

TOF & AC-LGAD Friends RDOs

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	Module Board ("FEB")	↔ RDO	ASICs per RDO	Readout ASIC	Transceiver	↔ DAM up+down	
FTOF	2x2 ASICs (module)	Copper Connector (short)	≤28	1 IpGBT	1 VTRX	1+1 fiber	direct to DAM
BTOF	1x82 ASICs (stave)	Copper Flex PCB ~1.5m	≤82	4 IpGBT	1 VTRX	1+4 fibers	8:1 fiber aggregator?
FF AC-LGAD Friends	1x4 ASICs (stavelet)	Copper Cable ~1.5m	16	1 IpGBT	1 VTRX	1+1 fiber	direct to DAM

	RDOs	VTRX+ #	IpGBT #	Fibers down+up	Fiber Aggregators 8:1 (if used)	FELIX# with Aggregators	FELIX# wo Aggregators
FTOF	132	132	132	132+132	17	1	3
BTOF	288	288	1152	288+1152	144	3	24
FF AC-LGAD friends	92 (for all 3)	92	92	92+92	~12 (doesn't pay)	1 minimum but 3 better	3

⇒ **FF AC-LGAD Friends are 3 separate detectors**: B0, Roman Pots, Off-momentum. The hope is that they share the same readout scheme [Alex]. It is better that each has its own FELIX for system partitioning reasons so Fiber Aggregators are not required.

⇒ **We need to operate IpGBT in the FEC5 mode**. We can choose the 5 Gbs uplink mode (instead of 10 Gbs) because it is sufficient for us. OTOH, we should all use 10 Gbs if this is what other detectors choose.

⇒ **We would like to avoid a Fiber Aggregator** because it adds another clock jump which can increase clock jitter and add to the clock phase uncertainties which is something *we don't want for precise AC-LGAD timing detectors*.

- A. Fiber Aggregators are only a cost saving device. They are not required for any other reason.
- B. They do add to the effort and need additional resources (engineering, prototyping, firmware, space, crates, etc). We would need a significant count of those (~150) thus also adding to the cost.
- C. We could envision a cheaper FELIX card with cheaper Firefly's with e.g. ECUO-Y12-14 instead of ECUO-Y12-25?
- D. **However**, apart from the actual FELIX card one also needs to add the cost and space of the DAQ PCs housing those FELIX cards.

On the IpGBT Fiber Aggregator (FA) Protocol

The FA will connect/bridge N=1-8 IpGBTs on one end and 1 DAM fiber on the other.

The IpGBT data format is very specific and doesn't have spare bits. *We need spare bits on the DAM side* so that the DAM can address which of the N fibers a command/configuration is going to.

I propose we turn off the FEC encoding from the DAM to the FA and repurpose those bits as e.g. the destination IpGBT/fiber address and/or for other things. Since the FA is not in a radiation area we don't need error correction, IMHO.

Similarly for the uplink, the IpGBT packet from fiber N needs to be addressed/tagged with the fiber number so that the destination DAM knows from which fiber/IpGBT the data came.

Additionally, we need to compress the IpGBT uplink data to match the data rates (e.g. 8X 10 Gbs IN ⇒ 1X 10 Gbs to DAM). Thus the FA firmware needs to suppress empty IpGBT ASIC and IC/EC link words. The data format for the uplink (FA→DAM) should only contain non-idle decoded words and doesn't need to be the full IpGBT. Care must be taken that the total rate of 8 (e.g.) input links doesn't exceed the single link to DAM!