drvTS

improvements for soft timing

EPICS Collaboration Meeting
Argonne National Laboratory

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DESY Cryogenic Controls

Agenda

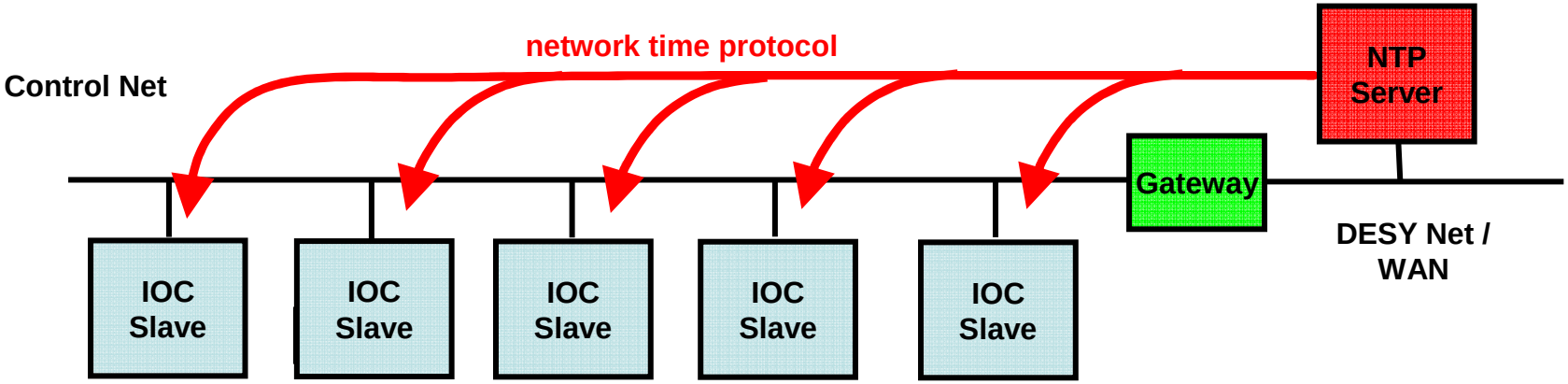
- Time Requirements for Cryogenic Controls
- Soft Time Synchronization in EPICS
- Improved NTP Synchronization
- Network Delay Consideration
- Compensating Clock Oscillator Errors
- To Do / Nice to Have

The Requirements for Cryogenic Controls

- **95% inputs are scanned periodically with 1 second.**
- **Time accuracy in IOC should be < 1 second.**
  - ►Soft (network) timing is sufficient
  - ►No event system
- **Many IOCs (~45) with different TS-configuration. Some can not be rebooted before a machine shutdown.**
- **Accurate time is delivered by NTP servers outside the control network subnet.**

Existing 3.13.x EPICS implementation

1: All IOCs are configured as timing slaves



+ IOCs have same and correct time if NTP-server is up.

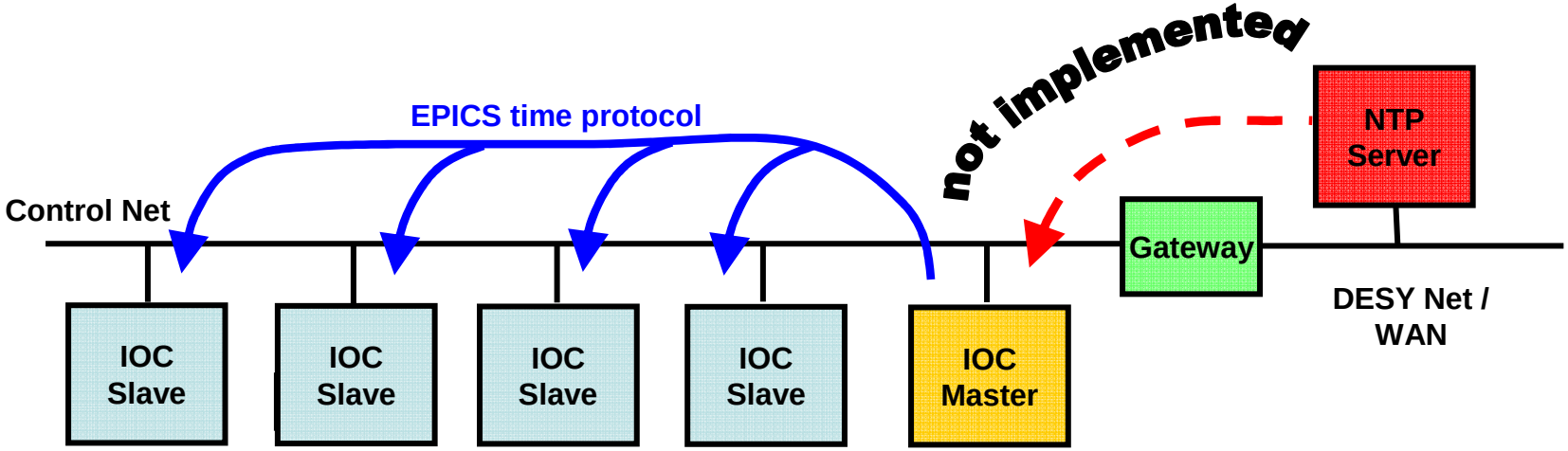
- no master allowed on subnet! All slaves would connect to master.

- no time synchronization any more if NTP-server or gateway fails.

- no time synchronization if the NTP-Server is not up at IOC boot time.

Existing 3.13.x EPICS implementation

2: Solution with a timing master



+ IOCs have the same time

- IOC clocks are drifting with master clock (if no GPS-HW etc. is present)

- Master can not synchronize with NTP-server.

Improvements for Soft Timing

1. New mode (type) in TSconfigure

"type" is the last parameter in TSconfigure ().

0 (default) = Use event system hardware, if present.

1 = Do not check if HW is present, use soft timing!

2 (new) = Force to use NTP synchronization.

Mode 2 for timing slaves:

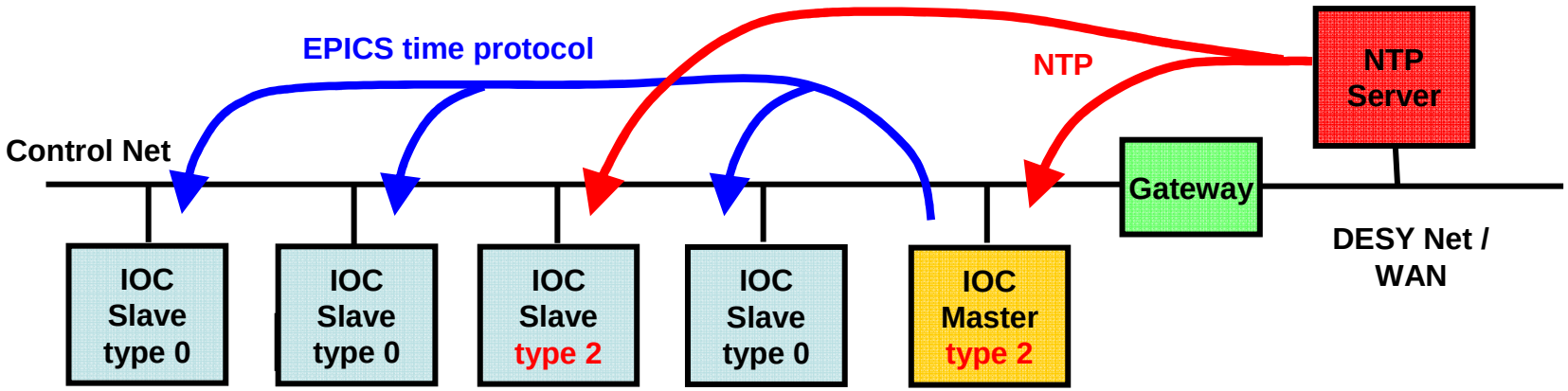
Like 1. Do not try to get time from Master, use NTP-Servers!

Mode 2 for timing masters:

Like 1. Start the synchronization task like a slave and use NTP to synchronize the internal time.

Improvements for Soft Timing

EPICS-TP and NTP is possible in parallel now



+ Slaves can select if they want the time from a master or NTP-server

+ Master can synchronize with NTP-server.

Improvements for Soft Timing

2. Use more than one NTP-Server

The environment parameter “EPICS_TS_NTP_INET” can now contain a list of servers.

If the currently selected server fails, the next one will be used to get the time.

At boot time:

First try NTP to get the time from a server from the list.

Then try NTP to get it from the boot host.

At last try Unix time protocol to get it from the host.

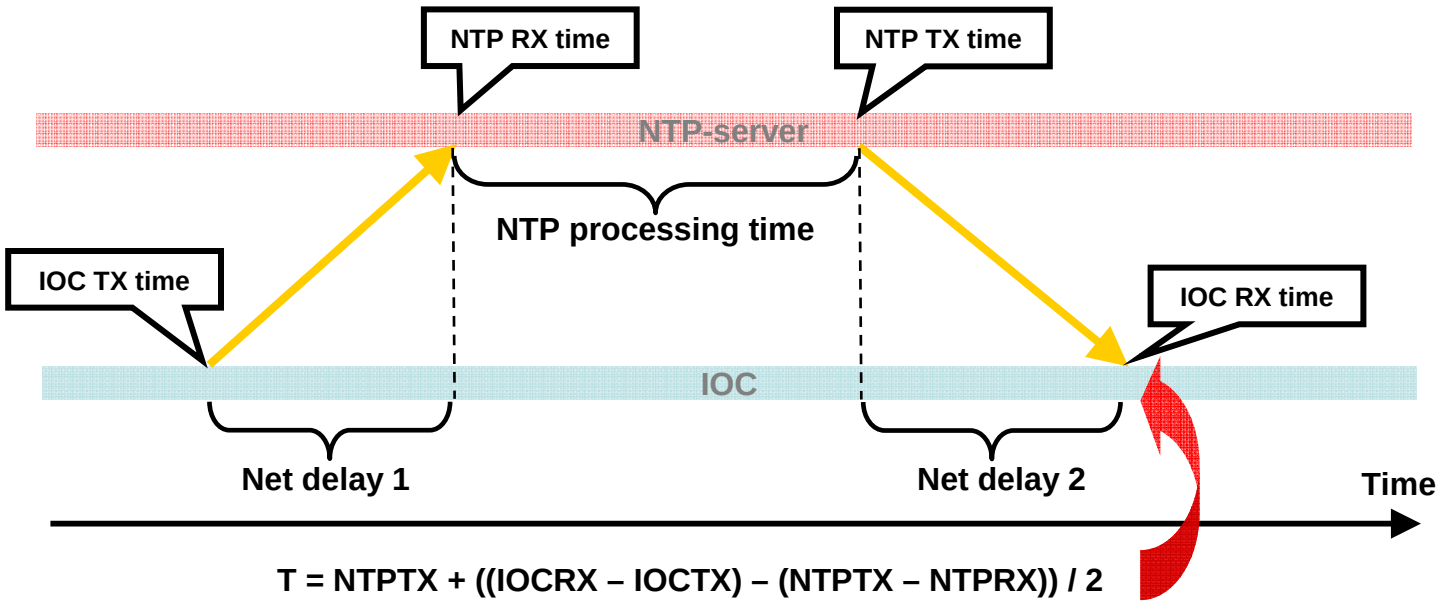
Later synchronization:

Use NTP with servers from the list only.

Improvements for Soft Timing

3. Enhanced NTP Functionality

- **The network delay times are considered in a new function called "TSgetEpicsTimeFromNtpBuffer ()".**



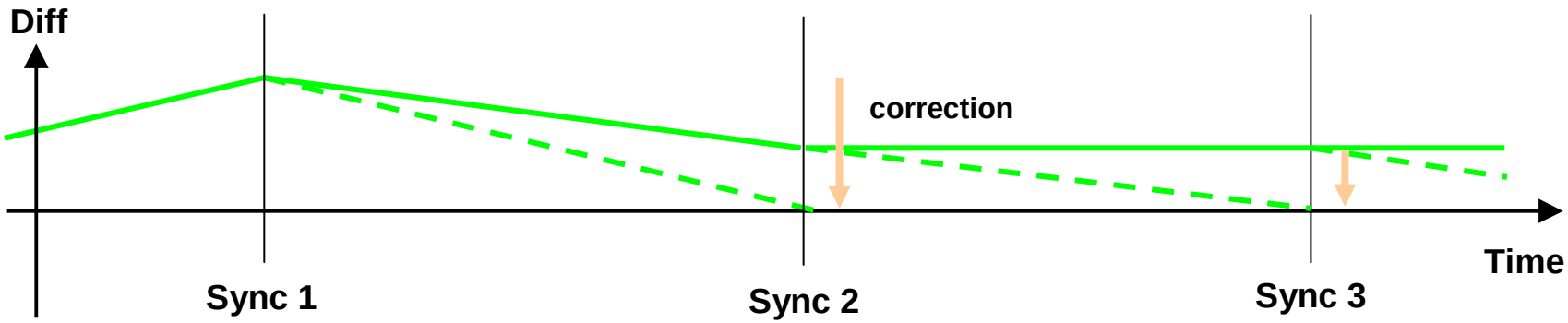
T = NTPTX + ((IOCRX – IOCTX) – (NTPTX – NTPRX)) / 2

Improvements for Soft Timing

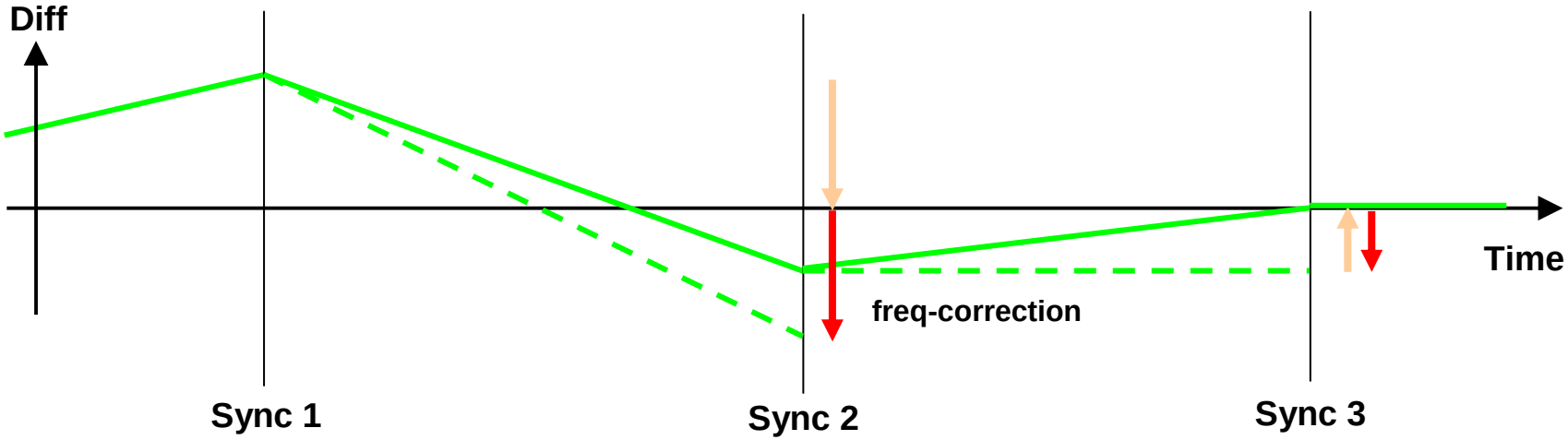
4. Internal Clock Correction

- **In spite of correct NTP or EPICS time synchronization, some IOC have wrong time of a few seconds – why?**
  - When a ‘sync’ is done, the difference is scheduled to be driven to zero until the next expected synchronization.
  - But: During this time the clock of the IOC causes a new deviation if the frequency of the oscillator is wrong.
    - **Need a correction of the frequency error!**
    - **existing offset correction is unchanged.**
    - **frequency correction runs continuously and is adjusted incrementally at each synchronization.**

Improvements for Soft Timing



without frequency compensation



with frequency compensation

Results , Future Plans

1. Yes, it works.
2. The effect of network delay compensation is small. As long as the local time resolution is 1/60 second it works too coarsely for short delays! At the moment this functionality is disabled for delays <= 2 ticks.
3. It is implemented into R3.13.10 and can (should) be merged into R3.14.x.
4. The usage of a fast running timer (most BSPs support this) could be implemented.
   - Network delays could be compensated correctly.
   - Accurate timestamps were possible without extra hardware.

Conclusion

- Soft timing is now more comfortable
- NTP and EPICS-TP can be used in parallel
- More NTP servers can be used for redundancy
- NTP network delays are compensated
- Frequency error of the IOC clock oscillator is compensated
- no 3.14 version yet
- no fine resolution (accurate timestamp) yet

End