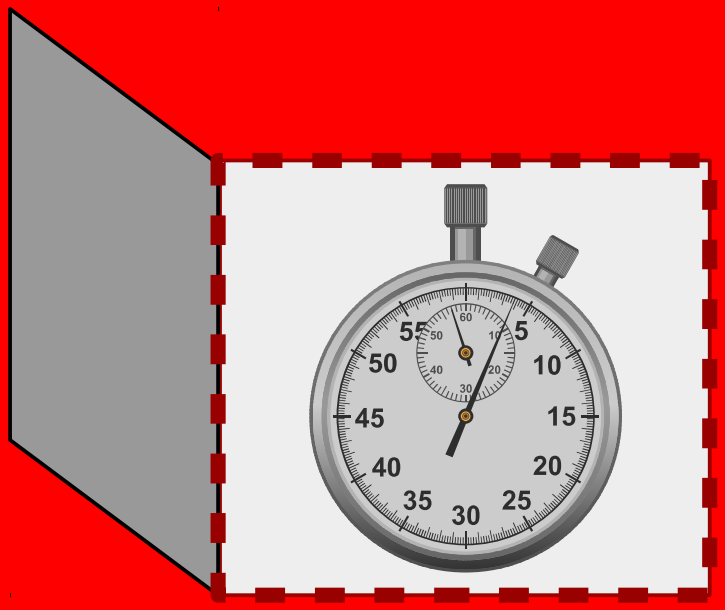
R^3B deadtime 2021
- statistics opportunities -

Håkan T. Johansson, Chalmers, Göteborg

R^3B-meeting, Dec 2020

R^3B deadtime 2021
- statistics opportunities -



Håkan T. Johansson, Chalmers, Göteborg

R^3B-meeting, Dec 2020

R^{3}B 2021 deadtime

	Electronics	ME	Deadtime (µs)	Limit (main)	S455	S515	S494
S2	VFTX						
S8	VFTX						
Sofia START	VFTX, (MADC32)						
Sofia Triple MUSIC	MDPP16						
Sofia Twin MUSIC	MDPP16						
Sofia TOF wall	VFTX						
CALIFA	FEBEX3						
AMS	SIDEREM+SAM						
-	INFN AMS DAQ						
Sofia MWPC	VMMR8						
NeuLAND (12 DP)	FQT+TAMEX3						
LOS	VFTX						
LOS	TAMEX						
X5 PSP	FEBEX3						
R3B MUSIC	MDPP16						
SiPM fiber vacuum	PaDi+Clock-TDC						
Fiber vacuum	PaDi+KILOM/cTDC						
Fiber end	PaDi+KILOM/cTDC						
ROLU / SEETRAM / ionis.	Scalers						
R3B TOF wall	FQT+TAMEX3						
XY Fiber	PaDi+KILOM/cTDC						
Fibers	PaDi+KILOM/cTDC						
MASTER (trig)	VULOM						

Strategy:

1) List all systems.
   Thanks to Hans, Bastii.
2) For which experiments.
3) Expected deadtimes.
4) Find bottlenecks.
   (per experiment)
5) Focus attention!

VME

R³B 2021 deadtime

	Electronics	ME	Deadtime (µs)	Limit (main)	S455	S515	S494
S2	VFTX						
S8	VFTX						
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Sofia Twin MUSIC	MDPP16						
Sofia TOF wall	VFTX						
CALIFA	FEBEX3						
AMS	SIDEREM+SAM						
-	INFN AMS DAQ						
Sofia MWPC	VMMR8						
NeuLAND (12 DP)	FQT+TAMEX3						
LOS	VFTX						
LOS	TAMEX						
X5 PSP	FEBEX3						
R3B MUSIC	MDPP16						
SiPM fiber vacuum	PaDi+Clock-TDC						
Fiber vacuum	PaDi+KILOM/cTDC						
Fiber end	PaDi+KILOM/cTDC						
ROLU / SEETRAM / ionis.	Scalers						
R3B TOF wall	FQT+TAMEX3						
XY Fiber	PaDi+KILOM/cTDC						
Fibers	PaDi+KILOM/cTDC						
MASTER (trig)	VULOM						

Strategy:

1) List all systems.
   Thanks to Hans, Bastii.
2) For which experiments.
3) Expected deadtimes.
4) Find bottlenecks.
   (per experiment)
5) Focus attention!

Where?

When?

Who?

Why?

VME

R^{3}B 2021 deadtime

	Electronics	ME	Deadtime (µs)	Limit (main)	S455	S515	S494
S2	VFTX				X X	X ?	
S8	VFTX					X ?	
Sofia START	VFTX, (MADC32)				X X		
Sofia Triple MUSIC	MDPP16				X X		
Sofia Twin MUSIC	MDPP16				X X		
Sofia TOF wall	VFTX				X X		
CALIFA	FEBEX3				X	X	
AMS	SIDEREM+SAM				X	X	
-	INFN AMS DAQ					X	
Sofia MWPC	VMMR8				X X	X	
NeuLAND (12 DP)	FQT+TAMEX3				X (X)	X	
LOS	VFTX					X	
LOS	TAMEX					X	
X5 PSP	FEBEX3					X	
R3B MUSIC	MDPP16					X	
SiPM fiber vacuum	PaDi+Clock-TDC					X	
Fiber vacuum	PaDi+KILOM/cTDC					X	
Fiber end	PaDi+KILOM/cTDC					X	
ROLU / SEETRAM / ionis.	Scalers					X	X
R3B TOF wall	FQT+TAMEX3					X	X
XY Fiber	PaDi+KILOM/cTDC						X
Fibers	PaDi+KILOM/cTDC						X
MASTER (trig)	VULOM				X	X	X

Strategy:

1) List all systems.
2) For which experiments?
   Thanks to Roman, Julien, Aleksandra, Audrey, Hans, Bastii.
3) Expected deadtimes.
4) Find bottlenecks.
   (per experiment)
5) Focus attention!

Mistakes are mine...

VME

R³B 2021 deadtime

	Electronics	ME	Deadtime (µs)	Limit (main)	S455	S515	S494
S2	VFTX		**15**		X X	X ?	
S8	VFTX		**31**			X ?	
Sofia START	VFTX, (MADC32)		**9**		X X		
Sofia Triple MUSIC	MDPP16		**25**		X X		
Sofia Twin MUSIC	MDPP16		**40**		X X		
Sofia TOF wall	VFTX		**31 (est. 20-25)**		X X		
CALIFA	FEBEX3				X	X	
AMS	SIDEREM+SAM				X	X	
-	INFN AMS DAQ					X	
Sofia MWPC	VMMR8				X X	X	
NeuLAND (12 DP)	FQT+TAMEX3				X (X)	X	
LOS	VFTX					X	
LOS	TAMEX					X	
X5 PSP	FEBEX3					X	
R3B MUSIC	MDPP16					X	
SiPM fiber vacuum	PaDi+Clock-TDC					X	
Fiber vacuum	PaDi+KILOM/cTDC					X	
Fiber end	PaDi+KILOM/cTDC					X	
ROLU / SEETRAM / ionis.	Scalers					X	X
R3B TOF wall	FQT+TAMEX3		**3** ; 21			X	X
XY Fiber	PaDi+KILOM/cTDC		**3** ; 21				X
Fibers	PaDi+KILOM/cTDC		**3** ; 21				X
MASTER (trig)	VULOM		**13**		X	X	X

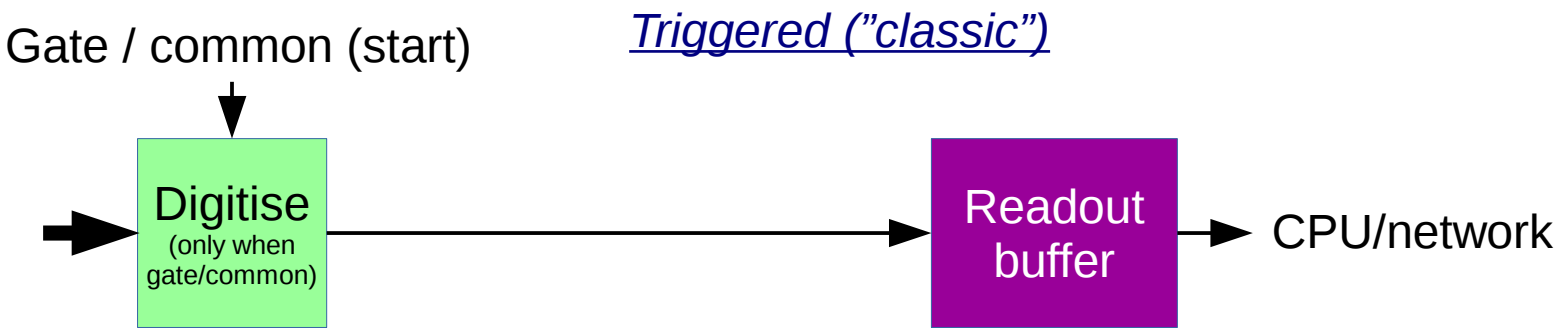
Strategy:

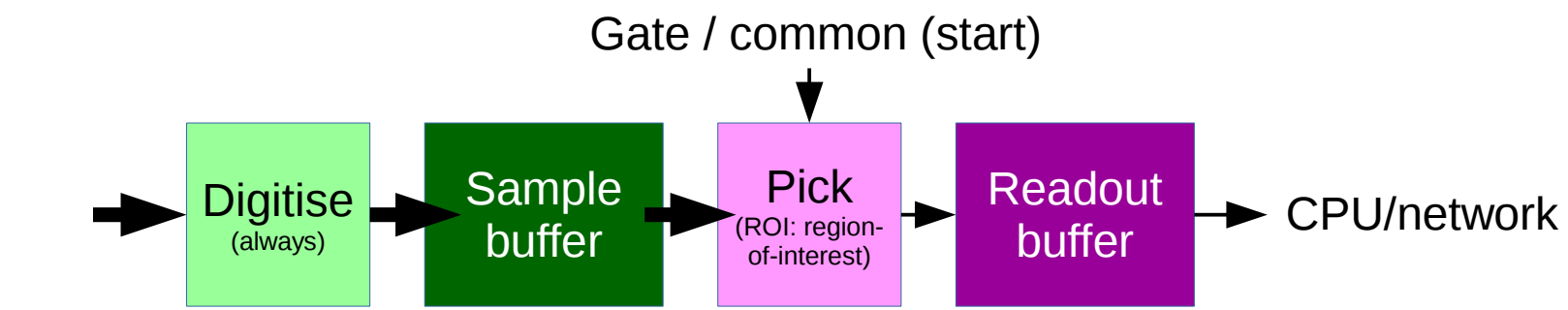
1) List all systems.
2) For which experiments?
3) Expected deadtimes.
   Thanks to Roman, Julien, Aleksandra, Audrey, Hans, Bastii.
4) Find bottlenecks. (per experiment)
5) Focus attention!

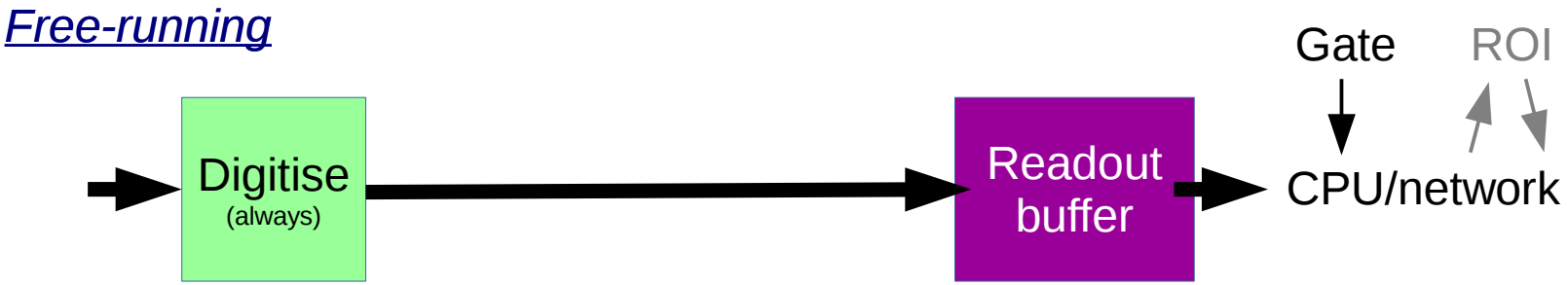
(Almost) every effort has been made to keep assignments accurate and numbers good. Found a minor inconsistency → please send e-mail! Major → shout!

VME

Data flow / Buffer topology

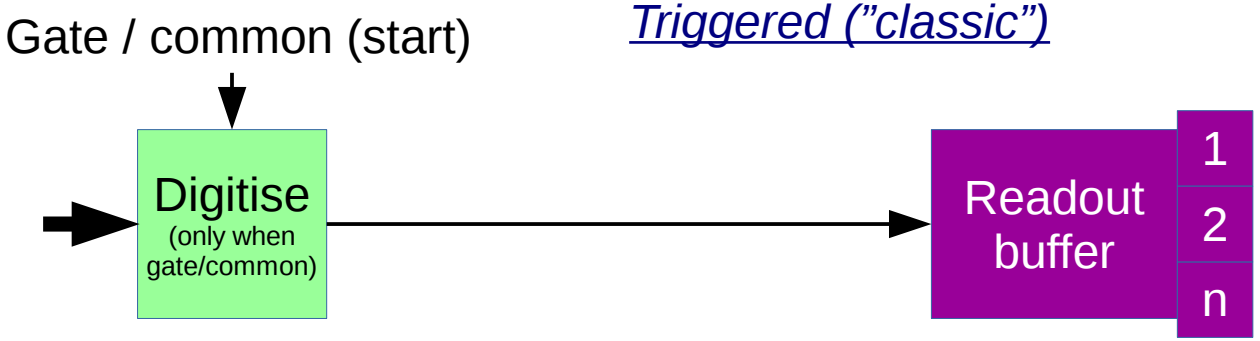






Data flow / Buffer topology

Triggered ("classic")



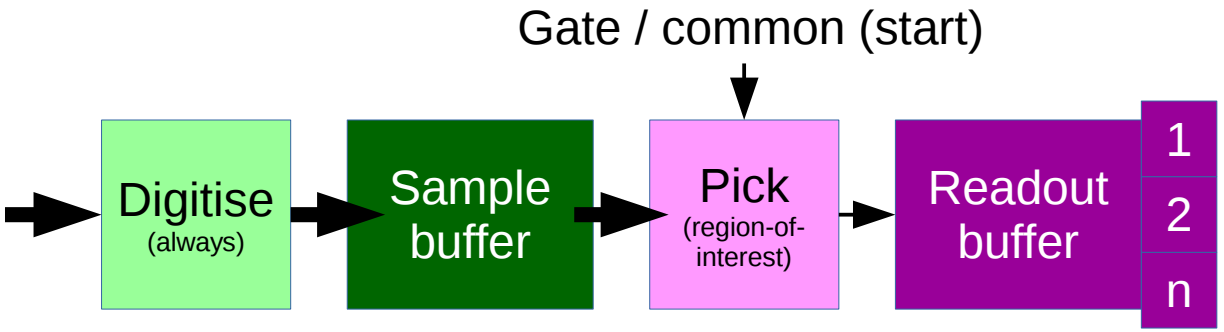
Readout strategy:

Single-event

Single-event, early DT-release

Multi-event (e.DT-rel,shadow)

Triggered, free-running front-end



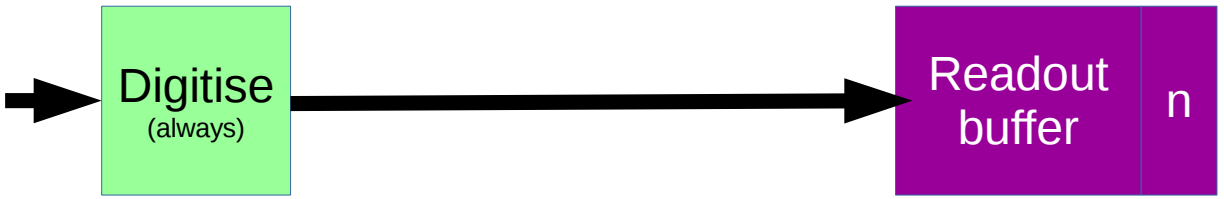
Readout strategy:

Single-event

Single-event, early DT-release

Multi-event (e.DT-rel,shadow)

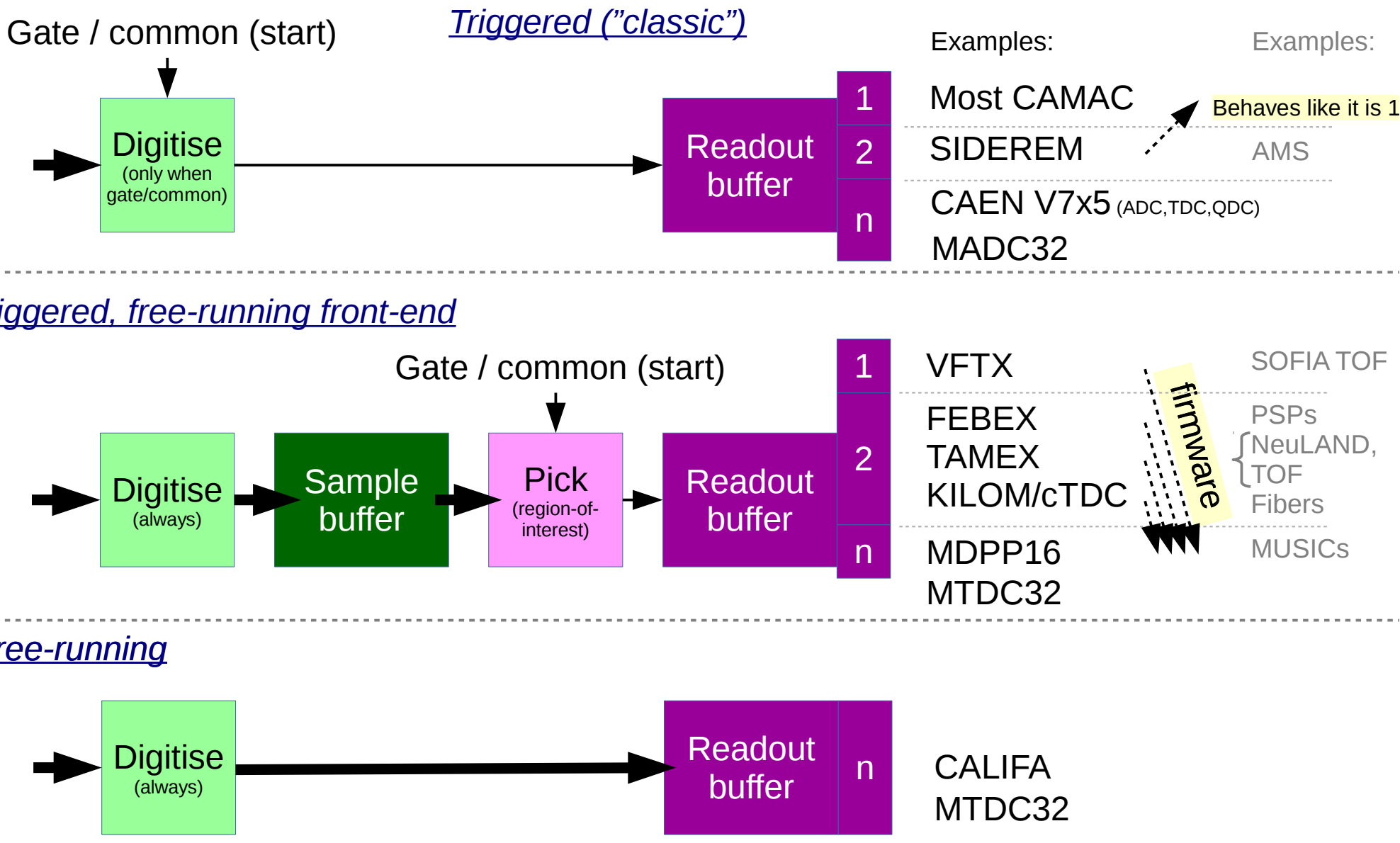
Free-running



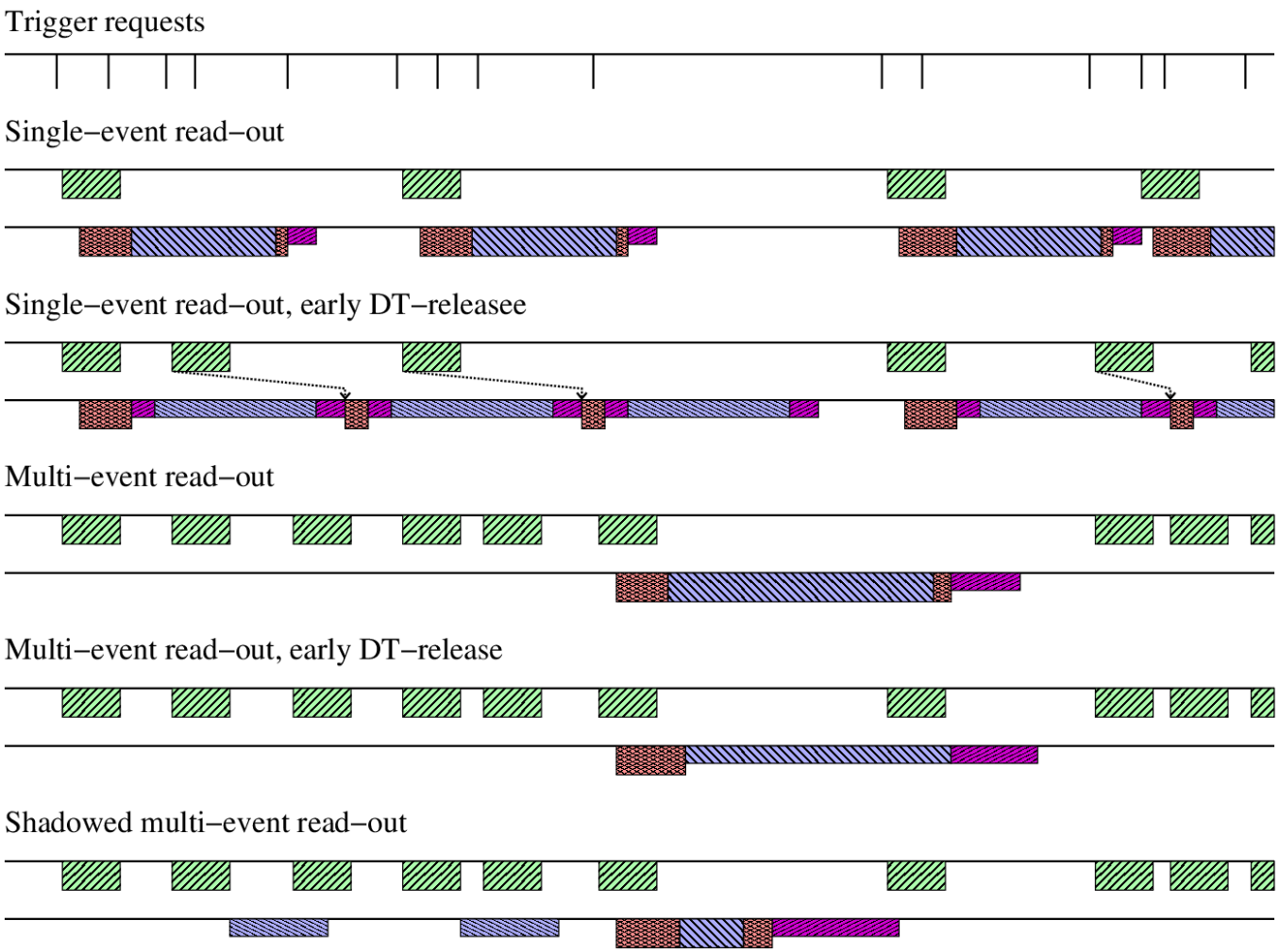
Readout strategy:

Free-running
(pick ROI by CPU if wanted)

Data flow / Buffer topology



Readout style Taxonomy



R³B 2021 deadtime

Multi-event capable?

Values are for full create readout.

	Electronics	ME	Deadtime (µs)	Limit (main)	S455	S515	S494
S2	VFTX	N	**15**		X X	X ?	
S8	VFTX	N	**31**	Readout (RIO3?)		X ?	
Sofia START	VFTX, (MADC32)	N,Y	**9**		X X		
Sofia Triple MUSIC	MDPP16	Y	**25**		X X		
Sofia Twin MUSIC	MDPP16	Y	**40**		X X		
Sofia TOF wall	VFTX	N	**31 (est. 20-25)**		X X		
CALIFA	FEBEX3	Y	free-running	35 µ dead/pile-up per ch. ?	X	X	
AMS	SIDEREM+SAM	N	**100** ; 300	Readout	X	X	
-	INFN AMS DAQ					X	
Sofia MWPC	VMMR8	Y	**27**		X X	X	
NeuLAND (12 DP)	FQT+TAMEX3		**50**	CPU↔PEXOR	X (X)	X	
LOS	VFTX		9			X	
LOS	TAMEX		3 ; 15			X	
X5 PSP	FEBEX3		**3** ; 43 ?	CPU↔PEXOR		X	
R3B MUSIC	MDPP16	Y	**20**			X	
SiPM fiber vacuum	PaDi+Clock-TDC					X	
Fiber vacuum	PaDi+KILOM/cTDC		**3** ; 21	CPU↔PEXOR		X	
Fiber end	PaDi+KILOM/cTDC		**3** ; 21	CPU↔PEXOR		X	
ROLU / SEETRAM / ionis.	Scalers					X	X
R3B TOF wall	FQT+TAMEX3		**3** ; 21	CPU↔PEXOR		X	X
XY Fiber	PaDi+KILOM/cTDC		**3** ; 21	CPU↔PEXOR			X
Fibers	PaDi+KILOM/cTDC		**3** ; 21	CPU↔PEXOR			X
MASTER (trig)	VULOM	Y	**13**	Readout	X	X	X

VME

Values from previous year(s) (need update)
Estimates
Values needed

Second value is until f_user return (early DT release)

Limiting

Excluding AMS

Limiting next readout (early DT release)

R³B 2021 deadtime

Deadtime is ***not*** like **bad weather!**
It can be addressed!

Multi-event capable?

Values are for full create readout.

		ME	Deadtime (µs)	Limit (main)	S455	S515	S494
		N	**15**		X X	X ?	
S8	VFTX	N	**31**	Readout (RIO3?)		X ?	
Sofia START	VFTX, (MADC32)	N,Y	**9**		X X		
Sofia Triple MUSIC	MDPP16	Y	**25**		X X		
Sofia Twin MUSIC	MDPP16	Y	**40**		X X		
Sofia TOF wall	VFTX	N	**31 (est. 20-25)**		X X		
CALIFA	FEBEX3	Y	free-running	35 µ d a p.e-up per ch. ?	X	X	
AMS	SIDEREM+SAM	N	**100**; 300	Readout	X	X	
-	INFN AMS DAQ					X	
Sofia MWPC	VMMR8	Y	**27**		X X	X	
NeuLAND (12 DP)	FQT+TAMEX3		**50**	CPU↔PEXOR	X (X)	X	
LOS			9			X	
LOS			3 ; 15			X	
X5 PSP			**3**; 43 ?	CPU↔PEXOR		X	
R3B MUSIC		Y	**20**			X	
SiPM fiber vacuum	Clock-TDC					X	
Fiber vacu	PaDi+KILOM/cTDC		**3** 21			X	
Fiber end	PaDi+KILOM/cTDC		**3**; 21			X	
ROLU / SEETRAM / ionis.	Scale					X	X
R3B TOF wall			**3**; 21			X	X
XY Fiber			**3**; 21	CPU			X
Fibers			**3** 21	CPU↔PE			X
MASTER (trig)	VULOM	Y	**13**	Readout	X	X	X

200?
DSP code?

3; 50
early DT release

Needs debug (with beam??)

Also affects

; ~ 15
PEXOR firmware

EE dev.

10?
VME CPU

Second value is until f_user return (early DT release)

Values from previous year(s) (need update)
Estimates
Values needed

VME

Limiting

Excluding AMS

Limiting next readout (early DT release)

S455 (Coulex)

- Single-event mode: ~70 µs 4xMDPP16
  (~128 payload data words)
- Audrey and Hans:
  Multi-event mode: ~20 µs /ev after DT release!
  (Conversion ~5 µs?)

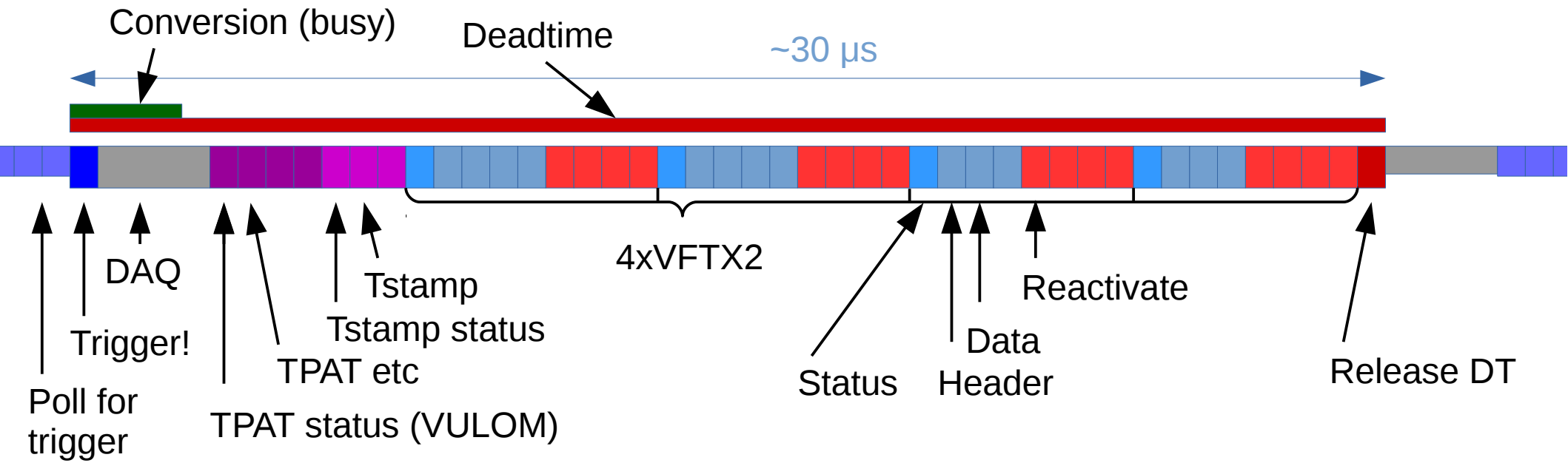
Multi-event has two rates:
longer-term average (bandwidth-limited), ...

… and momentary rate (busy-time limited).

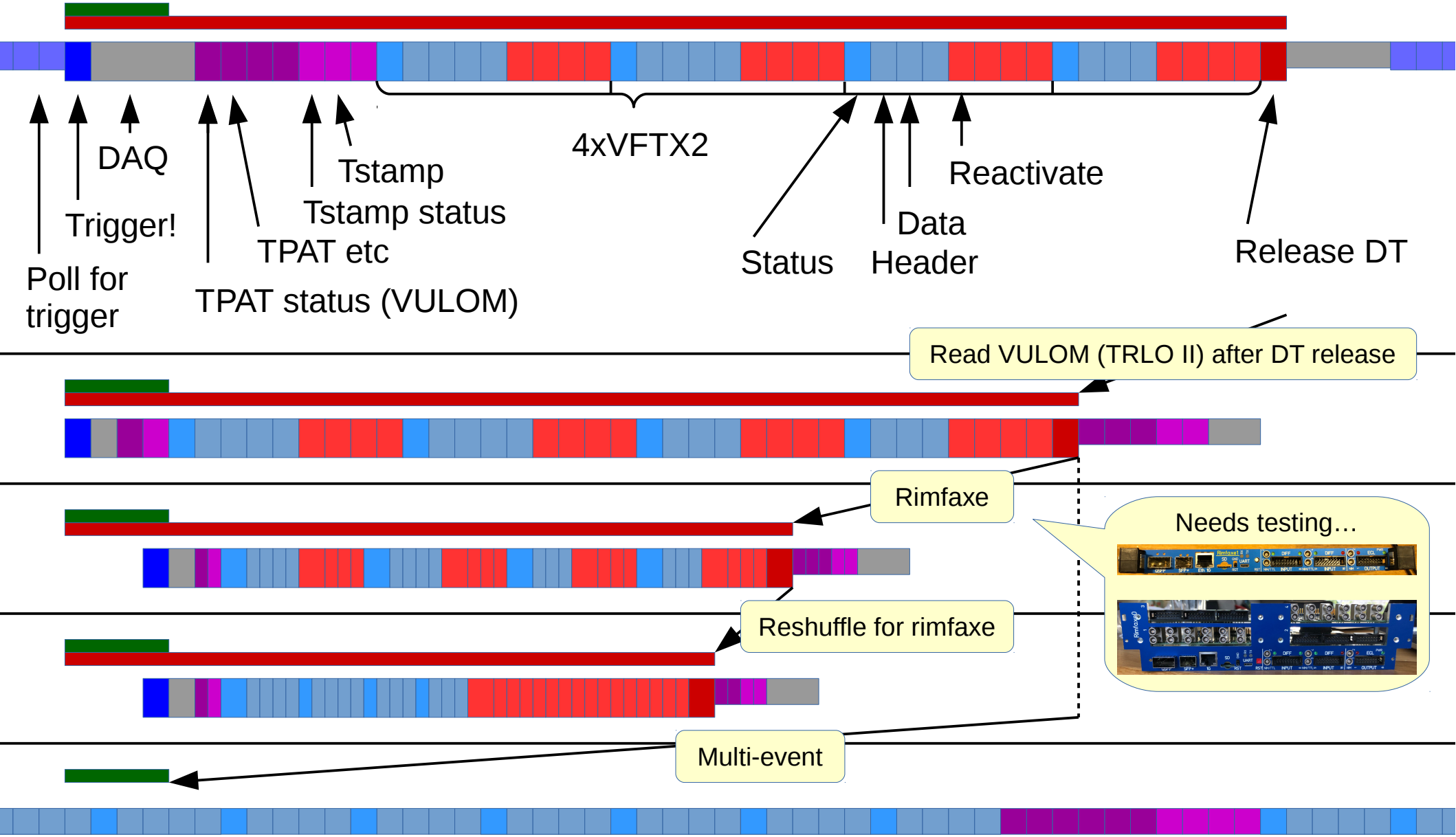
- New bottleneck: 4xVFTX2 (~30 µs)

VFTX2

- Best time-resolution available!
  (no alternative known)
- Drawbacks:
  - Single-event readout
  - Requires 4 writes to reactivate after readout



Rearranging VFTX2 readout

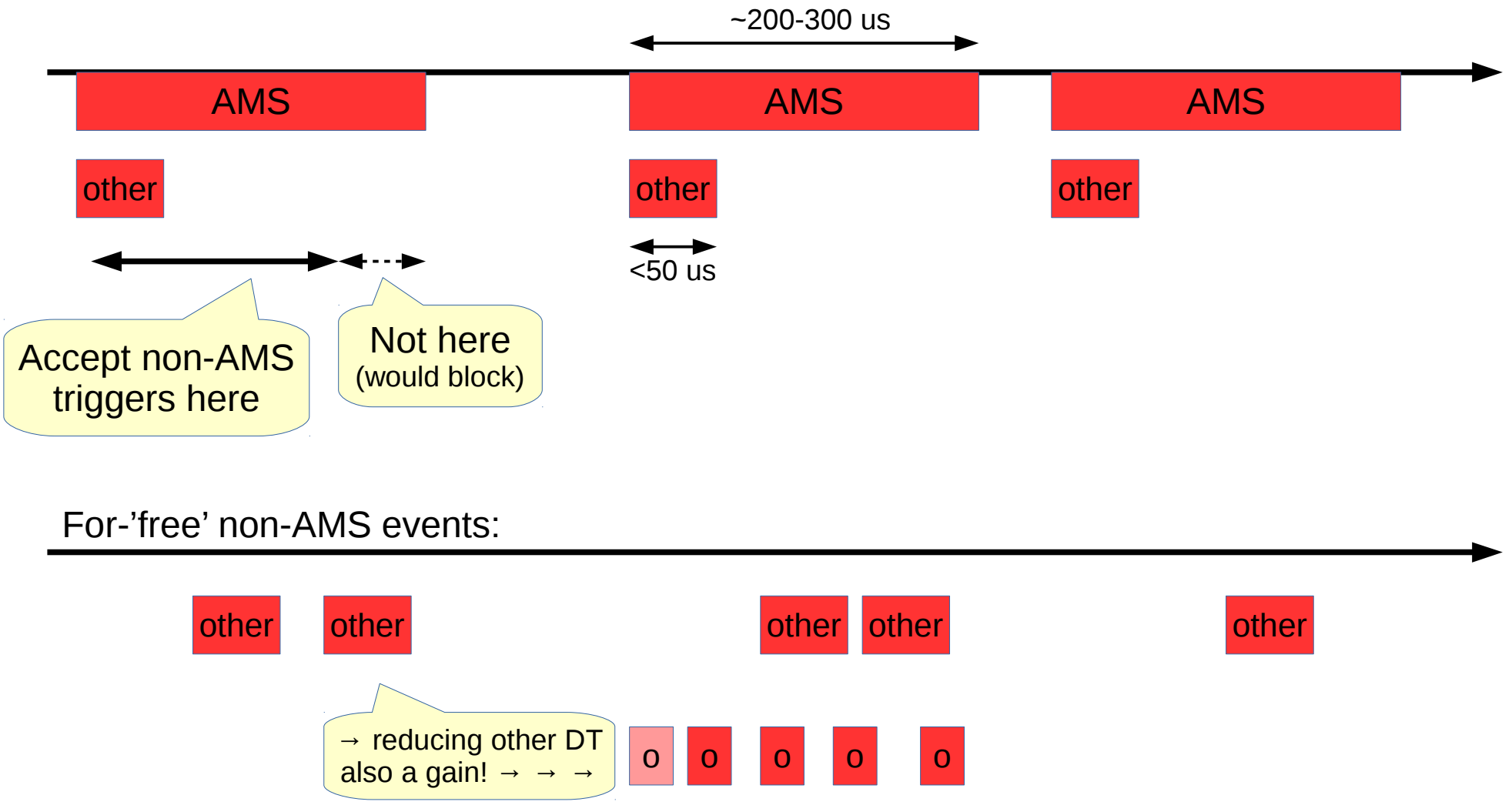


S515 / S455 (p,2p)

- Limited by AMS readout (SIDEREM)
- AMS / SIDEREM should be enjoying retirement.
  Instead:
  It is guarding the front flanks of R^3B...
- Testing new zero-suppression in DSP
  (taking charge-sharing between strips into account)
- Main effect: reduce GTB transfer (SIDEREM → SAM)
- Good pedestals important (also for ’old’ compression)
  → Sticky events
- SIDEREM timings not understood!
  → no numbers here; → some future Sxxx preparation meeting.

S515 / S455 ’free’ non-(p,2p)

- Take non-(p,2p) events while AMS busy



S494 - ^{16}O breakup

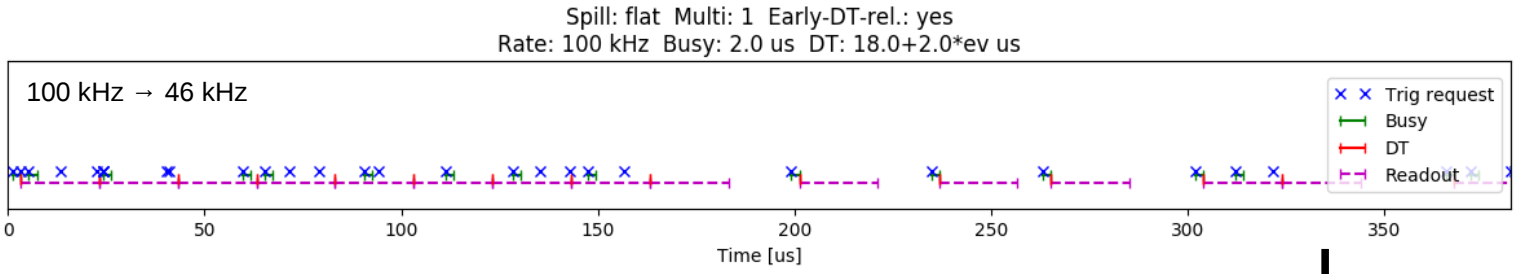
- High-rate experiment: 100 kHz

M. Heil; even a few 100 kHz...

- Only two kinds of systems: KILOM TAMEX

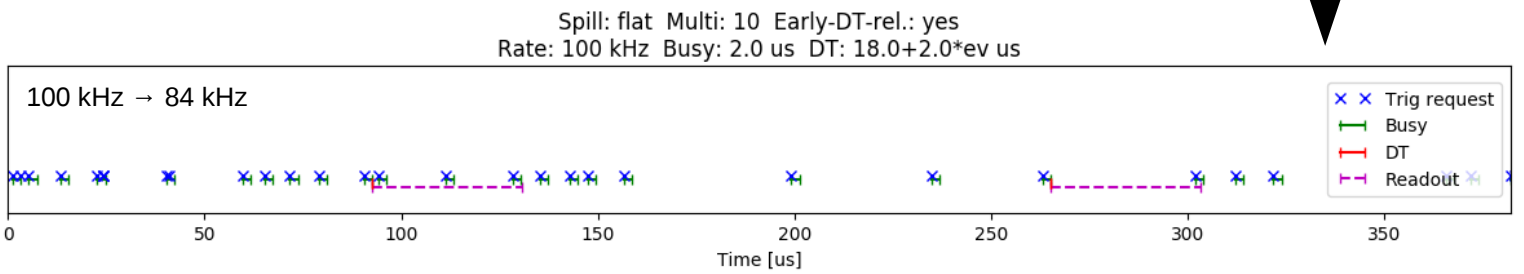
= third event not before 20 µs

- Assume early DT-release after 2 µs, readout 20 µs.



+ 80 %

- Multi-event (10 events):



Needed:

Readout buffer

2

n

- Bonus: Good for evil spill structure.

Checklist

BEFORE BEAM ON	
SOFIA MULTI-EVENT	SET
MIXED-MODE UNPACK	TBD
AMS DSP	TBD
FREEBIE TRIGGERS	TBD
KINPEX SPEED-UP	SET
KILOM / TAMEX MULTI-EVENT	TBD

BEFORE BEAM ON	
SOFIA MULTI-EVENT	SET
MIXED-MODE UNPACK	TBD
AMS DSP	TBD
FREEBIE TRIGGERS	TBD
KINPEX SPEED-UP	SET
KILOM / TAMEX MULTI-EVENT	TBD

Thank you!