



Accurate time. Worldwide.

NTP vs PTP: How do you get accuracy

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Characteristics of NTP and PTP

Queuing noise

- NTP falseticker and ensembling

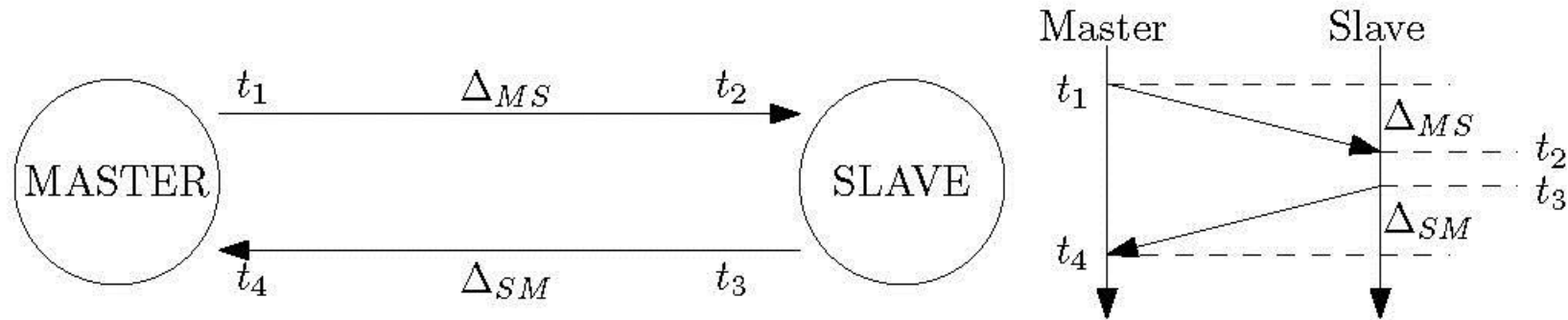
- PTP on-path support

Best practices for accuracy

Two way time transfer

Information flows in both directions

Propagation delay measured and corrected for



$$\text{Slave offset} = (t_1 - t_2 + t_4 - t_3) / 2 \quad \text{iff} \quad \Delta_{MS} = \Delta_{SM}$$

| | IRIG | NTP | PTP |
|----------------------------|--------------------------|---------------|--------------|
| Typical accuracy | 1 μ s | 1 ms | 1 μ s |
| Network characteristics | Dedicated coaxial cables | LAN, WAN | LAN |
| Self calibrating (two-way) | No | Yes | Yes |
| Specialized hardware | Yes | No | Yes |
| Communication paradigm | Master/Slave | Client/Server | Master/Slave |

First developed in 1980s

Standardized by IETF (the Layer 3 people)

Traditional applications

- Designed to set log file timestamps in servers and routers

- Provide timing for tickets in authorization protocols, e.g. Kerberos

Low resource use more important than time accuracy.

- Use little bandwidth in 10 Base-T networks

- 1 server can keep 100,000 clients happy, server simple, client smart

Fault tolerant

- Redundent servers

- False ticker identification

Invented by John Eidson at HP labs (test and measurement)

Assumed that time should be traceable

One grandmaster per network, no ensembles from multiple sources

Standardized by IEEE (the Layer 2 people)

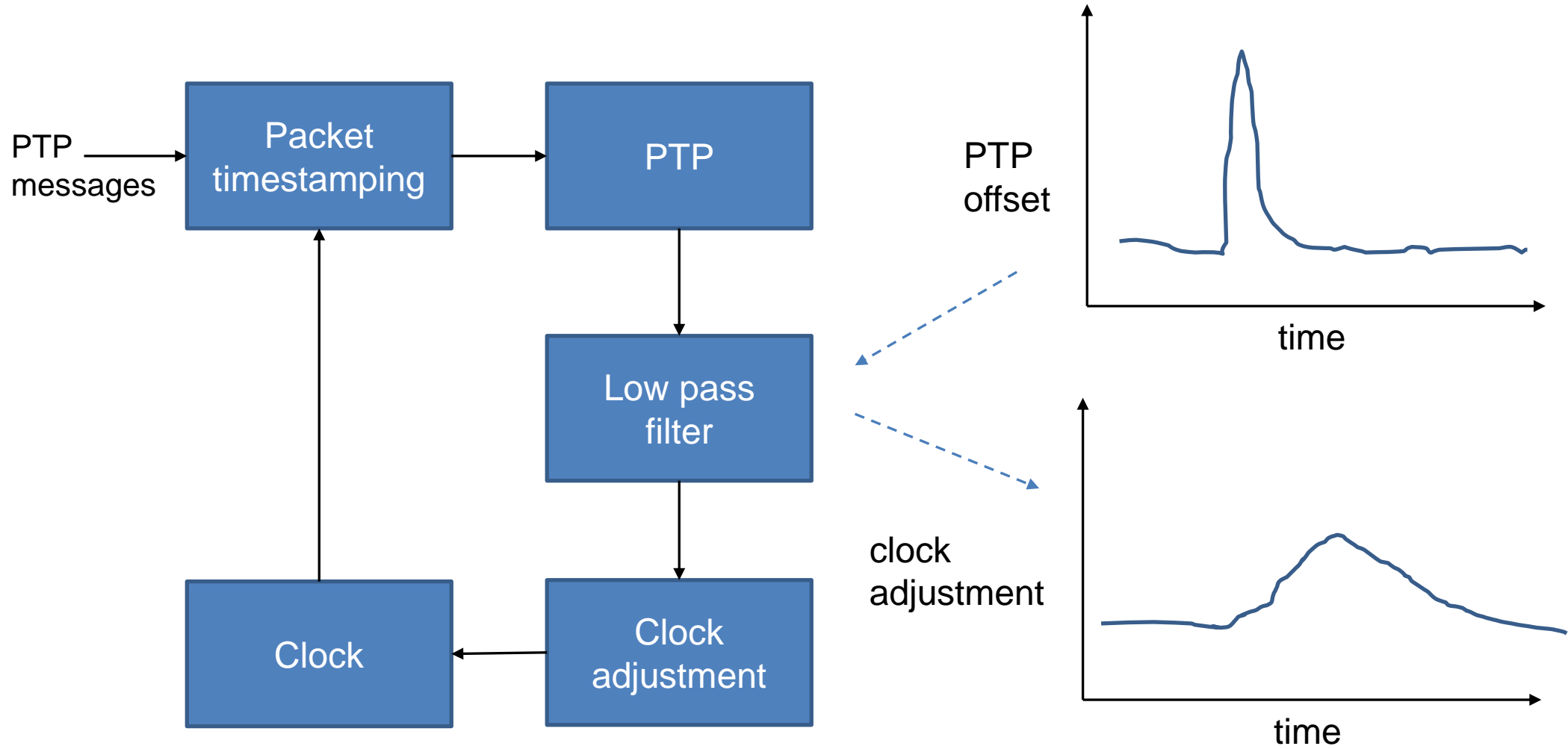
First used in industrial automation

Small networks, usually 1 subnet

Network designed with timing in mind: Timing aware Ethernet switches

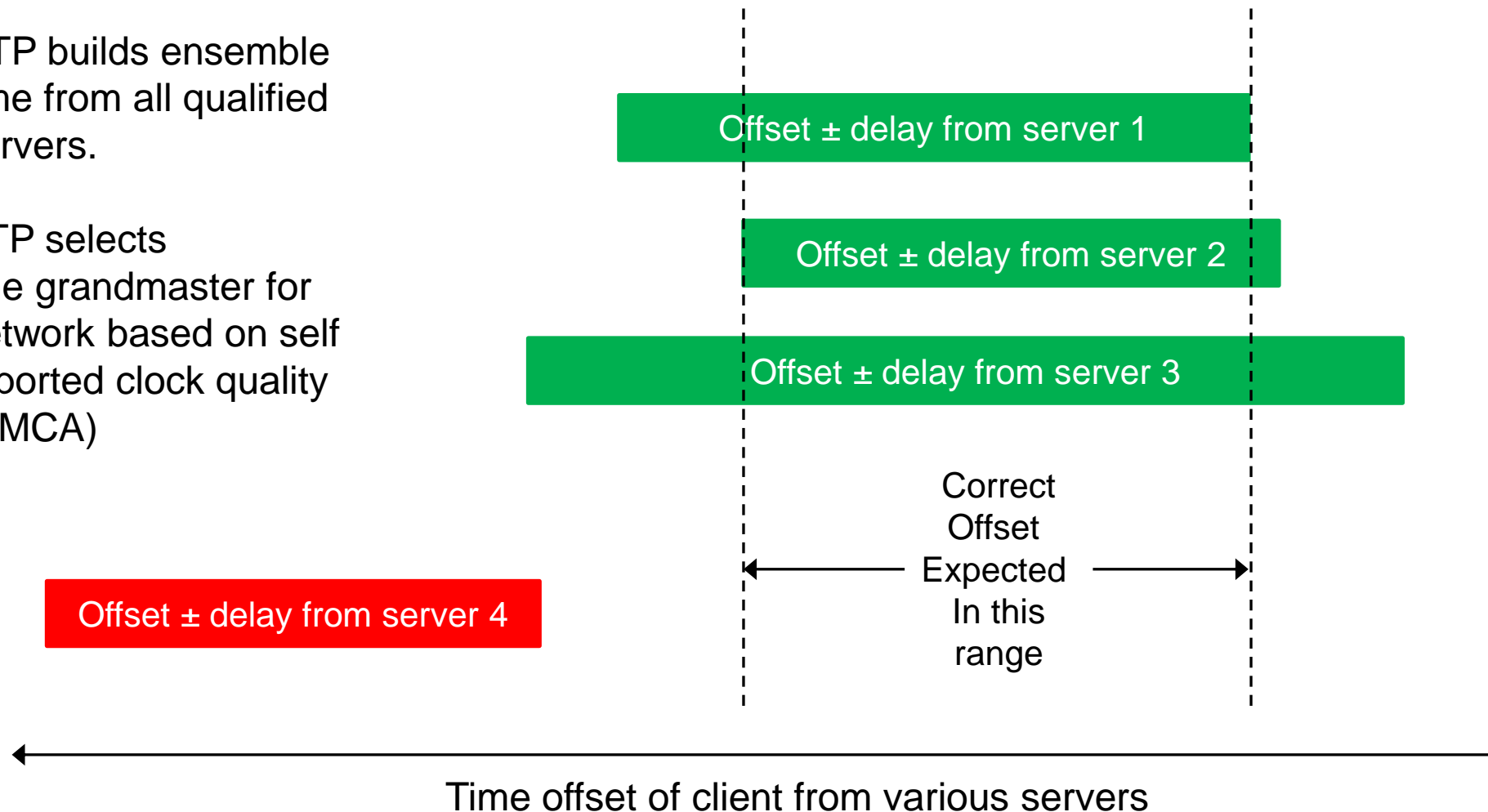
Slaves simple (e.g. temperature sensor), GM and switches are smart

Currently also used in telecommunications, power, television studios, audio-visual networks, aerospace, defense, finance, and particle colliders

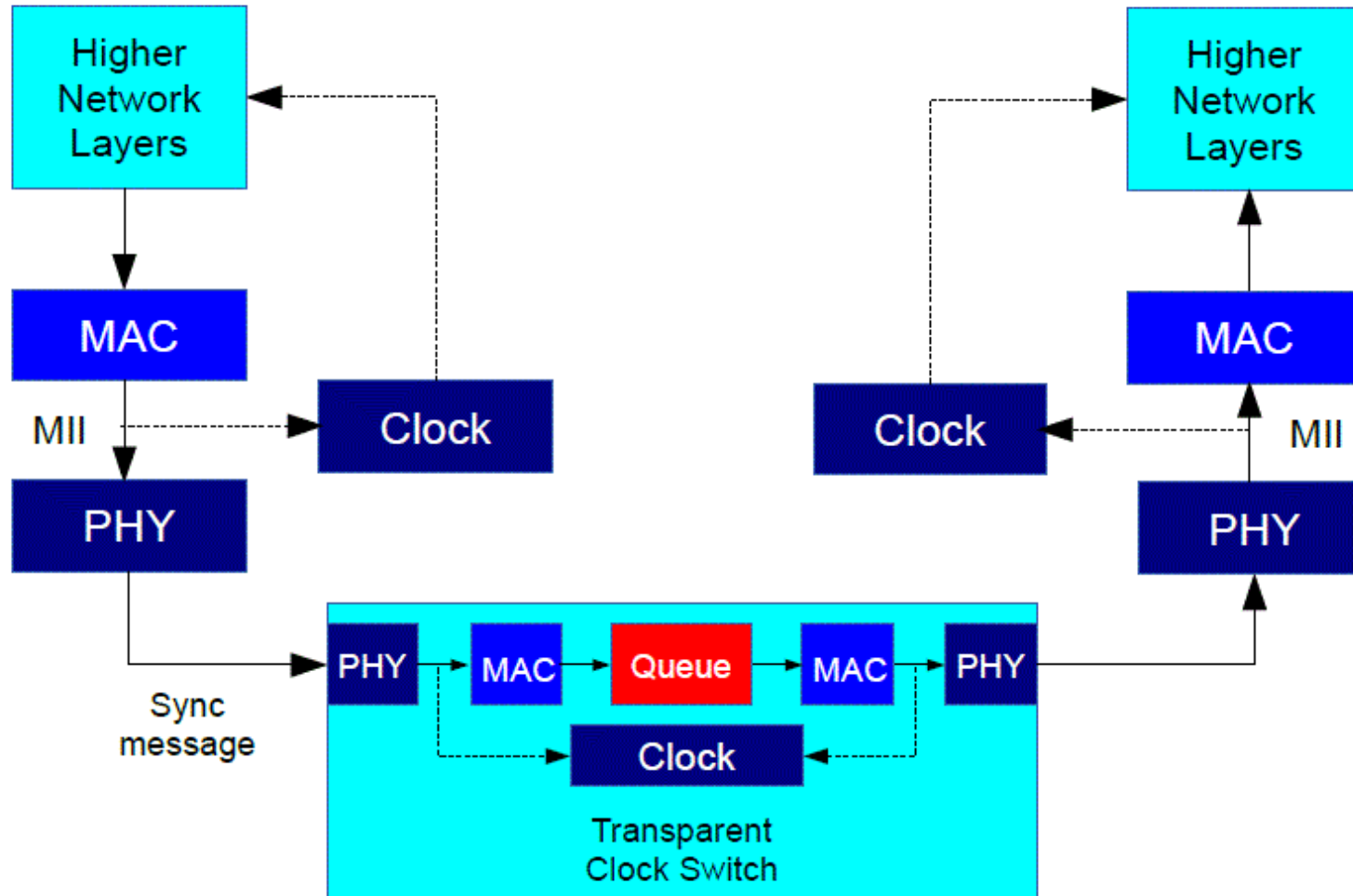


NTP builds ensemble time from all qualified servers.

PTP selects one grandmaster for network based on self reported clock quality (BMCA)



What makes PTP precise: Hardware timestamping!

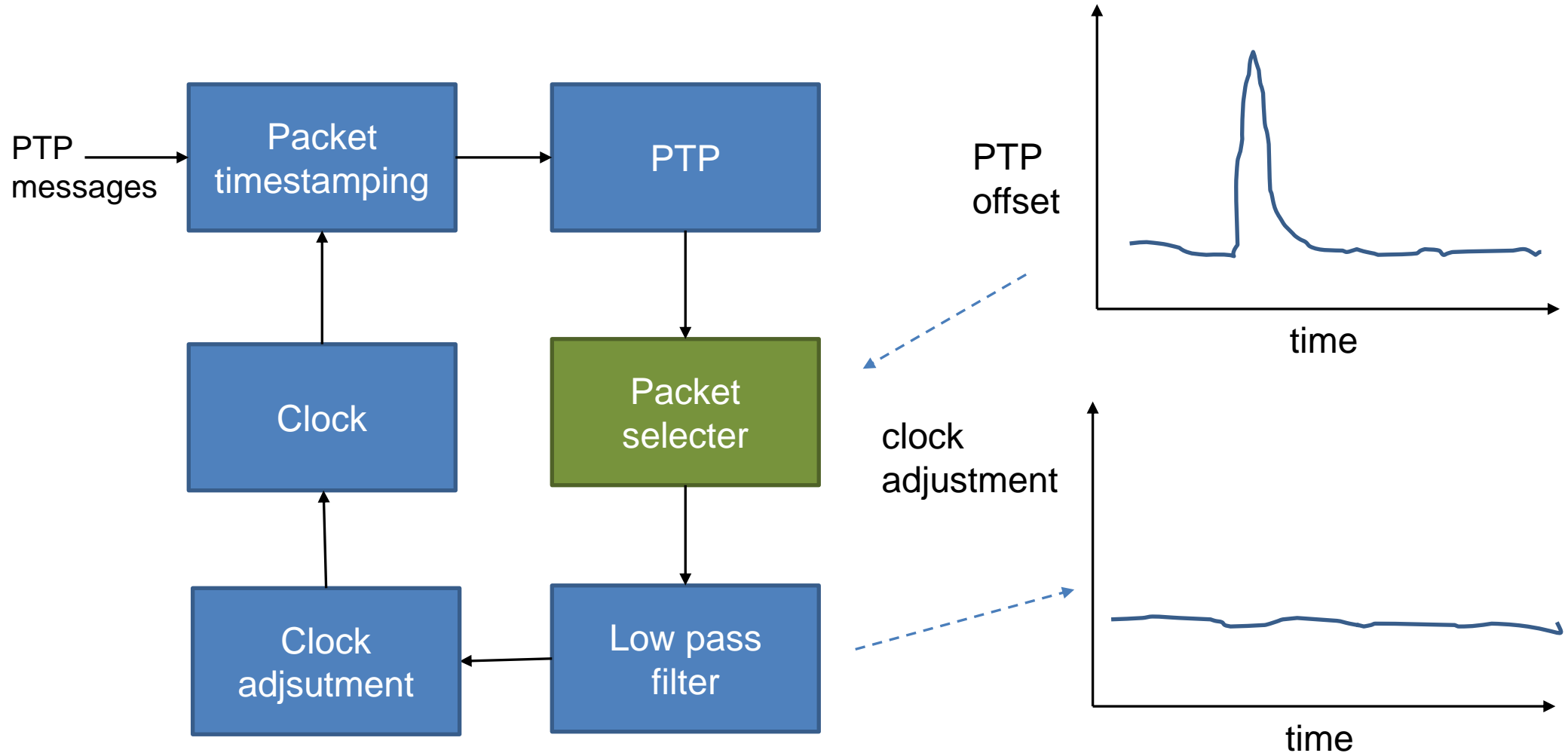


NTP

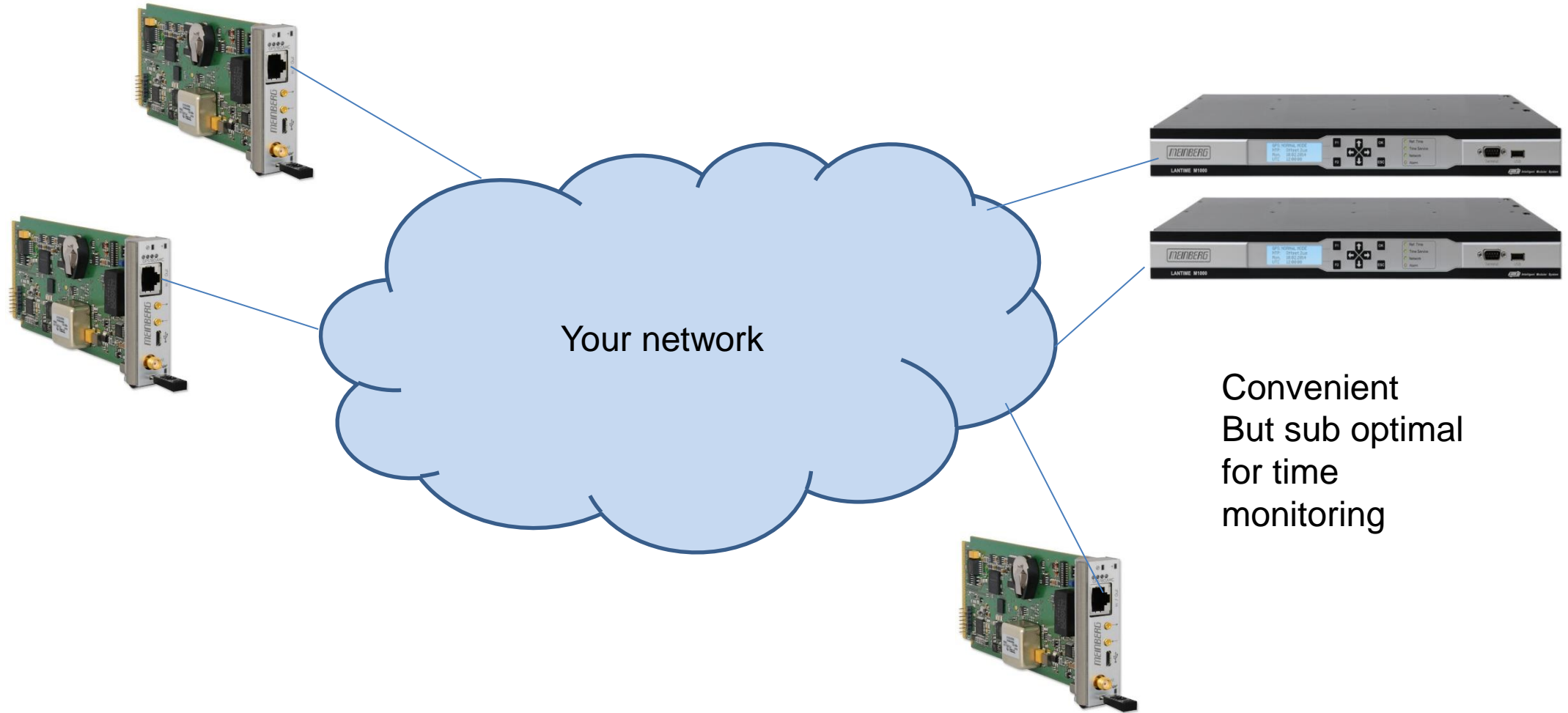
- NTP servers with hardware timestamping and a good oscillator
- Server located as close to clients as possible
- Switches are low latency and lightly loaded
- Redundancy: Clients use multiple servers
- Monitoring: servers monitor each other (peer stats)

PTP

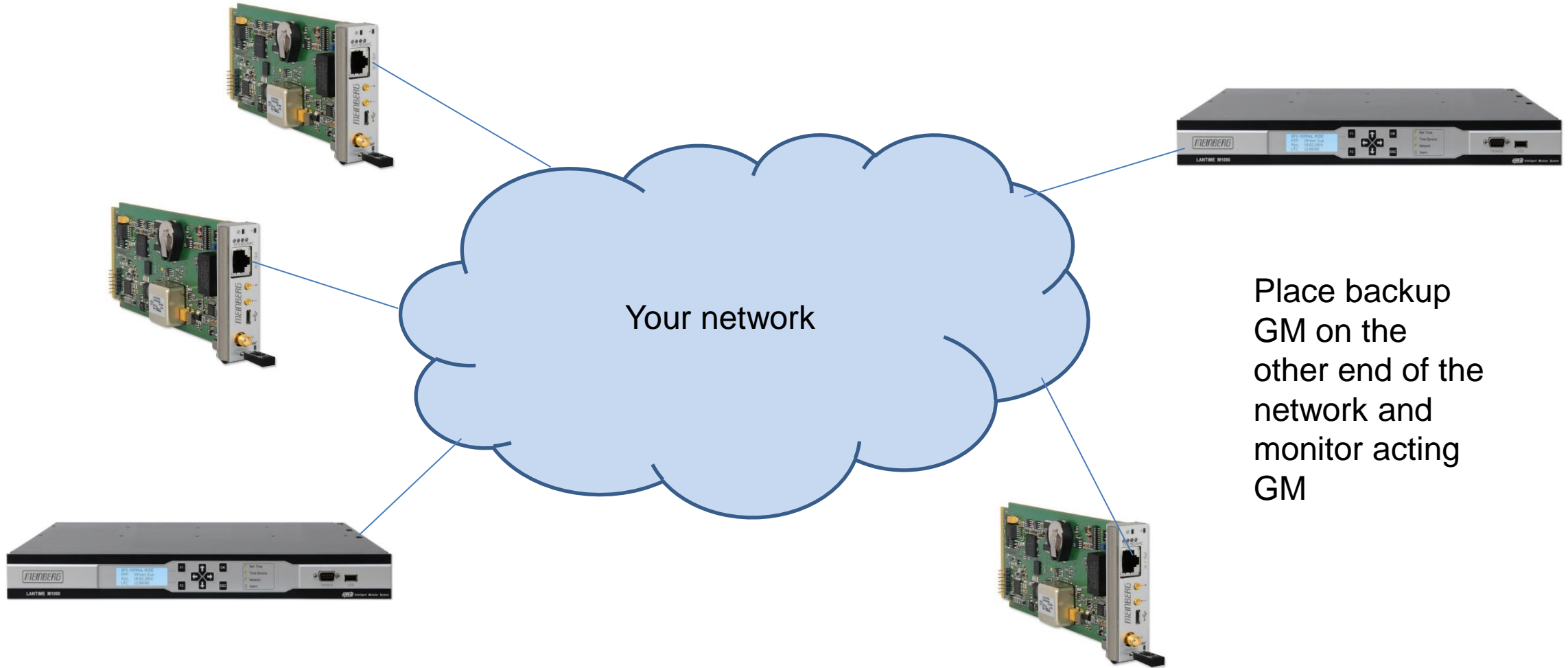
- Switches are transparent clocks or boundary clocks
- Or use telecom profile technology (ITU-T G.8265.1 or G.8275.2)
- Redundant GMs monitor each other
- Hardware slaves (e.g. PCIe card) when possible



Monitoring: because networks change



Monitoring: because networks change



Place backup GM on the other end of the network and monitor acting GM

Vanilla NTP not accurate enough for Financial timing

NTP identifies bad servers (or servers behind high queuing noise)

PTP has on path support and available hardware slaves

Use telecom profile technology with PTP without on path support

Monitor your NTP/PTP network with backup servers/masters at opposite ends of network



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Thank you for you attention.

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