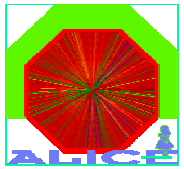
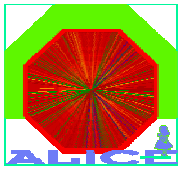


ALICE Computing Model

The ALICE raw data flow

P. VANDE VYVRE – CERN/PH

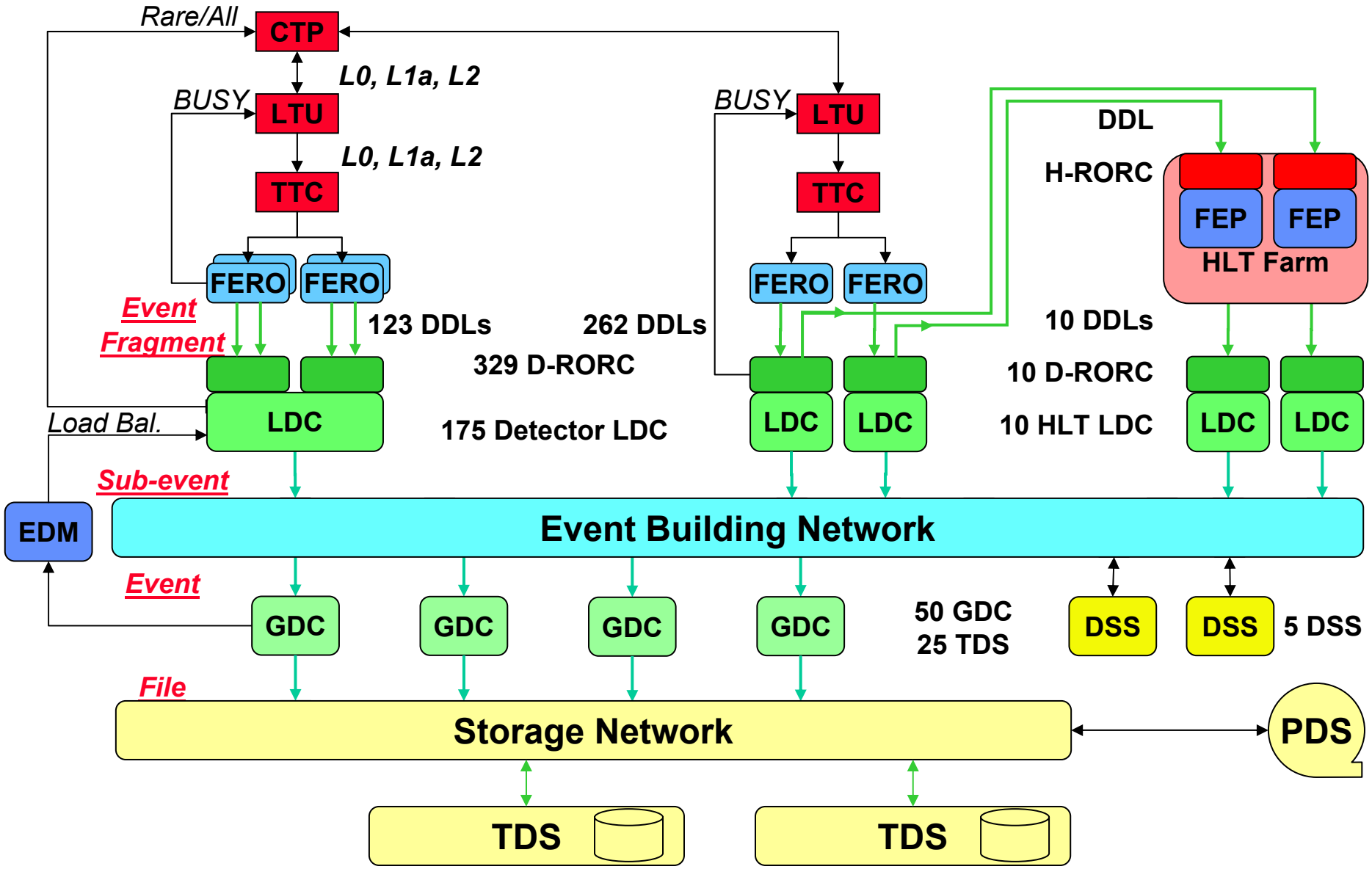
Computing Model WS – 09 Dec 2004 - CERN



Outline

- TRG, DAQ, HLT architecture
- Dataflow inside DAQ from detectors to storage
- Raw data format inside DAQ
- Trigger readout
- HLT decisions handling, HLT readout
- DATE ROOT recorder
- Conclusion

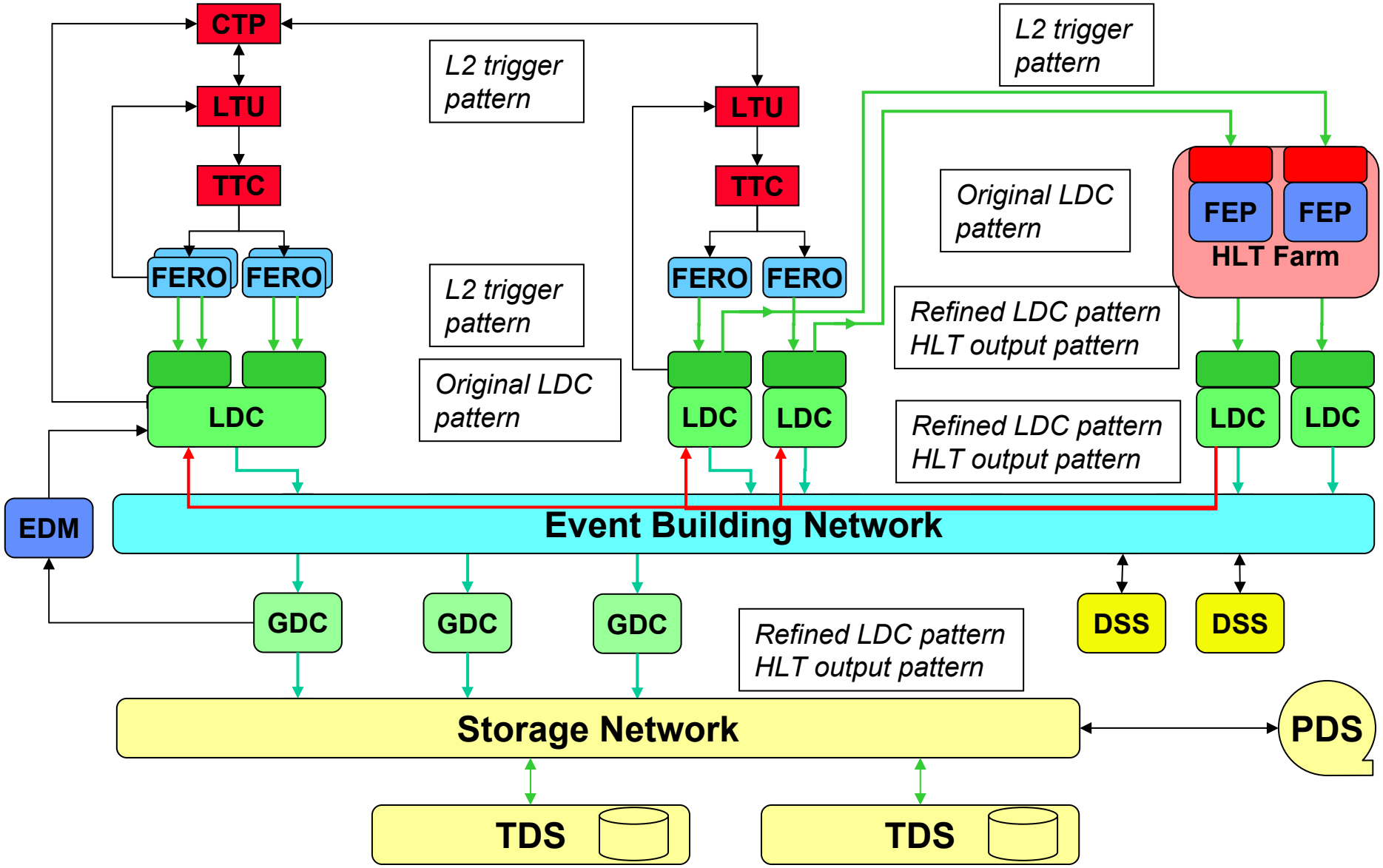
TRG, DAQ, HLT architecture



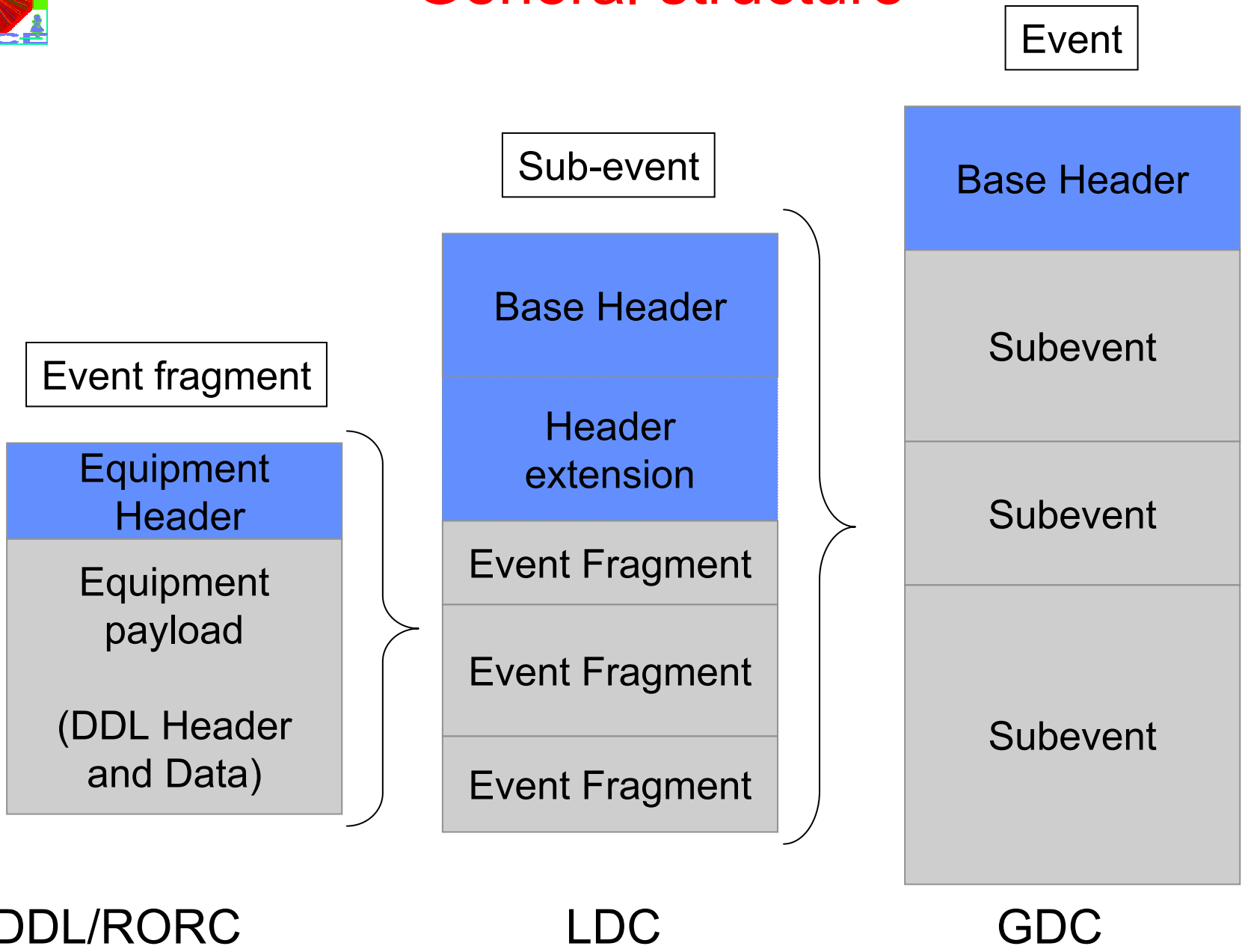
Data Format

- Physics data:
  - Raw data to DAQ and HLT = f (interaction, Triggers L0 L1 L2)
  - Raw data to storage = f (raw data, mode, HLT decision and processing)
- Event Structure
  - Set of subevents (selection by Trigger and HLT)
  - Each subevent made of 1 or several event fragments
- Event fragments include
  - LHC clock at the time of the interaction
    LHC clock = orbit number + bunch crossing
  - Trigger parameters
  - Both LHC clock and trigger parameters distributed by Central Trigger Processor to all detectors electronics readout

Distribution of HLT decisions inside DAQ

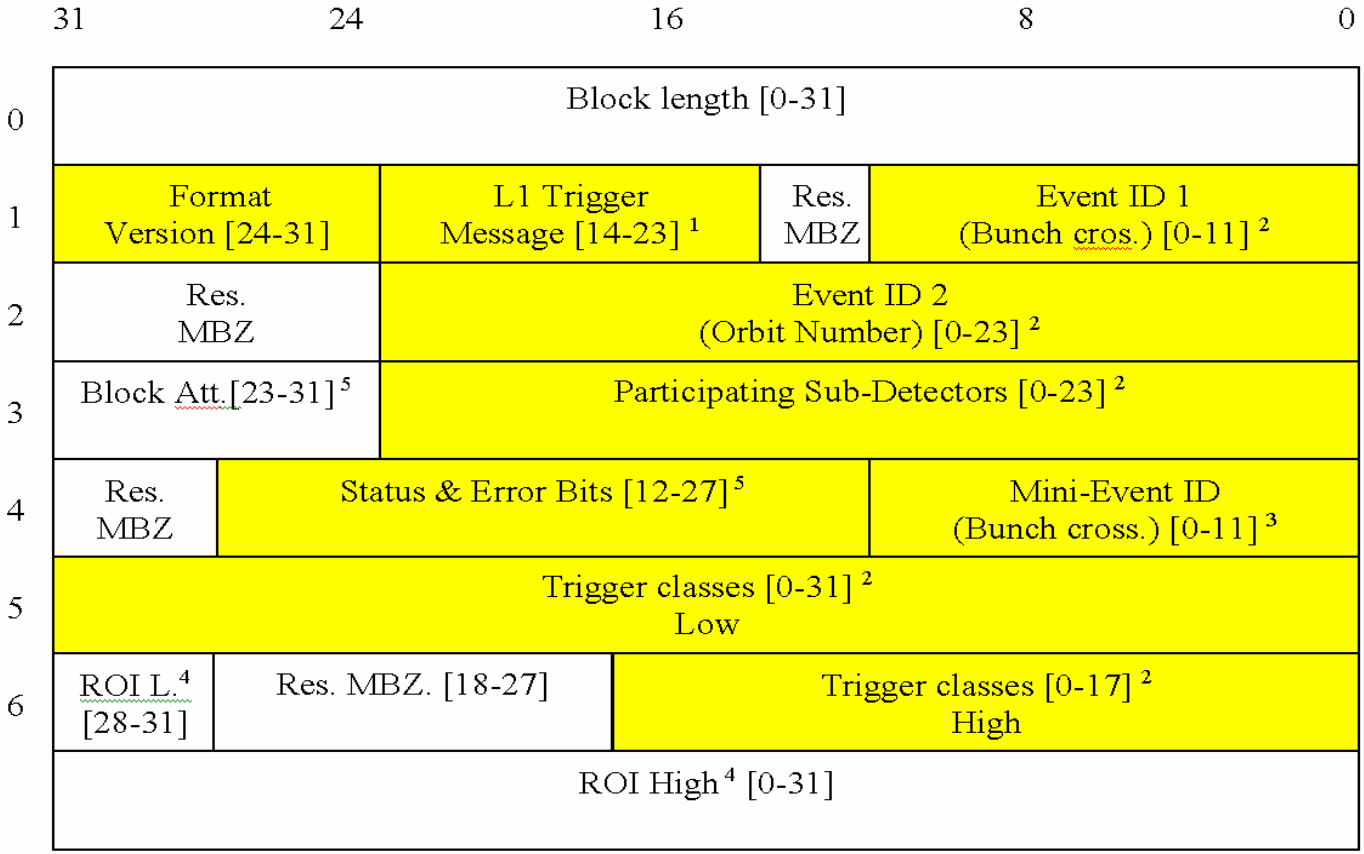


General structure



DDL Common Data Header

- Event identification: bunch crossing and orbit number
- Consistency check: Mini-Event ID
- Trigger parameters:
  - Physics TRG: L1 Trigger flags, Trigger classes, ROI
  - Software TRG: Participating Sub-Detectors



Event identification

- Global Event identification [L2a Message]
  - 12 bits for bunch crossing number (3564 bunches per orbit)
  - 24 bits for orbit number (2^{24} * 88 μs = 1476 s. = 24 min.)
  - Further event identification added by sw in the DAQ

- Local Event identification (for verification) [Local TTCrx]
  - Mini-event ID: 12 bits of local TTCrx BC counter
  - Essential for data consistency check
  - If 1! TTCrx for each DDL ⇒
    - **No problem**
    - **Automatic check in DAQ sw**
  - If > 1 TTCrx for each DDL ⇒
    - **1 TTCrx content in the header**
    - **All TTCrx in the data**

Trigger parameters

- Trigger status (8 bits) [L1 or L2a Message]
  - L2SwC *Trigger-type flag (Physics=0, Software=1)*
  - ESR *Enable Segmented readout (if used by detector) [L1]*
  - CIT *Calibration Trigger flag (Only if L2SwC=1)*
  - RoC *Readout Control bits (4 bits) (Only if L2SwC=1) [L1]*
- Participating sub-detectors (24 bits) [L2a Message]
  - If L2SwC = 0 (Physics) L2Cluster [6..1] *Cluster [6..1]*
  - If L2SwC = 1 (Software) L2Detector [24..1] *Detector [24..1]*
- Trigger classes (50 bits) [L2a Message] (If L2SwC = 0 Physics)
  Each trigger class:
  - Logic condition
  - Trigger cluster (set of detectors)
    (e.g.: all for central and MB, Muon+Pixel for Muon TRG)
  - Frequent/Rare: for feedback from DAQ
  - Downscaling
- ROI (Region Of Interest) 36 bits

CTP Readout, Interaction Record & Scalers

- Central Trigger Processor (CTP)
- CTP readout (sent for every L2A over DDL)
  - Data block of a few words from TRG CTP to TRG LDC
  - Mainly a sub event header (event ID., etc)
  - Contribution from CTP to physics events
- Interaction record (sent on a regular basis over DDL)
  - For every orbit 1 record:
    - **Orbit number (all should be present)**
    - **1 word for every bunch crossing in which interaction detected**
      Bunch crossing and interaction type (Peripheral/Semi-Central)
- Scalers
  - Sent by CTP to DAQ on a regular basis
- DAQ sw will format and handle these data flows
  - CTP readout part of physics events
  - Interaction records and scalers in separate streams

CTP Readout (Physics Trigger)

DNC: Do Not Care

	31 … 14	13	12	11 … 8					0
0	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**Event ID 1 (Bunch cross.) [11-0]**					
1	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**Event ID 2 (OrbitID) [23-12]**					
2	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**Event ID 3 (OrbitID) [11-0]**					
3	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**DNC (0)**	**ESR**	**DNC (0)**	**L2SwC = 0**	**L2Cluster [6-1]**	**L2 Class [50-49]**
4	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**L2Class [48-37]**					
5	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**L2Class [36-25]**					
6	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**L2Class [24-13]**					
7	**DNC (0)**	**BlockID = 0**	**DNC (0)**	**L2Class [12-0]**					

CTP Readout (Software Trigger)

DNC: Do Not Care

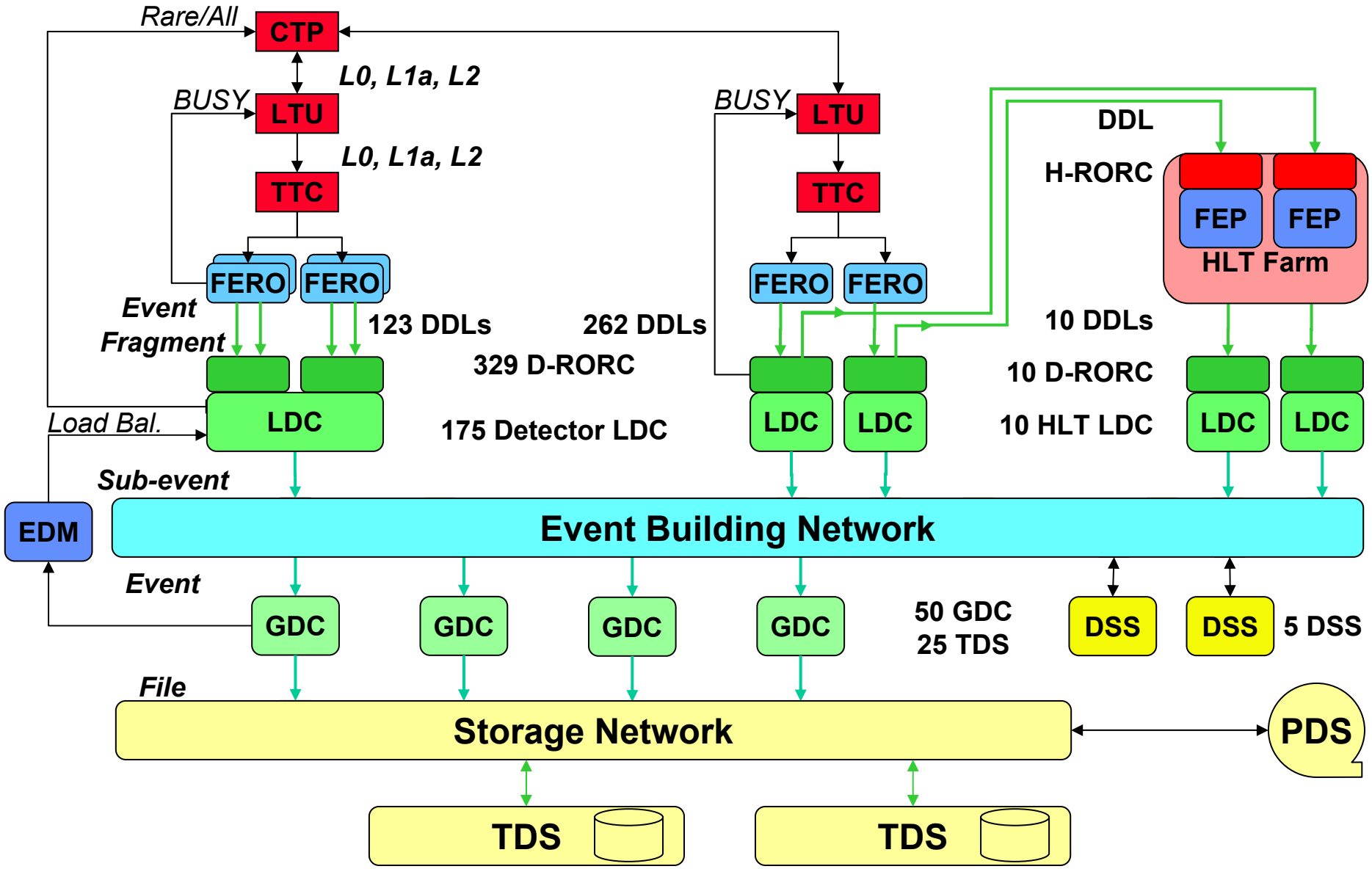
	31 … 14	13	12	11 … 8	… 0
0	DNC (0)	BlockID = 0	DNC (0)	Event ID 1 (Bunch cross.) [11-0]	
1	DNC (0)	BlockID = 0	DNC (0)	Event ID 2 (OrbitID) [23-12]	
2	DNC (0)	BlockID = 0	DNC (0)	Event ID 3 (OrbitID) [11-0]	
3	DNC (0)	BlockID = 0	DNC (0)	DNC (0) | DNC (0) | CIT | L2SwC = 1 | DNC (0) | DNC (0)	
4	DNC (0)	BlockID = 0	DNC (0)	L2Detector [24-13]	
5	DNC (0)	BlockID = 0	DNC (0)	L2Detector [12-1]	
6	DNC (0)	BlockID = 0	DNC (0)	DNC (0)	
7	DNC (0)	BlockID = 0	DNC (0)	DNC (0)	

CTP Readout (Interaction Record)

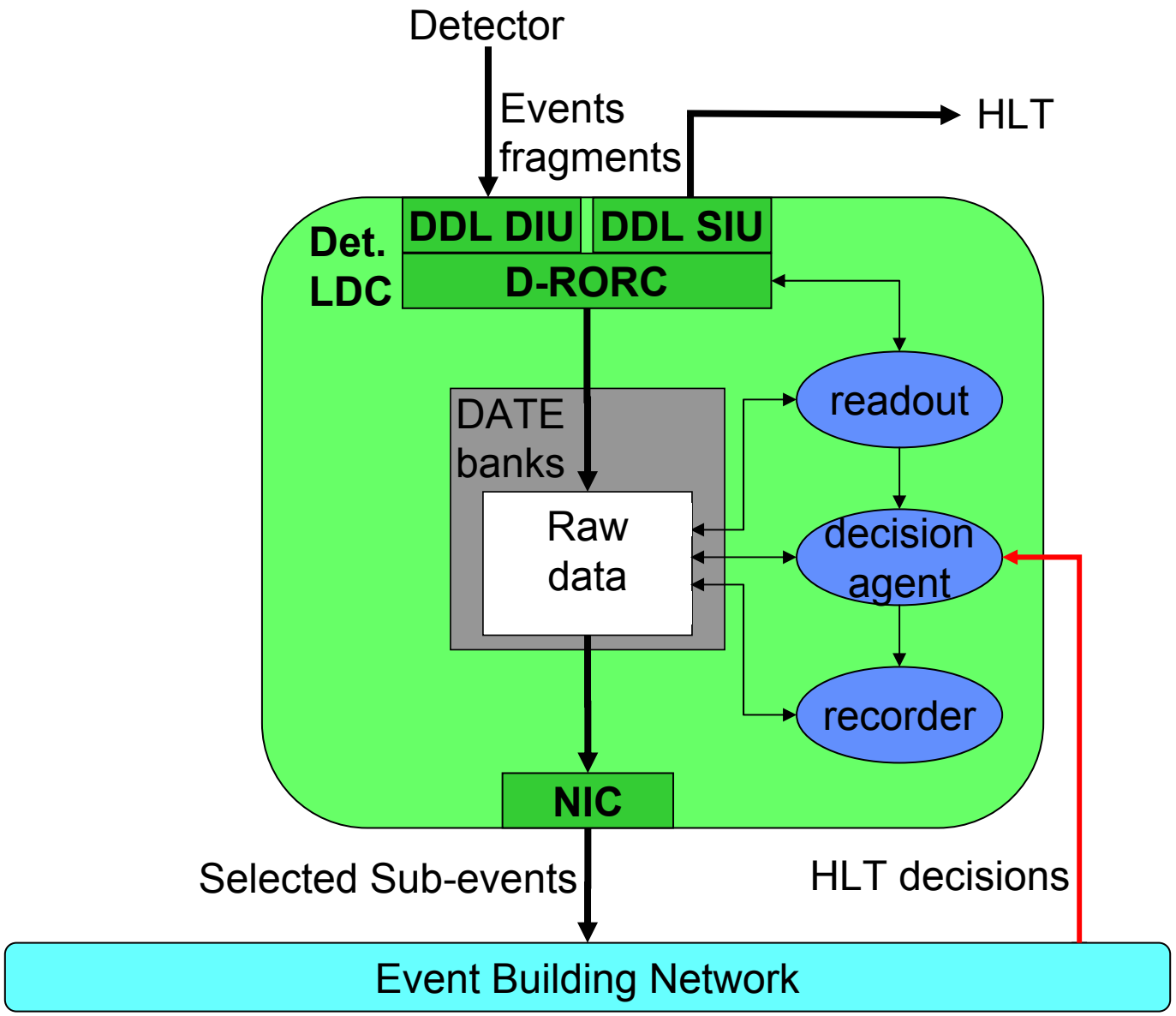
DNC: Do Not Care

	31 … 14	13	12	11 … 8	0 … 0
1	DNC (0)	BlockID = 1	ERR	(OrbitID) [23-12]	
2	DNC (0)	BlockID = 1	ERR	(OrbitID) [11-0]	
3	DNC (0)	BlockID = 1	InT	(Bunch cross.) [11-0]	
4	DNC (0)	BlockID = 1	InT	(Bunch cross.) [11-0]	
…	DNC (0)	BlockID = 1	InT	(Bunch cross.) [11-0]	
251	DNC (0)	BlockID = 1	InT	(Bunch cross.) [11-0]	
252	DNC (0)	BlockID = 1	InT	(Bunch cross.) [11-0]	
253	DNC (0)	BlockID = 1	0	Incomplete record (hFFF)	

Data handling and formatting in LDCs and GDCs



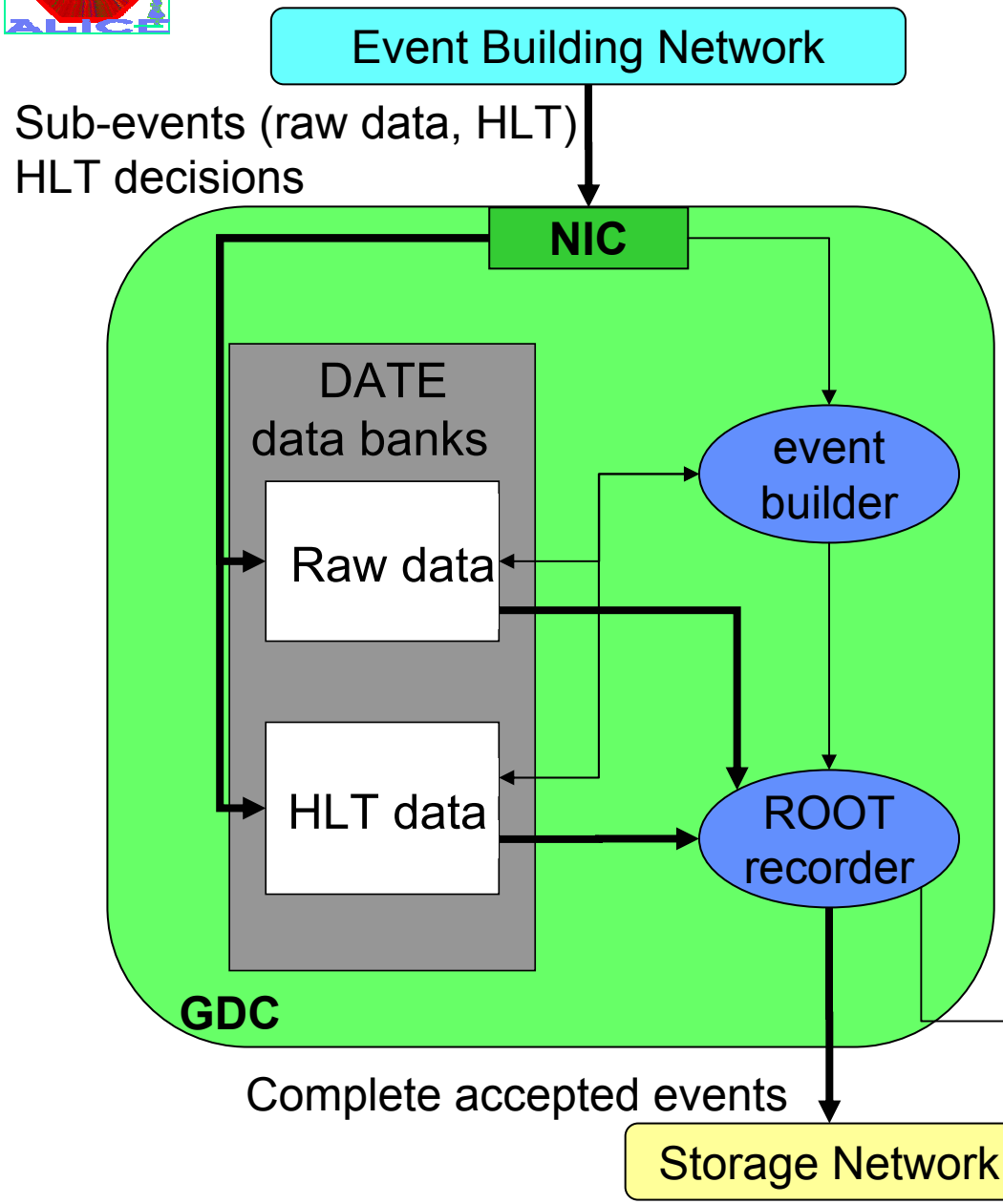
HLT decision handling in LDC



HLT Data Readout

- All data sent by HLT over DDL will be event-built and recorded
- Decisions
  - Events accepted: event-built according to decision
  - Events rejected: keep a trace of decision
- ESD produced by HLT
  - Events accepted: ESD and any other data event-built with raw data
  - Events rejected:
    - If needed all ESDs could be kept as a separate ESD stream
    - Typical application of HLT decision

Event building and data recording in GDCs



- Event builder:
  In: subevents
  Out: I/O vector
  Set of pointer/size pairs

- ROOT recorder:
  ROOT data format
  Possibly parallel streams
  CASTOR file system
  Interfaced to the GRID

DATE ROOT recorder

- New program in development (part of DATE V5)
  - Structure of a DATE application (interfaces to AFFAIR, Infologger etc)
  - Data formatting with the data handling library of AliMDC (profit from years of development and tests)
- Data format:
  TFile object with collection of raw data and ESD
- Files created in CASTOR
- File structure:
  - Complete events: all consistency checks done
- Interface to GRID (AliEn/GLite/YAG)
  - Declare CASTOR file
  - Create metadata: trigger parameters and run conditions
- Tested in current Computing DC

Conclusion

- Data format based on requirements and architecture
- All elements of physics data (event fragments, subevents and events) tagged with Trigger info
- CTP readout
  - 1 stream event-built with physics data
  - 2 asynchronous streams
- HLT readout
  - Decisions
  - ESD
- DATE recorder
  - Formatting by AliMDC library
  - Interfaced to the GRID