



EtherTime: Cross-vendor Evaluation of PTP/NTP on Ethernet-based COTS Embedded Platforms

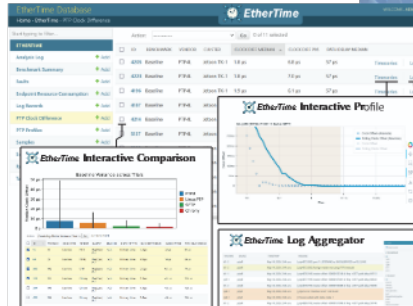
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* Chair for Computer Architecture and Parallel Systems
Technical University of Munich

** Systopia Lab
Department of Computer Science
University of British Columbia



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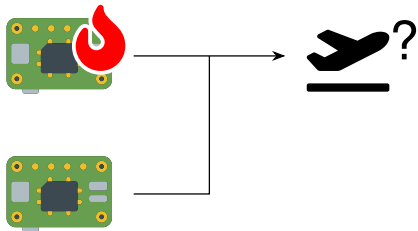
Time in Distributed Systems



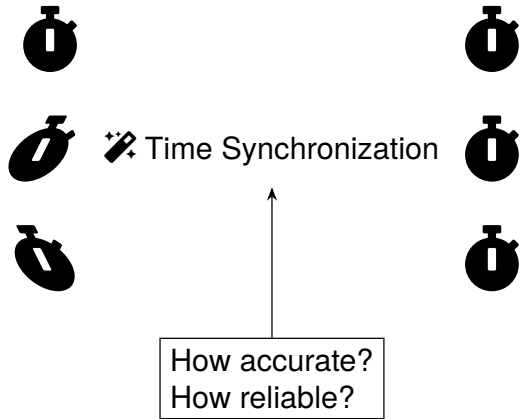
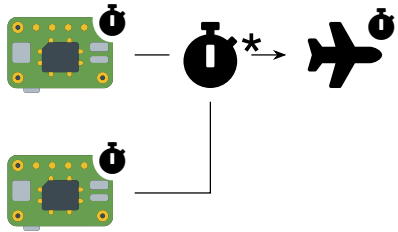
Time in Distributed Systems



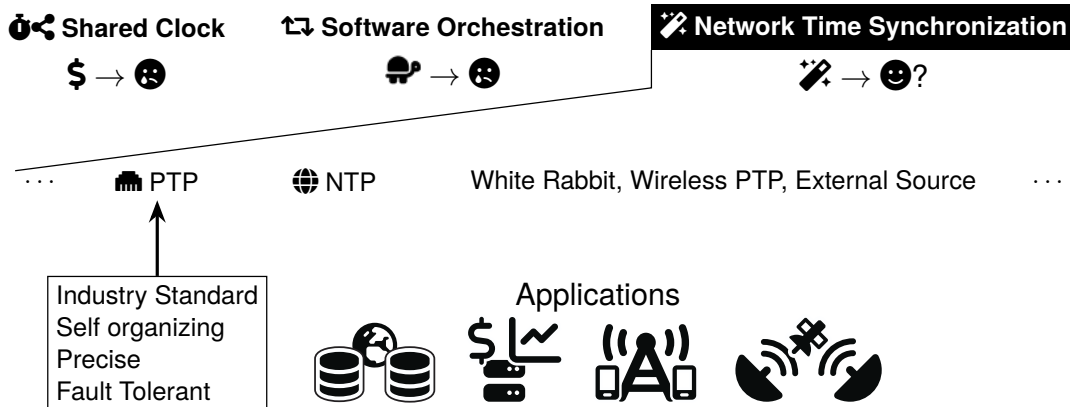
Time in Distributed Systems



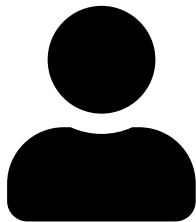
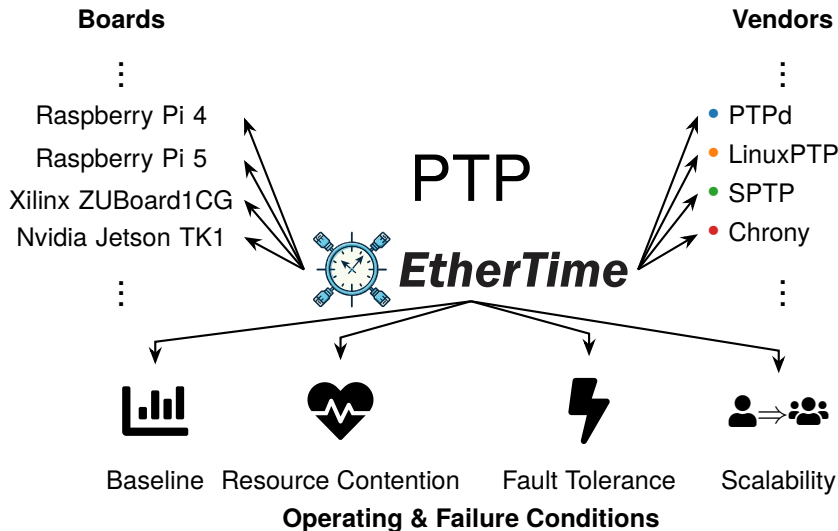
Time in Distributed Systems



Distributed Synchronized Time



Precision Time Protocol



Action: 0 of 11 selected

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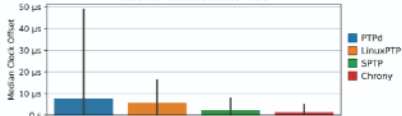
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Baseline Variance across Trials



Active Create Key Metric Value Chart » Go 4 of 43 selected


ID	Profiled	Baseline	Hardware	Cluster	Machine	Deployment Type	CPU Buff Memory	CPU Buff Width	Per-Batch Read W
55	23	Baseline	PTM	Raspberry Pi 4	esp8266	Primary Slave	0.2 µs	30 µs	81 µs
64	28	Baseline	PTM	Raspberry Pi 4	esp8266	Primary Slave	0.3 µs	14 µs	84 µs
283	132	Baseline	SPFP	Raspberry Pi 4	esp8266	Primary Slave	2.5 µs	8.7 µs	74 µs
375	133	Baseline	Cherry	Raspberry Pi 4	esp8266	Primary Slave	1.3 µs	4.3 µs	132 µs
384	140	Baseline	Cherry	Raspberry Pi 4	esp8266	Primary Slave	1.3 µs	4.6 µs	133 µs
460	142	Baseline	Cherry	Raspberry Pi 4	esp8266	Primary Slave	1.4 µs	4.9 µs	133 µs

<input type="checkbox"/>	ID	BENCHMARK	VENDOR	CLUSTER	CLOCK DIFF MEDIAN	CLOCK DIFF P95	PATH DELAY MEDIAN		
<input type="checkbox"/>	4205	Baseline	PTP4L	Jetson TK-1	1.8 μ s	6.8 μ s	57 μ s	Timeseries	Log
<input type="checkbox"/>	4223	Baseline	PTP4L	Jetson TK-1	1.8 μ s	7.0 μ s	57 μ s	Timeseries	Log
<input type="checkbox"/>	4196	Baseline	PTP4L	Jetson TK-1	1.9 μ s	6.1 μ s	57 μ s	Timeseries	Log
<input type="checkbox"/>	4187	Baseline	PTP4L	Jetson					
<input type="checkbox"/>	4214	Baseline	PTP4L	Jetson					
<input type="checkbox"/>	5137	Baseline	PTP4L	Jetson					



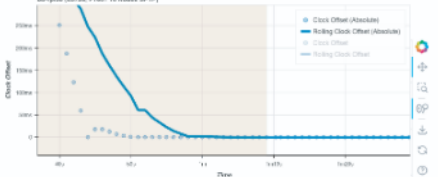
EtherTime Interactive Profile

h0-ep30 (EST30, P100): 10 Nodes SP77



Click Offset (Absolute)

Source: U.S. Census Bureau, 1990. *U.S. Census of Population and Housing*, 1990. Washington, D.C.: U.S. Government Printing Office.



id	src	target	type	comment
1	srcip	dstip	IP	
2	srcip	dstip	IP	
3	srcip	dstip	IP	
4	srcip	dstip	IP	
5	srcip	dstip	IP	
6	srcip	dstip	IP	
7	srcip	dstip	IP	
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93	srcip	dstip	IP	
94	srcip	dstip	IP	

Show counts

✕ Clear all filters

↓ By cluster id

All

petalinux

rpi-4

npi-5

TK-1

↓ By vendor id

All

chrony

[linuxptp](#)

ptpd

sftp

1 By endpoint type

All

Master

Primary Slave

Secondary Slave

Tertiary Slave

↓ By benchmark id

All

base

fault/hardware/master

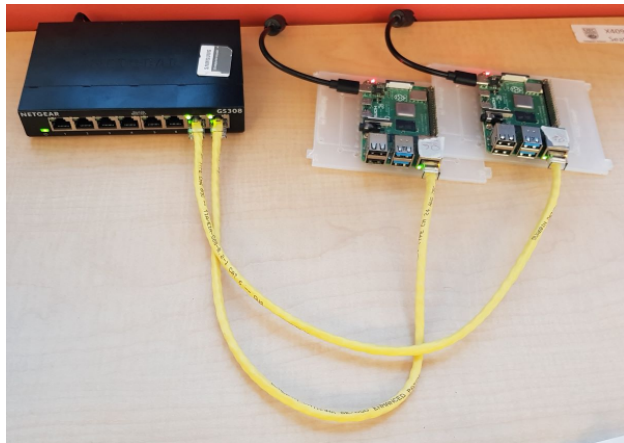
fault/hardware/master_failover

fault/hardware/slave

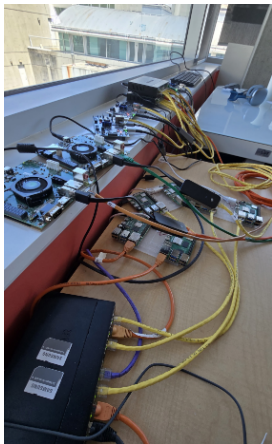
fault/hardware/switch






load/aux_alarm/load_100

Hardware Setup

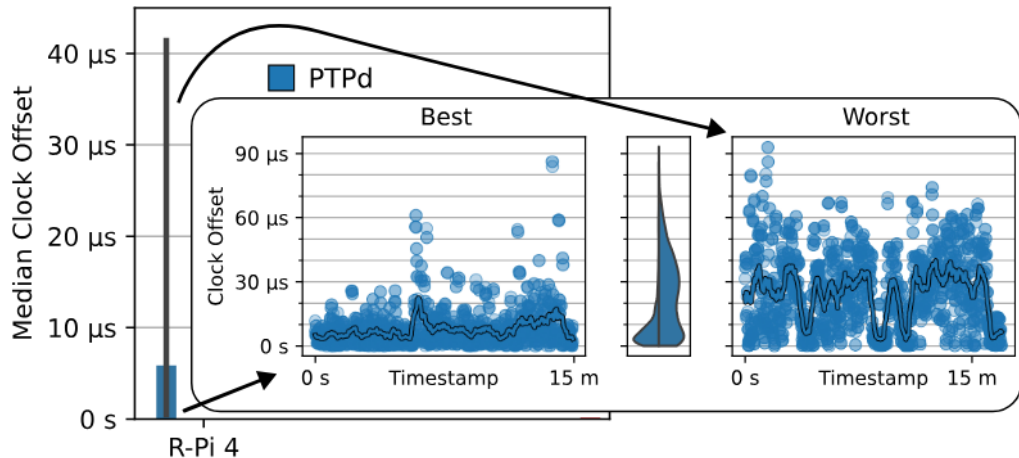


Hardware Setup

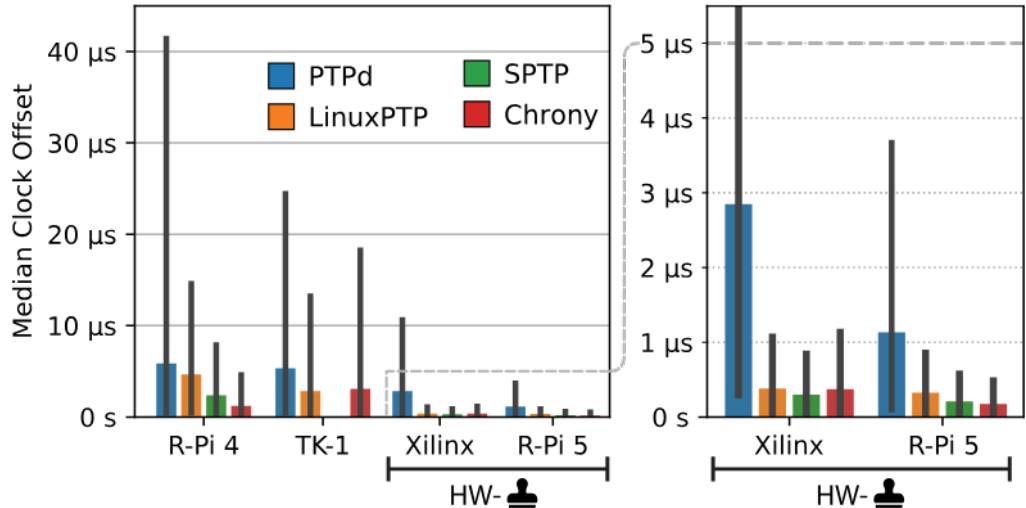


	Purpose	HW- 	RTC
Raspberry Pi 4 	General	✗	✗
Raspberry Pi 5 	Next-Gen	✓	✓
Xilinx ZUBoard 1CG 	Real-time	✓	✓
NVIDIA Jetson TK-1 	GPU	✗	✗

Baseline



Baseline



Base Metrics

Accuracy

Stability

• PTPd



• LinuxPTP



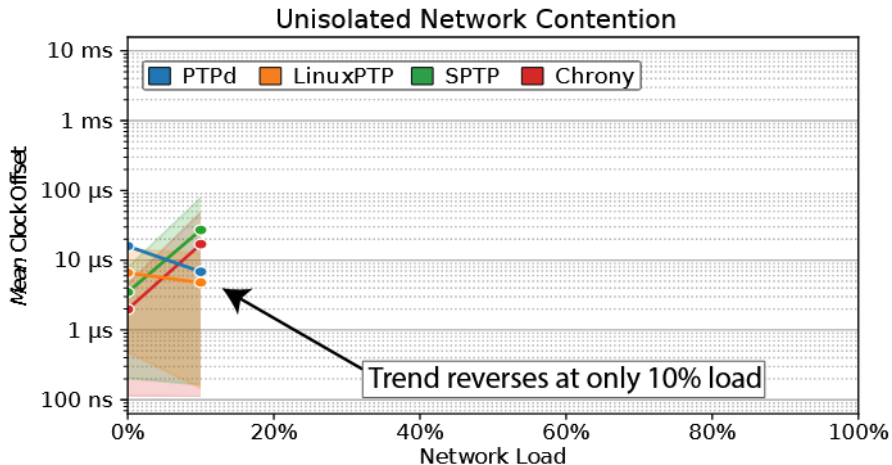
• SPTP



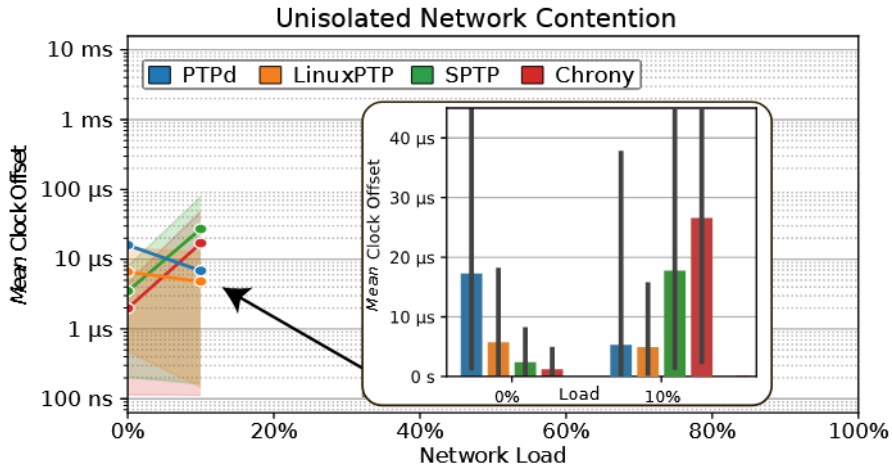
• Chrony



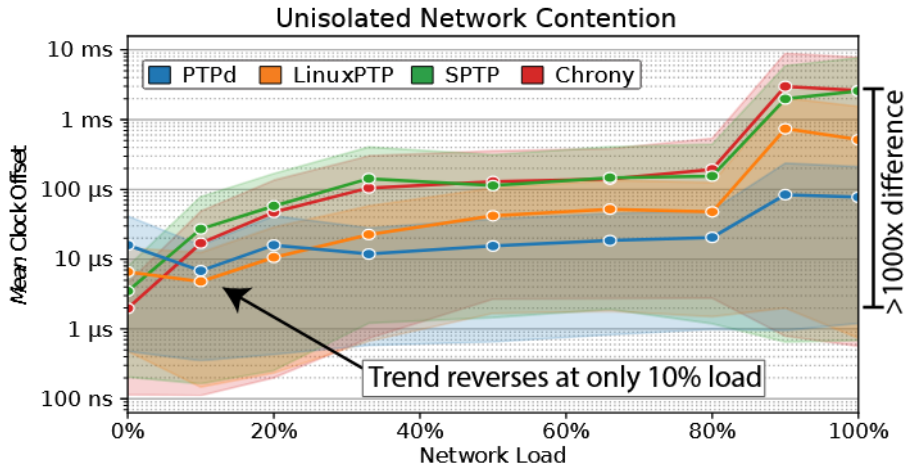
Resource Contention (Network)



Resource Contention (Network)














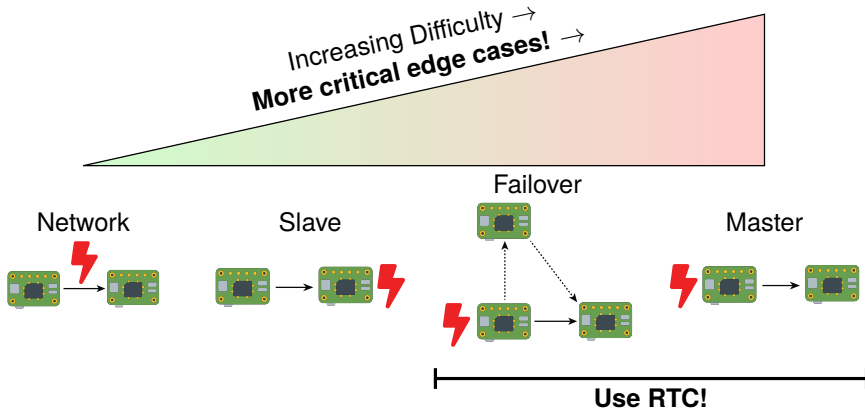
Resource Contention (Network)





Traffic Prioritization

	• PTPd	• LinuxPTP	• SPTP	• Chrony
Base Metrics				
Accuracy				
Stability				
Resource Contention				
Network		~		
Others	—	—	—	—



	• PTPd	• LinuxPTP	• SPTP	• Chrony
Base Metrics				
Accuracy				
Stability				
Resource Contention				
Network		~		
Others	—	—	—	—
Fault Tolerance				
Recovery		~		
Isolation			~	~
Scalability				
Synchronization				
Resources				
Total	~		~	
<div> <div>Introduction</div> <div>PTP & Ethertime</div> <div>Benchmarks</div> <div>Evaluation</div> </div>				

Conclusion – State of PTP Implementations

① Accuracy?



② Dependability?



③ Features?



④ Vendor?

LinuxPTP/*Chrony*
~~PTPd~~



EtherTime

More performance results in paper



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