HELLO!

ALICE RUN3/RUN4 COMPUTING MODEL SIMULATION SOFTWARE DEVELOPMENT STATUS

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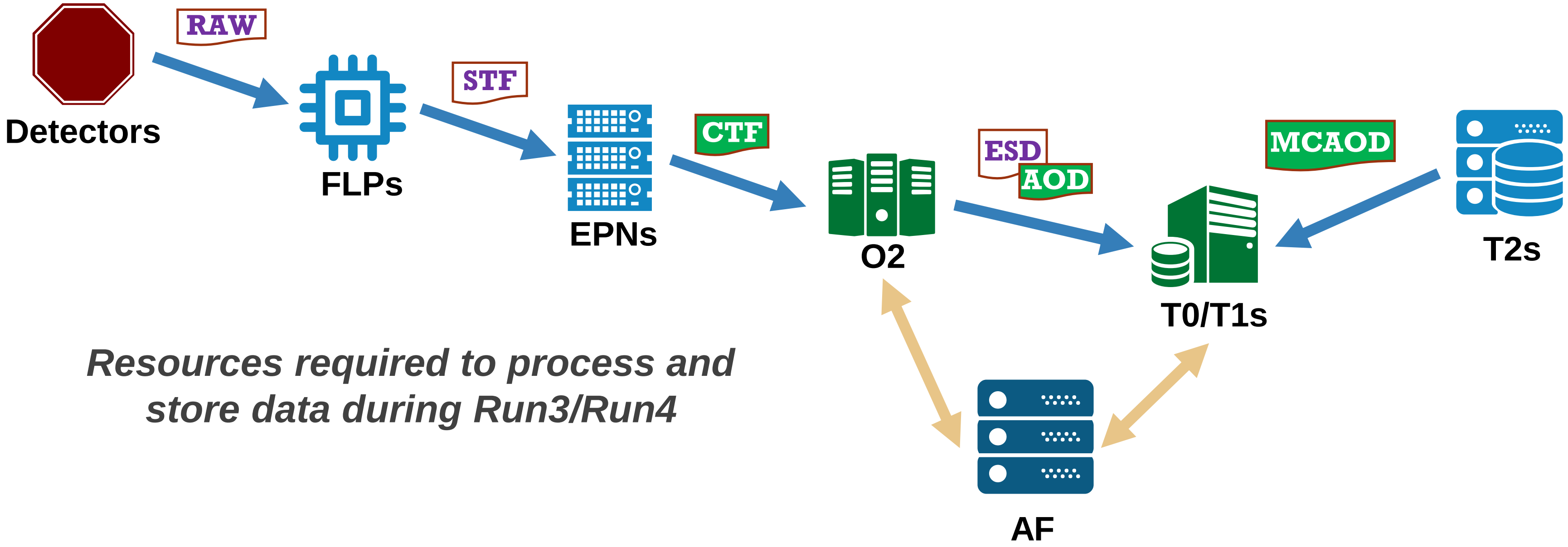
ALICE Offline week
(09 November 2017)

O2 Computing System upgrade program for ALICE Run3 and Run4

The purpose ALICE Computing Model (O2 model) for ***Run 3 (2020-2022)*** *and* ***Run 4 (2025-2027)*** *is to reduce the data volume to the maximum possible extent to minimize the storage cost and requirements of the computing resources needed for data processing while minimizing the impact on physics performance.*

ALICE CoMAPI – ALICE Computing Model simulation software

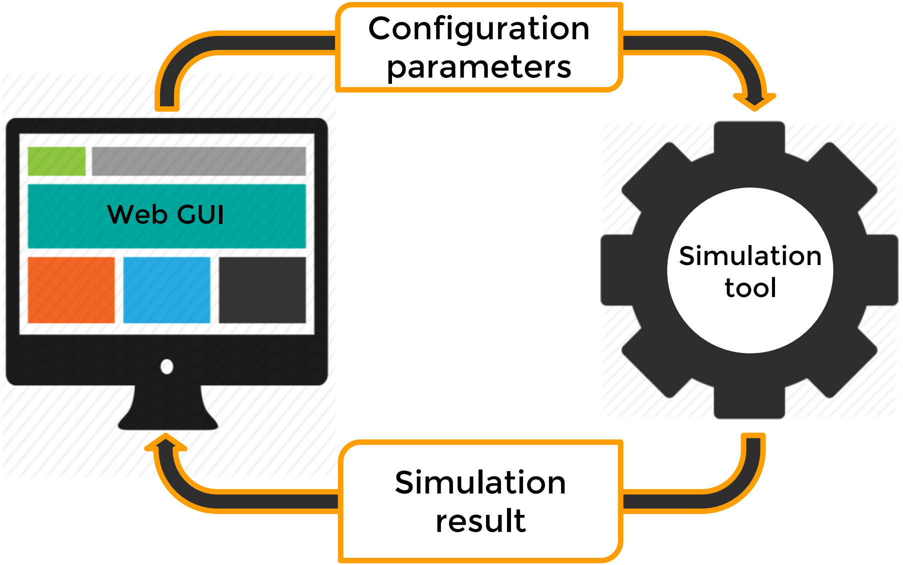
The software is to perform discrete-event simulations (DES) of ALICE data taking process for certain period of time for a given computing model layout with the aim to estimate the usage of ALICE resources required to process and store the data during Run 3 and 4.*



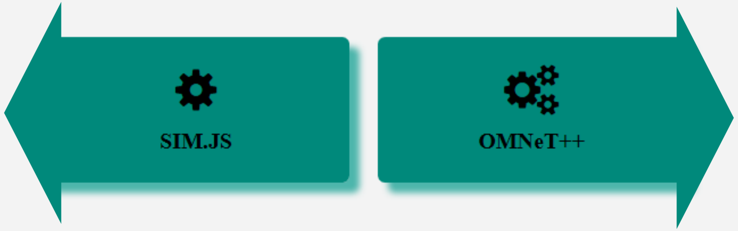
Resources required to process and store data during Run3/Run4

* *A combination of FLPs, EPNs and other resources, their role as well as the network topology by which these resources are connected.*

Current structure of CoMAPI



Two, basically different software tools are used to perform DES of data taking process:



This is done in order to have more realistic picture of ALICE data taking during Run 3 and 4.

State of CoMAPI using OMNeT++

WEB GUI gives possibility to:

1. Define experiment specific (Detectors, FLPs, EPNs, etc) and/or custom resource types.
2. Graphically visualize the computing model components and their topology.
3. Automatically create and visualize the 3 layouts of computing models proposed in ALICE O2 TDR.
4. Import/Export models in XML/JSON format and export graphics in PDF format.

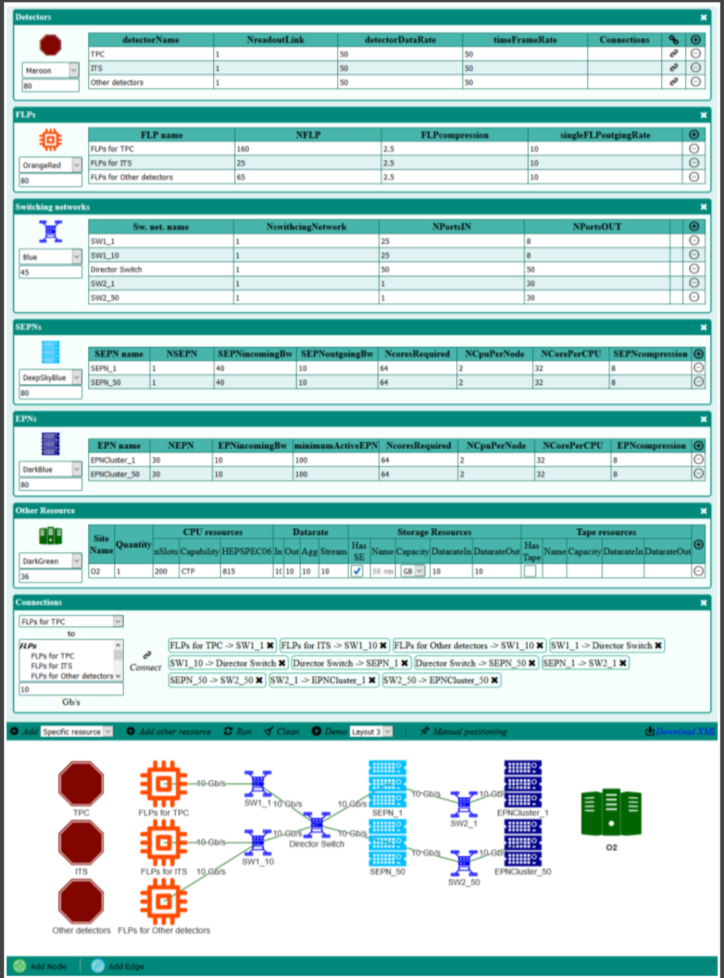
Simulation tool using OMNeT++*

Under development

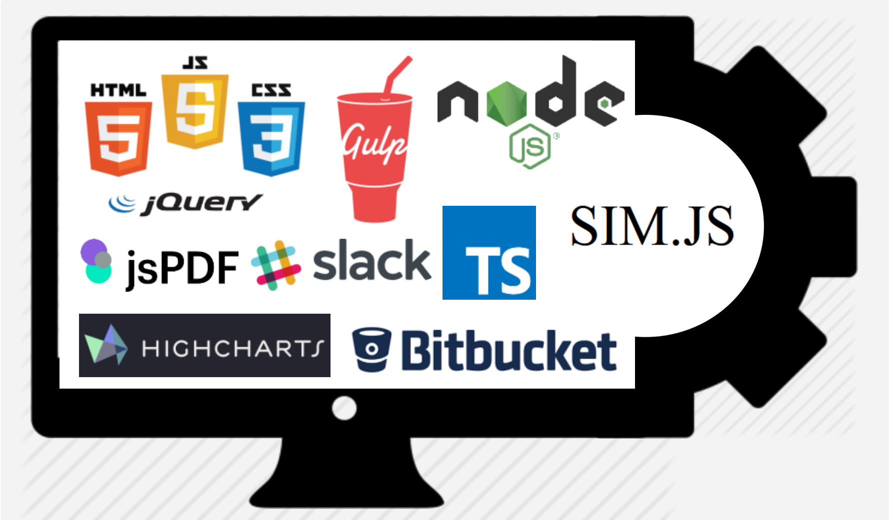
The works on the simulation with OMNET++ are done in collaboration with Eugen Mudnic.

** An extensible, modular, component-based C++ simulation library and framework, primarily for building network simulators.*

State of CoMAPI using OMNeT++(Web GUI screenshot)



State of ALICE CoMAPI using SIM.JS



Under development

Flexible and highly configurable tool that gives possibility to estimate (via DES) the **CPU** and **storage resource** usage required to process and store each type of ALICE data (during Run3 and 4), by taking into account *LHC running schedule*, *Conference calendar*, ***data management/removal policies*** and any other criteria.

The works on the simulation with SIM.JS are done with Tim Hallyburton.

Thanks for skill exchange and fruitful collaboration.

A little bit about SIM.JS

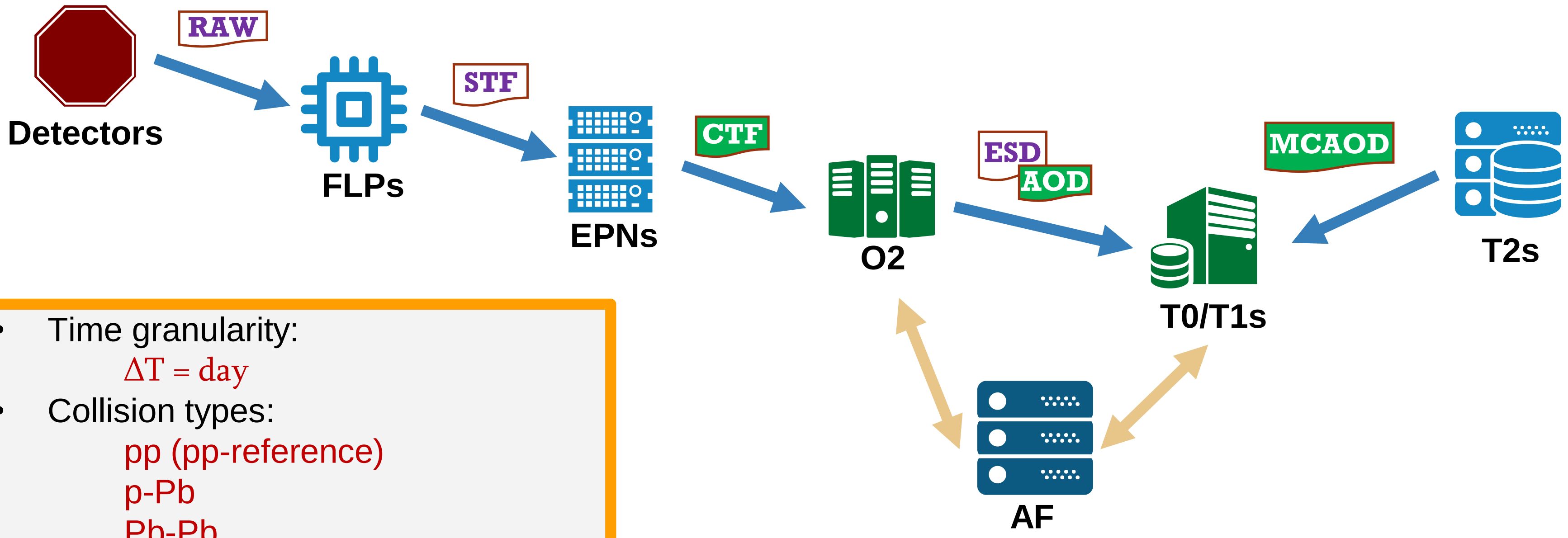
Sim.js is a JavaScript library to perform Discrete Event Simulations.

It allows to create:

- ***Entities*** - Actors of the system that require service.
- ***Facilities*** – Resources/Services that are used by ***Entities.***
- ***Buffers*** and ***Stores*** – Space where ***Entities*** can store and retrieve any information.
- **Events** – System state changes, for which all entities are waiting on.
- **Messages -** By which ***Entities*** communicate with each other.

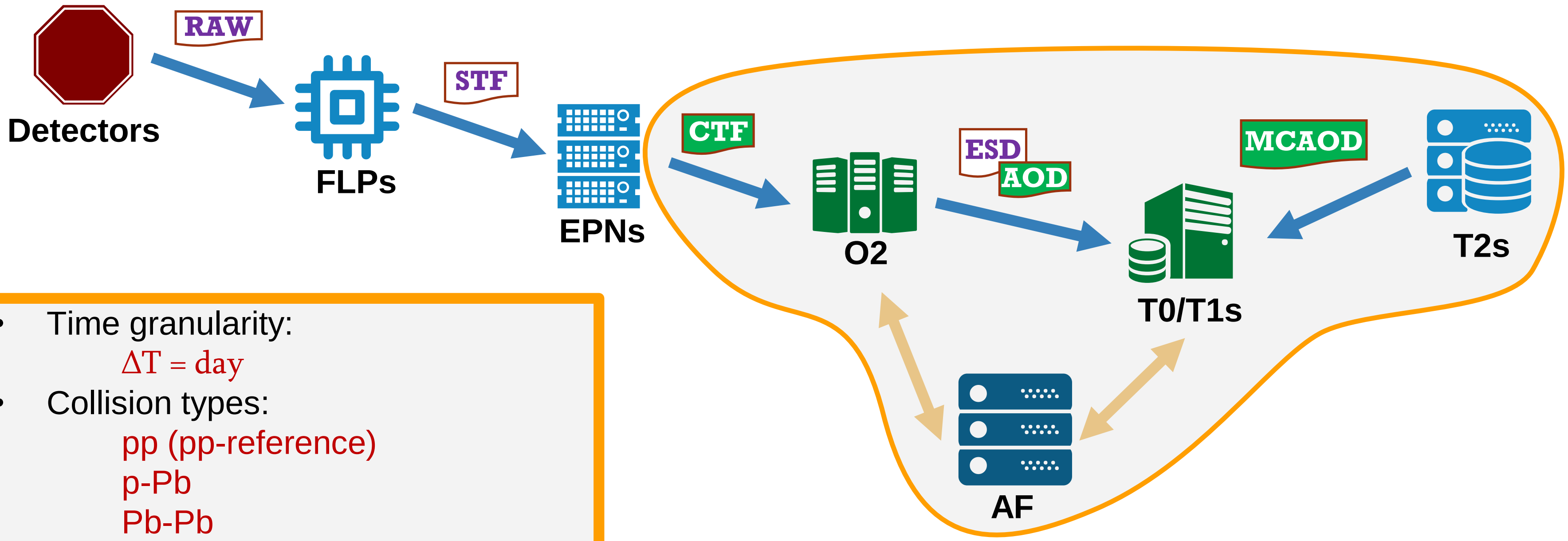
SIM.JS also provides a random number generation library to generate seeded random variates from various distributions, including uniform, exponential, normal, gamma, pareto and others.

DES of ALICE data taking process



- Time granularity:
  $\Delta T = \text{day}$
- Collision types:
  pp (pp-reference)
  p-Pb
  Pb-Pb
- Data types:
  CTF
  ESD (15% of CTF size)
  AOD (10% of CTF size)
  MC (100% of CTF size)
  MCAOD (30% of CTF size)
  HISTO (1% of ESD size)

DES of ALICE data taking process



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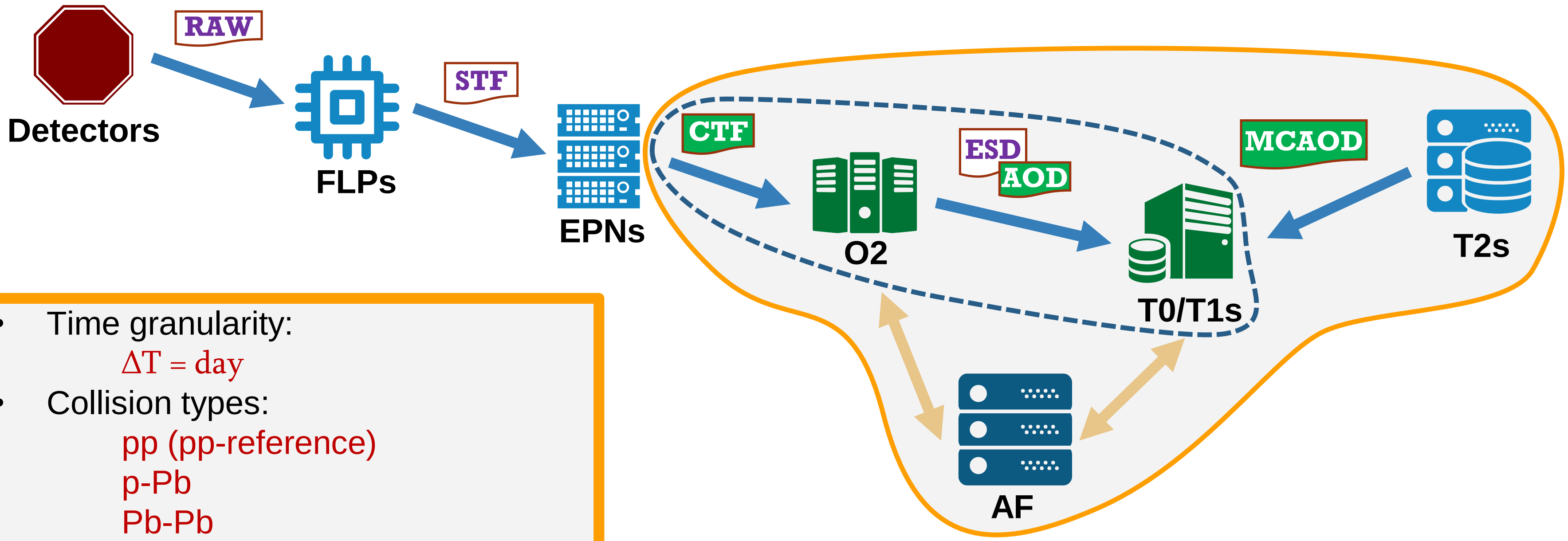
DES of ALICE data taking process



- Time granularity:
  $\Delta T = \text{day}$
- Collision types:
  pp (pp-reference)
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  CTF
  ESD (15% of CTF size)
  AOD (10% of CTF size)
  MC (100% of CTF size)
  MCAOD (30% of CTF size)
  HISTO (1% of ESD size)

General conditions and Input parameters for simulation

For each collision type we specify:

- ✓ Planned number of collisions (for year) – $N_{collisions}$
- ✓ Collision rate (Number of collisions per second) - C_{rate}
- ✓ CTF size per event - E_{size}
- ✓ Data taking efficiency factor– Efficiency (%)

$$CTF\_size\_per\_day = (C_{rate} * E_{size} * Efficiency/100) * Seconds\_in\_a\_day$$

Parameters that we can play with (?):

- C_{rate}
- Efficiency

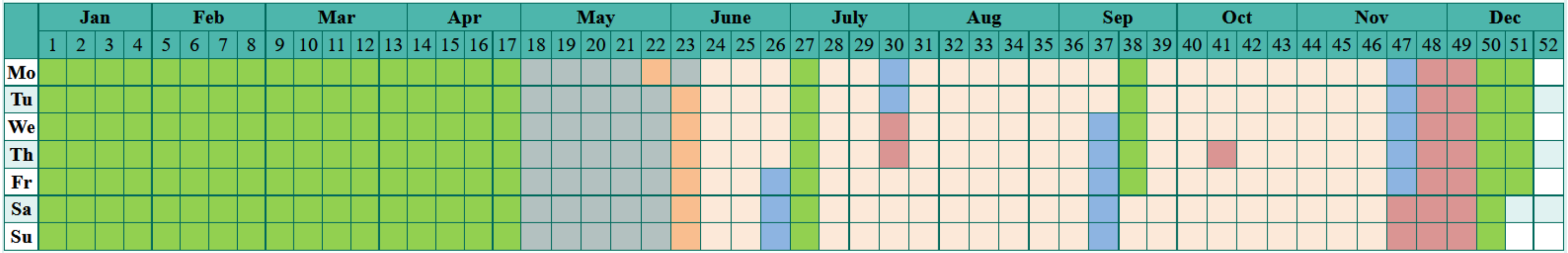
ALICE running scenario for the LHC Run3 and 4

	Year	Collision type	$N_{collisions}$	E_{size} (kB)
Run3	2020	pp Pb-Pb	$2.7 * 10^{10}$ $2.3 * 10^{10}$	50 1600
	2021	pp Pb-Pb	$2.7 * 10^{10}$ $2.3 * 10^{10}$	50 1600
	2022	pp pp	$2.7 * 10^{10}$ $4 * 10^{11}$	50 50
Run4	2025	pp Pb-Pb	$2.7 * 10^{10}$ $2.3 * 10^{10}$	50 1600
	2026	pp Pb-Pb p-Pb	$2.7 * 10^{10}$ $1.1 * 10^{10}$ 10^{11}	50 1600 100
	2027	pp Pb-Pb	$2.7 * 10^{10}$ $2.3 * 10^{10}$	50 1600

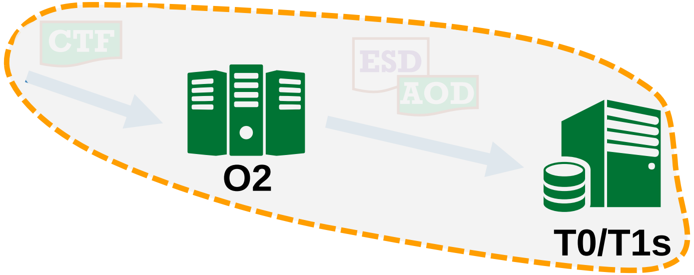
LHC Schedule as an input for simulations

LHC Schedule (2017)

- Technical stop
- Recommissoning with beam
- Scrubbing (indicative - dates to be established)
- Machine development
- Physics runs
- Special physics runs (indicative - schedule to be established)

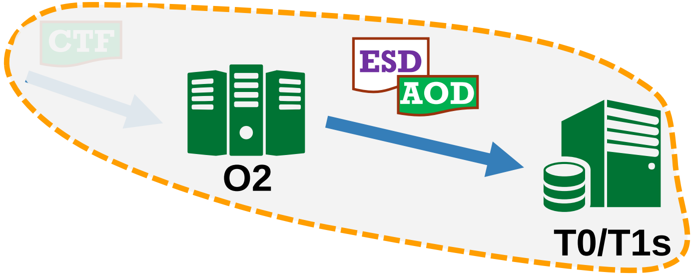


Input parameters (Resource types and their capacities)



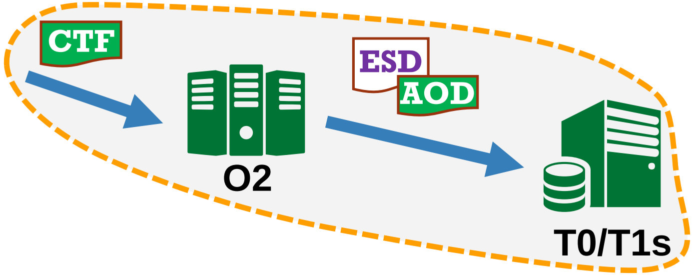
Site Type	Site Name	CPU resources (N of CPU cores)	Storage Resources		Tape resources		⊕
O2	O2	5000	90000	GB	80000	GB	⊖
T1	T1	7000	80000	GB	60000	GB	⊖
T2	T2	25000	10000	GB	0	GB	⊖

Input parameters (Job types and their CPU consumption)



	CpuTransformations (HS06 - consumed CPU seconds per event)				CpuShare (%)			
	pp	pPb	PbPb	pp-ref	O2	T1	T2	AF
RAW -> CTF	0	0	0	0	100	0	0	0
CTF -> ESD -> AOD	300	710	3800	300	67	33	0	0
MC -> MCAOD	1000	3000	45000	1000	0	0	100	0
AOD -> HISTO	200	700	3700	200	0	0	0	100
⊕								

Input parameters (Data management policies)



Data Types	Replication factor		Storage Sharing (%)					LifeTime on Disk (days)				
	Disk	Tape	O2	T0	T1	T2	AF	O2	T0	T1	T2	AF
CTF	1	1	66.6	0.0	33.3	0.0	0.0	270	0.0	270	0.0	0.0
ESD	1	0	75.0	0.0	25.0	0.0	0.0	10	15	25	0.0	0.0
AOD	1	1	15	0.0	0.0	1.0	0.0	150	250.0	100	0.0	100
MCAOD	1	1	0	25	75	0.0	1.0	100	100.0	100.1	5.0	100
HISTO	1	0	10.0	5.0	75.0	0.0	10.0	10.0	100.0	150.0	0.0	50.0
⊕												

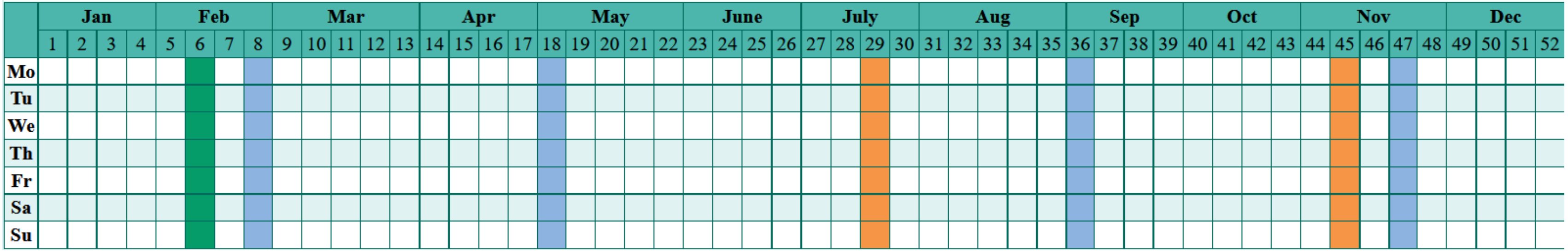
ALICE Calendar as an additional input for simulations

ALICE Calendar (2017)

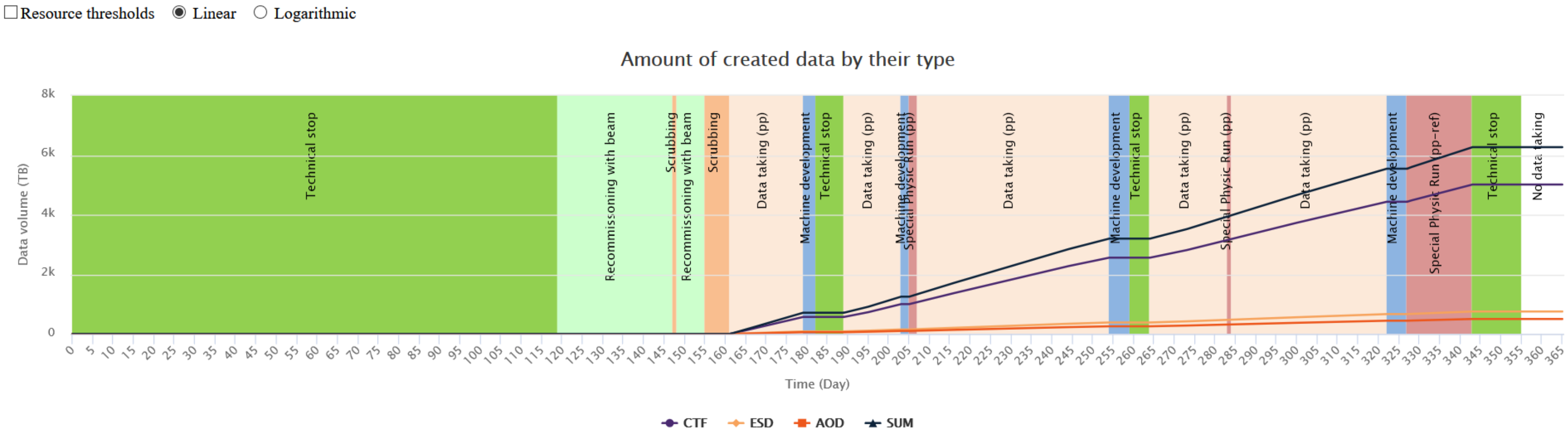
WK	Monday	ALICE	CERN	WK	Monday	ALICE	CERN
0			*CERN restart 05-Jan / FR Holidays 03-Jan*	26	26-Jun	**EPS/SQM Approvals, Boards**	
1	02-Jan			27	03-Jul		**EPS-HEP**
2	09-Jan	**QM Previews**		28	10-Jul		**SQM**
3	16-Jan		**FCC week**	29	17-Jul	OFFLINE WEEK	
4	23-Jan	**QM Approvals, Boards**		30	24-Jul	**ALICE Week**	
5	30-Jan		CMS week	31	31-Jul		
6	06-Feb		**Quark Matter**	32	07-Aug		
7	13-Feb		ATLAS week	33	14-Aug		
8	20-Feb	**LHCC week**		34	21-Aug	**IS Previews**	
9	27-Feb		LHCb week	35	28-Aug	**Boards**	
10	06-Mar	**ALICE Week**		36	04-Sep	**IS Approvals**	07-Sep closed/Jeûne Genevois
11	13-Mar		Council Week	37	11-Sep	**LHCC week**	
12	20-Mar			38	18-Sep		**Initial Stages**
13	27-Mar	OFFLINE WEEK		39	25-Sep	**Mini Week**	Council Week, CMS week (outside CERN)
14	03-Apr	**Mini Week**	CMS week	40	02-Oct		
15	10-Apr		14-Apr closed/Easter	41	09-Oct		ATLAS week (outside CERN)
16	17-Apr		17-Apr closed/Easter	42	16-Oct	**Mini Week**	
17	24-Apr	**Spring RRB**		43	23-Oct	**Autumn RRB**	
18	01-May	**Mini Week**	01-May closed	44	30-Oct		
19	08-May	**LHCC week**		45	06-Nov	OFFLINE WEEK	
20	15-May		**LHCP**	46	13-Nov	**ALICE Week**	
21	22-May		25-May closed/Ascension	47	20-Nov		
22	29-May	**Mini Week**		48	27-Nov	**LHCC week**	
23	05-Jun		05-Jun closed/Whitsun	49	04-Dec	**APW (outside CERN), Incl. Boards**	LHCb week, CMS week
24	12-Jun	**EPS/SQM Previews**	Council Week - LHCb week	50	11-Dec		Council Week
25	19-Jun		ATLAS week, CMS week	51	18-Dec		*CERN closure 23-Dec 2017 to 07-Jan-2018*
				52	25-Dec		*CERN closure 23-Dec 2017 to 07-Jan-2018*

Under development and discussion stage

LHCC week
ALICE week
Quark Matter



Initial results of simulations (with example parameters)



With the LHC 2017th schedule and Run3/Run4 configuration parameters (without data removal), at the end of the year we expect (only on T1 site):

SUM – 6.1 PB
CTF – 4.9 PB
ESD – 0.7 PB
AOD – 0.5 PB

THANKS!

Questions and suggestions?