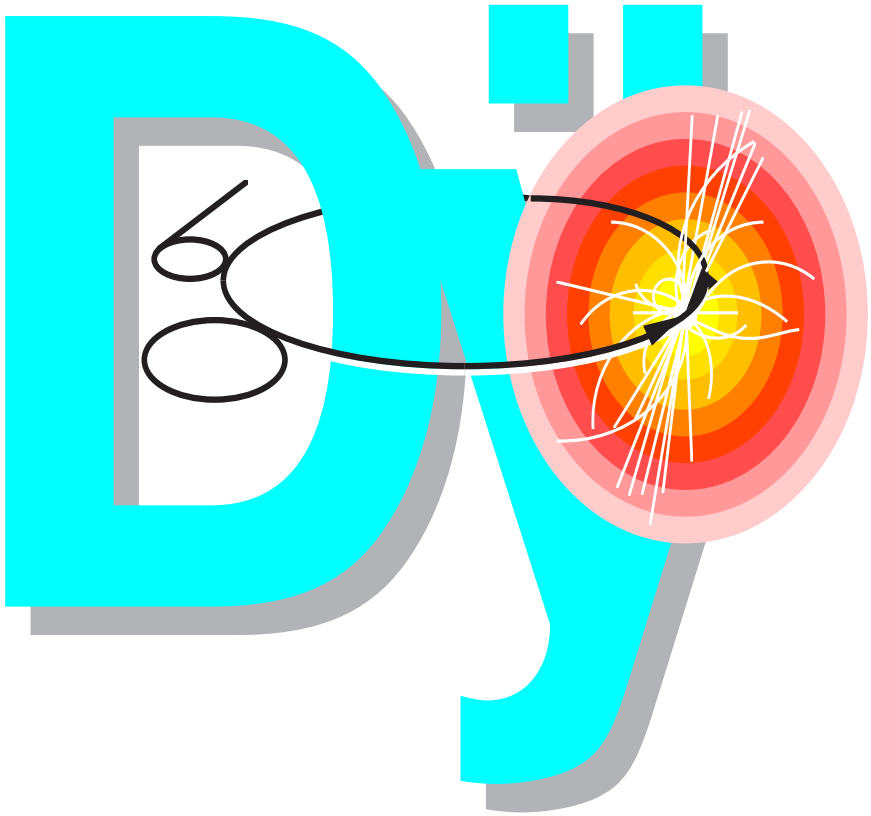
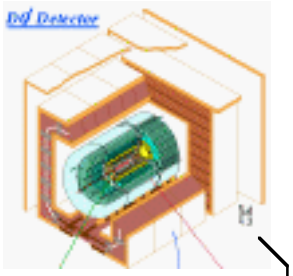


The



Fast Readout

Level 0 & 1 (50 kHz)

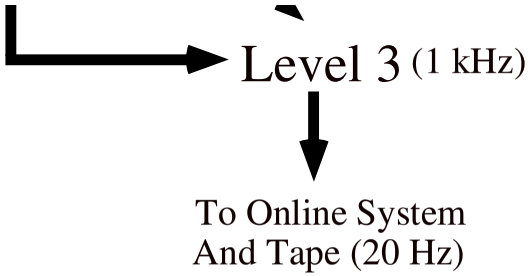
Level 2 (10 kHz)

Full Readout (250 kB per event)

At Fermilab, pp collisions occur at the rate of 5 million times a second; interesting events are saved at a rate of 20 Hz by a multilevel trigger system.

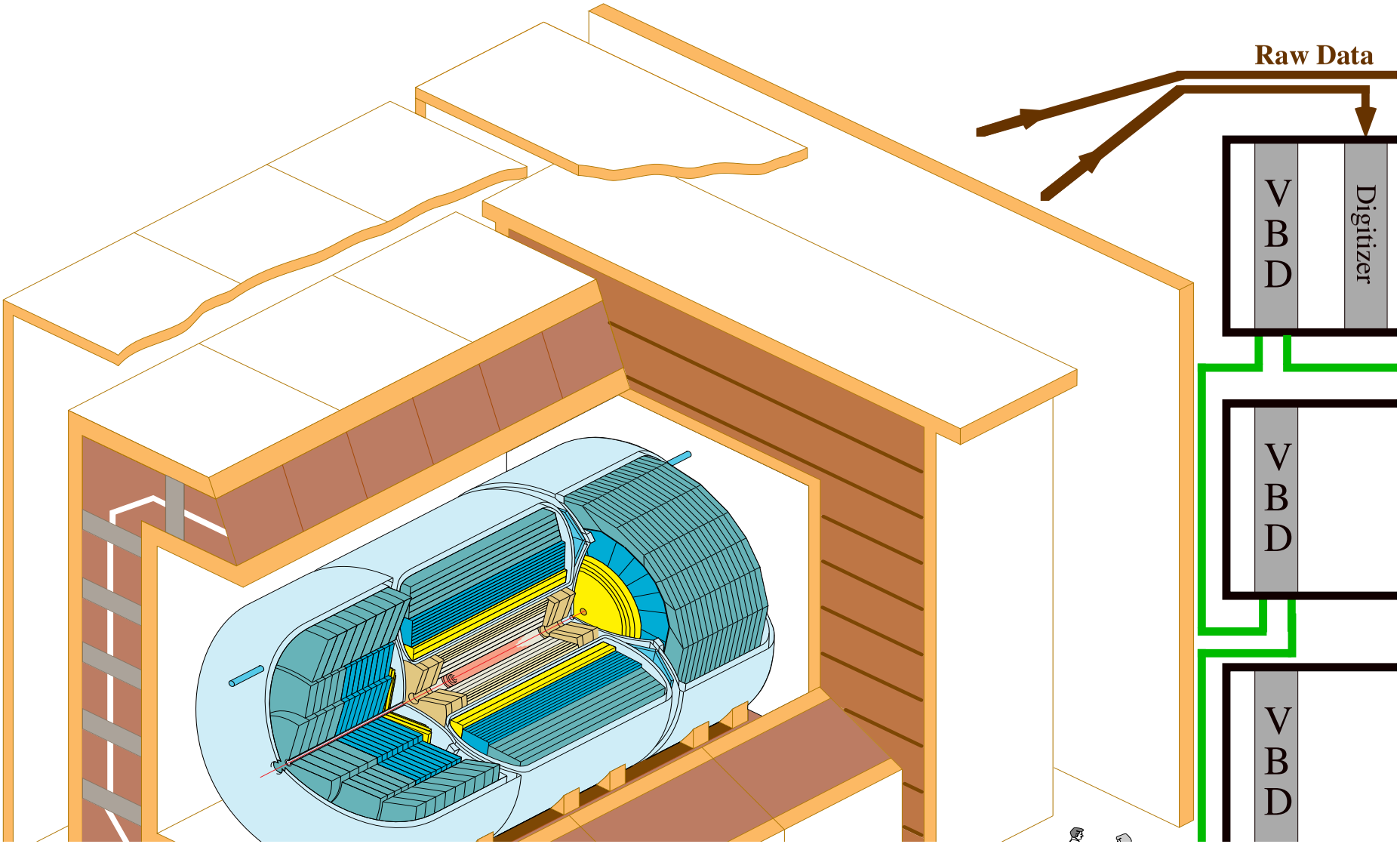
Fast readouts of the detector supply the first two D0 trigger levels with information to make their decision. These triggers are run on dedicated hardware.

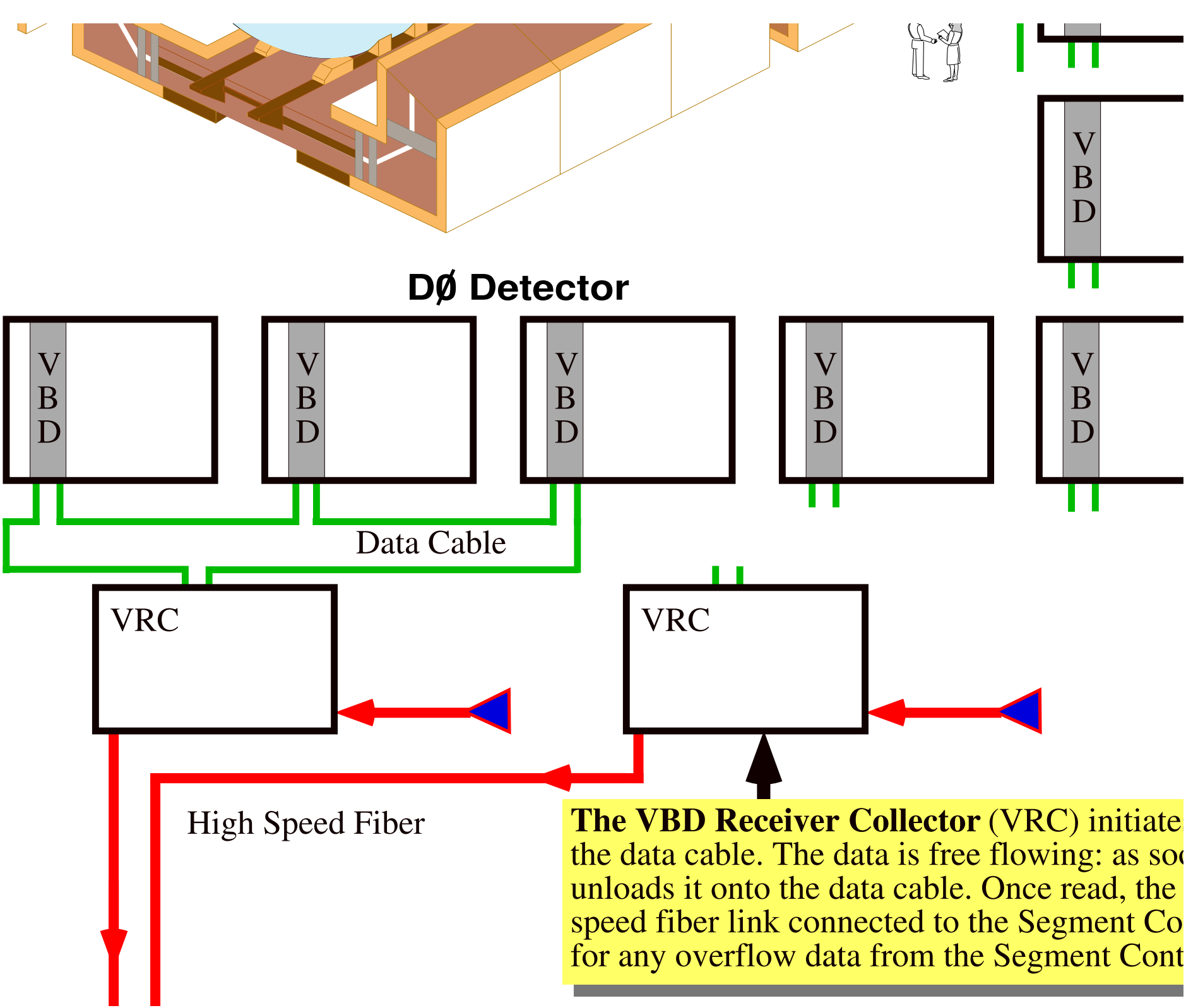
The D0 Level-3 Trigger, based on commodity processors, also has a full

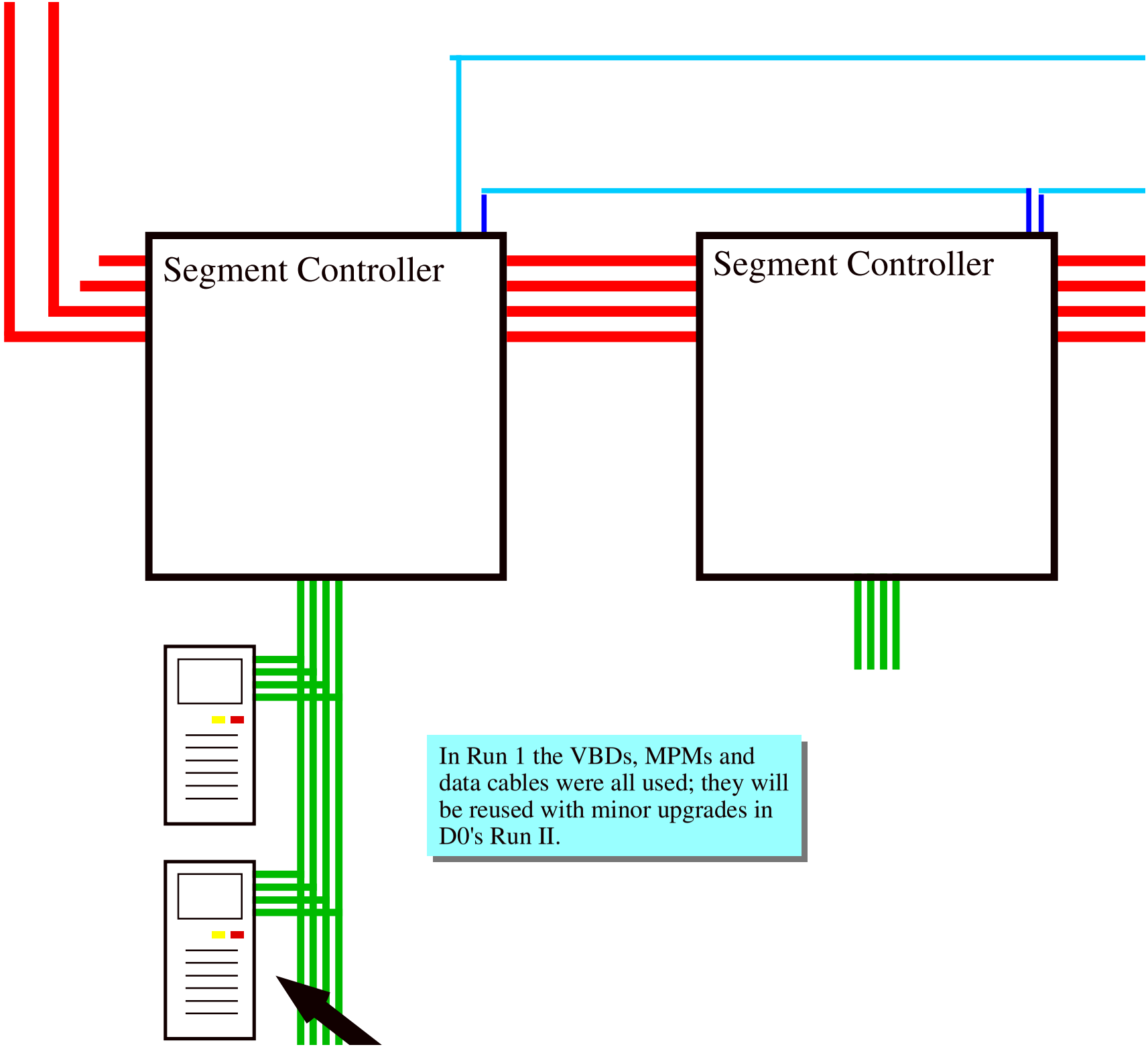


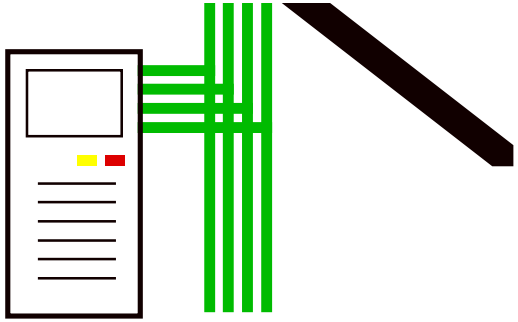
readout of the event.

This poster describes the full readout path and the Level-3 processor farm.




DØ Detector
VBD
VBD
VBD
VBD
VBD
Data Cable
VRC
VRC
High Speed Fiber
The VBD Receiver Collector (VRC) initiate
the data cable. The data is free flowing: as soo
unloads it onto the data cable. Once read, the
speed fiber link connected to the Segment Co
for any overflow data from the Segment Cont


Segment Controller
Segment Controller
In Run 1 the VBDs, MPMs and data cables were all used; they will be reused with minor upgrades in D0's Run II.



The Level-3 Farm Nodes each are multipr
computers with a large amount of memory.
linked to the VME bus via an adaptor card
as well as mapping VME address space int
address space. The machines will be runnir
NT. The VME crate is populated by **MPM**
the data cables.

DØ Level-

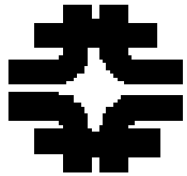
ID 307

The Brown Level-3
Development Group:

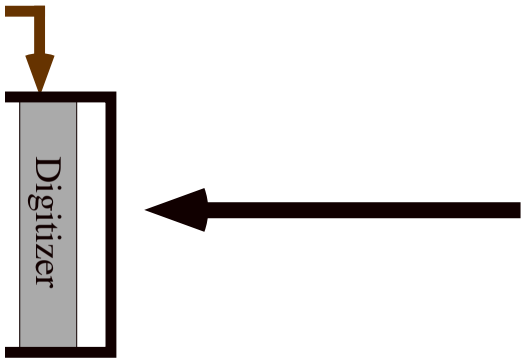
Dave Cutts
Jan Hoftun
Gordon Watts
Ray Zeller

Brown High Energy Physics

The D0 Detector is located at the
Fermi National Accelerator Laboratory,
in Batavia, Illinois, USA.



This work is in part supported by U.S. Department of Energy Grant DE-FG02-91ER40688



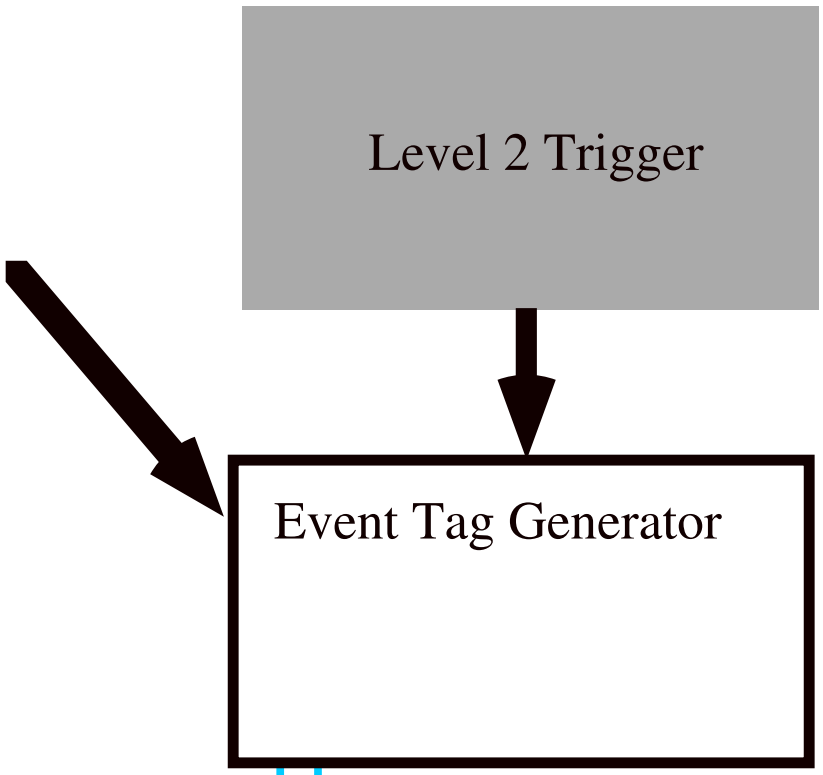
The Front End Crates (FECs) are responsible for extracting the data, in digital form, from the D0 detector. Each FEC is a VME crate (some VME64, some VME32) and contains a **VBD** card. The VBD card's DMA engine reads the data from the detector cards in the crate and pumps the data onto the data cable. The VBD, with some minor modifications, is the same card as used in D0's Run I.

The Data Cable (DC) is a 32 bit wide twisted pair ribbon cable connecting the VBDs to the VRCs. Its peak throughput is 48 MBytes/sec. The protocol is token based: a token is passed from VBD to VBD; a VBD may write to the data cable only when it has possesion of the token.

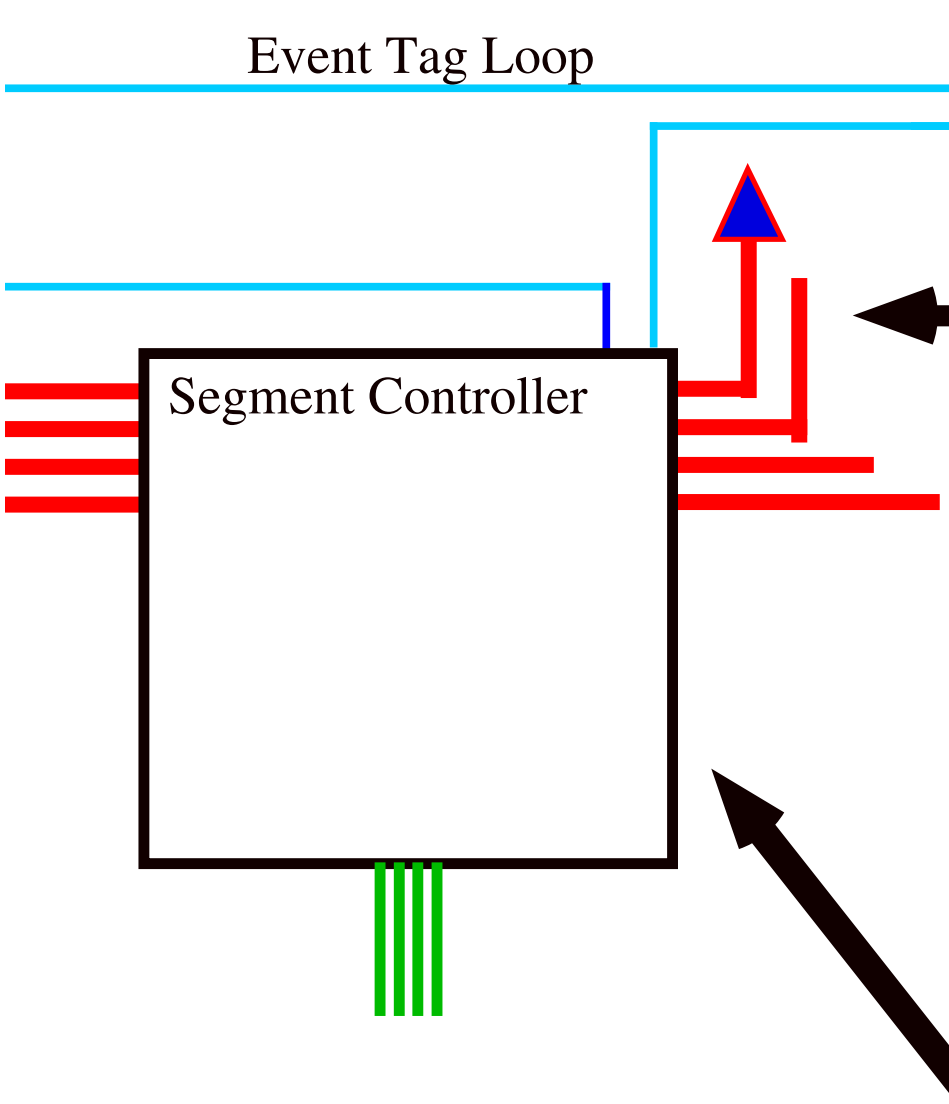
Staging: The Level-3 Upgrade is designed to be built in stages.

Stage	A	B	C	D
# VRCs	16	16	16	24
# SCs	2	3	4	4
# CPUs	48	48	64	64
50% Data Rate (MB/sec)	200	300	400	600

The Event Tag Generator (ETG) manages the assignment of new events to free Level-3 processing nodes as well as the update of routing tables in the Segment Controllers. It gets its information from Level 2 and from tables downloaded at the beginning of the run. Using the Level 3 information, the ETG assigns the event a class. The class tag is passed around on a small token loop till a SC signals it has a node that can handle the event.



s the data cable token and reads
on as a FEC has data ready it
VRC pumps the data out on a high
ntrollers. It has a fiber return path
rollers.



Recirculation is a self-limiting flow mechanism for Level-3. If a SC does not have enough room for a data packet it is sent on to the next SC, and eventually out of the last SC and back to the VRC. There it is immediately sent around the loop again. When the SC has room it will grab the data packet and remove it from the stream. Since the data packate is taking up bandwidth on the fiber cable, there is less room for new data. The provides an effective throttle for the Level 3 trigger.

The Segment Controller (SC) is responsible for routing event data from the high speed fiber inputs to the data cable outputs for each segment, The SC keeps a routing table of what node is working on which event which is updated by the ETG. If the SC does not have room on one of its internal queues for a data packet it passes the packet along to the next SC. Since no one else is

rocessor commodity
. Their PCI bus is
allowing DMA access
o a process'
ng a varriant of Windows
cards, which land the

interested in the data packet, the packet is eventually returned to the VRC.

-3 Trigger

Simulating the Level-3 Upgrade

The Level-3 upgrade is complex. The system must be simultaed to be assured of its ability to perform the task at hand, as well as to learn of bottlenecks in the system.

The Brown group has used a commercial tool, MODSIM by CACI Products Co., a discreet event simulation object oriented simulation tool.

Queue Simulation	Discrete Event Simulation
Based on work flow	Based on tasks that are done to the data
Queues & work	Objects representing physical