IEEE-1588 Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

-Test and Measurement Applications-

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Test and Measurement

1. **Moving from bus (IEEE-488 aka. GPIB) connected instrument systems to network connected modular systems.**
2. **Synchronization needs vary widely with application**
   a. **Low to sub-nanosecond for most demanding**
   b. **Microseconds to milliseconds for less demanding**

Military Systems

1. Variety of potential applications
   a. Depot and test ranges
   b. Flight test & qualification
   c. Operational systems
2. Requirements very similar to test and measurement

LXI Consortium

- **Consortium of test and measurement equipment vendors and users**
- **LXI Specification:**
  - **Mandates the use of IEEE 1588 for LXI Class B instrumentation**
  - **Specifications on how to use IEEE 1588 in instruments**
    - **Timestamp data and events**
    - **Time-triggers**
    - **Peer-peer LAN messages containing event timestamps**
- **LXI paper during this conference.**


Agilent
N8241A
Arbitrary Waveform Generator
10 MHz REF
CH 1 OUT
CH 2 OUT
DATA PORT
AUX PORT
MARKER
TRIGGER
PWR
LAN
1588
RST


PWR
LAN
1588
RST

Styles of Measurement and Control

a. **Message based**

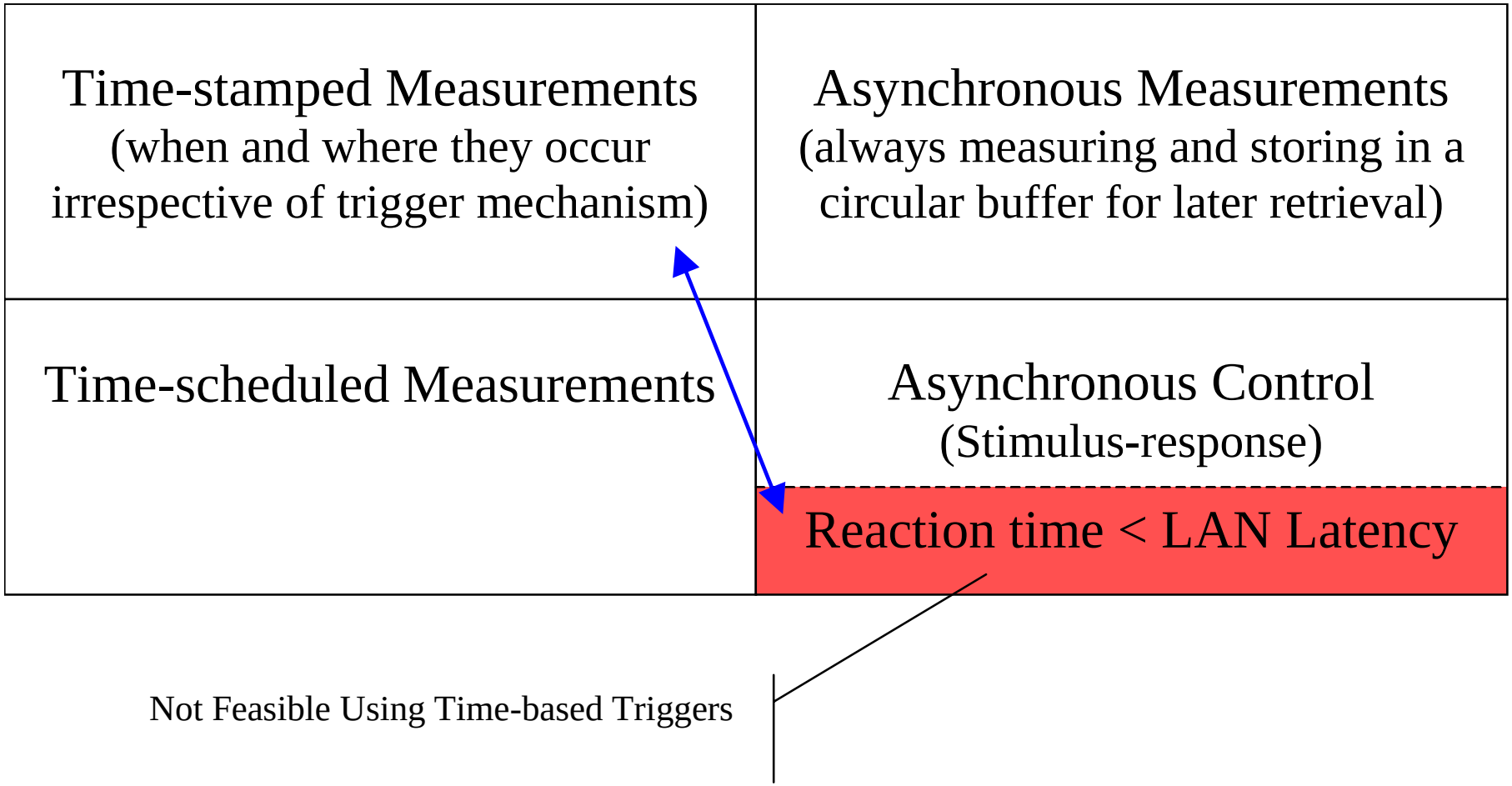
b. **Periodic**

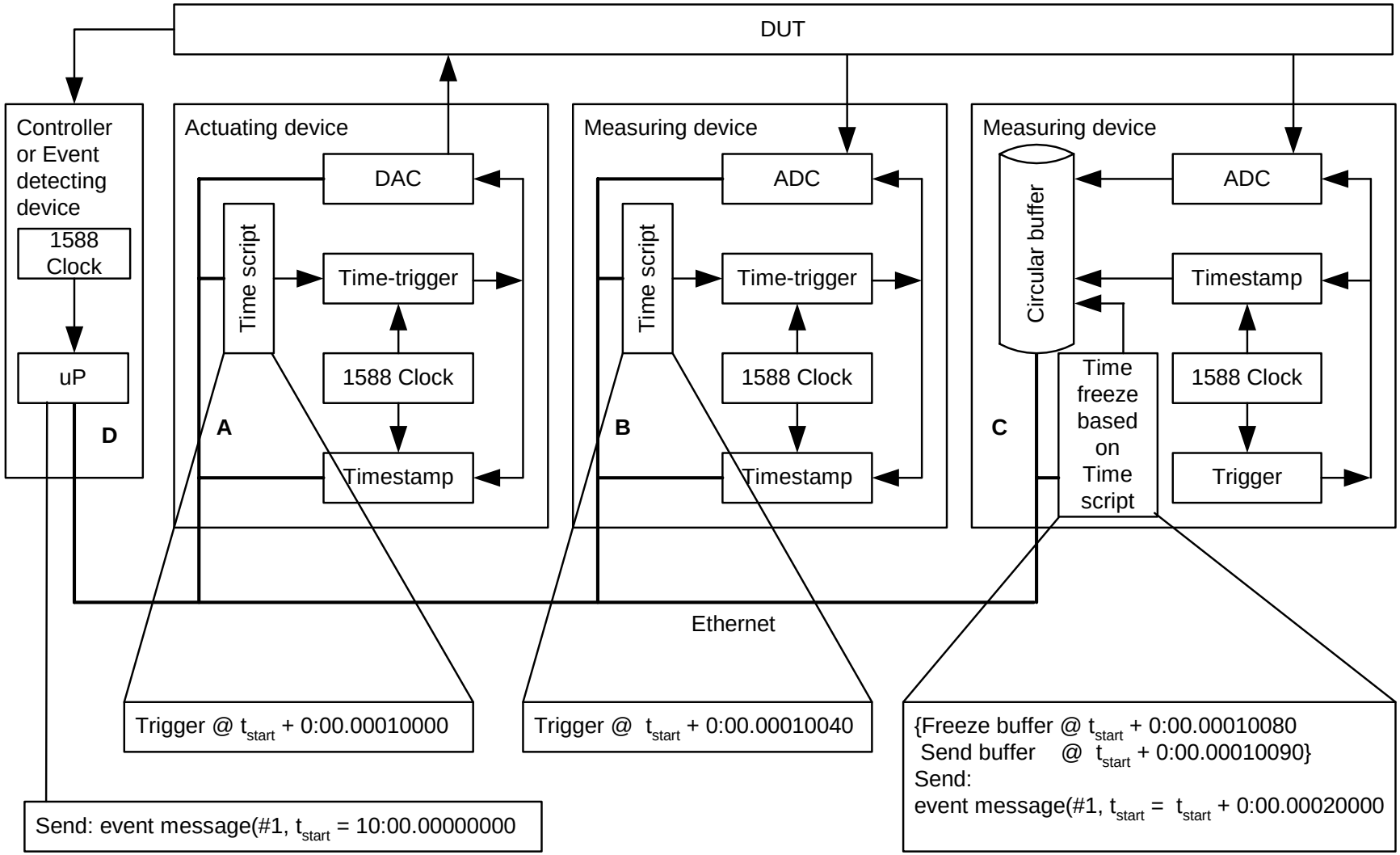
c. **Time-based**

Styles of Control

	Message-based	Cyclic	Time-based
Information dependent on message	Value and timing	Value and timing	Value and time specification
Timing accuracy limited by:	Fluctuations in message generation timing and delivery latency	Fluctuations in cycle periodicity	Accuracy of clock synchronization
Update timing resolution limited by	Latency and minimum inter-message interval	Cycle period	Resolution of the clock
Ordering of data to/from multiple sources	Dependent on messaging protocol	Tied to cycle	Limited by synchronization accuracy and clock resolution

Test and Measurement Application Space




DUT
Controller or Event detecting device
1588 Clock
uP
D
Actuating device
DAC
Time script
Time-trigger
1588 Clock
Timestamp
A
Measuring device
ADC
Time script
Time-trigger
1588 Clock
Timestamp
B
Measuring device
Circular buffer
ADC
Timestamp
1588 Clock
Trigger
Time freeze based on Time script
C
Ethernet
Trigger @ t_start + 0:00.00010000
Trigger @ t_start + 0:00.00010040
{Freeze buffer @ t_start + 0:00.00010080
Send buffer @ t_start + 0:00.00010090}
Send:
event message(#1, t_start = t_start + 0:00.00020000
Send: event message(#1, t_start = 10:00.00000000

Questions?