Generation and Transmission of Safe Beam Parameters

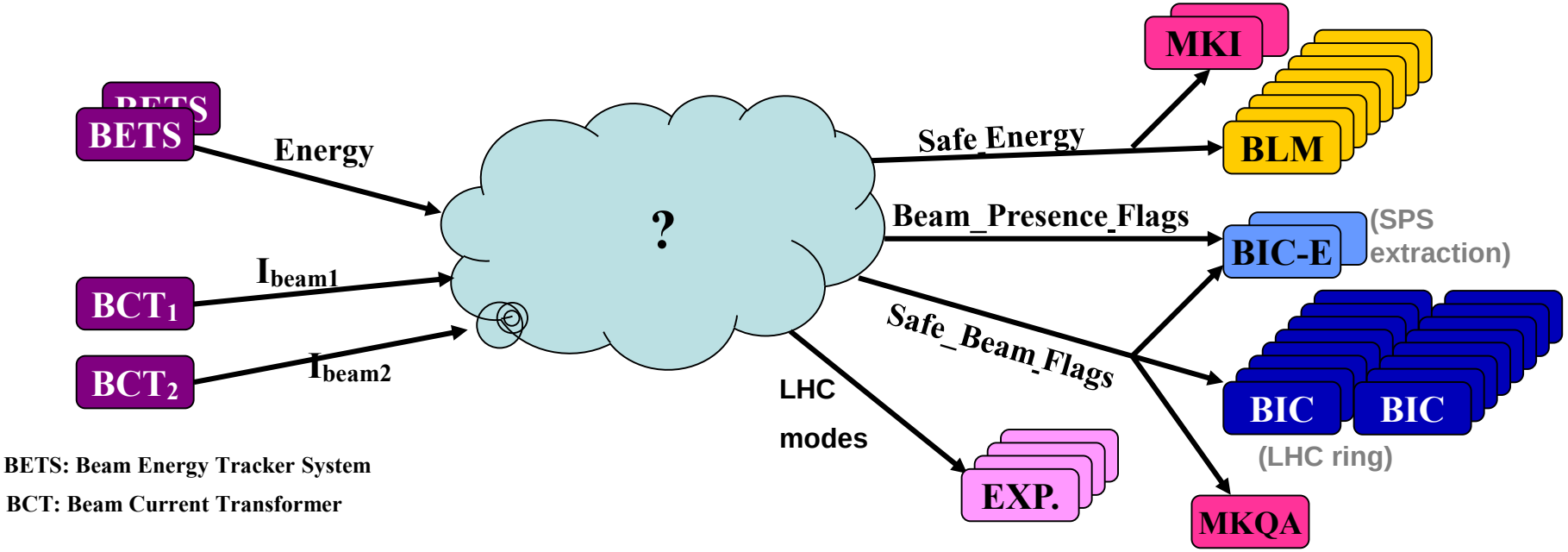
Reminder on Safe LHC Parameters

Name	Format	Rate	Derived from (producer name)	Distributed to	Safety level
LHC ENERGY	2 bytes	1Hz	Current in main dipoles (BEM)	Beam Loss Monitors	SIL2
				Injection Kickers	SIL2
SAFE BEAM FLAGS	2 bits (SBF_1& SBF_2)	1Hz	LHC ENERGY and Beam Intensities (BCT)	LHC Beam Interlock System	SIL2
				SPS Extraction Interlock	SIL1
				Aperture Kickers	SIL2
BEAM PRESENCE FLAGS	2 bits (BPF_1 & BPF_2)	**1kHz**	Beam Intensities (BCT)	SPS Extraction Interlock	SIL1
LHC BEAM MODES	1 byte	1Hz	Automatic (?) process with Operators input	Experiments	SIL2
				Injection Kickers	??
				Beam Dilutors (at injection)	??

SIL4 is the highest safety level
…
SIL1 is a moderate safety level

Reminder on the main requirements

Produce LHC Beam Parameters & Transmit them to some dedicated systems:



- Flags are built from Energy and Beam Intensities
- Parameters should be delivered with reliability over long distance to various systems
- In most* of the cases, the transmission rate is not critical (*1Hz is enough*)

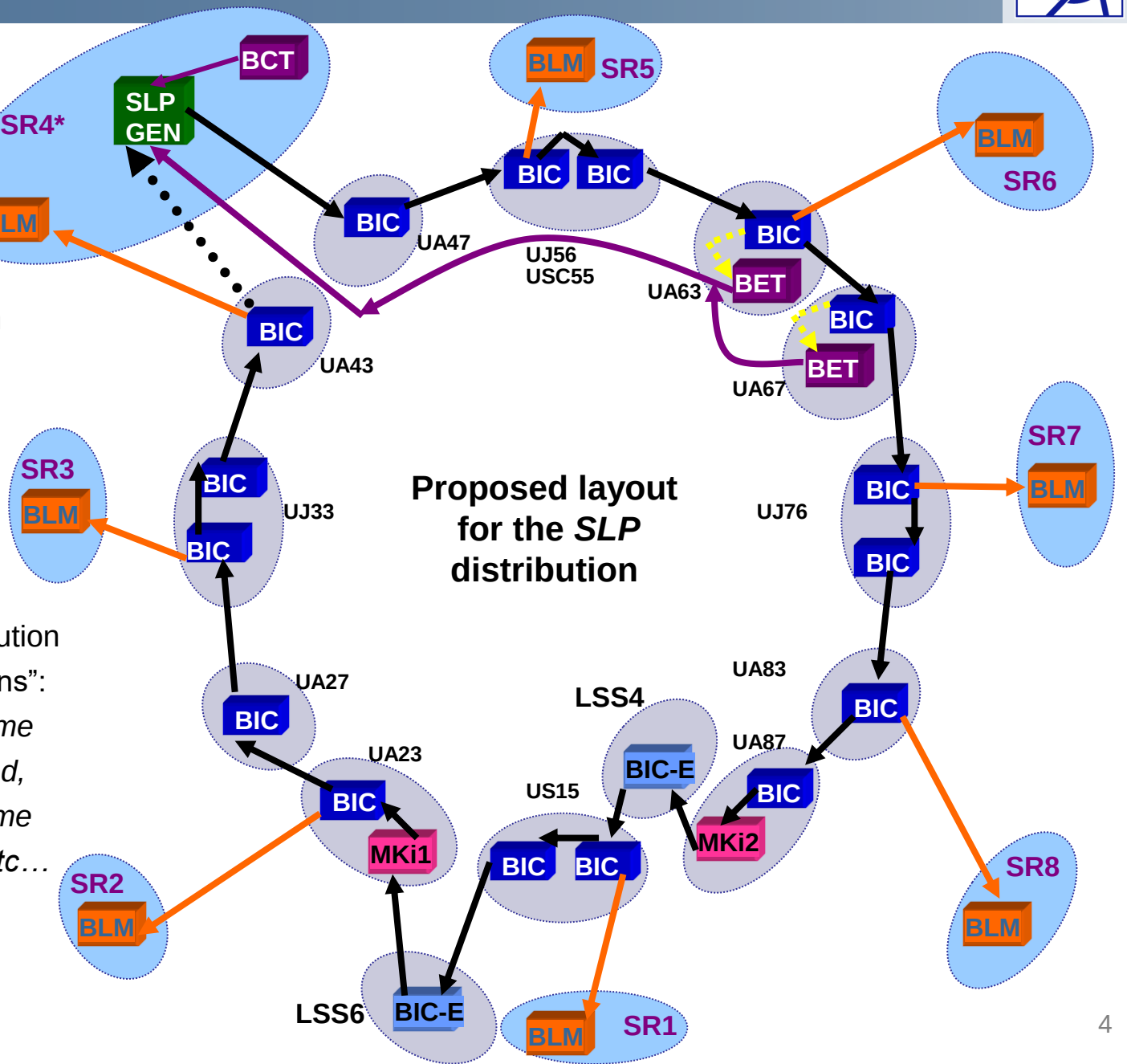
  [*: 1KHz for **B**eam_**P**resence_**F**lags]

Layout of the initial proposal

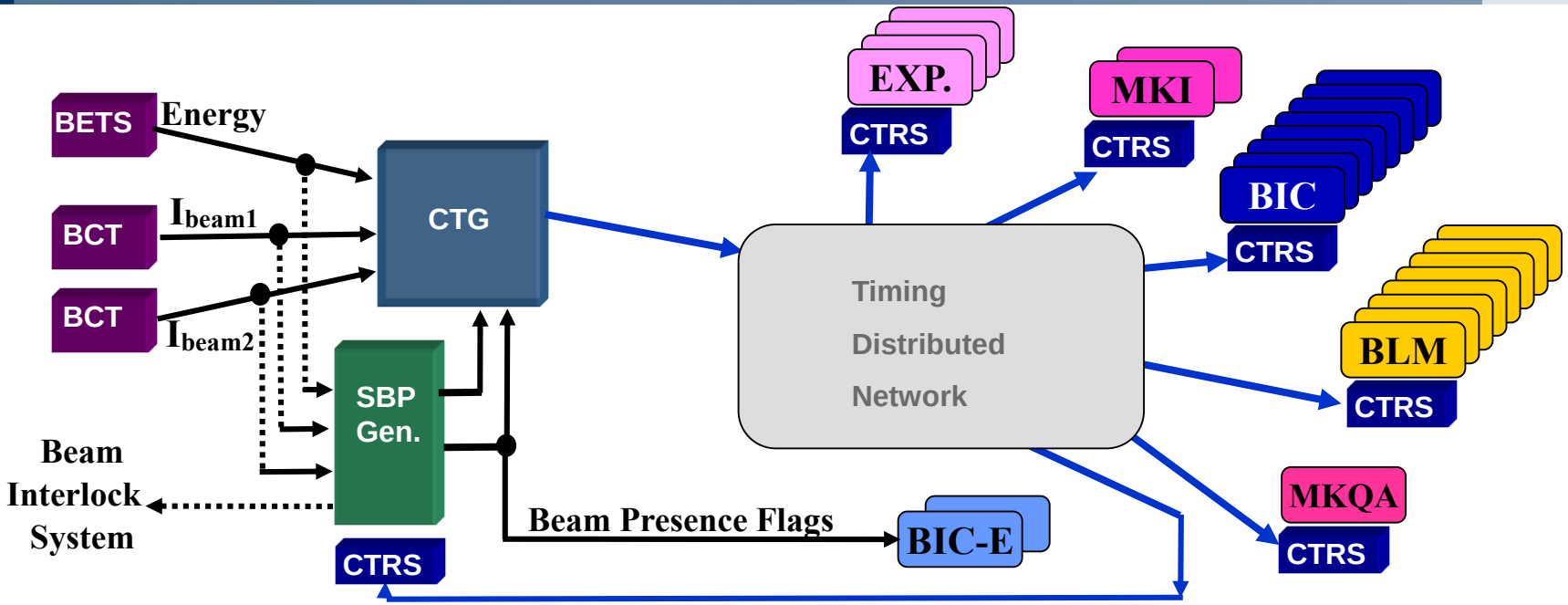
Ring distribution with
1 *SLP* generator
+
20 *SLP* User boards

(BLM not included in the daisy chain)

Transmission and distribution are using “Timing solutions”: *same frame protocol, same transmission rate & speed, same frame receiver, same optical fibre interfaces, etc…*



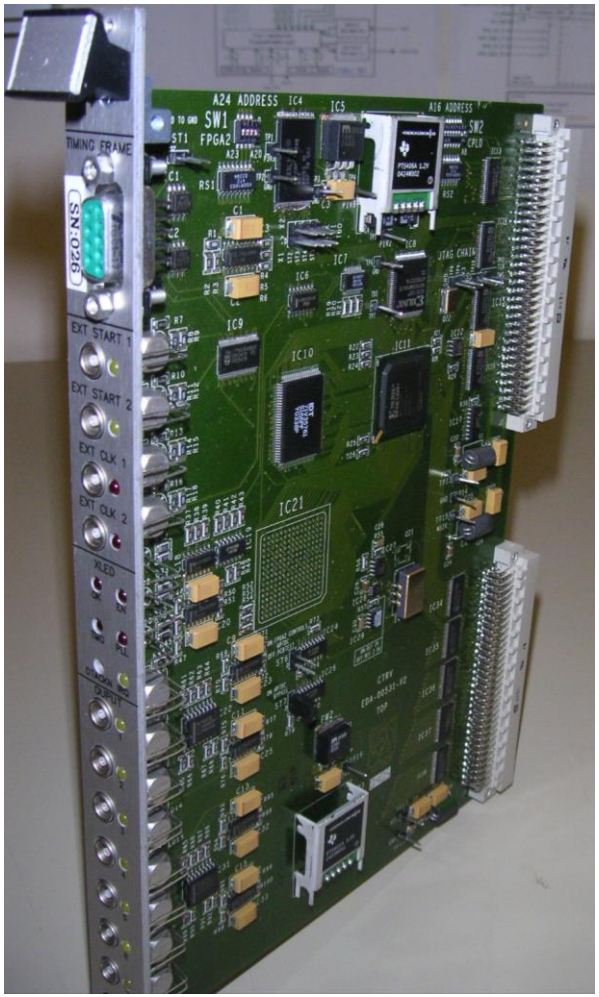
Layout for Safe Beam Parameters distribution via the timing



- E & Intensity values are transmitted to the Timing Generator (CTG) and to the SBP Generator
- SBP-G computes (*using on-board FPGA*) the Safe Beam Flags and Beam Presence Flags and transmit them to the CTG (*using external event interface*)
- CTG sends regularly (*10Hz is proposed*) Parameters over the Timing network as "standard" frames
- Safe Beam Parameters are received by the Users via dedicated Timing Receiver VME board ("CTRS")
- SBP-G performs a cross check in receiving Parameters via a "CTRS"
  => sends alarm and possibly requests a Dump
- SBP-G outputs could still be only used:
  - If rate << 1second as for exemple the Beam Presence Flags
  - If SIL2 not sufficient

“ CTRS” = Safe Beam Parameters Receiver board

temporary name



CTRV: Standard Timing Receiver card for VME systems

- ➔ CTRS is very closed to a CTRV

  with dedicated SBP connections
  - for BLM: Energy data available on P0 connector
  - For BIC: Safe_Beam_Flag as a differential signal on P2 connector
  - etc…
- ➔ Fail-safe state will be implemented in case of missing information *(after a defined time-out)* :
  - Safe_Energy forced to a defined value

    => 0xFFFF for ex.
  - Safe_Beam_Flag forced to “FALSE”
  - etc…
- ➔ For remote monitoring: CTRS = CTRV
  - same LynxOS driver
  - same diagnostics

Why using the Timing system for the Distribution?

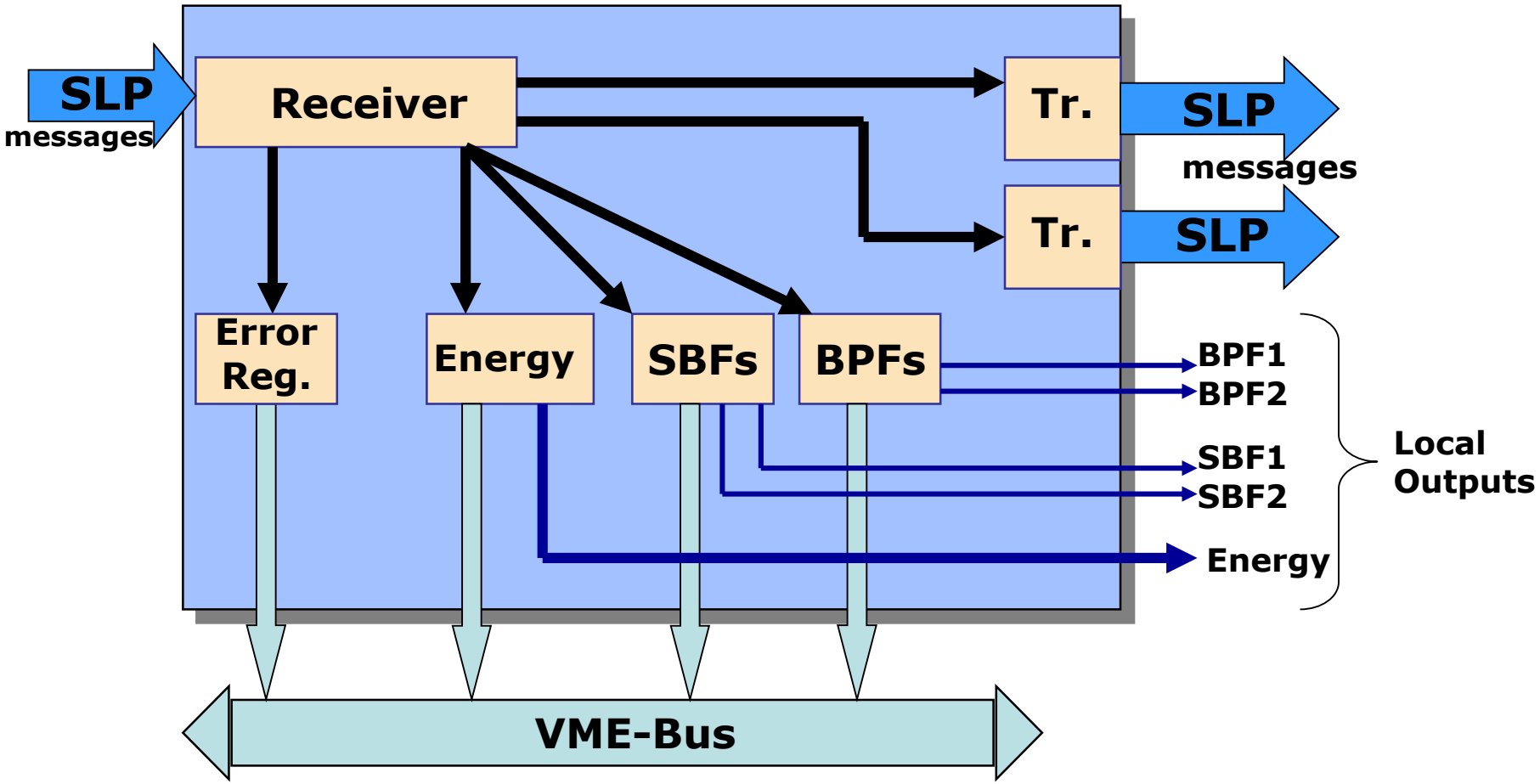
- Initial proposal was using already a lot of Timing solutions
- With initial proposal: same information was broadcasted via 3 systems (GMT, BST & SLP)
- After studies, the expected level of reliability is now SIL2 (t.b.c)
- LHC Timing Generator will be decoupled from the other Timing Generators
- LHC Timing system will be little used: few events are going to be generated → time available for transmitting other data over the network.
- CTG generation of Safe Beam Parameters is performed by Hw → independent of event generation process
- Timing is distributed everywhere *(including SLP clients)*
- Reliable Transmission system with existing monitoring facilities *(as the 1mS watch-dog for ex.)*
- Close collaboration between Interlock team & Timing team in order to put effort on Reliability

In conclusion: Transmission of Safe Beam Parameters via Timing System Network is a valuable solution for replying to the requirements (SIL level, rate, diagnostics …) in using existing resources

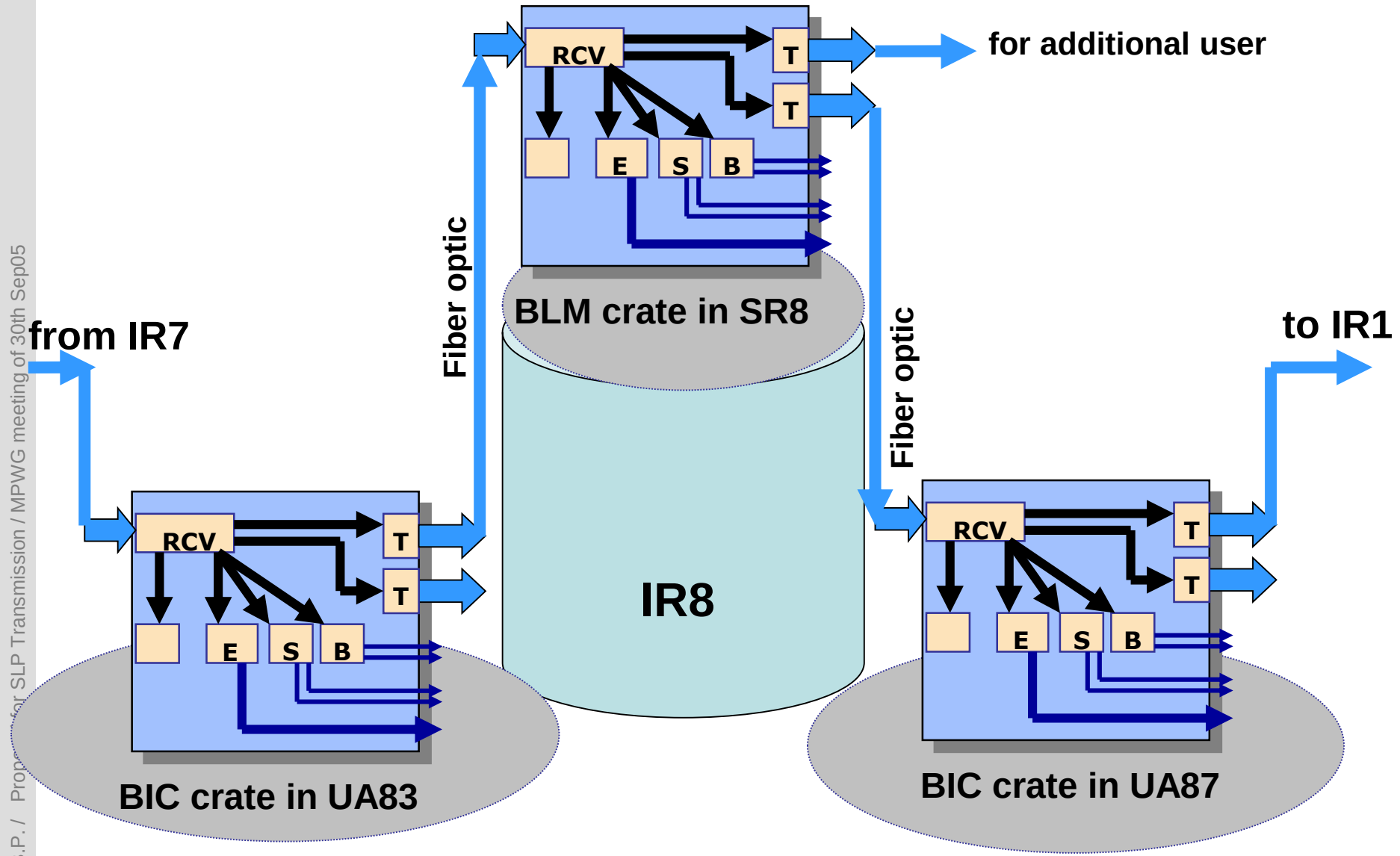
There is no reason to assume that this solution is less reliable than this initial one.

That's all

Simplified block diagram for the SLP User Board



Two Outputs for Ring and Star Distribution



Simplified block diagram for the SLP Generator