



## The Virginia Tech PMU and PDC Test System

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## NIST PMU Test System



3 V 3 I

NIST PMU Dynamic Testing System [1]

CTs

Output

DUT

Three Voltage Amplifiers

Three Trans-

conductance Amplifiers

UirginiaTech









## PDC Test System

- Performance Requirements
  - PDC Processing Time
    - Latency
  - Data re-sampling
    - Up-sampling
    - Down-sampling
  - Communication Requirements
    - TCP/IP
    - UDP/IP
    - IP Multicast



# Flag/Reporting Rate Check and re-sampling are performed with the PMU Test System

R	unDUT TCP Arbiter.vi	
Eile	Edit View Project Operate Tools Window Help	RunDUT
		2 Arbiter
	90 for 2nd Arbiter, 95 for 1st 214 for 6 phasors other, 474 for GE 8 phasors, Mehta Tech 694, 5 phasors so 1204, and 3rd so 1413.	
	25 for SEL, 22 for GE, PMU ID code Config 2 Config bytes actual number	Phasor Polar
	254 Frame size to read of bytes read status code 0 0.00457 V1YPM	0
	DUT address TimeBase 4/4 4/4 4/4 4/4 VAYPM	Phasor Float
	Port Data Data size Config Read? Config Read? 0.00457 I1WPM	0
	4712 Framesize 0 0 0 STOP 0.00457 IBWPM	Freq Float
	GPS Timestamp Sec Year Time Zones to 1/7 SoC to SoY DUT data rate NomFreq PhNmr 0.00021 ICWPM	out
	€ 0.00 € 2011 € -5 EDT= -5 GE EDT= -4 Arb -1293858000 30 60 8 0.00021 stat	us code
		0
/	AA 31 1 DA U FE 38 D3 E3 EF 0 0 0 0 FF FF FF 0 1 53 54 41 54 49 0.00021 -34044/453.0332 solution	rce
	+ 0 AA 1 0 38 0 FE 38 D3 E3 F2 0 F7 77 77 0 0 0 0 0 0 0 0 0 0 0 0 0	
/		
•		
		$\langle \rangle$
1		
~	Config 2 array	TCP Time
_		-340447453 03
		010111100100
_	Data row	
0	AA 1 0 38 0 FE 38 D3 E3 F2 0 F7 77 77 0 0 0 0 0 0 0 0 0	0 0 0

Invent the Future

### Latency Test System



A dual Port PMU is used as a base PMU

Wireshark is used in the Data Analyzer to capture data and compute delays



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Initial data shows problem with OS delay

System is being implemented in a Linux OS to reduce OS effects



- Time difference between data frames  $\neq$  (1/frame rate)
- Huge delays between data frames



DUT A: Time Difference between data frames(1.5 ms -50ms)



DUT B: Time Difference between data frames(1 ms -150 ms)



Virgin

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#### References

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- [2] IEEE Standard for Synchrophasors for Power Systems, IEEE Standard C37.118-2005, March, 2006.
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- [4] IEEE C37.118-2011 "Standard for Synchrophasor Measurements for Power Systems"
- [5] PMU System Testing and Calibration Guide. Technical Report for NASPI, Performance and Standard Task Team, team leader G.Stenbakken.
- [6] IEEE Standard 1588-2002, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

