
CERN

CLIC-ACM

Acquisition and Control System

B. Bielawski [1] F. Locci [1] S. Magnoni [1]

[1]CERN, Geneva, Switzerland
Beams Department, Controls Group

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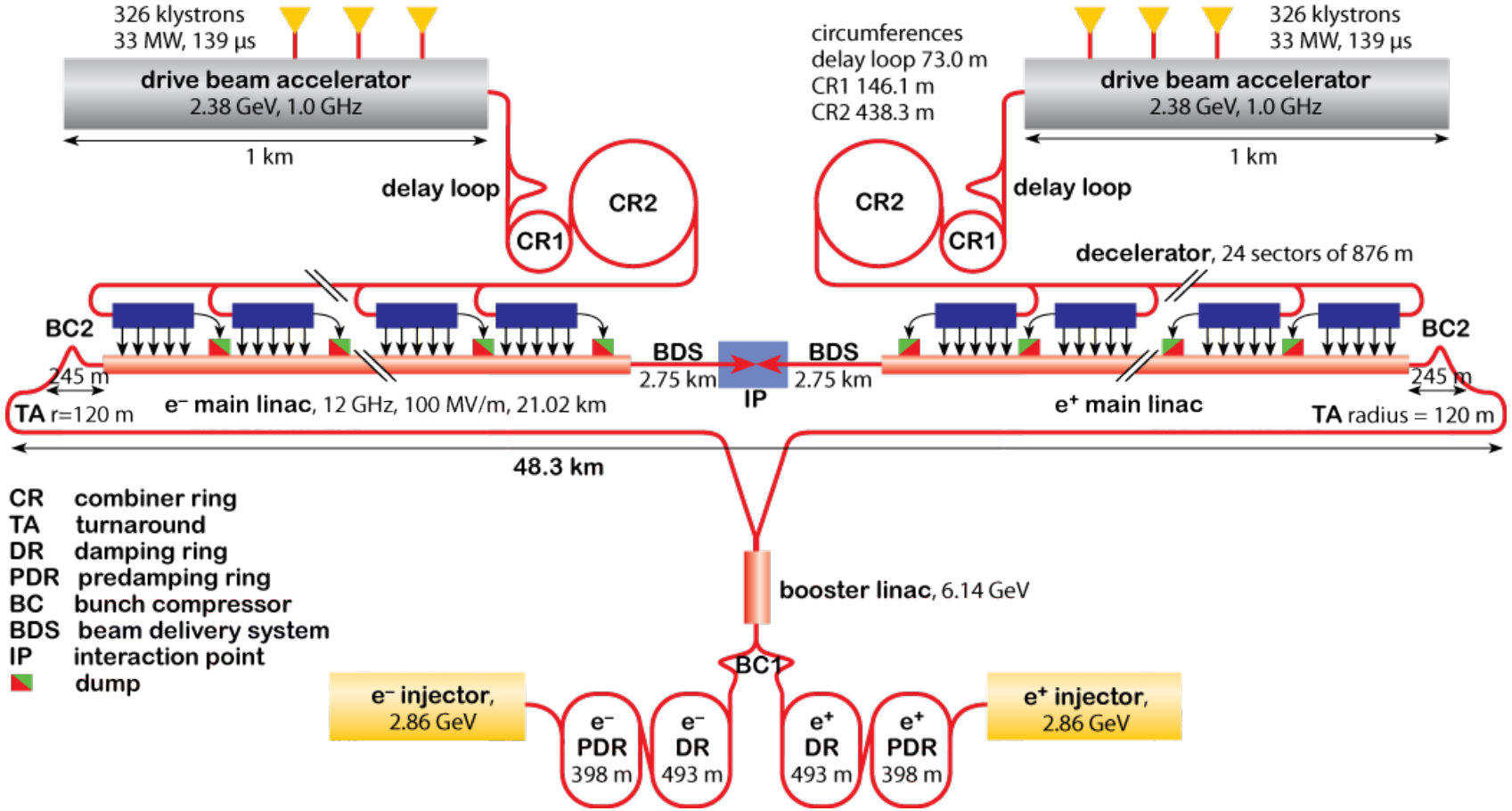
The Layout


326 klystrons
33 MW, 139 μs
drive beam accelerator
2.38 GeV, 1.0 GHz
1 km
delay loop
CR1
CR2
circumferences
delay loop 73.0 m
CR1 146.1 m
CR2 438.3 m
326 klystrons
33 MW, 139 μs
drive beam accelerator
2.38 GeV, 1.0 GHz
1 km
delay loop
CR2
CR1
decelerator, 24 sectors of 876 m
BC2
245 m
TA r=120 m
e⁻ main linac, 12 GHz, 100 MV/m, 21.02 km
BDS
2.75 km
IP
BDS
2.75 km
e⁺ main linac
BC2
245 m
TA radius = 120 m
48.3 km
CR combiner ring
TA turnaround
DR damping ring
PDR predamping ring
BC bunch compressor
BDS beam delivery system
IP interaction point
dump
booster linac, 6.14 GeV
BC1
e⁻ injector, 2.86 GeV
e⁻ PDR 398 m
e⁻ DR 493 m
e⁺ DR 493 m
e⁺ PDR 398 m
e⁺ injector, 2.86 GeV

CLIC in Numbers

Two Beam Module (TBM)

A basic building block of CLIC — a compact integration containing all the components required to accelerate the beam.

Acquisition and Control Module (ACM)

A device providing timing, data acquisition and control to the TBM module (Alignment, Stabilization, Power, Vacuum, Cooling, ...), communicates with Front End Computers (FECs) installed in alcoves.

Some numbers describing CLIC:

- 2 main beam linacs (each 1.5 TeV),
- 24 sectors ($\sim$880 m long) per linac,
- 440 TBMs and ACMs per sector,
- **21000+** TBMs and ACMs in total,
- 50 Hz repetition rate.

Physical Constrains of the CLIC-ACM

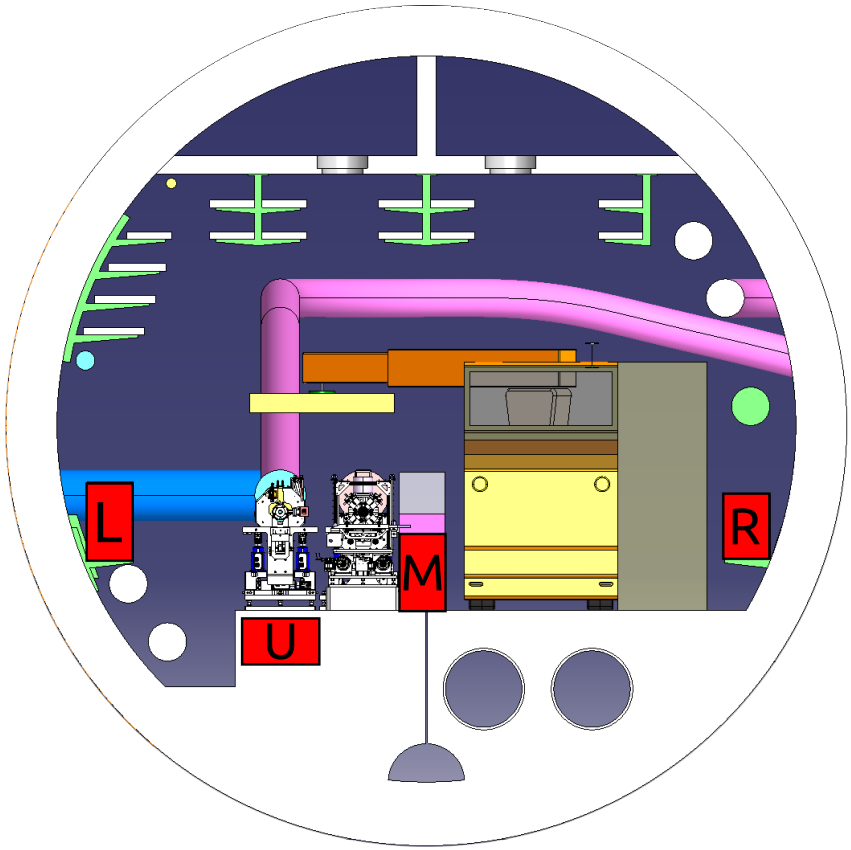
- Power consumption $\leq$ 50 W,
- TIDs 100–1000 Gy per year,
- Limited space to place the ACM, possible placements:

  left — hard to access, short cables,

  under — hard to access, short cables, risk of flooding, collides with the Drive Beam support system,

  middle — easy access, short cables, risk of physical damage,

  right — easy access but very long cables.



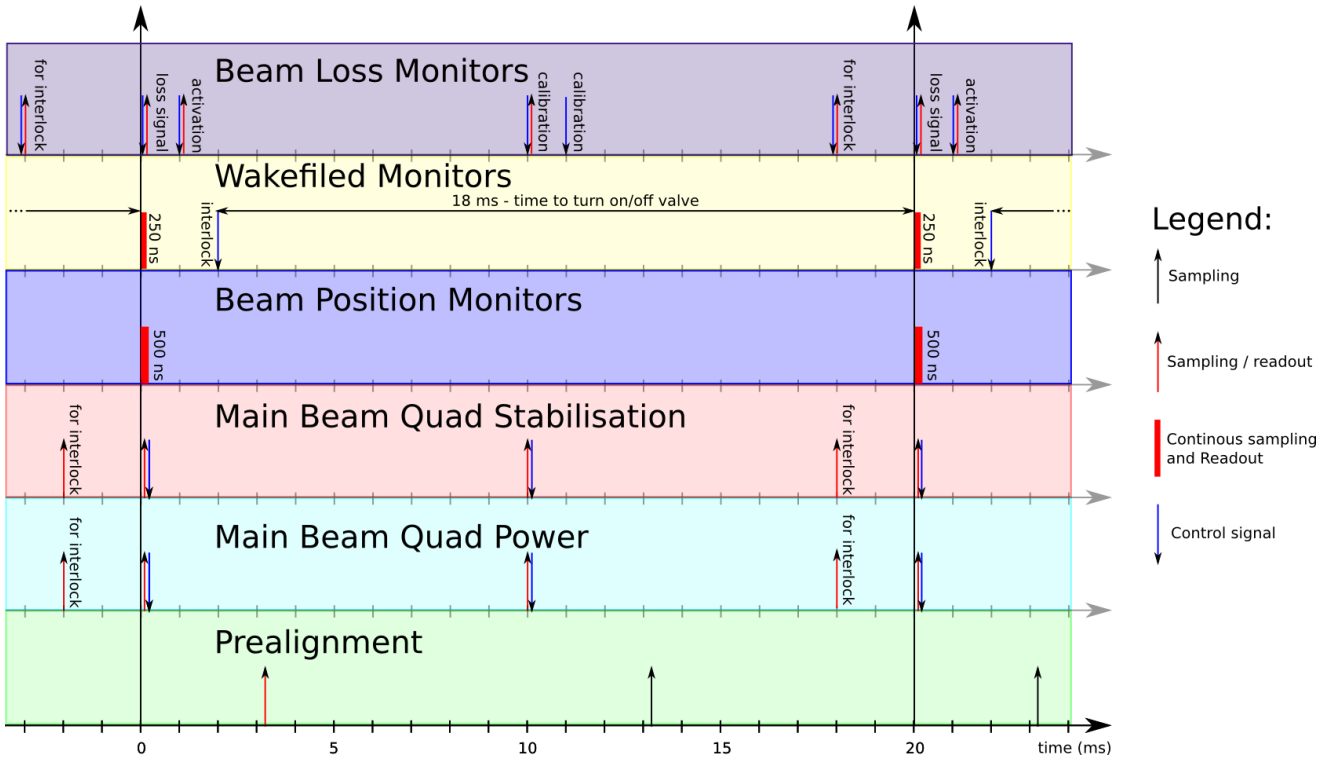
Requested Acquisition and Control Channels

Requested:

Type of channel	# of ch.
Fast ADC (200 MS/s, 14 b)	28
Slow ADC (10 kS/s+, 16 b)	55
Raw DIO	110
Serial IO (RS232/485)	18
Slow DAC (10 kS/s+, 16 b)	24
Total	300+

Additional:

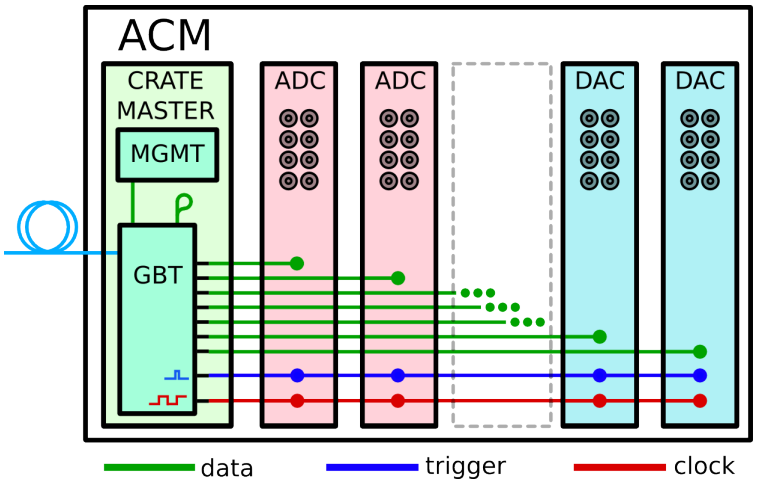
Original signals		300
Spare signals (50%)		150
Critical signals	+	50
Total	=	500



Solution — Data Transfer and Synchronization

GBT

A CERN project aiming at delivering reliable rad-hard devices and protocol for timing and data acquisition.



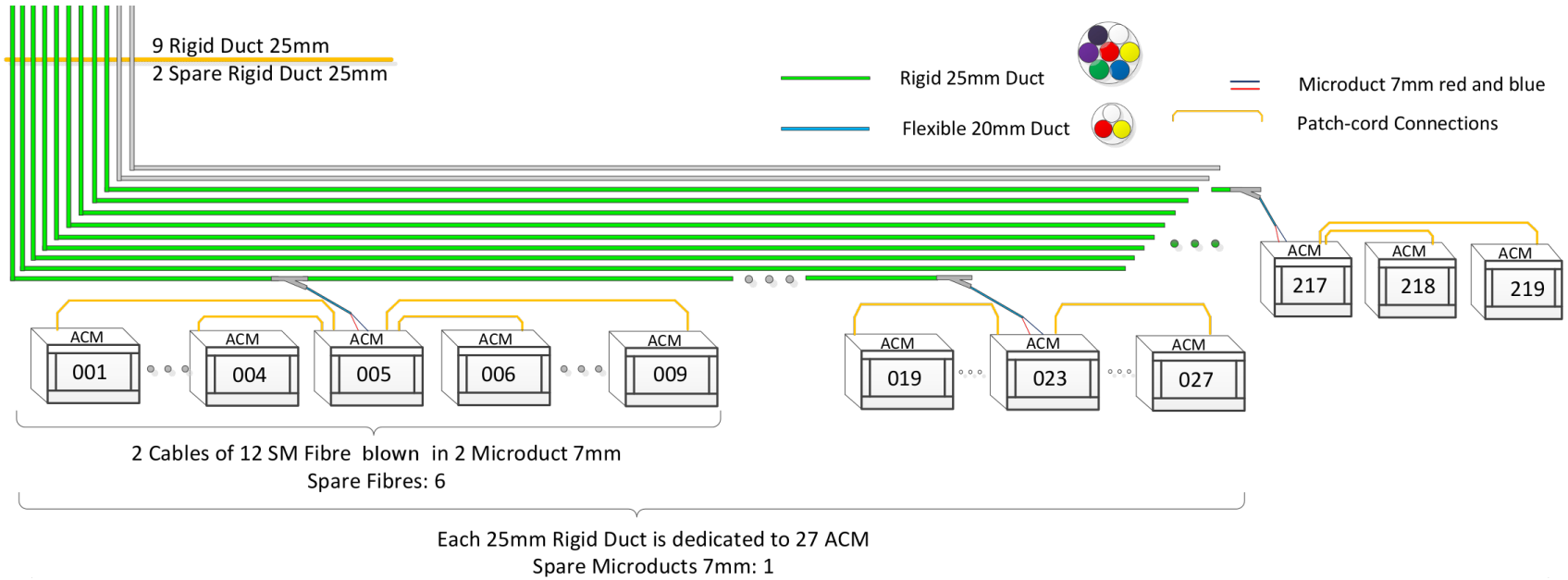
Features:

- 3.2 Gb/s (40 ch, 80 Mb/s each),
- build-in e-link switch,
- radiation resistant (up to 3 kGy),
- clock recovery (40 MHz),
- guaranteed fixed latency,
- low power consumption — 2 W.

Solution — Network Topology

Three network topologies have been taken into account.

Topology	Cost[1]	FECs	Timing	Bandwidth
Star	Medium	N	Easy	B
Ring 8[2]	High	N/8	Medium	B/8
Ring 16[2]	Low	N/16	Hard	B/16



[1] With 8/16 devices in the ring

[2] Cost estimations and image courtesy of Simao Machado, CERN

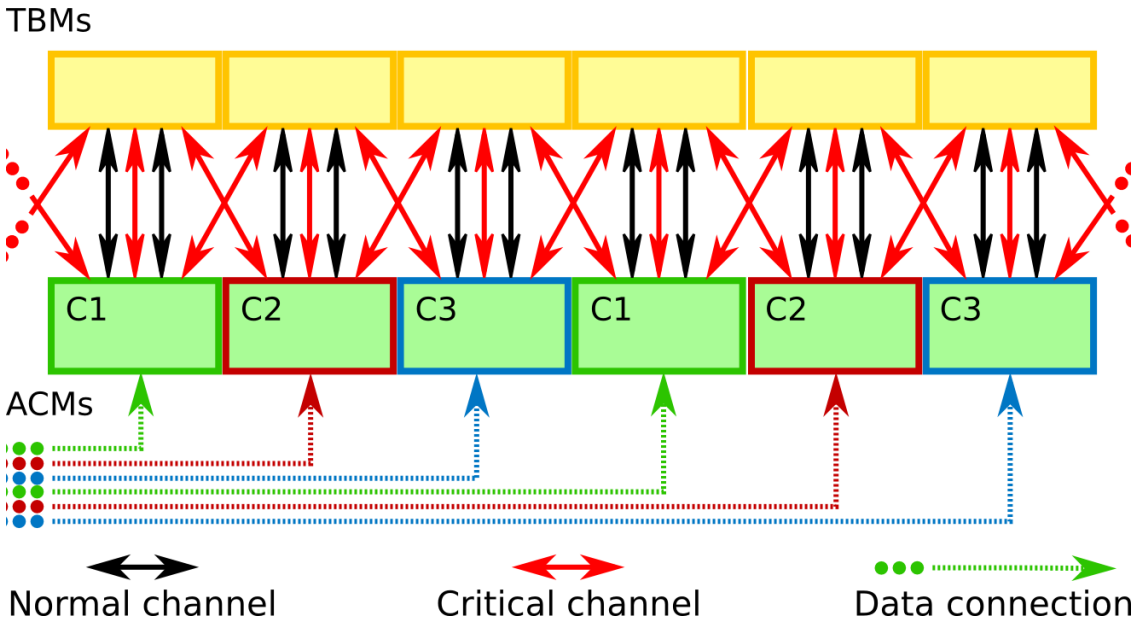
Solution — Reliability and Availability

Critical Signals

Signals which are necessary for Machine Protection and not receiving results from these channels will cause immediate machine stop.

Two ways to increase reliability of acquisition of critical signals:

- acquiring critical signals in adjacent ACMs,
- connecting adjacent ACMs to separate networks.



Summary

Current plans for the CLIC Control System include:

- the ACM capable for acquiring/controlling over 500 channels,
- use of the GBT chip providing timing and communication,
- Double Star network topology with interleaving for increased reliability,

Future plans:

- making more precise simulations of radiation in the tunnel,
- ACM placement selection,
- selection of technology for acquisition cards in the ACM.

Finally:

- Design and development of the ACM and all the boards installed inside.

Questions & Answers

www.cern.ch