

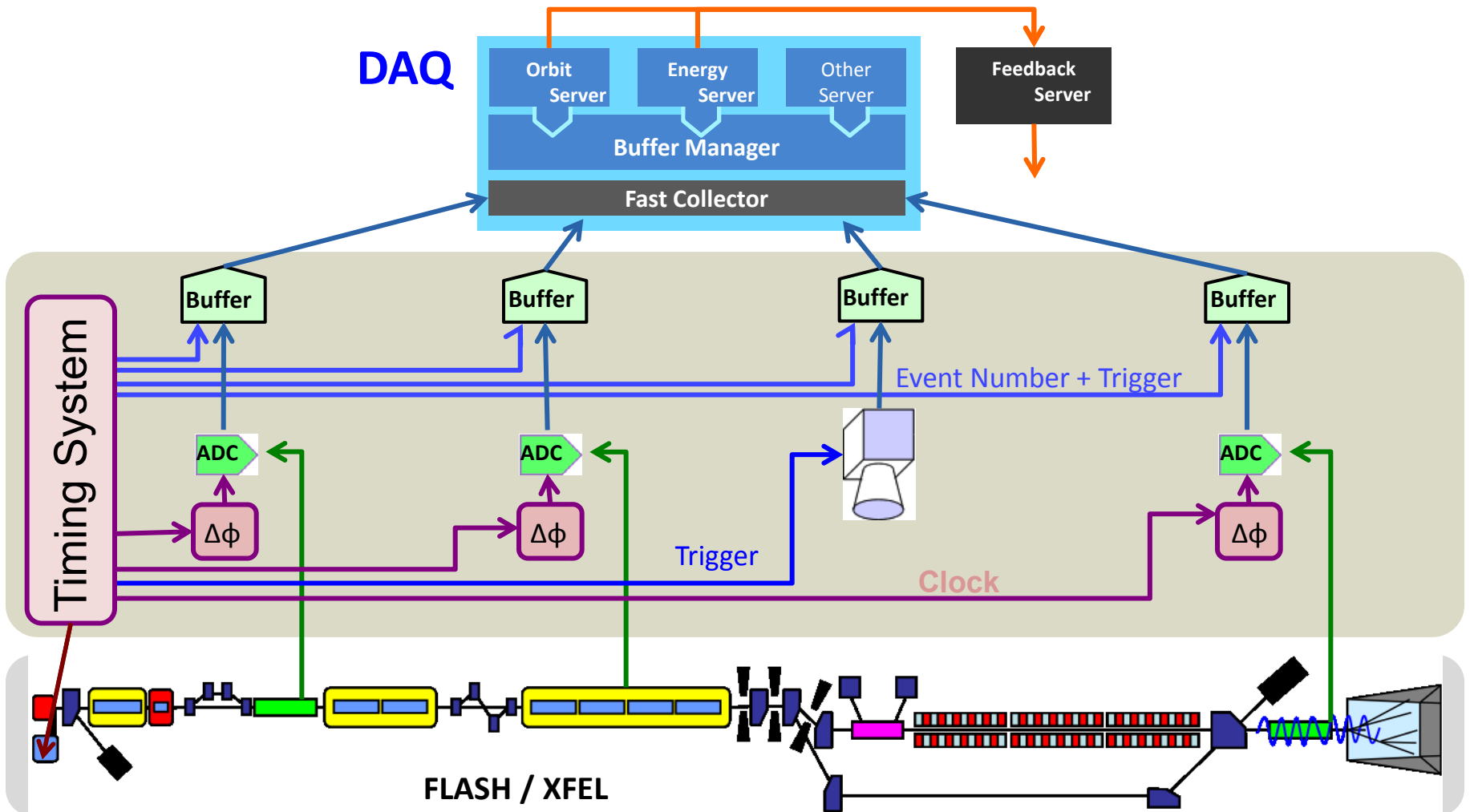
The New XFEL and FLASH Timing System

Clock and Triggers
Bunch Synchronized Readout
Hardware
Software

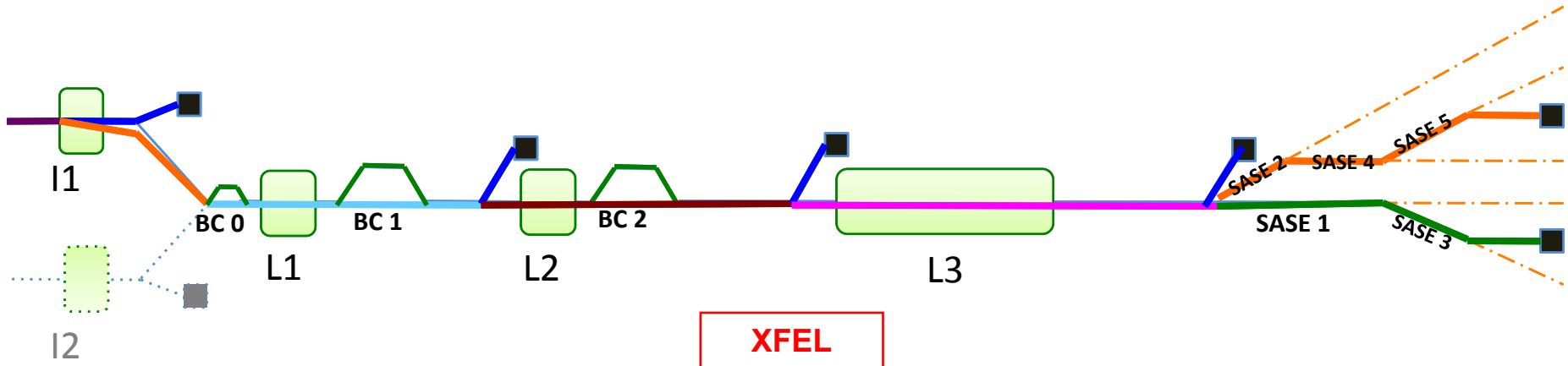
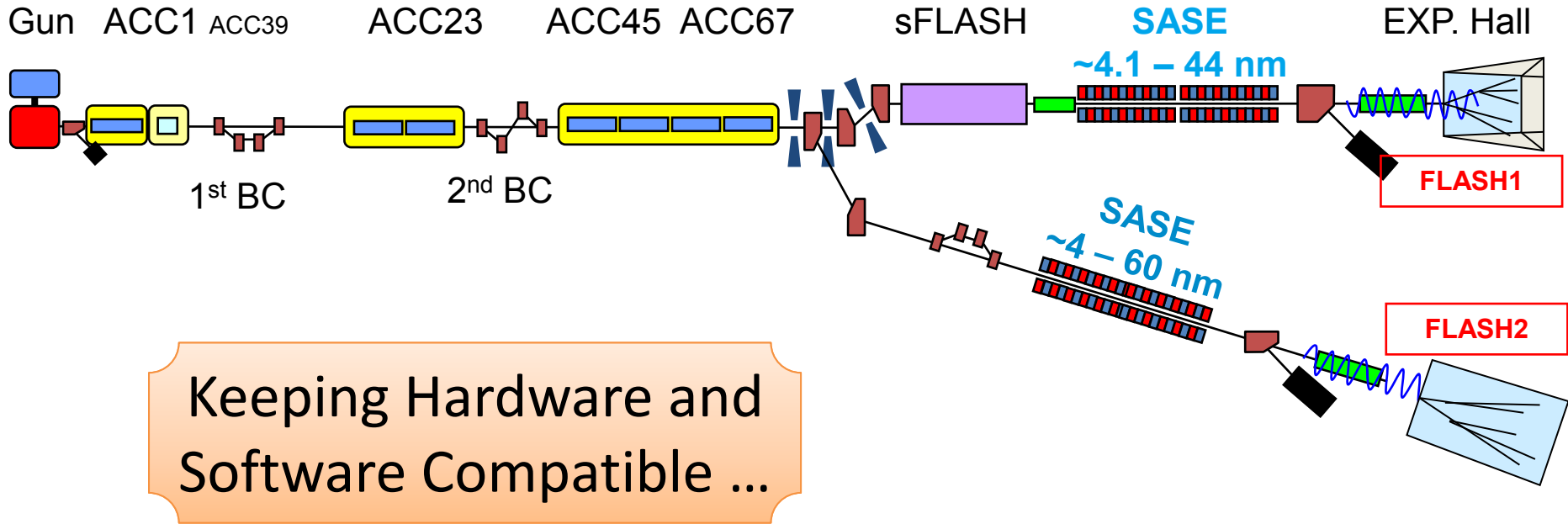
Kay Rehlich
19. March 2013

Timing and Data Acquisition Concept

Console Applications: access to all components

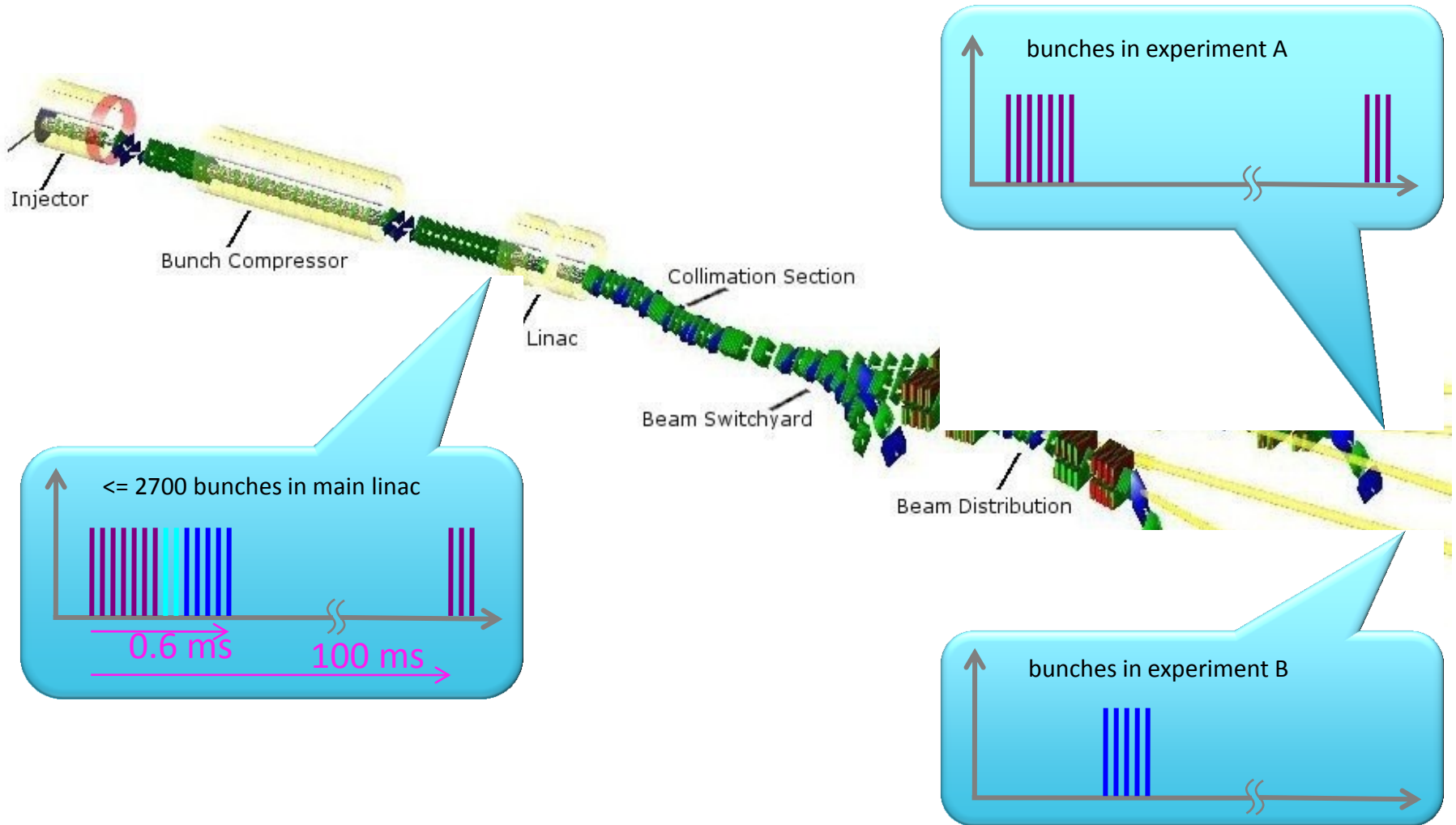


FLASH2 -- XFEL

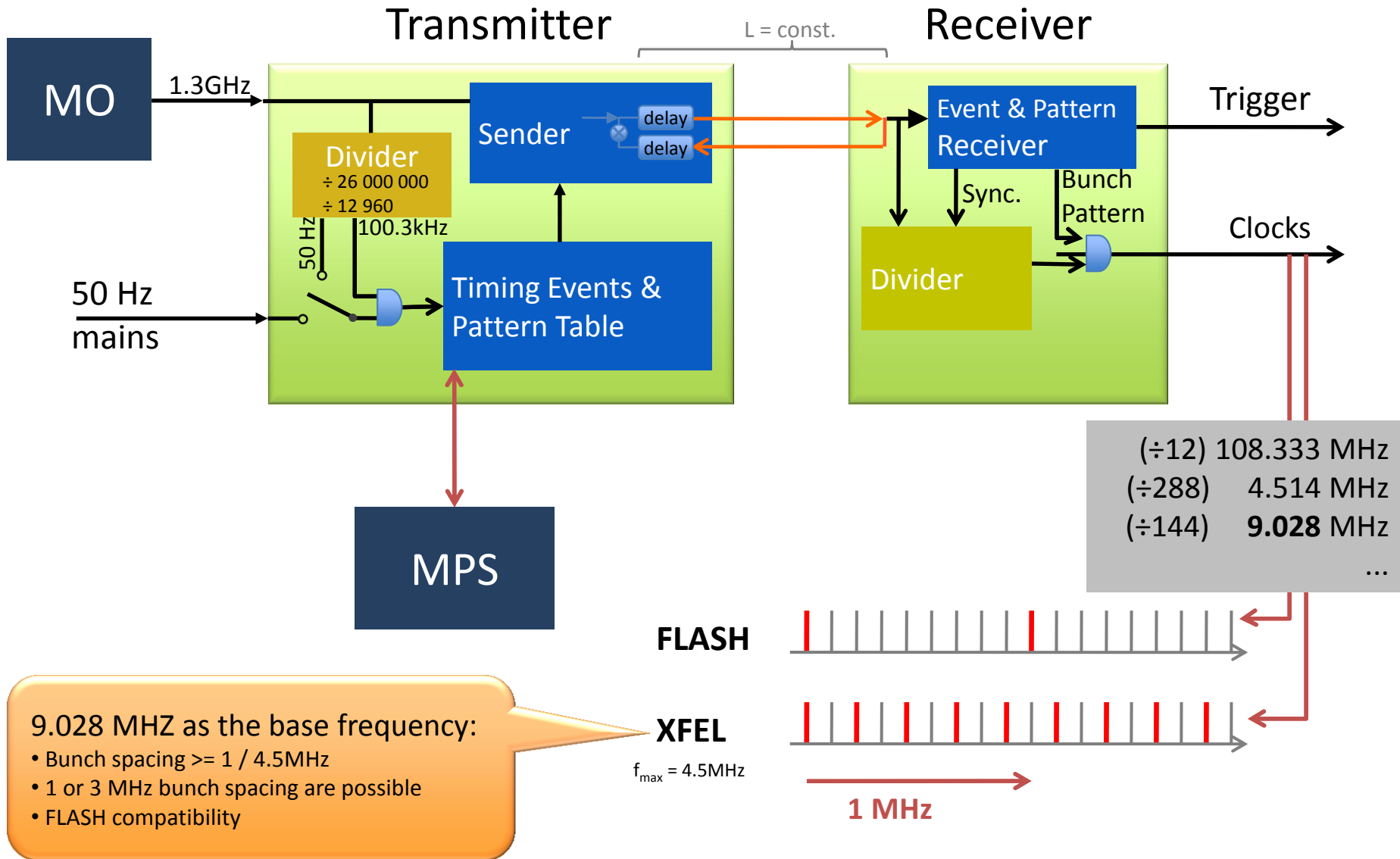


Bunches in XFEL

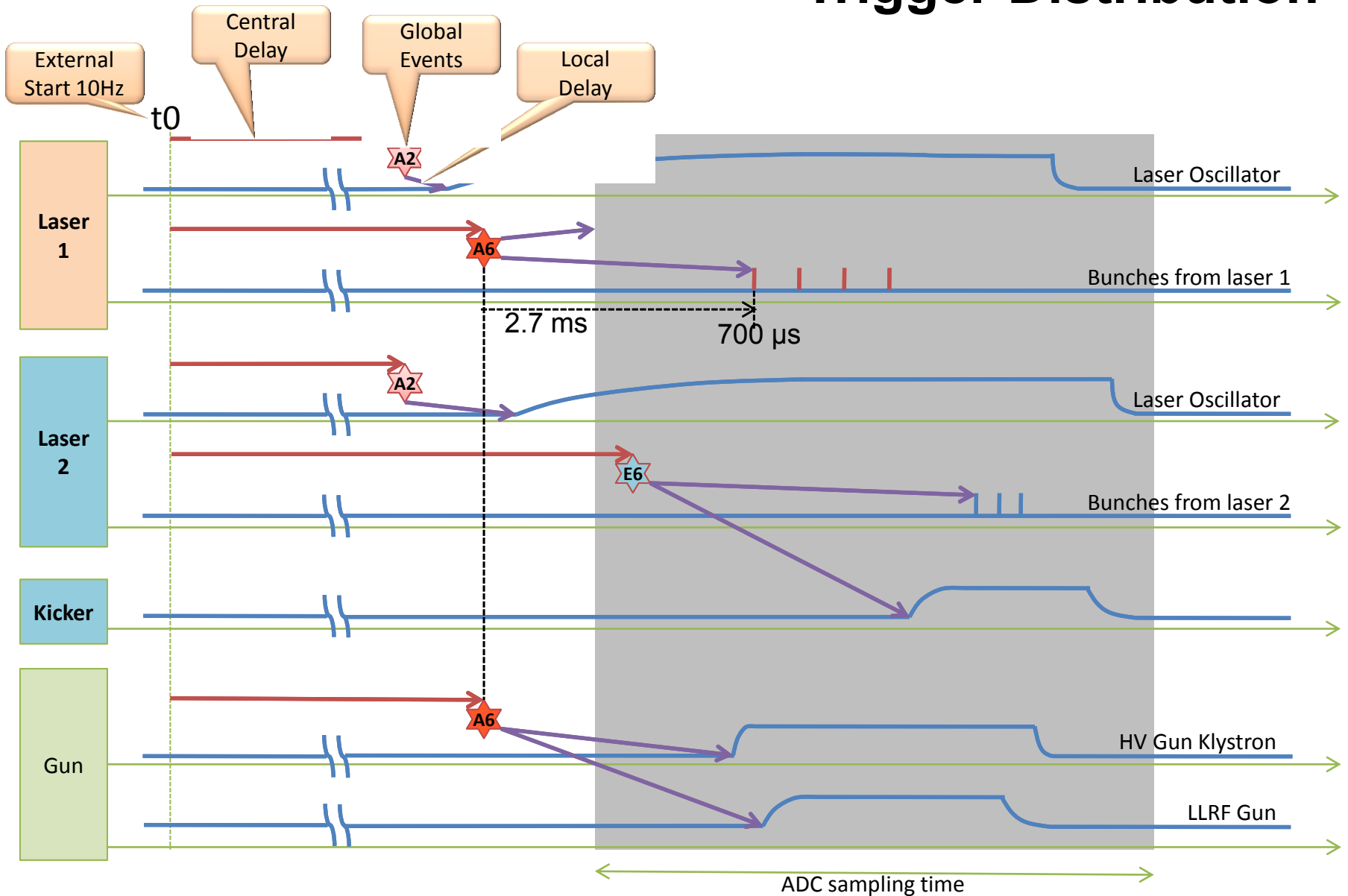
- The XFEL can produce 27 000 bunches per second



New Timing System for XFEL and FLASH



Trigger Distribution



32 Bit Bunch Pattern Defines Every Bunch

! Charge ranges: To be changed !

'Distortions' to ignore

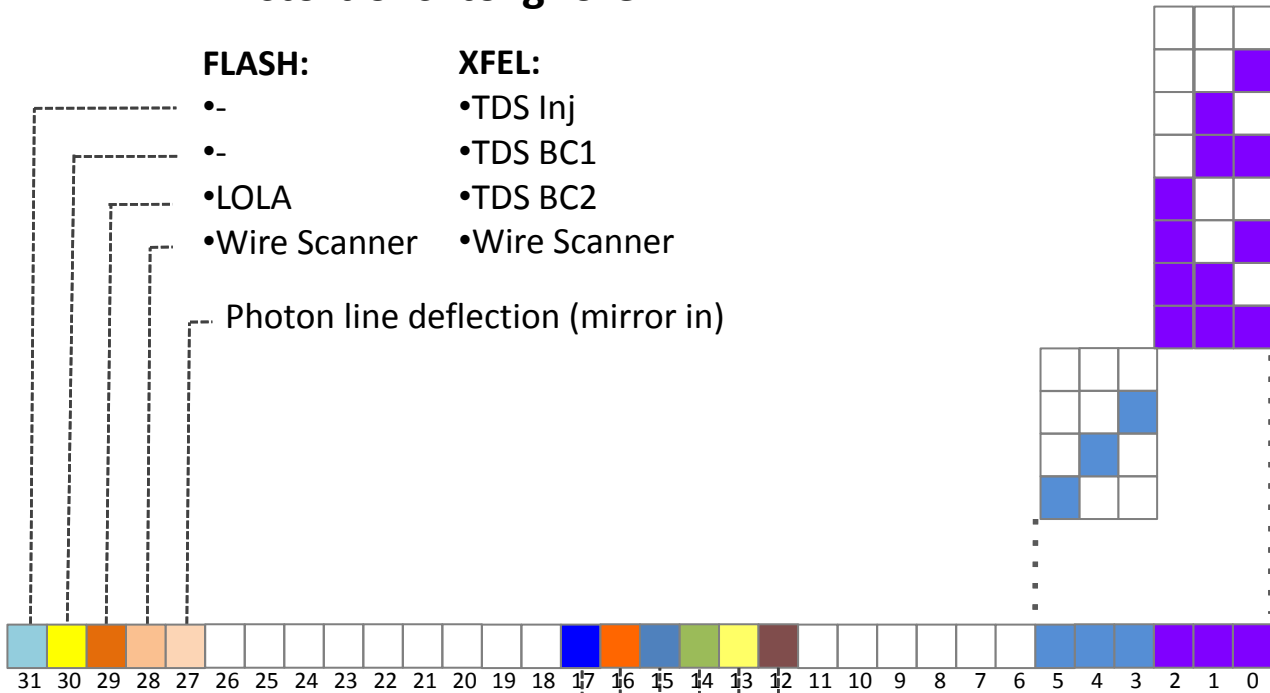
FLASH:

- -
- -
- LOLA
- Wire Scanner

XFEL:

- TDS Inj
- TDS BC1
- TDS BC2
- Wire Scanner

Photon line deflection (mirror in)



Charge:

- No bunch
- Low: < 0.1 nC
- 0.1 – 1 nC
- High: > 1 nC
- TBD
- TBD
- TBD
- TBD

Alternative:

- No bunch
- < 0.125 nC
- 0.125 – 0.25 nC
- 0.25 – 0.5 nC
- 0.5 – 1 nC
- 1 – 2 nC
- > 2 nC
- free

-
- 1. Laser
- 2. Laser
- 3. Laser

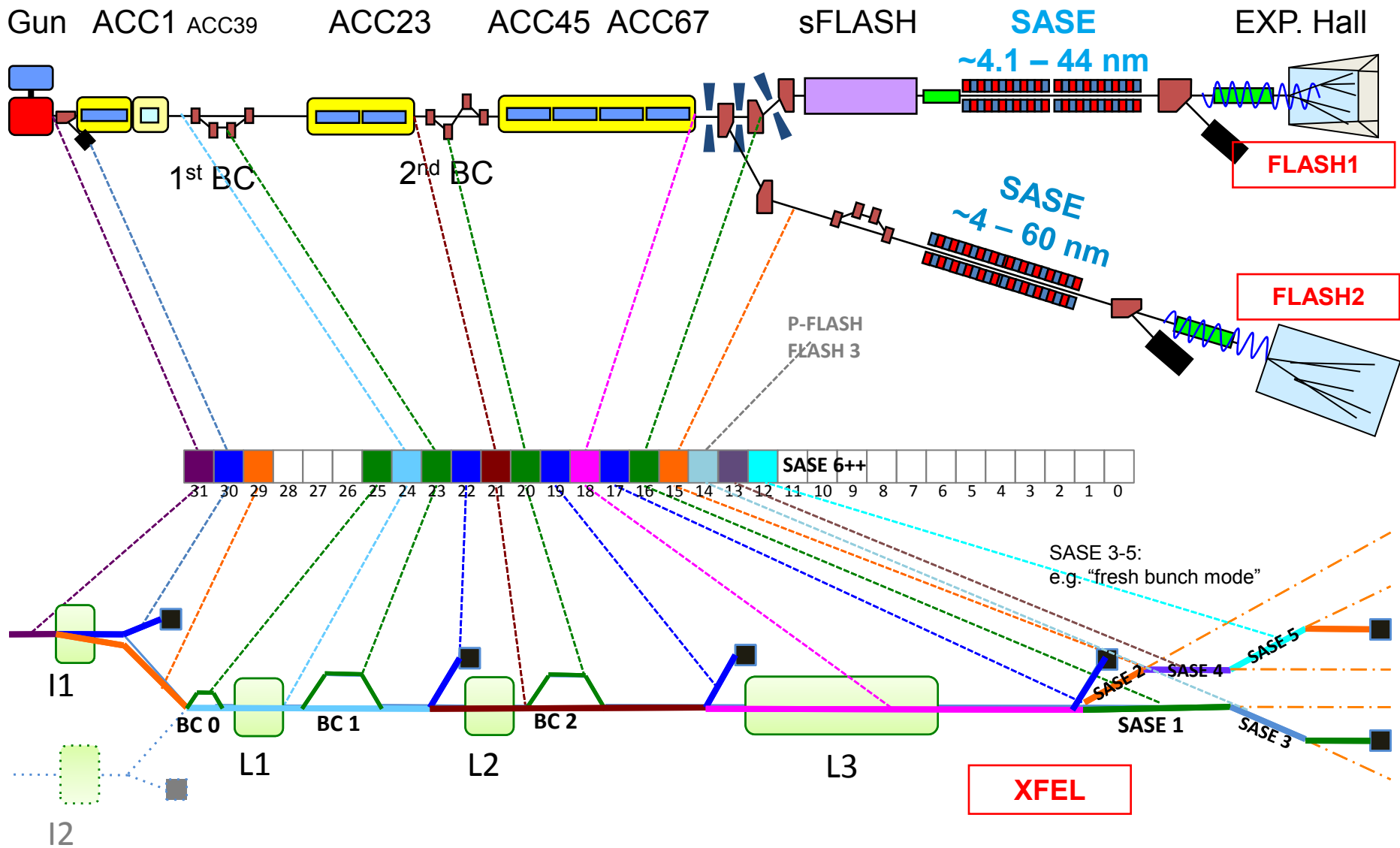
FLASH:

- -
- -
- FLASH 3 e-
- FLASH 2 e-
- FLASH 1 e-
- -

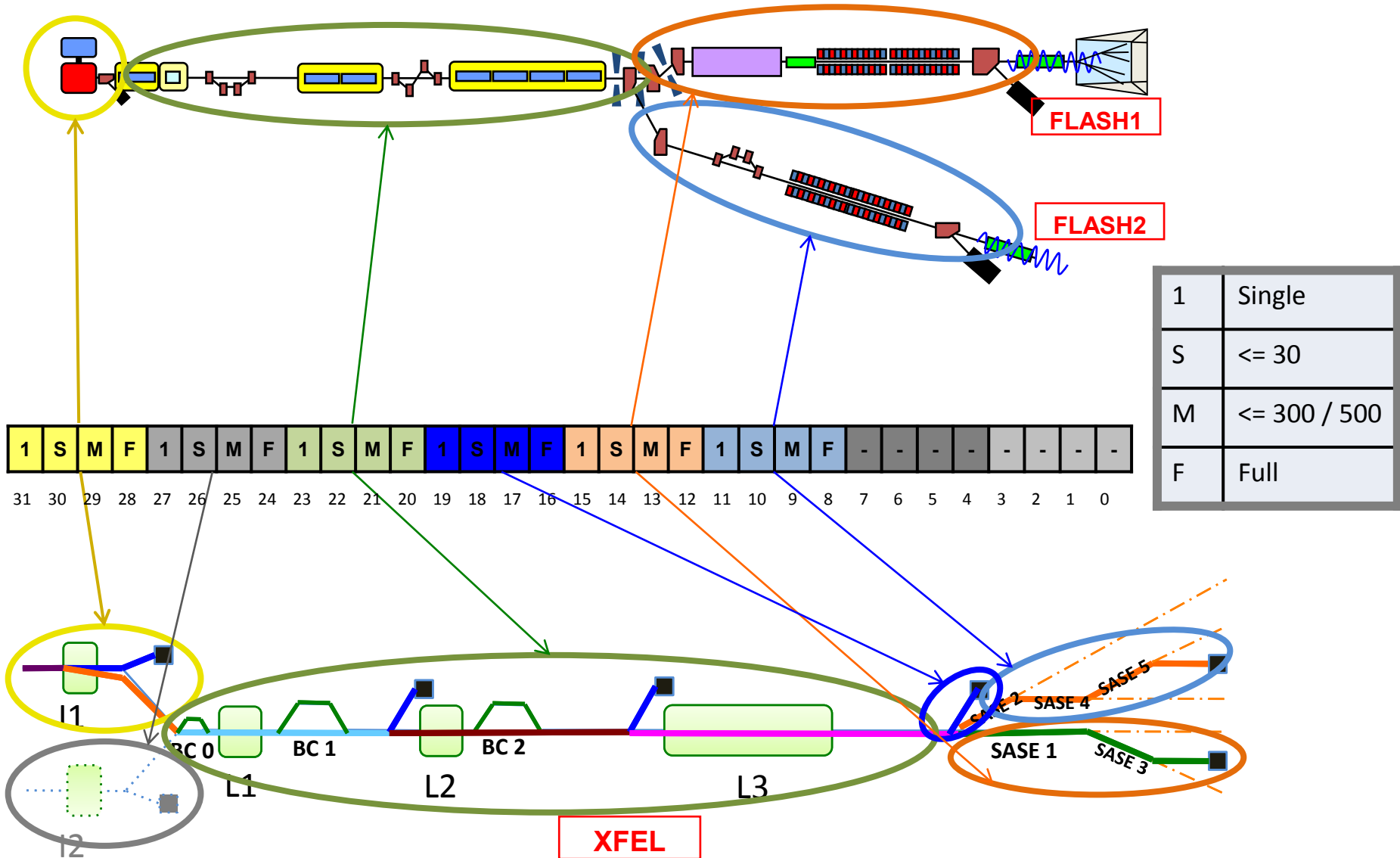
XFEL:

- SASE 5 special mode
- SASE 4 special mode
- SASE 3 special mode
- SASE 2 e-
- SASE 1 e-
- Main dump

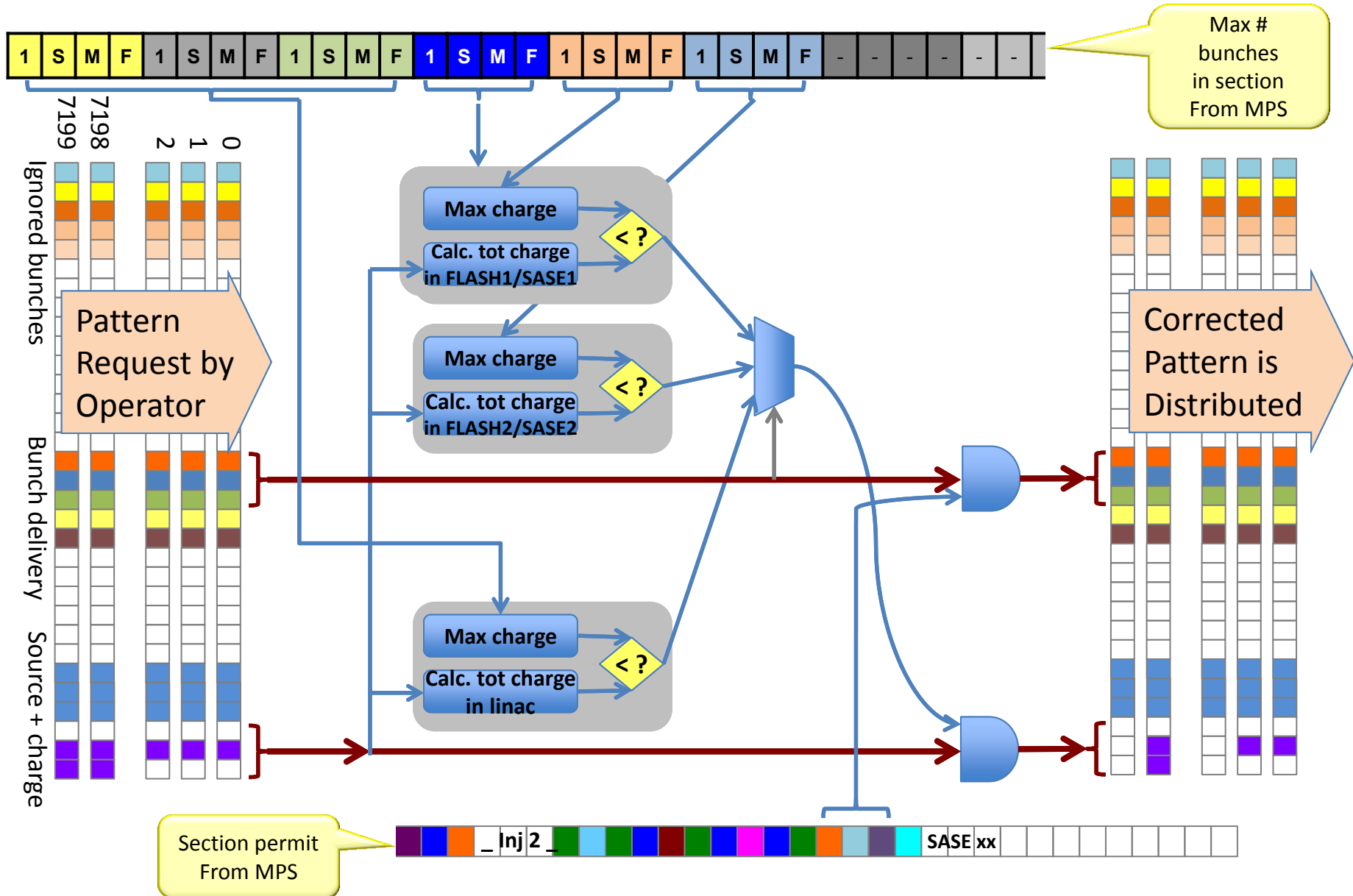
Section Pattern for XFEL and FLASH (MPS)



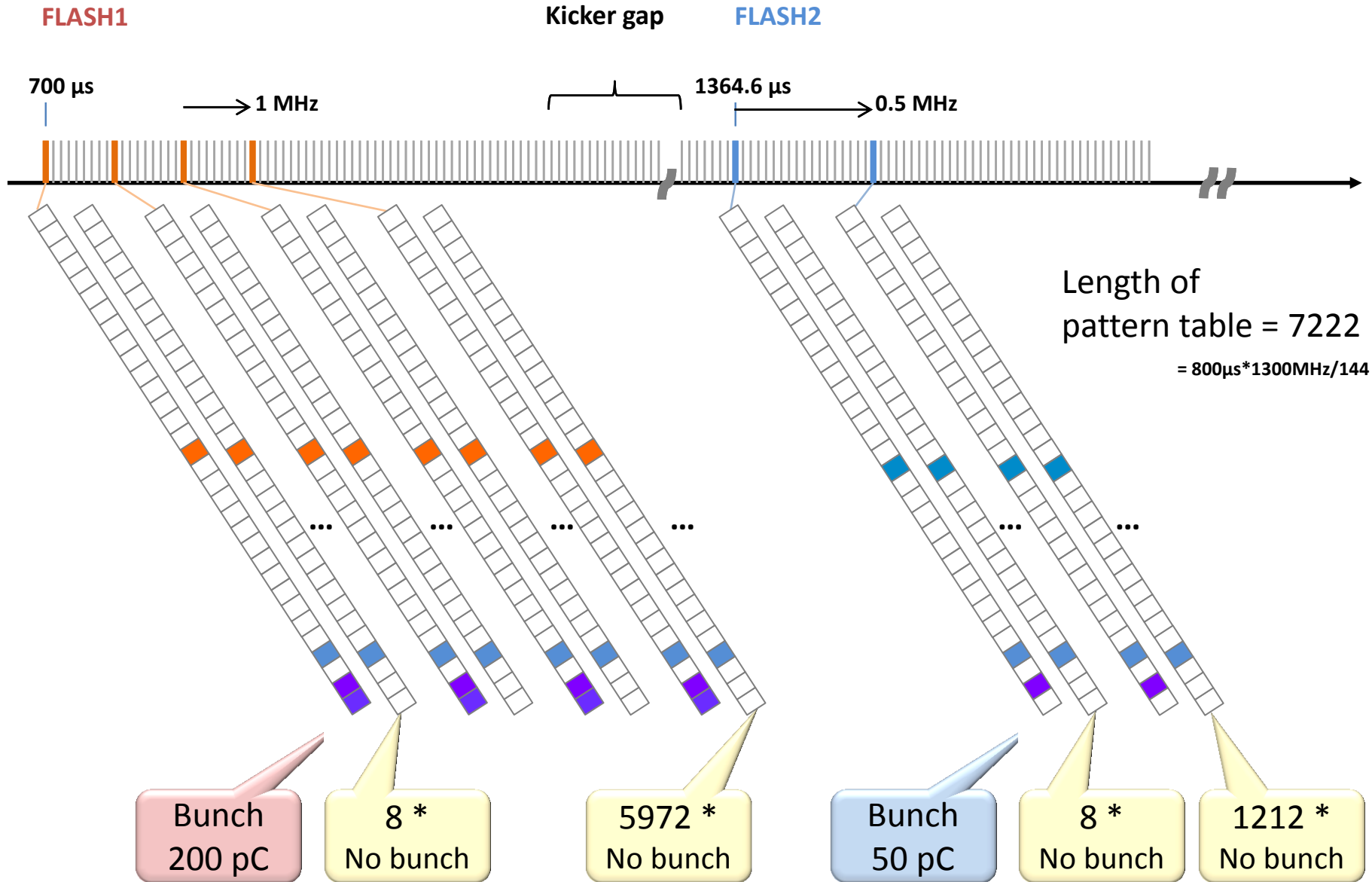
Beam Modes: max. # of Bunches in Section, 32 bit Word (MPS)



Timing System With Restrictions by MPS

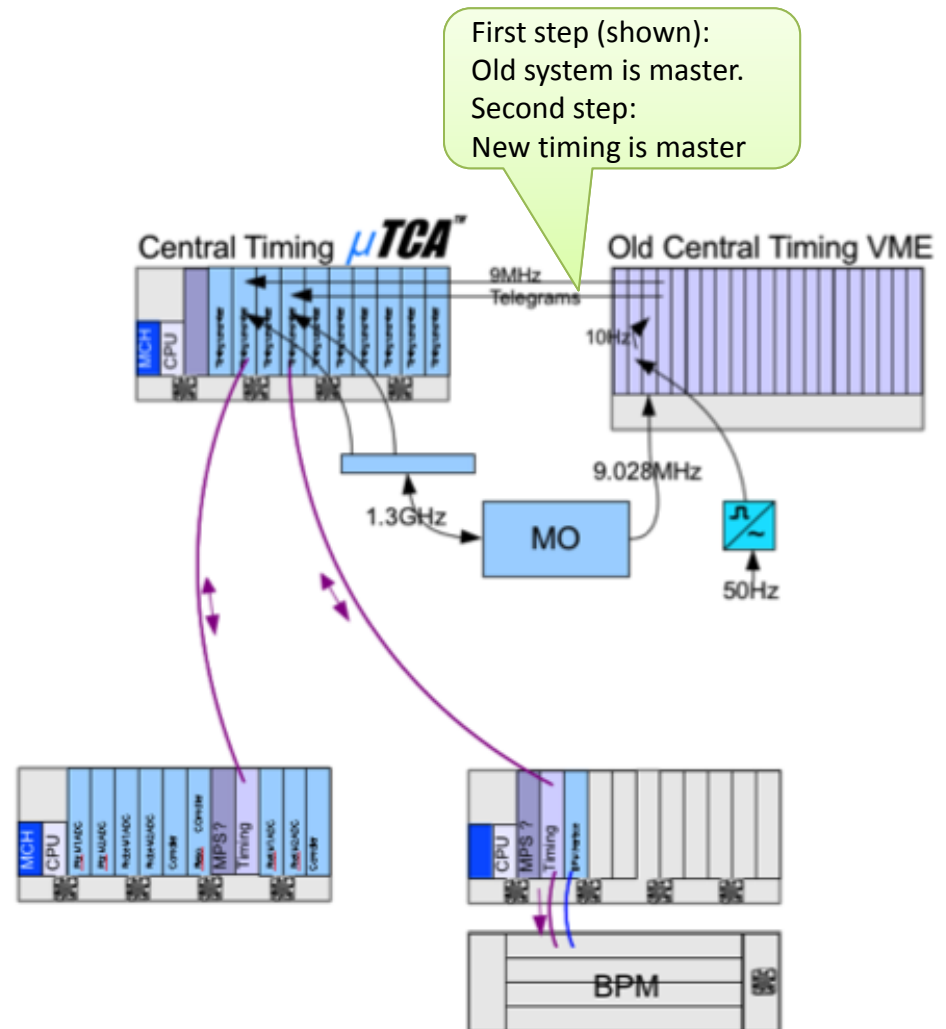


Example: 4 Bunches in FLASH1, 2 in FLASH2



The New Timing System for FLASH

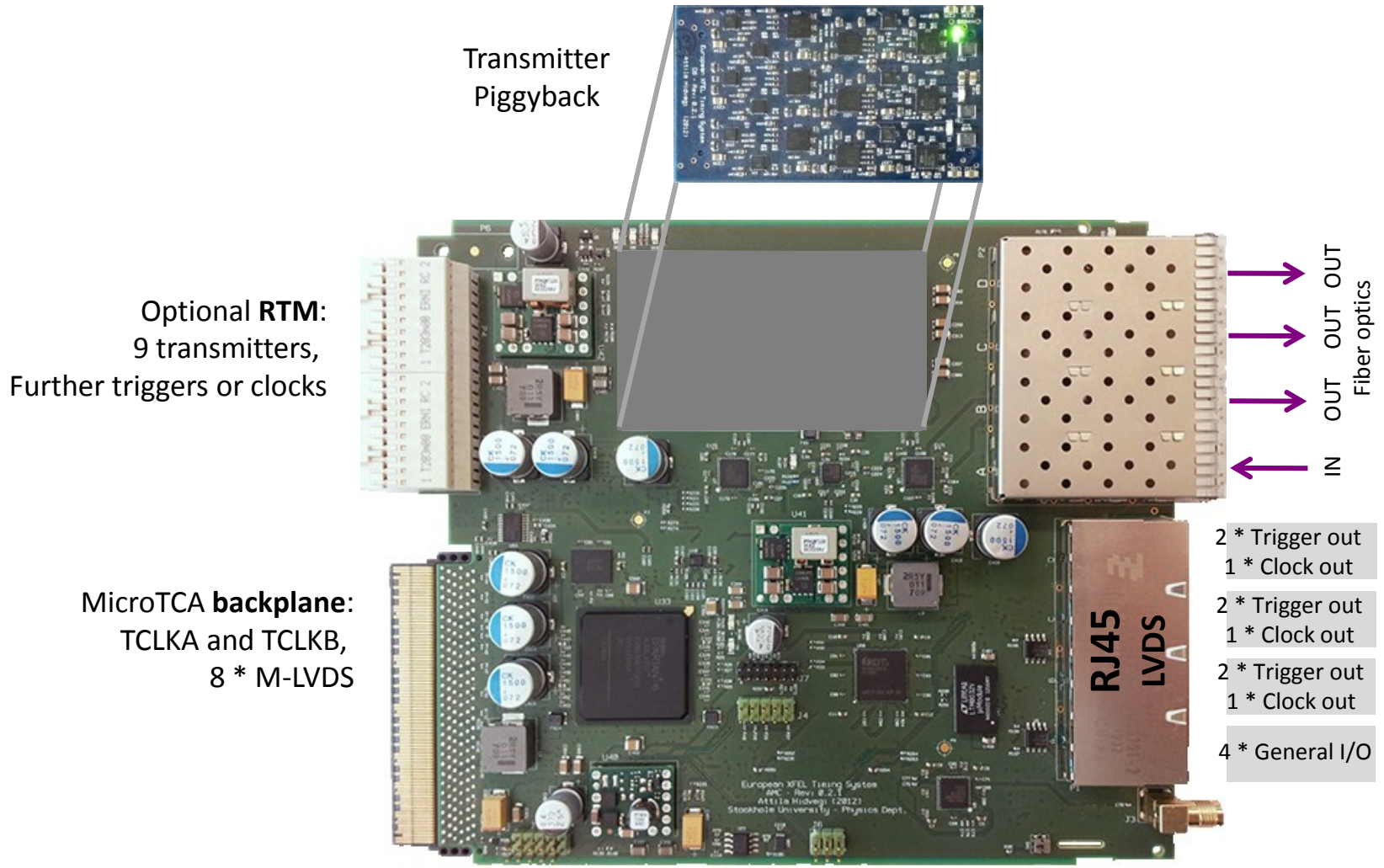
- All **MicroTCA** systems will connect to the new system
- **VME** remains on old 9 MHz timing



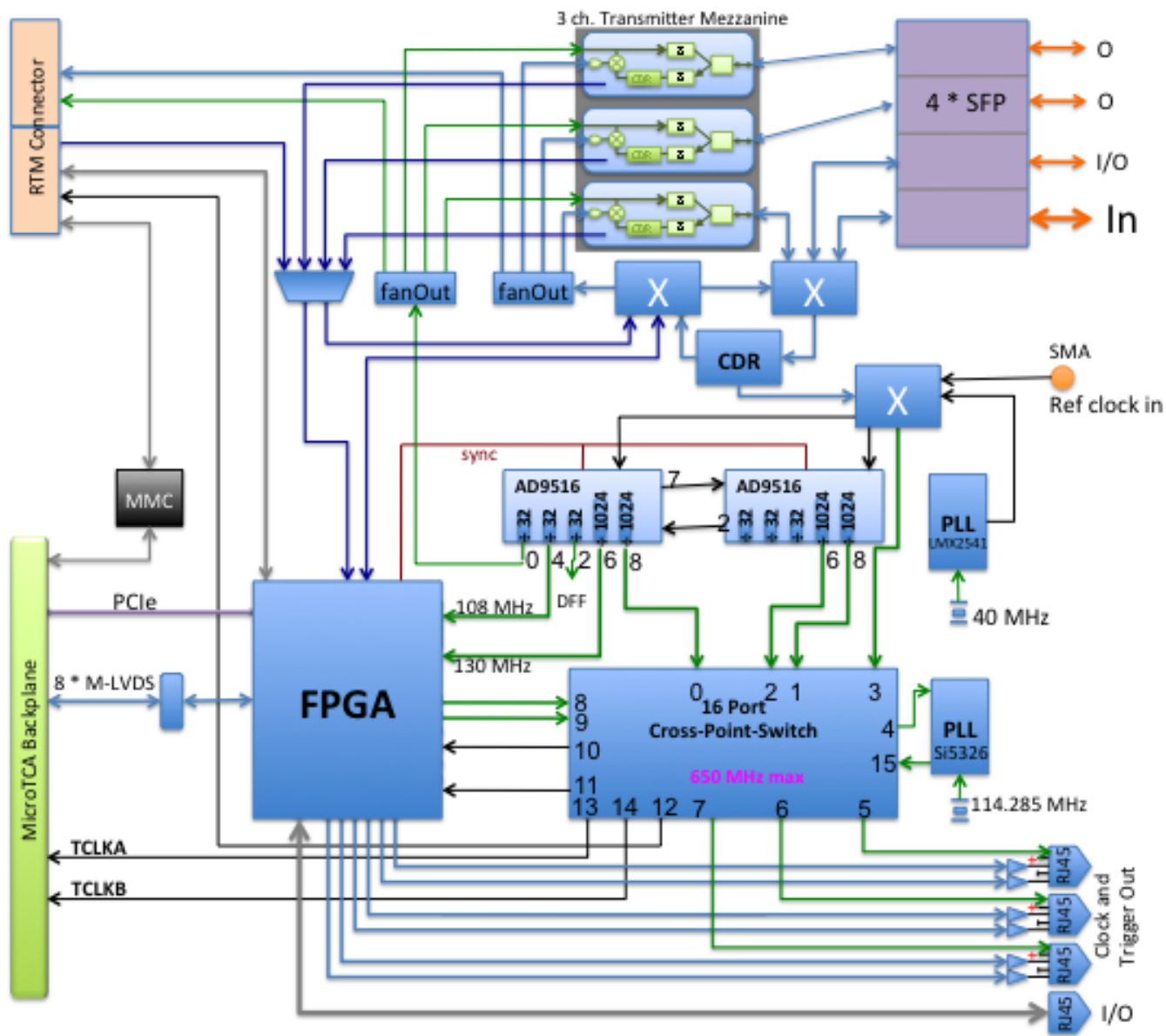
Features of the New Timing

- More outputs, more functions, better resolution
- Distributes bunch patterns
- Fiber optical distribution
- Based on 1.3 GHz (old 9.028 MHz)
- Less jitter
- Trigger and clock distribution on backplane

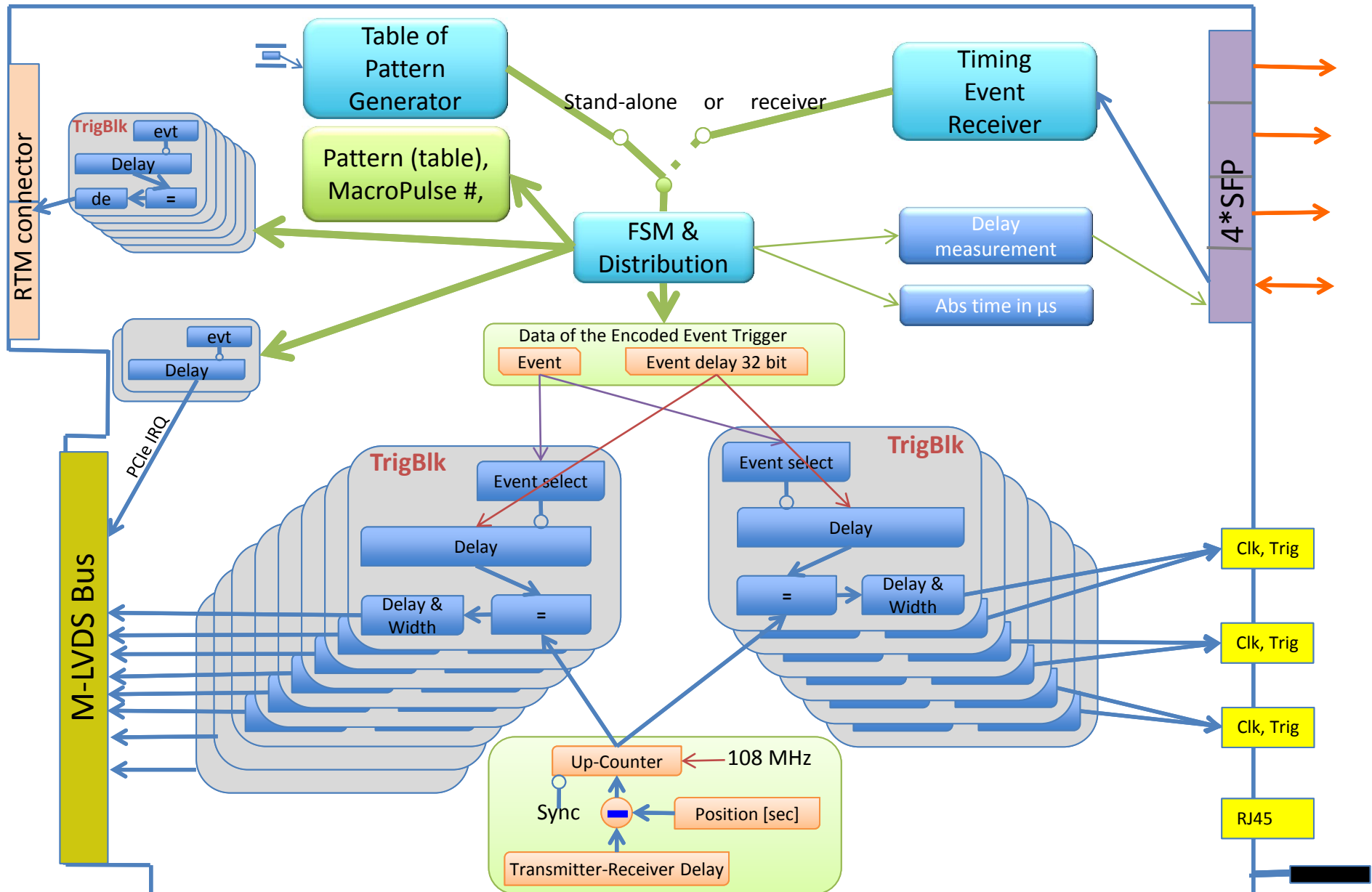
New Timing Module



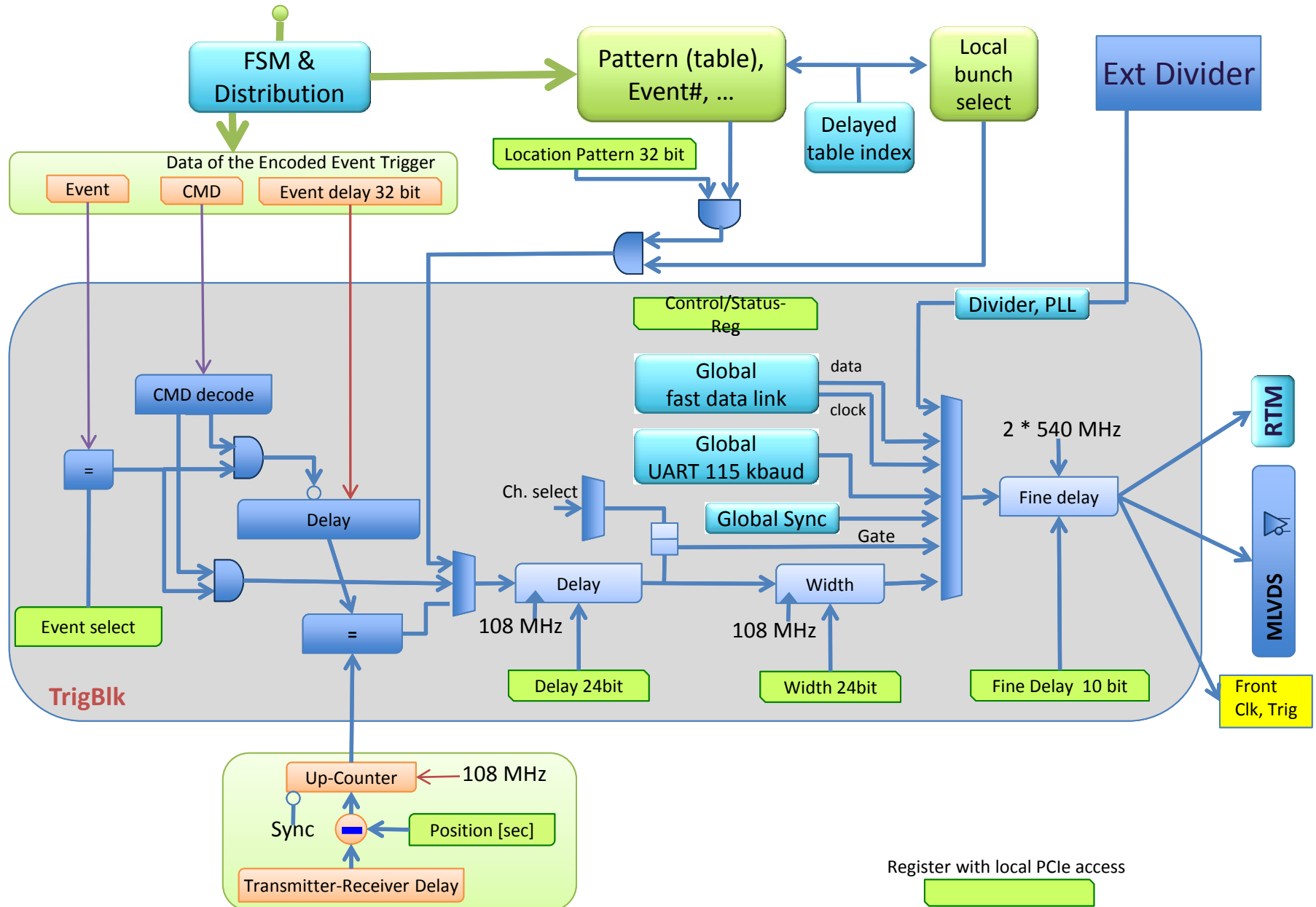
Timing AMC Block Diagram



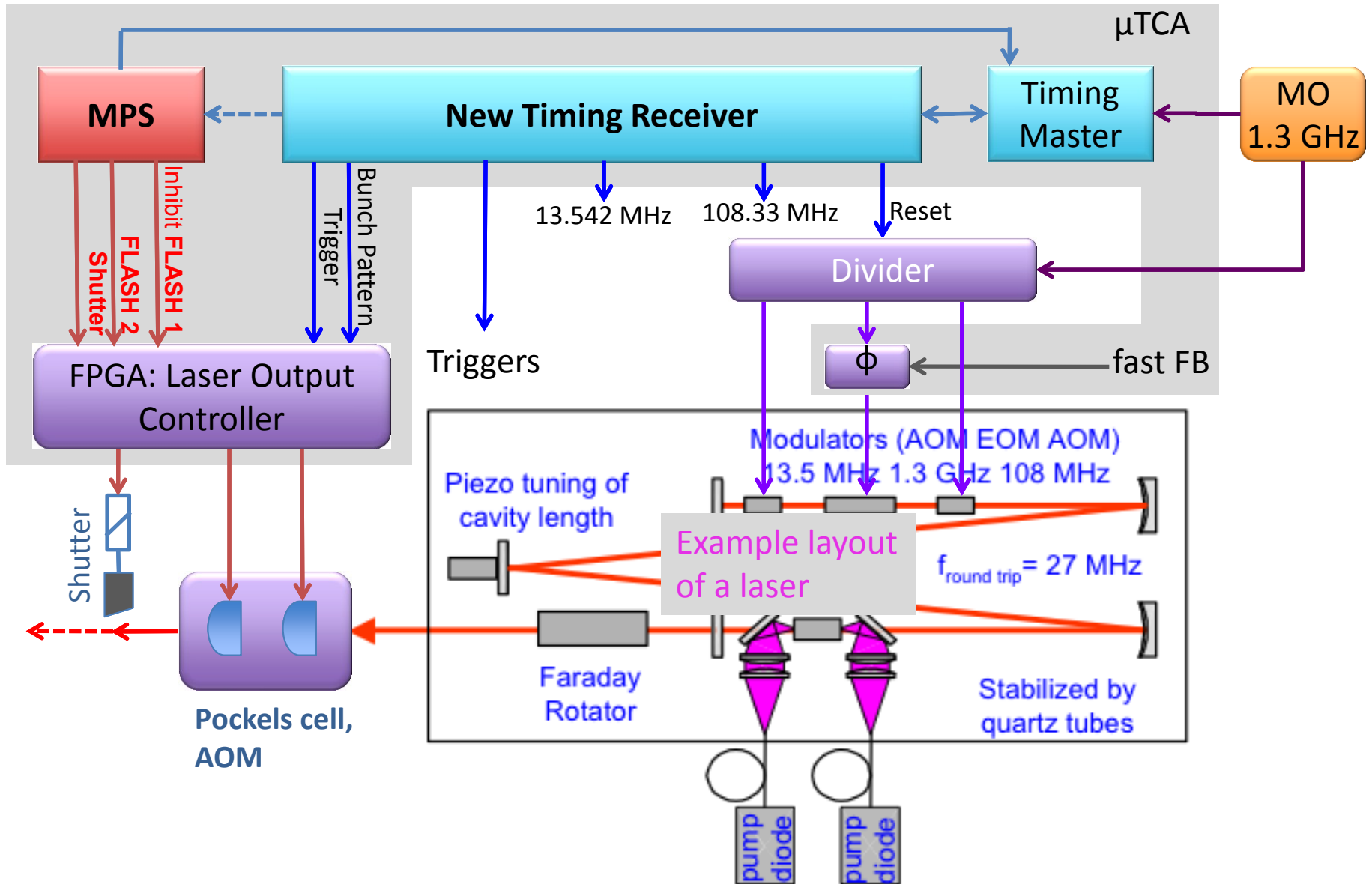
FPGA Handles Triggers and Tables



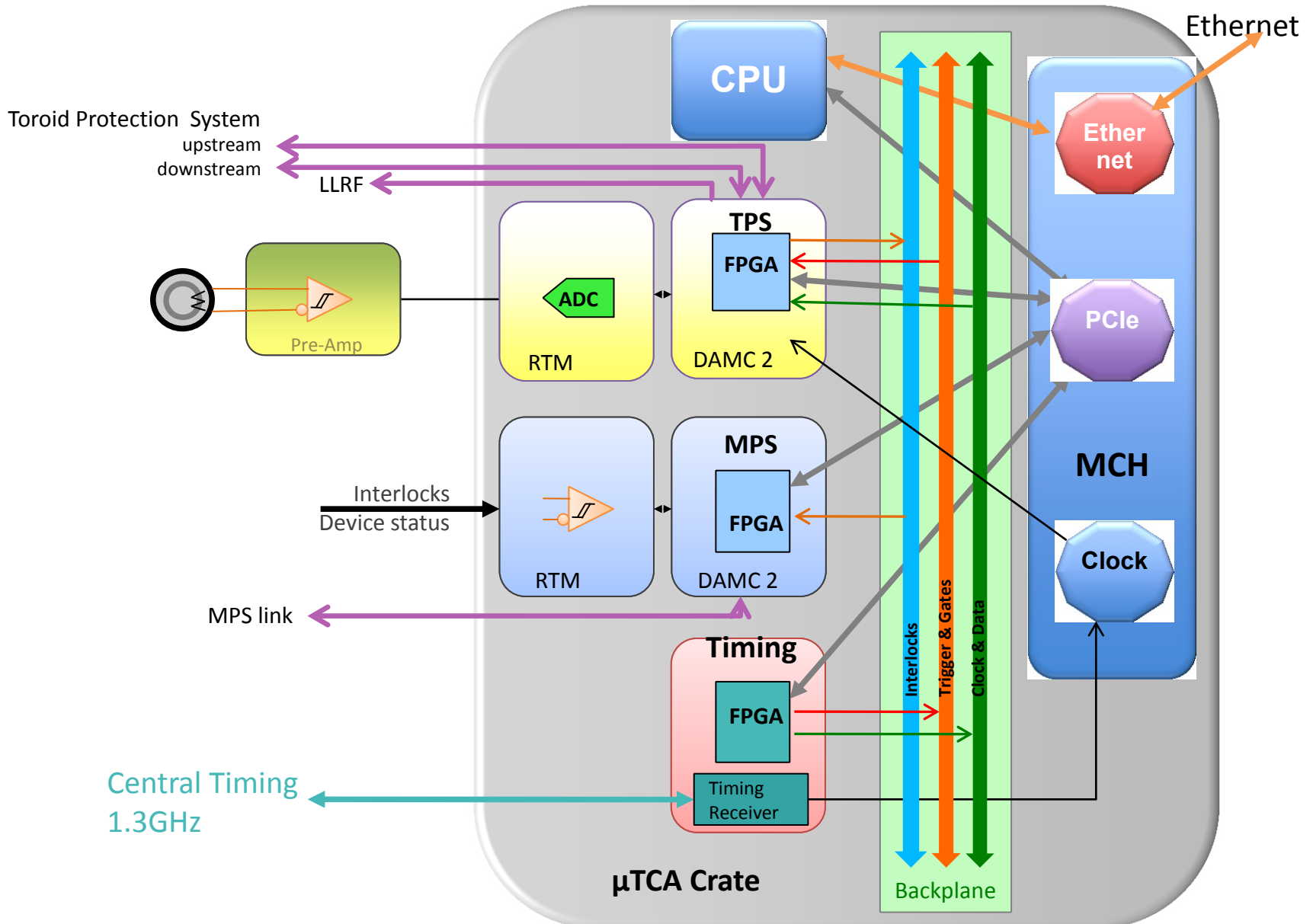
Timing: One Channel (out of 22) Block Diagram



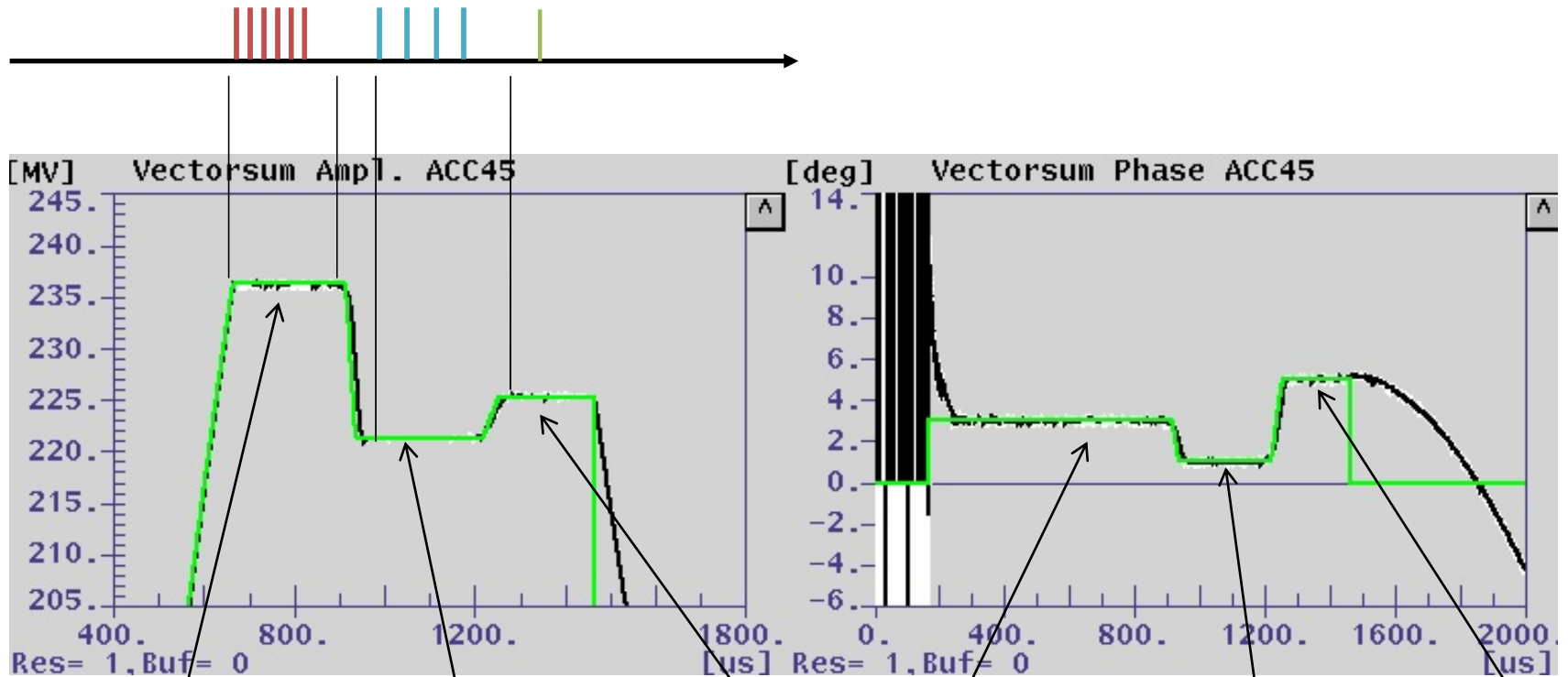
Controlling the Injector Laser



Example: Timing Connections within a MicroTCA Crate



LLRF with different Settings FLASH 1 / 2 / 3



FLASH1

FLASH2

FLASH3

FLASH1

FLASH2

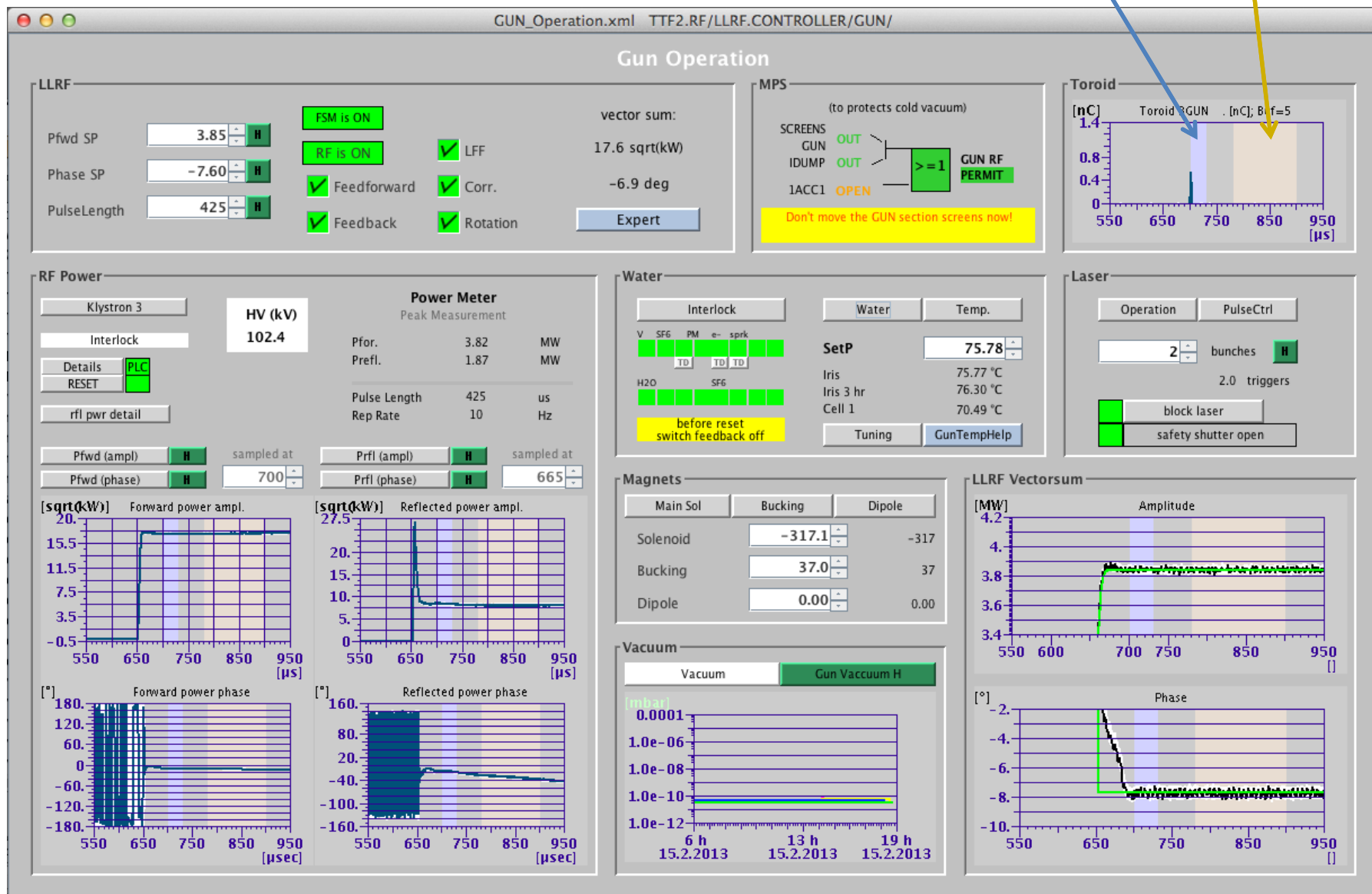
FLASH3

— RF response

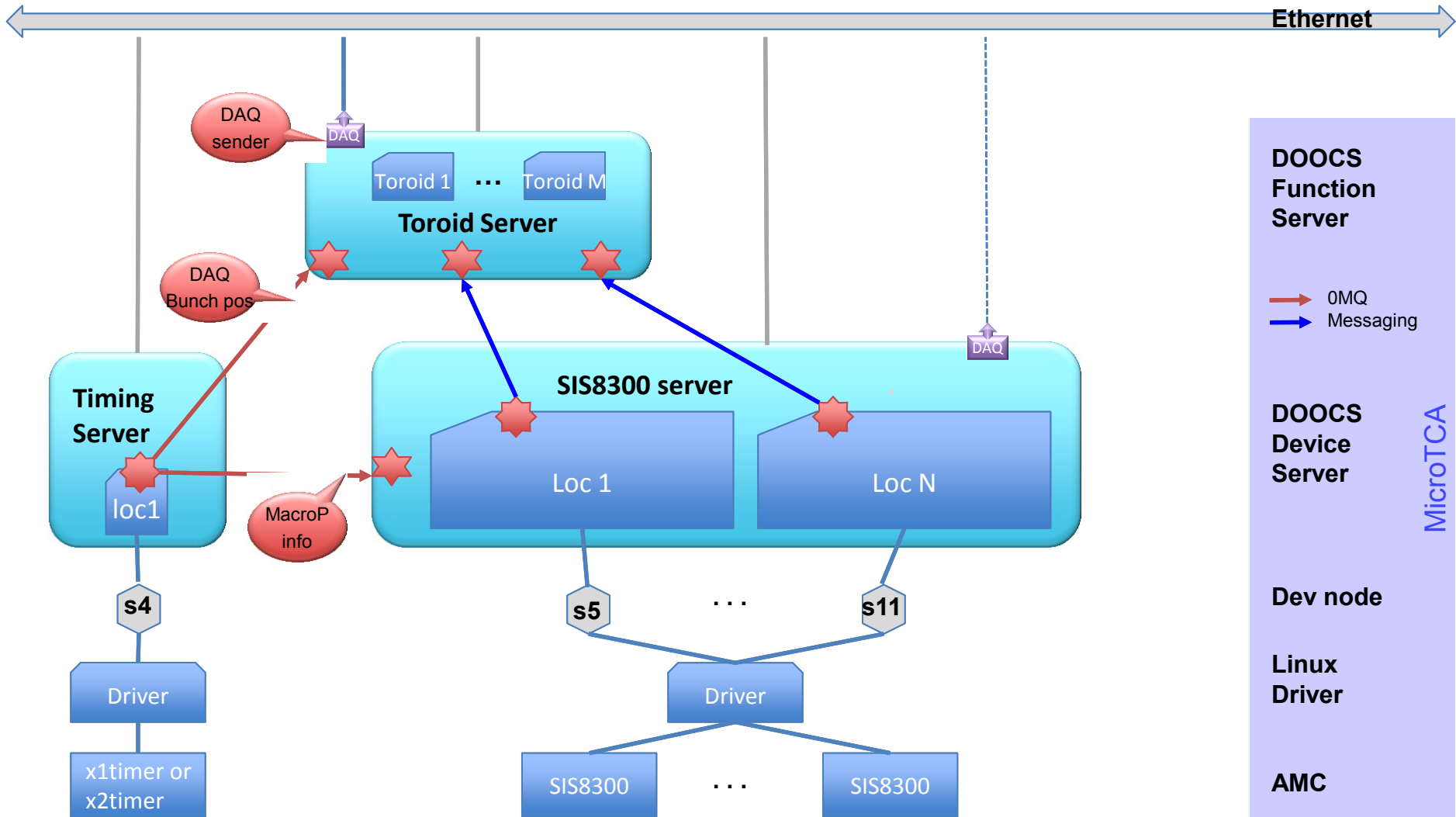
— Requested RF Pulse shape

Gun Control Panel

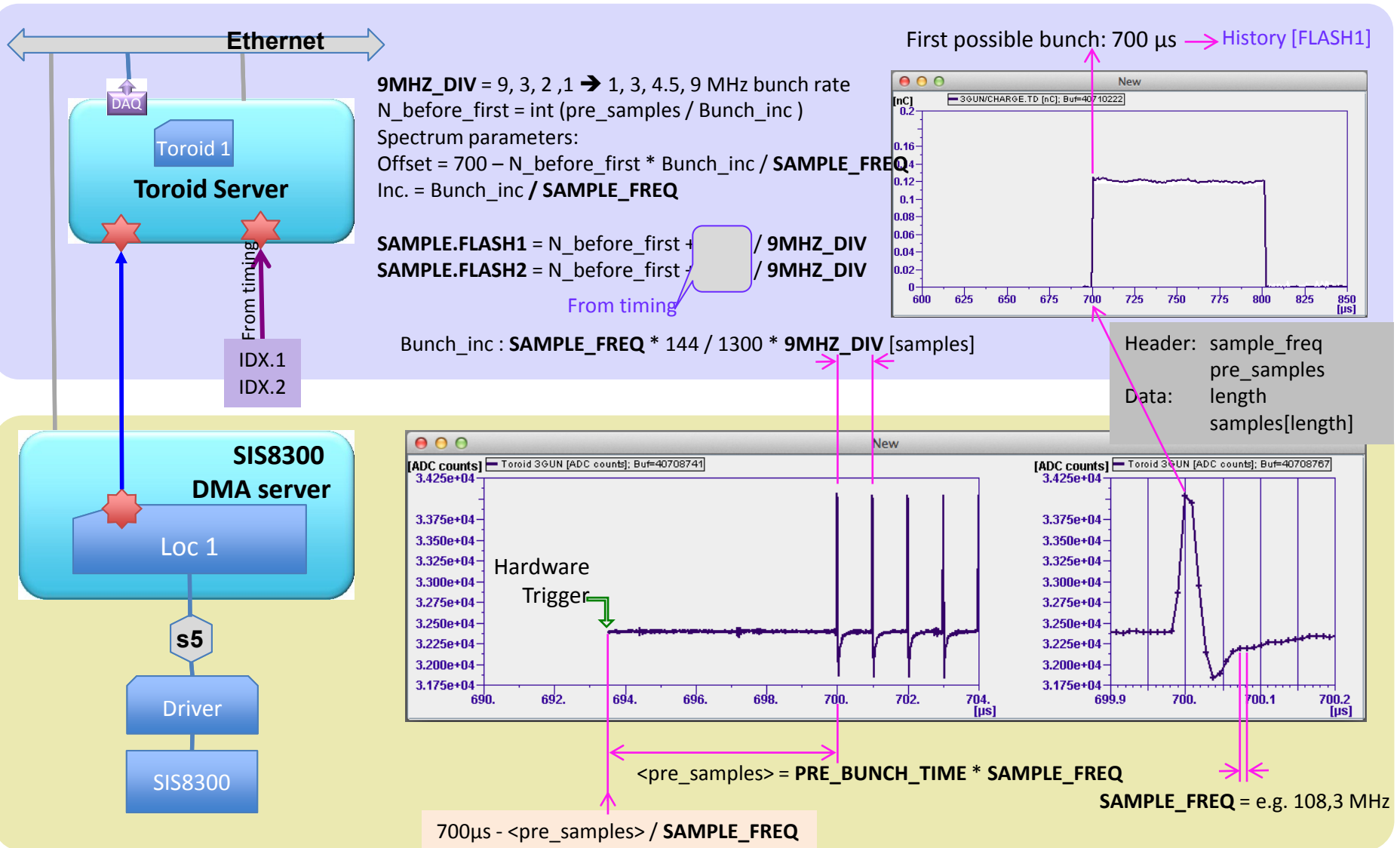
FLASH 1 FLASH 2



New Software for MicroTCA

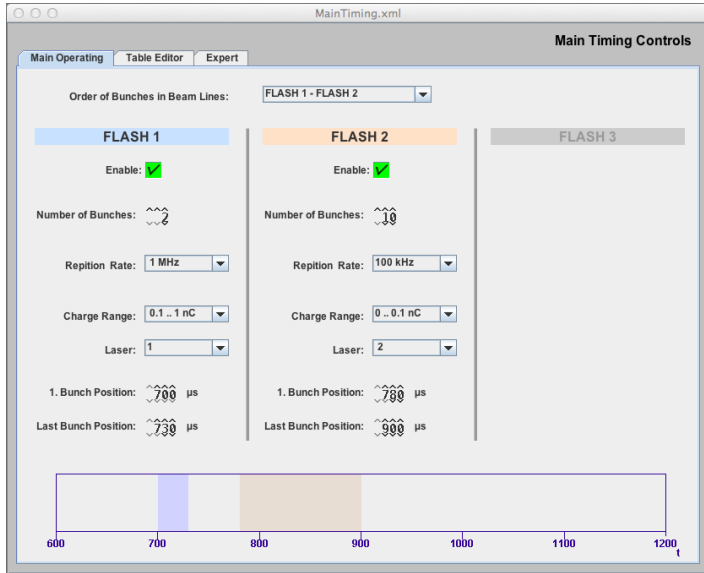


Toroid Front-end Software

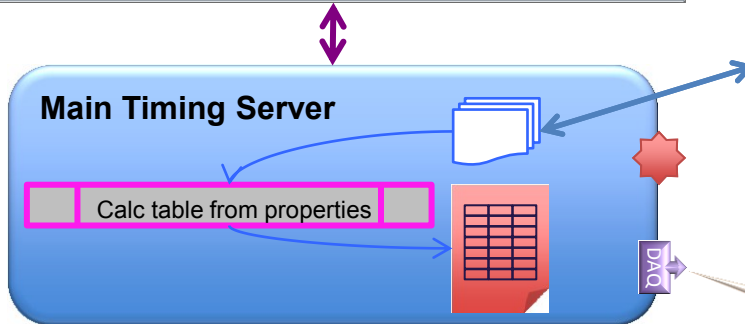


Bold text: property

Main Timing Server



Property		Description
FIRST_BUNCH_INDEX.1/2	int	1. Bunch of FLASH 1/2 in pattern table
FIRST_BUNCH_POSITION.1/2	float	1. Bunch FLASH 1/2 in μs
LAST_BUNCH_POSITION.1/2	float	Last Bunch FLASH 1 in μs
ENABLE.1/2	int	Single bit to enable bunches in FLASH1/2
NUMBER_BUNCHES.1/2	int	Fills the number of bunches into the table
REP_RATE.1/2	int	Repetition rate of the bunches (enum)
CHARGE_RANGE.1/2	int	Charge range filled into table (enum)
LASER_SELECT.1/2	int	Selected laser for bunches in FLASH1/2
ORDER_BEAMLINES	int	0: FLASH1, FLASH2; 1: FLASH2, FLASH1
MACRO_PULSE_NUMBER	int	Unique number
SHOT_ID	Int	ID of the cycle type
BEAM_MODE	Int	Max allowed number of bunches in section
SECTION_PATTERN	Int	Beam permission in sections



Data to DAQ:
 Bunch Pattern, MacroPulseNumber, ShotID, Time, BeamMode,
 Section Pattern, First and Last Bunch Position of Beam Lines

Vielen Dank!

- Das Team:
 - Attila Hidvégi, Uni Stockholm
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 - Ludvig Petrosyan, MCS4
 - Vahan Petrosyan, MCS4
 - Kay Rehlich, MCS4
 - Christoph Stechmann, MCS4