High Performance NTP Server using FPGA

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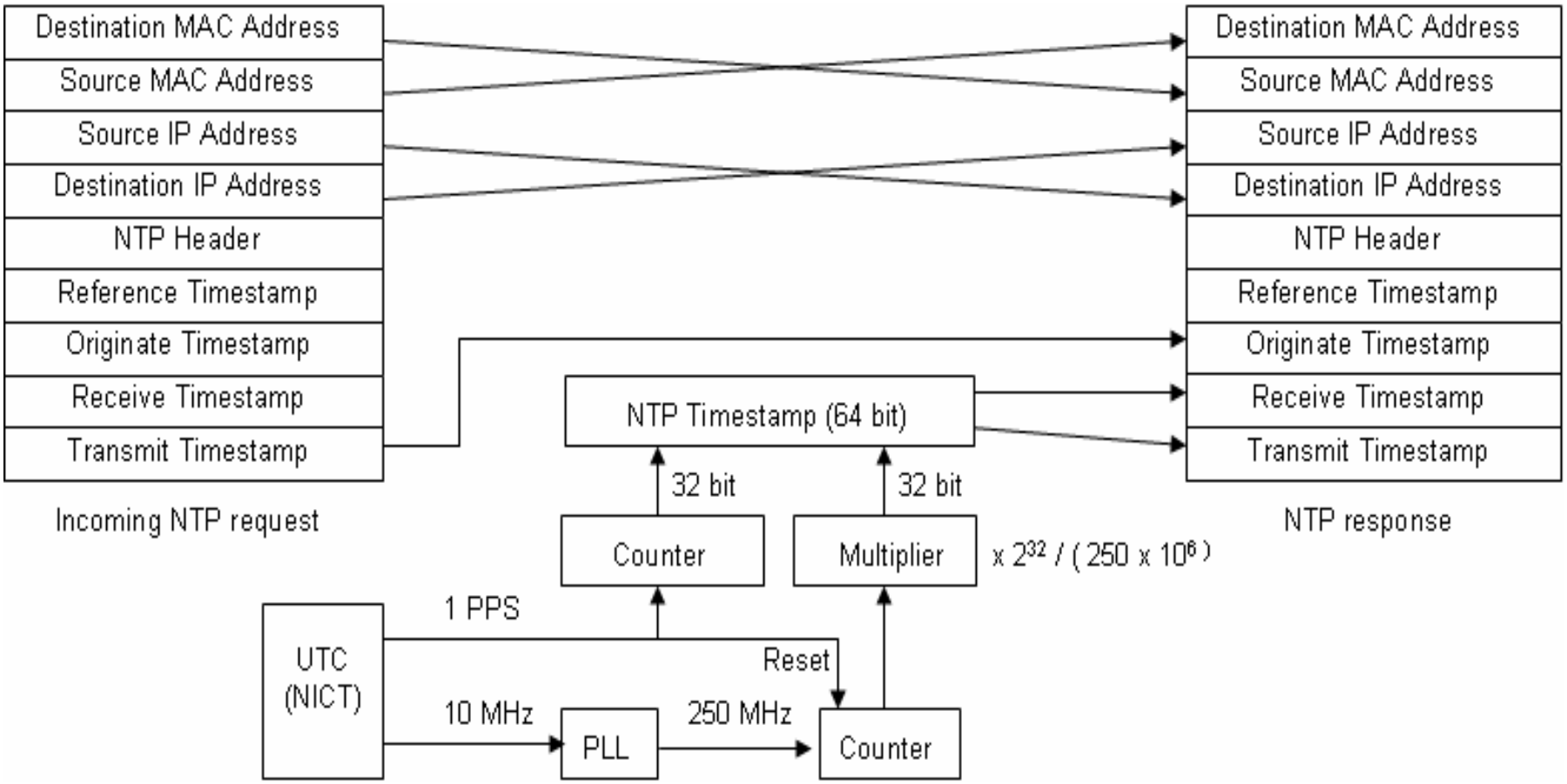
Simple Functions (subset of SNTP)

- NTP server request / response
- Single Reference Clock
- IPv4 and IPv6 unicast

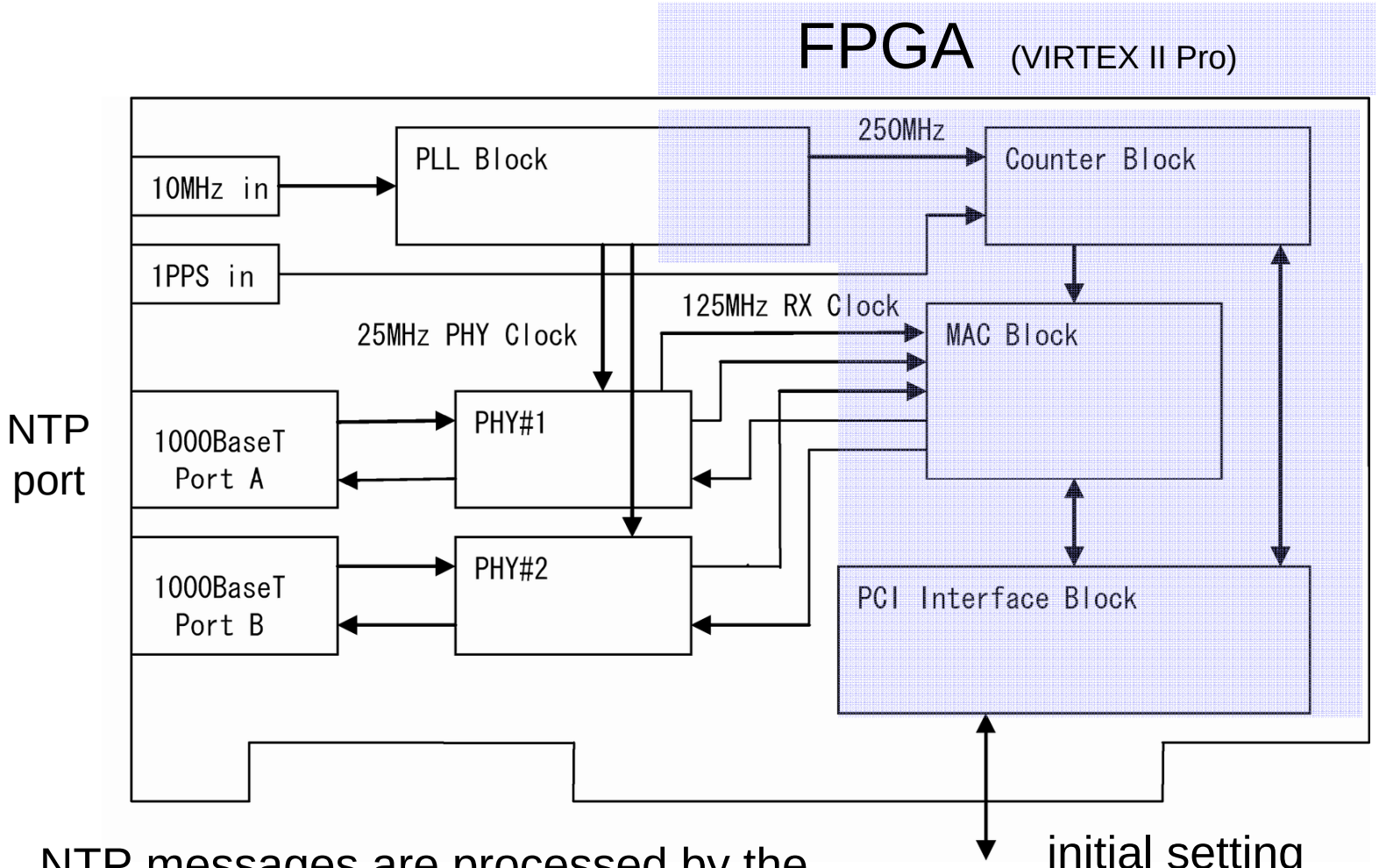
High Performance

- 8 ns accuracy
- 1 Gbps wire-speed throughput
- Intrusion tolerant

Processing Ethernet frame directly

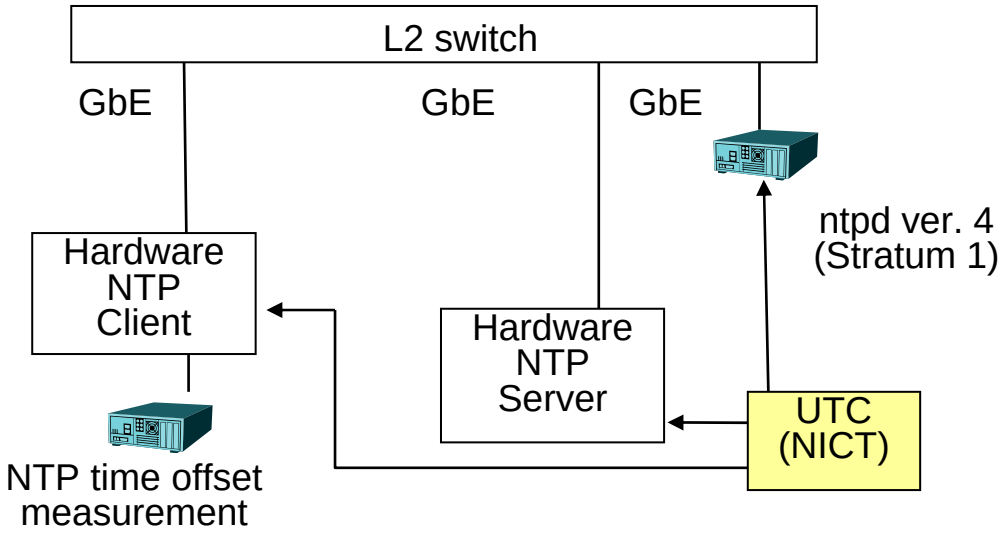


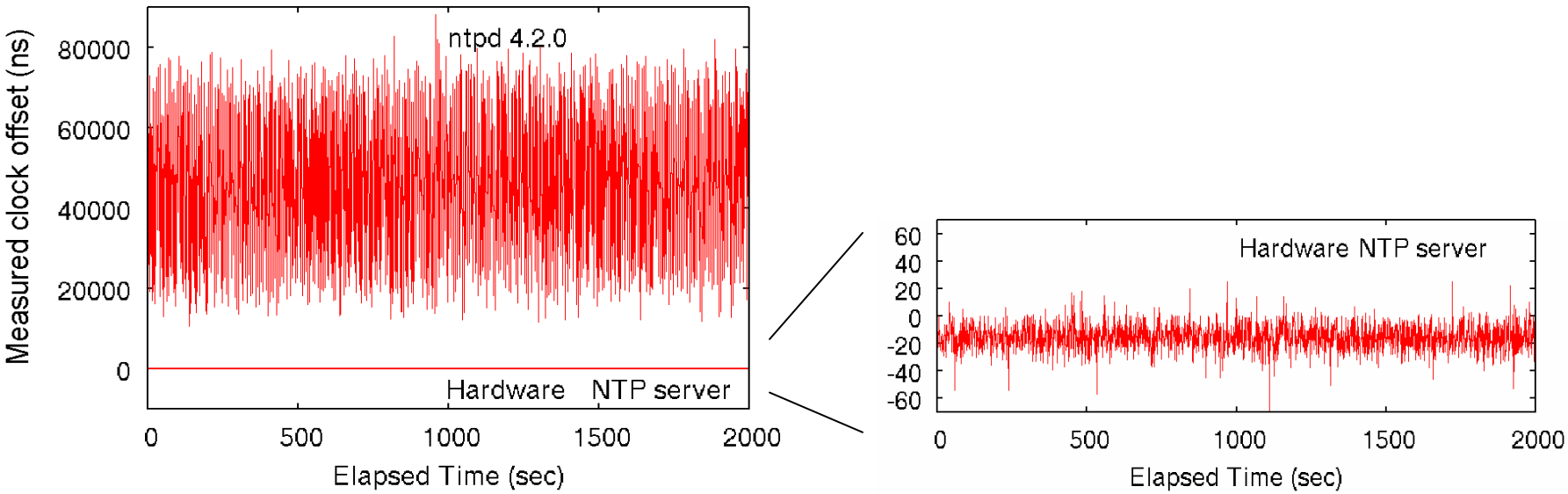
Hardware implementation



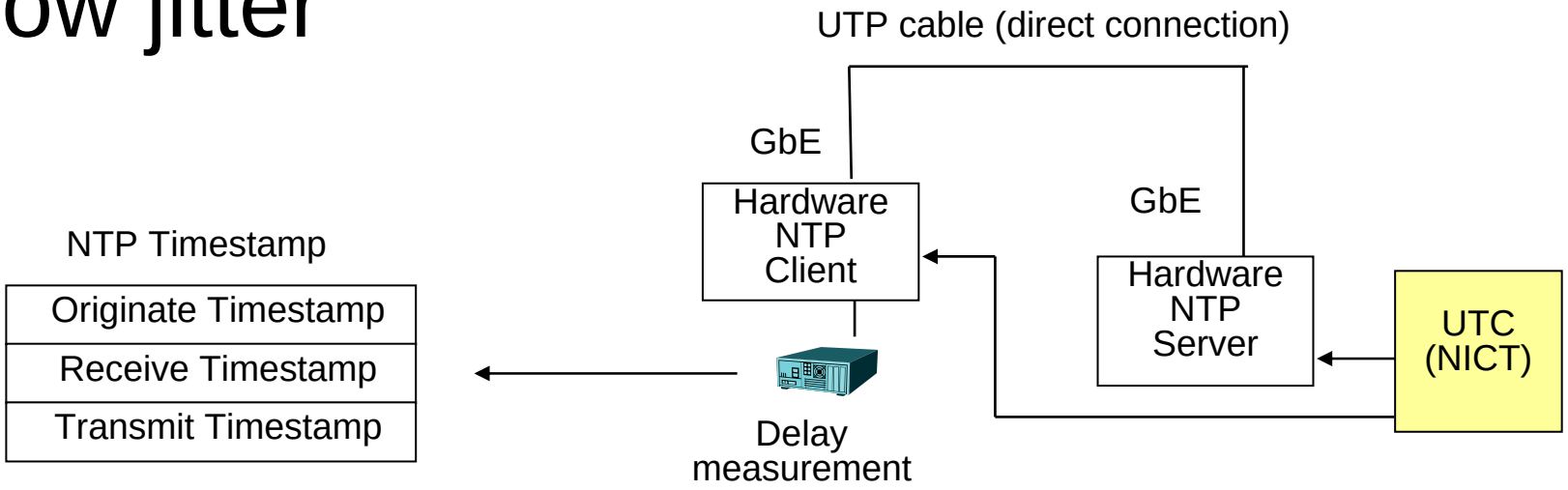
NTP messages are processed by the hardware pipeline in MAC block.

Low jitter

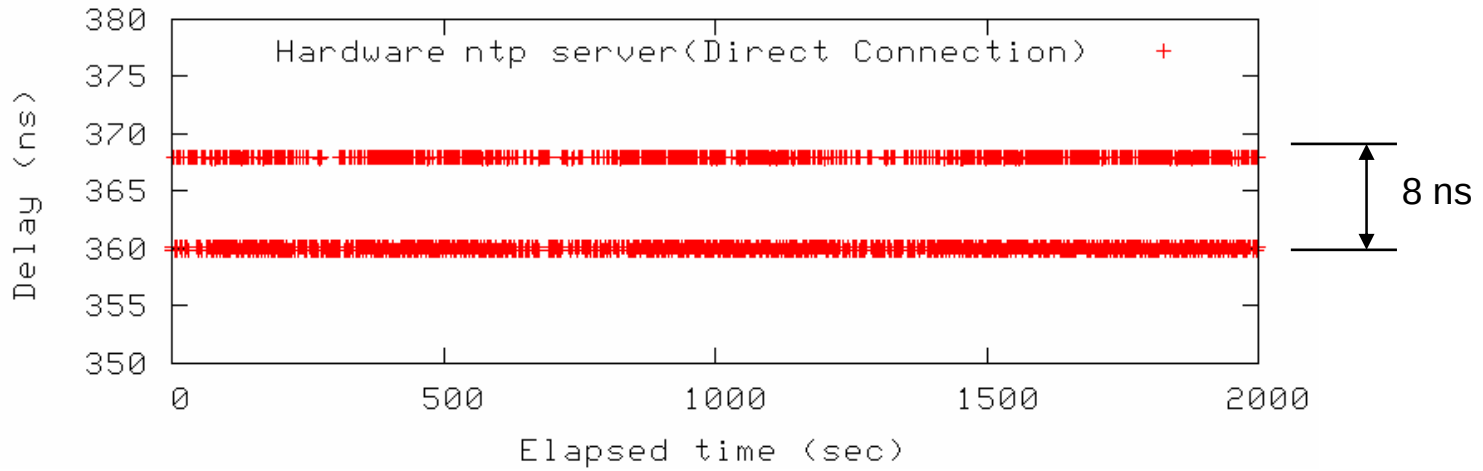

L2 switch
GbE
GbE
GbE
ntpd ver. 4
(Stratum 1)
Hardware
NTP
Client
Hardware
NTP
Server
UTC
(NICT)
NTP time offset
measurement


ntpd 4.2.0
Measured clock offset (ns)
80000
60000
40000
20000
0
Hardware NTP server
0
500
1000
1500
2000
Elapsed Time (sec)
60
40
20
0
-20
-40
-60
Hardware NTP server
0
500
1000
1500
2000
Elapsed Time (sec)

Low jitter



Delay = (Receive Timestamp) - (Originate Timestamp)



Purposes of our server

- **Stratum 1 public NTP server**
  Up to 1 million requests per second
  Intrusion tolerant

- **Accurate Time-transfer**
  ～ 50ns within Local Area Network
  ～ 1μs using High-speed backbone

Future plan

- Access rate limitation:

  using the hash table of source IP addresses.

- Reliability improvement:

  checking the clock signal using internal OCXO.

- Security improvement:

  developing server authentication method with keeping some performance.