Timing Module R&D Update

Beam Premeeting - 3/11/24

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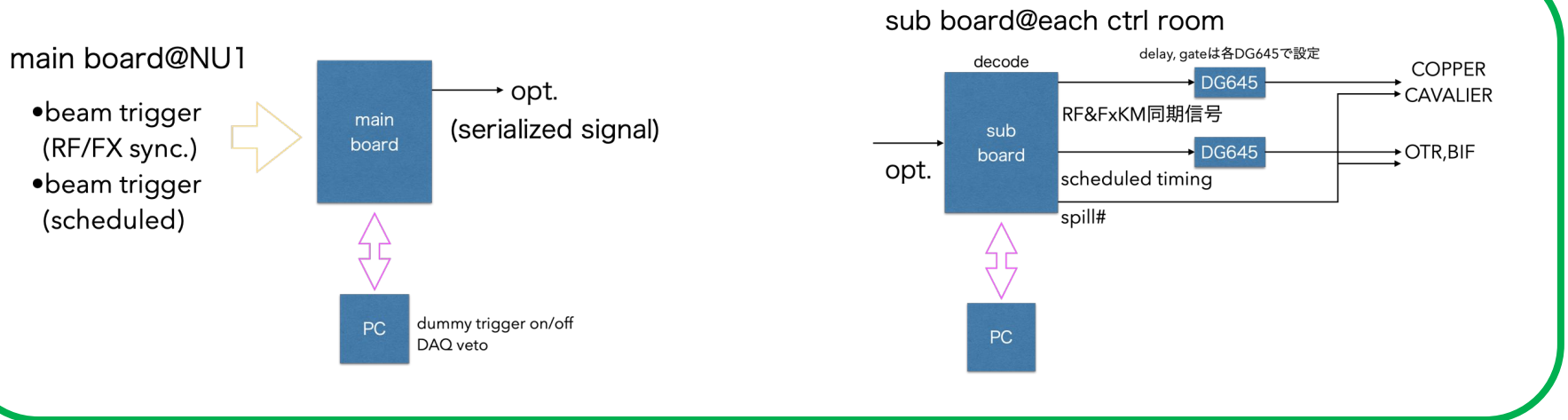
Motivation

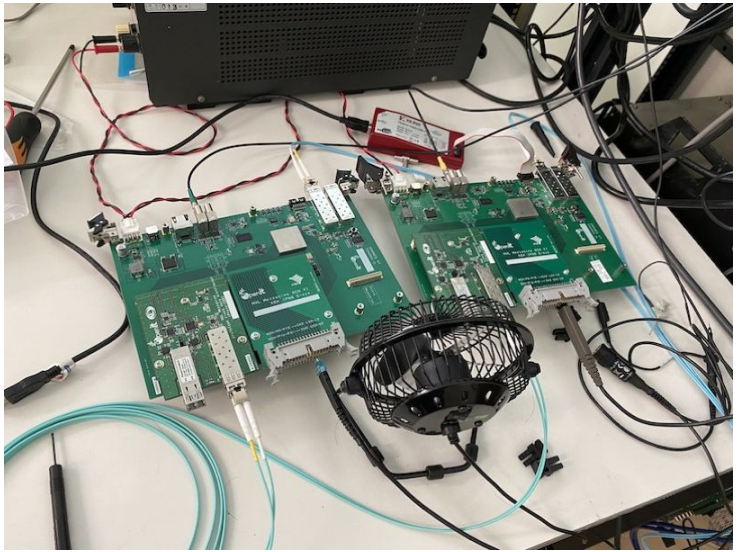
- J-PARC neutrino beamline timing/trigger distribution system is needed to be upgraded because some devices/modules are discontinued modules
- Plan to replace the old modules with recent technologies

Idea of new configuration



Initial test

- As a first step, we are evaluating the performance and functionality of an existing electronics which developed for J-PARC g-2/EDM and hadron experiments
  - AMANEQ/MIKUMARI board

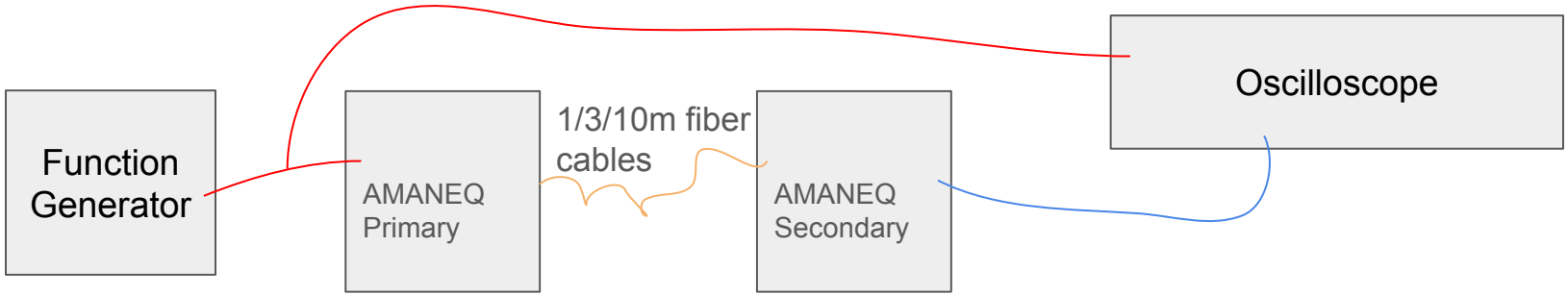


Timeline for Timing Module R&D

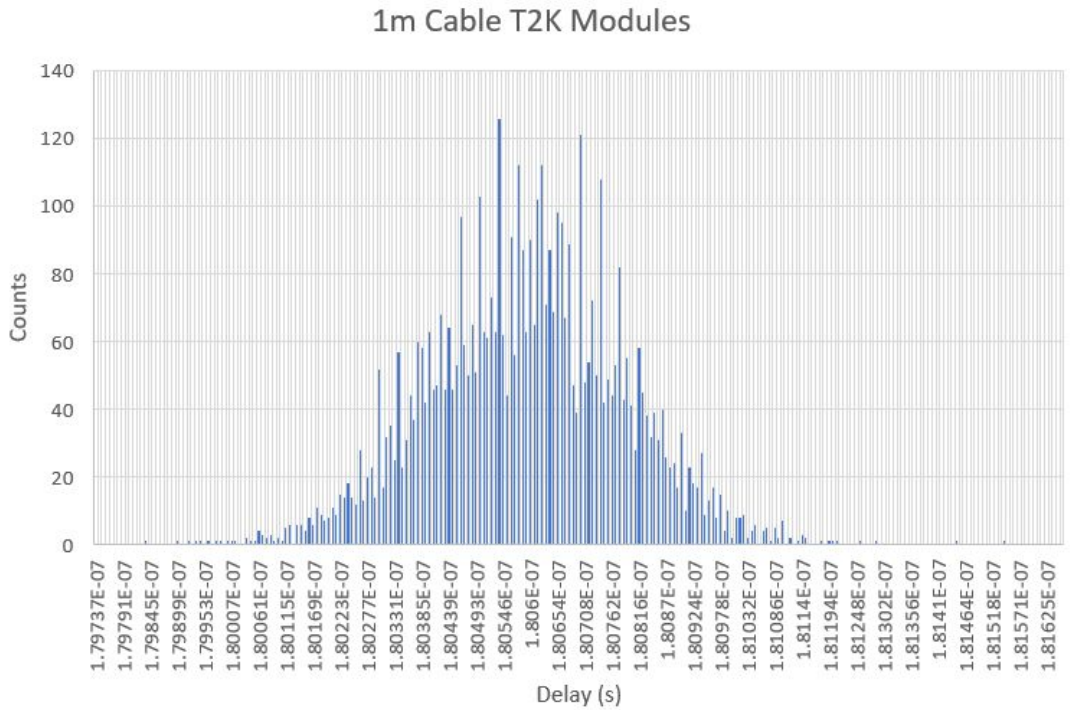
1. Assessment of AMANEQ Module for T2K Timing purposes
2. Development of AMANEQ Firmware ← We are here currently
3. Assessment of updated Firmware
4. Replacement of old modules with AMANEQ should

Procedure

- Created some input of some pulse from pulse generator
- Transmitted pulse between two boards using fiber optic connection
- Took output of 2nd board to oscilloscope
- Measured delay between function generator and board output using rising edge->rising edge with oscilloscope (~5000 data points)
- Plotted distributions and took standard deviation to find jitter.



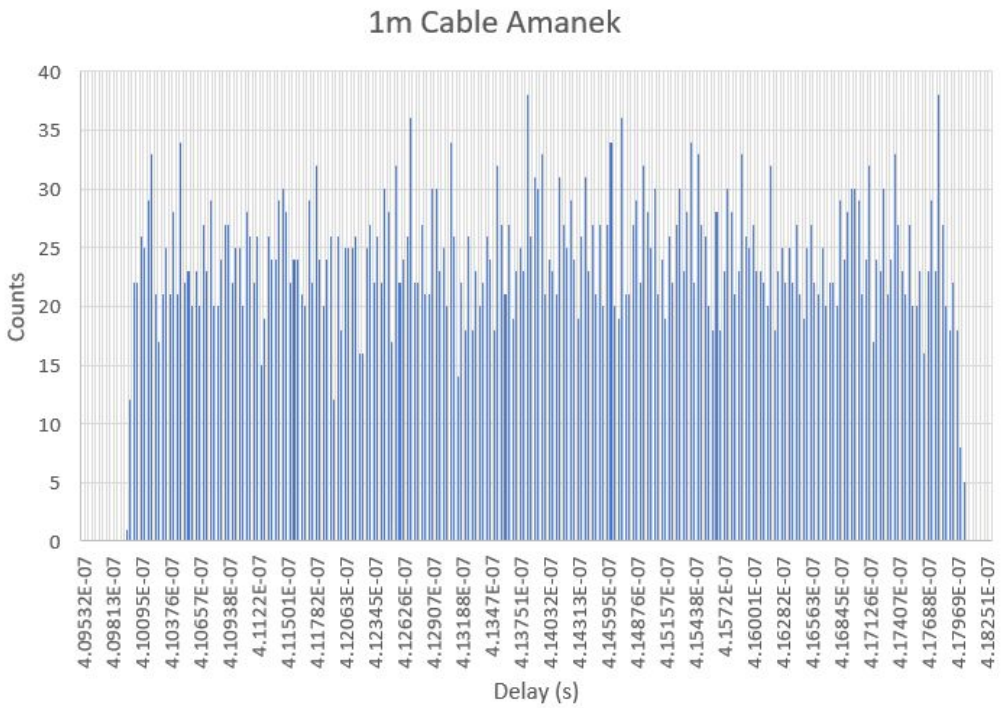
Delay Distribution of Current T2K modules



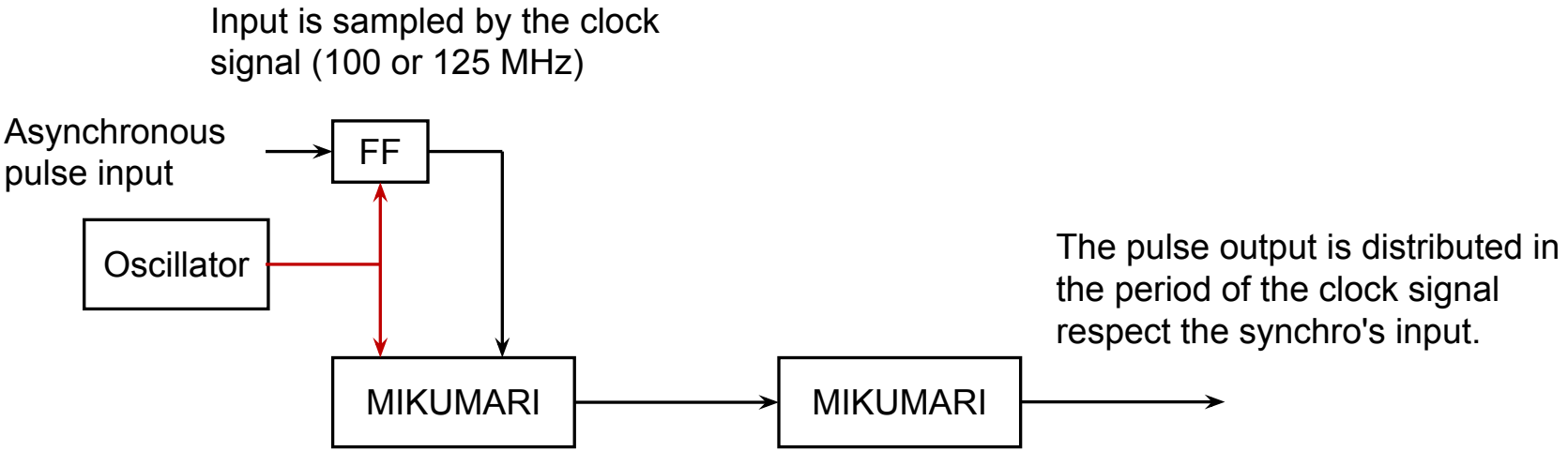
- Gaussian form, standard deviation is ~0.17-0.2ns of timing jitter depending on cable length

Delay Distribution of Amanek Modules

- Flat Distribution with a standard deviation of ~2.3ns.
- Result of difference between clock and input signal.



Current situation

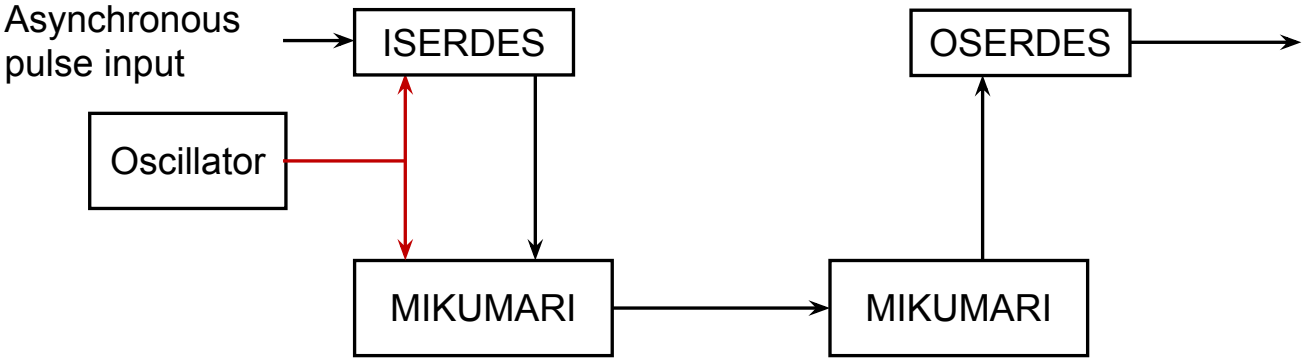


Updated idea

Pulse is reproduced based on TDC info.

Introduce 1ns TDC by ISERDES

Pulse is distributed in 1ns. Much better.



Pulse is transmitted together with TDC info.

MIKUMARI update is necessary

Beam Monitor/Detector Side

- Old T2K timing module has jitter of around 0.2ns maximum timing jitter, while new module is expected to be ~1ns.
- Is this level of jitter acceptable for use at monitors and detectors that use this information?