



# Beam Interlock System & Safe Machine Parameters Overview



B. Todd / B. Puccio

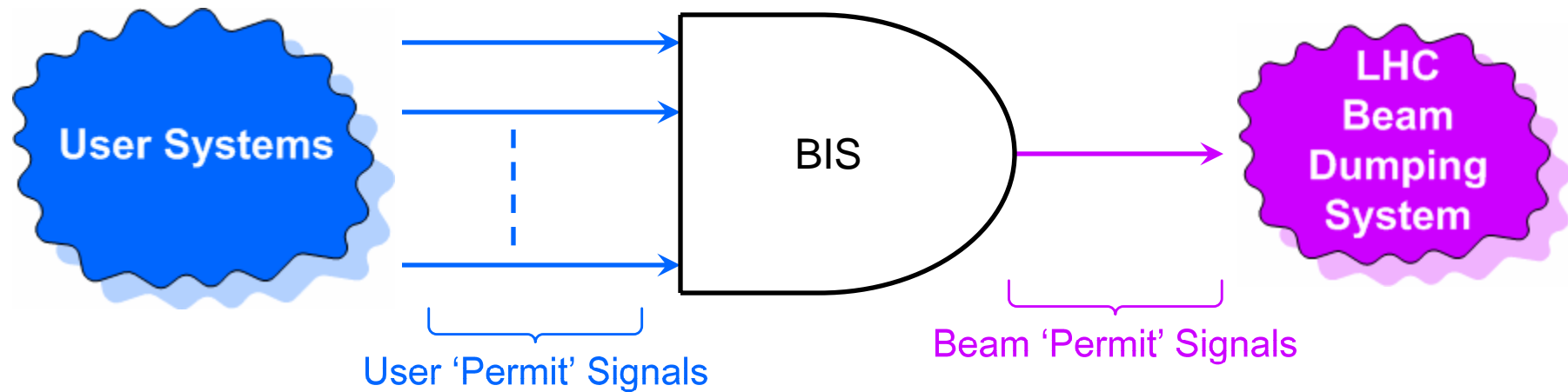
AB/CO/MI

12<sup>th</sup> June 2007

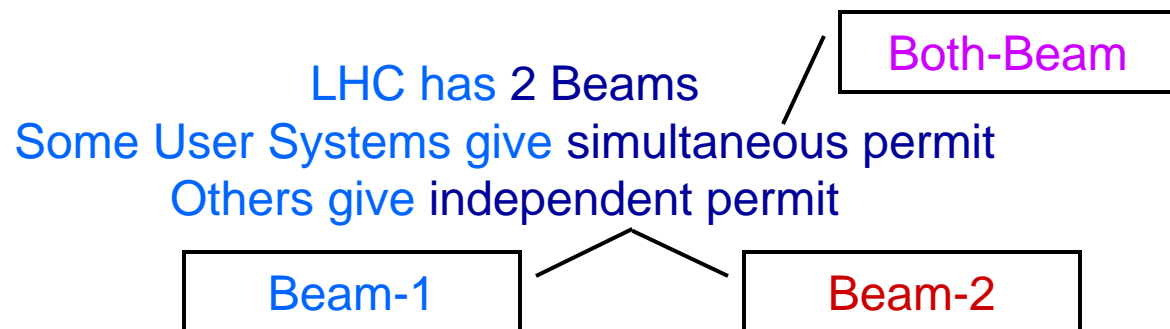




# Basics of the Beam Interlock System

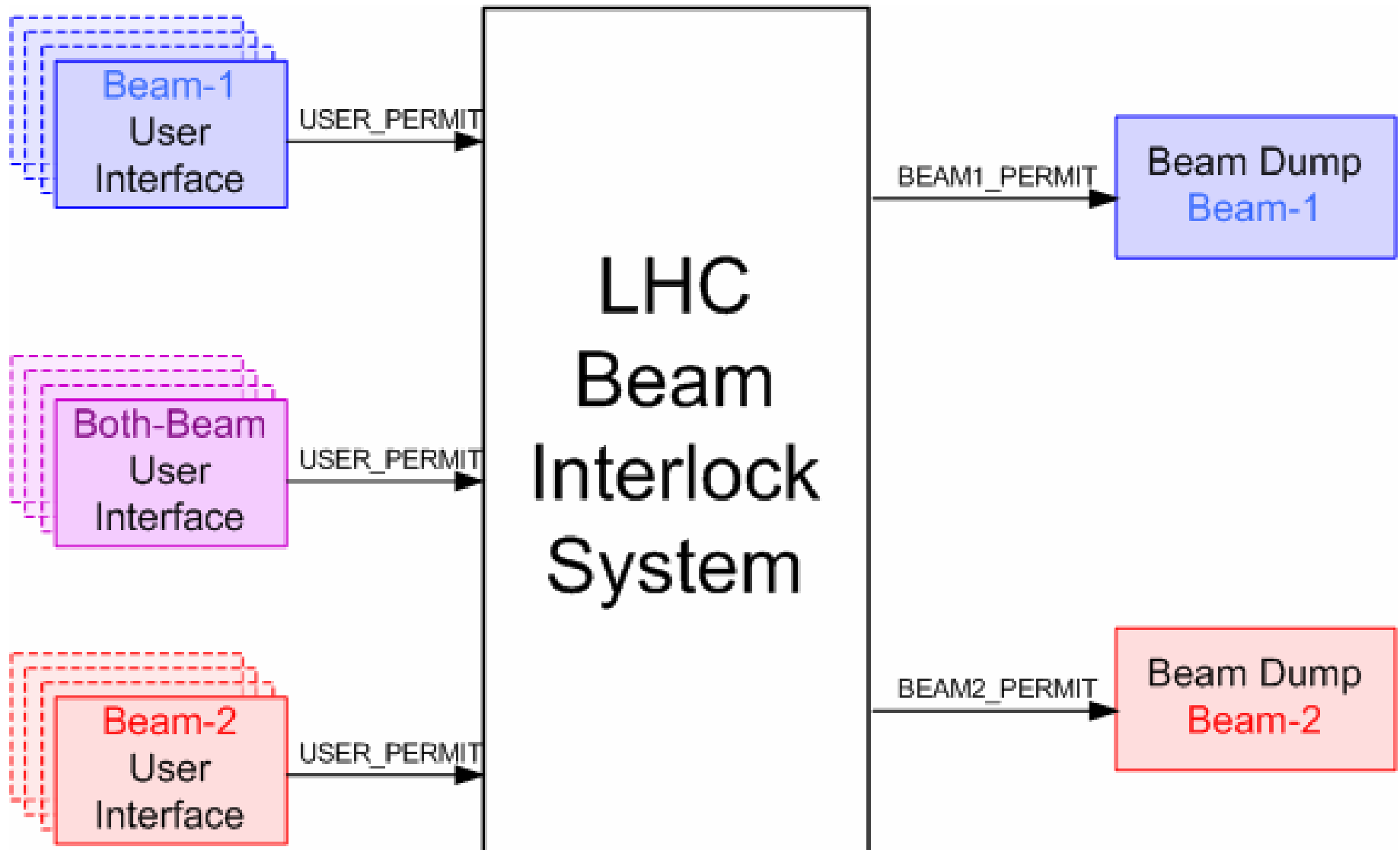


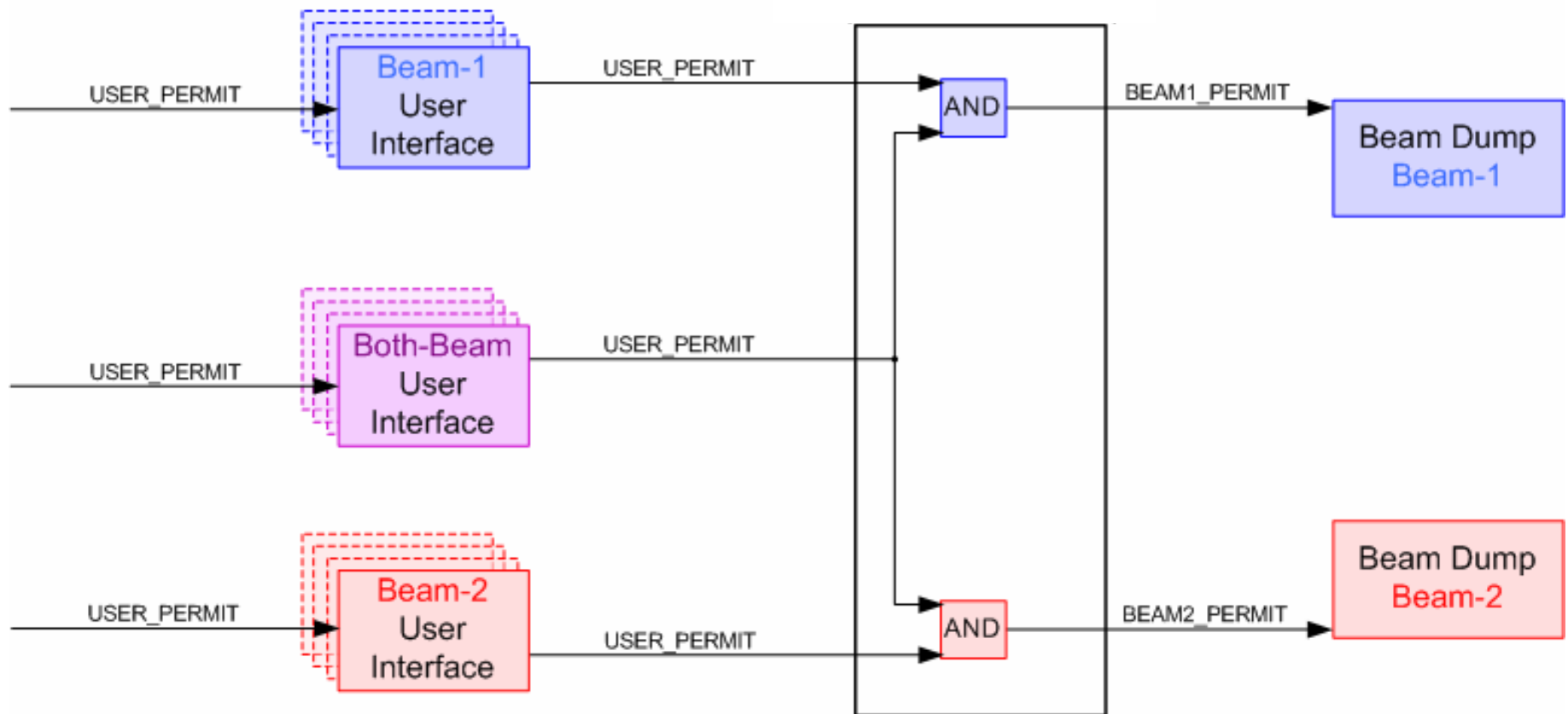
~200 User Systems distributed over 28kms

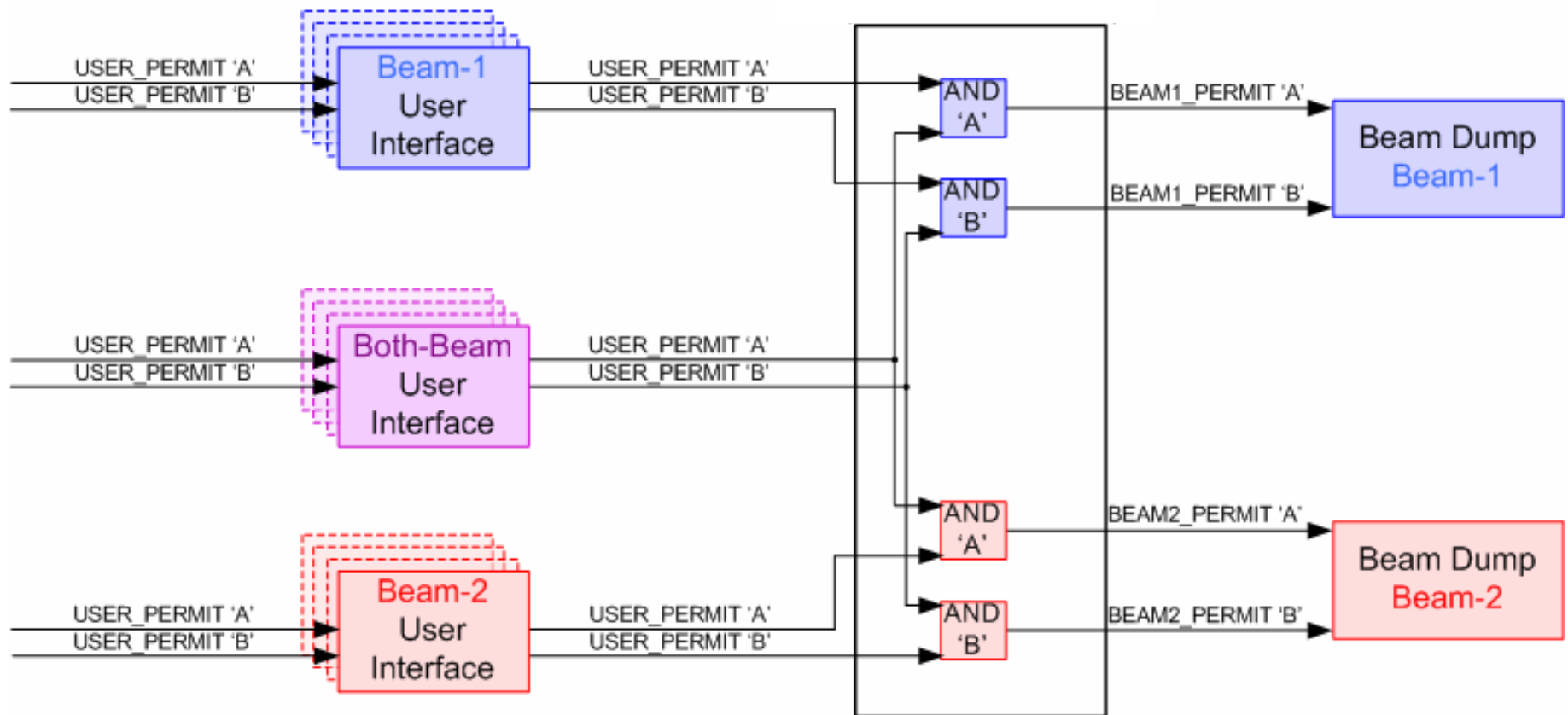


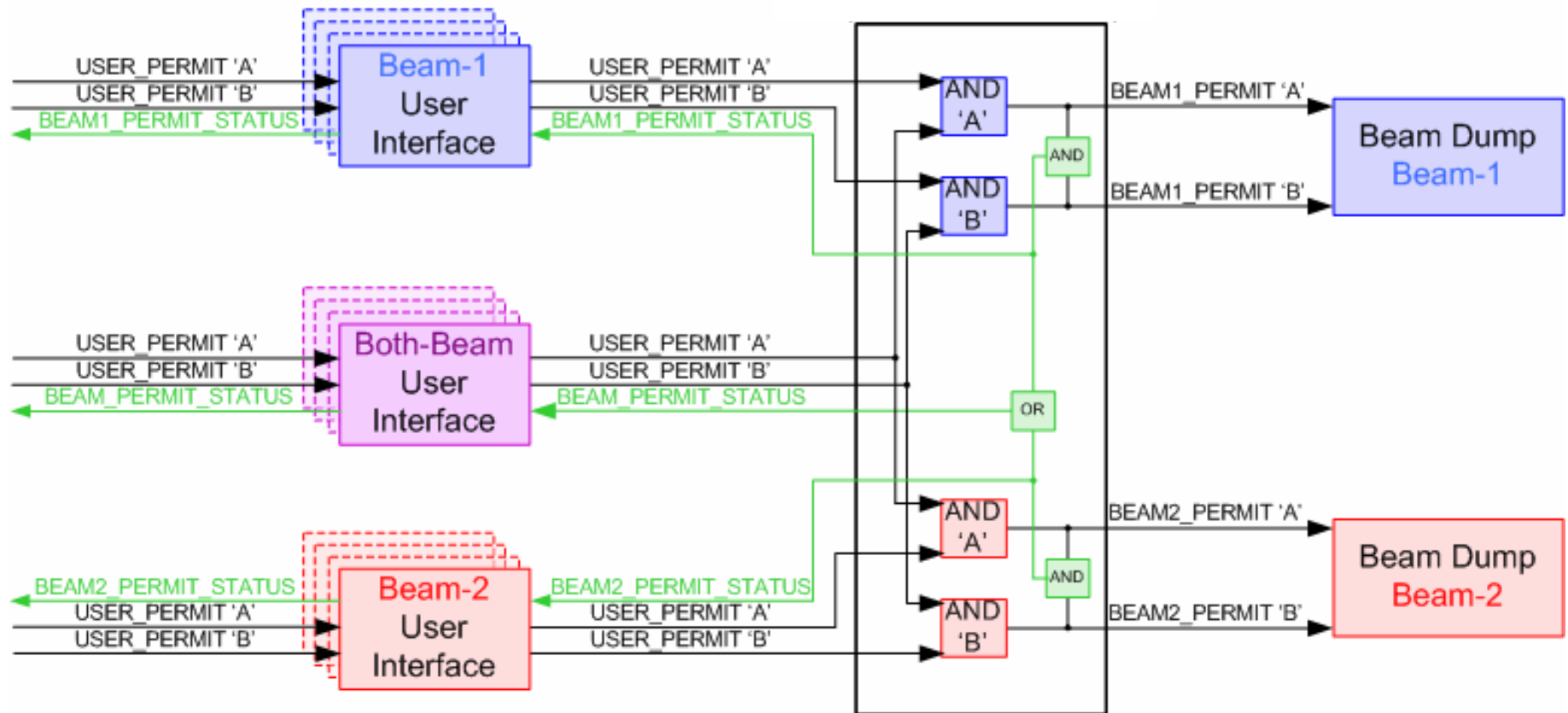
System is HIGH SPEED, HIGHLY DEPENDABLE (SIL 3)

Beam Interlock System forms a transparent layer from User System to Beam Dump







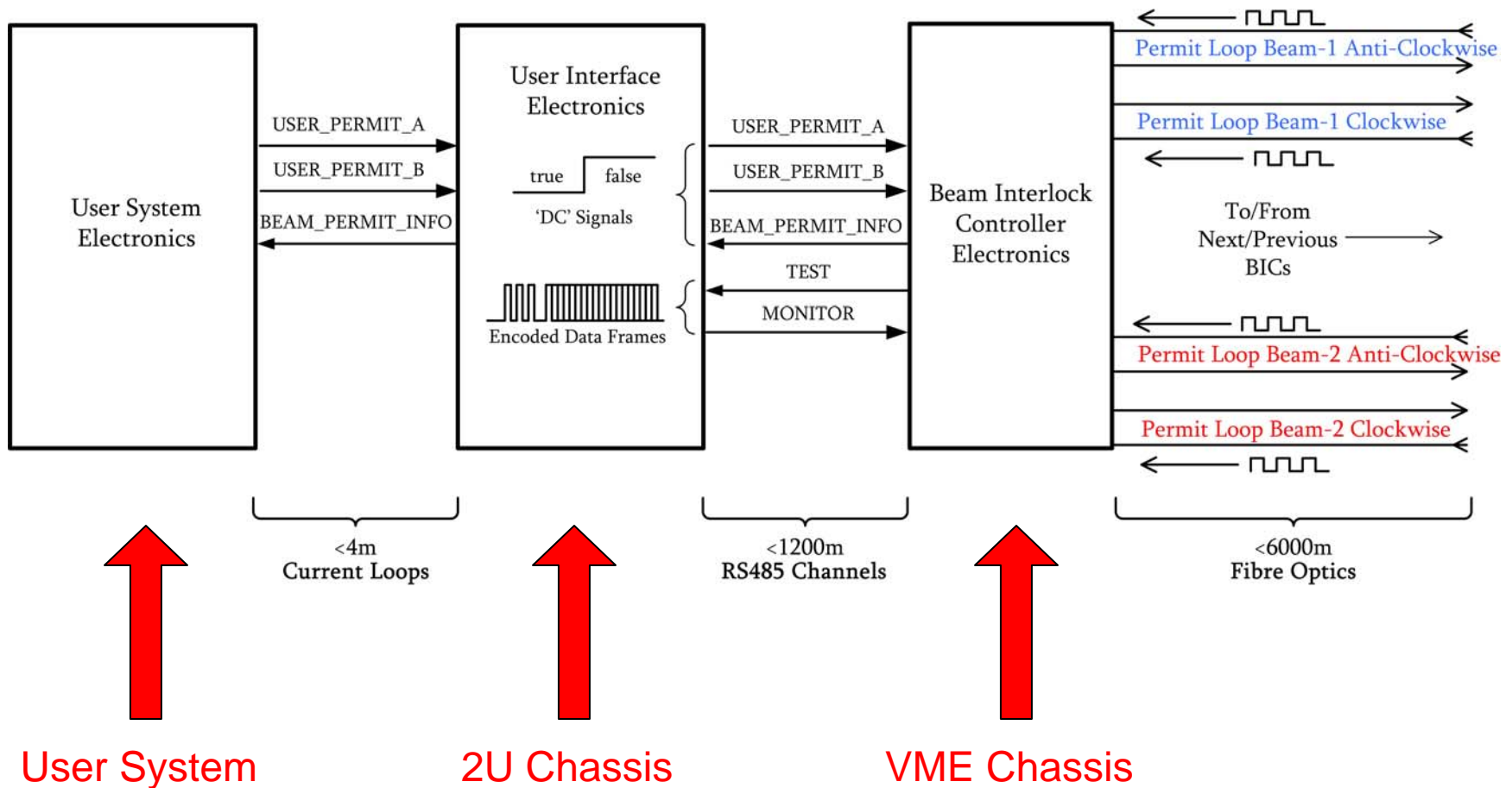


BEAM\_PERMIT\_STATUS is now called BEAM\_PERMIT\_INFO

In USER rack

Cable

In INTERLOCK rack





# Key Features Concerning the USER



1. User Systems can be Maskable or Unmaskable
  - This is hardwired
  - Safe Beam Flag controls the mask at the controller

experiments are unmaskable <= Heavy influence on commissioning!

2. redundant Links are required
  - For every interlock
  - test mode needed which can check this redundancy

<https://edms.cern.ch/file/636589/1.4/CIBU-User-Manual-1v4.pdf>

Describes Interface to CIBU...

- two power supplies, needs two 220V sockets

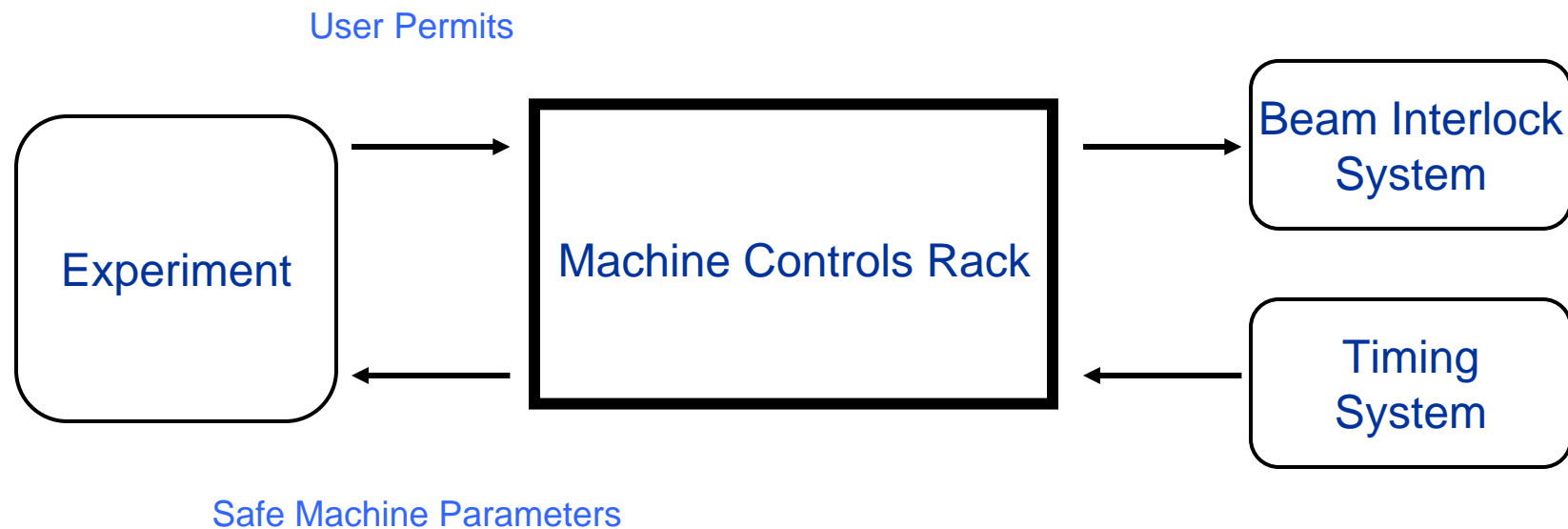




# Experiment Connections



- A Rack has been designated near each experiment to help integration to the Beam Interlock System and Safe Machine Parameters



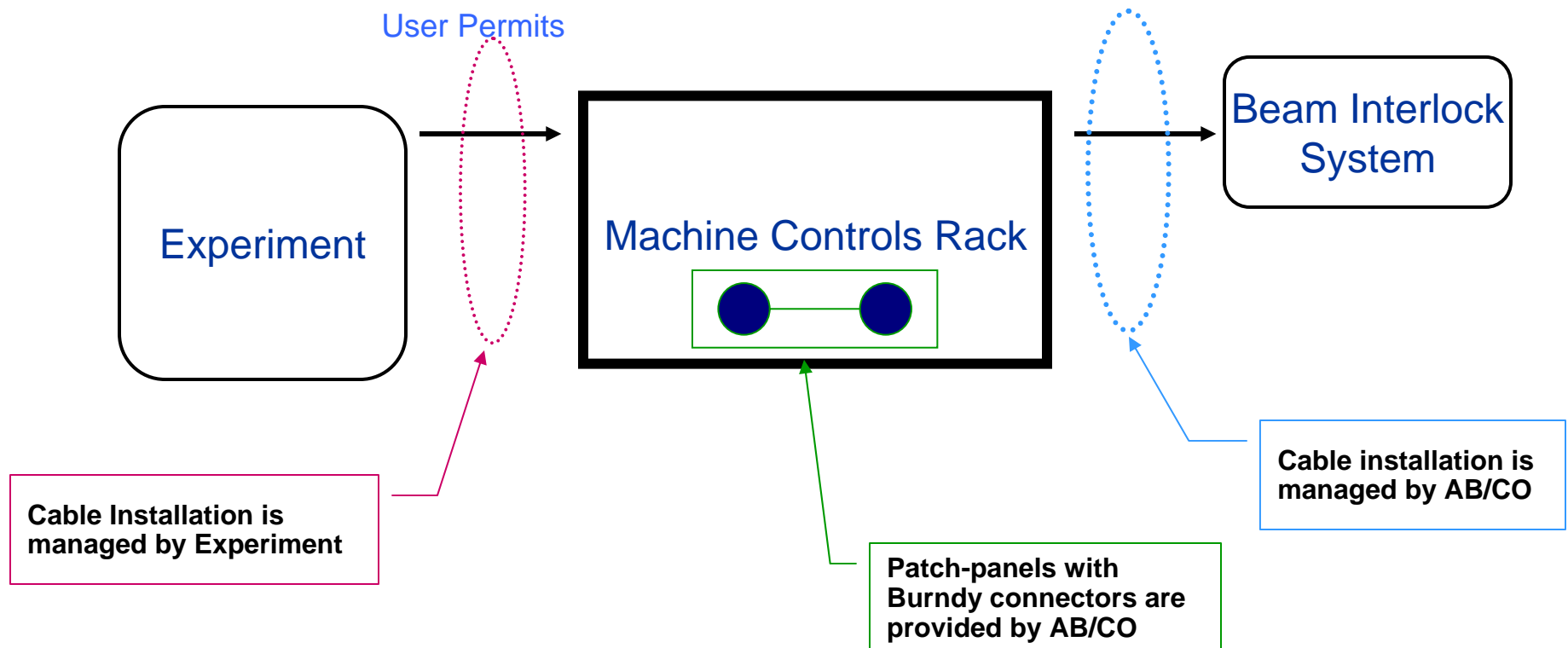
**Rack numbers:**  
**4Y.02-03.A1 : US15**  
**C28 : RB26**  
**S1E08 : USC55**  
**7Y-D3B09 : UX85**



# Experiment Connections



- Rack can contain User Interface (Alice) or Patch Panel (CMS) or both!





## Safe Machine Parameters...



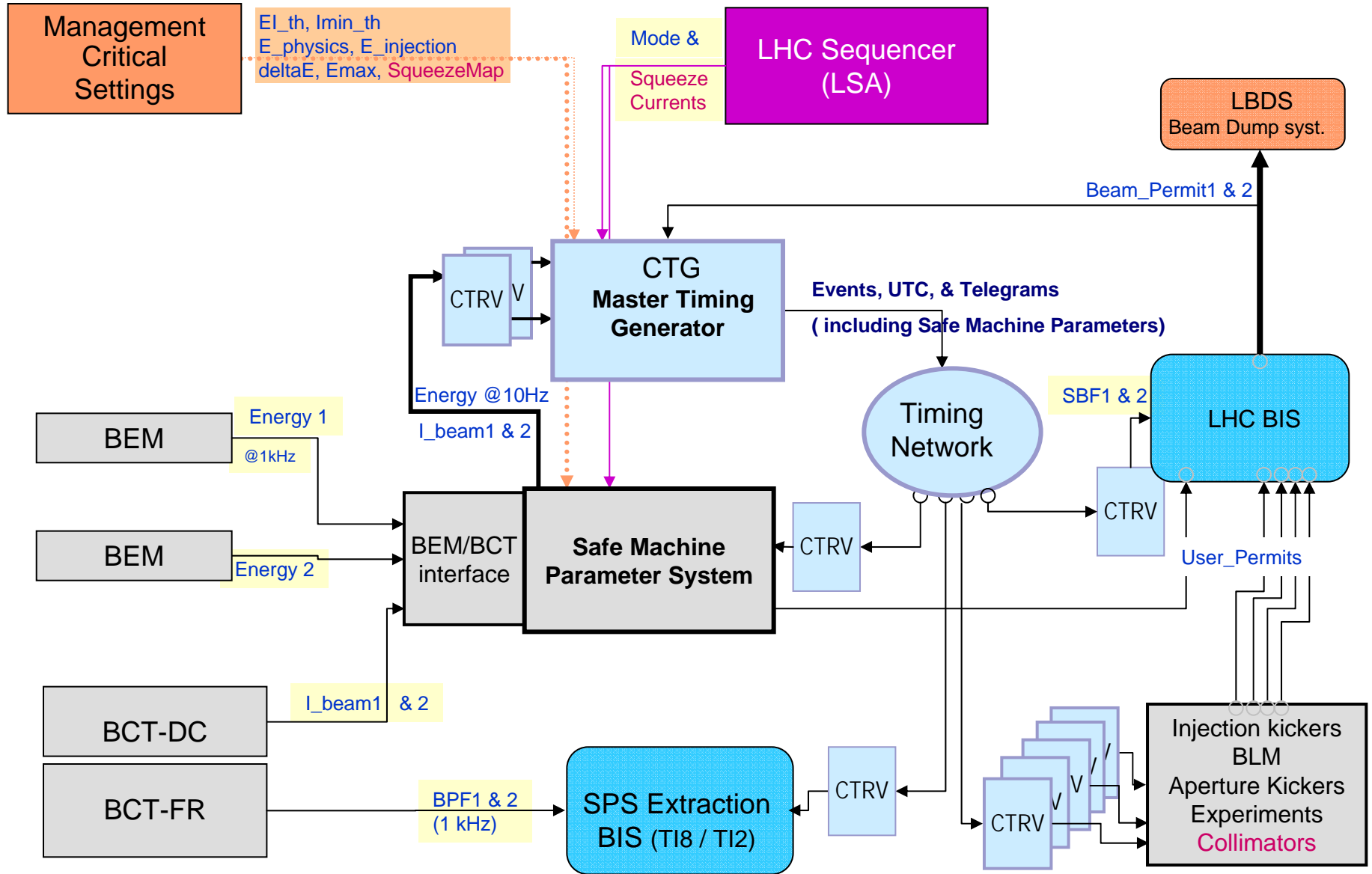
# What are the Parameters



Name	Format	Rate	Derived from (producer name)	Distributed to
LHC ENERGY	2 bytes	10Hz	Current in main dipoles (BEM)	Beam Loss Monitors
				Injection Kickers
SAFE BEAM FLAGS	2 redundant bits (SBF <sub>1</sub> & SBF <sub>2</sub> )	10Hz	LHC Energy (BEM) & Beam Intensity (BCT)	LHC-BIS
				Extraction-BIS
				Aperture Kickers ?
SAFE STABLE BEAM FLAGS	2 bits (STF <sub>1</sub> & STF <sub>2</sub> )	10Hz	Beam Mode (from LHC Sequencer) + Energy= 7TeV	Experiments
"Movable Detector in Allowed" FLAG	1 bit (MDF)	10Hz	LHC Sequencer?	Experiments
BEAM PRESENCE FLAGS	2 redundant bits (BPF <sub>1</sub> & BPF <sub>2</sub> )	1kHz	Beam Intensity (BCT)	Extraction-BIS



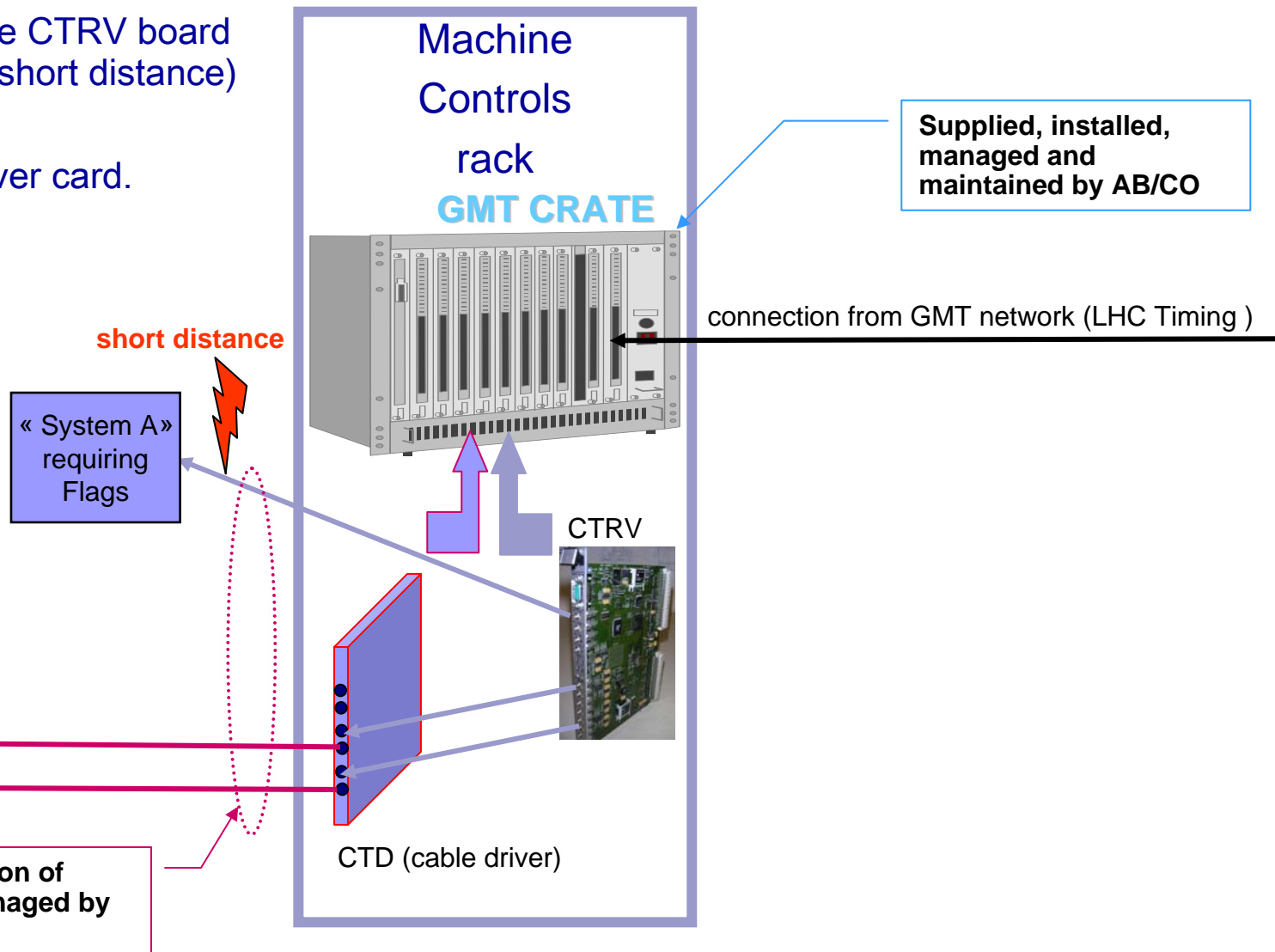
# Distribution



The “Machine Controls” rack hosts the GMT system for delivering the Flags:

Directly from the CTRV board (TTL signal => short distance)  
or  
via a Cable Driver card.

Supplied, installed, managed and maintained by AB/CO





# Issue concerning the GMT system installation



The GMT system can either be VME or PC based depending on the number of triggers, fanout and space available in the dedicated rack.

Nobody (except LHCb) has replied to our request (meeting of May 14<sup>th</sup>)!

- We must know soon for the points 1,2 and 5:
  - How many systems are going to use the Flags?
  - How far are they from the rack?
  - (Except CO systems) which system is going to be also present in the rack?  
Consequently what is the space available in the rack?

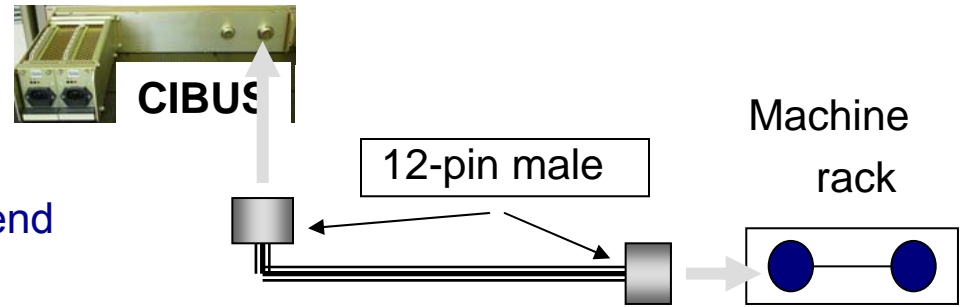


Fin...



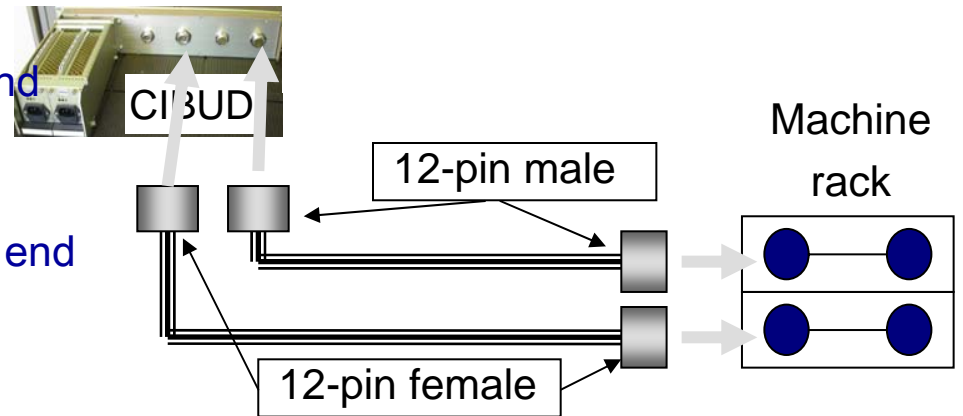
- In all cases: cable type is NE12

- for Both-beam connection:  
a 12-pin male Burndy is required at each end



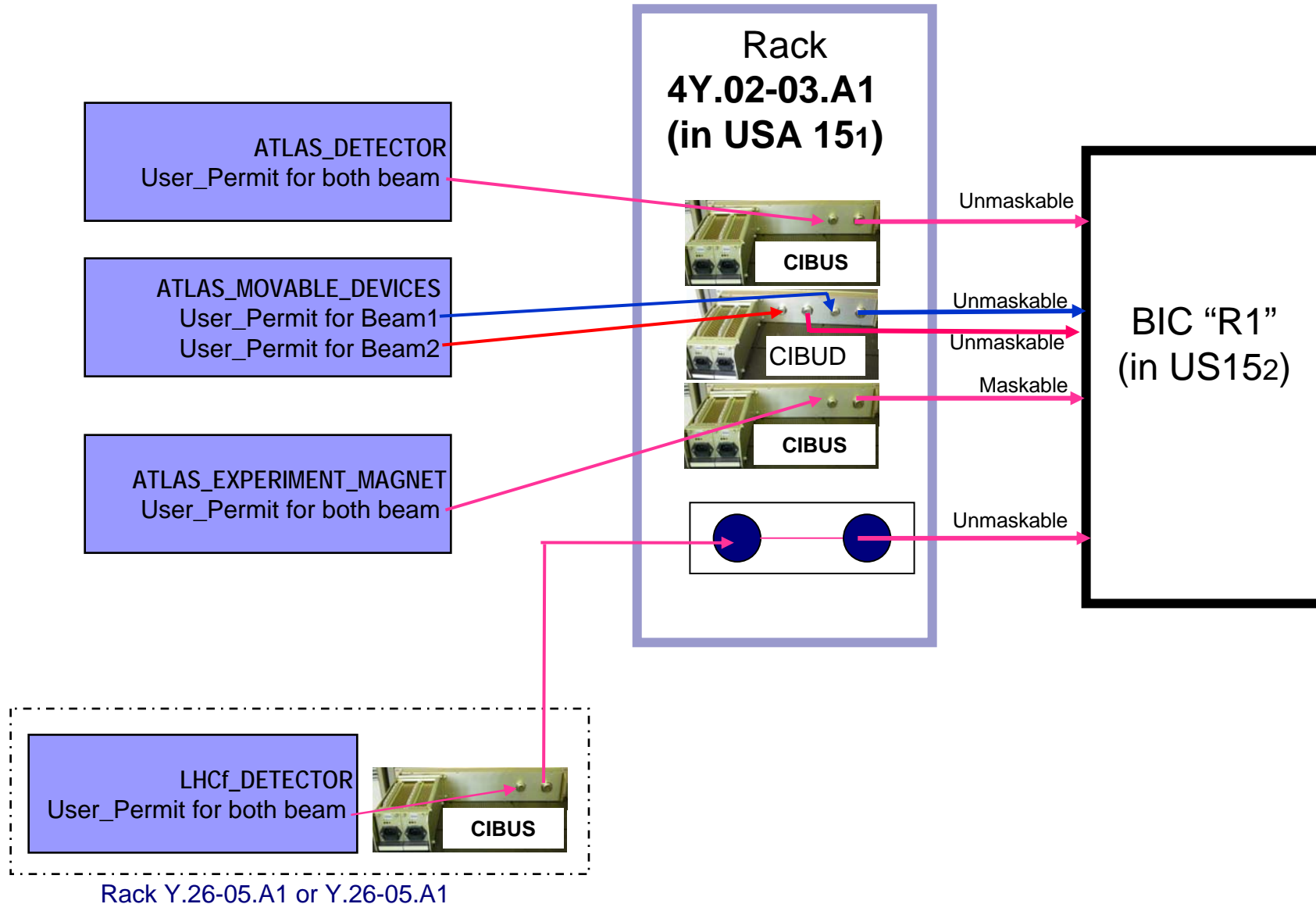
## FIN

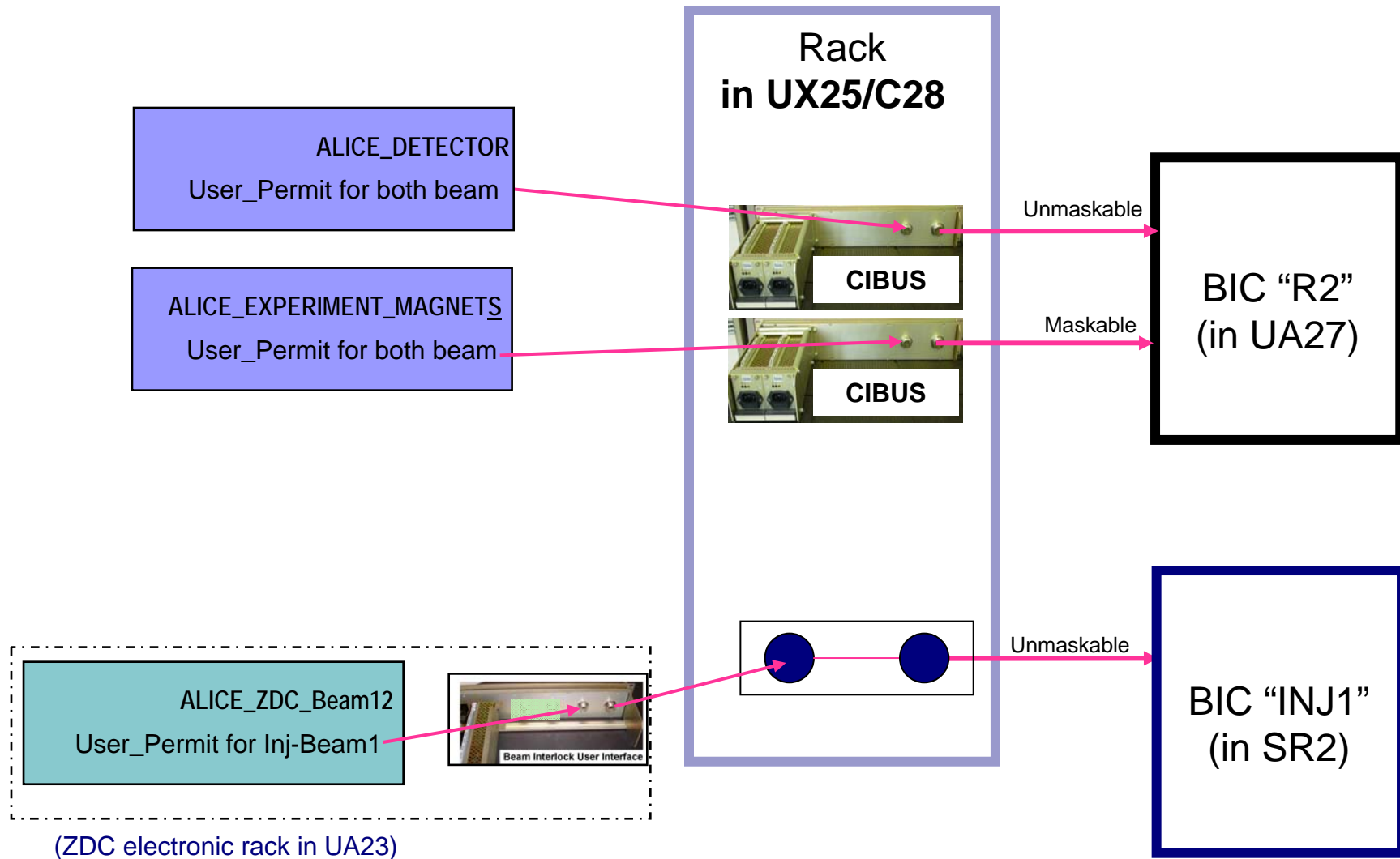
- for the Beam-1 connection:  
a 12-pin male Burndy is required at each end
- for the Beam-2 connection:  
a 12-pin female Burndy is required at each end

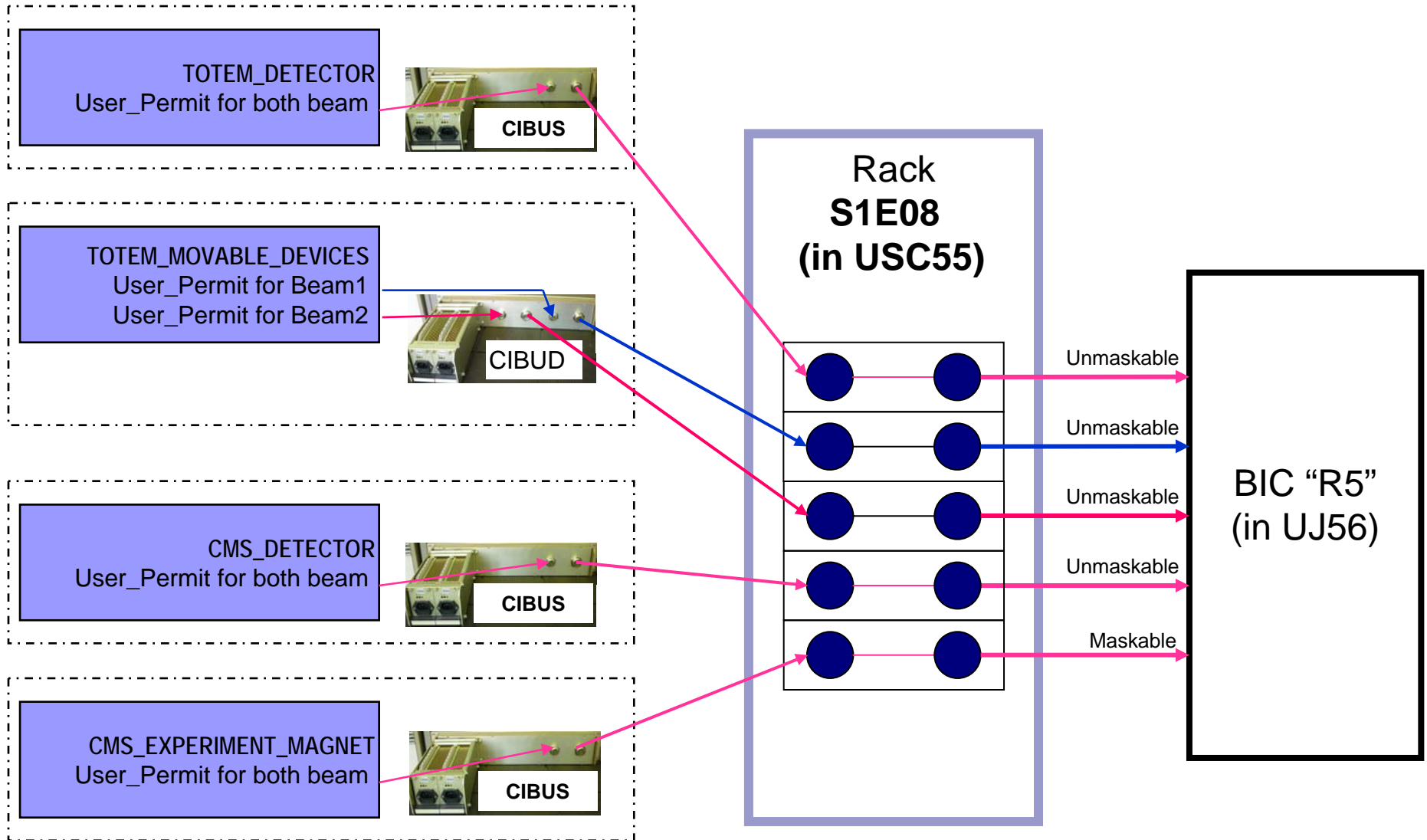


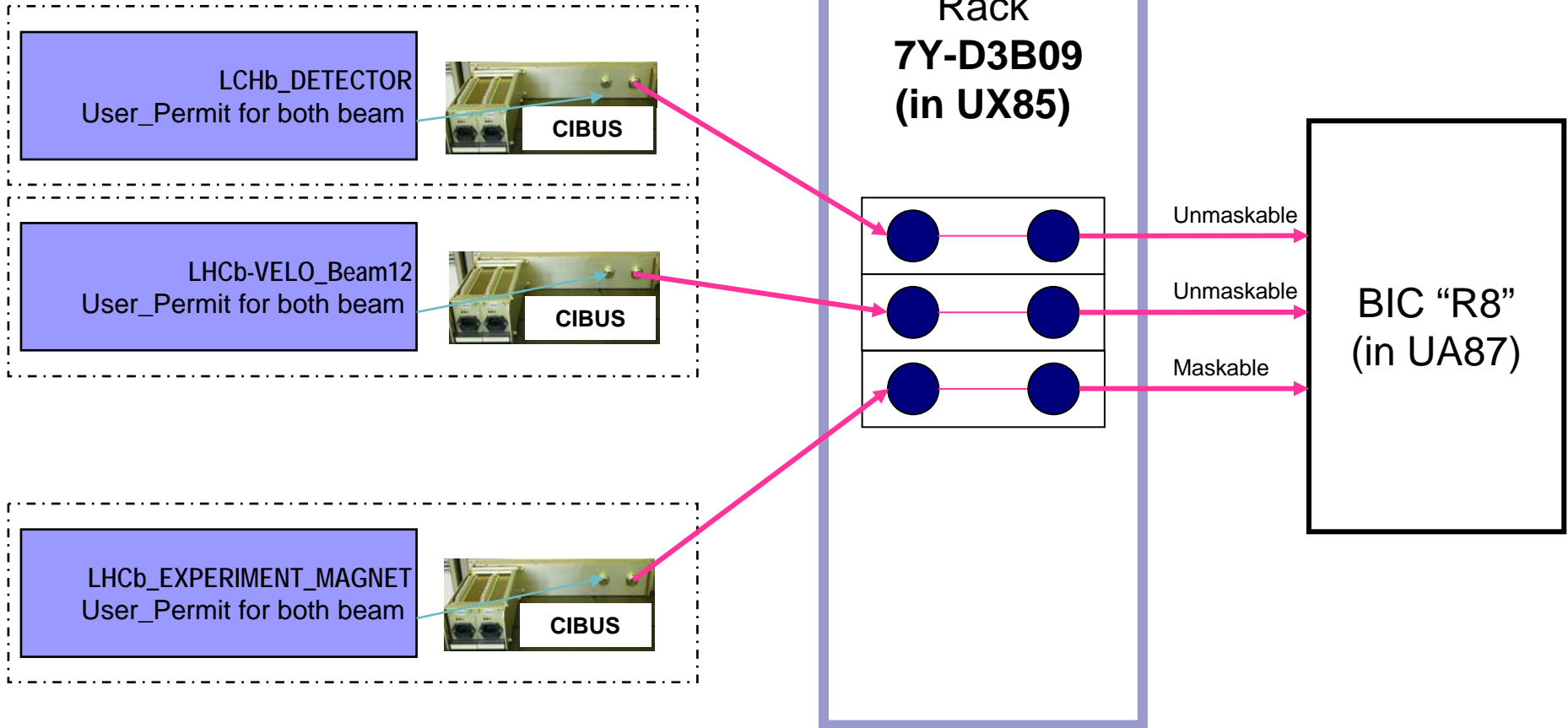
- For EMC Compatibility and Signal Integrity:  
a cabling convention MUST be followed => see dedicated document on the cable assembly procedure:

<https://edms.cern.ch/document/766261/1.0>





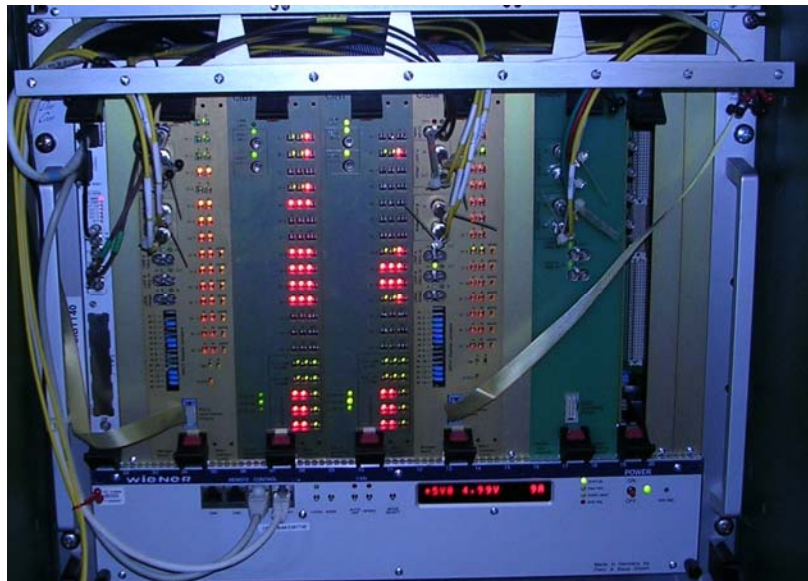




User Interface

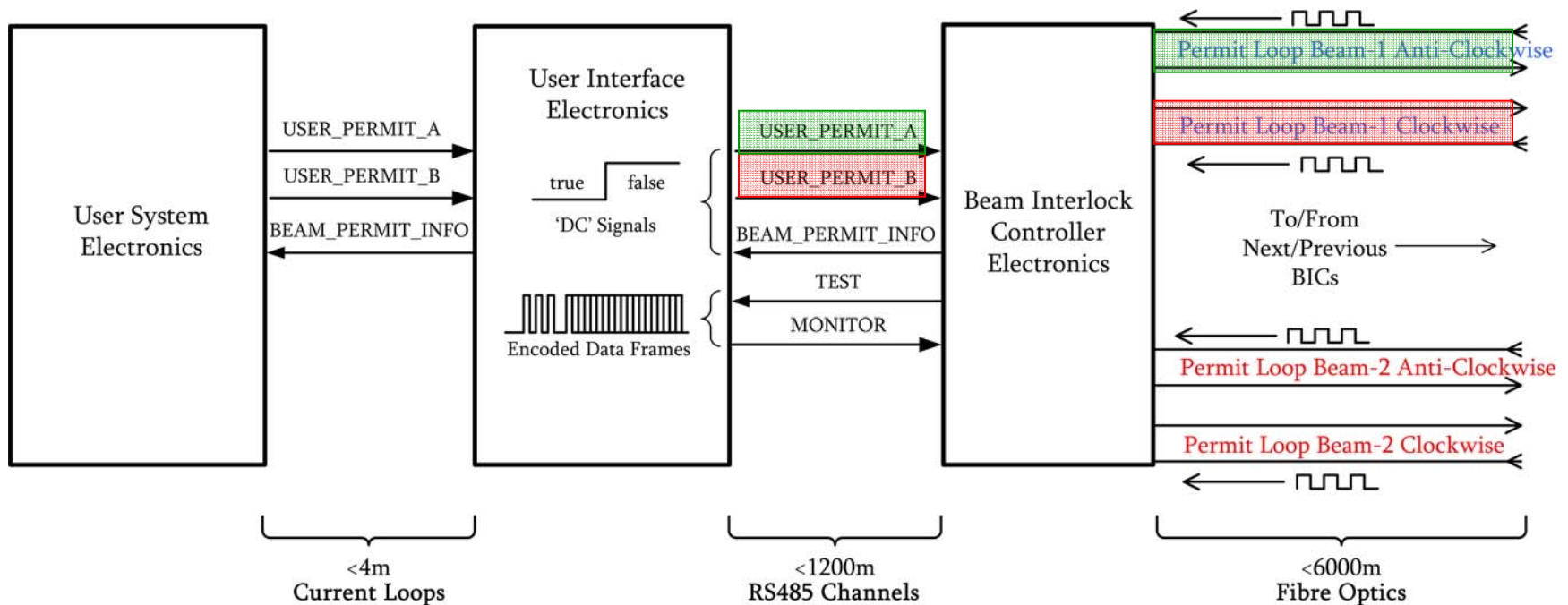


BIC (Front) TT40



BIC (Rear) TT40

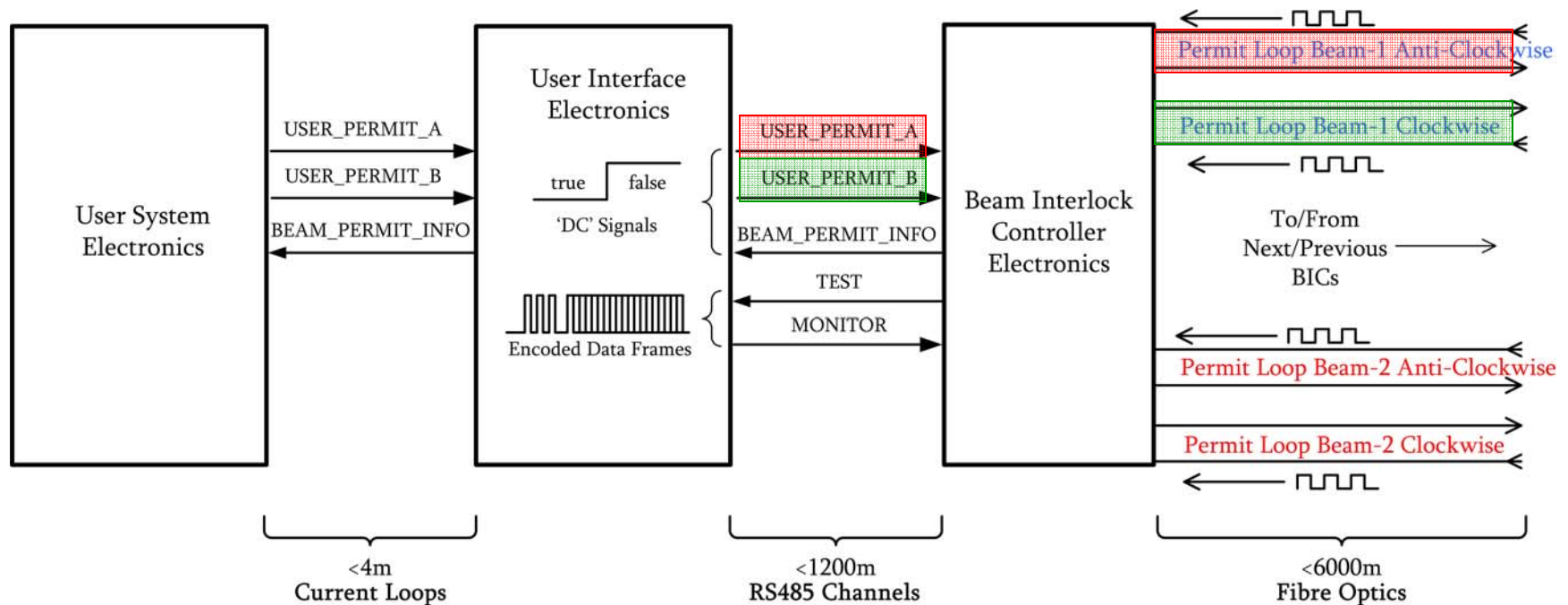




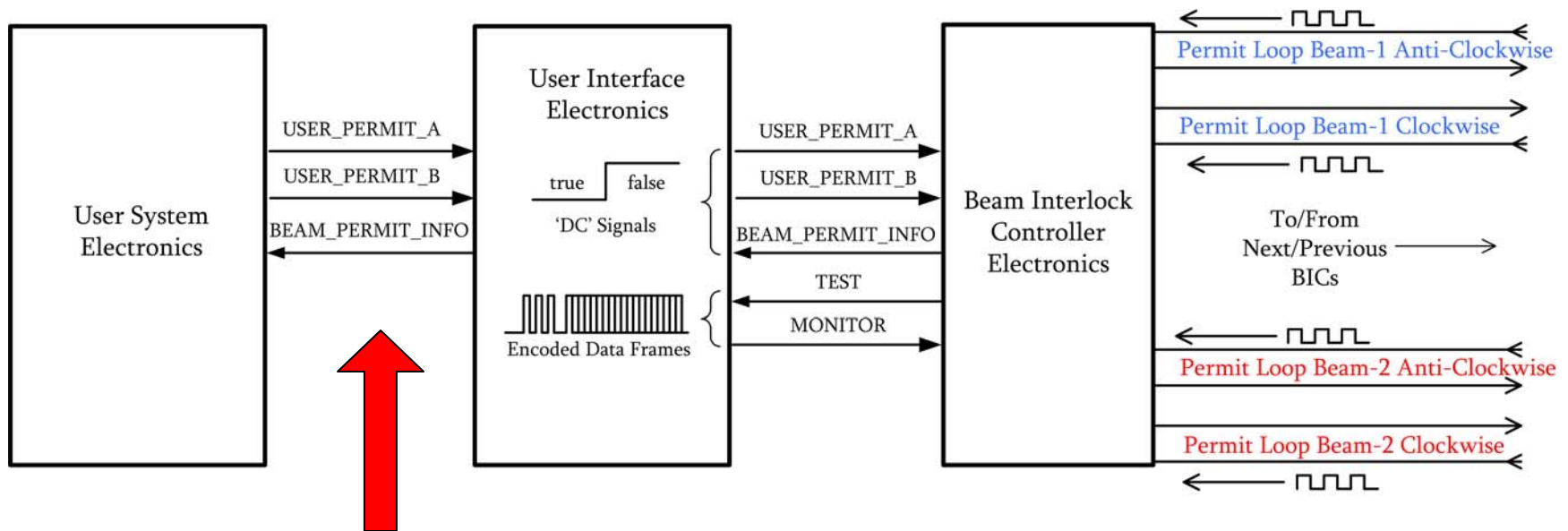




# Testing with 'A' and 'B'







User System to User Interface  
TEST in the same way



# Beam Permit Loops & BICs



4 fibre-optic channels from Point 6  
 1 clockwise &  
 1 anticlockwise for **each** Beam

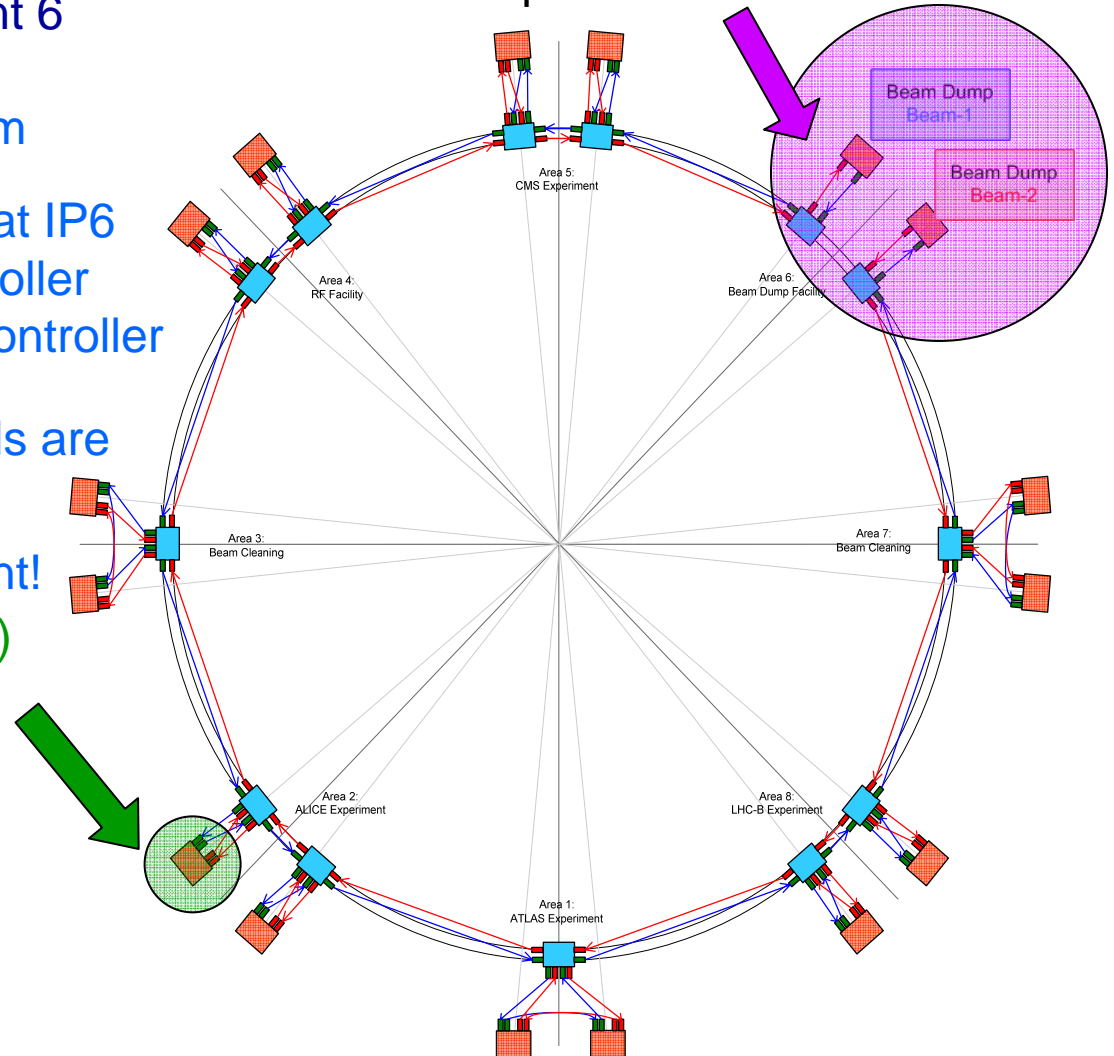
10MHz Square wave generated at IP6  
 -Signal can be cut by any Controller  
 -Signal can be monitored by any Controller

When any of the four 10MHz signals are  
 absent at IP6, BEAM DUMP!

Beam-1 / Beam-2 are Independent!  
 Beam Interlock Controllers (BIC)

16 BICs per beam  
 - Two at each Insertion Point  
 Up to 20 User Systems per BIC  
 6 x Beam-1  
 8 x Both-Beam  
 6 x Beam-2

## Beam Dump Beam-1 and Beam-2

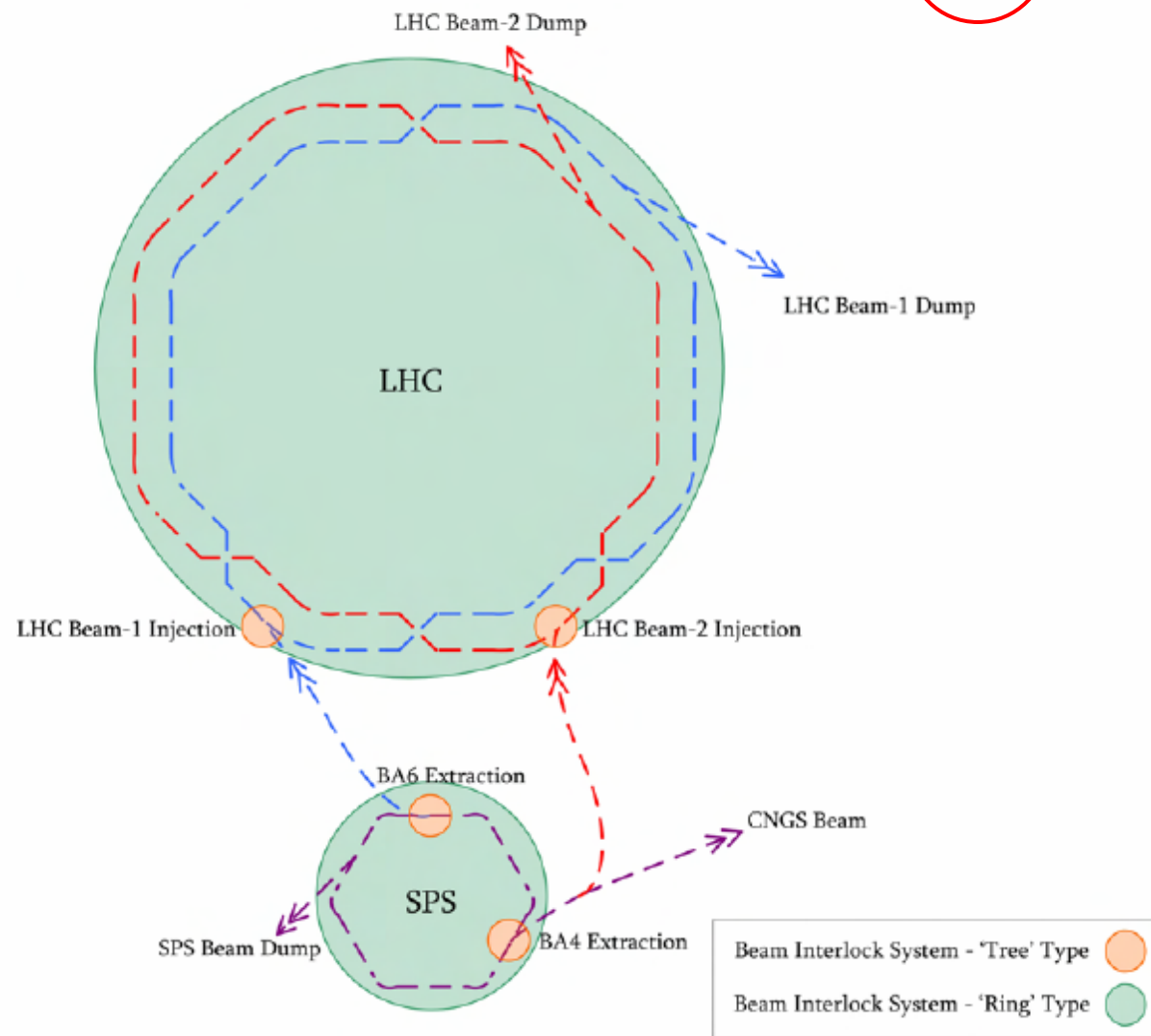




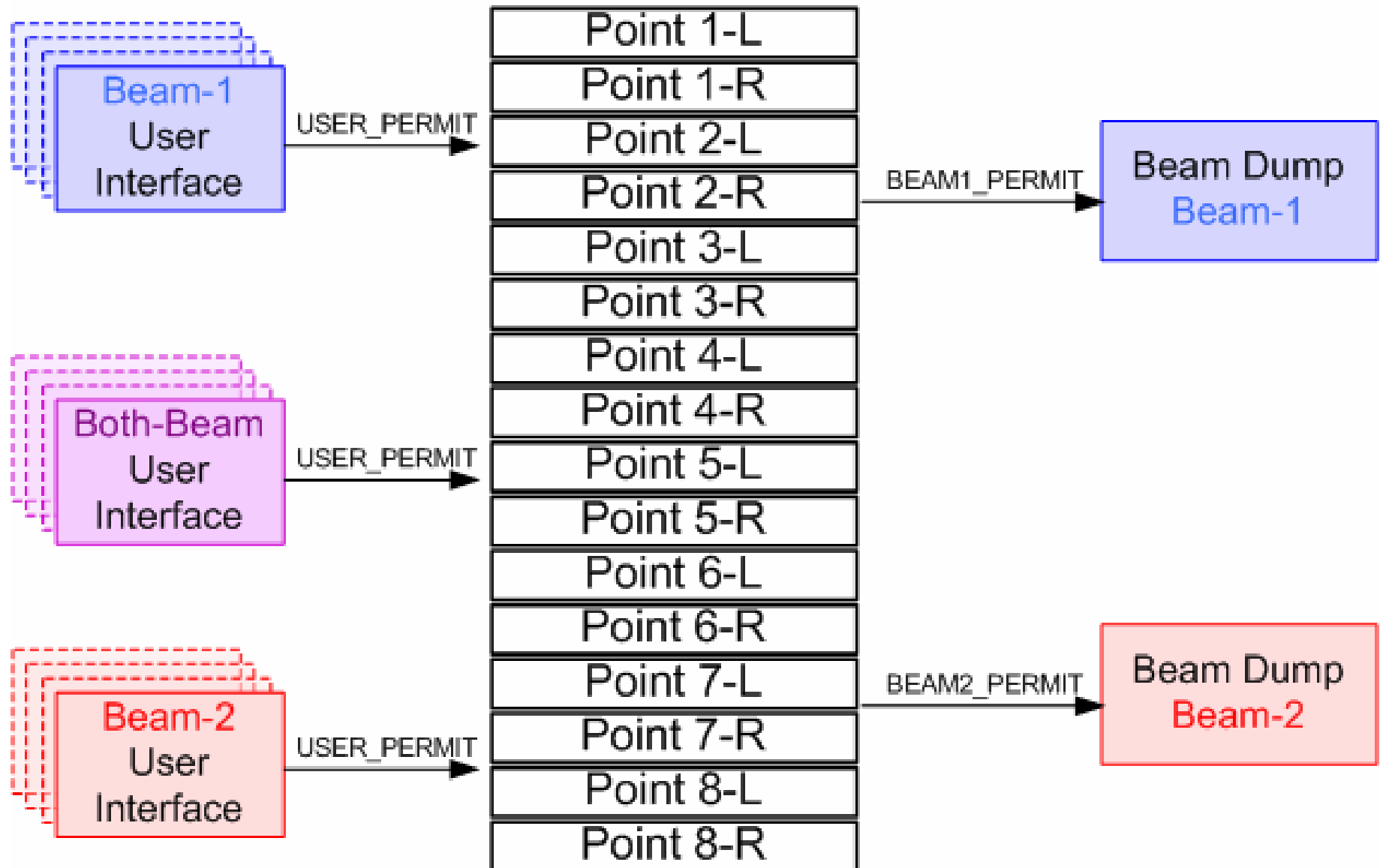
# Beam Interlock System Locations



Designed to protect CERN high energy accelerators = SPS / LHC / INJ / EXT



In LHC, BIS forms a transparent layer from User System to Beam Dump



In LHC, BIS forms a transparent layer from User System to Beam Dump

