HRS DAQ Deadtime
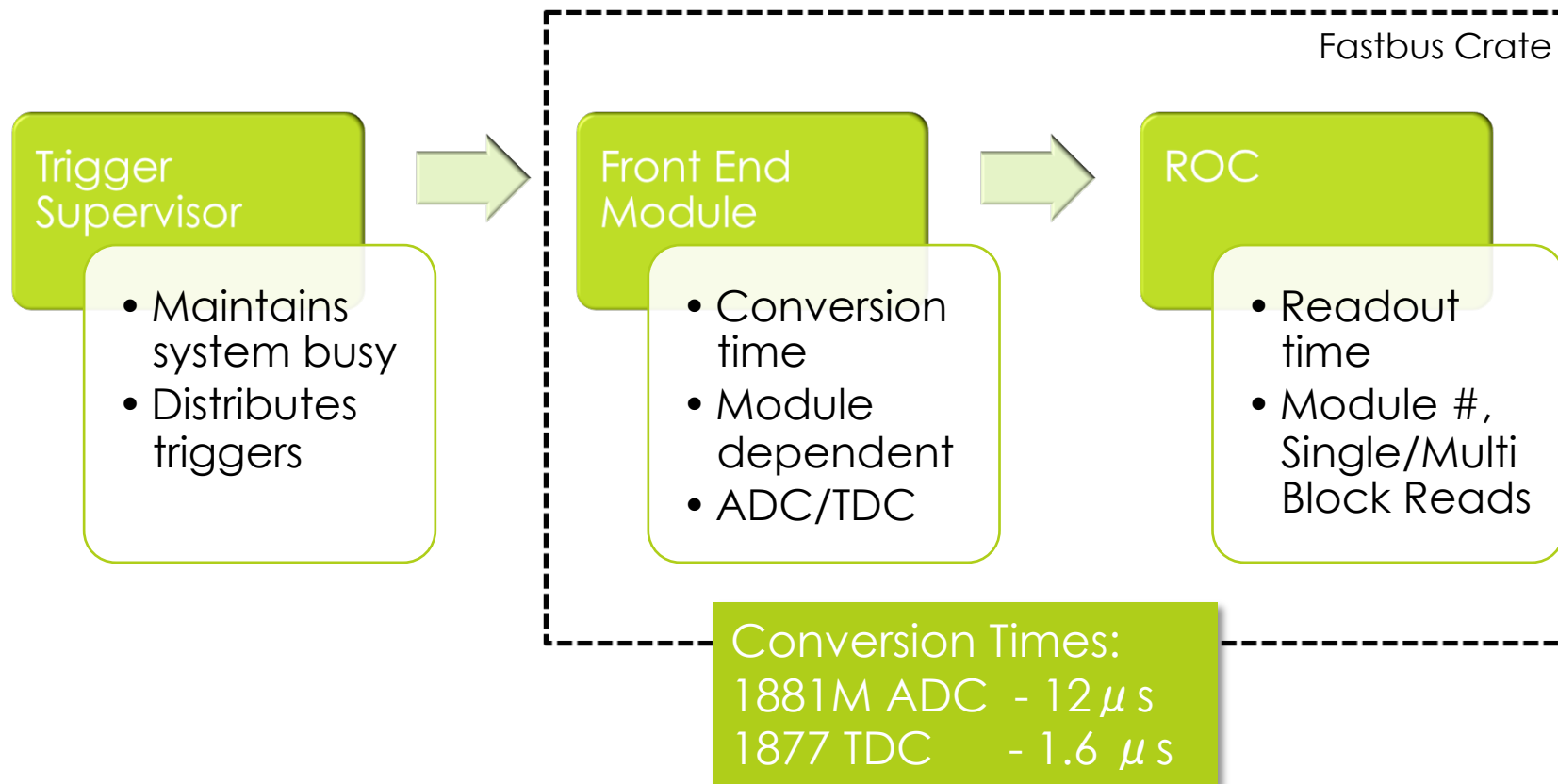
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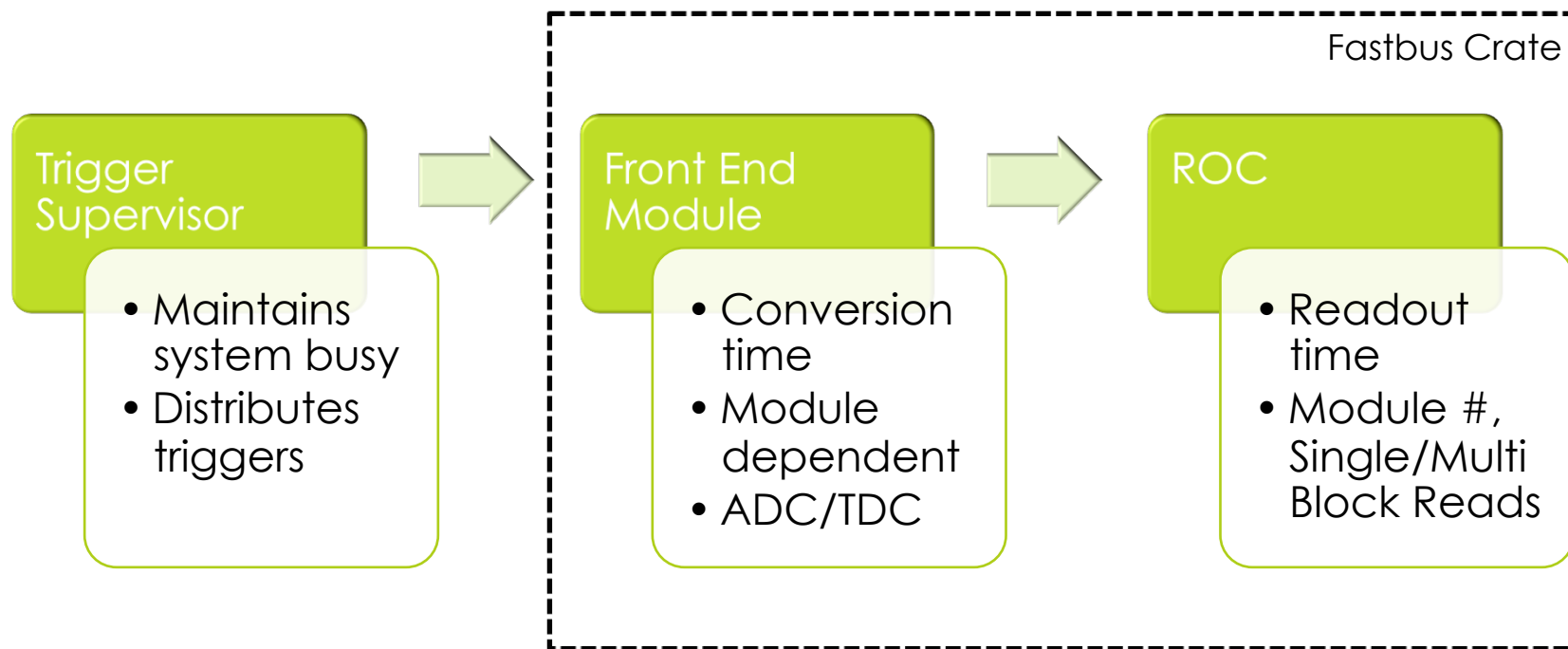
Overview – What is Deadtime?

▪Deadtime occurs if DAQ cannot accept another trigger

Fastbus Crate

Trigger Supervisor
- Maintains system busy
- Distributes triggers

Front End Module
- Conversion time
- Module dependent
- ADC/TDC

ROC
- Readout time
- Module #, Single/Multi Block Reads

Conversion Times:
1881M ADC - $12\,\mu s$
1877 TDC   - $1.6\,\mu s$

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▪With one trigger and no prescale deadtime $\approx D_r + D_c$

  ▪D_r is the readout deadtime
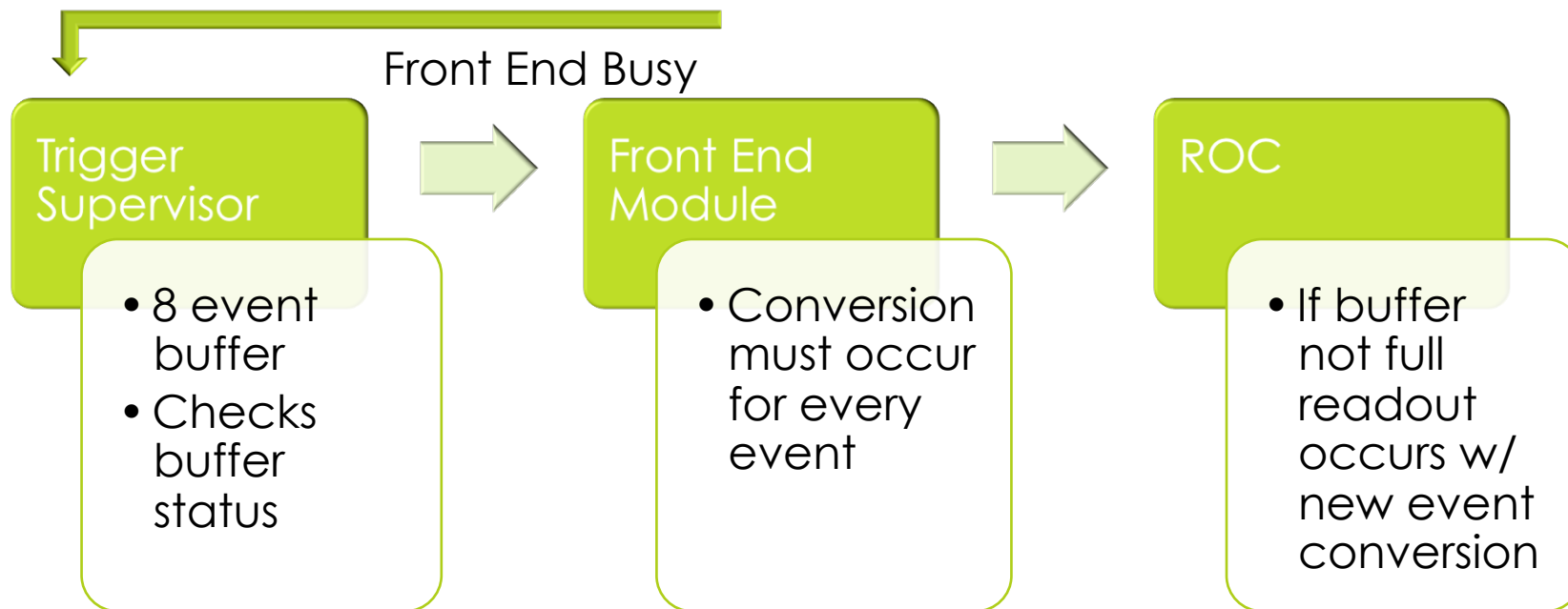 ▪D_c is the conversion (frontend) deadtime

Buffering the Trigger Supervisor

▪Can process a new event while reading out previous event

▪Buffering decouples the front end time from the readout time

Front End Busy

Trigger Supervisor
- 8 event buffer
- Checks buffer status

Front End Module
- Conversion must occur for every event

ROC
- If buffer not full readout occurs w/ new event conversion

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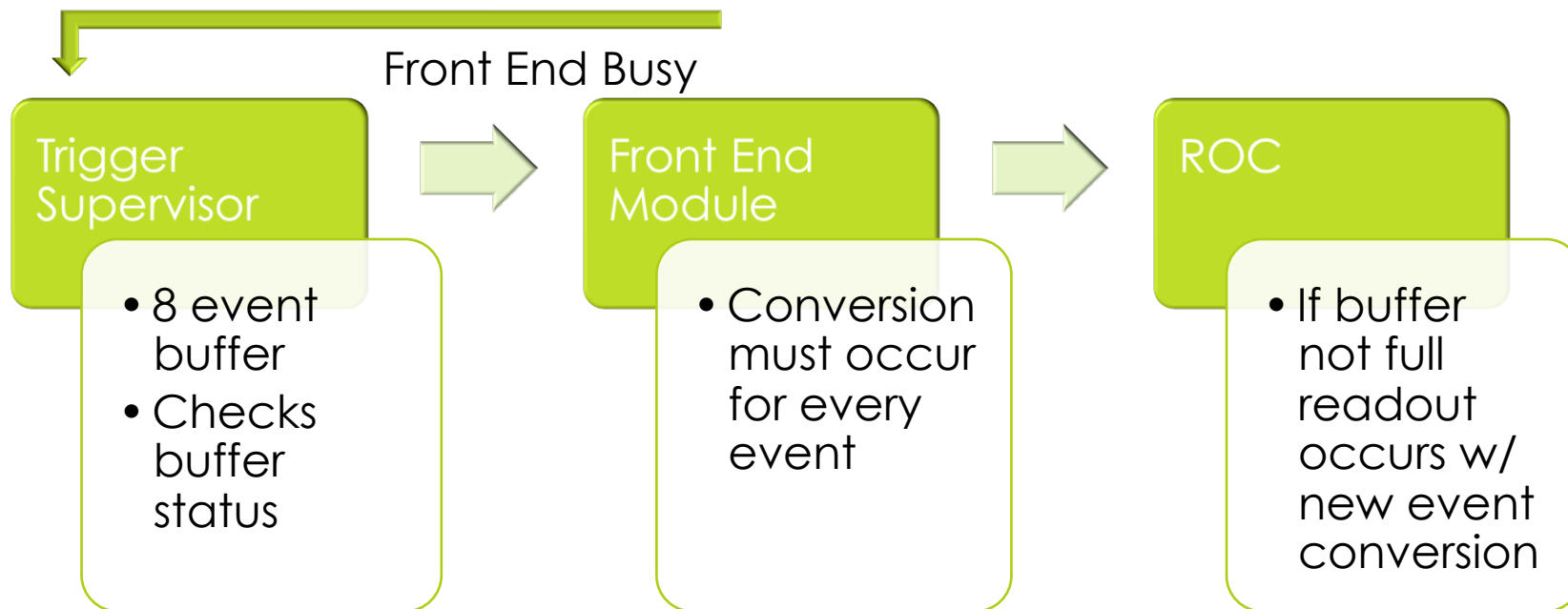
▪ Happex crate doesn't support buffering
   ▪Separate branch of TS with TS Scaler Crate

▪Scaler readout is tied to "sync events"
   ▪Sync events are unbuffered events and check sync status of crates

Deadtime Model: Poisson Probability

If the expected number of occurrences in a given interval is lambda, then the probability that there are exactly k occurrences (k = 0,1,2...) is

$$f(k;\lambda) = \frac{\lambda^k e^{-\lambda}}{k!}$$

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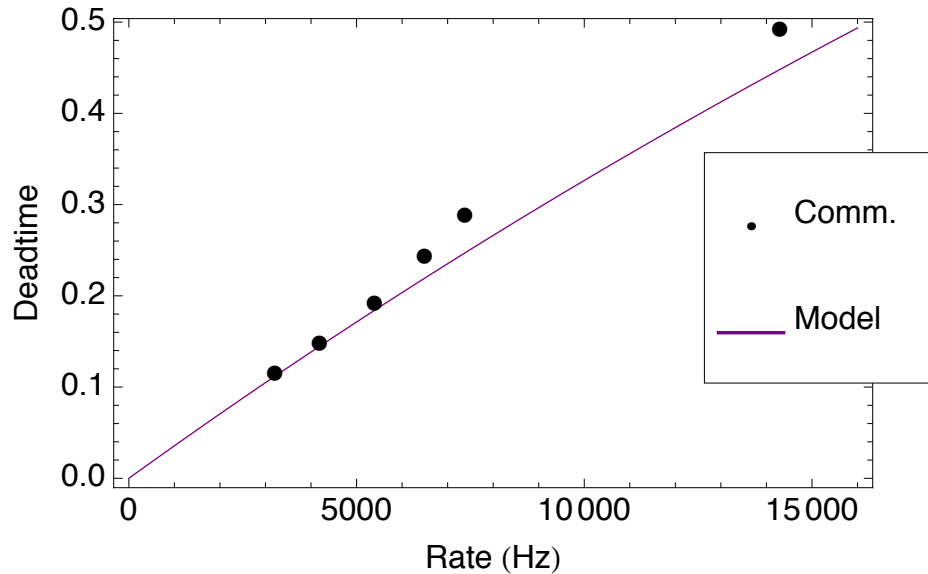$$f(k;\lambda) = \frac{\lambda^k e^{-\lambda}}{k!}$$

▪Can break down deadtime components into two infinite sums

$$D_c = \sum_{n=1}^{\infty} \frac{\mu_c^n e^{-\mu_c}}{n!} \qquad D_R = \sum_{n=1}^{\infty} \frac{\mu_R^{(n+b)} e^{-\mu_R}}{(n+b)!}$$

▪b is the buffer factor, R is rate, μ_C = RT_C, μ_R = $R(T_R - T_C)$, T_C is conversion time, and T_R is the readout time
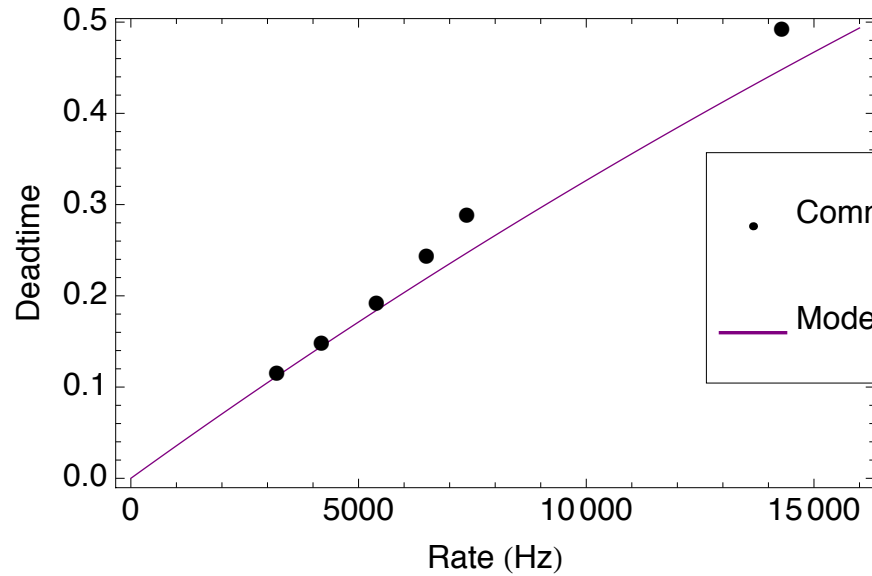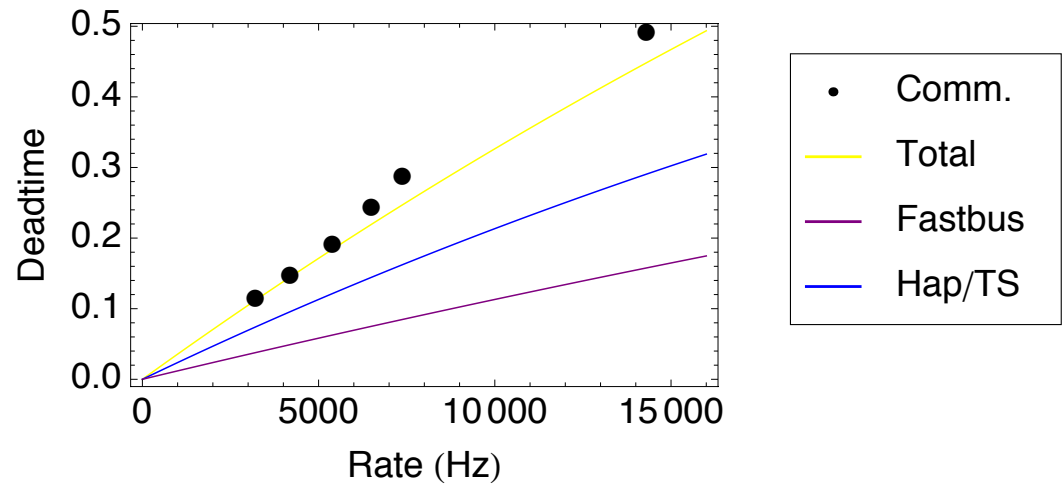
Left HRS: Commissioning Results

- All busy times measured with comics
- Used times of slowest Fastbus crate

Crate	$T_c\,(\mu s)$	$T_R\,(\mu s)$
Happex/TS		36
Fastbus	12	90

Left HRS: Commissioning Results

- All busy times measured with comics
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Components

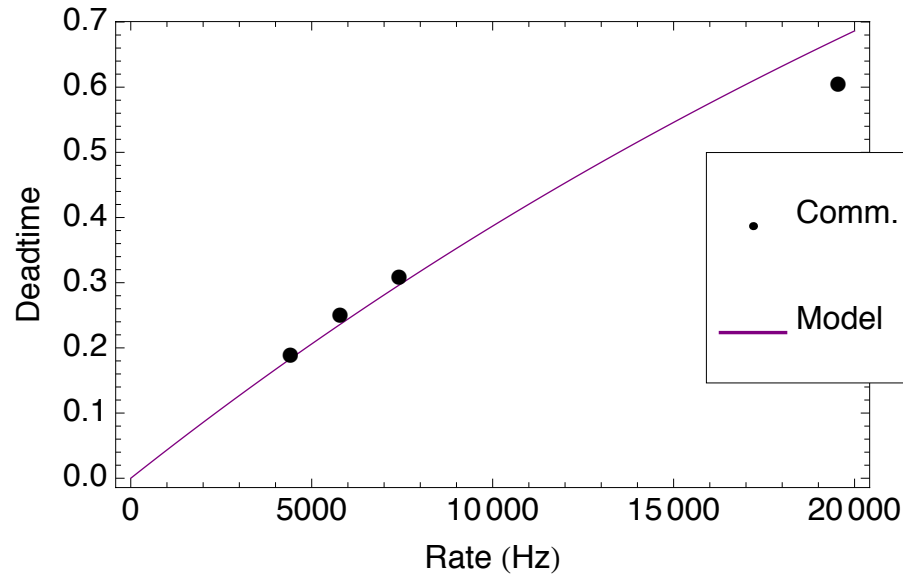| Crate	T_c (μs)	T_R (μs)
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Right HRS: Commissioning Results
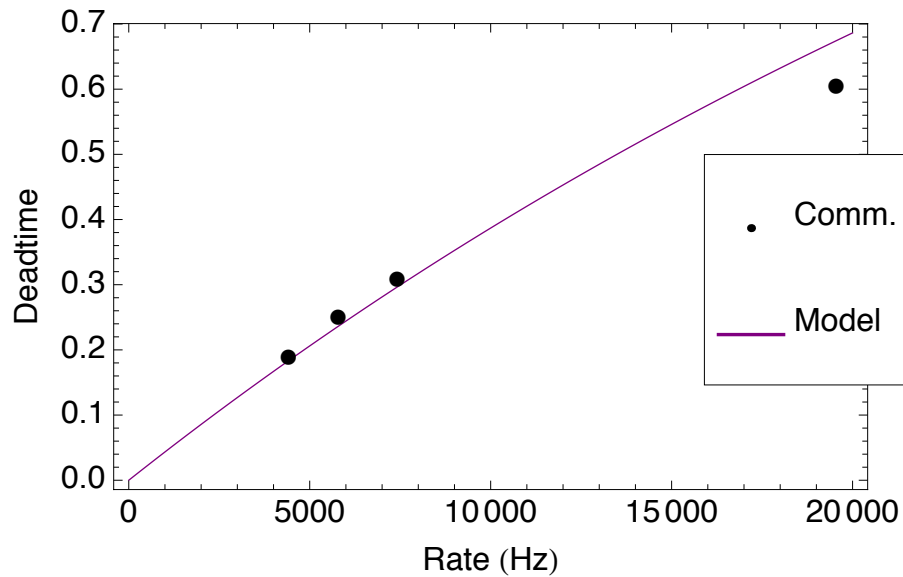
- All busy times measured with comics
- Only two Fastbus Crates

Crate	$T_c\,(\mu s)$	$T_R\,(\mu s)$
Happex/TS		44
Fastbus	12	100

Right HRS: Commissioning Results

- All busy times measured with comics
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Components

Crate	$T_c\ (\mu s)$	$T_R\ (\mu s)$
Happex/TS		44
Fastbus	12	100