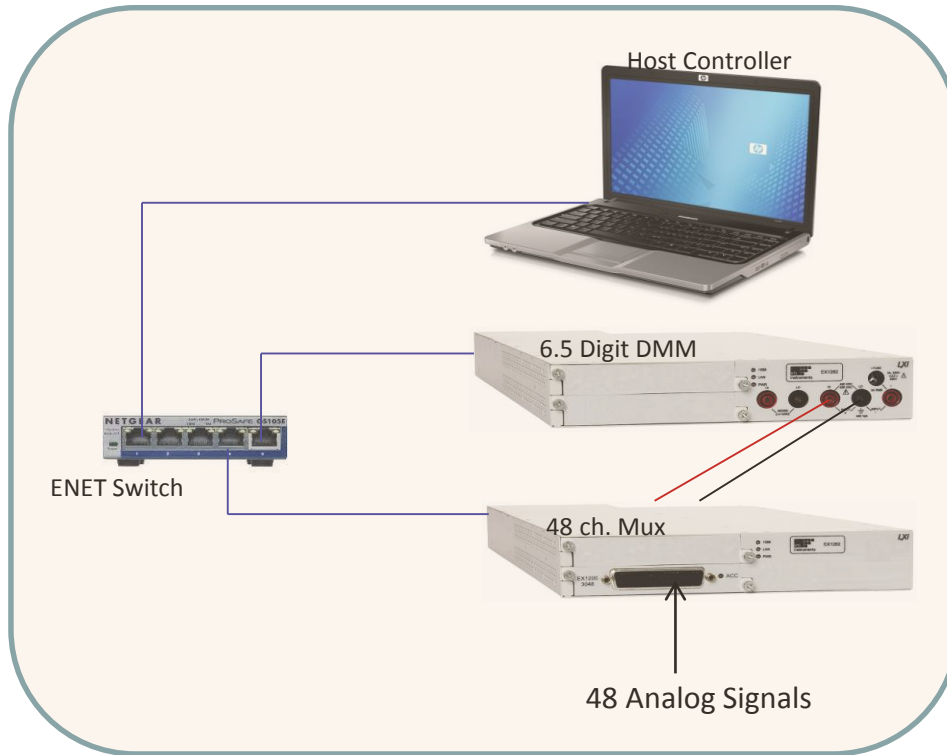


ATE System Industries

- Manufacturing
- Avionics
- Aerospace
- Military
- Defense

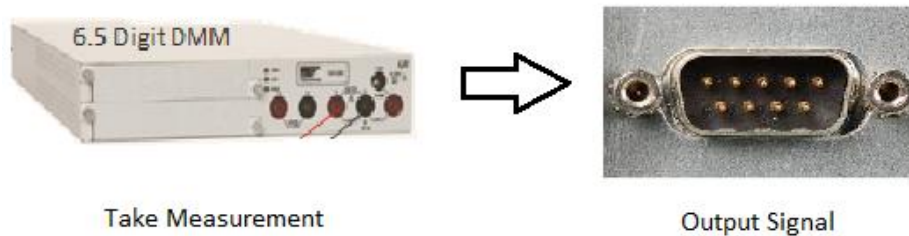
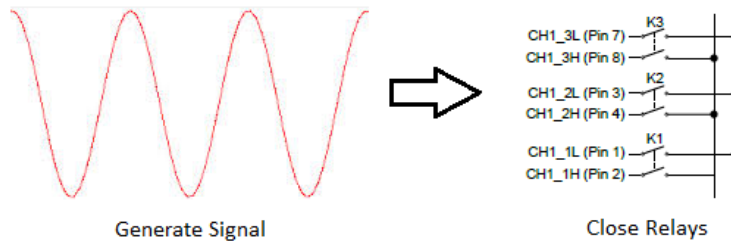
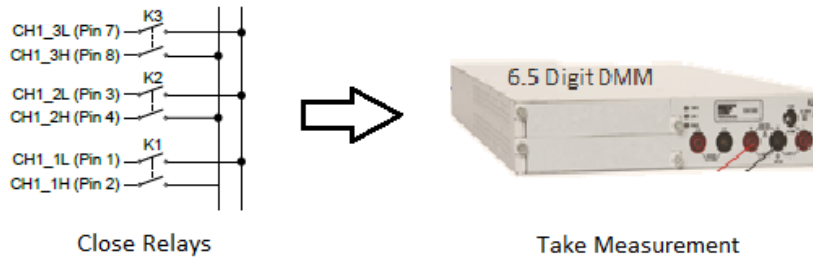


LXI-based ATE System Connection



ATE System

Triggering Between Multiple Devices



Triggering Methods

- Digital I/O
- Backplane
- External Hardware Trigger
- **LAN Event**
- **LXI Trigger Bus**
- **Software Triggering**

Triggering Methods

Software Triggering

VTEXDmm IVI Driver Reference

VTEXDmm_SendSoftwareTrigger Function

[Low Level Measurement](#) [See Also](#)

Sends a software trigger, which causes the DMM to take a measurement.

Function Tree Node: \VTEXDmm\Measurement\Low Level Measurement\Send Software Trigger

Declaration: VTEXDmm.h

Implementation: VTEXDmm.dll

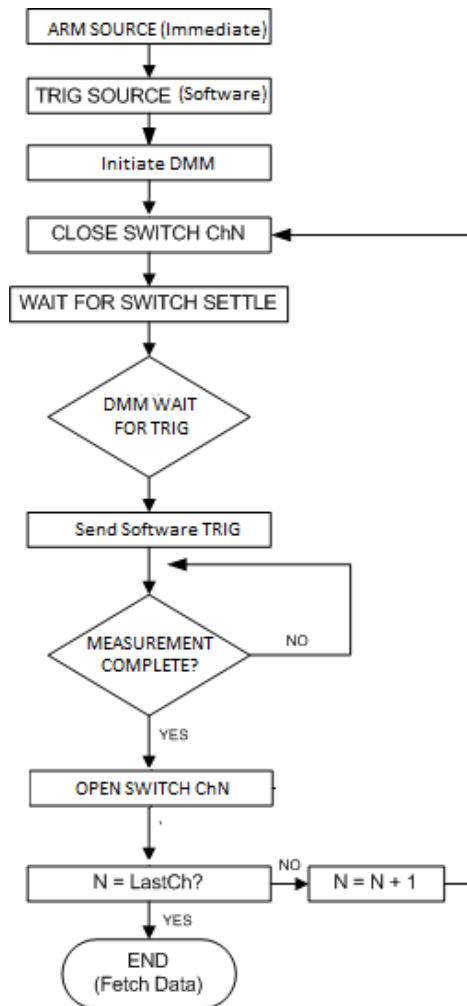
☐ Syntax

Visual C++

```
ViStatus VTEXDmm_SendSoftwareTrigger(  
    ViSession Vi  
);
```

Triggering Methods

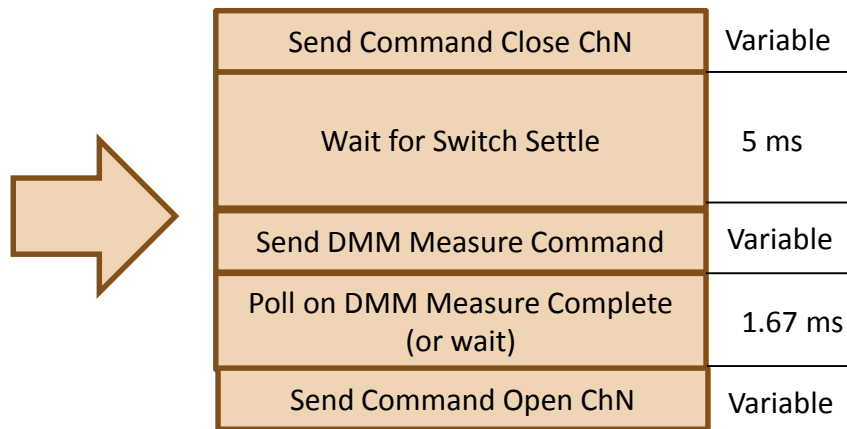
Software Triggering



Triggering Methods

Software Triggering

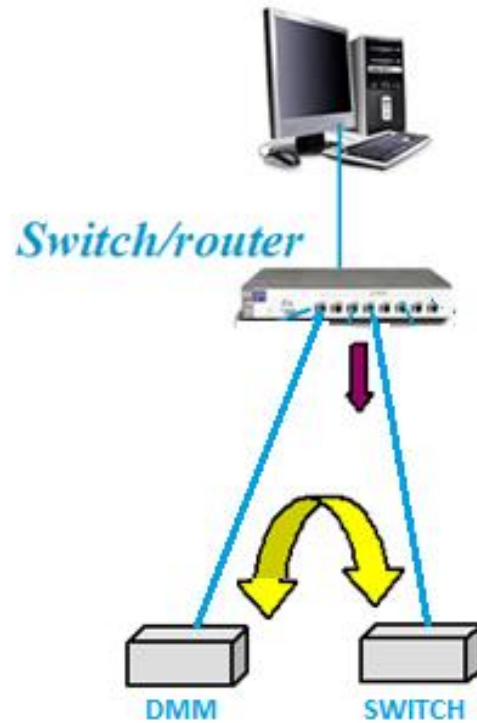
Removing all variables, best case scenario
 $1 / (1.67 \text{ ms} + 5 \text{ ms}) * 384 = 2.56 \text{ seconds}$
150 readings/second



Actual Measured: 63 rdgs/s
Protocol overhead carried for every switch measure loop

Triggering Methods

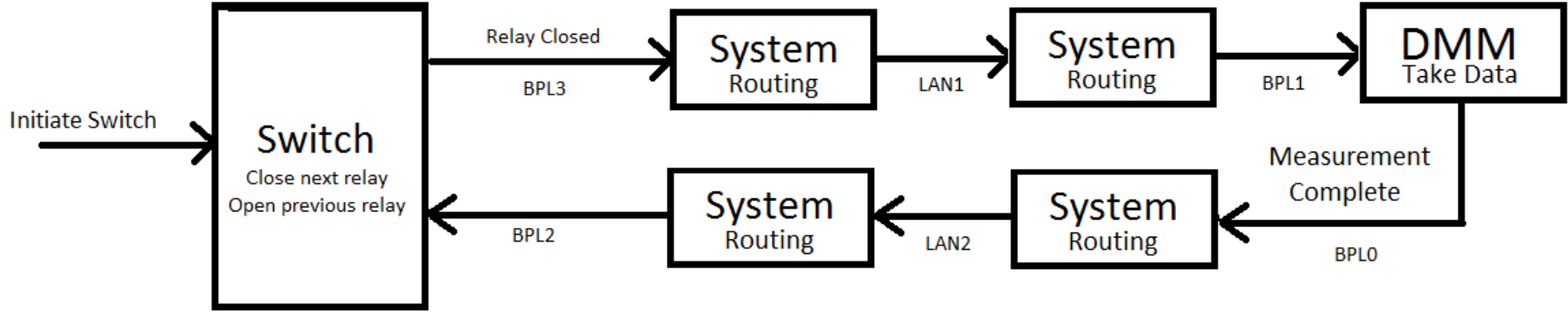
LAN Events



LAN Events - No PC Intervention

Triggering Methods

LAN Events



Actual Measured: 92 rdgs/s

Processing LAN events/implementation impacting efficiency

Triggering Methods

LAN Events

```
//Dmm trigger setup
dmm.Trigger.MultiPoint.MeasurementComplete =
VTEXDmmMeasCompleteDestEnum.VTEXDmmMeasCompleteDestBPL0;
dmm.Trigger.Source = VTEXDmmTriggerSourceEnum.VTEXDmmTriggerSourceBPL1;

//Switch trigger setup
sw.Scan.ConfigureTrigger(0,
VTEXSwitchTriggerInputEnum.VTEXSwitchTriggerInputBPL2,
VTEXSwitchAdvancedOutputEnum.VTEXSwitchAdvancedOutputBPL3);

//Route the signal from LAN2 to BPL2
swSystem.InstrumentSpecific.Route.Destinations.Item["BPL2"].SourcesList = "LAN2";
swSystem.InstrumentSpecific.Route.Destinations.Item["BPL2"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;

//Route the signal from BPL3 to LAN1
swSystem.InstrumentSpecific.Route.Destinations.Item["LAN1"].SourcesList = "BPL3";

swSystem.InstrumentSpecific.Route.Destinations.Item["LAN1"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;
```

```
//Route the signal from BPL0 to LAN2
dmmSystem.InstrumentSpecific.Route.Destinations.Item["LAN2"].SourcesList =
"BPL0";
dmmSystem.InstrumentSpecific.Route.Destinations.Item["LAN2"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;

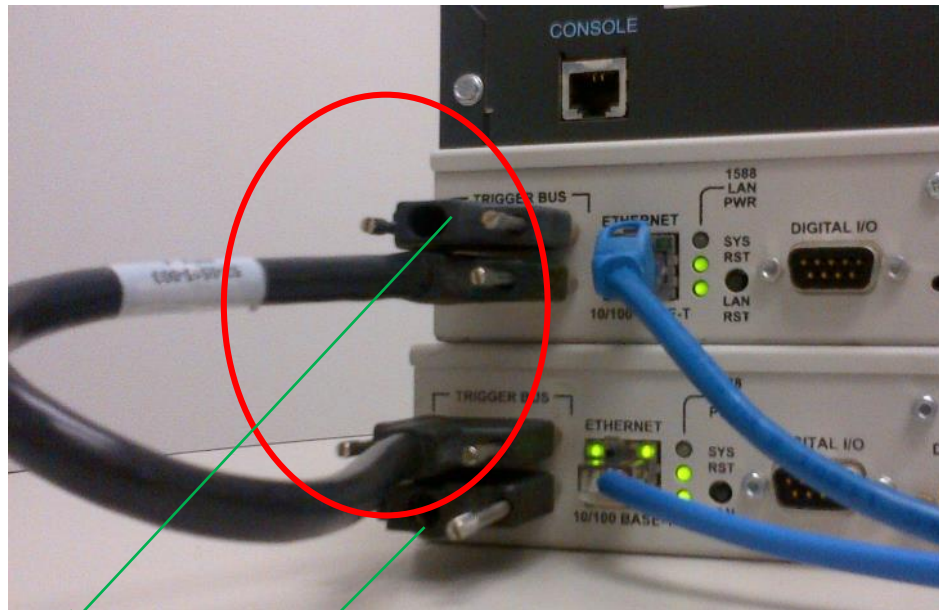
//Route the signal from LAN1 to BPL1
dmmSystem.InstrumentSpecific.Route.Destinations.Item["BPL1"].SourcesList =
"LAN1";
dmmSystem.InstrumentSpecific.Route.Destinations.Item["BPL1"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;

//Initiate switch and dmm
dmm.Measurement.Initiate();
sw.Scan.Initiate();

//Fetch all the data from the FIFO in 1000ms
dmm.Measurement.FetchMultiPointTimeStamped(1000, ref reading, ref second, ref
fraction);
```

Triggering Methods

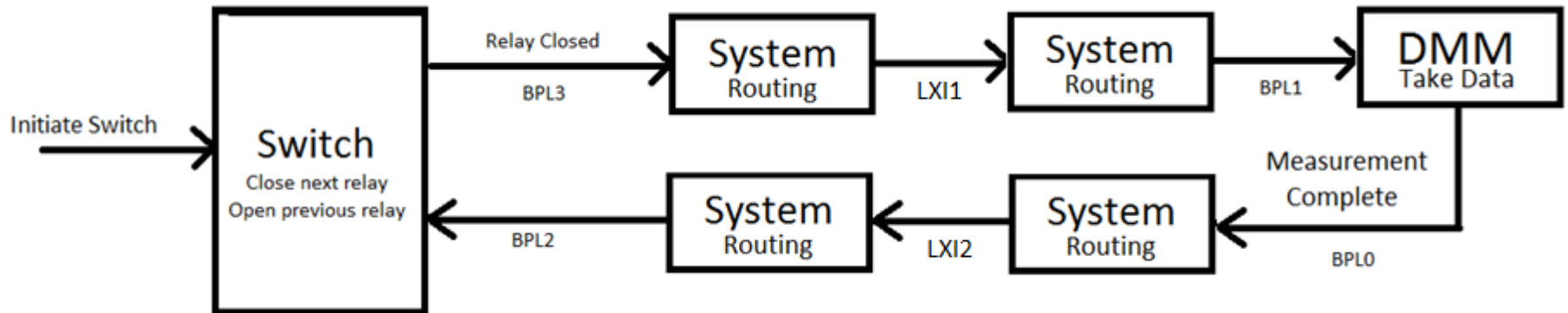
LXI Trigger Bus



WTB Termination

Triggering Methods

LXI Trigger Bus



Actual Measured: 145 rdgs/s

Again, there is minimal impact due to protocol overhead

Triggering Methods

LXI Trigger Bus

```
//Setup LXI domain of each EX1200 system
dmmSystem.LXIDomain = 0;
swSystem.LXIDomain = 0;

//Dmm trigger setup
dmm.Trigger.MultiPoint.MeasurementComplete =
VTEXDmmMeasCompleteDestEnum.VTEXDmmMeasCompleteDestBPL0;
dmm.Trigger.Source = VTEXDmmTriggerSourceEnum.VTEXDmmTriggerSourceBPL1;

//Switch trigger setup
sw.Scan.ConfigureTrigger(0,
VTEXSwitchTriggerInputEnum.VTEXSwitchTriggerInputBPL2,
VTEXSwitchAdvancedOutputEnum.VTEXSwitchAdvancedOutputBPL3);

//Route the signal from LAN2 to BPL2
swSystem.InstrumentSpecific.Route.Destinations.Item["BPL2"].SourcesList = "LXI2";
swSystem.InstrumentSpecific.Route.Destinations.Item["BPL2"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;

//Route the signal from BPL3 to LAN1
swSystem.InstrumentSpecific.Route.Destinations.Item["LXI1"].SourcesList = "BPL3";

swSystem.InstrumentSpecific.Route.Destinations.Item["LXI1"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;

//Route the signal from BPL0 to LAN2
dmmSystem.InstrumentSpecific.Route.Destinations.Item["LXI2"].SourcesList =
"BPL0";
dmmSystem.InstrumentSpecific.Route.Destinations.Item["LXI2"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;

//Route the signal from LAN1 to BPL1
dmmSystem.InstrumentSpecific.Route.Destinations.Item["BPL1"].SourcesList =
"LXI1";
dmmSystem.InstrumentSpecific.Route.Destinations.Item["BPL1"].DriveMode =
VTEXSystemEventDriveModeEnum.VTEXSystemEventDriveModeDriven;

//Initiate switch and dmm
dmm.Measurement.Initiate();
sw.Scan.Initiate();

//Fetch all the data from the FIFO in 1000ms
dmm.Measurement.FetchMultiPointTimeStamped(1000, ref reading, ref second, ref
fraction);
```



Trigger Methods

Results Comparison

Method (Electromechanical, 5 ms settle)	Measured
Software Triggering	63 rdgs/sec
LAN Event	92 rdgs/sec
LXI Trigger Bus	145 rdgs/sec
Theoretical Max	150 rdgs/sec

Determinism	
Software Triggering	Below Average
LAN Event	Average
LXI Trigger Bus	Excellent

Method (Solid-State, 0.2 ms ON time)	Measured
Software Triggering	60 rdgs/sec
LAN Event	123rdgs/sec
LXI Trigger Bus	522 rdgs/sec
Theoretical Max	535rdgs/sec

Resolution of WAIT statement



Summary

- Software Triggering
 - Intuitive and straight-forward to implement
 - Significantly affected by program overhead
- LAN Event
 - More complicated to implement
 - Provides millisecond level of triggering
 - Easy distribution without distance limitation
 - Does not require external cables
- LXI Trigger Bus
 - More complicated to implement
 - Provides nanosecond level of triggering
 - Cannot be distributed
 - Requires external cables



LAN eXtensions for Instrumentation

Thank you !

