



# ALICE RUN3/RUN4 COMPUTING MODEL SIMULATION SOFTWARE DEVELOPMENT STATUS

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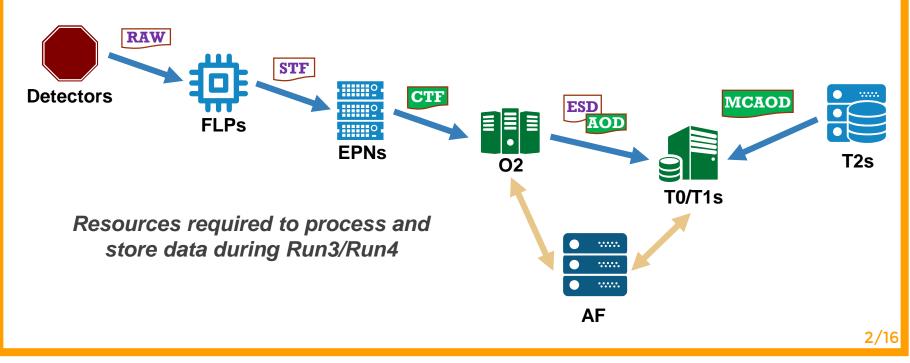
> ALICE Offline week (09 November 2017)

# 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.

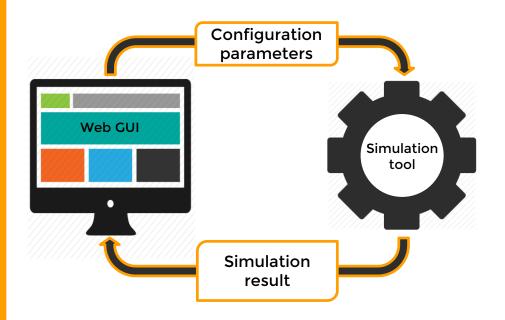
# ALICE CoMAPI - ALICE Computing Model simulation software

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.



\* 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.* 4/16

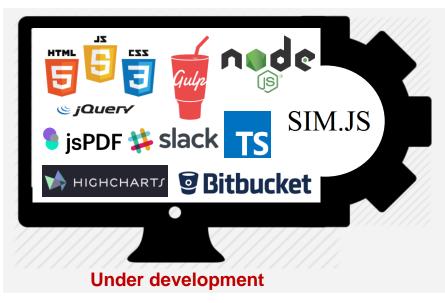
\* An extensible, modular, component-based C++ simulation library and framework, primarily for building network simulators.

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

	detect	orName	Nread	loutLink	detectorDa	ataRate	timeFra	meRate	Cor	nections	₽ (
-	TPC		1		50		50				0
Maroon ~	πs		1		50		50				0
80	Other detectors		1		50		50				0
FLPs											
FLPS	_										
•	FLPs for TPC	LP name	160	NFLP	2.5	FLPcomp	ression	10	ngleFLPout	gingRate	
OrangeRed ~	FLPs for ITS		25		2.5			10			e
80	FLPs for Other d	etectors	65		2.5			10			ē
Switching networ											
		net. name		NswithcingNetwo		NPorts			NPortsOU	т	0
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Blue ~	SW1_10 Director Switch		1		25			8 50			6
45	SW2_1		1		1			30			6
	SW2_1 SW2_50		1		1			30			6
SEPNs											
	SEPN name	NSEPN	SEPNincomi	ngBw SEPNor	tgoingBw Ncore	Required	NCpuPerNode	NCorr	PerCPU	SEPNcom	pression
	SEPN_1	1	40	10	64	2		32	8		
DeepSkyBlue 🗠	SEPN_50	1	40	10	64	2		32	8		
80											
EPNs											
10	EPN name	NEPN	EPNincomin	gBw minimum	ActiveEPN Ncore	esRequired	NCpuPerNode	NCon	ePerCPU	EPNcomp	ression
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	EPNCluster_1	30	10	100	64	2		32		5	
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Other Resource     Other Resource     DataCoven     D	EPHChuter_50	30 30 30 30 30 30 30 50 50 50 50 50 50 50 50 50 5	10  resources  into, IEPSPECoc at3  TPC > SW1_11  > Duretor Swite  Cobs	140           Datarate           To Our Age Stream           To Our Age Stream           To To To To           No Decore Stream           Clean           O Decore Stream           Decore Stream	64 mm   Max   Name Ca   27   55 mm   Ca > 55W1_10 m   F±1 > 55W1_10 m   F±1 > 55W1_10 m   F±1   55W2_1 mm (Leyout 3 \vee) 10,005   55W2_1 10,005   10,005	2 orage Resource pacity Datarate is ∞ 10 Pr for Other de Dector Swi 50 > EPNClus \$0 > EPNClus \$0 > Mommal T0-60-5 SW	es In Datarate Out 10 Ectors -> SW1_ tectors -> SW7 ter_50 H partitioning 10.05 EPNCJas EPNCJas	az fas ape 0 × SW SEPN SEPN SEPN	Tape reso Capacity Da 1_1 ~ Direct 1 ~ SW2_1	B urces transeln Da or Switch 1 X	tarateOut
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🚯 Add Node 🛛 🕘 Add Edge

## State of ALICE CoMAPI using SIM.JS



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.

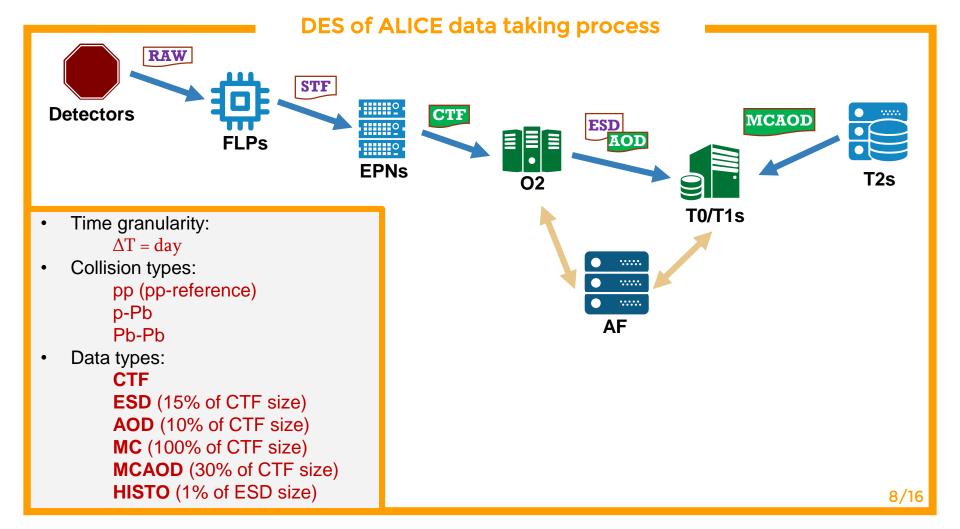
## A little bit about SIM.JS

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

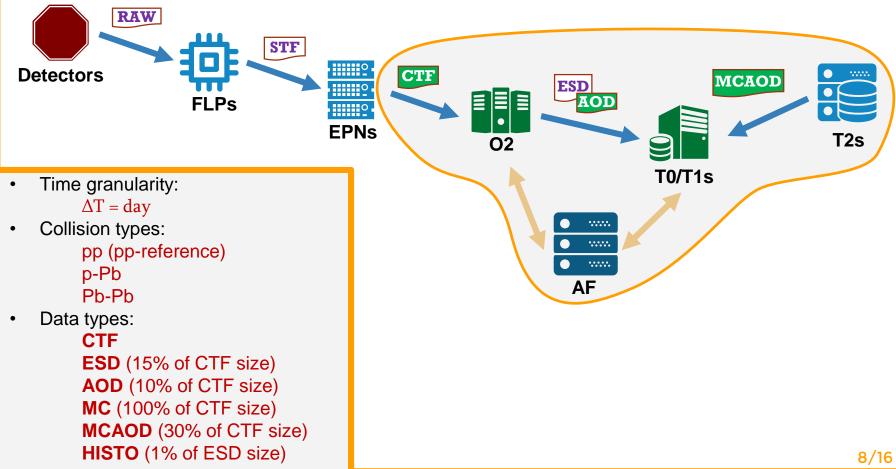
It allows to create:

- *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.

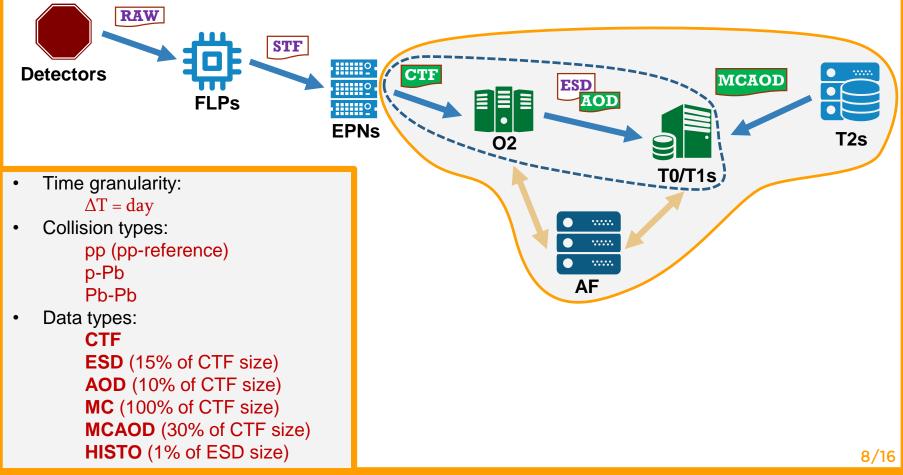
SIM.JS also provides a random number generation library to generate seeded random variates from various distributions, including uniform, exponential, normal, gamma, pareto and others.



### **DES of ALICE data taking process**







#### General conditions and Input parameters for simulation



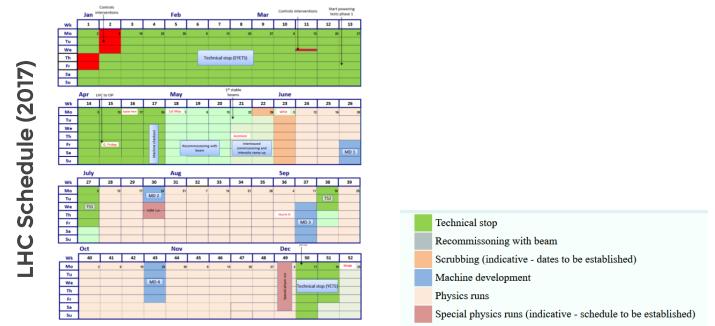
For each collision type we specify:

- Planned number of collisions (for year) N<sub>collisions</sub>
- ✓ Collision rate (Number of collisions per second) C<sub>rate</sub>
- ✓ CTF size per event E<sub>size</sub>
- ✓ Data taking efficiency factor Efficiency (%)

#### ALICE running scenario for the LHC Run3 and 4

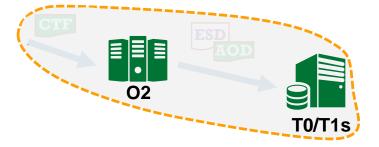
	Year	Collision type	N <sub>collisions</sub>	E <sub>size</sub> (kB)
2	2020	pp Pb-Pb	2.7 * 10 <sup>10</sup> 2.3 * 10 <sup>10</sup>	50 1600
Run3	2021	pp Pb-Pb	2.7 * 10 <sup>10</sup> 2.3 * 10 <sup>10</sup>	50 1600
	2022	pp pp	2.7 * 10 <sup>10</sup> 4 * 10 <sup>11</sup>	50 50
	2025	pp Pb-Pb	2.7 * 10 <sup>10</sup> 2.3 * 10 <sup>10</sup>	50 1600
Run4	2026	pp Pb-Pb p-Pb	2.7 * 10 <sup>10</sup> 1.1 * 10 <sup>10</sup> 10 <sup>11</sup>	50 1600 100
	2027	pp Pb-Pb	2.7 * 10 <sup>10</sup> 2.3 * 10 <sup>10</sup>	50 1600

## LHC Schedule as an input for simulations



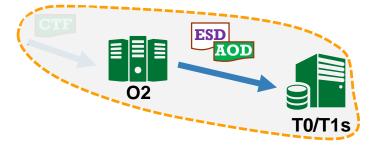
		Jan         Fe           2         3         4         5         6			'eb				Ma				$\mathbf{A}$					May					ne			Ju	•				Aug				Se	-			Oc					ov				Dec				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38 :	39 4	40 4	41	42 4	3 4	14 4	5 4	6 4	7 4	8 4	9 50	0 5	1 5	2
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# Input parameters (Resource types and their capacities)



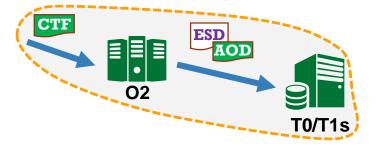
Site Type	Site Name	CPU resources (N of CPU cores)	Storage Resources	1	Tape resources		9
O2	02	5000	90000	GB 🔻	80000	GB 📢	6
T1	T1	7000	80000	GB 🔻	60000	GB 🔹	e
Т2	Т2	25000	10000	GB 🔻	0	GB 📢	• 6

# Input parameters (Job types and their CPU consumption)



	CpuTransfor	mations (HS06 - co	onsumed CPU seco	onds per event)		CpuSh	are (%)	
	рр	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
Ð					·		·	

# Input parameters (Data management policies)



Dat	ta	Replica	tion factor		Sto	orage Sharing (	(%)			Life	Fime on Disk (	days)	
Тур	es	Disk	Tape	O2	TO	T1	T2	AF	O2	TO	T1	T2	AF
СТ	F	1	1	66.6	0.0	33.3	0.0	0.0	270	0.0	270	0.0	0.0
ES	D	1	0	75.0	0.0	25.0	0.0	0.0	10	15	25	0.0	0.0
AO	D	1	1	15	0.0	0.0	1.0	0.0	150	250.0	100	0.0	100
MCA	OD	1	1	0	25	75	0.0	1.0	100	100.0	100.1	5.0	100
HIS	го	1	0	10.0	5.0	75.0	0.0	10.0	10.0	100.0	150.0	0.0	50.0
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## ALICE Calendar as an additional input for simulations

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

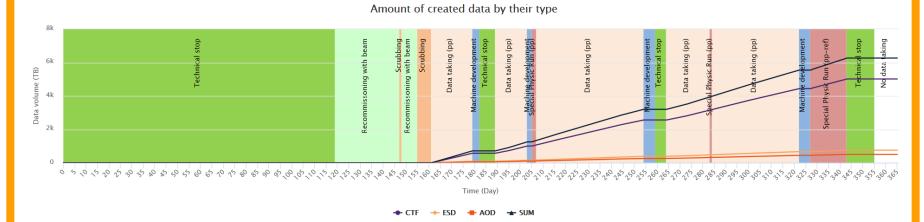
#### Under development and discussion stage

LHCC week
ALICE week
Quark Matter

		J	Jan         Feb           2         3         4         5         6         7				Feb				Μ	ar				Α	pr				Ma	ıy				Jun	е			Jul	y				Aug	ļ.			S	Sep			0	Oct				No	ov				De	ec	
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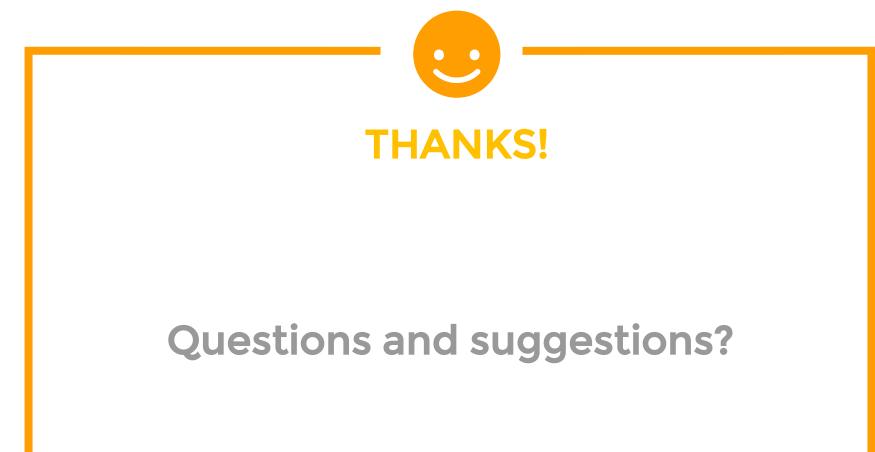
## Initial results of simulations (with example parameters)

 $\square$  Resource thresholds  $\bigcirc$  Linear  $\bigcirc$  Logarithmic



With the LHC 2017<sup>th</sup> 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



16/16